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INTERVIEW CASTLEVANIA MUSIC COMPOSER MICHIRU YAMANE

OCTOBER 2006

# gamedeveloper

THE LEADING GAME INDUSTRY MAGAZINE

» **POSTMORTEM**

MYTHMAKING IN ACTION:  
IRON LORE'S TITAN QUEST

» **ARTFUL RELATIONSHIPS**

WHAT DESIGNERS WANT  
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» **MATCH-UP SHOWDOWN**

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## POSTMORTEM

### 36 IRON LORE'S TITAN QUEST

TITAN QUEST, the mythic fantasy game from Iron Lore Entertainment, united a start-up studio with one clear vision—put entertainment first. From the game's good publisher contract to unfinished and late design documents, the development team learned to juggle realistic expectations and ideal implementation. Producer Jeff Goodstill shares the ups and downs of this well-received PC hack and slash's development.

*By Jeff Goodstill*

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*By Trevor Wilson*

### 25 RANKING AND MATCHMAKING

Online game modes are gradually becoming the standard for console games, rather than an added bonus. But how do you get the right players playing against the right people, close enough in skill to be challenging, but not so difficult as to be frustrating? Microsoft's Thore Graepel and Ralf Herbrich discuss the concepts behind TrueSkill in this extended technical article.

*By Thore Graepel and Ralf Herbrich*

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In this capsule interview, we unearth the roots and ruminations of Konami's Michiru Yamane, celebrated composer of the modern CASTLEVANIA series, whose career in sound runs the gamut from the arcade heyday to the next generation.

*By Brandon Sheffield*

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# THE UP SIDE?

## IT'S ODD HOW THE MOOD OF THE GAME INDUSTRY

can turn on a dime. Only a few months ago, I remember tremendous consternation as the console transition started to bite current-generation sales, but Xbox 360 supplies were anemic and digital distribution was even more unproven than it is now.

But as of press time, NPD U.S. retail sales are showing notable upturns over last year; the PlayStation 3 and Wii launches are explicitly dated (if wobbly in terms of PlayStation 3 supply); and the increasing success of services such as Valve's Steam and Xbox Live Arcade, well ... the sky's the limit, right?

Well, yes. And no. Let's examine, for each of these points, why we should be cheerful and why we should be just a little wary going into the 2006 holiday season.

## INCREASED REVENUES?

The first thing to note is that yes, the North American game business is making more money than it did last year. However, a lot of that money is attributed to the first properly competitive handheld market in many years, thanks to the maturing of Sony's PSP and Nintendo DS. The Xbox 360 may be nudging things along nicely in North America, increasing its install base by a couple of hundred thousand units per month, but it's not really the console market which is yet leading any resurgence.

All signs point to this holiday season being the start of a robust new generation for the video game business (PlayStation 3-related issues notwithstanding), and there will be plenty of room for everyone in both hardware and software markets when all three consoles have debuted. Call this the handheld dawn before the console sunrise?

## CONSOLE LIFTOFF

There's little to say other than the uncertainty is over—but it's not. It's over inasmuch as we know the remaining major next-generation consoles are going to launch this holiday season in some form, with PlayStation 3 manufacturing woes ruling out Europe.

Still, there are the matters of supply and building up an install base. It's not really whether manufacturers get console into stores, it's how swiftly they can reach a 5 million, 10 million, or 20 million install base. Given that the whole world seems to want consoles at the same time nowadays, supply issues are rampant.

Hardware makers have got to start somewhere, and that's at zero units shipped. The Wii and PlayStation 3 are bringing enough heavyweight chums along for the ride (mascots like Mario for the Wii, developers like Ninja Theory and Insomniac and Naughty Dog for the PlayStation 3) that the hype alone will take the install bases high enough to allow developers a chance to release games and make decent money. Consoles only fail swiftly when they can't get off the install base launchpad, as the Dreamcast couldn't, and I can't believe this would happen for any of the next-gen machines.

## DIGITAL DOWNLOADS

From previous discussions in this column, many readers already know that I believe compact, intelligently designed, independent games are going to be entering somewhat of a golden age, thanks to digital downloads on consoles and PC. But look at the music industry as an example. The opening up of digital downloads has led to a massive broadening of the market, and amazing possibilities for grassroots success using the internet and other personalized marketing.

The downside for performers is that the top music acts just don't sell what they used to because the market is diffused in a greater way.

In looking at revenues in the game market, even the top Xbox 360 Live Arcade titles right now are making just \$2 or \$3 million in revenue—small beans for traditional publishers. Yet, 50 percent of Xbox Live Arcade revenues go directly to developers, which allows for a possibly holy grail, a self-sustaining developer business model that doesn't rely on publisher advances.

Let's not throw out the baby with the bathwater, though. Games are still darn tricky to make and predict success on, and putting all your eggs into one basket (the revenue on one game) is extremely risky.

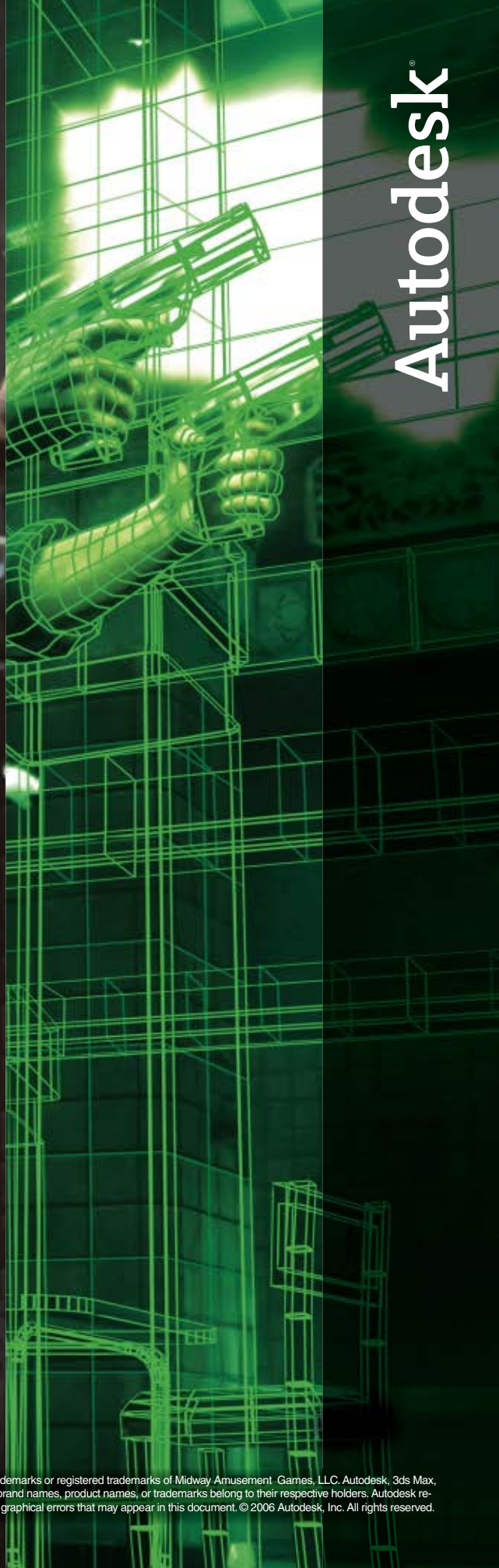
Why shouldn't a developer still get paid to make a game for a publisher and let the publisher assume the risk alongside the reward? I wouldn't be surprised if we start to see more of this in the digital download market, too.

In other words, there's never one answer. All kinds of hybridized models are probably going to appear in the near future. But the democratization of gaming, and all of the good and bad things that it implies, has begun. ✖



Simon Carless, editor-in-chief





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# HARDCORE FEMALES HOT ON HORROR

## SURVIVAL HORROR IS THE MOST APPEALING

genre of games to hardcore female game players, according to the report "Games Women Play," released by U.K.-based Strange Agency, a group that uses proprietary software-generated statistics to analyze trends and design in video games.

The criteria used to evaluate game genres were attacking, defending, exploring, investigating, music, story, and a number of other gameplay elements.

Strange Agency's Jo Clay explains why survival horror and similar genres appeal to female gamers. "In most of the games preferred by women, violent activities are counterbalanced by a strong story element; women have a particular desire for a reason to fight before they can become fully immersed in a game's aggressive activity."

The study aims to create a "perfect recipe" for a game which would appeal to a female hardcore

gamer, but it cannot deny that many of these traits are universal to games.

Still, both story and combat must function harmoniously in order to satisfying the female hardcore demographic, according to the organization. "Survival horror displays both these traits; a need to save or rescue someone close to you, the playable character, and an equal need to kill anything that stands in your way, particularly anything of the zombie nature."

Strange Agency has explored other game elements across a wide variety of genres as well (see graph), ranking their importance among certain demographics in several specific games.

"It could be argued that story, investigation, and puzzling are also desirable features for male gamers when playing a violent game, which is true," says Clay, "but the inclusion of this pattern of activity is essential for a female gamer."

—Brandon Sheffield

## ACTIVITY PROFILE: HOW WOMEN RATE GAME ELEMENTS

ACTIVITY GROUP	LEVEL OF IMPORTANCE		
	ZELDA	TOMB RAIDER	FABLE
attacking	low	mid	mid
confronting	high	mid	high
exploring	mid	mid	low
investigating	high	high	mid
skill enhancement	-	low	mid
story	mid	mid	mid
trading	high	-	mid

# EA'S DATE WITH EPIC

## Multi-title Unreal Engine 3 license announced for next-gen development

### IN SURPRISING NEWS, MAJOR

publisher Electronic Arts has announced it has licensed Epic's Unreal Engine 3 for "several next-generation titles that are currently under development."

The brief announcement states that EA "employs a variety of engines, tools, and technologies to best serve the needs of each game and development team," and raises interesting issues regarding the Criterion-authored RenderWare engine—which was purchased by the company in 2004 alongside the BURNOUT

developer—and its intended global EA rollout.

Executives have been relatively quiet regarding companywide technical solutions. But at last year's Tokyo Game Show, EA's Neil Young and John Buchanan commented on the company's engine strategies, noting that EA was moving toward a "common technical structure" over all internal studios, which was intended to be RenderWare in the long term.

Young also mentioned at his 2005 TGS talk that the version of Renderware being used at

Electronic Arts Los Angeles at the time was internally called RenderWare 4.5, essentially RenderWare 4 plus an unspecified EA code base. However, it seems that some as-yet unnamed Electronic Arts teams have switched to Unreal Engine 3 for their projects, with EA management's blessing.

Paul Lee, president of EA Studios, commented on the announcement, "At EA, we give our development teams the tools they need to make great games. We license cutting edge tools like the Unreal Engine 3

and combine them with our own systems to create state-of-the-art development technology."

No further details have been given regarding which EA titles will use Unreal Engine 3, an engine that's licensed by many other publishers and developers, including Microsoft Game Studios, Atari, Real Time Worlds, Namco, Midway, Silicon Knights, and Vivendi Games; and of course, Unreal Engine 3 powers Epic's own flagship Xbox 360 title GEARS OF WAR.

—Simon Carless

# TELEPHIA: U.S. MOBILE GAMES GROW IN Q2

**NEARLY 13.5 MILLION WIRELESS** customers in the U.S. downloaded at least one game during the second quarter of 2006, according to a new research report from independent consumer metrics firm Telephia.

This figure represents an average monthly revenue of \$46.9 million across the quarter, a number that has seen an impressive 63 percent jump since Q3 2005.

The "Q2 2006 Telephia Mobile Game Report" also indicates that

revenue share for EA Mobile's TETRIS led all titles for the period with a 5.1 percent share. Namco Networks' PAC-MAN ranked second in overall share with 3 percent, followed by EA Mobile's BEJWELED with 2.8 percent of the total revenue share.

Another Namco Networks title, MS. PAC-MAN, claimed 2.3 percent of total revenues to become the fourth most lucrative mobile title for the quarter, while WORLD POKER TOUR—TEXAS HOLD 'EM by Hands-

On Mobile secured a 2.2 percent share for fifth.

The firm noted that overall, EA Mobile was responsible for more than 29 percent of total publisher revenues in the second quarter, with its closest competitors, Namco Networks and Hands-On Mobile, coming well behind with an 8.4 and 8.2 percent share, respectively. Glu Mobile secured 7.4 percent of mobile revenue, followed by Gameloft with its 7.1 percent share.

"In less than a year, average monthly mobile game revenues have increased by nearly two-thirds, from \$28.7 to \$46.9 million during the most recent quarter," said Kanishka Agarwal, Telephia's vice president of new products. "Backed by an increasingly growing audience, both big gaming brands and new upstarts have taken a slice of that revenue pie."

—Jason Dobson

## product news.....

# AUTODESK 3ds MAX 9

### A NEW VERSION OF

Autodesk 3ds Max is the first version to support both 32- and 64-bit Windows systems. Version 9, which will be available as of October 16, also includes a new mental ray sun and sky shader and a new Pro Booleans tool for modeling inorganic shapes using

Boolean operations.

Max 9 also gives users the ability to do more from directly within the viewport (for example, switching between high and low resolution bitmap proxies), more streamlined character animation workflow, and improved hair and cloth features.

Although no groundbreaking new features have found their way into Max 9, additional improvements include enhanced FBX support (such as improved mesh



3ds Max 9 offers new MentalRay tools, like sun and sky shaders.

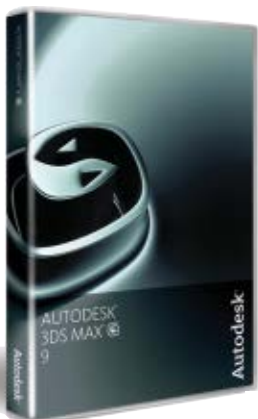
compatibility and pixel accuracy when transferring data between Max and Maya) and display support for DirectX and CG Shaders—users can now load cgfx files into the DX material and have them displayed in the viewport.

3ds Max 9's suggested

prices are \$3,495 (standalone); \$3,995 (network); \$795 (upgrade from Max 8); \$1,395 (upgrade from Max 7); and \$500 (education price).

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—Jill Duffy



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### Serious Games Summit D.C.

Crystal Gateway Marriott  
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### GStar

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[www.gstar.or.kr](http://www.gstar.or.kr)

### GDTW 2006: International Conference on Game Design and Technology

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Canadian-born Mark Rein is Vice President of Epic Games based in Raleigh, North Carolina. Their Unreal series of games is reported to have sold over 7 million copies world-wide. Epic's Unreal Engine 3 has won Game Developer Magazine's Frontline Award for Best Game Engine for the past two years. Since 1992 Mark has worked on Epic's licensing & publishing deals, business development, public relations, academic relations, marketing and business operations. Currently in development at Epic: Gears of War for Microsoft and Unreal Tournament 2007 for Midway.

#### Upcoming Epic Attended Events:

**Tokyo Game Show**  
Makuhari Messe,  
September 22-24

**GDC London & London Games Summit**  
London, UK October 3-5

**Serious Games Summit**  
Washington, DC  
October 30-31

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# Unreal® Technology News

by Mark Rein, Epic Games, Inc.

## ELECTRONIC ARTS LICENSES UNREAL ENGINE 3

Electronic Arts recently announced that they have entered into a license agreement for EA to adopt Unreal® Engine 3 for use in several next-generation titles that are currently under development. With the largest studio operation in the world, EA employs a variety of engines, tools and technologies to best serve the needs of each game and development team.

Paul Lee, president of EA studios commented, "At EA, we give our development teams the tools they need to make great games. We license cutting edge tools like the Unreal Engine 3 and combine them with our own systems to create state-of-the art development technology."

## CHEYENNE MOUNTAINS' STARGATE WORLDS MMORPG TO USE UNREAL ENGINE 3

Cheyenne Mountain Entertainment has also announced that they have licensed Unreal Engine 3 to create a massively multiplayer online role-playing game (MMORPG) based on the highly popular science fiction television series Stargate from MGM.

Cheyenne's VP says Unreal Engine 3 will allow them to "deliver groundbreaking game content for Stargate Worlds commensurate with the quality of the #1 rated sci-fi franchise and future multi-platform games."

## BROTHERS IN ARMS FROM GEARBOX

Brothers in Arms is the highest rated WW2 video game franchise in the world. Brothers in Arms Hell's Highway is based on a true story and uses next-generation technology to recreate history – to take you back in time and put you in the boots of a real 101st Airborne Paratrooper squad leader in the real places with the real soldiers fighting in the real battles. Brothers in Arms lets you play your part in history.

Gearbox Software first licensed Unreal Engine 2 Technology in 2002 for the development of the original Brothers in Arms game, Road to Hill 30. According to Randy Pitchford, CEO of Gearbox "because of our experiences with Unreal Engine 2 and because of the great

support relationship we have with Epic Games, Gearbox was excited to be one of the earliest licensees of Unreal Engine 3 for the next generation."

"Out of the box, Unreal Engine 3 is a great and complete set of technology. But, we've been really happy with how easy integration has been – whether using third party systems or proprietary systems that we've developed at Gearbox."

Randy points out that Gearbox engineers, while confident they could have created an engine comparable to Unreal Engine 3 themselves, feel licensing is a better alternative. According to Randy, "All of us at Gearbox believe that licensing Unreal Engine 3 is a very smart decision. The biggest reason why we are proponents of Unreal Engine 3 is because Epic's technology allows us to conserve the opportunity cost of building it ourselves.

The team here can focus all of the energy on what matters most – making games."

We asked Randy in what ways Epic's Unreal Developer Network (UDN) has been beneficial to his project...

"Unreal Developer Network is a great resource because it connects us with the Epic engineers and the other Unreal Engine licensees.

We can influence future engine decisions and go right to the source when we want to get the most out of a particular system. Unreal Developer Network is one of the biggest advantages of Unreal Engine Technology over other choices we have used in the past or considered for our future."

Brothers In Arms Hell's Highway is coming to PC, PlayStation3 and Xbox360 in 2007. For more information about this game visit: [www.gearboxsoftware.com](http://www.gearboxsoftware.com)



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# BETTER GAME CHARACTERS BY DESIGN

BY KATHERINE ISBISTER

## MOST GAME DEVELOPMENT TEAMS

have a common goal of creating a blockbuster game. Yet very few have a detailed creative design process—only the vague goal of “making cool characters and a fun game.”

Don’t believe me? If you work for a game development company, try this experiment: Walk up to the lead game designer, art director, or producer and ask, “Are we using a psychological approach to our game’s character design?” It’s very likely you will receive a blank stare and be asked whether you’d like to take a psychological approach to getting back to work.

Game designer extraordinaire Tim Schafer laments in the foreword to *Better Game*

*Characters By Design: A Psychological Approach*, “When I was in college we didn’t have courses in game design.” He goes on to humorously express the same initial reservations that I had upon encountering this book—that an academic researcher in psychology may not be a source of relevant tips and advice on the day-to-day grind of how to make games.

But in fact, the author, Katherine Isbister, not only has developed and taught courses at Stanford University on game character design, but is an avid game player as well. Isbister is currently an associate professor in the department of Literature, Language, and Communication at the Rensselaer Polytechnic Institute, with a research focus in social psychological and affective approaches to human-computer interaction with special attention to games.



## Review by Bijan Forutanpour

specific chapters are presented in a way that allows the reader to start integrating ideas into an existing and advanced development process with a tight timeline. Still other chapters are targeted toward the preproduction and design phase. Finally, for novices, the appendix provides a good collection of game summaries, genres, and character design options.

Isbister strikes a perfect balance between theory and practice by not only describing concepts in abstract academic terms but also conducting interviews with industry

veterans who describe their approaches to design. It becomes clear that the designers interviewed make conscious decisions about the look, behavior, dialogue, culture, and relationships between the game characters, as well as the environment and the target audience.

The target audience, its age, gender, and ethnicity, is something the interviewees are very conscious of, and character design decisions are targeted accordingly. Everything the author describes in academic terms is applied by those interviewed, which gives the reader a better, more concrete understanding of how the concepts might manifest in practice.

The application of theory into practice is made even clearer by frequent summaries of bullet point lists in sections called “Design Pointers.” These make great checklists for designers

Most books on character design approach the topic from the animation, filmmaking, or fiction discipline. Yet, the emotional engagement, fun factor, and believability develop from the interaction between the audience (player) and game character—and this is where psychology plays a large role. To this end, *Better Game Characters by Design* provides both compelling evidence for using and an excellent roadmap for implementing a psychological approach.

One of the book’s main themes is knowing your target audience demographic in order to relate to them most effectively. The author follows this approach and guides the reader based on his or her background and game development needs. The book may be used in its entirety (as a college textbook, for example) or in part, as

## BOOK REVIEW



### STATS

#### TITLE

*Better Game Characters By Design: A Psychological Approach*

#### AUTHOR

Katherine Isbister

#### PRICE

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#### PUBLISHER INFORMATION

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during the concept development phase of a game. Another unique aspect about the information presented is that every chapter begins with a subsection titled, "What is covered and why," material I found enormously useful because it showed the logical flow of different aspects of character design and motivated me to continue reading.

Thematically, the book is separated into five parts of two chapters each. The first section focuses on the visual aspect of a character, mainly facial features and body language, although Isbister also delves into the issue of stereotyping. While she recommends using stereotypes to quickly convey a character, she also advises breaking them to add depth and a richer, more memorable character.

Part two focuses on the player character and the importance of gender and culture as presented in the game versus the culture of the target audience. Particularly fascinating is an interview with Ryoichi Hasegawa and Ropyyaku Tsurumi of Sony Computer Entertainment Japan, who discuss the differences between video games in Japan and the U.S., and the acceptance of foreign games in the respective countries. For example, facial characteristics are very important to an American game being accepted in Japan, and as it stands, typically they are not widely embraced, or at least not until certain modifications are made.

Part three focuses on the importance of facial expression, body language and tone of voice. Facial expressions can telegraph intention as well as create emotion for the players themselves. Physical contact between player characters, such as a pat on the back, can communicate encouragement. Tone of voice can be an important tool in expressing emotion, too.

Part four focuses on player characters (PC), and non-player characters (NPC). The experience of a player's psychological experience of a PC is broken down into four layers: visceral, cognitive, social, and fantasy. Each layer is explained in detail, and MAX PAYNE and HALF-LIFE are cited as successful implementations. Social roles in games are also discussed, such as sidekick, ally, guide, mentor, boss monster, competitor, archenemy, and many more. The section provides a good summary of the typical roles game characters can play.

Part five focuses on the overall game development process and the importance of

usability tests and marketing tests. An interview with Tim Schafer, creator of FULL THROTTLE and GRIM FANDANGO, and currently head of Double Fine Productions (PSYCHONAUTS) appears in this section, in which he shares his approach to character design, communicating designs to team members, and the evolution of character design during the development process.

What I found particularly clever and innovative was his innovative use of Friendster.com to create homepages for his virtual characters, as if the characters themselves had created them, and linked to one another, and established relationships, likes and dislikes, and personalities.

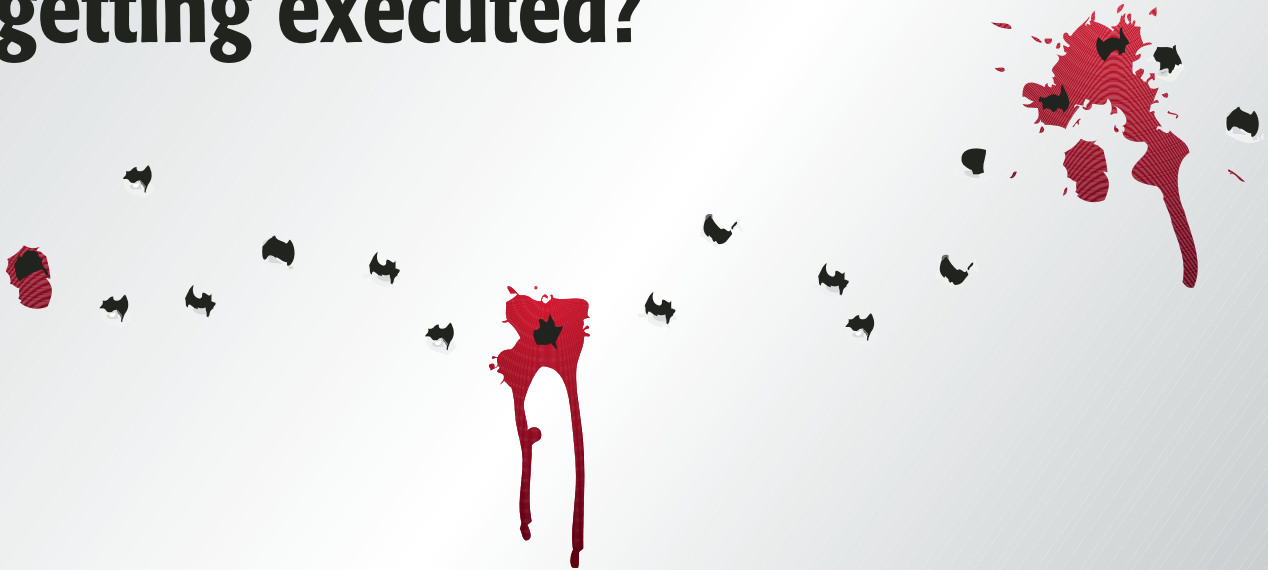
Other interviews contained in the book include a chat with Chuck Clanton, who was involved with the making of There.com (an interactive online community that arguably does or does not constitute a "game") on several levels, as well as Marc Laidlaw, who's best known in game circles for writing HALF-LIFE and HALF-LIFE 2. Additionally, Nicole Lazzaro of XEODesign is interviewed about play testing.

The book includes a DVD, which contains screen shots from a number of video games and a few movie files. The movies (which are referenced in the text) illustrate certain aspects of character design and gameplay. The DVD could have benefited from brief description files, reiterating points made in the book, as a convenience. But these shortcomings are minor, and in the context of each other, it was interesting to see the different approaches taken by different developers to create visuals and gameplay.

I would say without hesitation that this book is one of the best game and character design books available, and should be required reading for all game designers, artists, and producers. Programmers, too, stand to gain a lot from it, as the book offers them a new perspective on the art and science of game development. ❖

**BIJAN FORUTANPOUR** is a senior graphics programmer who has worked in the visual effects and game industries for 12 years, four of them specifically in video games. When he's not writing graphics code, he's thinking about writing graphics code. Email him at [bforutanpour@gdmag.com](mailto:bforutanpour@gdmag.com).

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TOP

20

PUBLISHERS

**2006 BRINGS THE FOURTH ANNUAL GAME DEVELOPER TOP 20 PUBLISHERS RANKING, AND**

along with it evidence of an industry in flux as it prepares for the next generation of console hardware. Some publishers have sought to beef up their existing talents and resources to handle the oncoming storm, while others have contributed to the constant consolidation the industry has been experiencing.

Some familiar faces have joined forces with others (Bandai and Namco), and some have shaken up others' spots on the ranking (notably Take-Two and Nintendo).

There are two newcomers to the list, and one graceful exit: Buena Vista Games and NCsoft both made respectable first showings this year, bumping off Codemasters. And while this ranking arguably marks the end of a console generation, the next will show just who has been most effective in making the transition, so there can only be more rise, fall, and shakeup as the industry matures.



**ELECTRONIC ARTS™**

**1. ELECTRONIC ARTS**

**Year formed:** 1982

**Headquarters:** Redwood City, Calif.

**Studios:** Criterion (Guildford, U.K.); Digital Illusions CE (London, Ont., Stockholm) EA Black Box (Vancouver); EA Canada (Burnaby, British Columbia); EA China (Shanghai); EA Los Angeles (Playa Vista, Calif.); EA Mobile; EA Montreal; EA Mythic (Fairfax, Va.); EA Japan (Roppongi, Japan); EA Redwood Shores (Redwood City, Calif.); EA Singapore; EA U.K. (Chertsey, U.K.); Maxis (Emeryville, Calif.); EA Phenomic (Leipzig, Germany); EA Tiburon (Orlando)

**FOR THE FOURTH YEAR IN A ROW, EA**

resides at the top of our ranking. Despite a loss reported in its earnings for the fourth quarter of fiscal year 2006, a \$15.6 million settlement paid to end a lawsuit over the company's labor practices, and results below company expectations in 2005's holiday season, the publisher managed to maintain robust revenue.

EA's sports titles made an even more impressive performance than in previous

years, and THE SIMS series and its expansions continue to generate high sales. Even a lower average review score than in last year's tally hasn't altered the company's position in the top publisher ranking.

Perhaps to that end, the Redwood Shores, Calif.-based company has announced an intention to focus more on original intellectual properties. Along these same lines, EA ended its contract with the *James Bond* license early, likely due to poor sales of games from the franchise. Licensed properties continue to be a major source of income, however, with games based on *The Godfather* and *Harry Potter and the Goblet of Fire* having sold millions of copies each.

This megapublisher has continued to diversify its stable of development houses and partnerships. It has brought online its own digital distribution system for games and a system for collecting micro-transactions for in-game purchases. It carried off a major coup d'état when it acquired Jamdat Mobile, a global publisher of mobile phone games and the largest distributor of its kind in the U.S.

Other acquisitions included developer Hypnotix, responsible for OUTLAW GOLF and

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OUTLAW VOLLEYBALL, who now reside at EA's Tiburon studio, and German strategy-game developer Phenomic. In February 2006, EA announced a partnership with Neowiz, a Korean publisher of online games, and by the end of June the resulting project FIFA ONLINE had beaten all previous records for online games in Korea. Plus, the publisher has further expanded into Asia, ramping up development with new hires in its Shanghai studio and opening a division for Asian localization in Singapore. With all the above and a five percent staff cut made in February, the company is well-positioned for the current generational transition.



## 2. NINTENDO

**Year formed:** 1933

**Headquarters:** Kyoto, Japan

**Studios:** Intelligent Systems [Kyoto]; Nintendo Entertainment Analysis and Development (Kyoto, Tokyo); Nintendo Software Technology Corp. (Redmond, Wash.); Retro Studios (Austin); Systems Research & Development [Kyoto, Osaka]

### NINTENDO'S DS PORTABLE HAS COME INTO ITS OWN DURING THIS YEAR'S

considered period, moving the company into second place with increased software revenues and nearly double the number of releases. The incredible mass appeal and resulting sales of the company's NINTENDO DS, BRAIN TRAINING, and related titles, as well as the company mainstay's latest foray, NEW SUPER MARIO BROS., more than made up for its continually sliding console-game revenues.

The DS stands as the company's clear focus—as far as portable games go—for the immediate future. By introducing a revised DS hardware piece, the sleek DS Lite, Nintendo further boosted the handheld platform's popularity. Additionally, sales of Game Boy Advance titles have been steadily declining, as further evidence of the transition.

E3 2006 saw Nintendo unwrap its next-generation console, now known as Wii, which looks to boast the same bold design sense and philosophy of mass appeal as the DS hardware. If the new console can manage to reach an audience similar to that of the DS, Nintendo's position near the top of our list will likely be solidified for next year. The company continues to maintain excellent relations with third-party publishers and external developers as well, and received the highest scores for producers and milestone payments out of any company via our anonymous survey.

# ACTIVISION®

## 3. ACTIVISION

**Year formed:** 1979

**Headquarters:** Santa Monica, Calif.

**Studios:** Beenox (Quebec City); Infinity Ward (Encino, Calif.); Luxoflux (Santa Monica, Calif.); Neversoft (Encino, Woodland Hills, Calif.); Raven Studios (Madison, Wis.); RedOctane (Sunnyvale, Calif.); Shaba Games (San Francisco); Toys For Bob (Novato, Calif.); Treyarch (Santa Monica, Calif.); Vicarious Visions (Mountain View, Calif., Troy, N.Y.); Z-Axis (Foster City, Calif.)

### KNOCKED DOWN TO THIRD PLACE FROM LAST YEAR'S SECOND BY NINTENDO'S

powerhouse DS push, Activision retains a place near the top thanks to its CALL OF DUTY and TONY HAWK franchises—CALL OF DUTY 2 and CALL OF DUTY: BIG RED ONE sold extremely well across many platforms. Activision's release count declined over 2005, but a higher average review score and favorable developer survey ratings helped the EA rival maintain its footing in our list's top three.

The most artful work we've seen from Activision on the business side has been to carefully secure intellectual properties and licensing agreements to sustain its projects for years to come. The company struck agreements that gave it licenses to produce games based on the *Spider-Man* and *Transformers* movies, four additional new Dreamworks pictures, Mattel's Barbie toy line, and the potentially lucrative *James Bond* franchise, taken over from EA. GUITAR HERO's brisk sales led Activision to purchase the game's publisher RedOctane in May, yielding an original IP for the publisher—but the company's number one original IP in 2005 was GUN.

Activision has not proved to be immune to the sorts of legal threats that have faced its competitors, specifically EA and Take-Two. As of this writing, the company faces two separate lawsuits: one over its labor practices and another over allegedly backdated stock options. At the same time, the company has tightened its belt for the generational transition by reducing its workforce by seven percent back in February.

## methodology

### THE GAME DEVELOPER TOP 20 RANKS

publishers using a score calculated from each publisher's performance in the following six measures: annual turnover, number of releases, average review score, quality of producers, reliability of milestone payments, and quality of staff pay and perks.

Annual turnover figures come from the publishers' annual accounts or, when

these are not public, from our own estimates based on the sales of games they release. The number of releases, which counts the publication of the same game on different formats as separate releases, was obtained from information on the publishers' web sites and dedicated gaming web sites. The average review score ratings were based on information from Metacritic.com. A

confidential online survey of developers provided the data for the quality of producers, reliability of milestone payments, and pay and perks.

The top 30 publishers were ranked according to each of these six measures. The highest scoring publisher in a category was assigned a figure, and this figure was counted down from in regular intervals for each publisher on the list, in

order. The totals were weighted and added to produce a final score, which determined the top 20.

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<sup>1</sup>Intel® Threading Building Blocks available in C++ only.  
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## 4. SONY COMPUTER ENTERTAINMENT



**Year formed:** 1993  
**Headquarters:** Tokyo  
**Studios:** Bend, Ore.; Cambridge, U.K.; Contrail (Tokyo); Foster City, Calif.; Guerrilla Games (Amsterdam); Incognito Entertainment (Salt Lake City); Insomniac (Burbank, Calif.); Liverpool, U.K.; London; Polyphony Digital (Tokyo); San Diego; Naughty Dog (Santa Monica, Calif.); Seoul; SN Systems (Bristol, U.K.); Tokyo; Zener Works (Tokyo)

**SONY GAINS THE NUMBER FOUR SPOT ON THE TOP 20 PUBLISHERS LIST,** as Microsoft drops from the top five. Despite strong continued sales of GOD OF WAR and a respectable showing by MLB 2006 THE SHOW for PlayStation 2, first-party software sales for the platform fell off during the period considered in our methodology. First-party PSP software sales buoyed Sony though, and allowed the Tokyo-based company to hold steady in terms of revenue. A slightly higher average review score—to which SHADOW OF THE COLOSSUS's shining critical reception contributed—doubtless helped the company's standing in our ranking.

Guerrilla Games has proved to be a valuable asset to Sony's first-party portfolio, with KILLZONE games on the way for PSP and PlayStation 3, and Sony acknowledging the fact more concretely by acquiring the Dutch developer this year.

## 5. TAKE-TWO INTERACTIVE



**Year formed:** 1993  
**Headquarters:** New York  
**Studios:** Cat Daddy Games (Bellevue, Wash.); Firaxis Games (Hunt Valley, Md.) Irrational Games (Quincy, Mass.; Canberra, Australia); Kush Games (Camarillo, Calif.); Rockstar Leeds (Leeds, U.K.); Rockstar North (Edinburgh); Rockstar San Diego; Rockstar Toronto; Rockstar Vancouver; Rockstar Vienna; Venom Games (Newcastle, U.K.); Visual Concepts (San Rafael, Calif.)

**TAKE-TWO INTERACTIVE, THE OWNER OF THE POWERHOUSE ROCKSTAR** Games publishing label and the lucrative GRAND THEFT AUTO franchise, has proven successful at maintaining a plateful of successful releases, even in a year without a new mainline GTA release. THE ELDER SCROLLS IV: OBLIVION, co-published with Bethesda, broke sales records for Xbox 360 games and was no slouch in the PC format either. CIVILIZATION IV also performed well, and the PSP release of GRAND THEFT AUTO: LIBERTY CITY STORIES proved to be one of the top-selling titles on the platform during the period considered. Unsurprisingly, the now \$20 GRAND THEFT AUTO: SAN ANDREAS continued to contribute to the company's revenues.

Take-Two acquired sterling independent developer Irrational Games in January as a result of a relationship the two companies formed around Irrational's upcoming release BIOSHOCK. Nabbing this team will likely result in

Publisher	Rank				Final score	No. of releases	Average game review score	Producer rating	Milestone payment rating
	2006	2005	2004	2003					
Electronic Arts	1	1	1	1	258	129	72.75%	9.3	8.5
Nintendo	2	4	10	3	255.5	39	76.1%	10	10
Activision	3	2	7	4	245.85	45	71.58%	9.3	8.65
Sony Computer Entertainment	4	5	3	2	239.5	43	72.47%	8.5	8.5
Take-Two	5	10	8	6	225.5	57	68.04%	8.5	8.5
Microsoft	6	3	2	9	224	12	76.75%	8.5	8.5
THQ	7	8	4	13	220.15	76	64.74%	9.7	8.5
Ubisoft	8	6	5	12	218.75	67	66.07%	9.25	8.5
Konami	9	7	15	8	214	57	67.79%	8.5	8.5
Sega Sammy Holdings	10	9	14	10	211.8	39	69.85%	9.55	9.55
Namco Bandai	11	11/17	20/-	16/15	205.5	58	65%	8.5	8.5
Vivendi Games	12	12	11	5	201.7	26	65.31%	9.4	7.3
Square Enix	13	16	16	11	193	10	76.2%	8.5	8.5
Capcom	14	15	-	14	192.5	35	69.14%	8.5	8.5
NCSOFT	15	-	-	-	180.5	3	79.67%	8.5	8.5
SCI/Eidos	16	16	6	19	176	25	69.6%	8.5	8.5
LucasArts	17	20	-	-	173.55	6	76.67%	8.5	8.5
Buena Vista Games	18	-	-	-	173.2	21	67%	7.5	9.4
Atari	19	13	9	7	169.5	32	68.22%	8.2	7.3
Midway	20	19	17	20	158.5	38	63.13%	8.5	8.5

even more high quality, original IPs for the publisher and create an opportunity for Irrational's often-niche projects to receive more marketing attention than they have in the past.

The scandal over GRAND THEFT AUTO: SAN ANDREA's "hot coffee" was still threatening Take-Two as this ranking's period of consideration began. While the company in June received a subpoena from the District Attorney of New York County's office for documents related to "hot coffee" and regarding financial issues, in July the FTC let Take-Two off the hook by announcing that no penalties or fines would be imposed as a result of its investigation. Of course, the FTC did gently remind Take-Two to properly represent games' ratings and content descriptors in the future.



## 6. MICROSOFT GAME STUDIOS

**Year formed:** 1975

**Headquarters:** Redmond, Wash.

**Studios:** Bungie Studios (Redmond, Wash.); Ensemble Studios (Dallas); FASA (Redmond, Wash.); Lionhead Studios (Guildford, U.K.); Microsoft Game Studios Japan (Tokyo); Rare (Twycross, U.K.)

### MICROSOFT'S INTERNAL GAME

development endured a transition phase during this period, ignoring the all-but-defunct Xbox platform and preparing new titles for the Xbox 360. The lack of a release as popular as the company's HALO series for Xbox has caused the publisher to drop three spots in our ranking. The stable of studios holds much promise for its home platform, however, with HALO 3 on the way and a pledge of support from FINAL FANTASY creator Hironobu Sakaguchi and his studio Mistwalker. With a lower console price point than Sony, Microsoft has some real opportunities to move forward in the coming generation.

On the PC side, AGE OF EMPIRES III has consistently cleaned up the charts since its October release, reaching platinum status and becoming the fastest selling entry in the long-running series, and a Windows Vista-only HALO 2 will make for interesting results next year.

Pay and perks	No. of internal studios
8.9	15
8.5	5
8.5	11
8.5	16
8.5	12
8.5	6
8.35	16
8	14
8.5	4
8.5	7
8.5	6
9.7	9
8.5	4
8.5	6
8.5	3
8.5	4
8.5	1
8.5	2
8.5	4
8.5	6

## 7. THQ

**Year formed:** 1989

**Headquarters:** Calabasas Hills, Calif.

**Studios:** Blue Tongue Entertainment (Melbourne); Concrete Games (Carlsbad, Calif.); Cranky Pants Games (Kirkland, Wash.); Heavy Iron Studios (Los Angeles); Helixe (Burlington, Mass.); Incinerator (Carlsbad, Calif.); Juice Games (Warrington, U.K.); Kaos Studios (New York); Locomotive Games (Santa Carla, Calif.); Paradigm (Dallas); Rainbow Studios (Phoenix); Relic Entertainment (Vancouver); THQ Australia Studios (Spring Hill, Australia); THQ Wireless (Calabasas Hills, Calif.); Vigil Games (Austin); Volition (Champaign, Ill.)



### THANKS TO HEIGHTENED REVENUES, THQ MOVES UP TWO SPOTS ON THE LIST

this year, though the company had a lower average review score, and respondents to our survey were less than favorable when ranking their milestones and payments. THQ's highly rated producers and significant revenue aided the publisher's climb up the list of Top 20 Publishers.

While the company has continued to expand its original releases, its bread and butter is still its collection of licensed titles, several of which sold more than one million copies during the period and aided the publisher's rise on our charts (CARS and WWE SMACKDOWN VS. RAW 2006 being the company's most notable hits).

THQ expanded its operations and added considerable talent to its resources with the establishment of the internal studios Kaos and Incinerator, and the acquisition of Juice Games, Vigil Games, and Paradigm Entertainment (along with its STUNTMAN franchise). And in what seems to be a running industry trend, THQ is also now under SEC investigation for its handling of stock options over the years.

## 8. UBISOFT

**Year formed:** 1986

**Headquarters:** Paris

**Studios:** Annecy, France; Barcelona; Blue Byte (Düsseldorf, Germany); Bucharest; Casablanca; Milan; Montpellier, France; Montreal; Montreuil, France; Quebec City; Red Storm (Morrisville, N.C.); Reflections (Newcastle, U.K.); Shanghai; Wolfpack (Austin)



### SLIDING TWO POSITIONS DOWN THE LIST FROM 2005, UBISOFT'S AVERAGE

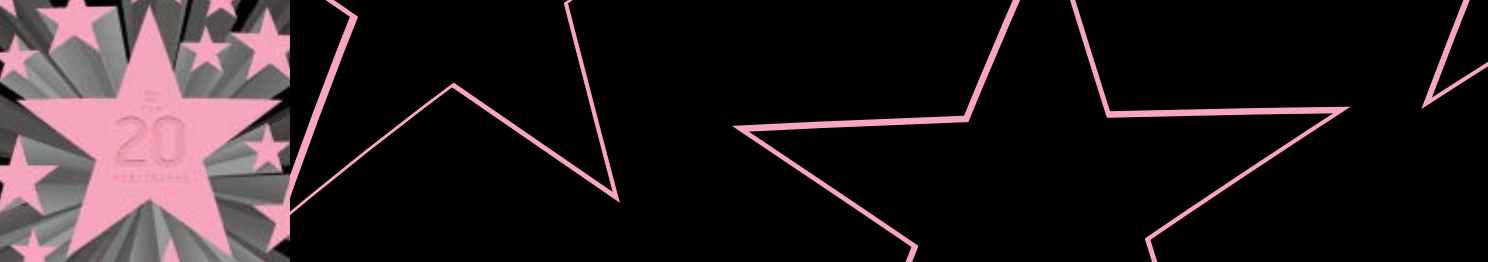
review score and pay and perks ratings fell a bit from last year. The Parisian company's revenues were quite solid, however, and were kept steady by healthy sales of TOM CLANCY'S GHOST RECON ADVANCED WARFIGHTER, PETER JACKSON'S KING KONG, 3DO acquisition HEROES OF MIGHT & MAGIC V, and releases from the FAR CRY franchise.

While FAR CRY developer CryTek has signed an exclusivity agreement with EA, Ubisoft has purchased the game's engine and intellectual property. Another key acquisition this year was Ubisoft's purchase of DRIVER developer Reflections from the ailing Atari.

Overall, the company hasn't been as active as other major publishers in snatching up outside development houses, preferring to develop its existing talent instead, promoting its name talent and original IP whenever possible.

CONTINUED ON PAGE 18





CONTINUED FROM PAGE 17

## 9. KONAMI

**Year formed:** 1973

**Headquarters:** Tokyo

**Studios:** Blue Label Interactive (Los Angeles); Hudson Soft (Tokyo, Sapporo, San Francisco); Konami Computer Entertainment (Tokyo); Konami Software Shanghai



### KONAMI THIS YEAR HAS CONTINUED ITS RESTRUCTURING EFFORTS, WHICH

began last year with the consolidation of its Japanese development studios into a single branch. Gaming and non-gaming divisions have been shuffled and reorganized, culminating with the consolidation of Konami's European business operations into a single branch located in Germany, and the closure of its Honolulu studio.

Sales of games in the METAL GEAR SOLID, CASTLEVANIA, YU-GI-OH!, and DANCE DANCE REVOLUTION series brought the publisher relatively consistent success in the U.S., though PAWAPRO and WINNING ELEVEN sports titles brought much more success in other territories. Also looking to increase its involvement in the ever-growing mobile market, Konami purchased Los Angeles mobile developer Blue Label Interactive and formed a partnership with casual game publisher PlayFirst for mobile distribution of its games. But the Japanese publisher is clearly affected by the transition as well, with fewer major releases this year and more effort being spent on next-generation development.



## 10. SEGA SAMMY HOLDINGS

**Year formed:** 1952 (Sega); 1975 (Sammy)

**Headquarters:** Tokyo

**Studios:** Creative Assembly (West Sussex, U.K., Fortitude Valley, Australia); Racing Studio (Birmingham, U.K.); Secret Level (San Francisco); Sega Shanghai Studios (Shanghai); Sega Studios (Tokyo); Sega Studios USA (San Francisco); Sports Interactive (London)

### SEGA SAMMY'S CONSUMER GAMES DIVISION (THE COMPANY SIMPLY

publishes under the Sega brand) has continued to post profits this year, with elevated revenues rescuing the company's overall financial results from an ailing pachinko (Japanese gambling machines) division. U.S. sales of games in the SONIC series, especially the platinum-selling SHADOW THE HEDGEHOG, held down the fort in the U.S., while the company published a mix of Japanese and Western-developed titles, like Treasure's GUNSTAR SUPER HEROES and the first TOTAL WAR title, resulting from Sega's acquisition of The Creative Assembly.

Sega has set its sights on Western audiences for the next generation of consoles. Over the last 12 months, the company has acquired skilled developers Sports Interactive and Secret Level, and has formed partnerships with Obsidian, Petroglyph, and Bizarre Creations for exclusive next-generation and PC projects. Sega has proved apt at managing relations with Western studios like these; the company received high marks with regard to producers and milestone payments in our anonymous survey.

The company has tuned up its Japanese-oriented next-gen development as well, with SONIC titles promised across all new home consoles, including the Xbox 360, PlayStation 3, and Wii, in the coming year.

## 11. NAMCO BANDAI

**Year formed:** 1950 (Bandai); 1955 (Namco)

**Headquarters:** Tokyo

**Studios:** Banpresoft (Tokyo);

Namco Networks America; Japan Bec Co., Ltd. (Tokyo); San Jose, Calif.; Yokohama; Tokyo



### THIS YEAR WE SEE THE FIRST RESULTS OF THE MERGER BETWEEN NAMCO

and the Japanese mega-conglomerate Bandai, which consolidated their U.S. operations in January. Unfortunately for both participants, sales of their major titles (including SOUL CALIBUR III and RIDGE RACER 6 domestically and MOBILE SUIT GUNDAM titles overseas) fell short of expectations for the year.

The publisher admits to being too soft in taking advantage of handheld development for the surging DS platform. The resultant decreased release count and a marginal review score has kept the publishers' combined efforts out of the top ten, but the company has managed to remain in its Namco-occupied position from last year.

Licensed titles proved to be the biggest help for the company over the period, with its externally-developed CURIOUS GEORGE games debuting in the U.S. market, and a new line of TAMAGOTCHI games doing well in all territories. In addition, the publisher lost no time in taking advantage of the mobile market. In October 2005, Namco established a subsidiary mobile games division in the U.S. known as Namco Networks America.

## 12. VIVENDI GAMES



**Year formed:** 2000

**Headquarters:** New York

**Studios:** Blizzard Console

(Aliso Viejo, Calif.); Blizzard Entertainment (Irvine, Calif.); Blizzard North (San Mateo, Calif.); High Moon Studios (Carlsbad, Calif.); Massive Entertainment (Malmö, Sweden); Radical Entertainment (Vancouver); Sierra Entertainment (Bellevue, Wash.); Swordfish Studios (Birmingham, U.K.); VUG Mobile (Meudon, France)

### BLIZZARD'S ONLINE RPG WORLD OF WARCRAFT—STILL THE MOST POPULAR

game in the world—was responsible this year for driving revenues reported by the French conglomerate's games division. Now simply called Vivendi Games (dropping "Universal"), the publisher's income increased significantly over last year's records, thanks to WORLD OF WARCRAFT mainly, but also successes such as 50 CENT: BULLETPROOF and games based on the Ice Age 2 movie license.

Seeking to capitalize on the wireless-game boom, parent company Vivendi established a mobile development division in Meudon, France. Vivendi Games added more talent to its studio list in January by snapping up DARKWATCH developer and former internal Sammy developer High Moon Studios—and the DARKWATCH franchise along with it.

All has not been so well for other development efforts, though. Even after a developer switch and years of production, Blizzard's STARCRAFT: GHOST was put on indefinite hold recently.

The company stayed put on our ranking at number 12, with a reduced release schedule and lower average review scores hurting its overall score, while a higher producer rating raised them back up.

Interestingly, Vivendi Games has chosen to revive the Sierra publishing brand for a number of its products, playing on the nostalgia of gamers for that venerated label, which had been dormant for two years.

CONTINUED ON PAGE 21

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eidos

XBOX 360

VIDIA

XBOX







CONTINUED FROM PAGE 18

## SQUARE ENIX™

### 13. SQUARE ENIX

**Year formed:** 2003

**Headquarters:** Tokyo

**Studios:** Beijing; Osaka; Tokyo; UIEvolution (Bellevue, Wash.)

2005–2006 SAW A CONSERVATIVE RELEASE SCHEDULE FROM the Japanese publisher, with less than one title released for each month of the period considered. Sequels in mainstay series performed well, including DRAGON QUEST VIII and especially the Buena Vista Games partnership KINGDOM HEARTS II, which sold even faster than its predecessor. Square Enix nurtured its online games business during the period, with FINAL FANTASY XI receiving an expansion during the year and increasing its subscriber base to over 500,000 users. A friendly takeover of Japanese publisher and arcade distributor Taito was completed during the period, but that merger has not had much of an effect on U.S. software publishing to date; Taito's strengths are in amusement machines and mobile development.

A high average review score and the successes of its mobile releases helped the publisher rise from two previous years spent in the number 16 spot on our list.

## CAPCOM®

### 14. CAPCOM

**Year formed:** 1979

**Headquarters:** Osaka

**Studios:** Capcom Interactive (Los Angeles); Clover Studio (Osaka); Cosmic Infinity (Burlington, Ont.); Flagship (Tokyo); Team 1 (Osaka); Team 2 (Osaka)

CAPCOM RISES A NOTCH THIS YEAR, THANKS IN PART TO THE runaway success of MONSTER HUNTER 2 (PlayStation 2) and MONSTER HUNTER FREEDOM (PSP). Financial reports issued by the company obliquely referred to brisk sales for lower-priced titles, which seems to indicate good revenues brought by DEVIL MAY CRY 3 SPECIAL EDITION and Capcom's wide variety of retro remakes and compilations made available this year.

The DS version of the innovative courtroom adventure game PHOENIX WRIGHT: ACE ATTORNEY surpassed Capcom's sales expectations again and again in the U.S., and the title received four reproductions over five months of release. Two of the Japanese publisher's attempts to appeal more to the Western market fell flat however, with BEAT DOWN and FINAL FIGHT STREETWISE failing both critically and commercially. Those titles' poor critical reception helped drag down the publisher's average review score this year, and STREETWISE's failure was the final nail in the coffin for California-based internal developer Capcom Studio 8, which was shut down in March. But more talent was brought on board this year as Capcom's new mobile division, Capcom Interactive, bought up Ontario wireless developer Cosmic Infinity in May.

## NCSoft®

### 15. NCSoft

**Year formed:** 1997

**Headquarters:** Seoul

**Studios:** ArenaNet (Bellevue, Wash.); Austin; Seoul

NEW TO THE TOP 20 PUBLISHERS LIST IS KOREAN COMPANY NCsoft, whose sales of GUILD WARS have reached more than two million, bringing the company to our list for the first time. An expansion to the online role-playing game entitled GUILD WARS: FACTIONS, which also sold well, has helped to make up for another new release this year that didn't fare so well: AUTO ASSAULT. Overall, NCsoft boasts only three releases for the year considered, which definitely helped the company secure the highest overall review score in our listing (which also contributed to its ranking this year).

Regardless of its three decent games, the publisher's future among the big 20 may already be in doubt: the first of said releases, CITY OF VILLAINS, reportedly has been experiencing a drop in subscriber headcount (as of press time), which likely contributed to significant layoffs among NCsoft's U.S. staff in June. Analysts have expressed concern over AUTO ASSAULT's failure and whether Richard Garriott's long-awaited MMO TABULA RASA would make its current launch window. Luckily, the publisher doesn't seem opposed to diversifying its efforts: NCsoft formed a partnership with the veteran staff at Spacetime Studios for a new online game, and it will also be publishing the Barcelona-developed, hooligan-friendly SOCCER FURY.

## eidos

### 16. SCI/EIDOS

**Year formed:** 1990

**Headquarters:** London

**Studios:** Beautiful Game Studios (London); Crystal Dynamics (Palo Alto, Calif.); IO Interactive (Copenhagen); Pivotal Games (Bath, U.K.)

SINCE ITS PURCHASE BY COMPETITOR SCI LAST YEAR, EIDOS seems to have kept its day-to-day operations largely independent from the parent company. But a slow release schedule and slightly lower average review scores have caused it to drop from the number 14 spot it held last year on the Top 20 list.

As an upswing, Eidos' TOMB RAIDER series has been revitalized by Crystal Dynamics-developed TOMB RAIDER: LEGEND. The game was met with multi-platinum sales and favorable critical reception. Additionally, the latest HITMAN release, BLOOD MONEY, sold over a million copies as well. SCI predicts that the company will be catapulted back into profitability by this welcome success, in the black again for the first time since the merger with Eidos, which bodes well for both halves of the relationship. During restructuring under SCI, the original TOMB RAIDER series creator Core Design was sold to developer Rebellion, ending the years-long business relationship between Core and Eidos once and for all.

CONTINUED ON PAGE 22



CONTINUED FROM PAGE 21

## LUCASARTS

### 17. LUCASARTS

**Year formed:** 1982  
**Headquarters:** San Francisco  
**Studio:** San Francisco

**UP FROM THE NUMBER 20 SPOT AND LANDING AT NUMBER 17** this year comes San Francisco-based LucasArts. LucasArts only published six games during the year considered, but a high average review score and high revenues, fueled by smash hits *STAR WARS BATTLEFRONT II* and *STAR WARS: EMPIRE AT WAR*, have propelled the rather quiet publisher to its current ranking. The company also released *STAR WARS GALAXIES: TRIALS OF OBI-WAN*, an expansion for its struggling massively multiplayer online game, only to dole out refunds to players who were distraught over sweeping (and widely unpopular) changes made to the game in an update released just after the expansion.

But future prospects are bright. Partnerships with Day 1 and Free Radical for next-generation console development should bring more *MERCENARIES*-style, non-*Star Wars*-dependent successes, and Traveller's Tales has just finished a sequel to the hit *LEGO STAR WARS*.



### 18. BUENA VISTA GAMES

**Year formed:** 1994 (as Disney Interactive)  
**Headquarters:** Burbank, Calif.  
**Studios:** Avalanche Software (Salt Lake City); Propaganda Games (Vancouver)

**ALSO NEW TO THE TOP 20 PUBLISHERS ROSTER IS BUENA VISTA Games**, Disney's game publishing division. The company enters at number 18 due the success of *KINGDOM HEARTS II*, which was published and developed in partnership with Japanese developer Square Enix and has sold more than one million copies. The publisher has beefed up its internal development since the release of the first *KINGDOM HEARTS* with the purchase of Salt Lake City-based Avalanche Software and the establishment of a Vancouver studio, Propaganda Games, which is staffed largely by former EA employees. Also successful for Buena Vista this year were games based on the *Chronicles of Narnia* movies.

Buena Vista's monetary foundation is admittedly rooted in a wide variety of games based on Disney-owned intellectual property, but the company has made some surprising moves this year toward original material and other licenses. In April, Buena Vista announced a deal to publish four games by Tetsuya Mizuguchi-headed studio Q Entertainment. Propaganda will be developing a new game based on the *TUROK* license, taking the reins from previous license-holder Acclaim, and Japanese handheld developer Jupiter Corp. will be responsible for *SPECTROBES*, an entirely new anime-styled RPG.

### 19. ATARI

**Year formed:** 1983  
**Headquarters:** Lyon, France  
**Studios:** Atari Melbourne House (Melbourne); Eden Studios (Lyon, France); Humongous Inc. (New York); Shiny Entertainment (Newport Beach, Calif.)



**ATARI HAS HAD A ROUGH YEAR. THE FRENCH-OWNED PUBLISHER** posted reduced revenues over the past 12 months, which resulted in significant losses. *THE MATRIX: PATH OF NEO* and *MARC ECKO'S GETTING UP: CONTENTS UNDER PRESSURE* underperformed. It faced mountains of debt, multiple lawsuits (two of which had been settled at the time of writing), and a warning from the Nasdaq stock exchange that the publisher would be de-listed if it didn't improve its stock price.

Soon after the warning from Nasdaq, Atari announced a series of efforts aimed at hauling itself out from the muck, beginning with a 20 percent reduction in staff and the sales of two of its major subsidiary developers—Reflections (*DRIVER*) and Paradigm (*STUNTMAN*).

The publisher still hasn't returned to profitability, Atari is losing much less money than it was around this time last year. The revenues it has managed to post, its fair release count, and a middling average review score have helped it stay in the top 20 this year, and its promising lineup for the next year (which includes *NEVERWINTER NIGHTS 2*, two *Dragon Ball Z* titles, the next-generation iteration of *ALONE IN THE DARK*, among others) should help push Atari closer to the black ink.



### 20. MIDWAY

**Year formed:** 1988  
**Headquarters:** Chicago  
**Studios:** Austin; Chicago; Los Angeles; Pitbull Syndicate (Newcastle, U.K.); San Diego; Surreal Software (Seattle)

#### **OCCUPYING THE FINAL SPOT ON THE LIST OF TOP 20**

Publishers is Midway, who has suffered low revenues and losses all year long due to the generational transition and development costs. The publisher acquired studios in Australia (Ratbag) and England (Pitbull Syndicate) in August and October, respectively. But just a few months later, after posting major quarterly and yearly losses, Midway closed down Ratbag and gave the pink slip to all employees there. The revenues that the company did manage to post and its still-healthy release schedule saved Midway from sliding off the Top 20, as its average review scores fell considerably from last year's grade. Keeping the publisher ranked this year were its mainstay sports titles, most notably *NBA BALLERS: PHENOM*, *NFL BLITZ: THE LEAGUE*, and the successful *MORTAL KOMBAT* side-trip *SHAOLIN MONKS*. ❖

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LARA CROFT  
**TOMB  
RAIDER**  
LEGEND





**THORE GRAEPEL** and **RALF HERBRICH** are researchers at Microsoft Research Cambridge, U.K., where they are heading the Applied Games Group, a team focused on applying machine learning and Bayesian inference to problems in game AI and games of social interaction. The group is responsible for such technology as the Drivatar AI in FORZA MOTORSPORT and the development of the TrueSkill Ranking and Matchmaking system in Xbox Live. Email them at [tgraepel@gdmag.com](mailto:tgraepel@gdmag.com) and [rherbrich@gdmag.com](mailto:rherbrich@gdmag.com).

## RANKING AND MATCHMAKING

### GROUPING ONLINE PLAYERS FOR COMPETITIVE GAMING

**WITH THE WIDESPREAD AVAILABILITY OF BROADBAND** connections and the emergence of unified online gaming services, more and more games provide online multiplayer modes in which gamers can play together, either cooperatively or competitively, and often even in teams. Playing with or against other human players can be much more interesting and fun than playing with a typical game AI.

But developers need to address two major questions when they create games that will be played by a variety of people simultaneously. First, how can they help match the best groups of players to optimize the game experience? Second, how can the game provide players with incentives to continue playing?

A key consideration in answering both these questions is the players' skills. Aside from social aspects of matchmaking (such as language, age, or gender), skill level has the

strongest effect on making a multiplayer game balanced and fun. In this article, we consider how a multiplayer online game, together with a suitable skill-rating system (or ranking system) should be designed to enable a great and sustainable experience for the participants.

We will consider three aspects of designing such an experience: the underlying ranking and matchmaking system, the rules of ranked game modes, and the question of how to display skill ratings.

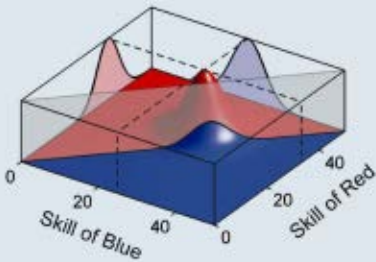
#### SKILL-BASED RANKING AND MATCHMAKING

The key idea behind skill-based ranking and matchmaking is that a game is fun for the participating players if the outcome is uncertain in the sense that each of the participating teams of players has a fair chance of winning.





# RANKING AND MATCHMAKING



**FIGURE 1** An illustration of the joint performance distribution for two players with skill 25 (blue) and 33 (red) is shown. The blue volume is the probability of winning for blue because at each blue point blue's performance is greater than red's performance, the blue/red boundary separating virtual game outcomes ("blue wins" and "red wins").

In most sports, players are awarded points according to their performance in certain competitive events. Often, these points are purely cumulative, meaning athletes who participate in more events are usually better for earning more points. Also, simple statistics like batting averages in baseball or win-loss ratios are often tracked. The resulting statistics, however, only partially reflect the player or team's overall skill since they disregard the quality of the opposing player or team.

In contrast to sports, there's chess. In 1959, Professor Arpad Elo introduced the Elo rating system for the game, which was adopted by the World Chess Federation in 1970. In the Elo system, the ultimate goal of estimating a player's skill is to predict whether one player will beat a specific other player. TrueSkill, the system we've incorporated into Xbox Live, uses the same principle.

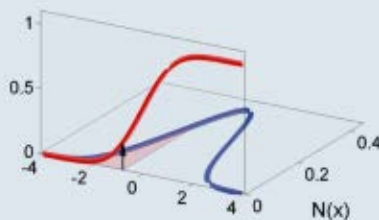
In a two-player game, the probability of winning or losing is modeled in terms of Gaussian probability densities, sometimes called bell curves. Figures 1 and 2 illustrate how to obtain the winning probabilities from the skill ratings in a two-player game.

In Figure 1, suppose the blue line represents a player with a skill level of 25 whereas red represents one at 33. The performances of both players will vary from game to game around their skills as shown by the red and blue performance distribution curves on the walls. If the blue player's performance exceeds the red's, we predict a victory for blue.

The probability of these two events is proportional to the red and blue volume under the two-dimensional bell curve in Figure 1, respectively. This probability is most efficiently computed using the code in Listing 1, an implementation of the red  $\Phi$  function in Figure 2.

The Elo system aims to adjust the ratings such that the observed game outcome becomes more likely under the assumed model. This results in the two-player Elo update

**FIGURE 2** The graph shows a plot of the Gaussian density function,  $N(x)$ , also called a bell curve (blue curve) together with its cumulative density function  $\Phi(x)$  (red curve), representing the area under  $N(x)$  (red area) up to this point. In Elo and TrueSkill, the probability of a win is given by  $\Phi$  (skill difference).



function given in Listing 2 (page 28). Note that this algorithm can only deal with game outcomes between two players.

The TrueSkill system featured on the Xbox 360 Live online service is a proprietary generalization of the Elo system in which two or more players compete in teams. TrueSkill also explicitly models draws and tracks the uncertainty associated with a player's rating, thereby automatically adjusting the step-size in the update equations. Currently, only Xbox 360 games take advantage of the TrueSkill system, so we will describe ways to achieve similar results based on the standard Elo update and use TrueSkill as the gold standard to evaluate Elo's performance.

## RATING SYSTEMS

You can gain some interesting insights about the behavior of rating systems by simulating them on records of game outcomes, for example on the data gathered during HALO 2 beta testing in 2004 (see Resources, page 34). Two interesting quantities to check are skill development of individual players and skill distribution over the whole population.

Figures 3 and 4 (page 28) compare the TrueSkill and Elo systems on the HALO 2 beta data of the free-for-all game

## LISTING 1 numerics code

```
// Computes the complementary error function.
public static double erfc (double x)
{
    // check for boundary cases
    if (double.IsNegativeInfinity (x)) return 2.0;
    if (double.IsPositiveInfinity (x)) return 0.0;

    // ... otherwise do the hard work
    double z = Math.Abs (x);
    double t = 1.0 / (1.0 + 0.5 * z);
    double Result = t * Math.Exp (-z * z
        - 1.26551223 +
        t * (1.00002368 +
        t * (0.37409196 +
        t * (0.09678418 +
        t * (-0.18628806 +
        t * (0.27886807 +
        t * (-1.13520398 +
        t * (1.48851587 +
        t * (-0.82215223 +
        t * 0.17087277)))))))));

    return (Result = (x >= 0.0) ? Result : 2.0 - Result);
}

// Computes the cumulative Gaussian distribution.
public static double Phi (double t)
{
    return erfc (-t / 1.4142135623730951) / 2.0;
}
```



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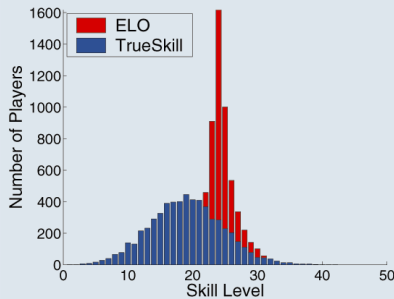


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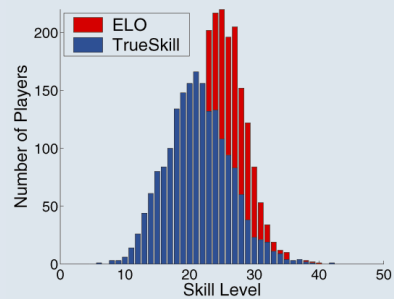
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# RANKING AND MATCHMAKING



**FIGURE 3** Skill distributions for Elo and TrueSkill for the Free-for-All game mode over all 5,943 players is shown. The height of each vertical bar indicates the number of players at the corresponding skill level.



**FIGURE 4** Skill distributions for Elo and TrueSkill for the Free-for-All game mode over all players who have played at least 50 games is shown. The height of each vertical bar indicates the number of players at the corresponding skill level.

mode. For the entire player population (Figure 3) the distribution of Elo ratings still peaks around the starting level 25 while the TrueSkill distribution is already nicely spread out due to its adaptive learning rate based on the tracked uncertainty of ratings.

However, when considering only players who have played at least 50 games (Figure 4), the distributions start to match up. Figures 5, 6, and 7 (page 30) show individual players' skill developments as a function of the numbers of games played.

TrueSkill converges extremely fast; that is, the estimated skills as functions of the number of games played approach their terminal values quickly. The speed of convergence of the Elo system can be controlled by a parameter  $\alpha$ , which trades off convergence speed with stability. Large values lead to fast convergence but single-game outcomes still have a large effect on the rating.

For small values of  $\alpha$ , the Elo system reaches the actual skill more slowly (>100 games), leading to a more stable estimate. Note that reducing  $\alpha$  as a function of the number of games played could be used to further mitigate this behavior.

It is interesting to note that Elo's update equation depends only on the win/loss outcome. Similarly, TrueSkill's update equations take into account only the finishing order of the players or teams involved. Neither of the systems incorporates the actual final score, such as the number of kills in a shooting game or the finishing time in a racing game. There are several reasons in favor of such systems.

First, taking into account only the finishing order makes these rating systems universal because in almost any game, a finishing order can be computed from the detailed game outcomes. Modeling the detailed game outcomes may lead to slightly more accurate ratings and faster

convergence at the cost of a more complex and less transparent rating system.

Second, it is crucial that the purpose of the game and the behavior of the rating system be aligned. People striving for high ratings should be forced to play in accordance with the spirit of the game. For example, taking into account the margin by which a game was won can lead to undesired player behavior. Consider a trailing soccer team that puts all its players on the attack in the last few minutes of a game, even though doing so gives the winning team a higher chance of counter-attacking should they get the ball. As a result, the winning margin may be increased, even though it's a reflection of the correct tactical choice of the trailing team. Note that the

## LISTING 2 Elo core code

```
public static void ELOUpdate (ref double skill1, ref double skill2, GameOutcome outcome,
ELOParameters param)
{
    double K = param.Alpha * param.Beta * Math.Sqrt (Math.PI);
    double C = Phi ((skill1 - skill2) / (Math.Sqrt (2.0)*param.Beta));
    double Delta = 0.0;

    switch (outcome)
    {
        case GameOutcome.Player1Wins:
            Delta = K * (1.0 - C); break;
        case GameOutcome.Draw:
            Delta = K * (0.5 - C); break;
        case GameOutcome.Player2Wins:
            Delta = -K * C; break;
    }

    skill1 += Delta;
    skill2 -= Delta;
}
```

winning margin is more significant in games that have less player interaction, such as golf.

For the updates of the individual players' scores in team games, we recommend considering the finishing order of the teams only. If individual performance metrics are used in the rating system, players will try to maximize those metrics instead of teaming up with their teammates to win the game. For example, if you reward the number of flags scored in a game of capture the flag, don't be surprised if you find everyone rushing for the flag at once, and some corpses with flags in their hands, betrayed by overly ambitious teammates.

### SKILL-BASED MATCHMAKING

The main purpose for skill rating is to inform matchmaking. Ideally, if every player has played enough matches to estimate his or her skill, and if enough players of each skill are available for matchmaking, it's possible to compose matches such that every team basically has the same chance of winning.

The TrueSkill matchmaking system uses the draw probability based on skill ratings of the players or teams involved to find the most balanced matches possible. A simple heuristic way of achieving similar results is to use the rating differences of players directly to match them. One simple criterion for a multiplayer match is to ensure that the difference between the highest and lowest rating does not exceed a predefined rating level gap.

This gap should be chosen depending on the expected size of the population. If the gap is small, tight matches result, but it's harder to find players of appropriate skill. If the gap is large, more unbalanced matches may result, but it's easier to find

players of appropriate skill. The following method can be used to assign players to teams. First, order the players by their skill ratings; start by assigning the strongest player to team A, the next strongest to team B. Once each team has exactly one

### LISTING 4 general Elo code with dueling heuristic

```
private static GameOutcome Compare (double points1, double points2)
{
    if (points1 > points2)
        return (GameOutcome.Player1Wins);
    if (points1 < points2)
        return (GameOutcome.Player2Wins);
    return (GameOutcome.Draw);
}

public static double [] ELOUpdate (Game game, double [] skills, ELOParameters param)
{
    double [] newSkills = new double [skills.Length];

    // loop over all players in all teams
    for (int cTIdx = 0; cTIdx < game.Teams.Length; cTIdx++)
    {
        Team cT = game.Teams [cTIdx];
        for (int cPIIdx = 0; cPIIdx < cT.PlayerIDs.Length; cPIIdx++)
        {
            int noUpdates = 0;
            double delta = 0.0;
            int idx = cT.PlayerIDs [cPIIdx];

            // loop over all other players in all other teams
            for (int oTIdx = 0; oTIdx < game.Teams.Length; oTIdx++)
            {
                if (oTIdx == cTIdx) continue;

                Team oT = game.Teams [oTIdx];
                for (int oPIIdx = 0; oPIIdx < oT.PlayerIDs.Length; oPIIdx++)
                {
                    double tmp1 = skills [idx];
                    double tmp2 = skills [oT.PlayerIDs [oPIIdx]];
                    GameOutcome outcome = Compare(cT.Points,oT.Points);
                    ELOUpdate (ref tmp1, ref tmp2, outcome, param);
                    delta += (tmp1 - skills [idx]);
                    noUpdates++;
                }
            }

            if (noUpdates > 0) delta /= (double) noUpdates;
            newSkills [idx] = skills [idx] + delta;
        }
    }

    return newSkills;
}
```

### LISTING 3 data structures

```
public struct Team
{
    public int [] PlayerIDs; // List of player IDs.
    public double Points; // The victory points.
}

public class Game
{
    public Team [] Teams; // The list of teams for a game.
}

public struct ELOParameters
{
    public double Alpha; // Weight of current game outcome.
    public double Beta; // Performance variation.
}

public enum GameOutcome
{
    Player1Wins, Player2Wins, Draw // Three different game outcomes.
}
```





# RANKING AND MATCHMAKING

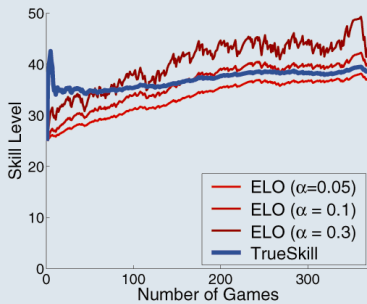


FIGURE 5 The graph shows skill development of a highly skilled player for the Free-for-All game mode for the TrueSkill system and for the Elo system with three different values of the parameter  $\alpha$ , which determines how much the new game outcome is weighted against the old skill estimate.

FIGURE 6 Skill development of a low skilled player for the Free-for-All game mode for the TrueSkill system and for the Elo system with three different values of the parameter  $\alpha$  is shown. Note that after 100 games played, the Elo ratings are nowhere near the TrueSkill rating which is already converged after  $\sim 10$  games.

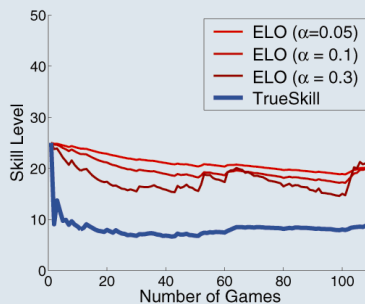
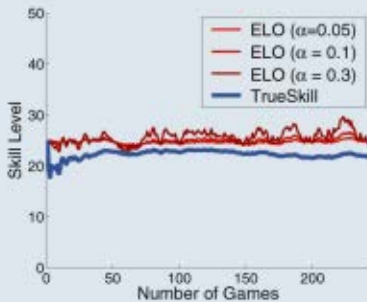


FIGURE 7 The graph shows skill development of an average skilled player for the Free-for-All game mode for the TrueSkill system and for the Elo system with three different values of the parameter  $\alpha$ . The effects from Figure 6 are not as pronounced for an average skilled player because Elo's initial guess of 25 is approximately correct.



player, always assign the next player to the team with the lowest total skill rating, as given by the sum of the individual team members' ratings.

## MULTI-TEAM RATING MADE EASY: GENERALIZED ELO

The classical Elo system is designed to handle games between two individual players. However, in online games it's quite common to have games with more than two players or more than two teams.

While the TrueSkill system addresses these issues in a principled way, we will describe here the so-called dueling heuristic that allows you to use the Elo update equation in these more general cases. The key idea of the dueling heuristic is simple: After a game is finished, the game outcome is seen as a collection of two player game outcomes (hence the "dueling").

In a game with  $k$  players, there are  $k*(k-1)/2$  pairs of players. Calculate all the pairwise Elo updates for each player using his or her relative standing in the finishing order—without adjusting the ratings of the participating players—and average those updates to obtain that player's update.

In a game with teams, a heuristic that's essentially the same is used. The only difference is that now each player has duels with all the players on the other teams, again calculating all the individual Elo updates based on the relative standing of the respective teams and averaging those rating updates. This heuristic should only be applied if the matchmaking process ensures that each team has approximately the same number of players and all players across the teams have similar skills.

The data structures for representing team game outcomes are given in Listing 3, and the code for the dueling heuristic is provided in Listing 4.

One problem associated with multi-player team games is players dropping out before the end of the match—early droppers. Although it may be tempting to punish these players via the rating system, for example, by declaring them losers by default, we advise against it. The early droppers should be

## guidelines for ranked game mode design

AN IMPORTANT ASPECT OF RANKED GAMES is fairness, both in an objective sense to give everyone a level playing field as well as in a subjective sense for the perception of the gamers. Nothing is more frustrating than seeing other players achieve an unfair advantage. As a consequence, ranked play works best if it is organized much like a sports tournament with certain rules enforced.

1. No individual player ("host") should enjoy any privileges over the other participating players. This includes privileges such as decisions about the game mode (including maps, tracks, and

rules), booting unwanted players, setting the start time for the match, or deciding team assignments. Ideally, even network-based advantages should be leveled, possibly by appropriate matchmaking.

2. Matchmaking should be based primarily on skill and otherwise not be under the influence of the players. Ranked re-matches should be disallowed or limited to one to avoid the risk of collusion.

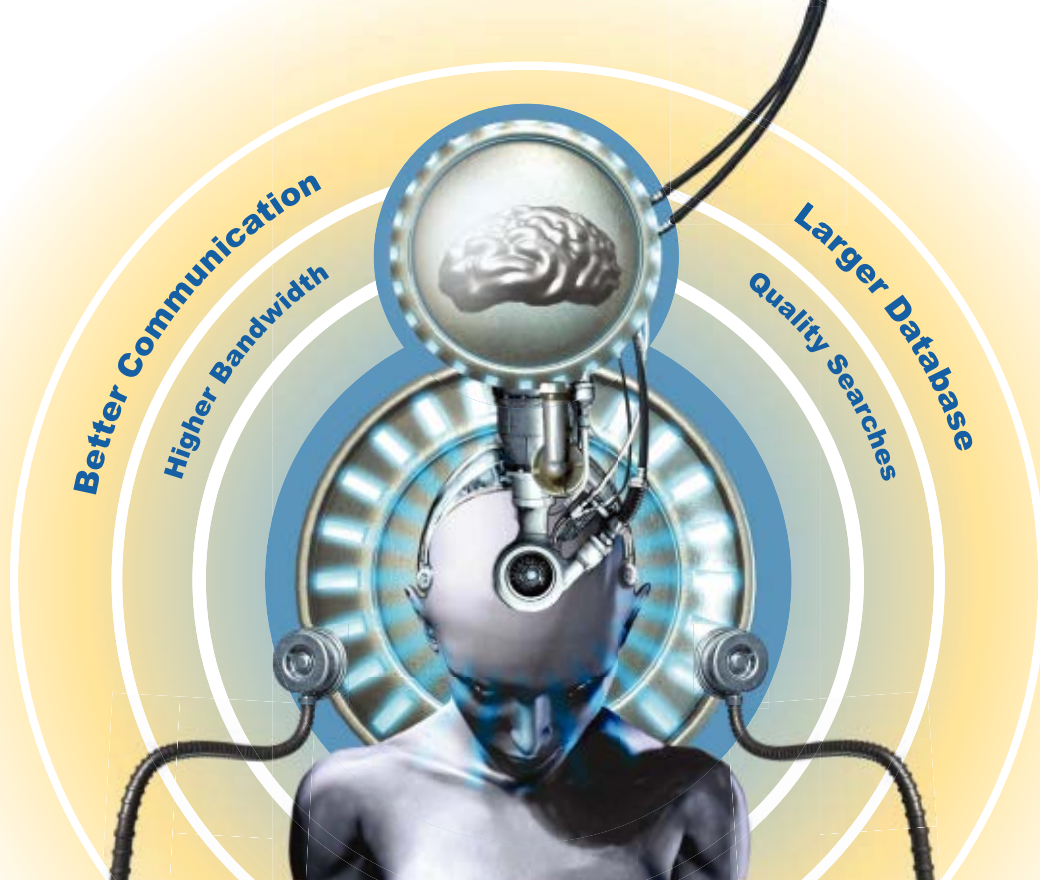
3. Players should not be allowed to drop from the pre-game lobby once they have gained knowledge about the upcoming match such as map/track, other participating players, or game type.

Otherwise, they would be able to drop out selectively, gain an advantage, and prolong waiting times for the other participants. Drop-outs should be treated as forfeits.

4. Termination criteria for games should be designed such that it is impossible for a player or team to force others into giving up by delaying the end of the game. For example, in a racing game once the first player crosses the finish line, a fixed timer might count down the seconds until the end of the race, forcing the match to end when the countdown is complete.

5. Try to prohibit players from using multiple accounts or identities because it can facilitate them in manipulating the rating system. Ideally, there should be a cost associated with creating new accounts that discourages multiple identities.

6. In order to discourage de-leveling by dropping, we recommend to either prevent a player from joining a new session when the session they dropped from is still running or to make their Elo update proportional to the fraction of time they spent in the match.



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# RANKING AND MATCHMAKING

treated as if they had finished the game. The diminished team performance will on average lead to a loss in their ratings and thereby discourage early dropping.

## HOW MUCH RATING INFORMATION FROM A SINGLE GAME?

Suppose you have two players, A and B, and the only possible outcomes are A wins or B wins. A game outcome conveys at most 1 bit of expected information—"at most" because if we knew from the ratings that player A was much stronger than player B, the game outcome A wins would be no surprise and almost no information would be conveyed.

So, how many bits of information are contained in a ranking of  $n$  players?

Suppose you wanted to store an integer with each of the players reflecting their position in the ranking. You would need  $n$  integers each of which having a range of at least 0 to  $n-1$ , requiring  $\log_2(n)$  bits per integer for a total of  $n*\log_2(n)$  bits.

Suppose you have a popular game mode with 64,000 players. Then you need to learn about  $64,000*\log_2(64,000)$  bits  $\approx 1,000,000$  bits of information for a complete ranking. Incidentally,  $k*\log_2(k)$  is also an upper bound on the information you can learn from a game with  $k$  participating parties (single players or teams). So, suppose you have 8 players individually competing in a game, then you can learn at most  $8*\log_2(8)$  bits=24 bits from that game.

Consequently, we need about  $1,000,000 \text{ bits}/24 \text{ (bits/game)} \approx 40,000$  games to learn the overall ranking. Since we assumed that each game requires 8 participants, each player must play about  $40,000 \text{ games}*8 \text{ players}/64,000$

players=5 games to achieve an accurate ranking. Note, that in the case of team games, the learned information is shared among the players, so team games with big teams tend to convey very little information about an individual player's skills.

The TrueSkill system almost attains the information-theoretic limit discussed above. For the (generalized) Elo system, this back-of-the-envelope calculation still gives a rough lower bound on how many games are required for convergence.

## GAMING THE SYSTEM

A question often asked in relation to rating systems is if the system can be gamed, that is, if the ratings can be manipulated.

In combined rating and matchmaking systems, there are essentially two ways in which gamers may want to manipulate the system. For one, they might want their ratings to appear higher than they should be to show off on the leaderboards. Or second, they might want their ratings lower than they should be to manipulate the matchmaking so they get easy-to-win games (de-leveling).

Stats-boosting in Elo-like systems is essentially only possible if the boosters are able to manipulate the game outcome in their favor, for example, if they have a higher-skilled gamer play under their account or if they play against friends who are willing to throw the game for the player's benefit.

Some hardcore gamers will also try to beat the system by de-leveling from time to time, which allows them to play at a lower level than their actual ability, thereby ensuring a winning game. De-levelers will reset their stats by opening a new account, or by throwing matches on purpose, or by quitting a game as soon as it has begun. The best way to

## match quality and waiting time

**SUPPOSE YOUR MULTIPLAYER ONLINE game can be described by the following numbers:**

- $N_{Modes}$  is the number of different game modes in your game, where gamers can only ever get matched if they choose the same game mode.
- $T_{Match}$  is the average duration of a match in minutes.
- $N_{Participants}$  is the average number of players in a single match.
- $N_{Skills}$  is the number of buckets required to divide the gamer population into buckets of players with roughly equal skill.
- $T_{Waiting}$  is the average time in minutes a gamer has to wait until the match starts.
- $N_{Online}$  is the average number of players online in the title at any given time.

Then we have the following formula:  
 $T_{Waiting} = N_{Modes} * T_{Match} * N_{Participants} * N_{Skills} / N_{Online}$

As a consequence we know that the waiting time decreases as more people play online. Second, we know that the waiting time increases as the duration of each match increases, as the number of game modes increases, as the number of participants for each match increases, and as the number of skill buckets increases.

The take-away message of this calculation is that the more players there are online in the game, the more you can afford to have any of the following while maintaining an acceptable average waiting time per player:

1. Long matches that take away players from matchmaking for a long period of time.
2. Big matches that take away many players from matchmaking.

3. More game modes that reduce the matching pool of players to the same game mode.
4. Tight matches that reduce the matching pool of players to buckets of similar skill.

As an example, suppose you have  $N_{Modes}=10$  game modes, your average match takes  $T_{Match}=10$  minutes and requires  $N_{Participants}=8$  participants all of which should belong to the same of  $N_{Skills}=10$  skill buckets. Then, in order to have a waiting time of not more than 1 minute you should have at least 8,000 players online at any moment in time playing your game. Note that this calculation does not even take into account that the very low and very high skill buckets are probably under-populated, that some game modes may be much less popular than others, and that player populations vary greatly across time of day and different time zones.

While the previous calculation indicates that there should be less rather than more game modes for a typical title, it is also important to consider the actual skills necessary to succeed in a given game mode. The general rule of thumb is that a game mode should comprise games that require similar skills. Not only will the gamers appreciate the grouping of games according to the skills required, but the skill estimation process will benefit from homogeneous game modes and allow for more consistent matchmaking. For example, in a first-person shooter it may be good to have separate game modes for team games and for Free-For-All games because these require different skill sets. For the same reason, it may be good in a racing game to have separate game modes for low-powered and high-powered cars.





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# RANKING AND MATCHMAKING

counter these tactics is to have a fast and reactive rating system that quickly (re-)establishes the rating of players to enable appropriate matchmaking.

## DESIGNING THE EXPERIENCE

In multiplayer online games, the participants are both demanding customers as well as resources who can help serve other customers; remember it's the players who provide the intelligent opposition for other players.

In an ideal world there would be an unlimited supply of players online at any time, for every game mode, and at every skill level. But in practice, the number of players online is limited. And players who are online have varying skills and preferences.

As a result, the matchmaking algorithm in the game must be able to find appropriate matches for a player in an appropriate amount of time (see "Match Quality and Waiting Time," page 32).

Displaying skill rating information to players can create healthy competition and provide an incentive to continue playing and practicing. It gives great opportunities for bragging in the online community, with many players even identifying with their skill rating ("I am a level 40"). If skill-based matchmaking is used, displaying the skill ratings leads to a predictable and transparent system.

On the other hand, displaying skill ratings can also be an incentive for cheating and unsporting conduct. Some players are willing to do anything to see a high rating associated with their online identity. As a consequence, fierce competition can destroy the relaxed and fun atmosphere of a game. Also, some people may feel frustrated if they see their skill ratings stagnate or even decline.

Finally, as discussed in the sidebar, a fair ranked game mode requires certain restrictions on the configurability of the game that may be undesired for fun play.

As a compromise, a title ideally provides both a competitive set of game modes with strict rules and skill rating displayed as well as a set of fun game modes that can be freely configured and do not display any skill ratings.

Note that skill-estimation and matchmaking can still be used under the hood for such a fun mode. In any case it is important to provide the players with incentives and achievements that complement the skill rating and continue to reward players even when their skill ratings have converged.

If skill ratings are to be displayed, a decision has to be made where, when, and how to display them. The obvious starting point is a leaderboard ordered by skill rating. We found that two kinds of leaderboards are of interest to players: 1) the top players from the global leaderboard, and 2) the player himself in a leaderboard with their friends or buddies.

Furthermore, statistics about rank in the global leaderboard, number of players in the global leaderboard and the percentage of players above the player in the global leaderboard are interesting quantities to display. In general, the more relevant you can make the displayed statistics to the player and the more positive you can spin them the more interesting they are ("You are in the top 30 percent of the population!" rather than, "You are at leaderboard position 45,987!").

One important concern with skill-based leaderboards is that players who occupy the top ranks may retire from active play in order to defend their leaderboard positions because they cannot lose matches and rating if they don't play against anyone. This behavior can be discouraged, for example, by not displaying players in the leaderboard who haven't played within a given period of time.

Other places to display the skill rating are the pre- and post-game lobbies. In the pre-game lobby the displayed skills help players understand the matchmaking process, gauge the strength of the opposition, and set goals for the match to come ("I am ranked number 3 out of 8, so I had better come out at least third in the match!"). A recent study has shown that in the post-game lobby players are primarily interested in how they performed as compared to their pre-game rank and in how the past game has affected their skill rating. Finally, one can imagine interesting ways of incorporating the skill ratings into the game itself, for example, by automatically setting a goal position in a racing game.

## RESOURCES

Mark Glickman's ratings page  
<http://math.bu.edu/people/mg/ratings.html>

Elo dueling heuristic  
[www.lifewithalacrity.com/2006/01/ranking\\_systems.html](http://www.lifewithalacrity.com/2006/01/ranking_systems.html)

HALO 2 ranking system  
[www.bungie.net/Stats/page.aspx?section=FAQInfo&subsection=stats&page=statoverview](http://www.bungie.net/Stats/page.aspx?section=FAQInfo&subsection=stats&page=statoverview)

Data set from HALO 2 beta test  
<http://research.microsoft.com/mlp/apg/downloads.htm>

TrueSkill main page  
<http://research.microsoft.com/mlp/trueskill>

Microsoft technical report  
[ftp://ftp.research.microsoft.com/pub/tr/TR-2006-80.pdf](http://ftp.research.microsoft.com/pub/tr/TR-2006-80.pdf)

For more on information theory, see MacKay, David J. C. *Information Theory, Inference, and Learning Algorithms*.  
[www.inference.phy.cam.ac.uk/itprnn/book.htm](http://www.inference.phy.cam.ac.uk/itprnn/book.htm)

## WITH POWER COMES RESPONSIBILITY

Skill-based ranking and matchmaking are crucial elements for designing competitive yet enjoyable online gaming experiences. They are essential tools of game design and help shape the experience of online gamers similar to the careful design process necessary to tune offline game AI. We hope that this article not only provides the technical tools for implementing skill-based rating but also helps the game designer make the right choices in this relatively uncharted territory of game development. After all, unleashing the competitive element can bring a lot of fun and excitement to online gaming—but with it comes a responsibility to carefully design the experience. ❖

*Acknowledgment:* The authors acknowledge comments from and discussions with Chris Butcher, Max Hoberman, and Roger Wolfson at Bungie, Mark Edmonds and Dave Herod at Rare Ltd., Matt Scadding at Ensemble Studios, Vince Curley, Patrick O'Kelley, and David Shaw at Xbox Live, and Pierre Dangauthier, Dumitru Erhan, and Joshua Menke. They also thank Vince Curley, Patrick O'Kelley, and David Shaw for implementing the TrueSkill system into Xbox Live. Credits for the use of the HALO 2 beta data set are given to Microsoft Research Ltd. and Bungie.



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## IRON LORE'S

# TITAN QUEST

### **BUILDING NEW TECHNOLOGY AND TOOLS FROM SCRATCH, HIRING**

a new team, or introducing a new franchise—any one of those events can be a difficult undertaking. Doing all three at once can cause severe caffeine addiction, loss of hair, and brutal acid reflux.

Iron Lore Entertainment was founded in October 2000 by life-long friends Brian Sullivan and Paul Chieffo, whose goal was to create TITAN QUEST, a new epic adventure action-RPG. Convincing a publisher to commit to this risky business took nearly three-and-a-half years, far longer than first expected.

During this initial startup phase, Brian and Paul hired a couple of artists and two programmers, and enlisted the help of several other contractors and friends to create a playable demo. Once the demo, budget, and pitch for the game were complete, key team members made multiple trips to both France and the west coast. By the time we were done, even our demo machine was eligible for platinum frequent flyer status. Those early years were not always easy, but they were fun.

Over the next two-and-half years, the studio underwent rapid transformation. We moved to a new office, hired an additional 35 full-time developers, and learned to work together as a cohesive team. As we did this, we had our share of problems, including a couple of contract extensions and some personnel issues. In the end, we made a game that we are not only happy with but also proud of.

### **WHAT WENT RIGHT**

#### **1 STRONG VISION FOR THE PRODUCT AND AUDIENCE.**

From the beginning of production, the vision for TITAN QUEST was always clear. We wanted a bright friendly world set in a historical but mythological time frame. We wanted to offer unique gameplay features that would appeal to hardcore gamers yet always be accessible to the casual audience. Fun and commonsensical approaches always trumped historical accuracy, which helped to keep the focus on player enjoyment. Moving forward, we made all our decisions in light of this overarching vision, and in the end we built what we set out to build.

All the game's systems were guided by this principle of putting fun first. The character class and skill system, for example, allow players to develop their characters while playing the game, instead of requiring them to learn about the game's systems before getting started.

Casual players can choose a character class and select a couple of active skills and one or two passive skills and be successful, while the more serious players can analyze all the intricate relationships between the eight available masteries and 160 skills before settling on the character type they want to play.

Another example of this two-pronged approach is the monster proxy system, which will randomly select from a variety of monsters within a set range of difficulties based on the player's level, allowing TITAN QUEST some degree of self-leveling. Again and again throughout the design and production phase

---

JEFF GOODSILL was the producer on Iron Lore Entertainment's TITAN QUEST. He has been the company's general manager and producer since 2002, with an additional eight years of leadership experience in the game industry. Previously, he was general manager of Papyrus Raging Games and Ensemble Studios. Email him at [jgoodsill@gdmag.com](mailto:jgoodsill@gdmag.com).





## GAME DATA



**DEVELOPER**  
Iron Lore  
Entertainment

**PUBLISHER**  
THQ

**WORLDWIDE  
RELEASE**  
June 2006

**PLATFORM**  
PC

**PEAK TEAM SIZE**  
39

**DEVELOPMENT TIME**  
30 months

**LOCALIZATIONS**  
French, Italian,  
English, Spanish,  
German, Russian,  
Czech, Polish

**TOOLS USED**  
3ds Max, Photoshop,  
Miles, GameSpy,  
PathEngine, Open  
SSL, ODE

**LINES OF CODE**  
533,063 (excluding  
comments)

**FIRST CRACK  
AVAILABLE**  
Three days before  
ship





## POSTMORTEM

of the title, our strong and locked-down vision for the game helped us make decisions in an efficient manner.

The familiar historical setting gave the design and art departments a strong baseline to work from. A wealth of mythological monsters and gods informed their styles—more than half of our 80 unique monsters came directly from mythology. There was also no shortage of interesting historical places to tap for inspiration, and our bookshelves became stocked full of reference materials.

Still, some compromises were needed along the way. For instance, many Greek soldiers, historically speaking, fought naked, but including them in all their glory would not fly with our teen rating. Similarly, roads between city states in ancient Greece rarely existed, but the game needed to have paths to help guide players. Scholars have discovered that Greek architecture was actually painted—the Parthenon was swathed in really garish colors—but most people think of white marble when they think of Greece, so we played toward people's perceived familiarity instead. There were various issues of this nature, but when questions came up, we could always turn to our vision statement for guidance and inspiration.

**2 COMMITMENT TO VISUAL STYLE.** When we set out to make TITAN QUEST, we chose a near-photorealistic Hollywood look. We wanted a bright world that was diverse, rich, and full of detail.

We then made decisions regarding the engine, hiring, and artistic choices to help get us to our goal. For instance, we developed polygon grass that reacted to the player's movement, which was relatively easy to implement and paid large

dividends. The polygon grass uses sheets of grass, flowers, or brush that bend and spring back as they collide with objects. The result was an added level of interaction that helped to make the ancient lands of TITAN QUEST come to life.

At the time of contract signing, we didn't have the entire art and design team assembled, which was actually a plus in some ways. It allowed us to specifically hire the talent we needed to create the look we wanted. We found talented artists who had strong photorealistic work in their portfolios. We also interviewed and screened out many content designers.

Our editor was fully functional early on, so we were able to put every candidate through an extensive on-site level creation test. I'm not sure how many people we screened out, but let's just say the hiring process started to become very annoying from a scheduling point of view. Yet, patience won out in the end, and we assembled an art and content creation staff that was able to deliver TITAN QUEST's look.



With an abundance of photo references and an uncompromising art director, we were able to push the look of the game. Some objects required many passes to create, but we would always go back and make necessary adjustments until they looked right. The more we focused on the details of the world, the more believable it became. Because of our focus on and commitment to a distinct visual style and a high level of quality, the graphics of the game not only stood out, they came together to create an immersive and coherent world.

**3 TARGETED INNOVATION.** Our objective was not to reinvent the action RPG genre, but to use a proven gameplay style at the core while extending and polishing it to add innovation. This strategy had worked for various projects in the past, and it proved successful on TITAN QUEST as well. It's difficult to improve upon the surefire fun of whacking monsters and watching them fly through the air and crash-land across the screen.

Exploring richly detailed worlds, fighting an ever-increasingly powerful set of varied opponents, making meaningful decisions about how your character develops, and being rewarded regularly but unpredictably—these were the foundations of our gameplay. Once we had that in place, we tried to limit all other distractions as much as possible, such as eliminating long dialogue trees or cutting scenes and loading screens that remove the player from the action, or simplifying the user interface. We wanted to keep the monsters flying and the rewards coming.

We always stayed faithful to the core gameplay mechanic—combat. Around this we innovated in many areas including our skill system, character classes, loot, and the editor. One feature that won unexpected praise was the monster equipment system. Players will never find an object dropped from an enemy that is not actually used by that enemy; players really enjoy being able to pick up items that they see on monsters. This gives the player one more piece of information when deciding what monsters to fight and gives them a little more sense that the world is organic rather than arbitrary.

Another key feature for players is the flexible skill and character development system. Not only does this increase the



# SMARTER

A person in a dark hoodie and pants is shown from the waist up, pointing their right index finger towards a glowing white trail. The trail starts from the person's hand and curves upwards and to the left, forming the word 'SMARTER' in a stylized, cursive font. The background is a plain, light gray.

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## POSTMORTEM

range of options for players, it constantly gives them meaningful decisions about whom their characters are in gameplay terms. You can literally play through TITAN QUEST hundreds of times and never play the same character with the same skillset. By focusing on an established gameplay mechanic, we were able to build a game we knew would be fun, and at the same time, we could spend a lot of energy developing fresh and innovative approaches.

**4 DEVELOPER AND PUBLISHER TEAMWORK.** From the outset, we had an excellent relationship with the publisher's production staff. One of the first things that went right was the creation of the contract. It was set up in a non-confrontational way to encourage teamwork. We both were motivated to do what was in the best

interest of the franchise.

Iron Lore and THQ jointly collaborated to define each milestone and make adjustments as needed. We communicated openly and frequently with little fear of retribution. Both parties went into this deal expecting there would be problems, but we were set on doing what we could to help each other overcome our hurdles. For example, THQ helped us work out design processes with level creation and design documentation and offered plentiful constructive criticisms of our schedules. They helped work out problems with our story creation process as well. And

they handled the lion's share of the work of contracting for and finishing a high quality intro cinematic with Blur.

For our part, we helped THQ market the game and understand the reasons for design, technical and schedule decisions. Rather than wasting time and energy fighting with each other over what should be done or who should do it, we were able to pull together to make TITAN QUEST a great game.

**5 A FLEXIBLE AND POWERFUL EDITOR.** Prior to signing our contract with THQ, we invested heavily in researching and developing a world builder that would allow us to quickly produce detailed organic worlds. We developed several novel technologies to aid us, including a system for naturally blending multiple textures and a terrain sculpting technique that combined the advantages of tile based systems and height map systems.

The texture blending system offered level designers the ability to paint down multiple texture layers that the system automatically combined using realistic patterns. With the terrain sculpting system, designers can quickly morph the terrain into rolling hills using simple height map manipulation tools. Then, artists can seamlessly drop and stitch into the height map their meshes representing cliffs and other features, creating a



topographical look that's normally impossible to achieve on a height map. These systems required time to smooth out, but in the end we were able to create levels very efficiently and with stunning results.

### WHAT WENT WRONG

**1 DESIGN DOCS NEITHER EARLY NOR DETAILED ENOUGH.** We struggled getting 25 detailed design documents to the technical department on time. We were still working on first cut design documentation more than one year after the start of the project, so the technical team had to fly blind in the beginning and some systems had to be redone.

There were several reasons for this late delivery, including a small systems design team. We did not hire our second and third systems designers until 10 and 12 months after the start of the project. We were able to mitigate this problem by closely scheduling critical path items first, teaming one designer with one programmer, providing partial design documents and giving verbal direction as needed.

There was a fairly constant issue of design documents not being detailed enough for technical implementation. We instituted an approval process that required the technical director, producer, publisher's creative manager, and lead designer to sign off on every document before we called it complete. This slowed down the process a little in the beginning. However, it helped to clarify and solidify the details behind each system before it got coded.

**2 STORY FINALIZED VERY LATE.** We knew we wanted an epic story written by a Hollywood writer, but we grossly underestimated the time it would take to negotiate, sign, and work with a name writer who had no game experience.

The story was a critical path for many areas including level design, quests, art, localization, voice over, and music—practically every aspect of the game. We had specifications and an excellent writer identified well before our contract was signed in January 2004. Despite the urgency, we burned a couple of months trying to negotiate and sign the deal, but the writer had schedule conflicts and had to drop out.

By the time we identified and signed a deal with a new writer, it was the fall of 2004. Hollywood script deals are considerably







different than game deals, and many expectations were made on both ends before we could come to an agreement. We did make some progress with the back story prior to contract signing. However, we burned a great deal of time in revisions. It was difficult to communicate our gameplay issues with someone who was not familiar with games and was three time zones away from the development team. We ended up doing some extensive revisions to the dialogue that all needed to be approved. We would not have the final script in place until one year after we started the project, which was one week before the scheduled voice over recording session.

The delays seriously affected both level design and audio. With no time to rewrite music, we had to create music and levels in a generic way.

Levels had to be revisited many times to add story-specific art, and at times, quests had to be shoehorned into levels. We put a great deal of work into the story but ended up with something that was only considered a secondary feature by most. The jury is still out on whether we would use another Hollywood writer, but I believe an optimal solution can be found, one that we will all be figuring out in the years to come.

**3 COULDN'T HIRE QUALITY PEOPLE FAST ENOUGH.** Negotiating our contract took six months longer than planned. We kept moving up our hiring schedule and added people as needed. We knew this would greatly increase the risk but we had a plan.

We were off to a good start on the hiring front. We had several key people identified and they were ready to start as soon we got the contract signed. I was dedicated to getting our team up and running as soon as possible. As time went on and production issues expanded, though, I needed to spend more time in my producer role, and hiring suffered.

We continued to maintain a high standard, screening out many candidates so as not to compromise the quality of the game, and end up with personnel issues that hurt us in the long run. Still, for every candidate we screened, we lost time from making TITAN QUEST. What a catch-22. With fewer people than expected, each person had to spend more time on deliveries, which meant less time for hiring; less time for hiring resulted in fewer staff to make deliveries. We did end up hiring a fantastic team, but not without some unscheduled crunch time that could have been put to better use.

**4 OVERLOADED TECH TASKS.** With design for many systems coming in late we were forced to program very broad systems that could do more than needed, code in a customized manner, deliver technology that was not fully functional, or deliver it past a scheduled dependency.

In some cases, such as the skill system, technology had to wait for design. As a result, many of the skills had to be painstakingly customized as they were defined because there was no generalized definition to work from. With this method, we had to use scarce programming resources every time we needed to change a skill, so every iteration took technology time as well as design time.

Sometimes the programming team created robust systems that could do it



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# POSTMORTEM

all but at the price of being too complex for the rest of the team to use effectively. Our quest system offered a great deal of flexibility, but it was difficult to use and hard to modify. We ended up having to assign unscheduled quest implementation tasks to the technology team in order to get all our quests into the game. Some secondary systems were delivered past a scheduled dependency. The tutorial, for example, was not delivered until after our first round of usability testing, which resulted in less than optimal feedback from the usability lab.



With programming always under the gun, and with many unscheduled special requests being made of the team, we also had less time than we would have liked to fully test systems before they were released to other departments. When there were problems with these systems, we never had enough time to address them in a timely manner. The worst aspect was that some of our build tools were not always stable, and the design team lost work they had spent days on. Pathing broke and tiles for the underground environments mysteriously became unstitched. As a result, we had problems testing the game and spent a lot of time going back over the same areas looking for and fixing pathing and tile issues.

While the code team did an incredible job, especially considering how few programmers we had on a project of this scope, they were simply overloaded for the last half of the project, which made life difficult not only for them but also for everyone else.



**5 NOT ENOUGH POLISH AND BALANCE TIME.** We always told ourselves that six months would be the right amount of time to balance and polish the game. With more than 30 hours of gameplay at each of three difficulty levels and entirely new technology, we needed all of that scheduled time and then

some. Just balancing the skill system, with all the combinations of masteries and skills, not to mention the thousands of pieces of equipment with hundreds of thousands of variants, was going to be an epic task.

In the end, we only had three months.

We used a couple of external groups to accelerate the balancing and polishing phase as much as possible. We enlisted the help of a group of a dozen committed beta testers, we offered numerous play test nights for local gamers, and we used THQ's quality assurance staff extensively. While all these contributions certainly helped, our own internal team was clearly the most efficient and effective at finding weaknesses in the game.

Some compromises had to be made. We prioritized the most frequent areas of play and tackled those first. We spent a great



deal of our available time on the first half of the game, and because we did not have enough time, we let epic and legendary difficulty levels slide until almost the very end of the project. Multiplayer was another casualty of this short polish and balance cycle. I can specifically remember one very scary night with only three months until final shipment, sitting at my desk and trying to figure out if the tech to scale monster difficulty to the number of players was working, or if it was even in the game at all.

Luckily, we were able to whip the game into shape, but we also had pages of polish feature suggestions that we simply ran out of time to implement.

## PROMETHEUS UNBOUND

Starting a new team, developing new technology, and launching a new franchise are business decisions that are full of risks, which, if fully understood beforehand, would prevent many games from ever being made. We were fortunate to work with a publisher that understood those risks and a team that was willing to adjust in order to mitigate those risks.

It was a long and tough road, and looking back at where we started, it's pretty amazing just how far we've come. Hopefully, the tale of how we got here will help others avoid the hazards we encountered along the way. Personally, I am excited about the road ahead and the opportunities and challenges that it holds. ❖



# SYMPHONY OF THE NIGHT

## AN INTERVIEW WITH COMPOSER MICHIRU YAMANE

**MICHIRU YAMANE IS THE PRINCIPAL** composer for the game series *CASTLEVANIA*, among others. Her classical and dark arrangements in *CASTLEVANIA: SYMPHONY OF THE NIGHT* have earned her more prominence among game music writers, Konami fans, and the industry at large.

Having worked in games since the late 1980s, Yamane is one of the most recognized female composers in the field. *Game Developer* spoke with her about her influences and inspirations, as well as her plans for the future.

**Brandon Sheffield:** How did you first start at Konami?

**Michiru Yamane:** Just before my fourth year of college, I started looking around in the recruitment office for different jobs I could apply to, and I found Konami there. That's the whole story!

**BS:** It seems like a lot of the people I've talked to at Konami joined up right after college.

**MY:** I actually had a teaching license at the time, and I did get another job, but it was part-time, and it didn't suit me at all. The school I was working for didn't really like me that much either, so I started looking for another job, and that's when I decided to join Konami.

**BS:** Did you study music in school?

**MY:** As a kid I started learning piano, and I went to a high school that had an emphasis on advanced piano. It was specifically a musical high school. But there were so many piano virtuosos who had technical skill and I didn't want to compete in that way, so I chose a university that had strong music composition courses.

**BS:** What made you interested in this particular style of music, this sort of old, gothic, Victorian style?

**MY:** I guess it comes down to my schooling again. When I was at university, my thesis was based on the music of Bach, so I was immersed with pretty classic yet dark music, but I don't really want to have that stereotype, if possible.

**BS:** What was the first game you did music for?

**MY:** *GANBARE GOEMON 2* in Japan, then some arcade titles, and some Game Boy work, but often I only did partial soundtracks. I moved on to some Super Nintendo and Genesis stuff as well, with *CASTLEVANIA: BLOODLINES* and *ROCKET KNIGHT ADVENTURES*. I'd say my big break was *CASTLEVANIA: SYMPHONY OF THE NIGHT*.

**BS:** What sound chip did you prefer from the old days?

**MY:** Probably the Genesis. For that system I got to do all the work, not just composition, but also synthesizing the music into the program. So it's particularly memorable for me.

**BS:** Do you ever have any influence on the design of games?

**MY:** Not from the early stages, but I can certainly influence design from a sound standpoint, in terms of how things are implemented and the direction of events.

I remember a specific time when my vision and [CASTLEVANIA director] Koji Igarashi's vision didn't overlap. At that time, I basically had to change my way of thinking to match his, so maybe I don't have that much control. But usually we're on the same page.

**BS:** With *CASTLEVANIA* specifically there's a lot of revision of classic music, it seems. Is that a problem for you?

**MY:** I do get to create lots of new music for the series, even with arrangements. I did one for *SYMPHONY OF THE NIGHT* and several more for the Game Boy Advance. I really like the music of *CASTLEVANIA* already, so it doesn't bother me at all.

**BS:** What games have influenced you in terms of sound?

**MY:** I really love the *TOMB RAIDER* games—well, 1 and 2 anyway. They don't have any music, but they have really good sound work, so that made me think more carefully about the way I use music in games.



**BS:** It seems like lately the *CASTLEVANIA* series is becoming less and less popular in Japan. Have you considered hiring a Visual Kei band [a Japanese music style that integrates rock and classical, in a manner similar to *CASTLEVANIA*'s music] to do a tie-in with a future game?

**MY:** I haven't, but it seems like a good idea. For the next game we do plan to integrate some music with vocals, but it won't be rock. It'll be more operatic.

**BS:** What kind of music do you listen to?

**MY:** In the rock category, Dream Theater. I'd love to do collaborate with them some day, but somehow I don't think that will ever happen.

**BS:** Do you ever make music just for yourself?

**MY:** Well, not really, unfortunately. Since I'm a Konami employee, I'm always devoting my full efforts to the music of whatever game I'm working on, usually *CASTLEVANIA*. But someday I'd like to.

I'm afraid that if I did make my own music, it would sound quite a lot like *CASTLEVANIA* music anyway ... would that be all right?

**BS:** Definitely! ❖





MICK WEST

## » THE INNER PRODUCT

# VISUALIZING FLOATS

### FLOATING POINT NUMBERS PERMEATE

almost every area of game programming. They are used to represent everything from position, velocity, and acceleration, to fuzzy AI variables, texture coordinates, and colors. Yet, despite their ubiquitous role, few programmers really take the time to study the underlying mechanics of floating point numbers, their inherent limitations, and the specific problems these can bring to games.

This article explores some of the problems with floats, illustrating certain examples in the hope that programmers will be somewhat less surprised when these problems crop up mid-project. With any luck, you will be better equipped to visualize and deal with these and other related problems.

### WHAT IS A FLOAT?

The term “floating point number” can be used to describe many different kinds of number representation. But for game programmers, there are really only two that we need to be concerned with: single and double precision floating point numbers.

By far the most common is the single precision 32-bit floating point number, commonly referred to by its C keyword “float.” Due to the convenient size and the requirements of the hardware, this is the most popular format for storing and manipulating numbers on all modern gaming platforms (although some platforms use 24-bit floats in part of their hardware graphics pipeline, which

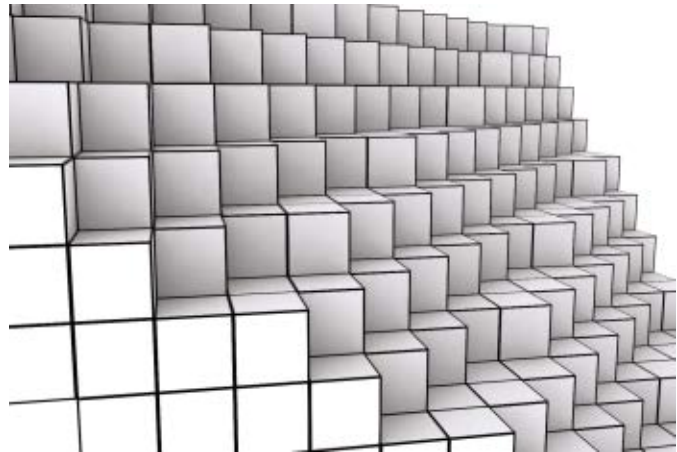


FIGURE 1 A 3D shape is represented in floats as a series of cubic volumes.

can greatly magnify the problems discussed below).

A float consists of 32 bits: a sign bit, an 8-bit exponent [e], and a 23-bit significand [s]. For precise details, see References, page 46.

To visualize the problems with floats, it’s useful to visualize the differences between floats and integers. Consider how the 32-bit integers represent space. There are  $2^{32}$  integers; each one can be thought of as representing a region between two points on a line. If each integer represents 1 millimeter, then you can represent any distance using integers from 1mm to  $2^{32}$ mm. That’s any distance up to about 4,295km, about 2,669 miles, with a resolution of 1mm.

Now picture how one might represent 2D space with integers. If you again consider a resolution of 1mm, you can represent any position in a 4,295x4,295 kilometer square area to a resolution of 1mm. Imagine zooming in closely and seeing the actual grid of integers.

Now take it one more step and use the same setup to represent 3D space. This time each individual position can be

thought of as the space within tiny 1mm cubes, so full 3D space is made up of a grid of these identically sized cubes.

You can’t represent anything smaller than 1mm, and objects that are only a few millimeters in size will have a blocky appearance. Figure 1 represents the general idea.

The important thing to remember about these integer-defined cubes is that they are all the same size. In 3D space, the cubes of space near the origin are the same as the cubes of space a mile away from the origin.

### FLOATS VS. INTEGERS

Let’s compare the 3D integer arrangement to floats. First off, note that both integers and floats (in practice) are stored as 32-bit words. Since there are only  $2^{32}$  possible bit patterns, that means the number of possible floats is the same as the number of possible integers. Yet floating point numbers can represent numbers in a range from 0 to  $2^{128}$ . [Note: There are actually a few less floats, as some float bit patterns are “not a number” (NaN), but we’ll ignore that for simplicity’s

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sake. For the purpose of this article, I will also simplify the treatment of signed quantities.]

How this larger range of numbers works is fairly obvious if you study the representation of a float. Still, it's useful to look into this to gain an understanding of what's going on.

The key thing to note is that there is the same number of floating point numbers between each power of two. So from 1 to 2 there are 8,388,608 (or  $2^{23}$ ) possible different floating point numbers, and from 2 to 4 there is the same total number. There's also the same number of possible floats between 32,768 and 65,536, or 0.03125 and 0.0625.

Here's another way of thinking about it: If you represent a position with a floating point number, then there are more possible points between the origin and a point 1mm away than there are possible points between the origin and a point on the other side of the planet. This means the precision of your floating point representation of a position depends on where you're standing and what units you're using. If, again, a floating point value of 1.0 represents 1mm, then when you stand near the origin (meaning your represented position is close to 0,0,0) your position can be represented to an accuracy of about 0.0000001mm, which is incredibly precise.

However, as you move away from the origin, your accuracy begins to decrease. At only 1 kilometer away from the origin (1,000,000mm), the accuracy drops to 0.125mm, which is still pretty good. But if you move even farther to a distance of 64km from the origin, the accuracy drops precipitously to 4mm, which means you can only represent a position with an accuracy of 4mm—a quarter of the resolution the integers could detect.

It gets worse. If you travel farther out to the edge of the space that could be represented with integers, at 4,295km (roughly the distance from Los Angeles to New York), you are at  $2^{32}$ mm; yet,

since we can only represent  $2^{23}$  bits of precision, our accuracy drops to  $2^9$ mm, or 512mm—about half a meter.

So if you used 32-bit floats to represent positions in a game that spanned the continental U.S., then on one coast your positions can only be represented with an accuracy of half a meter (1.5 feet), and clearly, that is unacceptable.

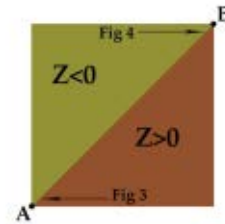
## SOME SOLUTIONS

*Scale your units.* Using a floating point value of 1.0 to represent 1mm means half your usable resolution is in the region between the origin and 1mm away. Unless your game has a super-shrinking hero in it, you probably don't need that resolution. If you instead arrange your units so 1.0 represents 1 meter, then you increase your usable range by a factor of 1,000.

*Use relative coordinates.* The origin in your universe is in a fixed position, but you can perform all your calculations in a space relative to an origin closer to the action, such as the camera viewpoint. Positions themselves can be stored as floats relative to some other local origin, whose position relative to the universe origin is defined in a more accurate manner.

*Use fixed points.* If it's important to your game that everything look and act the same whether near the origin or far away from it, then you can use fixed-point numbers to store your positions. Essentially, it's like using integers but with a sufficiently small unit, so for example 1 could represent 0.1mm, or whatever works for your situation. This can be extended to use 64-bit fixed points for even greater range and accuracy.

*Use doubles.* For defining points that are a long way from the origin, you can use double precision floating point numbers. You can either define all positions as doubles and then convert to a local space for manipulation as floats, or define a remote region's position using doubles and use relative positions within that space using floats.



**FIGURE 2** The line from  $A=[0,0]$  to  $B=[-5000,5000]$  separates all points  $P$  in this region into two triangles based on the sign of  $z$  of the cross product  $AP \times AB$ .

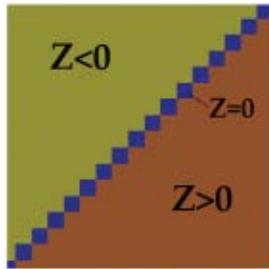
## BOUNDARY CONDITIONS

We often think of polygons and their edges as pure mathematical planes and lines, which is useful when formulating algorithms to solve certain problems. Consider a simple 2D problem: deciding which side of a line a point is on. This kind of test is often used when determining if a point is inside a triangle or other similar tasks. So, we specify it mathematically: Given a line formed by two points  $A$  and  $B$ , and a third point  $P$ , we calculate the  $Z$  component of the cross product of  $AP$  and  $AB$ ,  $Z$ , such that  $Z = \{(P-A) \times (B-A)\}.z$ .

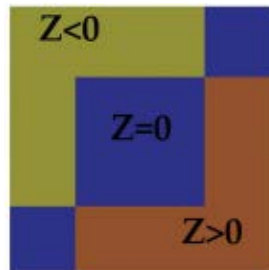
If  $Z$  is negative, then  $C$  is on the left, and if  $Z$  is positive, it's on the right of the line. This relationship is purely mathematical.

To see if a point is inside a 2D triangle, a simple method is to traverse the points of the triangle in a clockwise order and use the same test to see if the point is to the right of each of the three edges of the triangle. This test can also be used for 3D line-triangle collision detection by first transforming the triangle's points into the space of the collision line (using the transform that would make the line parallel to the  $z$ -axis, reducing the problem to two dimensions).

If we have two triangles that share an edge (as most triangles do in video games), and we apply the above tests to them, we should be able to accurately determine which triangle a line lays on. Figure 2 shows two



**FIGURE 3** In the region  $x$  and  $y$  from 800.0 to 800.001 there are a number of indeterminate regions between the triangles.



**FIGURE 4** At a different position on the same edge ( $x$  and  $y$  from 4,800.0 to 4,800.001) the indeterminate regions are much larger.

triangles and the results of the test ( $Z < 0$ ) on the line  $AB$  that defines the edge they share. What a nice, clean, mathematical split.

Of course, the obvious problem with this test is for points that lay on the line between the polygons, where  $Z = 0$ . In our pure mathematical world, a line is an infinitely thin region between the polygons. But in the practical world of floating points, the reality is rather different.

If you zoom in on the line, down to the level of the individual float regions I described earlier, you will see the line defined by  $Z = 0$  is composed of a series of regions (see Figure 3). What's more, if you zoom in on the same line, but go

farther from the origin, you see that the size of these regions increases (as Figure 4 illustrates).

The result of this could go two ways depending on how you implement your logic. If you started out saying, " $Z > 0$  implies the point is to the left of the line," then all the floating point regions that are on the line ( $Z = 0$ ), will show up as little holes—regions where the collision fails. The quick solution here is to change the test to  $Z \geq 0$ . This eliminates the problem of holes but creates a new problem—the regions on the line ( $Z = 0$ ) are now shared by both triangles.

Problems can arise if the collision routine returns a list of all the triangles it detects a collision with. The logic might not be set up to deal with having contact with two different surfaces in the same logic frame, leading to problems such as sound effects being stuck on or events failing to trigger.

More commonly though, a line-environment collision test will return the closest collision point. Since both polygons will return the same point (which, as we see in the figures, is actually an overlapping region), then the polygon detected will be determined by the order in which the polygons are tested.

Historically, the polygons are tested in the same order. However, with the increasing prevalence of multi-core architectures, it's increasingly common for programmers to implement some kind of data-level parallelism, where the order in which the individual polygons are tested is not guaranteed and varies based on the way additional tasks use the cores and by the state of the memory cache, which varies from frame to frame.

The result can be that the same collision test performed on the same data might return either of two polygons in a seemingly random manner. Most likely, it will return one polygon 99.99 percent of the time, with the other polygon cropping up extremely rarely. You might even find a Heisenbug, which can be incredibly difficult to track down,

since a) it surfaces very rarely, b) the conditions can be impossible to replicate, and c) introducing test code can "fix" the problem.

There are a number of solutions. For one, you can change your multi-core data sharing algorithm so that polygons which might share an edge are always submitted in the same batch—but it would still leave you with the potential problem of two polygons being returned with the same collision point. You could also try to guarantee that the regions on the line  $Z = 0$  always belong to one polygon or the other, which you could do by flagging the edges of a polygon so one side uses  $Z < 0$  and the other effectively uses  $Z \geq 0$ .

### PINNING DOWN DRIFTERS

Floats are a very useful way of representing numbers, but keep in mind that they do not perfectly represent the mathematical world that you use when creating algorithms. Floating point coordinates represent regions in space rather than points. Those regions get a lot bigger as you move farther from the origin and eventually create noticeable artifacts such as jittering and visible seams. This is an important consideration if you are attempting to scale an existing engine to one that supports a much large world.

Floating point inaccuracies can lead to indeterminate boundary regions of variable size, and these need to be dealt with explicitly to avoid Heisenbugs. ❖

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NOAH FALSTEIN

» GAME SHUI

# PUBLISHER COMPATRIOTS

## What game designers need from their sugar mommas

**WHAT DOES A GAME DESIGNER EXPECT—** or fear—from a publisher? Often, designers have little choice about who will publish the games they work on. Yet, the publisher often has a strong influence on the design of the game, and there are many considerations a designer must face when working with one.

The most precious thing a publisher can provide may well be trust in the skills of the game's developers. Sadly, there are sometimes problems, even disasters, when publishers insist on imposing creative changes, particularly when the developers are given conflicting messages. But it's easy to complain about things going wrong—what are some of the things publishers can do right?

### SAVOIR-FAIRE

I asked a number of designers this question and of those who responded, not all wished to be named.

Several designers talked about the value of good playtesting and focus group feedback. Focus groups have been a part of the game industry since the very beginning, and like the old adage about fire, they are a good servant, but a bad master.

One positive formula for using a focus group can be to have a good, professionally run group representative of your game's audience set up with a chance to see a game in progress. Then the developers can observe the group's interactions with the game, ideally from behind one-way glass as well as after the fact with recorded video.

Playtesting of this kind should not be used to provide new ideas or ask for new features. Invariably, when you ask a

group of game players what they want to see, they ask for more of every feature they liked in the most recent game they played: "Make it like GRAND THEFT AUTO, but with a whole world to play in with billions of people."

If you make the mistake of giving them that, then they'll tell you, "It's too big, too many people. I liked GTA better." But when the focus group members play the game under the eyes of the developers, all of the hard to understand or awkward parts will stand out in bold relief, and that's what focus group observers should home in on.

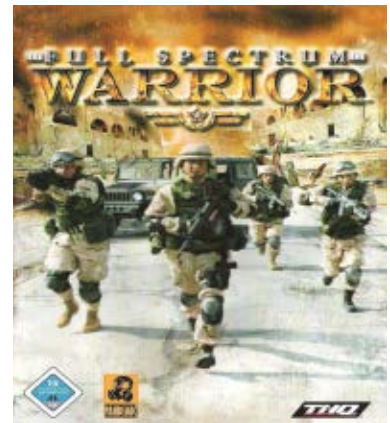
### STAT DEALERS

Another role of a good publisher is to provide information. Market statistics, evaluations of competition and trends, demographics of players for the specific platform in question, or even information about what other games those players have likely bought recently can be of great help.

For PC titles, information about the hardware and software present at the time is invaluable. Even for consoles, there's benefit from information about the types of TVs in use and the use of custom controllers or special hardware add-ons.

Laralyn McWilliams, formerly of Pandemic Studios (FULL SPECTRUM WARRIOR, DISNEY'S STITCH: EXPERIMENT 626), and TellTale Games' Dave Grossman (DAY OF THE TENTACLE, BONE: OUT FROM BONEVILLE) also had a few comments to add.

**LARALYN MCWILLIAMS, FORMERLY OF PANDEMIC STUDIOS:** "THQ has both traditional and 'design' producers (now called creative managers). That was terrific and a huge help for us on FULL SPECTRUM WARRIOR. We (the developer and specifically the design team) had someone who understood our creative goals and would go to the table to fight for what was important to us. [Our design producer] was involved in all the marketing, so what was important to us,



FULL SPECTRUM WARRIOR benefited from a communicative developer-publisher relationship.

like having an Army tie-in or being respectful to soldiers, was represented. It made such a significant difference in the publisher's relationship with the developer and the product itself that I'm really surprised more publishers don't do it."

**DAVE GROSSMAN, TELLTALE GAMES:** "What I need most from a publisher goes right to the root of the word 'public.' They are my conduit both to and from the public. Savvy publishers know their audiences well, and the best thing they can do for me up front is to give me as clear a picture as possible of whom those people are, as well as how they (the publishers) see the content I'm developing fitting into the larger picture of their line. That way I know where to aim.

"If I'm working with a licensed property, it's also helpful if I can have some contact with the original creator, and sometimes a publisher can arrange that more easily than I can. Even a 15-minute conversation is enormously helpful in capturing the feel of the IP, more so than even the best character bible. Oh, and I generally like it if they can provide me some money with which to build the game. That helps." ❖

**NOAH FALSTEIN** has been a professional game developer since 1980. His web site, [www.theinspiarcy.com](http://www.theinspiarcy.com), has a description of The 400 Project, the basis for these columns. Also at that site is a list of the game design rules collected so far and tips on how to use them. Email him at [nfalstein@gdmag.com](mailto:nfalstein@gdmag.com).





TOM BUSCAGLIA

## » BUSINESS LEVEL

# THAT WASN'T THE DEAL!

### THE BUSINESS LEADS AT A GAME

developer are sometimes able to negotiate a deal with a publisher that fully meets their studio's needs. But, as is often the case when confronted with an unfamiliar and tedious task, they become more interested in getting their contract signed than in getting it right. As a result, the studios frequently will lose deal points that they spent time and effort negotiating in their preliminary discussions with the publisher by entering into a written contract that bears little resemblance to the deal they originally discussed. Understanding why this predicament happens and learning how to deal with it are essential skills needed to build a successful studio.

### CASE IN POINT

Several years ago I was working with a team which had made a very successful PC mod who were forming an independent development studio. Their agent contacted the publisher of the original game, trying to get its permission to commercially release the mod. The publisher wouldn't allow it, but in order to keep upgrades to the mod coming out, which helped drive sales of the original title, the publisher agreed to pay the team to continue developing the mod.

The new studio retained the IP rights, but gave up control over the release dates of its updates to the mod. This would let the publisher time the update releases for the free mod so they would not compete with the publisher's own expansion pack release dates.

Overall, it was a pretty good deal for the studio, which allowed them to start acting like a real development house.

With all the deal points in place, the publisher sent over the contract for my review. I was dumfounded. The written

agreement they sent was a "work for hire" subcontractor agreement. That's the type of contract publishers use with outside individuals or companies that they hire to work on their own games. It transferred all IP in the original work to the publisher and did not have one single element of the deal that the studio and publisher's representative had spent months working out. You have to wonder why, after two or three months of negotiation, the publisher would send a contract that did not even vaguely resemble the deal they had cut. In practice, this is not at all an uncommon scenario—just a rather extreme example.

### THE NATURE OF THE BEAST

I rarely see an initial written contact that accurately reflects the actual negotiated deal points, especially when the deal is in any way different from the standard deal offered by the publisher. The reason is that within many publishers the product acquisition team has little to do with the detailing of the written contract once the deal is negotiated.

The product acquisition lead is already on to the next deal, after telling the contract people that they have a deal to acquire a game and to get the written contract done. The folks who do the contract work are usually in the legal department if it's a large publisher, or one of the business leads in smaller ones. The person handling the written contract may not even have been briefed on the deal points. Or maybe they just think it's easier to send the standard base contract and let the developer fix it, if they have the patience and skill to do so.

The contact person usually just sends the standard agreement for publishing deals to start the process. These base publisher contracts range from extremely publisher-friendly to downright predatory. An example of what might result is the publisher presents the development studio with a "work for hire" agreement instead of a license deal [which would have let the developer retain its intellectual property rights]. This publisher-favored deal might

keep the studio from participating in movie or other ancillary revenues, or it might allow for no escalating royalties, even though they had been agreed to early on in the negotiation process.

### IN YOUR OWN INTEREST

Remember, it's not the publisher's job to make sure you get the deal you negotiated. That's the developer's job. It's the publisher's job to get the most out of every deal for the publisher, just as you try to get the most for yourself.

The publisher likely does not even intend to cheat the developer out of the deal they agreed to verbally—it may just be administrative overhead getting in the way. But without fail, if you sign a written agreement with the wrong terms you can and will be legally bound by it.

All these agreements have a standard "incorporation" clause that says that the written agreement is the final agreement, and any verbal representations made in the negotiation process, which are not in the written agreement, don't count.

### PATIENCE PAYS

After you verbally negotiate the best deal you can, be ready to start the process all over again in the written agreement. It helps to keep in email contact with the publisher representative throughout the negotiation process, summarizing the deal points as they are agreed to. You may need these emails later to remind the person doing the written contract what was discussed and agreed to already.

When you get that first proposed written contract don't be offended by it. Like the mob boss says in the movies—it's nothing personal, it's just business. Besides, they don't really think you're that stupid [though they can always hope]. It's best to just look at it as the clumsy way things get done around here. If you're at all unsure of what you're doing or just don't want to deal with the hassle, get professional help. Be patient and never sign a written contract that doesn't accurately reflect the deal you made. ❖

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STEVE THEODORE

## PIXEL PUSHER

# A SHADY DEAL



**FIGURE 1** Vertex and pixel interpolation do similar things, but vertex interpolation is limited by the resolution of the mesh.

### DEFINING 'SHADER'

This article uses the term "shader" to mean "a functional chunk of the rendering pipeline" to keep the terminology in line with the way most people talk about it casually.

If you need to be precise, pixel shaders should really be called fragment shaders, due to the fact that an anti-aliased pixel drawn to the screen may reflect calculations on many rendered pixels.

Make sure to correct your artist buddies every chance you get—it's a surefire hit at parties!

**SOMETIMES YOUR HUMBLE COLUMNIST** feels like the Lorax, always grouching how this new technology or that industry trend will endanger everybody's settled ways and cushy jobs. But only the Grinch could deny that it's a fun time to be a computer artist, and shader technology is a perfect example.

We've all seen the swanky demos and heard the marketing hype. We've all participated in those blue sky "wouldn't it be cool if we could get a shader to ..." discussions. It's an exciting time for graphics geeks.

For the typical artist, though, shaders are about as unfriendly a medium as you can imagine. Pick up a book about shaders and the only art that comes to mind is Munch's "The Scream."

But there's hope. If you strip away the coder-speak and look at what really goes on in a typical shader, you'll find that most of the "new" shader technology is old news to any 3D artist. A Photoshop filter here, a 3ds Max space warp there—you might not realize it, but you already know a lot of this newfangled shader stuff.

Writing good shaders is another story, but developing looks and prototyping effects is definitely a task mere mortals like us can handle.

This column is devoted to giving you a tour of the modern shader pipeline. Bear in mind this isn't a comprehensive technical guide to shaders. It's intended to help artists grasp the basics of the technology so they know where to start dreaming up new uses for it.

### SHADER TYPES

Shaders come in two main flavors: vertex and pixel.

Vertex shaders deal with geometry, including normal calculations, deformations, and any other kind of per-vertex data. As we'll see, much of what vertex shaders do can be prototyped in any plain old 3D application. Pixel shaders do calculations on each pixel of a texture or a rendered object. Much of this functionality is familiar from Photoshop. Nowadays, many pixel and vertex shader capabilities overlap a good deal. The choice between them is often based on the tradeoff between speed and detail.

A complete in-game visual effect requires both vertex and pixel shaders, but may involve several shader bits in series (to add to the confusion, the whole thing will probably also be known as a shader). Not surprisingly, having more shader chunks means more computations, and the temporary textures they create mean a bigger appetite for VRAM. When you get into prototyping, you'll want to learn which steps involve welding a new section into the shader pipeline so you can use them sparingly. Your local shader engineer will be more than happy to tell you when you get too ambitious.

### VERTEX SHADERS

Vertex shaders, unsurprisingly, are how GPUs deal with geometry. Their primary job is to provide the geometric information that a pixel shader needs to know for final lighting calculations, such as standard position, normal and vertex color data, or any other kind of information tagged to individual vertices.

Vertex shaders are efficient and cheap, so they're popular with programmers. But they're cheap because the vertices are their only data points—everything between vertices is just interpolated. The downside is that they lack precision; the lumpy look of Gouraud shading is the

product of this kind of interpolation, and it's a good guide to the feeling produced by most per-vertex effects (see Figure 1).

Vertex interpolation works best for large scale, low contrast effects where the artifacts aren't too pronounced. If you want to get at details that are smaller than your triangles, you'd need to use pixel shaders.

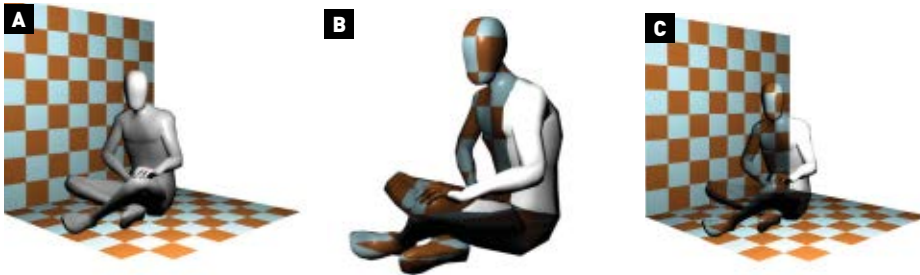
The power of vertex shaders is their ability to rewrite vertex attributes on the fly. A simple example is vertex lighting, which involves rewriting a set of vertex colors based on the angle between vertex normals and incoming lights. A vertex shader could just as easily rewrite those colors based on some other factor such as distance from the camera or height in world space.

Vertex shaders can also deform objects by moving vertices around. Many modern games use vertex shaders to skin characters. And combining vertex deformation with color effects can be very powerful. For example, you could create a vertex mask for a snow texture based on the surface direction of an object, and then push the snowy vertices up to represent snow accumulation.

Luckily for those of us without propeller beanies and pocket protectors, most vertex operations are procedures we're already doing in 3D applications. Let me share a few examples of operations that could be done in vertex programs which any artist can easily prototype in 3ds Max or Maya.

*Deforming geometry.* Almost any vertex deformation you can animate can be reproduced inside a vertex shader. Wave- and noise-based deformations, blend shapes, free form deformations

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**FIGURE 2** A model (A) is remapped with UVs that match the camera's view and mapped with an image of the background (B), creating a chameleon effect (C).

(FFD), and cluster or soft-selection transforms can be done inside vertex shaders. In-game uses range from simple procedural effects, like rippling water, to precisely scripted vertex animations.

The hard work of making the effect happen in real time falls on the coders, who have to worry about storing vertex offsets in texture maps and other arcane hacks to save memory and processor time. Creating a working example with traditional deformation tools in Max or Maya is much simpler. It also makes the programmer's job infinitely easier as it's much simpler to implement a concrete example than to invent a look and implement it at the same time. Besides, nothing beats a good demo when it comes to inspiring the coders to new heights of cleverness.

*Remapping UVs.* Vertex shaders can create or change UVs on the fly. A classic example of using UVs on the fly would be to create a scrolling texture by animating the UV coordinates over time. A more esoteric example would be to create a chameleon camouflage shader, which projects a blurred image of the rendered scene onto a character using camera-based UVs. The actual application of the texture takes place inside the pixel shader, but the UVs, which make it work, come from the vertex shader.

Obviously, experimentation with standard UV projections and extra UV channels is the way to learn what runtime UV mapping can do. Keep in mind that projection effects like the chameleon shader, which require rendered images as source material, will always be fairly expensive, computationally speaking. You have to render the entire scene once to generate the texture, and you must keep it in temporary texture memory until you need it. Projections that only rely on UV manipulation (for example, a simple movie-projector effect or a color ramp mapped to world-space height) are more affordable. On-the-fly UV mapping can be very powerful. See Figure 2.

*Manipulating normals.* A vertex shader lets you edit the normals of a surface in a number of interesting ways. You could flip all the normals in a surface to reverse it, or flip only backfacing normals so that the surface appeared double-sided.

To achieve more unusual effects, try forcing the normals to point in useful directions. For example, you could squash an object but keep its normals undisturbed for a cartoonish effect when the character deforms but his features still stand out. Playing with normals allows for interesting effects, as Figure 3 shows.

Prototyping normal manipulations is easy for small proof-of-concept tests, since you can manually realign normals in both Max and Maya. It's tedious for larger jobs and probably requires some

fairly complex scripting to really get right. Shaders can also store multiple sets of normals, which can't easily be done in traditional apps and would have to be faked by compositing in Photoshop.

*Coloring and alpha blending.* The obvious use for vertex colors is low-cost lightmapping, but vertex shaders can equally easily assign colors based on any calculation you want: the facing of surface normals, vertex positions, distance from the camera, and so on. Any of these calculations could factor into vertex coloration, which you could render directly or use to modulate textures in a pixel shader. For example, a vertex shader could make grass grow greener in valleys than on hillsides. The color changes will still show that lumpy Gouraud-style interpolation, though, so they will be unsightly if you have too many sharp contrasts or very sparse meshes.

This kind of operation is trickier for Maya users, since Maya doesn't like to plug vertex colors into shading operations, other than simple lighting. Ramp textures applied with world-space UV projections are a good workaround for effects like shading by altitude; and snow-type falloff procedurals are good stand-ins for normal based coloring. Unfortunately, the workarounds will be better looking than real vertex effects.

## PIXEL SHADERS

Pixel shaders are the second half of the shader pipeline. They get geometric information from vertex shaders, run some operations on it, and write it out to the screen. They evaluate every pixel of the rendered image directly, so unlike vertex shaders, they can show effects smaller than a triangle. Pixel shaders can also do Photoshop-like operations on textures.

Coolest of all, you have the ability to render the entire scene into a texture (also known as a "render target") and pass it off to another pixel shader. This trick lets the subsequent shader(s) add effects like motion blur, depth of field, night vision, or fake film grain—all the filter effects you learned to hate in the early days of desktop publishing.

Pixel shaders may seem the most daunting part of shader technology because they're potentially so powerful. However, this is an area where old school

**FIGURE 3** Rewriting normals in a vertex shader lets you shade models independent of their actual geometry.





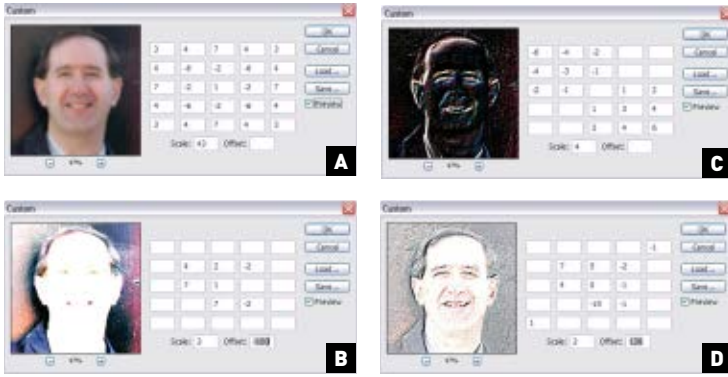


FIGURE 4 Photoshop's Custom filter is a great way to prototype pixel and shader texture effects.

## RESOURCES

For an introduction to what the Custom filter does, see

[www.tutorio.com/tutorial/photoshop-custom-filter](http://www.tutorio.com/tutorial/photoshop-custom-filter)

Nvidia's FXComposer [http://developer.nvidia.com/object/FXComposer\\_Shaders.html](http://developer.nvidia.com/object/FXComposer_Shaders.html)

ATI's Rendermonkey [www.ati.com/developer/demos.html](http://www.ati.com/developer/demos.html)

skills have found a second life. If you can hack up a Photoshop action that creates the effect you're looking for, it's a good bet you can work out a shader to do the same thing.

Here are a few pixel shader techniques that every game artist already knows how to exploit:

**Colors and alphas.** You can write colors and alpha values into pixels based on any set of calculations you want, much in the same way vertex shaders can. In the pixel version, a given effect will be free of Gouraud-style artifacts, but will typically be slower to process. Any position, normal, or parameter-driven coloring scheme that you can hack up in Max or Maya can probably be reproduced by a pixel shader.

**RGB blending operations.** Pixel shaders can reproduce all the classic layer blending modes to composite incoming textures: adding RGB values (called Screen Mode in Photoshop), subtracting them (Photoshop's Difference), multiplying, inverting, minimizing (Darken), or maximizing (Lighten) them, and so on. As in Photoshop, these values can be blended at less than full intensity as well.

**Filters.** Pixel shaders can easily mimic a whole class of familiar Photoshop filters. Blurs, Motion Blurs, Edge Sharpening, Embosses, Solarization, and Median filters are easy to implement in pixel shaders. Photoshop's Custom filter is a great tool for prototyping pixel shader effects and translates very easily into shader instructions (see the Tutorio entry in Resources; see also Figure 4 for an example).

Just as in 2D, the combination of blending modes and filters can produce an infinite range of effects. You can achieve striking non-photographic effects by rendering your object, or even the entire scene, to a texture and running a series of filters and blends on the resulting image (bearing in mind, of course, the costs of the runtimes involved in rendering the whole scene multiple times). Best of all, you can prototype these ideas quickly and

cheaply without taking a programming course at your local community college.

**Normal maps.** The one place where pixel shaders break radically new ground is in the use of normal maps, which stuff surface normal information into texture maps. Lighting calculations can now operate on millions of samples instead of thousands—a 256-pixel normal map contains as much lighting as 65,000 vertices. Per-pixel lighting is a huge advance on old-school Gouraud shading.

But normal maps do more than just lighting. Any kind of calculation that needs a directional input can use them. For example, a reflection shader uses a normal map vector to find reflected colors in an environment map. With a normal map, the reflection will be pixel accurate, rather than showing old-fashioned vertex interpolation artifacts. Since pixel shaders can manipulate that normal data at runtime, you can create distortions in the lookup for effects like heat shimmer or refraction.

These kinds of effects can often be prototyped by using cubic or spherical reflection maps and normal maps inside a standard 3D package. The reflection maps themselves can be pixel processed as well to create blurs or better contrast ratios.

## DEGREES OF SHADY

That's the 10,000-foot overview of what shaders can do. It certainly doesn't exhaust the topic, but the real point is obvious: behind all the technobabble, shader technology is made from familiar building blocks, and you can explore it without having to go back to school for a CS degree.

Of course, a quick summary like this is no substitute for cruising the shader galleries that come with Nvidia's FXComposer or ATI's Rendermonkey (see Resources).

Don't be daunted when the "artist friendly interface" they show you looks like the control panel of a starship. It may be ugly, but fundamentally, you already understand this stuff. Shader building isn't one of these only-geniuses-need-apply jobs like writing art columns or finding a decent lunch at GDC, so go to it! ✖

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JESSE HARLIN

## » AURAL FIXATION

# MUSICAL SYMMETRY

**OVER THE LIFE OF THE MEDIUM, GAMES** have been defined in part by their role as marketing-driven assistants to the grand Hollywood machine. In no other form of entertainment does the concept of sequels flourish quite as much as it does in the world of games. Endemic to both of

these facts is one central truth: Games frequently exist solely to give players more of what they already love.

Everyone involved in expanding an existing franchise plays a delicate balancing act between faithfully rendering what the players expect and infusing a new creative mark on the title. A team of artists and designers tackles the look, while an army of production staff

tackles level design, gameplay, and the script. Only when it comes to music is a large chunk of responsibility for the game's faithfulness to players' expectations frequently placed into the hands of a single person: the composer.

### TEMP EXEMPT

With so much riding on the composer's shoulders, the first step in any franchise game is to understand the project's intent. A franchise game will only ever do one of two things: stay true to the original material or veer off in a new direction in an attempt to reshape an existing intellectual property.

Any composer working on a franchise that's faithful to its predecessors must begin by doing his or her homework. Consider all the music that came before you to be the temporary track (or temp

track) for your game and the overriding creative direction to which you're being asked to adhere. Watch the film(s) or play the original game(s). Familiarize yourself with the musical language of the original source score. Make sure you're familiar with all the thematic material that may be applicable to the game, including character, location, or key event themes. Take note of the original instrumentation or any signature production techniques that define the original. Firmly ground yourself in the music of the world into which you've stepped. Your music is a linear continuation of work already familiar to an established audience and needs to fit as a natural extension of the existing musical language.

### IN THE KEY OF ELEMENTAL

That said, a new STAR WARS game does not automatically mean using John Williams' music any more than a new SPYRO game means using music akin to Stewart Copeland's work on SPYRO 2: RIPTO'S RAGE. Games aren't movies. Characters, when ripped from a film and plummeted into a game, can sometimes find themselves engaged in everything from dodge ball to vehicular combat to button-mashing brawls on the interactive screen. Because games are a great way to expand the universe of an existing IP into different genres, composers will frequently find that they're being asked to reinvent the music of a franchise rather than re-create it.

When this is the case, the composer must first distill the essence of the original score. The challenge is to depart from the existing music without stepping so far away that the soundtrack feels as though it's not part of the same universe anymore. Again, established motifs, signature instruments, or stylistic genres will provide the framework within which your reinvention can take shape.

However, rather than dictating the full scope of your music, these hooks can function as sign posts to listeners, letting them know they're still within their

beloved world. Input from the production team as well as concept art and design docs will help you determine the new tone and direction of the IP and its made-over sound.

### FRANCHISES TO BE

One of the more challenging jobs composers face is the task of scoring a game tie-in to a movie that's still in production. When the film comes out, the movie's score will become the definitive soundtrack for that new universe. But due to differences between production schedules for games and films, it's entirely possible that the game may have a composer writing before the film's composers have even started—let alone finished—their score.

These days, composers can benefit from recent strides made across the industry to better integrate film and game production teams. If the film already has a composer, the game's producers can most likely arrange for you to have a conversation via phone or email.

If you get the opportunity, pick their brain about everything from instrumentation to thematic motifs. Push the game's production staff to acquire any assets that might be helpful and available, such as rough mixes of the film score, DATs or Pro Tools sessions of the film's scoring sessions, or photocopies of the conductor scores. While you're unlikely to get all these things, any one of them can be a huge help in miming as-yet unreleased material.

If the film's composer is unavailable or none of the final score is accessible to you, ask if you can either see a rough cut of the film or hear the film's temp track. While not as helpful as the actual score, the temp track will give you an idea of the direction in which the film's score is moving and the original intent of the director.

With any franchise game, the most important thing to remember is that the sandbox for the world you're working within already exists. You're simply being allowed to build your own castle. ❖



Does music for future SPYRO games need to sound just like the music from this one?

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## Use Case: Multi-Player Bugs

**Crunch Time.** Every team knows it. Eidos did, and Replay helped them through it. Multi-player testing is tough enough, but when your developers are in Europe, and your test team is in California, it's tougher. Eidos used Replay to send 16-player game crashes overseas in minutes. Developers pressed 'Play', saw the crash, and fixed it. A new build was out within hours.

*"Because Replay data is so small and reliable, we were able to get the turn-around time down from days, to **minutes**."*

—John Chwanec, Lead Producer, Eidos

## What Does Replay Record?

Replay records **everything, without source code**. Use Replay on your entire game including 3<sup>rd</sup> party binaries. Here's a short list of the tougher stuff:

- |                                  |   |
|----------------------------------|---|
| 1. Multi-thread context switches | 4. Uninitialized Stack & Heap Memory Access |
| 2. All User Input                | 5. Async File, Network, XboxLive, Callbacks |
| 3. Timers & Random Sources       | 6. Assembly Instructions (like RDTSC)       |

Replay is applied to **compiled-binaries** only. You can always Replay your recordings in any debugger, set breakpoints, single-step and inspect data.

## Use Case: Memory Corruption Sucks.

Crystal Dynamics had a really tough bug caused by accessing uninitialized memory. Replay records all access to uninitialized stack and heap memory, so if you find that bug once, just press play and see watch it happen again!

*"Replay **\*rocks\***. I doubt we'd have found it otherwise. It turned out to be an occasional array overwrite that would cause random memory corruption."*

—Meilin Wong, Developer, Crystal Dynamics

## Do You Have Your Own Replay System?

Maybe you've built your own Replay system for your title already. Maybe it works pretty well. Ask yourself these questions:

- Does it always work when you need it?
- Can you replay async IO and multi-thread race conditions?
- Does it replay uninitialized stack and heap access crashes?
- Can you add 3<sup>rd</sup> party libraries and new code without breaking it?
- Do you spend resources keeping it working during the dev cycle?

Wouldn't it be great to get back all the time you spent tracking down those hard-to-reproduce bugs?

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# Seapine Software

## New Advancements in Game Development Tools

There is no time like the present to review the development tools you are using to create your next title. Advances in software application lifecycle management (ALM) tools are bringing cost and time savings to game developers. Seapine Software is leading the way with major upgrades to Surround SCM and TestTrack Pro, and a new product, TestTrack TCM, to automate and streamline key development and QA processes.

### Surround SCM 5

In Surround SCM 5, Seapine offers you more precise control of your configuration management process than any other solution. New branch-level workflow provides greater control over the state of individual files in your source code repository. Now you can know at a glance whether a file is new, in development, has been reviewed or edited, or requires additional action. Surround SCM manages and enforces the source code workflow that you define for development needs. Version 5 also introduces custom metadata and in-application definable triggers. Custom metadata lets you define and track other data with your files. With in-application definable triggers you can create highly functional, event-driven scripts from within Surround SCM. In-application triggers can perform actions based on the state of the file or the contents of custom metadata fields, giving you additional power without the need to write complex externally called applications.

### TestTrack Pro 7.6

The leading defect and issue management solution, TestTrack Pro 7.6 includes new game developer-friendly features. Targeting multiple platforms with your next title? A new multiple selection list field lets you use a single field to indicate the platforms that a bug is found on. TestTrack Pro 7.6 also includes much tighter integration with Surround SCM, letting you assign defects to changelists and giving you the ability to work with defects and development issues from within Surround SCM.

### TestTrack TCM

New TestTrack TCM automates and simplifies managing your testing process. TestTrack TCM handles all aspects of quality assurance including the creation, organization, and execution of test cases and management of test results. Test variant support lets you develop title-specific test cases and easily create unique test runs for each platform and international language you are targeting. With TestTrack TCM's test coverage support, you know at a glance what has been tested and what hasn't, making it easier to stay on top of a massive QA effort. Seamless integration with TestTrack Pro means issues discovered during a test run are automatically captured and enter your defect management process.

### Successful title creation begins with Seapine tools

In Surround SCM, TestTrack Pro, and TestTrack TCM, you have a tightly integrated, complete change management and quality assurance solution unmatched by other vendors. From tracking and understanding why change occurs to testing and tracking features and bug fixes, Seapine's integrated development tools reduce the time it takes to develop and deliver games, giving you more time to add features that will make your next title a success.



### Seapine Software, Inc.

5412 Courseview Dr., Suite 200  
Mason, OH 45040  
Tel: (513) 754-1655

[www.seapine.com](http://www.seapine.com)

### SELECTED FEATURES

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- Test case management with integrated defect tracking
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- Support for popular development IDEs
- Single sign-on and LDAP support
- 24x7 worldwide customer support team





**Softwrap Limited**

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[www.softwrap.com](http://www.softwrap.com)  
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**WHAT SOFTWRAP OFFERS:**

- World's most robust DRM licensing system
- Dynamic subscription license solution
- Seamless instant software activation for end-users
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SOFTWRAP™



The Complete Digital Rights Management Solution For PC Software

**It's never been so quick and easy to begin selling your software securely online before!**

Distributing software online may seem like a straight-forward exercise, but publishers continue to report on the very many issues that they face when trying to handle all the marketing, e-commerce and digital rights management requirements. The Softwrap solution is designed to alleviate all these responsibilities so that publishers can focus their resources on product design and development.

Softwrap's complete DRM solution ensures that your software can be freely distributed both online or through retail channels whilst always remaining protected from casual piracy. In fact, the more users who share your purchased secured titles the better, as the software will revert back to its trial state when installed on new PCs. This alone increases sales by an average of 4% and doesn't require any additional distribution costs or marketing efforts.

Softwrap's revolutionary system incorporates a complete e-commerce facility. This allows publishers to sell from within the trial-software, transforming it seamlessly into a full-working product as well as directly from their website. Launching a cart is almost instantaneous and there are no additional setup fees.

Publishers no-longer need to look for a variety of service providers to converge the many facets of software distribution. Softwrap will take care of all these requirements creating a one-stop-shop saving time, money and resources.

'Funcom ([www.funcom.com](http://www.funcom.com)) chose Softwrap for its robust security and ease of use both from an end-user and developer's perspective', commented Trond Aas, Funcom CEO. Trond continued to say, 'Softwrap has been extremely efficient, friendly and professional to deal with. We look forward to many titles being distributed electronically with the Softwrap technology.'

It's 100% free to open an account and try out our services as there are zero upfront fees. Softwrap only bills you when you are successfully selling software.

For more information visit the Softwrap website at [www.softwrap.com](http://www.softwrap.com) or contact us by phone on +44 207 089 4111 or by email at [info@softwrap.com](mailto:info@softwrap.com).

**Softwrap - The Complete Digital Rights Management Solution For Software Distribution**





## Finally, a Content Pipeline for Video Games 'Out-of-the-Box' Solution Save Up to 30% in Production Costs

MOGware's new flagship product **MOG** marks the beginning of a new middleware era of data pipeline products. It is a flexible framework that can be customized to fit the specific needs of any project's data pipeline. MOG has been proven over the past four years in active game development and is backed by industry veterans with more than a decade of practical experience. MOG is a complete solution designed specifically for the demanding needs of the video games industry.

With the continual increase in asset counts and complexity, MOG outfits teams with an architecture specifically designed to alleviate the scalability issues of today's asset pools, as well as the asset pools of the future. It **maximizes production time** by limiting the adverse effects of poorly managed assets. Rather than creating and maintaining internal pipeline solutions, teams can now focus their resources toward **better gameplay** with **richer environments** and more **refined content**.

The MOG pipeline encapsulates all the complexities of asset preparation and distribution with a friendly interface well suited for content creators. Using a unique inbox-style of workflow, team members interact with assets like they do with email. Users can import, process and optimize their data all within their own MOG inbox. The pipeline retains the properties of each asset so users can iteratively import assets quickly and painlessly without having to specify or remember past settings. MOG supports simultaneous **multi-platform** data preparation, completely masking all the headaches and complexities often found in multi-platform development. Team members will be able to see their changes in the game **within seconds** with nothing more than a single click of a button. Each user creates and tests content within an isolated workspace without the fear of disrupting the rest of the team until their assets have been perfected, submitted and approved. Projects that use MOG will see a significant increase in the team's overall efficiency and quality of work.

The MOG framework provides many benefits to any proprietary in-house or commercial game engine. For example, integration into **UE3** allows the tracking and revisioning of each microscopic change in a package. In addition, multiple users can work within the same package simultaneously. **New or existing UE3 projects will be able to utilize this integration and be up and running within hours.**

Artists, Animators, Programmers, Level Designers, Sound Engineers, Testers and even Management will all benefit immensely. MOG obviously enhances **team collaboration** and dramatically **improves production**.

*"MOG is all about making production iterations faster, cleaner, more accurate."*

**Robin Johnson**

**Sr. Technical Artist - Trilogy Studios**

Get Your Free Evaluation Version  
[www.MOGware.com/Evaluate](http://www.MOGware.com/Evaluate)



### MOGware, Inc.

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(801) 769-0203

[www.MOGware.com](http://www.MOGware.com)

[Info@MOGware.com](mailto:Info@MOGware.com)

### MOG BENEFITS

- > Content version control
- > Workflow checks and balances
- > Exporting from Maya/Max/Photoshop
- > Email notifications
- > Distributed network processing
- > Asset reporting and tracking
- > Multi-platform development
- > **UE3** package support
- > **UE3** Editor Integration\*
- > Custom/Inherited asset metadata
- > Data branching
- > Concurrent local workspaces
- > Entire project importing/exporting
- > Custom packfile/clusterfile support
- > Project definable custom toolbox GUI
- > Remote VPN support
- > Command line API
- > Microsoft .Net support

*\*Only available to UE3 licensees*



**Technicolor Interactive Services**

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[Info@technicolorinteractive.com](mailto:Info@technicolorinteractive.com)

**SERVICES & CAPABILITIES**

**Design and Visuals**

- Game Design and Implementation
- High Concept/Prototyping
- Cinematics
- In-Game Art Assets
- User Interface Design

**Audio**

- Sound Design
- Cinematic Editorial and Mixing
- Voice-Over Recording
- Sound Implementation

**Localization**

- Project Evaluation
- Translation and Script Preparation
- Casting
- Voice-Over Recording & Editing
- In-Game Text
- Paper Parts



**TECHNICOLOR®**

**The Complete Solution For Game Developers**

Technicolor Interactive Services, part of the Services division of Thomson, provides a complete solution, designed by game developers for game developers including: design, visuals, audio and localization. Technicolor provides industry-leading creative services on time, on budget and on demand while continuing to set the standard for creativity, reliability and innovation.

**Design & Visuals**

Technicolor Interactive Services offers a unique combination of innovative game design and development experience with full-featured, high-end art production capabilities. Our talented team of game industry veterans continues Technicolor's leadership in high quality visual effects, compositing and post production services.

We understand the unique needs of the gaming community and are pleased to bring Technicolor's history of creativity, reliability and customer service to every game project. Some of our recent projects include THE CON, SILENT HILL EXPERIENCE, THE LEGEND OF SPYRO: A NEW BEGINNING and next generation titles currently in production.

**Audio**

Our award-winning staff has helped to create the audio for an impressive list of titles, including: THE LEGEND OF SPYRO: A NEW BEGINNING, GOD OF WAR, JADE EMPIRE, NEED FOR SPEED: MOST WANTED, RATCHET & CLANK, JAK & DAXTER, and SPIDERMAN 2.

Clients benefit from the full scope of Technicolor's facilities and staff, which include some of the top sound designers working in film and TV, as well as our shared 2 terabyte library of sounds. Our sound designers' state-of-the-art studios, foley stages and field recording gear give them creative freedom to make the critically acclaimed sound for which they are known. On-site engineering support and easy access to additional facilities and personnel help make us a highly flexible, completely reliable resource for work on any scale.

**Localization**

Utilizing Technicolor's worldwide facilities and existing relationships in 30 different territories, Technicolor Interactive Services offers a turnkey solution for all of your game localization needs. Our skilled staff has worked on such titles as: UNREAL ENGINE 3.0, GOD OF WAR, HI HI PUFFY AMI YUMI, THE ANT BULLY and SILENT HILL EXPERIENCE. Technicolor manages your project locally to ensure direct lines of communication while using talent in each territory for the creative aspects of production.

*"We are extremely pleased with the support and professionalism which Technicolor Interactive Services provided to the development team on this extremely ambitious title. Mike and his team at Technicolor have always been great collaborators and the quality of their work speaks to the special care they have given to the rebirth of SPYRO."*

**—Greg Goodrich, Executive Producer for Vivendi Games**

*"The localization work Technicolor has performed has been crucial for us in the Japanese market. We started with conservative plans, but we were so impressed with Technicolor's quality and turnaround times that we greatly increased the scope of our project. They handled the increased volume without skipping a beat and we are still getting top-notch speed and quality."*

**—Dr. Michael Capps, President of Epic Games, Inc.**



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With its stable of powerhouse composers, Killer Tracks offers a full-scale aural assault ready for any realistic sports action, adrenaline-rush adventure or sci-fi fantasy sim you can muster. Not for the faint of heart, our sonic quality will put you in sensory overload! Now producing in 5.1 and with loopable stems available, Killer Tracks has the perfect soundtrack to fit your wildest imagination. Medieval combat, extreme sports & high-speed car chases never sounded so good.

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[www.killertracks.com](http://www.killertracks.com)  
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### SELECTED FEATURES

#### Games

- > Mortal Combat
- > Sony Playstations 1 and 2
- > Twisted Metal Black
- > Midway Games
- > Michimen Graphics

#### The Big Screen

- > 2 Fast 2 Furious
- > Domino
- > The Matrix
- > Independence Day
- > Spawn

#### Sports

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- > NFL Films
- > MLB

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#### SERVICES AND CAPABILITIES

- Audio Implementation
- Cinematics and other in-game movies
- 5.1 Mixing
- Custom Location Recordings
- Sound Design-Specializing in Weapons, Explosions, Destruction, Creatures, Vehicle Engine Assets & Ambiences

## FEATURE SOUND IN YOUR GAME®

**GAMETRACKS®** is the interactive entertainment division of L.A. based DANETRACKS, Inc., known for 20 years of sound effects design on major motion pictures. We bring that same passion in sound design that won an Academy Award for Sound Editing on THE MATRIX to our work in game Cinematic Sound Effects design. Sound is an organic, real experience and for us creating sound is creating art. By making a "soundscape" sound organic, we add a depth and resonance to the journey that brings the experience much further into the audience's consciousness.

## PLAY WITH YOUR EARS®

**GAMETRACKS®** has been working with game developers for more than 6 years, to achieve an exceptionally high standard of audio by implementing and designing in-game assets without the use of commercially available sound effects libraries. **GAMETRACKS®** goal is to give each game its own unique sound by creating a living, breathing, believable sonic atmosphere. Our recent game credits include GHOST RECON ADVANCED WARFIGHTER, SAINTS ROW & ARMY OF TWO.

## SAINT'S ROW Review

By Vicious Sid, GamePro.com

*"The audio sparkles, too. Saints Row's sound effects are simply perfect, with meaty firing effects, booming explosions, and rumbling bass from passing cars."*

## GHOST RECON ADVANCED WARFIGHTER Review

By Bob Colayco, GameSpot

Posted Mar 8, 2006 6:04 pm PT

*"The different guns have very unique sound effects, and they're all very sharp and impactful, which adds to the chaos of pitched battles. The best sound effect in the game, though, is the high-pitched whine of the Vulcan cannon as you spin it up and fire out the side door of a Blackhawk during the helicopter-combat portions. Just the sound of that gun as you hose down enemy infantry and vehicles with a hail of depleted uranium is enough to get any action-fan's blood pumping."*

# image metrics

## MEET ILANA

### The Future Never Looked So Good

Ilana is not just the future of digital facial animation, she's the new spokeswoman for Image Metrics. She is capable of conveying all the complexities and subtleties of the human face, thanks to Image Metrics' patented, proprietary technology that works through computer vision. This performance-driven process transfers a human being's facial performance directly onto any digitally-created character, no matter what the animation style – from 2D and 3D to photo-realistic visual effects.

The video stream of the actor's performance is what drives the animation, capturing everything: eye movements, subtleties of expression and speech. All 44 muscles of the face, mouth, eyes, tongue and skin can be mapped. And that all translates to emotion.

Gone are the days of markers, makeup, special stages and setups. This approach is completely unobtrusive, allowing for natural and life-like results. What's more productivity increases up to tenfold. Our technology brings speed, simplicity and savings, plus the final product is of a higher quality than what can be achieved with traditional techniques. The capabilities of the new consoles combined with the skill of Image Metrics mean that the possibilities for facial animation in next-gen video games are endless.

You can see some characters who've come to life courtesy of Image Metrics in Rockstar's TABLE TENNIS and the GRAND THEFT AUTO series. They also appear in 24: THE GAME, KILLZONE 2, RESERVOIR DOGS, CALL OF DUTY 2 and METAL GEAR SOLID 4 as featured on Sony screens at E3.

Look for our animated characters in two major motion pictures in 2007.

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# GOD OF WAR™



**Oracle**—Fighting through the burning carnage of Athens, Kratos encounters a mystic vision of the Oracle of Athena complete with transparency, particles, and beams of light.

## Planet Blue

Milt Alvarez, Executive Producer  
1250 6th St. Suite 102  
Santa Monica, CA 90066  
(310) 899-3877 office  
(310) 899-3787 fax

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*"When we were designing GOD OF WAR, we wanted the player to be as engaged by the story as they would be by the gameplay. There were three scenes that were key to the story, that had to resonate with the player, reward them for their progress, and compel them to keep playing. Our goal was that the movies be indistinguishable from regular gameplay, but I wanted these three movies to have a distinct look, above and beyond what we could do with our engine. Planet Blue was able to take our movies and add effects to let the player know what they were seeing was important. The results looked better than I'd imagined, but more importantly they added a level of polish and excitement that helped make GOD OF WAR the epic adventure we wanted it to be."*

—David Jaffe, Director, God of War

The cinematics for GOD OF WAR were generated using the same engine that powered the regular gameplay. This was done so the player would not be taken out of the gameplay experience whenever the storyline needed to be advanced. However, there were three sequences that needed more punch, calling for effects that were beyond the abilities of the rendering engine.

When Sony Computer Entertainment of America needed a team to deliver digital effects worthy of their ancient Greek epic, Planet Blue was selected.

Using the original frames, mattes, and camera data generated by Sony, Planet Blue was able to create effects fully realized in 3D space that integrated seamlessly with the existing footage, interacted with characters and objects moving through the scenes, and fit into the spectacular visual style established by the development team.

Creating visual effects that both matched and exceeded the abilities of Sony's game engine renderer was a challenge, but one which Planet Blue was able to meet, with stunning results.

Planet Blue has worked with numerous game developers including EA and Lucas Arts delivering on time and on budget.

Planet Blue's award winning digital artists work with you as a team to bring exceptional visual effects to your game. With years of expertise and experience in games, VFX commercials and feature film effects, we can bring the visual component of your cinematics and in game cinematic to the next level, giving gamers a higher quality gaming experience.

In business since 1989 specializing in digital effects including compositing, 3D CGI, design, finishing and visual effect supervision, Planet Blue continues to push the boundaries of the digital effects world. Now you can benefit from our depth of experience on your next project.

Courtesy © 2005 Sony Computer Entertainment America Inc.  
God of War is registered trademark of Sony Computer Entertainment America Inc.





Say Design, Inc. is an independent game development studio known for its creative game design and an obsession with quality. Our ability to invent truly unique game concepts and play mechanics enables us to make games that stand out as innovative and refreshing.

Now in our 17<sup>th</sup> year of business, Say Design has always challenged its team to push the envelope of technology and creativity. With our established reputation for producing immensely popular, outside-the-box games for major Internet portals and leading media companies, our developments on alternate platforms such as restaurant kiosks, the iRiver™ Clix mp3 player, and real-time Web to mobile multiplayer networks demonstrates that we aren't afraid of trying new things.

Whether it is pushing the boundaries of existing genres, inventing new ones, or bringing game innovations to new devices and platforms, Say Design will continue to pioneer new ways to think and play.

Our game development expertise is diverse, ranging from casual games for Web & PC/Mac to next-gen console development. We invite you to learn more about Say Design and to contact us via our Web site. We look forward to discussing your particular project needs.

## Say Design Game Highlights

### **Poker Pop**

Just one example of Say Design's invention and innovation, this deluxe downloadable game published by PlayFirst, Inc. combines elements of world travel, strategic tile matching, and poker, bringing about a new genre of game play. Players are immersed in rich music and graphics representing 5 different countries spanning across 50 levels.

### **The Arcade Strikes Back**

The Arcade Strikes Back celebrates video game history and was used by VH1 as its inaugural game to launch its new gaming portal.

### **Jammed Again!**

Winner of the 2003 RealOne Arcade Game Developer Showdown, Jammed Again! provides a large number of puzzles in a rich isometric 3D playfield, taking place in 5 different settings (from an African safari to the North Pole). Players must work their way out of each site by strategically moving obstacles blocking the way, in the fewest moves possible.

*Look forward to more Say Design innovations on Microsoft XBOX Live Arcade!*



### **Say Design, Inc.**

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Complete elements of your design easily and efficiently with more than 14 wizard tasks for fast information input. Use the online collaboration tool to increase interactivity amongst team members. Users are also granted access to GameDesignShare.com, a free portal available to registered users of our software that allows anyone with an internet connection to view or edit password protected designs. Manage your changing development environment by using the version history function, explain concepts better by inserting design notes, and control pesky feature creep with the future features tool. Convey your designs visually by using your program to create tables, graphs, timelines, storyboards, flowcharts, and UML diagrams. There's even a script toolbar for your in-house game writers that allows them to easily format the text of their in-game dialogue and cut-scenes into the appropriate screenplay format.

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Download white papers, view product demos, and learn more about our offering at [www.TheCorpament.com](http://www.TheCorpament.com). Call or email us today so we can discuss your game design and developmental needs.

*"A useful tool that eliminates worries over structure and format, allowing the designer to concentrate on the all-important content."*  
**—Johannes Piek, Game Designer, Rift Software Limited**

*"This seems like a tool that every development studio could use, yet simply doesn't have the time or resources to develop."*  
**—Sean Timarco Baggaley, Author, Game Design Perspectives**





## Q3DIMENSION™: QUALCOMM's Graphics Solution for Wireless 3D Gaming

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QUALCOMM's Q3Dimension™ solution brings superior, hardware-accelerated 3D graphics capabilities to mobile handsets for an exceptionally rich 3D wireless gaming experience. Q3Dimension powers a variety of rendering engines that enable not only rich and lifelike games but also animations, user interfaces, 3D avatars and other applications to provide an advanced experience comparable to that of many of today's sophisticated handheld gaming devices.

At QUALCOMM, we help bring the advanced capabilities of third-generation (3G) wireless technology to mobile phones. The 3G wireless networks proliferating worldwide offer real benefits to game developers and publishers. These faster, more robust networks allow users to wirelessly download larger and more interesting games by using the network as a "virtual hard drive" and downloading games in segments. Over-the-air delivery eliminates the need to distribute a physical product, providing easy access to content by hundreds of millions of users while overcoming the problem of piracy in emerging markets. Traditional console/PC game developers and publishers can create mobile versions of key franchises, adding revenues from new sales and monthly subscriptions.

Powering the majority of today's 3G wireless devices, QUALCOMM's chipsets provide unsurpassed economies of scale and address the growing number of audiences interested in wireless gaming with three distinct performance levels – Multimedia, Enhanced Multimedia and Convergence. From casual gamers passing time on the bus to more advanced gamers, a QUALCOMM-powered phone is available customized to that demographic. The consistency that Q3Dimension provides across those platforms delivers significant volume and time-to-market advantages to the entire gaming ecosystem. QUALCOMM also offers a Game Developer Program ([www.cdmatech.com/3Dgraphics](http://www.cdmatech.com/3Dgraphics)) to facilitate developers and publishers in accelerating distribution of their games to the marketplace.

By driving the migration to 3G around the world and enabling unsurpassed gaming capabilities on mobile handsets with our Q3Dimension solution, QUALCOMM is bringing new capabilities to wireless devices – and making the mobile gaming experience more advanced, more compelling and more popular than ever.



### QUALCOMM CDMA Technologies

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#### BENEFITS OF Q3DIMENSION

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# CREATE IN NEXT GEN



Imagery from Midway's next-gen console game *John Woo Presents Stranglehold*

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- > GAME DESIGNERS
- > ARTISTS
- > PRODUCERS
- > ANIMATORS
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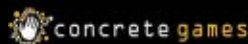
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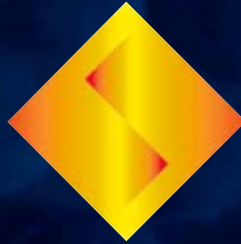
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by Rick O'Connor

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