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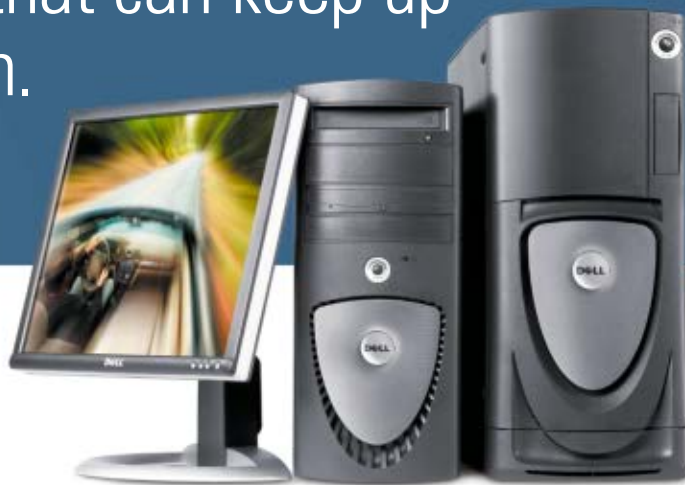
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POSTMORTEM

34 TWO TIMING: TIMEGATE STUDIOS' KOHAN II AND AXIS & ALLIES

After bursting onto the scene with *KOHAN: IMMORTAL SOVEREIGNS*, TimeGate Studios became a hot topic overnight. For its second feat, TimeGate took on two projects at once. Adel Chaveleh, president of TimeGate Studios, walks us through the growing pains his small company experienced as it expanded for the development of *KOHAN II* and *AXIS & ALLIES*, both of which shipped in the same quarter.

By Adel Chaveleh

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12 VISUAL FINITE STATE MACHINE AI SYSTEMS

AI can be tough to write effectively, and most top end programmers can't be expected to chart out the habits of dim-witted creatures. For simple enemies, like Goombas, Koopas, and Swoopers, finite state machines can provide a simple and quick way to create enemy attack patterns without all that nasty coding. Sunbir Gill lays out a method of designing AI systems in Microsoft Visio, outputting the charts to XML, and then translating the XML into your game as creature AI.

By Sunbir Gill

18 WRITESIZING

It wasn't so long ago that most games featured plots and stories that could be summed up in two pages of the manual. But anyone who's ever played *METAL GEAR SOLID* or *MORROWIND* knows story has become much more than filler text. Today, many companies have on-staff writers who create the dialog, story elements, and history that flesh out the deep worlds of games. Stephen Jacobs interviews a number of top game writers to find out just what makes a good game wordsmith, and discovers that writing for games is nothing like writing books or movies.

By Stephen Jacobs



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MAIDEN VOYAGE

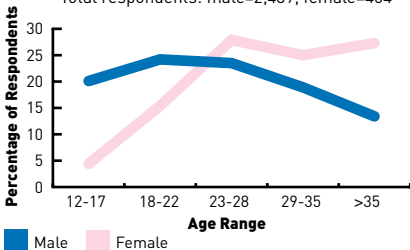
THE ELUSIVE FEMALE GAMER, IN HER NATIVE

habitat, has been just outside the reach of most publishers for years. But as games spread to the masses, women are becoming more relevant to the bottom line, slowly but surely. For many years, some game developers, publishers, and retailers rationalized that women hated violence and only appreciated long adventure games that nurtured their creativity. Tell that to my fiancé, who spends upwards of four hours at a time in the *VICE CITY* mall hacking apart valley girls with a machete.

Gamasutra.com recently ran the results of an MMO player survey conducted by Nick Yee. His statistics show that female MMO players are typically older than their male counterparts, a testament to the fact that older women are more likely to adapt to new game types. How's that for turning conventional wisdom on its ear?

Gender and Age Distribution

Total respondents: male=2,439, female=404



WRITE NOW

This month we're taking a look at the place of the writer in the game development process. While writers were here long before MMOs, they've found quite a niche in writing histories, myths, and lore for massives. A backstory is remarkably important in MMOs, and the divide between traditional game writing and MMO story writing is enormous.

Hiring a full-time game writer is certainly a change from 20 years ago, as is the idea of maintaining a 24-hour crisis team to patch holes in server code. But then, change is constant in our industry, as Noah Falstein points out in this month's Game Shui, on page 47.

The more things change, however, the more they stay the same. It's been 30 years, and the industry has yet to agree on a single word to describe electronic games. I've always advocated the use of the word "videogame" as an umbrella term for all digital games, and while *Game Developer* has

avored the use of simply "game," it has long acknowledged "videogame" as a real word with the same meaning. As I write this, Microsoft Word has underlined "videogame" with the infamous red squiggle, a sentiment echoed by the widespread refusal to eliminate the space from the nearly ubiquitous "video game" used throughout the industry.

So why isn't "videogame" included in Merriam-Webster's? If the Oxford English Dictionary can include "bootylicious," then we can certainly find a spot for our beloved and controversial "videogame."

Please e-mail me if you disagree. Perhaps a debate of semantics will provide you with some brief respite during the November crunch time we've all come to know and fear. If there's one thing that will never change within the videogame industry, it's the inevitable insanity of the holiday season. May you all enjoy your turkey day without a phone call from Q/A.

SETTING SAIL

As you may have noticed, Jamil Moledina is now holding sway over the Game Developer Conference, and aiming his considerable talents at improving the already terrific event. As a result, I, dear readers, have been granted the supreme executive power of editing this most honorable of publications. Fortunately for me, I'm joining a staff of incredibly talented and intelligent co-editors.

I'm not the only newbie here at *Game Developer*. Brandon Sheffield, who some of you may recognize from insertcredit.com, will be helping us keep a watchful eye on Japan. His knowledge of the Japanese language should give us the chance to play some strange and interesting games from that far off land. I'm proud to be a part of this excellent team, and hope you enjoy the new flavor we're bringing to the magazine. ✨

Alex Handy
Editor

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THEY ALREADY MADE THAT WHEEL

I just read the June/July issue of *Game Developer* magazine, the contents of which conspicuously highlight a point that bears repeating: The game industry is continually re-inventing wheels that have already been studied to death by the research community.

The first culprit is Jonathan Blow's column ("Experiments I'd Like to Work On"), in which he describes a would-be animation system that allows the AI itself to author the animations. Blow states that "This is a very difficult thing to do; as a general problem it is far out of our reach." And yet, it has been done. A perfect example is www.cs.ucla.edu/~pfa/animations/termSitFlushETCS or 320.mov. Certainly such simulations are far from being realizable in real time, but the work of people like Petros Faloutsos is a very good starting point for game developers to work off of.

Sharif Elcott
Ph.D. student,
California Institute of Technology

Jonathan Blow responds: *I have to disagree. For example, I don't understand why you think Faloutsos' stuff is not doable in real time. Sure, parts of the algorithm are computation heavy, but they are preprocessed. The run time is not so slow, and in fact would not be a big deal for a game that is already doing a bunch of physics. I think a soft-real-time version wouldn't be difficult.*

Faloutsos' Terminator stuff is about synthesizing kinematics; my article was about planning animations. They are different problems. They're not totally orthogonal, but the systems used to solve each would be very different. The reason I didn't write an article about synthesizing kinematics is that it's a much harder problem than just planning animations, and much more invasive to gameplay. Game

development right now depends on being able to control the way the game feels, the way characters move, etc. With a system like Faloutsos', that quality level just isn't there. My article was about keeping the kinematics in a more-or-less hardcoded, unrealistic arena (say, the player is a cylinder most of the time, except when he goes rag doll) and synthesizing animation on top of that. It's a totally different problem. And much easier. The logic can be stated as, "After this easier problem is tackled, we can work our way up toward full dynamics in a gradual manner."

I don't know any game developer who would consider Faloutsos' stuff of a high enough quality to base gameplay on. Maybe you consider it so, but all I can say is make the game and let's see how it comes out. I guess you could make a zombie game or something, where this tech was not used on the player, and it's okay that the other guys look like confused, shambling things because hey, they're zombies. I don't mean to be harsh on

Faloutsos' work. It's good work, and it definitely serves as a valid sample point in the research space of dynamic character control. But the idea that high quality, dynamic game animation "has been done," as you assert, is just silly. At the game-tech seminar this year we are going to spend two whole days on advanced character stuff (see <http://game-tech.com>). There will be plenty of academic character researchers giving lectures. But we're going to focus mostly on blending and by-example kinds of things for animation, because outright kinematic synthesis really is out of our reach, for the level of quality and control that we need.

YOU DAMN KIDS

I just finished reading your over-30 article ("Never Hire Anyone Over 30," August, 2004). The article boils down to:

Age discrimination is bad. Here are 50 reasons why people over 30 shouldn't be hired for game development.

You guys normally write some good stuff, but this is just lame. I am 30 and many of my colleagues are over

30. I find this article just plain thick-headed, inconsiderate, and contradictory. Then to add insult to injury, there are lines in the article like: "After line production, it's natural to move to management which is particularly hard for artists"—another gross generalization that is terribly derogative.

Brandon Gillam
Long-time reader, artist,
and designer

COPYLEFT

Greg Boyd provided a lot of interesting and useful information in his August 2004 article ("Copyright: The Big Gun for Game Developers"). But one detail should be emphasized.

Copyright has more clout when it is registered with the Library of Congress. No suit for copyright infringement can be prosecuted unless the copyright is registered. If the copyright had been registered before the infringement, the copyright proprietor may be able to recover statutory damages without proving actual loss, as well as its attorney's fees.

The attorney's fees provision can go a long way in interesting counsel to take the case when a cash poor developer has been infringed by a powerful publisher or media interest. Registration is effective from the day the form and deposit is received in Washington. It only costs \$30 and the certificate received back from the Register of Copyrights is like the deed to your car or house.

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Jim Charne
via e-mail





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» FILING ACCLAIM

ON SEPTEMBER 2, ACCLAIM ENTERTAINMENT officially filed for chapter 7 bankruptcy. The company had been under considerable financial strain for the past year, and in July it announced the need to secure new creditors. As of July 1, the company's assets totaled \$47.3 million while its debt was \$145.3 million. Despite many attempts throughout the summer, the company failed to raise the funding it needed to continue operations, and toward the end of August, the decision to liquidate the company was finally made.

According to Steev Kelly, a former technical character artist at Acclaim Studios Austin, the company locked its doors in late August. "The first time we heard about the bankruptcy for a fact was

a week after we'd been locked out of the building. We were locked out August 23 and that Saturday, the 27th or 28th we found out that they were going to file bankruptcy," Kelly said.

The situation in Austin was chaotic at first. "Nobody really knew how it was going to happen or when it was going to happen. Basically, one morning we were locked out. It was 'Don't bother coming in, they're late on their rent, once they pay it we can go back in,'" another (anonymous) former employee said.

Some employees are preparing to take legal action in order to reclaim their belongings.

Over its 17-year existence, Acclaim acquired a reputation for making games based on externally

licensed IP, and the company's former rivals—such as TakeTwo Interactive—have already expressed interest in purchasing IP-based titles left in the lurch. Properties such as *THE RED STAR*, *JUICED*, and *100 BULLETS* will likely find new publishers, despite the involvement of the judicial system. Already, BreakAway Games and Midway have both opened new facilities in Austin.

Acclaim was founded in 1987 by Gregory Fischbach and Robert W. Holmes, Jr. The company originally published titles for the Nintendo Entertainment System, and moved on to all major consoles thereafter. As of this writing, Acclaim stock is trading at \$0.02 on the open market.

—Alex Handy

JAMDAT MOBILE CASHES IN

JAMDAT MOBILE MADE AN INITIAL PUBLIC offering of its stock in early October. Immediately following the IPO, the share prices rose as investors clamored to purchase a piece of the cell phone, PC, and PDA game publisher. JAMDAT's titles use a number of established IPs, including *NEVERWINTER NIGHTS*, *The Lord of the Rings*, *TONY HAWK'S UNDERGROUND*, and *PITFALL*.

—Alex Handy



WORDS OF WISDOM FROM THE TOKYO GAME SHOW

THE TOKYO GAME SHOW WAS attended in record numbers this year, with total attendance peaking at just over 160,000. The industry

is in a period of flux, as the current hardware generation begins to phase itself out, and the new handheld generation stakes its claim. In a few interviews from the show floor, key developers imparted their wisdom upon us.



IGN Launches Direct2Drive Service

IGN ANNOUNCED IN SEPTEMBER THAT IT would be launching the Direct2Drive game service, which allows users to download full versions of commercial games directly to their hard drives. The service was developed with Trymedia Systems, who also worked with IGN on its Hit Points reward system. Executive vice president Jonathan Epstein says, "We went with Trymedia for a reason: it's easier for the publishers. They have acceptance from the publishers. People have to feel comfortable with the tech to want to do this. If publishers aren't comfortable, they'll hold back."

—Alex Handy



"I really liked the games from the Famicom days because they focused on gameplay over graphics. Graphically intensive games are still selling well on the market now, but in 10 year's time, will you still be able to say that those were the best games? The game market is going to be in trouble unless we look toward the long term and re-orient ourselves toward what makes games fun to play."

◀ *Nobuya Nakazato, producer of SHIN CONTRA for Konami, on the state of the Japanese game industry.*

"About half of the team is female. This game seems like it will be pretty popular with girls as well. It's kind of, how shall I say, naughty. Erotic, maybe. So of course girls love it!"

▶ *Yuji Naka, SONIC THE HEDGEHOG creator for Sega Sammy, on his new girlfriend simulator FEEL THE MAGIC: XY/XX.*



"I didn't originally intend to make games per se, but in middleschool I had various interests, including movies and games, and when I saw something interesting, I thought I'd like to make something like that of my own. But it wasn't that I wanted to make a game from the beginning—just something that would make people happy. Some day I want something that I have created to make a large group of people feel something. That would be interesting."

—*Fumito Ueda of Sony Computer Entertainment Inc. and creator of Ico on why he got into game creation.*

"There are a lot of games that use music just as a background; sound over a picture. I like the music to be able to stand on its own, yet affect the player. I can't really tell you how to do it effectively though."

—*Akira Yamaoka of Konami, producer and sound creator for the SILENT HILL series.*

Translations by Brandon Sheffield

NO MORE MEN'S CLUB

MORE THAN 1,400 PEOPLE ATTENDED THE AUSTIN GAME CONFERENCE (AGC) AND WOMEN'S GAME

Conference (WGC) in Austin, Texas, September 9 and 10, according to the organizers of the first event. The game business has only existed for about 30 years, and in that short time, males have dominated the industry from two dichotomous ends: creation and consumption. Speakers at the WGC as well as a few industry veterans voiced their opinions on the subject.

Audio recordings of all the AGC and WGC panel discussions are available for purchase online at www.gameconference.com/index.html.



"Publishers are missing out on a huge market. Female players know what they like and create games that they like. I'm a firm believer that games change people's lives. They let people spend time with their families, look at their relationships; they provide a safe learning environment to try on different hats. There's lots of social dynamics."

◀ *Laura Fryer of Microsoft Games on the importance of gender diversity in the game industry, from developers to consumers.*

"We spent 28 years saving up issues to address. Women play differently than men, but aren't in the development studios creating games for the way they play."

▶ *Patricia Vance, president of the Entertainment Software Rating Board on the nearly three decades of having a game industry before the first Women's Game Conference.*



"In this industry, our men are so young they can be taught."

◀ *Mary-Margaret.com recruiter, Robin McShaffrey's tongue-in-cheek comment about sexism in the industry.*

"It's not a matter of sexism so much as ratio. More consoles are bought for young men and boys than girls. What that led to was just more men than women playing games and having an interest in going into that career.

Gaming has become more mainstream especially with the Game Boy being played by all types of children. So I think you'll see more types of people wanting to become involved in the industry."

▶ *Lesley Mathieson, senior designer at Insomniac Games, (RATCHET AND CLANK:*

GOING COMMANDO) on why the game industry became more male-oriented.



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www.agdc.com.au

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» SONY PSP AND NINTENDO DS DEVELOPER IMPRESSIONS

AS THE HANDHELD GAMING MARKET

heats up, Japanese developers are beginning to get a clear sense of where the GameBoy DS and Sony PSP are going. Impressions are understandably mixed, depending on each developer's bent, but preliminary reports show that each system has its own faults and strengths.

Tetsuya Mizuguchi, creator of REZ and founder of Q Entertainment mentioned at the Tokyo Game Show that he found the PSP's visual memory to be below his standards, so too the quality of the MP3 music

encoding. But these specs are still far above that of the DS, which has limited 3D graphical power, even to the point of affecting game design. Koei's Yoshiki Sugiyama, in charge of the DS version of DYNASTY WARRIORS along with two other titles mentioned that "The DS can't do the higher quality graphics, so the 3D models are pretty tough. As a result we decided to make a game that's simpler looking, and plays simpler too."

The DS is reportedly very easy to develop for, however. "The library Nintendo provided allows us to do

various things, so we're satisfied.

The DS is more prepared, so it's easier to develop for at this stage," Sugiyama says.

Yuji Naka of Sega Sammy's Sonic Team agreed. "Oh, it's easy (to develop for). It's a very interesting piece of hardware. The touch pad is really new though, and our game also uses the mic, so that was a small challenge."

On the other hand, there are reports of some issues with the PSP's development kit. Takazumi Tomoike, the man at Koei in charge of the DYNASTY WARRIORS port from

PS2 to PSP says, "[I can't] say that it was easy—there were many problems. For instance you can't use the exact same models. With the specs it should work the same as it does in the PS2, but on this hardware it doesn't. So we had various problems like this. We also had problems with the library that Sony gave us. There are still quite a few bugs."

The DS will retail for \$149.99 on November 21 in the US, while the PSP's release date and price point are uncertain as of press time.

—Brandon Sheffield

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VIRTOOLS 3.0

Gregg Tavares

VIRTOOLS IS AN INTERACTIVE 3D EDITOR.

Maybe it's best to think of it as a game engine in the form of a 3D editor rather than a proper game engine. With most game engines, the engine is the core and tacked-on tools are secondary. With a traditional engine, you'd have to read a ton of docs, learn how to compile, add data, and do a variety of adjustments before you got started. With Virtools, you can get started immediately. You can drag and drop assets into your 3D scene, drag and drop behaviors on them, and in two to three minutes, you can have a character walking and running around a level.

The feature that sticks out about Virtools is its interactivity. With most engines, if you want to change something, you would stop the engine, edit some C++ or scripts, recompile, and then restart the game. In Virtools, almost everything is editable in real time with the game running. Models, textures, material properties, variables, arrays, attributes, 3D hierarchies, lights, and shaders—you can edit all of them while in the game. This makes creating a small game or testing out new ideas incredibly interactive and fun.

MASTERING VIRTOOLS

Like most 3D tools, Virtools is a very large program with thousands of features, so learning it and getting comfortable with it is not an overnight experience. Doing my first game with Virtools, I spent about a week and a half learning where to find particular solutions or features. Then I wrote a typical character action game with a character walking around and interacting with the environment. That took about one week. One of the designers at my company was able to put together a very large prototype with various enemies, power-ups, vehicles, and group dynamics, all within a month.

Virtools has an interface similar to many 3D modeling programs. This includes a 3D view for placing, moving, and orienting 3D and 2D objects, cameras, lights, and so on. This is one place Virtools could use some work. Editing and moving objects is functional but clearly not at the level of a product like 3DS Max or Maya

and can sometimes be frustrating. Switching from moving an object to moving the camera-view is somewhat cumbersome. I often find myself clicking on about six different places whereas it might take only one in Max or Maya.

Aside from the 3D interface, there are various editors for textures, materials, lights, arrays, scripts, shaders, and so on. The great thing is everything is editable in real time. For example, if you want to try a new texture on a model, you can bring up the texture editor, click load, then select a new texture file. The change is instantly visible in the game. Try it with or

without mips or adjust its filtering. Assign new materials to a model or adjust the material's properties. Edit an array of enemy attributes or weapon strengths. All can be done in real time.

PROGRAMMING

There are three different ways to program in Virtools. The main way—the way in which most of Virtools's features are designed to be used—is a visual scripting language or schematic. In this language, functions or (sometimes) game systems are represented as boxes, which Virtools calls Building Blocks (BB). On the left and right of those BBs are connectors called sequence INs and OUTs. For example if you wanted to execute a Follow BB followed by a Translate BB, you'd connect an OUT from the Follow BB to an IN on the Translate BB.



Virtools lets you tweak your game in real time.

VIRTOOLS 3.0

PRETTY SLICK

STATS

Virtools Canada

1250 Rene Levesque West Blvd. No. 2200
Montreal H3B4W8, Canada
(514) 989 3126
www.virtools.com

PRICE

Virtools Dev \$9,500; add-on packages start at \$6,000.

SYSTEM REQUIREMENTS

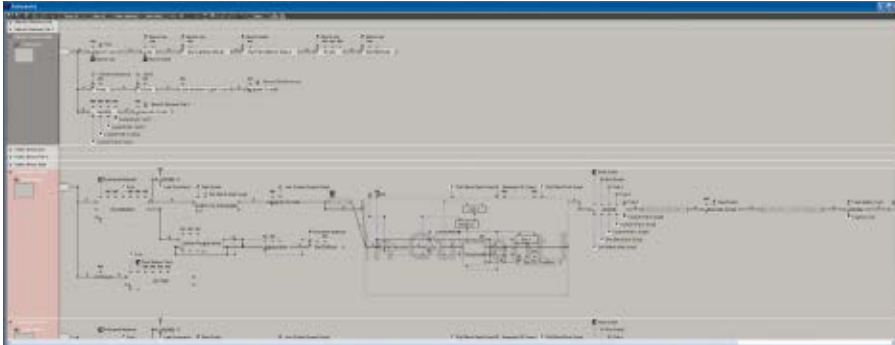
Pentium III or equivalent, Windows 95/98/98SE/2000/ME/XP, or Windows NT 4.0 [with Service Pack 6], 128MB RAM (256MB recommended), 100MB hard disk space, CD-ROM drive, Direct3D- or OpenGL-compatible 2D/3D accelerator card with 8MB RAM, sound card (not required but recommended), Internet Explorer 4.0 or higher (for the online reference).

PROS

1. Interactive real-time editing of nearly everything.
2. Visual scripting more approachable to non-programmers.
3. Extremely fast for prototyping.

CONS

1. Does not support team-oriented development well, for example, when more than one programmer wants to work on the same code.
2. Standard BBs are missing a few basic features.
3. The interface does not conform to some standards, which can affect the user's ability to use other programs while using Virtools.



Virtools 3.0 lets you view your work schematically.

On the top and bottom edges of a BB, you'll find parameter inputs and outputs to the BB. For example, a Translate BB would have an input for the amount to translate (an x, y, z vector) as well as an optional space input that lets you set what you want to translate relative to. Finally, there's an optional target input, which lets you select the object you want to translate. If you don't set the target, you will translate the object running the script. A Distance BB might have inputs for two vectors and an output of one float. You can connect that output to the input of another BB to move data around. Or, you can create variables to direct the output of a BB to a local parameter and later use it as an input to some other BB.

You can even make new BBs out of others. Put together a group of BBs, select Create Behavior, then drag a box around all the BBs you want in your new behavior and Virtools will create a Behavior. They look the same as other BBs. You can add both sequence INs and OUTs and parameter INs and OUTs, and then use them as built-in BBs.

This feature of visual scripting doesn't quite make programming a piece of cake, but it makes it easier for non-programmers to get a visual of what's happening. For the experienced programmer, it takes a while to get used to, but then so does using any new engine. The hardest part is learning and remembering all the various BBs. Like any large library, there are hundreds of them. While you can do something your own way, if you know what BBs are at your disposal, a quicker solution is often already available.

SCRIPTING LANGUAGE

Virtools provides Virtools Scripting Language (VSL). VSL looks quite similar to C++ and you can use it to create new BBs. Experienced programmers will often find this more comfortable. Using VSL, you can go all the way down and even edit pixels in textures or vertices on models. It seems to be fast and you can edit and compile as the game is running. It's amazing how much fun it is to edit and compile code and see the results immediately. Some of you have probably experienced this from using shader editors, such as Nvidia's FX Composer and ATI's RenderMonkey. Virtools brings that same instant feedback to the entire process of making a game.

Virtools has an SDK where you can create new C++-based BBs and even add to Virtools's interface. In a very smart move, Virtools gives you the source code to almost all the BBs that ship with it, so you have lots of working examples as well as the ability to adjust a BB that comes close but doesn't exactly fit your needs.

SHADERS

As of version 3.0, Virtools provides support for DirectX 9 high level shader language-based shaders. Again they work in real time and you can connect and manipulate them from BBs as well. Shaders in general are a relatively immature technology and Microsoft has not yet specified a set of standard semantics—the keywords that connect data in the 3D game engine to a shader.

This leaves each company to pick its own, which means shaders are not portable across game engines the way textures are. Virtools uses its own subset and names. For instance, you will not be

able to take an .FX file from some other tool and use it in Virtools without editing it to match Virtools-specific semantics and options. So if you are not a technical developer or artist with a certain level of proficiency in programming and 3D math, you may be limited to the example shaders Virtools has provided. I suspect that will no longer be an issue when Microsoft has set a standard.

ASSET MANAGEMENT

Version 3.0 also adds support for Alienbrain for asset management. As I am not an Alienbrain user, I didn't get a chance to evaluate this feature. In general, Virtools stores everything related to one game in one large file without lots of special work and coding. Most engines' code would separate this data into various C++ files or scripting files, and all assets would sit in the local path. With a traditional engine, all those separated files make it easier to work on the game when a team has various members responsible for editing different files. Virtools, on the other hand, seems more appropriate for a single user and for prototyping games. Certainly, you can use textures, models, animations, and other data from your team members and pull them into Virtools, but once imported, there is no easy way, short of lots of custom programming, to update them. (However, you can update them manually.)

Virtools loads most common texture formats (.JPG, .TGA, and .DDS, to name a few) and also comes with exporters for Maya, Max, and Lightwave, so getting new assets into it should not be a big problem. The exporters are far from perfect, but they do the job—and Virtools gives you the source code, so you could make them fit your style. The company has also recently announced an Xbox kit and there are rumors of a PS2 kit as well. Overall, Virtools is an important milestone in videogame development, making it easier to prototype or make games. ❖

Gregg Tavares lives in Japan and can be reached through his web site <http://greggman.com>.

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VISUAL FINITE STATE MACHINE AI SYSTEMS

» FINITE STATE MACHINES (FSMS) ARE A SIMPLE AND EFFICIENT METHOD

to implement many game features. FSMs are an element of, or can solve in entirety, many of the problems encountered in game programming: AI, input handling, player handling, UI, and progression. They may be diagrammed using a standard diagram format called a directed graph, which is easy to read and understand, even for non-programmers. It is a simple process to convert directed graphs to state tables and vice-versa. It is also easy to optimize an FSM to a minimum set of states.

This article will examine an approach to implementing FSMs such that no programming is necessary to take an FSM diagram from design-time to executing it in-game.

The usefulness of this system is that it saves programmer time. It offsets the work of creating FSMs to a designer. The best areas to use this system are where the savings can be leveraged the most. A repetitious programming task such as state-machine AI is a prime candidate.

A visual state machine system is a solution to designer-created AI problems that I've had in the past. Initially, we used a sequential script system to create AI on our projects. The system required scripting-knowledgeable designers and the AI scripts relied heavily on messaging [partially to compensate for lack of state tracking] which had a negative impact on performance. Our scripted AI ended up being composed of several different scripts. The scripted AI mismanaged its projectiles and spawned child entities that later led to memory and performance issues at the end of the project.

The technique described here was conceived to solve our problems with creating AI for handheld games. State-machines are a simple, effective, and efficient way to model AI on resource-limited platforms, and shorter development schedules make it beneficial to offset the work of creating AI and other game-world entities to designers.

WORKING THE SYSTEM

The elements of our system begin with Microsoft Visio, which is the front-end GUI that will be used to layout state machine diagrams. The FSM stencil is a document maintained by the programmer and created to define the shapes which designers will be using in their diagrams. Once the FSM has been laid out by a designer, it will be saved as an XML document. This is the final build asset for the game.

The real work for the programmers are the tools used to parse and interpret the XML FSM drawing. The first tool is a command-line tool that converts an XML FSM drawing into state table data. Next comes the XML parser, which does most of the command-line tool's work. Finally, the in-game FSM execution class is the code that executes the FSM table data at run-time.

Reference documents and source code described here can be obtained from www.gdmag.com.

The sample AI System presented here describes the data and logic required to implement an AI character that walks back and forth along the x axis, similar to a "Goomba" (commonly referred to as a patroller) in SUPER MARIO BROS.

Visio comes with dozens of templates to create accurate diagrams for many different standards. Users can also create templates, called stencils. Stencils can define the look and attributes of shapes and connectors that together are used to compose diagrams. It makes an ideal user interface for an FSM system and eliminates the need for any custom GUI tools.

SUNBIR GILL has worked on game and tools programming for several published Gameboy Advance titles including franchises such as *TONY HAWK*, *CRASH BANDICOOT*, *SPYRO THE DRAGON*, and *SPONGEBOB SQUAREPANTS*. He can be reached at sgill@gdmag.com.



PHOTO BY DARREN HESTER

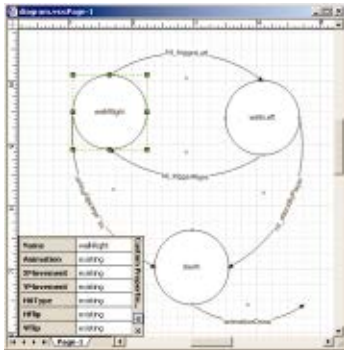


FIGURE 1 An example XML FSM AI drawing.

Drawings and stencils can be saved or converted to a variety of formats. In this system we maintain stencils and drawings in XML format (*.vsx and *.vdx, respectively).

SHAPES

In this sample AI System implementation, we will define 3 shapes: the state, the initial state, and the transition.

Of noticeable absence is a final state. We handle final states in the system implicitly. Any transition that ends with no state is considered to have entered a final state. Once an AI entity enters a final state it will be removed from the game.

CUSTOM PROPERTIES

Each shape can have a set of user modifiable attributes called custom properties. The custom property feature supports several types: strings, integers, booleans, drop-lists, and more. With the exception of the name attribute (a string), we exclusively use drop-lists. The reasoning behind this will be seen when we discuss how the game code maps these attributes to data. For our Goomba system we've defined the custom properties listed in Table 1.

Figure 1 is a screenshot of our Goomba AI in Visio. The patroller walks back and forth between two trigger entities. When it gets hit by the player, it is defeated and enters the final state. The Goomba will hurt the player if they touch it (described by the HitType

property; a value that lets the player know how to handle the AI collision data).

XML FOR MICROSOFT VISIO SCHEMA

Once a Visio stencil and a FSM diagram for the AI have been created, the next stage is to convert the relevant diagram data into a state table. The table should be a 2D array that is an equivalent model of the state machine and is suitable for processing in code.

The Visio XML diagram format is deep and complex. Fortunately, for our purpose of converting the XML to data, we need only concern ourselves with the sub-tree of the structure outlined in Figure 2 and described in Table 2.

By iterating through these tags the tool can obtain all the information required to convert a state-diagram into a state table.

PARSING XML

There are many freely available XML parsing libraries. In our example, we will use Microsoft .Net's C++ library XMLData-Document class. It acts as a DOM parser that both loads and contains the document. Accessor member functions make the

Table 1: State and Initial State

NAME	user-defined string
ANIMATION	drop-list with the following options: <ul style="list-style-type: none"> • existing • moveLeft • moveRight • death
XMOVEMENT	drop-list with the following options: <ul style="list-style-type: none"> • existing • left • right • death
TRANSITION	
CONDITION	drop-list with the following options: <ul style="list-style-type: none"> • hitTriggerLeft • hitTriggerRight • animationDone • hitByPlayer

FIGURE 2 A sub-tree of a the Visio drawing XML tag hierarchy.

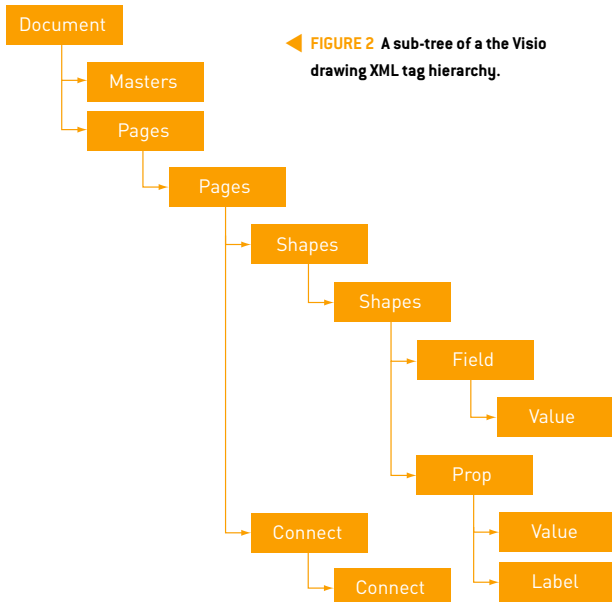


Table 2: Definitions for Figure 2

..._Masters	This sub-tree contains stencil object information that will be required when generating output data. This information can be very useful in catching human error, i.e. if the incorrect stencil was being used. It can also be used to automatically generate the state definition header file that we present in our sample code.
..._Shape	An instance of a Stencil object. Could either be a state or transition. Has a unique integer attribute named ID.
..._Shape_Field_Value	This tag holds the name of the state or transition.
..._Shape_Prop	This tag holds a property of the state or transition.
..._Shape_Prop_Label	This tag holds the property name.
..._Shape_Prop_Value	This tag holds the user-selected custom property value.
..._Connect	This tag holds a transition connection from state to state. It has the following attributes: <ul style="list-style-type: none"> • FromSheet—The ID of the transition shape. • ToSheet—The ID of the state. • FromCell—A value of either "BeginX" or "EndX" representing the start and end points of the connector line respectively.

iteration of nodes easy. DOM parsers are not as fast as single-pass SAX parsers, so if your project needs to support many AI constructs, and build-time is a priority, you may want to consider other options.

Parsing the diagram XML based on the aforementioned subset of the Visio schema should be straightforward. The sample code in Listing 1 illustrates how you can cleanly iterate through relevant nodes.

Listing 1 is a function that iterates through the Master tags in a document by their unique ID attribute. If the index is out-of-range, a NULL pointer is returned. Iterator functions are useful for simplifying the output code generation logic.

THE TOOL

The game engine will require a command-line exporter tool to convert the XML data to FSM data tables in C++ source, or a binary data file, as part of the build process. By using an XML parser to store the diagram data, we can iterate through the tags described in the previous section and collect the information we need. In Listing 2, we will generate C++ source code that can be compiled and linked into the binary executable.

Some useful data structure definitions shown in Listing 2 will be used by our generated output. Listing 3 is the actual generated output created by our command-line tool. In Listing 3 we have hand-rolled the file, but a mature tool could generate it directly from the stencil XML. The following list summarizes the purpose of the definitions used in Listing 2:

- The TransitionTestType enumeration names are mapped one-to-one with the custom properties drop-list for the Visio stencil transition shape.
- The TransitionTest structure is used to store custom properties from the transition shape.
- The StateEntryAction enumeration is a list of unique IDs for every action we could perform upon entry of state. In our

example, we will only be changing movement along the x axis and/or playing a different AI animation.

- The Animation and XMovement enumerations are mapped one-to-one with custom property drop-lists for the state shape.
- The StateEntryAction structure describes an action to take upon entry of a state. The mValue member holds the index into the data array of the type specified by the mType member.
- The State structure is composed of two arrays: an array of possible transitions to other states and an array of actions to take upon state entry. The mTransitions array is a list of indices into an array of TransitionTest structures. This indirection allows us to compress transition data by avoiding duplicate structures.
- Everything is tied together in the Param struct. It contains arrays of TransitionTest and State structures. The stateTable array is an n -by- m 2D array where n is the number of states and

LISTING 1 A <Master/> tag iterator function.

```
static XmlNode* getMaster(XmlDataDocument* xmlDoc, int ID)
{
    XmlNode* pResult = NULL;
    XmlNodeList* pElemList = xmlDoc->GetElementsByTagName("Master");

    for (int i = 0; i < pElemList->Count; i++)
    {
        XmlAttributeCollection* pAttributes = pElemList->Item(i)->get_Attributes();
        XmlAttribute* pAttrib =
        dynamic_cast<XmlAttribute*>(pAttributes->GetNamedItem("ID"));

        if (Int32::Parse(pAttrib->Value) == ID)
        {
            pResult = pElemList->Item(i);
            break;
        }
    }
    return pResult;
}
```

LISTING 2 "ai.h"—Header file defining data array indices and structures referenced by generated output.

```
namespace AI
{
    // transitions
    enum TransitionTestType
    {
        TEST_none = -1,
        TEST_hitTriggerLeft = 0,
        TEST_hitTriggerRight,
        TEST_animationDone,
        TEST_hitByPlayer,
    };

    struct TransitionTest
    {
        TransitionTestType mType;
        int mValue;
    };

    // states
    enum StateEntryActionType
    {
        ACTION_setAnimation,
        ACTION_setXMovement,
    };

    enum Animation
    {
        ANIMATION_moveLeft,
        ANIMATION_moveRight,
        ANIMATION_death,
        NUM_ANIMS,
    };

    enum XMovement
    {
        XMOVEMENT_left,
        XMOVEMENT_right,
        XMOVEMENT_death,
        NUM_MOVEMENT,
    };

    struct StateEntryAction
    {
        StateEntryActionType mType;
        int mValue;
    };

    struct TransitionTest
    {
        struct State
        {
            const int* mTransitions;
            int mNumTransitions;

            const StateEntryAction*
            mActions;
            int mNumActions;
        };

        // param
        struct Param
        {
            const TransitionTest* tests;
            int numTests;

            const State* states;
            int numStates;

            const int* stateTable;
        };
    };
}
```

m is the number of transitions. To find the destination state from state q upon successful transition test t is simply a matter of accessing index $(t * \text{numStates} + q)$ in `stateTable`.

RUN-TIME

Listing 4 describes a simple execution engine for our Goomba state machine. Additional sample code may be downloaded from www.gdmag.com. The tool output leads to a very data-driven, lightweight, and efficient implementation of FSM execution code. We use an instance of an FSM executor class, `AIObject`, a descendant of a game entity class, `VisibleGameObject`, to run the FSM in the game.

The `update()` member function handles state machine

execution. It is executed as an entity base class override that is called once per frame. It tests all outgoing transition tests for the current state and transitions to a new state if a test is successful. If entering a final state, designated by a -1 index in the state table, we make a base class call `setDeletePending()` to let the entity manager know that this entity should be removed from the game world.

The `receive()` member function processes asynchronous messages describing entity-entity interactions. We resort to using flags here to handle transition tests for these cases. After every message the state machine is updated with `update()` in addition to the regular per-frame call.

The `enterState()` member function handles the transitioning

LISTING 3 "_ai_goomba.cpp"—The generated output data file.

```
#include "_ai_goomba.h"
using namespace AI;
// transitions
const int numTransitionTests = 5;
const TransitionTest transitionTests[numTransitionTests] =
{
    { TEST_hitTriggerRight, 0 },
    { TEST_hitTriggerLeft, 0 },
    { TEST_hitByPlayer, 0 },
    { TEST_animationDone, 0 },
};
// states
const int numStates = 3;
// state 0
const int numState0Transitions = 2;
const int state0Transitions[numState0Transitions] = { 0, 2, };
const int numState0Actions = 2;
const StateEntryAction state0Actions[numState0Actions] =
{
    { ACTION_setXMovement, XMOVEMENT_left },
    { ACTION_setAnimation, ANIMATION_moveLeft },
};
// state 1
const int numState1Transitions = 2;
const int state1Transitions[numState1Transitions] = { 1, 2, };

const int numState1Actions = 2;
const StateEntryAction state1Actions[numState1Actions] =
{
    { ACTION_setXMovement, XMOVEMENT_right },
    { ACTION_setAnimation, ANIMATION_moveRight },
};

// state 2
const int numState2Transitions = 1;
const int state2Transitions[numState2Transitions] = { 3, };

const int numState2Actions = 2;
const StateEntryAction state2Actions[numState2Actions] =
{
    { ACTION_setXMovement, XMOVEMENT_death },
    { ACTION_setAnimation, ANIMATION_death },
};

const State states[numStates] =
{
    // state 0 - start state
    {
        // transitions
        state0Transitions,
        numState0Transitions,
        // actions
        state0Actions,
        numState0Actions,
    },
    // state 1
    {
        // transitions
        state1Transitions,
        numState1Transitions,
        // actions
        state1Actions,
        numState1Actions,
    },
    // state 2
    {
        // transitions
        state2Transitions,
        numState2Transitions,
        // actions
        state2Actions,
        numState2Actions,
    },
};
const int stateTable[numStates * numTransitionTests] =
{
    1, 0, 2, 0,
    1, 0, 2, 1,
    2, 2, 2, -1,
};
const Param ai_ref::param =
{
    transitionTests,
    numTransitionTests,
    states,
    numStates,
    stateTable,
};
```

from one state to another. All state-entry actions are performed here. The value members of entry actions are actual indices into data arrays.

As seen by the sample code, this system introduces a very streamlined programming model. Implementation is largely a set of the VisioStencil-mapped, granular transition-test cases and state-entry routines. Execution is completely handled within the update() member function and this encapsulation makes for easy tracing and debugging.

SUMMARY

Run-time performance is about as good as you could expect from a hand-rolled state machine. Potential space and time problems can be introduced during design. A poorly designed state machine can be confusing, require more states and transitions, and execute more code than necessary, but this is true for any such system. This

LISTING 4 "AIObject.h"—Our AI Entity class that executes upon generated FSM output data.

```
class AIObject : public VisibleGameObject
{
public:
    AIObject(
        const AI::Param& param,
        const Animation** anims,
        const MoveParam2D* moves,
        const Position& worldLocation
    );
    virtual ~AIObject();

    bool receive(const Hit& hit);

    void update();

protected:
    void enterState(const AI::State& state);

    void setAnimation(AI::Animation anim);
    void setMovement(AI::XMovement move);

    const AI::Param& mParam;
    const Animation** mAnims;
    const MoveParam2D* mMoves;

    int mCurrentStateIndex;

    union
    {
        unsigned int mMask;
        bool mHitByPlayer;
        bool mHitTriggerLeft;
        bool mHitTriggerRight;
    } mFlags;
};
```

problem can be partially solved by the tool, since FSMs are easily optimized.

The primary limitation of this system is that it does not scale well. As the number of states and transitions increase, the complexity of the document increases as well. Simply put, it is difficult to arrange large state-machine diagrams so that they are readable and understandable.

This FSM system can be expanded upon in several ways. Additional functionality can be achieved by supporting new shapes and new shape properties. Handling messages with a message-handler shape is one way to support asynchronous messaging without having to add transitions to every state. Integrating a stack can extend this solution as well. It would essentially make it a pushdown automata that is capable of solving a larger set of problems. Stack operations could be considered as just another type of state-entry action.

With XML, the future of game tools development is poised to make a radical shift. As the format is supported by more existing software packages, creation of large custom-GUI editors, application plug-ins, and scripts will become a thing of the past. XML data conversion, the driving idea behind this system, builds upon and extends functionality of current software and thus requires less training, less engineering, less support, and as a result, is a far more cost-effective tool solution. ❌

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WRITESIZING

OVER THE PAST SEVERAL YEARS AT GDC THERE'S BEEN A SLOW SHIFT IN attitudes and opinions regarding the 'S' word. Where there used to be heated debates about whether "story" got in the way of gameplay, there now seems to be some tacit agreement that good writing and talented writers are important to the creation of good games.

What's the difference between game writing and game designing? How do different companies ensure that the writing in their games will be as compelling as the gameplay? How does an entertainment medium still in its infancy, and unlike any other, need to evolve to establish a professional standard of writing? The answers differ depending on to whom you speak and what their projects are, but there are definitely some common themes.

CONTINUED ON PG 21

STEPHEN JACOBS teaches graduate courses in "History and Critical Analysis of Computer Games" and "Interactive Narrative" at the Rochester Institute of Technology, where he also directs the Lab for Technological Literacy. He's written over 200 published articles on technology and the arts, and currently produces the NPR affiliated radio show "What the Tech?" You can e-mail him at sjacobs@gdmag.com.



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Richard Dansky

Manager of design at Red Storm Entertainment and the central writer for Ubisoft's CLANCY IP

**RAINBOW SIX 3: RAVEN SHIELD (2003)
FAR CRY (2004)**

"There's more of a recognition that, yes, the writing is important. People are getting tired of the same old, same old when it comes to dialogue and story, and so there's more of a call for writers who are writers—people who are dedicated to just that aspect of the craft, and who can bring something new and exciting to the table."

HOW DO YOU DEFINE GAME DESIGN?

An initial problem is that the term "game design" means different things to different people. "There's a lack of good terminology there," says Raph Koster, chief creative officer for Sony Online Entertainment. "Formally speaking, game design is about building the rules and challenges, and the content side is about the settings within which the rules take place. In theory, you could change the fictional setting of *QUAKE* into something

about shooting cotton candy at fluffy bunny rabbits, and have exactly the same gameplay.

"Then you have the question of what you call the whole thing," adds Koster, "and we usually call that game design, which just complicates things. Is game design designing rule sets, or is it designing games, which include rule sets, content, writing, and so on? In fact, we often have folks called designers who don't ever get to touch a rule, but only make content."

Richard Boon

**Head of script services,
International Hobo, Ltd.**

**GHOST MASTER (2003)
MASHED (2004)**

"The status of writers isn't as important to games as the status of story. It is inevitable that a strong need for quality narrative in games will lead to the widespread use of talented writers. Story is still seen mostly as a necessary element to plug on the back of the game box, and it is this attitude that leads to scrappy storytelling and writing. But we have seen a few games that place as much emphasis on story development as scenario, so there is a slow, general improvement in the situation."

EMERGING PROFESSIONS

Alexis Nolent, editorial story design director for Ubisoft sees a growing clarification of the writer and designer roles.

"Writing is a specific expertise and talent, and so is game designing," says Nolent. "With games growing bigger, more expensive, and more demanding, each job tends to be a lot more specialized. The writer—the one who will take charge of the storyline, the dialog, the delivery, and the narrative structure—needs to be aware of what is going on with the game, what we want the player to do and feel, and what the engine allows us to do. On the other hand, the game designer needs to understand what is going on in the plot, what the level he is going to design will bring to it, what it needs to achieve, as far as activity and emotions are concerned."

Not only separate but equal, game writing and game designing are like the old Reese's Peanut Butter Cup commercials: different flavors that need to come together in one package.

"While game writing and game design are two different things, they need to appear as one in the end," says Nolent. "The mix is what will make the game great, interesting, entertaining, and moving. Game design can be defined as establishing the rules for the game, what will make the game experience unique and addictive, while game writing is what will make it believable and worthwhile, from an emotional and quality standpoint. When we get there, the two of them must appear to be impossible to differentiate. One has to enrich the



**Raph Koster, chief
creative officer,
Sony Online Entertainment.**

WRITESIZING

other. One has to help the other convey everything that it has to offer to the gamer.”

SIZE DOESN'T MATTER

Though Koster and Nolent work with large teams, massive projects, and giant corporations, the same goal of creative fusion between writing and design exists in smaller companies as well. Oddworld Inhabitants was formed by president and creator Lorne Lanning specifically to produce a series of games conceived as parts of a larger world and narrative. Lanning points out that writing for the interactive medium differs from traditional, linear storytelling in that story and play affect each other at every level.

“We try to integrate writing and character abilities to be synergized. For example, the character design and play need to complement the character's story arc,” says Lanning. “Today, play is still the driver. Story is mapped to actions in the gameplay. For example, the game we're working on now has a bounty hunter game character that doesn't like guns. In character development, how does he capture the guys he's after? That goes to the background of the character and all the way down to the code and implementation of the game's mechanics. The writer and game designer still have a long way [to go] to evolve their relationship. They're not as integrated as a writer and director are in the film world.”



Alexis Nolent,
editorial story design
director, Ubisoft.

Lanning goes on to point out that the battle for the soul of a computer game isn't just between the story and the gameplay. Technology, and its limitations, can influence and constrain both. Game writers need to work with and evolve alongside the technology that propels their tales.

“We are constantly fighting the boundaries of what we want to do creatively versus

what the game platform technology is able to deliver,” says Lanning. “As an industry, we are still waiting to get past the phase where it's a strain for writers and creative [people] to understand what can and can't be achieved. Game development still requires a solid understanding of the limitations that govern a game console's abilities. This is similar to where computer graphics was, for film production, 12 years ago.

“When you identify a great story and you try to integrate it into a game, the game can end up savaging the story,” says Lanning. “Our last game suffered from the technology being unable to meet the goals we set for it in the story. It's been better since we've pushed past the curve. Look at HALF-LIFE 2. I think you're getting to see an engine that has more



The title character from Oddworld Inhabitants' forthcoming STRANGER.

entertainment value built into its core abilities, so a writer will have a better understanding of what he can apply to it. Characters can react well to what's in the environment around them and what's happening to it. As the technology and software evolve, writers will have a lot more fun and input.”

DIFFERENT STROKES

Currently, a major sticking point for potential game writers is that every company has its own process for developing the literary aspects of its projects. In some places a company's chief creative officer may focus on the upper echelons of the in-game world, or may be directly involved in all content, or could simply oversee the hiring and integration of professional writers. In some smaller boutique companies, the story may be the vision of the president and founder, the lead game designer, or the project producer. Even here, interest in working with professional wordsmiths is growing.

Lorne Lanning went to the California Institute of the Arts and spent many years in almost all aspects of video, animation, and commercial production before starting his storytelling game company, Oddworld Inhabitants, in 1994. ODDWORLD: ABE'S ODDYSEE, the first in an envisioned quintology, was released in 1997. STRANGER, their new title to be distributed by EA next year, also takes place in Oddworld, but in a different locale than previous games. As the company was founded to implement Lanning's vision, it's not surprising that the writing begins and ends with him. What is surprising is that even with his background, and in a company created to implement his personal vision, Lanning has considered bringing in outside writers.

“In our group I've been the main writer thus far,” says Lanning. “I try to encourage input from the team at the pre-production/high concept stage. I then tend to write game scripts much like they're movie scripts. We then go back to the team and producers to break it down and figure out what we can and can't do. Once in production, we begin to learn what happens at each level, as per the micro plots.

“For example, 'I've got to get across the bridge so I've got to find the guy to let me across. Uh oh, he's in jail.' Sometimes the team

CONTINUED ON PG 24

- / What type of game should we develop?
- / Who is my competition?
- / What does the press have to say?
- / When is the best time to release?
- / Who wants my game?
- / How interested are they?
- / What other games do they like?
- / Where do they live?
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WRITESIZING

CONTINUED FROM PG 22

will do the writing in the micro goals and level design because they're more tied to the play they're creating.

"I've wanted to hire some outside professional writers, but so far we haven't because we're still challenging the tech at a more mundane level," says Lanning. "I know things will change when the engines evolve, but so far we need writers who can be flexible."

In larger companies that are developing many titles simultaneously, writing responsibilities can reside in numerous places: with a producer, a game designer, or others if there's not a writer on the team. Ubisoft created what is likely a unique position for Alexis Nolent, now editorial story design director, to ensure high quality writing across the company's titles. Nolent has written and published both traditional and graphic novels. He first entered the industry 10 years ago when he submitted an idea for a game to Ubisoft and was hired by the company to develop it. His historical adventure game with multiple endings, *LES 9 DESTINS DE VALDO* (*THE ADVENTURES OF VALDO AND MARIE*) was released in France in 1996.

"As the editorial story design director for Ubisoft," he says, "my job is to help the writers do the best possible job, and also to help them understand the game design side of it. I oversee all of our top quality games regarding the storyline, storytelling, and cinematics. As part of my job, I travel to our various studios around the world to meet with Ubisoft's writers as they create our games.

"I help hire the right writers for each project and I work with



Steve Ince

Freelance game writer/designer

BROKEN SWORD—THE SHADOW OF THE TEMPLARS (GBA) (2002), BROKEN SWORD—THE SLEEPING DRAGON (2003)

Nominated for Excellence in Writing at the Game Developers Choice Awards 2004

"I get the impression that many developers and publishers still see writing as something that should simply fall out of the design for a game. The writer's status has improved, but it often feels that there's a reluctance behind it. That said, more of the game writers I work with are coming with writing credentials before they got into games. I think that's vitally important in some ways. It certainly allowed me to develop as a writer when working alongside a writer from another medium. Cross-fertilization is an incredible catalyst for ideas."

them on the different phases of the writing process as the games develop," says Nolent. "I look for writers with an expertise in building story and characters. They might not be game experts, but they would have to be interested in that new medium for what it could achieve, and to explore new fields and new ways to convey emotions to the player."

THE PLACE IS THE THING

"Much of the writing that goes on in MMOGs is about building up a setting," says Koster. "The character-driven writing is relatively light (although there are tons of characters) because the real hero is the player, not the NPCs."

Koster, who has an MFA in creative writing from the University of Alabama, started MUDDING as a hobbyist in 1992, then began his professional career in 1995 at Origin Systems. Eventually he worked on *ULTIMA ONLINE* before working with Verant and now Sony Online Entertainment. The size and architecture of an MMOG require writing and design different from games like the *Oddworld* titles.

"It would be difficult to make an MMOG about, say, *Hamlet*, because *Hamlet* is a very particular story," explains Koster. "MMOGs are places, so you need lore and background information on the castle at Ellsinore, more so than you need it for *Hamlet* himself."

Unlike Lanning, Koster must involve a large team of writers, if for no other reason than sheer volume.

"We spend a tremendous amount of time writing," says Koster. "As an example, *EVERQUEST II* has something like 70,000 lines of dialogue. Since we're doing voiceover, that's around 120 to 130 hours of recordings, or the equivalent of 60 movies' worth. And often, the writing can get repetitive; in *GALAXIES*, there are literally hundreds of ways for NPCs to just say, 'Hello'."

"We use both the internal content teams (often, many content designers are aspiring writers) and professional writers—both scriptwriters and prose writers—published novelists, and so on ... Depending on the nature of the project, the writers may be conceptualizing the content as well as writing text, or they may be doing nothing but making sure the dialogue reads well."

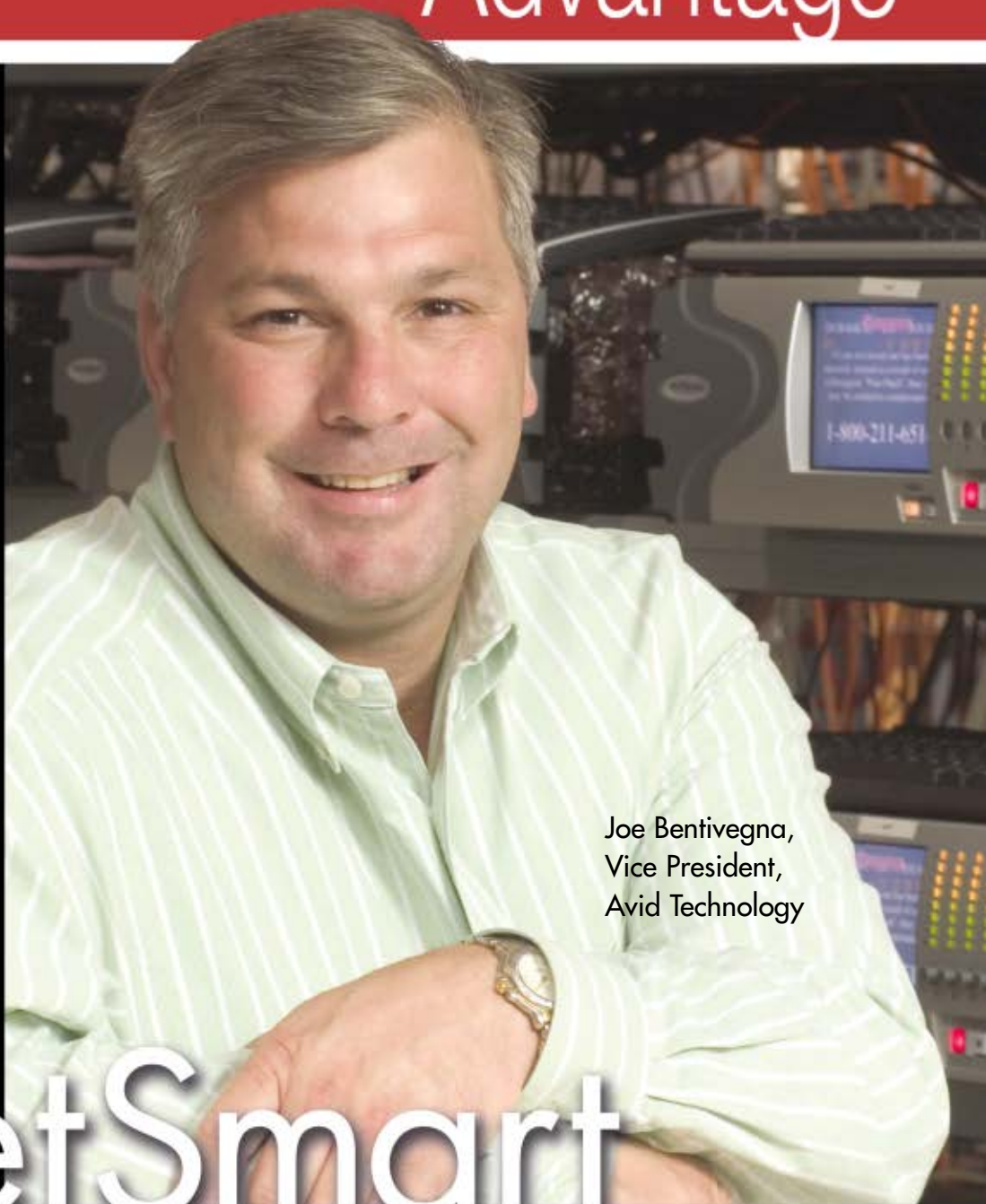
Lorne Lanning,
founder, *Oddworld*
Inhabitants.



The **Small Business** Advantage

Inside:

- > **TLC for the SMB**
- > **Finding technical expertise online**
- > **A cure for enterprise envy**
- > **New HP programs give small business a knowledge edge**



Joe Bentivegna,
Vice President,
Avid Technology

GetSmart

HP technology helps animate developers

TLC for the SMB

Absent large IT staffs, small and midsize businesses are discovering new sources of IT know-how

Forced to compete fiercely for every scrap of business, more than ever, small and medium-size businesses (SMBs) are turning to IT to boost productivity and retain their best customers.

But while many SMBs want to do more to automate, they don't always have the right people on staff to select and roll out the best technologies.

"SMBs have limited IT staff, but they still need all the expert advice that large enterprises enjoy," observes John Madden, director of the Selling to Small and Medium Businesses Practice at Summit Strategies in Boston.

Huge Challenge

This presents a huge challenge for smaller businesses. How can they compete in a business environment that increasingly demands real-time response and maximum cost efficiency, when they don't have the technology skills and experience they need?

Fortunately, Madden adds, "technology vendors are offering consulting and other services that are focused on the SMB market." These include many services, provided free or with the purchase of a product, such as online support and expert forums, knowledge centers, organizations that pool the knowledge of their membership and certification programs. In aggregate, they can provide the sort of affordable, industry-specific assistance that smaller businesses need.

For example, Hewlett-Packard offers a host of services that offer professional advice to small and medium businesses.

"Advice from HP is continuously available to SMBs through telephone support and online resources," says Robyn West, HP vice president for small and medium business. "HP also invests in educating and supporting an extensive network of industry partners, giving SMB customers access to the widest possible range of up-to-date help and information."

Tapping Into the Network

"Small companies are very concerned about costs and the value they get out of the systems they deploy," so finding affordable expertise is extremely important to them, confirms Fred Harrah, CEO of The Network Company of California (TNCC), a San Marcos, Calif., provider of local and wide area networking solutions.

TNCC is an authorized HP solution provider and takes advantage of various HP resources to provide knowledge and guidance to its cus-

"It's not just about the hardware; it's about knowing what you can do with the hardware and the benefits you can bring to the business."

— Fred Harrah, CEO of The Network Company of California

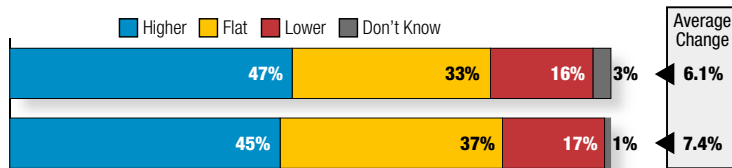
tomers. Says Harrah, "We make use of various HP resources, including white papers and case studies, which we pass on to our clients to show them some of the things they can do to improve operations and become more efficient."

He adds: "It's not just about the hardware; it's about knowing what you can do with the hardware and the benefits that you can bring to the business. We help our clients look at ways technology can cost-effectively solve problems."

TNCC customer Hobie Cat Co. of Oceanside, Calif., has benefited from the combined know-how of TNCC and HP. Hobie Cat, which makes sailboats, catamarans and kayaks, turned to TNCC when it wanted to upgrade from an outmoded IT infrastructure to a network of HP servers and PCs to better support its rapid growth.

"We had no experience with PC networks or how to upgrade," says Hobie Cat's CFO, Bill Baldwin. "We leaned on TNCC for their expertise, and we continue to rely on them for help with IT." ■

How does your company's overall 2004 IT budget compare with its actual spend in 2003?



Base: 1,002 IT and business decision-makers at North American SMB companies (percentages may not total 100 because of rounding)

Source: Forester's Business Technographics® March 2004 North American SMB Benchmark Study

Know-How at Your Fingertips

HP gears new support programs to meet SMBs needs

When it comes to the small and medium business market, Hewlett-Packard is putting its money where its mouth is. The IT vendor has declared that the SMB segment is vital to its business and has followed up with an array of programs to help smaller businesses maximize the benefits they derive from their IT investments. Many of these initiatives recognize that small and medium businesses often have a barebones IT staff and are designed to provide expert advice that doesn't cost an arm and a leg.

The following are the most frequently asked questions about HP's small and midsize business programs and the different kinds of professional guidance SMBs can expect from them.

Q Why is it so important that IT vendors provide small and medium businesses with affordable, industry-specific technology advice?

A: The complexity of IT can be daunting for SMBs. To simplify the technology and help smaller businesses realize more tangible benefits from their IT investments, they need ready access to expert know-how. Small and midsize businesses are under more pressure than ever to utilize technology to their competitive advantage. But they need help choosing and implementing the right solutions, so they can focus on their business – not on their IT infrastructure.

Q How does online support and local expertise from HP provide SMBs with comprehensive technology guidance that they can afford?

A: HP offers technology know-how whenever, wherever and however SMBs need it. The HP Expertise Centers for printing, imaging and mobility help small and medium businesses choose solutions through a variety of online tools, such as live chat, consulting services and educational resources. For example, the HP Learning Center provides a wide array of free online classes, how-to guides and expert advice.

Also, to help ensure that HP customers of any size can afford the solutions they need, HP Smart Finance offers flexible financing terms that can be adjusted to meet the needs of virtually any business. Smart Finance features

financing and leasing available directly from HP or through HP's channel partners. These include trade-in and trade-up programs, financing for many different brands of products – not just HP's – and complete product management services for the lifetime of the product, including the recycling phase.



Q How can SMBs benefit from using HP's online chat resources?

A: The goal of Live Chat is to help customers select and deploy the right HP products. The service does this by making it easy for SMBs to reach HP experts online for immediate answers to their questions.

Q How do the HP SMB Expertise Centers and the HP Mobility Solutions Center benefit small and medium businesses?

A: HP Expertise Centers for Printing and Imaging help small and medium businesses choose the solutions that are most suitable for their operations. They include access to a variety of online tools, Live Chat capabilities, phone and in-person consulting services and educational resources.

The Mobility Solution Center is an online resource that provides SMBs with information about mobility products and solutions that can help increase their productivity and extend their reach in the marketplace. HP now offers a live chat feature as part of the center. By simply clicking on the "chat" link, customers can have instant access to a live chat session with a knowledgeable HP representative who understands the kinds of challenges faced by smaller businesses and how the appropriate mobile computing solution can help address those challenges.

Q What is the PartnerONE SMB Network and how does it help HP small business customers?

A: In the U.S., the PartnerONE SMB network comprises HP technology specialists who have the knowledge to design, implement and support business solutions built specifically for SMBs. Today, more than 1,100 partners are in the network.

PartnerONE gives HP SMB customers access to local technology experts who can serve them as trusted advisors. These specialists offer a combination of local and industry-specific expertise along with HP-branded services. ■

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3 Tech support available miles from your office

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Thrilling Performance

HP technology helps animate Softimage's development team

White knuckles. Unexpected twists and turns. Edge of your seat excitement. This is what the Softimage Co. strives to create with its 3-D animation, 2-D cel animation and special effects software for the film, broadcast and interactive games industries . . .

. . . And what Softimage strives to avoid when it comes to the high-performance workstations and other IT systems that it uses to build its software. When it comes to its production environment, predictability, consistency and performance are the name of the game. And, for the Montreal-based subsidiary of Avid Technology, no one plays that game better than Hewlett-Packard.



Bentivegna: *Faster processing speeds improve interaction among artists.*

The Softimage product family helps entertainment companies such as The Mill, Pixel Liberation Front and Blue Sky Studios introduce innovation and collaboration throughout the production process. Its flagship product, Softimage XSI, is the industry's first 3-D nonlinear production environment, allowing animators and digital artists to produce everything from major motion pictures to cartoons and animated content for video games and Web sites.

Streamlining Animation

When it introduced the newest version of the software earlier this year, Softimage demonstrated its capabilities on HP dual processor workstations with PCI Express architecture. Equipped with the latest Intel® Xeon™ 64-bit processors, the HP workstations streamline time-consuming animation tasks such as modeling, texturing and rendering.

"HP provides us with extensive support and has become our preferred platform provider," says Joe Bentivegna, vice president of video development and operations at parent company Avid Technology.

Avid and Softimage use HP xw8000 workstations, in addition to HP printers and monitors, to support their product teams. "Almost our entire development environment is on the HP platform," Bentivegna says. "The speed at which you develop is driven by the quality of your engineering team, but it's HP's ability to deliver higher-performing workstations that has given our developers a very fast and efficient environment in which to work."

Bentivegna says Softimage's XSI software performs so well on the HP Workstations that it helps drive sales.

Another plus is HP's commitment to the 3-D development arena. "HP has continued to enhance its systems to optimize the 3-D processing pipeline," Bentivegna notes.

Processing Improvements

One of the most important improvements, according to Bentivegna, has been the addition of 64-bit processing capabilities to the HP workstations. "We've been working to make Softimage XSI 64-bit native for a long time, and now we can do that," he says. With the faster processing speed, Softimage has been able to reduce image rendering times by a factor of ten – from 30 minutes to just three.

The 64-bit architecture complements the latest HP workstations' PCI Express architecture, which enables Softimage developers to load graphics and data more quickly and achieve higher performance. But the advantages extend beyond the development team – Bentivegna says Softimage's XSI software performs so well on the HP workstations that it helps drive sales.

Softimage can also turn to HP for technology expertise when it's needed. "HP frequently steps in to assist us, whether it's with hardware or an interface we need to an operating system," Bentivegna adds. "It's great technology, but even more important is the relationship we have with HP. That has become critical to our business." ■

Mary DeMarle

Freelance Game
Writer/Designer

HOMEWORLD 2, 2003

MYST IV: REVELATION 2004



“About five years ago, I was working with a team of developers on a licensed game property. Representatives from the licensor—an established game development company in its own right—came in to meet with our team. As introductions were made, the licensor’s president kept staring at me in confusion. ‘So ... you’re a writer,’ he finally said. ‘What is it that you do?’

“Since that day, the status of game writers in the industry has not significantly changed, in my opinion. I am still often greeted by a look of total incomprehension when I approach companies at trade shows to ask whether they hire full-time or freelance writers to work on their games. However, many of the lectures I attended at this year’s GDC seemed to stress the importance of hiring professionals, so I sense things may be starting to change.”

CONTINUED FROM PG 24

COVETING THY NEIGHBOR’S PROPERTIES

While Lanning must be true to only himself and his vision, Koster and Nolent both work with licenses. Koster has the Lucas universe to grapple with in *GALAXIES*. Nolent and Ubisoft work with numerous properties, most significantly the Tom Clancy IP. While there are some additional expectations and constraints on the table with licenses, the challenge essentially remains the same.

“In the case of *GALAXIES*, LucasArts and Lucasfilm have a tremendous amount of material available,” says Koster, “and they have concordances and databases that they use internally to keep track of all that. Day to day, we relied pretty heavily on the publicly available resources—the *Essential Guides*, that sort of thing. We were able to work directly with our producer at LucasArts to clarify points that came up any time we had questions.

“In the case of *EVERQUEST*, we have a huge amount of lore created for the game, and of course we are able to leverage that for *EVERQUEST II*,” says Koster. “The lore needed to be updated to account for the changes in the time period, of course. In both cases, it then becomes something for the content team and writers to work with. They need to adhere to the tone and style of the background material.”

Nolent agrees with Koster that over time, internal properties develop their own sets of constraints due to their genres and histories. “The concern is to remain within the boundaries of the franchise while bringing something new and interesting to it, to refresh the franchise without losing what makes it special or interesting. *TOM CLANCY’S RAINBOW SIX* is squad, counterterrorist, worldwide, and geo-strategic. *TOM CLANCY’S GHOST RECON* is squad,

military, and behind the lines, while *TOM CLANCY’S SPLINTER CELL* is a lone operator, more like a spy. Along these lines, we have enough room to create something interesting and fresh each time, and add something new. Having something new within the gameplay, and the quality of the overall game is what actually drives the game, not the other way around. *PRINCE OF PERSIA* is a franchise too, and we have to refresh it every time. When it comes to 100 percent original intellectual property, then we have more room to look for different things, but the process to create something new and interesting remains the same.”

THE TENSION BETWEEN INNOVATION AND EXPECTATION

As a medium, games are at a tough point in their history. To grow and evolve they need to entice and excite new audiences without alienating the established bases. They also need to compete in an increasingly competitive atmosphere. Last but not least, they’re grappling with the same types of pressures that Hollywood is. As development costs skyrocket and production schedules

grow ever longer, the level of financial risk becomes a constraint of its own. The game industry faces its own forms of sequel-itis.

“Games are longer experiences than film and television,”

Lanning points out. “They need to entertain longer and hold the gamer’s attention longer. Innovation is risky even in a short film. It’s riskier still if you’re trying to create new types of characters, new types of play, and new types of technology. So it’s much easier to give a guy 50 types of weapons to use in a game than push the narrative/play envelope. But innovation is what needs to happen in the industry”

Nolent agrees that content and writing need to be as innovative as gameplay. “How many terrorist plots can you create that are interesting and challenging, without being silly, goofy, unoriginal, exploitive, too realistic, or not realistic enough? How many times can you go to ex-USSR countries and fight obscure irrelevant groups nobody fears? How far do we want to go? These questions resurface every time we start a new game.”

Koster says, “Writing is a discipline like any other. Craftsmanship pays off, and these days, there’s an increasing expectation among the customers that the writing will be decent. We live in a world where acceptable writing is readily available in entertainment (great writing, as always, is rare). So it’s important to meet and exceed the minimum bar.”

High quality, professional authors who play games and can create and innovate in a long-term production environment are best suited to the task of creating stories for digital games. In an environment where play drives story, and technology constrains as much as it empowers, the industry will need to learn how to identify, grow, and nurture these types of professionals if digital games are to move to the next level as an entertainment medium. ❖

POSTMORTEM POSTMORTEM

TWO TIMING: TIMEGATE STUDIOS'

KOHAN II

AND

AXIS & ALLIES

IN 2001, TIMEGATE STUDIOS, A lesser-known developer, released *Kohan: Immortal Sovereigns* and its expansion, *Ahriman's Gift*, won more than 30 industry awards and "Strategy Game of the Year" from publications such as *Computer Gaming World*, *PC Gamer*, and *Computer Games Magazine*. The games established TimeGate's positive reputation. Nevertheless, we were interested in expanding our market reach and visibility. To do so, we set an ambitious goal of creating two A-list games—*KOHAN II: KINGS OF WAR* and *AXIS & ALLIES*—in two years. Although the games had different publishers, subject matter, and

gameplay, they were released almost simultaneously. In both cases, we knew we had to raise the production values well above those of *IMMORTAL SOVEREIGNS* and *AHRIMAN'S GIFT*, which used a 2D tile-based engine. Regardless, creating a new engine from scratch and concurrently developing two games, each of which was larger in scope and complexity than anything we had done before, presented a host of new challenges and opportunities for TimeGate. Two years and a few bruises later, the games are done and TimeGate has established itself as a preeminent developer. Here are some of the lessons we learned in the process.



WRITTEN BY:

ADEL CHAVELEH is president and co-founder of TimeGate Studios and is responsible for implementing the company's vision and overall strategy. In his seven years in the interactive entertainment industry, he worked as producer on all the *KOHAN* series titles as well as co-executive producer on *AXIS & ALLIES*. He can be reached at adelachaveleh@gdmag.com



GAME DATA



PUBLISHER
Take Two

NUMBER OF DEVELOPERS
35

LENGTH OF DEVELOPMENT
27 months

RELEASE DATE
September 22, 2004

PLATFORM
PC Windows

DEVELOPMENT SOFTWARE USED
Bink, Bugzilla, GameBryo, GameSpy SDK,
Miles, Perforce, Visual Studio



GAME DATA



PUBLISHER
Atari

NUMBER OF DEVELOPERS
39

LENGTH OF DEVELOPMENT
22 months

RELEASE DATE
November 2, 2004

PLATFORM
PC Windows

DEVELOPMENT SOFTWARE USED
Bink, Bugzilla, GameBryo, GameSpy SDK,
Miles, Perforce, Visual Studio

WHAT WENT RIGHT

1 GREAT COMPANY BUZZ. Because of the critical acclaim of TimeGate's previous two Kohan games (IMMORTAL SOVEREIGNS and AHRIMAN'S GIFT), we already enjoyed a strong connection with industry news sources and critics. Likewise, the prominence of the AXIS & ALLIES IP ensured that the game would receive publicity in traditional computer game magazines and in the wider gamer community. This media attention presented some interesting public relations challenges, but in hindsight, it was an enormous benefit.

We went into the development of KINGS OF WAR and AXIS & ALLIES confident that we would not have to spend all our time drumming up interest in the projects. We could focus on creating solid, enjoyable games instead. We quickly realized that our built-in publicity guaranteed a baseline of coverage, and helped us gain a degree of prominence we never had before. AXIS & ALLIES and KINGS OF WAR were covered in print media, and both took top billing on the major gaming web sites. With a modest amount of PR work, we were able to raise TimeGate's profile dramatically.

While we would have been able to do this with either title individually, having two titles released together resulted in aggregate benefits as well as benefits that were greater than the sum of the games' parts. One aggregate benefit was that we got twice as much publicity, even if it was divided over two games; TimeGate's name was in industry sources twice as often as it otherwise would have been. The cross-fertilization benefits were more interesting. First, they allowed us to attract new fans to each game—those familiar with the AXIS & ALLIES brand started checking out KINGS OF WAR, and KOHAN fans became intrigued by AXIS & ALLIES. Second, rather than just our games getting noticed, our company started getting noticed. Because both games were in the press at once, previews, reviews, and commentary often mentioned TimeGate's role as the critical node. As an independent developer, it was important to establish our games and ourselves. Developing two games at once proved extremely useful in this regard.



2 MULTIPLE PUBLISHER RELATIONSHIPS. By having an opportunity to work with multiple publishers, we were able to learn more about what options are available to an independent developer. Atari and Take Two supported our creative autonomy and were willing to invest resources in developing and promoting our projects. Again, two is usually better than one. Having close relationships with two publishers was a way of guaranteeing support next time around. We won't have to work hard to convince a publisher of our abilities, because two major publishers already have seen how well we work. But there were advantages that went well beyond this doubling effect.

First, the two games and publisher relationships were very different, which allowed us to develop different aspects of the company. Atari wanted to create a game with broad appeal inspired by well known IP. Take Two was happy to support us in developing our own IP and let us continue to build our creation—the KOHAN universe—while expanding our fanbase.

Second, we learned an extraordinary amount about the publishing side of the game industry by working with two distinct, well-established companies. Because both companies invited us to participate in several processes, such as Q/A, marketing, public relations, and manual and box designs, we were able to integrate the knowledge from some of our publishers' experiences into our business model. This, in turn, has improved both our corporate side and our development side, and thus made us a sleeker, more desirable candidate to work with in the future.

3 MINIMIZED LONG-TERM RISK. As of the writing of this article, it's impossible to predict the market success of either title, though preliminary forecasts are quite positive. However, KINGS OF WAR is already released and has been receiving overwhelmingly positive reviews and several editor's choice awards. Though we are excited to have created two stellar products, we are also in the fortunate position of being able to weather the storm if one of the games is less successful. Having two games released concurrently ensures that whatever happens, TimeGate will, with high probability, come out on top and will have the revenue stream and market presence to create future titles. This foresight allowed us to gear up immediately for our next game, even before the last two were released, and to begin recruitment and preplanning confidently.



TimeGate Studios' development team.



Another way we minimized risk was by building on the successful models we had developed in *IMMORTAL SOVEREIGNS* and *AHRIMAN'S GIFT*. By relying on the unique unit control system from those games, we developed from an established baseline. This gave Kohan fans something to look forward to, but it also let us push *AXIS & ALLIES* in a new direction. Unlike *KINGS OF WAR*, *AXIS & ALLIES* is not a sequel, so we spent a lot of time advancing and refining the unit control system from the *KOHAN* series. The result is a more refined system in *KINGS OF WAR* and a next generation system in *AXIS & ALLIES* that will be as much of an innovation in the RTS genre as the original *IMMORTAL SOVEREIGNS* system was.

4 MANDATORY EFFICIENCY. TimeGate believes in efficiently staffing its projects to make sure that everyone has a meaningful say in the development process and significant responsibility in their field. When we took on two projects, there was no slack in the system—or at least no slackers—to absorb the increased workload. We had to focus our priorities and become more efficient in our development strategy. First, we filled our ranks with veterans, not only of game development in general, but of TimeGate's development style in particular. As we increased our team and our workload, we took those who had worked hard on prior projects and promoted them to positions of responsibility. With their experience, we were able to improve our efficiency significantly. Due to economies of scale and this improved efficiency, TimeGate's development capacity grew at a much greater rate than our development costs. TimeGate is now in an incredibly strong and competitive position relative to other developers. We also now have a larger leadership staff capable of tackling our next major challenges.

5 ESTABLISHING TIMEGATE. Although we had enjoyed solid sales and critical acclaim for titles before *KINGS OF WAR* and *AXIS & ALLIES*, TimeGate was not consistently viewed as a creator of high-profile games. Embarking on two major projects transformed the public's perception of the company and its economics and internal dynamics. By the time we completed both projects, we had the necessary resources and attitude to create major games, and the experience to do an even better job next time.

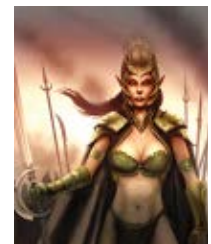
This may sound like a recap of the points made above, but our internal success created a synergy that exceeded the monetary,

public relations, and industry contact benefits. After working as hard as we did for as long as we did, our company was able to transform. Collectively, our abilities have become much greater, our size and flexibility has expanded, and our profile has risen enough that we can now take on projects that will test these new capacities.

WHAT WENT WRONG

1 GROWING PAINS. The flipside of improved efficiency and establishing TimeGate as a new sort of developer is the challenge of transforming internally to meet new demands. Though, as explained previously, we ultimately succeeded in this transformation, the road to get there was tough. For a long time, we held off expanding our team. As a result, we stretched our core developers too thin with a heavy workload. We quickly realized that we needed to hire more people, and once we did, things became much easier—although we then had the challenge of integrating new team members. Ultimately, these are the growing pains that a company in any industry faces, but they were tough on our team at the beginning. Because a great deal of the problems were simple logistical—such as how quickly we could fly people to Houston for interviews, relocate them, and get them up to speed on the projects—we might have had an easier time if we had expanded the team prior to beginning the projects. (Of course, hiring before starting a project is a risky affair.) By the end, however, the team had grown to a manageable, effective size, and the challenges helped us develop new abilities and find new talent.

2 MANAGING MULTIPLE FRONTS. One of the major challenges of working on two titles simultaneously was hitting two sets of milestone deadlines and keeping both publishers pleased and excited. Although we were able to handle both fronts, at times we stretched our resources tremendously. We weren't taking on too much work—we simply were not structuring our milestones as well as we could have. Indeed, milestones for *KINGS OF WAR* and *AXIS & ALLIES* sometimes fell on the same day—a feat we overconfidently believed we could manage. Once we got a better handle on the deadlines, we were able to stagger our milestones and space out the work in more appropriate intervals. This scheduling enabled us to meet our



deadlines without burning out and make sure that everything we sent to the publishers was perfect. We also had to develop a quick asset-delivery model for responding to requests from both publishers so we could provide marketing and public relations material essentially on-demand. In the end, the overhaul produced a more streamlined process, that, though often still very intense, produced much greater visibility in the market for our games and an excellent relationship with our publishers.



3 INTERNAL APPROVAL BOTTLENECKS. Our resources could have been better applied had we employed a more efficient approval system. Because we believe in devolving a lot of authority to the developers, designers, and artists—rather than employing the many-tiered, management-centric structure of other game companies—there simply weren't enough high-level leads to make sure the work was moving properly. When items came up for approval, they were often delayed unnecessarily because our project leads were spread too thin. Downtime and frustration resulted on the development side, and inefficient multitasking resulted on the management side. Ultimately, this problem created a surprising benefit: promotions. Newly promoted leaders took their jobs very seriously and provided a huge morale boost to the development of both projects.

4 MANAGING FANBASE EXPECTATIONS. Though the benefits of having two already-established fan-bases—*KOHAN* players and *Axis & Allies* board game players—were substantial, there were also noteworthy drawbacks. All these fans had strong expectations, which often conflicted with each other and with the demands of the game market. We were faced with the task of balancing: original board game features with RTS gameplay; intuitive controls with strategic depth; and traditional feel with high-end graphics and sound.

Our message boards were often filled with opinionated, loyal fans who expressed great attachment to their concepts of how the games ought to be. Every time a preview suggested that something was different from those conceptions, some fans reacted with dismay. Drawing from a game with as long a history as *Axis & Allies*' was particularly challenging because we were not creating a strict adaptation of the board game, rather, a RTS game inspired by the board game. Likewise with *KINGS OF WAR*, many game features were re-tooled from the earlier games to make it approachable for new players. Many hardcore fans felt that the game was not pitched to them, but to strangers.

Although we believe we ultimately succeeded in assuaging these fears and creating a game that satisfied the needs of the vast majority of our fans, we could have been more proactive in addressing the fans' concerns. As the release date approached

and gamers got a clearer idea of what they would get from the game, the problems evaporated. But it would have been better to address this issue sooner, as we would have been happier to know that our fans were completely pleased with the directions we were taking.



5 INTERNAL PROCESSES WERE NOT MULTITHREADED. Prior to starting these projects, our internal corporate and developmental processes were geared toward managing one project only. As mentioned previously, this was partly an issue of workflow and team size. But the problem also covered company policies and processes. Everything at TimeGate, from code and asset management to office layout, had been designed with an eye toward single-game development. We wasted a good amount of time and suffered several headaches when we switched to making two games simultaneously. Lines of communication were not running as well as they could have been, and because everyone was so busy, no one had time to address the problems. Here, the close relationship between management and the development team proved to be a big advantage. We reviewed all corporate policies and engaged in a thorough overhaul of internal development procedures. Because we had the financial resources to make the necessary changes, we met this challenge head-on before it became crippling. Nonetheless, if we had taken more time to plan our expansion in advance, we probably would have avoided a lot of costs in energy, time, and money.

KINGS OF WORLD WAR II

We learned many lessons developing *KINGS OF WAR* and *AXIS & ALLIES* at the same time, such as the huge benefit of doubling up. But perhaps just as important, we had to jump a number of hurdles to make this expansion. Fortunately, TimeGate had the financial resources, experience, and industry connections to take on two projects without buckling under the weight. For other companies in different situations, the decision to expand the development load may be more difficult. The key to making it work, as we discovered the hard way, is planning as much as possible in advance. Corporate and developmental structures that work well for single game development are often ineffective for developing multiple games. To the extent that structural changes can be made in advance, they should be—it saves time, work, and money in the long-run, and may give development houses in less secure positions the edge they need to handle a second game.

Simultaneously creating two top-notch, high-profile titles for two major publishers was a bit like boot camp for TimeGate—extremely grueling, frustrating at times, but incredibly rewarding at the end. We are now stronger and more experienced, and are in a position to capitalize on everything we gained in the process, for example, greater market presence, more resources, more experience, and strong publisher connections. As we launch our next generation of games, we aim to persistently push forward and drive innovation in both game design and development practices.

None of this, of course, could have been done without the hard work and dedication of our developers. Their skills, energy, and creativity, more than anything else, brought TimeGate to the next level. ❖



» THE INNER PRODUCT

BLEND DOES NOT
DISTRIBUTE OVER LERP

IN 1978 ED CATMULL AND ALVY RAY SMITH came up with the idea of integral alpha: storing alpha values with RGB components rather than as a separate image mask, as was the practice with film. A few years later, in 1984, Thomas Porter and Tom Duff published a paper detailing alpha compositing and advocated premultiplied alpha, in which the stored RGB values have been multiplied by the alpha value. Their

motivation was efficiency—irrelevant now since alpha-blending is performed by hardware. But Figures 1A–D illustrate that there's a different reason the game industry should be using premultiplied alpha: non-premultiplied alpha doesn't interpolate properly. The first publication I can find discussing this is Jim Blinn's *IEEE Computer Graphics and Applications* column in September 1994. It's 10 years old but still widely unknown in the game industry.

I've been trying to sell my friends and co-workers on the value of premultiplied alpha for a long time, but I've met resistance. Rather than write a column "Seven Reasons You Should Use Premultiplied Alpha" (No. 3: The movie FX houses use it), I decided to dig down into the mathematics underlying premultiplied alpha and to try to get a solid understanding of why it's better. That led to this column's title; it's not catchy, but I hope you'll remember it even if you remain skeptical about premultiplied alpha. To restate the column title more clearly, alpha-blending does not distribute over linear interpolation if you use non-premultiplied alpha.

A lot of mathematics in computer game development rely on linearity. Vectors are described by linear algebra; the DCT transformation used in image compression is linear; lerp itself is linear, by definition. One of the reasons linear equations and operations are so powerful and magical is because multiplication distributes over addition. Two terms with a common factor can always be combined using the distributive law. No matter how a set of vectors are linearly combined, the result can't escape the vector space they define. Contrarily, lack of linearity can cause problems—and alpha-blending interpolated colors is non-linear.

THE MATHEMATICS OF
ALPHA-BLENDING

Consider the bilinear interpolation of colors shown in Figure 2 (page 40). The result can be understood as a lerp of

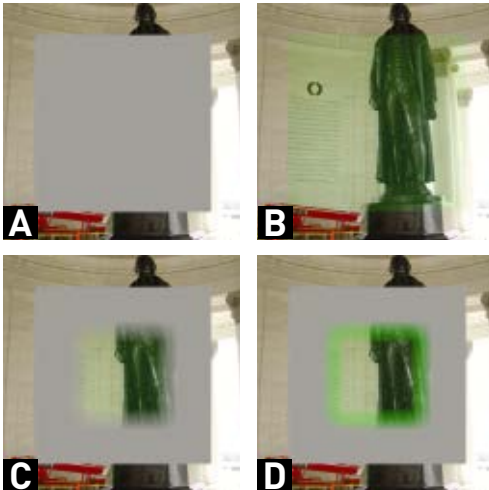
the top two colors, an identically-weighted lerp of the bottom two colors and then a lerp of the result; or a lerp of the two sides and a lerp of that result. The order doesn't matter; the result is the same. In some sense, lerp distributes over lerp, because the underlying multiplies in each formulation distribute to the same result. This distributive property can matter because it means the lerp can be computed in either order. Given only three colors to lerp between, say, $lerp[lerp[A, B, \alpha], lerp[A, C, \alpha], \beta]$, one can redistribute and use the more efficient $lerp[A, lerp[B, C, \beta], \alpha]$.

Although lerp is nicely behaved, alpha-blending is not, despite being basically linear. It is associative—you can compute $(A \text{ over } B) \text{ over } C$ or $A \text{ over } (B \text{ over } C)$ and get the same result. But mixing lerp and alpha-blending leads to problems. Consider Figure 3A (page 40). (Note that unlike lerp, *over* does not take an external parameter, so to create a 2D graph, I've put the linear interpolation on the horizontal axis, and the vertical axis shows the result of changing the α of the green color on the right.) The figure shows the result of lerp'ing and then blending: computing $lerp(A, B, \beta)$ over C . If alpha-blend distributed over lerp, the result would be the same as for $lerp(A \text{ over } C, B \text{ over } C, \beta)$. But instead we get the result shown in Figure 3B. Note how the green in Figure 3A bleeds much farther to the left; in 3B it's more localized to the right. The reason for the difference is because the first formula isn't linear.

To understand this, we need to unpack the alpha-blend operation. I'll restrict my attention to computing a single color channel; all three color channels are computed identically.

Given a background color $\langle r, \alpha \rangle$ and a non-premultiplied foreground color $\langle r, \alpha \rangle$, the basic alpha-blend computation $\langle r, \alpha \rangle$ over z is just $out = \alpha r + (1 - \alpha)z$.

Listing 1 shows the result from lerp'ing two different colors, $\langle r, \alpha \rangle$ and $\langle s, \beta \rangle$ by



FIGURES 1A–D Linear interpolation before alpha-blend introduces artifacts.

- 1A An opaque gray square.
- 1B A transparent green square with alpha 0.1.
- 1C A transparent green window in the middle of the gray square, using premultiplied alpha.
- 1D The same texture using non-premultiplied alpha.

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FIGURE 2 Bilinear interpolation of red, green, black, and white.

some lerp value λ and then blending, rather than blending then lerp. Listing 2 shows the terms regrouped (with the distributive law) and broken down in the form $Ar+Bs+Cz$.

C and C' are identical, but the rest are not. Note that if α and β are fixed, the results for blend-then-lerp are linear in λ , but the

results for lerp-then-blend are not linear in λ . Why not? Because r picked up a factor of λ during interpolation, but so did α ; so they're multiplied and we get λ^2 . Moreover, for blend-then-lerp, A , which is the contribution of r to the final result, depends only on α , the alpha value for r , and λ , the lerp interpolant. For lerp-then-blend, an additional term contains r multiplied by β (the alpha value of an entirely unrelated color) and $(1-\lambda)\lambda$. This term goes to 0 when λ is at 0 or 1 (so there's no visual error at either end of the lerp); it reaches its max when λ is 0.5, when an excess factor of $0.25\beta r$ is contributed. Consider the glowing green ring in Figure 1D. The inner green color has an α of 0.1, while the gray outer color has a β of 1.0. Bilinear texture interpolation happens before the blend with the framebuffer, so lerp-then-blend occurs, resulting in a bright green color. A ends up as 0.275, much larger than the 0.1 we'd like to be the largest possible weight applied to the green color. Of course, the texture in Figure 1D is extremely low resolution to exaggerate the problem.

With premultiplied alpha, the color values are stored multiplied by alpha; $\langle r, \alpha \rangle$ becomes $\langle r', \alpha \rangle$ where $r' = \alpha r$, and the alpha-blend computation over becomes $out = r' + (1-\alpha)z$.

This is a trivial refactoring of the alpha-blend computation, hoisting one of the multiplies up as a precomputation. The expanded math for blend-then-lerp would trivially match the non-premultiplied case. However, the results for lerp-then-blend come out differently than for non-premultiplied.

$$\begin{aligned} \text{lerped} &= \langle \lambda r' + (1-\lambda)s', \lambda \alpha + (1-\lambda)\beta \rangle \\ \text{out} &= [\lambda r' + (1-\lambda)s'] + [1 - (\lambda \alpha + (1-\lambda)\beta)]z \\ A'' &= \lambda \\ B'' &= (1-\lambda) \\ C'' &= 1 - \lambda \alpha - (1-\lambda)\beta \end{aligned}$$

To compare these to non-premultiplied alpha, we have to compare the actual color terms Ar with $A''r'$ and Bs with $B''s'$ (the C terms are identical).

$$\begin{aligned} \text{Blend-then-lerp} \\ A r &= \lambda \alpha r \\ B s &= (1-\lambda) \beta s \end{aligned}$$

$$\begin{aligned} \text{Lerp-then-blend (premultiplied)} \\ A'' r' &= \lambda r' = \lambda \alpha r \\ B'' s' &= (1-\lambda) s' = (1-\lambda) \beta s \end{aligned}$$

Thus the magic of premultiplied alpha is revealed: You can lerp then blend and get the same result as if you blended then lerp.

WE WANT BLENDING BEFORE LERPING

This matters because we usually want the result we'd get from blending before lerp (which is the same whether using premultiplied alpha or not, so we don't normally care which), but we're usually required by hardware to lerp before blending. Using premultiplied alpha gets us the same results both ways.

Take an alpha-blended sprite with an opaque interior and a transparent exterior. The edges of the sprite contain fractional alpha values which anti-alias the sprite when it's composited. One can model these alpha values as coverage values; the alpha indicates the percentage of the texel covered by the opaque part of the sprite. Drawing the sprite 1-to-1 texels-to-pixels requires alpha-blending the sprite, but that alpha-blend operation can be understood as representing splitting the covered pixel into two fragments, one of size α and one of size $(1-\alpha)$, replacing the former's color with the texel color, and averaging the results weighted by size.

Rescaling the sprite requires antialiasing the sampling of the sprite itself. Suppose a given screen pixel is partially covered by two source texels with non-premultiplied colors r and s (and alpha values α and β), each covering 50 percent [or in general, r covering it with weight λ and s covering with weight $(1-\lambda)$]. We can imagine splitting the screen pixel into two fragments, one of size λ and one $(1-\lambda)$. Then those fragments are split respectively by α and β as described in the last paragraph.

If α and β are the coverage values for r and s , then we'll end up with 0.5α (or $\lambda\alpha$)

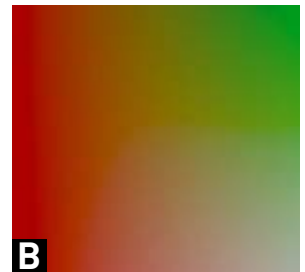
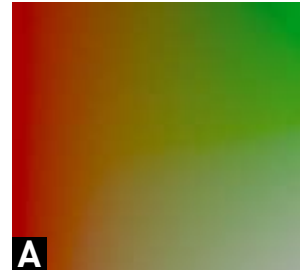


FIGURE 3A Lerp-then-blend. The horizontal axis lerp between the red color (opaque) and the green color. The vertical axis varies the green's alpha value from 0 at the bottom to 1 at the top. The result is alpha-blended over gray.
FIGURE 3B Blend-then-lerp of the same data. The results are identical at the top, but toward the bottom the green disappears as desired.

of the pixel covered by r and $0.5\beta [(1-\lambda)\beta]$ of the pixel covered by s , and the remainder covered by z . The total averaged color will be $\lambda \alpha r + (1-\lambda) \beta s + [\dots]z$, which is exactly the formula for blend-before-lerp. The "pixel coverage model" requires blend before lerp—or a mathematical equivalent.

There might be other models for alpha-blending where this isn't what you want—where the results from non-premultiplied blend after lerp give the right answer. But I've never encountered one, and I take the non-linear dependence on λ as evidence that it's highly unlikely.

WHY YOU SHOULDN'T NOT USE PREMULTIPLIED ALPHA

In the early days of PC hardware-accelerated games, many games suffered from "black creep" on their 1-bit alpha sprites (e.g. from 8-bit art that had had a

single, transparent color). This occurred because the developers used non-premultiplied alpha and set their totally transparent texels to black. The texture filtering bilerp would cause the black color to seem to creep into the edges of the sprite because the black with $\alpha=0$ still contributed a $(1-\lambda)\lambda\beta$ contribution due to the neighboring opaque texels with $\beta=1$. All that's needed to fix those is to change the blending mode; in the special case of 1-bit alpha, setting transparent texels to black is using premultiplied alpha. (DXT1 compressed textures generate black for the transparent texels as well, so the same rule applies.)

One project I worked on avoided this by processing $\alpha=0$ texels at the edges of the sprites, setting their RGB color to the average of all the adjacent opaque pixels. This works to prevent black creep, but it's a hack, and it can only be applied in the special case of $\alpha=0$. For example, if $\alpha=0.1$, as in Figure 1D, you can't change the color of a texel without changing the color of something meant to be seen. This technique also doesn't fix mipmaps; even with 1-bit alpha, all mipmap levels after the first can have non-1-bit alpha values. (Alternatively, you need to fill in the color of all transparent texels before generating mipmaps.) In fact, any mipmap generator that uses a linear filter will be a form of the antialiasing filtering I described earlier, and is actually computing the right results for premultiplied alpha and the wrong results for non-premultiplied alpha.

The main argument advanced against premultiplied alpha is that it squanders texel precision; as alpha goes to 0, the RGB values are forced to 0 and cannot represent the original color that well. If alpha is 1/16, then 8-bit RGB values are quantized to only 4 bits, and it just gets worse with smaller alpha. In practice, this is a problem only if you don't actually alpha blend the final color. A premultiplied RGBA image has effectively been pre-composited with black. Except for rounding errors in the bottom bit, the final result will be identical to non-premultiplied alpha. Rounding errors in the bottom bit are fairly insignificant compared to the enormous error non-premultiplied interpolation can produce; the rounding error gets proportionally larger where the alpha-blended image is

least visible. One could even get around this by using a non-premultiplied representation but premultiplied computation: hardware could premultiply alpha values before texture filtering. But I think that's overkill to fix a rounding error.

In fact, the premultiplied representation has other advantages. An RGBA value with color values larger than the alpha value can be understood as combining a transparent value with an emissive value; e.g. in the special case of $\alpha=0$, rendering with premultiplied over just adds the RGB values into the framebuffer. One application of this is in particle systems. You can pack both opaque/alpha sprites and purely emissive sprites into a single texture, allowing them to be rendered in a single operation.

This may seem to be a wacky special case, but premultiplied alpha generally just turns out to be better. For lossy image compression of RGB, it turns out you're actually better off compressing a premultiplied RGBA image, even though normally it's better to decorrelate channels. Non-premultiplied alpha will cause the codec to spend extra effort on nearly-transparent regions disproportionate to their contribution to the final image.

The potential pitfall for premultiplied alpha lies in hardware. Hardware is mostly agnostic about whether alpha is premultiplied (ignoring the lack of premultiplication before texture filtering), but there are a few issues.

One is that hardware implements a fogging model specified by OpenGL long ago. That model assumes non-premultiplied alpha. Premultiplied alpha requires that the fog color be scaled by the fragment

alpha before blending it with the fragment color; hardware fog instead assumes it will be later scaled by fragment alpha during framebuffer blend. Fortunately, pixel shaders can simply compute fog in any matter; however, if hardware continues to accelerate the traditional fog computation specially, it will continue this bias against premultiplied alpha.

The other issue is that texture compression is probably not as effective for premultiplied alpha because of the correlation introduced between RGB and alpha. Although there are special "premultiplied alpha" compression modes (DXT2 and DXT4), they merely tag the data, rather than decorrelating the alpha from RGB before compressing. The compression methods are based on assuming the colors in a 4x4 block lie approximately along a line segment in RGB space. Assuming this is true without premultiplication, it will not be true with premultiplication unless the original line happened to go through (0,0,0).

The bottom line is that you should probably just use premultiplied alpha all the time. Even if you're not blending to the framebuffer, any blending-like operations in a pixel shader built from a filtered texture (as in my brick texture example in the October issue) can introduce artifacts. If you avoid premultiplied alpha, at least stop and run a sanity check on your math for non-linearity, and remember the rule of thumb: blend doesn't distribute over lerp. ❖

LISTING 1

Blend then lerp:

$$\begin{aligned} b_1 &= \alpha r + (1-\alpha)z \\ b_2 &= \beta s + (1-\beta)z \\ \text{out} &= \lambda b_1 + (1-\lambda)b_2 \\ &= \lambda[\alpha r + (1-\alpha)z] + (1-\lambda)[\beta s + (1-\beta)z] \end{aligned}$$

Lerp then blend:

$$\begin{aligned} \text{lerped} &= \langle \lambda r + (1-\lambda)s, \lambda \alpha + (1-\lambda)\beta \rangle \\ \text{out} &= [\lambda \alpha + (1-\lambda)\beta][\lambda r + (1-\lambda)s] \\ &\quad + [1 - (\lambda \alpha + (1-\lambda)\beta)]z \end{aligned}$$

LISTING 2

For blend then lerp:

$$\begin{aligned} A &= \lambda \alpha \\ B &= (1-\lambda)\beta \\ C &= \lambda(1-\alpha) + (1-\lambda)(1-\beta) \\ &= 1 - \lambda \alpha - (1-\lambda)\beta \end{aligned}$$

For lerp then blend:

$$\begin{aligned} A' &= [\lambda \alpha + (1-\lambda)\beta]\lambda \\ &= \lambda^2 \alpha + (1-\lambda)\lambda \beta \\ B' &= [\lambda \alpha + (1-\lambda)\beta](1-\lambda) \\ &= (1-\lambda)\lambda \alpha + (1-\lambda)^2 \beta \\ C' &= 1 - [\lambda \alpha + (1-\lambda)\beta] \\ &= 1 - \lambda \alpha - (1-\lambda)\beta \end{aligned}$$



GET SOME BACKBONE

IF YOU'VE EVER TAKEN A FIGURE

drawing class, or read Stan Lee's *How to Draw Comics the Marvel Way*, you know that the most important aspect of a pose is the line of action, the sketch line that links the hips, torso, and head into a continuous whole. Unfortunately, few animation rigs are as flexible or expressive as a charcoal line. Many games animations are so stiff they set "Mr. Roboto" playing in our heads. Let's look at a couple of different strategies for rigging the hips, spine, and torso of humanoid characters that can give them some of the fluidity and grace they need.

FLAME ON!

Like every rigging question, building spine rigs evokes the animator's eternal dilemma: FK or IK. Debating forward and inverse kinematics seems to tickle the same brute instincts as arguing about PCs versus Macs, Windows versus Linux, or republicans versus democrats. However, we may be able to look at the debate objectively. Usually, we discuss the choice between FK and IK as one between different posing mechanisms. Framing the choice this way leads to many endless arguments: If you view FK and IK setups as alternative methods for doing the same task, most of the discussion will center on personal preference. But it's a mistake to think of FK and IK as competing methods of creating poses. In fact they are different ways of describing what happens *between* poses. We understand this instinctively. To set up a solid punch, you want an IK arm, but you would use a simple FK rig on the same arm swinging loosely through a walk cycle. Unfortunately this intuitive knowledge is often forgotten in the dreary

struggle with our setup tools. The central task of any rig is to help define and control what happens between the keys—not, as so many tutorials seem to suggest, just to make it easy to sketch a pose quickly.

Remembering this is critical for dealing with spine rigs, because the role we ask the spine to play varies widely from one animation to another. In some cases (imagine an athlete making a standing broadjump) the hips and shoulders power the entire animation. In other situations, for example a typical movement cycle, the trunk works like a shock absorber, dissipating energy instead of creating it. The rigger's job is to build a control setup that elegantly describes the kind of motion appropriate to a particular character in a particular situation. There's no such thing as the perfect rig—only the rig that's right for the job. As we step through a couple of alternative spine setups, keep in mind that you shouldn't judge the rigs as better or worse than one another, but you should decide which one better suits the task before you.

DON'T DIS OLD SCHOOL

The FK spine setup is the simplest—it's usually the one we learned in our first character animation tutorials. FK spines are typically rooted at the base of the spine, and the torso is animated by hand-keying each vertebral bone. The drawbacks of this kind of setup are pretty well known. For one thing, it's difficult to coordinate many keys on so many objects, particularly when trying to evenly distribute twisting movements. Moving the hips and torso at the same time requires a lot of counter-animation, so that even something as simple as shifting weight from one hip to the other requires a lot of fiddling.

Nevertheless, even the simple FK system does one thing very well: simulate dynamic whip action, or what cel animators call progressive breaks, because FK is all about nested rotations. Many kinds of actions, such as a sprinter

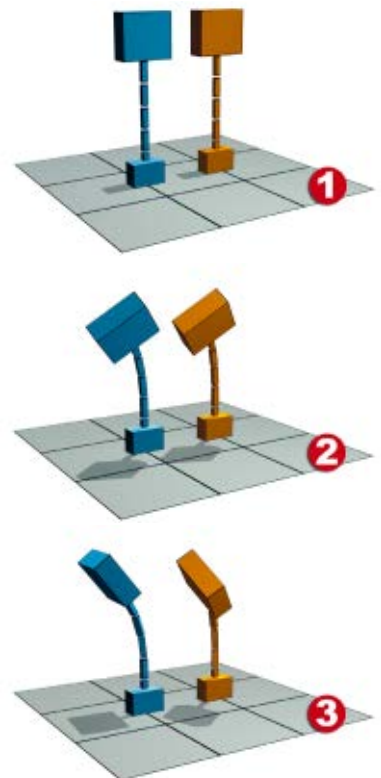
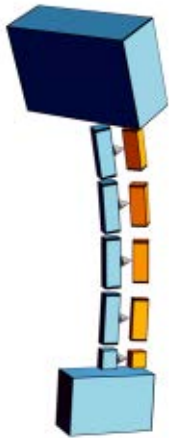


FIGURE 1 The blue spinal setup is rigged with a standard FK control scheme. Adding twist rotation to the torso causes the entire upper body to move, as you can see from the shadow. The 2+1 FK rig in orange can be posed and twisted without extra counter-animation.

popping out of the blocks or a pitcher unleashing a fastball, are best visualized in whip-fashion. (See Figure 1.) Trying to achieve the same effect with an IK-based setup will require as much counter-animation as trying to get a fluid weight shift with FK. Moreover, progressive breaks have gradually supplanted



▲ **FIGURE 2** A 2+1 FK rig is built by locking the twist rotation on the main spinal column (blue) and moving the twist rotation onto separate twist joints, which are parallel to the original spine hierarchy (in this illustration they have been moved for clarity).

traditional squash-and-stretch techniques in many modern cel animators' works (particularly Richard Williams of *Who Framed Roger Rabbit?* fame). Because so few game engines support squash-and-stretch natively, FK remains a key tool if you're working on a more flamboyant, cartoonish piece.

One of the easiest ways to make FK spines useful is to root the skeleton farther up the spine between the character's navel and breastbone. Moving the root means that hip and torso movement are no longer interdependent, so you can quickly and easily shift the weight in the hips without having to manually reposition the shoulders. This setup is particularly well suited for tasks in which the character remains basically upright, such as in movement cycles or theatrical animations, both of which involve constant adjustments in the hips—which is frustrating in a typical hip-rooted setup. However, the higher root arrangement is not well suited to movements that pull the body out of the vertical plane, since trying to maintain positional stability in the hips is much harder when the body's root is higher. In particular, sitting becomes problematic

because the hips can't be placed directly but have to be cranked into position by rotations from above. As always, no rig is perfect for every task.

I mentioned at the outset that handling twist movements in FK setups can be quite difficult. There are two reasons for this. First, a traditional FK setup requires you to manually spread the twist rotations between the hips and the shoulders. If I want to turn the shoulders of my six-link spine by 45 degrees, how far should each link in the spine twist? And if I decide to tweak that pose a little, do I have to manually readjust every link in the spine? Don't even try to do this by hand. It's not even easy grunt work; it's pretty complex grunt work. Each joint in the spine derives its orientation from the rotation of its parents, so adding a little bit of twist to each

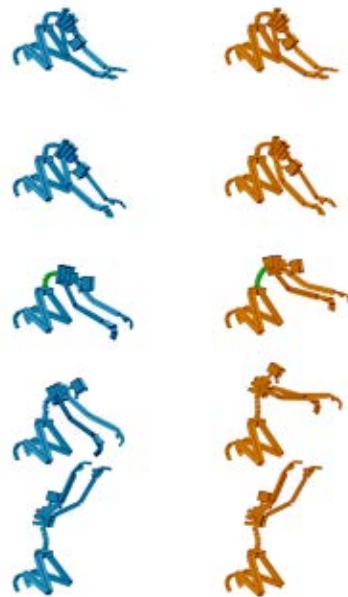
bone in the skeleton won't produce the results you expect. As you can see in Figure 1, it's not enough to simply divide the total rotation by the number of links and then add it to the twist axis of the spine bones. Changing the twist rotations has an annoying tendency to move the torso when you attempt to twist it. Fine-tuning a pose under these conditions can be a nightmare.

Luckily, though, there's a great setup strategy that eliminates this problem. In fact it's a variation on the twist fix-up bones I discussed in a previous column ("Twist and Shout: Fixing Twisted Deformations," April 2004). Lock the twist rotations on all the spine bones except for the hips and the torso. Limiting yourself to only two axes gives you a spine that's fairly easy to pose and positionally stable. You can handle the twist rotation by adding an extra bone to each of the bones in the spine in order to handle the twist rotations separately (see Figure 2). These extra bones stand alongside the regular hierarchy of the spine, and they can twist all they like without causing the torso to move. To drive the twist bones, use a simple expression to divide the rotation on the

torso equally among all the bones in the spine (for details on the setup see "Twist and Shout"). This speeds up posing and eliminates the number of keys you need to manage. Since we only care about getting a smooth transition from the hips to the torso, you're not surrendering any control. This "2+1" FK spine is almost always the best arrangement if you know you want an FK-style animation from a torso rig.

SPLINES FOR SPINES

Having given some overdue respect to FK setups, let's consider the alternative: spline-based IK. Spline IK does one thing



▲ **FIGURE 3** The sequence shows how differently a spline IK setup (blue) and an FK setup (orange) interpolate between the same start and end keys. In the middle of the animation, the FK spine keeps its whip-like curvature but the IK spine tends to crimp.

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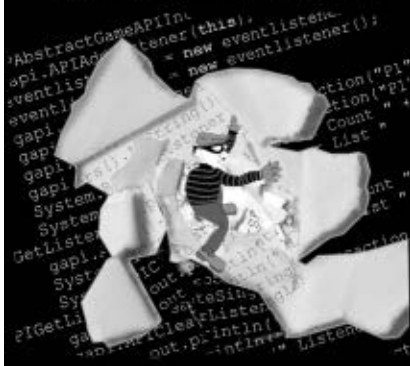
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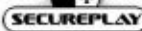
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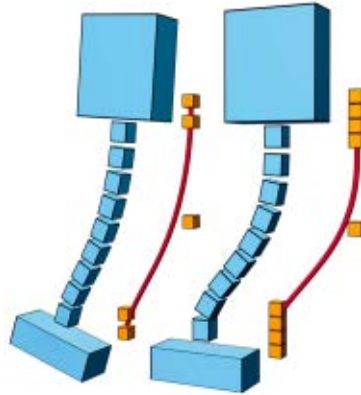


FIGURE 4 In order to keep the ends of a spline IK chain locked in place, you need at least four CVs grouped together at each end.

really well: capture the line of action. Thus, it's an elegant and efficient posing tool. There's no question that it's quicker to push and pull a spline IK character into position than to achieve the same pose with traditional FK rotations. Moreover, it doesn't matter how many bones you throw at a spline IK. If you want to do a full Gollum [from *The Lord of the Rings*] rig with a separate bone for each of the 24 vertebrae in the spinal column, a spline rig isn't effected. Twists, likewise, are handled easily. In effect, the spline solver does the same trick that we just outlined for FK setups, moving the twist into a separate category where it doesn't adversely affect the posing.

So far, so good. Unfortunately, spline IK demos well, but often disappoints in a production setting. The very same qualities that make spline IK such a great posing tool sometimes limit its effectiveness as a method of animating. The limits of spline IK are very similar to those in morph-target animations. In both cases, the interpolations between key shapes have a tendency to collapse because the morphing process will look for the shortest path from one pose to the next. The outcome is often unattractive, as in Figure 3. The only way to avoid this effect is to add more keys, which may introduce small hitches and makes timing adjustments more cumbersome.

Many animators find that spline IK rigs are too squirrely for reliable use. Hips and shoulders often seem to influence each other in unpredictable ways, so that a tweak to the shoulders may cause the hips to twitch. Luckily, we can eliminate this problem

quite easily. Spline IK squishiness derives from the mathematics of NURBS curves. The propeller-heads say that NURBS curves have a degree of 3, which in their quaint universe means that any point on the curve is affected by the nearest four control points. This is why moving a CV in the torso section of a spline may cause the hips to twitch (or vice versa) if there aren't enough control points between the hips and the torso to buffer the changes. To make your hips and shoulders dependably solid, make sure there are at least four knots at each end of the spline IK control curve, and group those knots so they only move as blocks. Figure 4 shows how this eliminates the infuriating tendency of spline rigs to wiggle. Don't assume that more curve CVs are always better, however. Too many knots can easily add to creating and popping in the middle of the spine as well as increasing your keyframe-management hassles.

If you get into the habit of making CV groups at the top and bottom of the spine to limit wiggling, you'll quickly discover that this tactic has another benefit. We've already walked through the way IK interpolation makes for mushy in-betweens. Using CV groups rather than animating CVs individually helps tighten up the in-betweens and cuts down on the number of keys you need to coordinate. The CV groups can be rotated as well as moved, so you can reclaim some of the natural whip-like motion of the spine, although FK is still better if whip motion is your ultimate priority. You can also scale the groups, which allows you to change the relative influence of the hips and shoulders on the body and is a great method for subtle tweaks.

OH NO, NOT TRADEOFFS AGAIN

There are many potential setups we haven't considered here. Nevertheless, the two strategies explained in this column [the 2+1 FK rig and the grouped-CV spline rig] cover most of the roles we require of a body rig. The 2+1 FK rig does a great job of emphasizing whip and spring movements for athletic moves or comic performance. The grouped-CV rig excels at producing fluid full body motion and accounting for subtle weight shifts. It shines in typical movement cycles and standing performance actions. If you can't decide between alternative rigs, think about doing both. Generally, your engine won't care how you rigged your model, so see if you can't maintain multiple rigs for different tasks. The rig, after all, is not a product in itself—it's just a tool to help you create a performance. Nobody cares how high-tech your rig is as long as you have a strong character, emotion, and action. Concentrate on getting past the tools and into the art. That's why you're a highly paid, respected professional. ... Wait, did I say something funny? ❖



ALEXANDER BRANDON

» AURAL FIXATION

TOP FIVE CLASSIC GAME SOUNDTRACKS

AS WE STEP THROUGH THE AGE OF licensed soundtracks and symphony orchestras for game music, we should pause and take stock of where we are and how we got here. We should acknowledge certain titles that pushed the envelope and established high standards in the many years before awards shows acknowledged them. Here are my picks for top five (unofficial) most important classic game soundtracks.

5. SHADOW OF THE BEAST, DAVID WHITTAKER. Released in 1989, *SHADOW OF THE BEAST* almost single-handedly put the Commodore Amiga at the forefront of high-end home computing graphics and sound. While the game was nearly impossible to complete, the effect of the multi-parallax environments and upbeat fantasy soundtrack catapulted players into a new kind of qualitative expectation. The soundtrack deserves recognition because it did not follow compositional trends for side-scrolling action games. The title track was very eerie and melodic followed by pieces that used similar instrumentation at a higher tempo during gameplay. But it did not pick up the tempo so much that it sounded like *CONTRA*, a game that had set the standard for side-scrolling action titles two years earlier. In addition, the instruments were samples of real instruments and not synthesized, which, along with other Amiga titles, amazed gamers with four-channel music that could imitate such 1980s hits as Herbie Hancock's "Rockit" and "Axel F" by Harold Faltermeyer. The compositional style of *SHADOW OF THE BEAST* influenced games using similar music technology (MODs) years later, such as *UNREAL* in 1998.

4. WING COMMANDER, DAVE GOVETT AND GEORGE SANGER. While *WING COMMANDER* for the IBM PC compatible market was

released a year after *SHADOW OF THE BEAST* (1990) and still used synthesized samples (for most of its market—the Roland MT-32 and LAPC-1 rivaled the sounds of *SHADOW OF THE BEAST*, but most users had Sound Blasters and AdLib cards at the time), it made groundbreaking progress with its cinematic *Star Wars*-like experience and adaptive quality. During battle, the music would shift to battle music, and when the player was victorious, a victory theme would play. In addition, Origin Systems, the developer, took the music so seriously that at the start of the game you saw an orchestra preparing to play the company's intro theme.

3. METROID, HIROKAZU TANAKA. Some games don't need technical breakthroughs to provide a new experience. *METROID* was one of them. Released in 1987, it was one of the first side-scrolling games to offer exploration on such a vast scale, combining action with adventure seamlessly, with little text. The soundtrack provided a unique experience using the same hardware as other Nintendo games, but taking itself a bit more seriously by not assuming that the chipset would need to cater to young children. The melodies and themes are very memorable and fitting for the graphical style of each area, and range from using standard tonal harmony (the Brinstar area), to modern dissonance (the Norfair area), to minimalism (the Ridley area). It was quite ahead of its time compositionally. The influence of the original *METROID* is so great that its themes are still being used in *METROID* sequels.

2. THE DIG, MICHAEL LAND. *THE DIG* has one of the few game soundtracks in history that broke new ground separate from the rest of the game. Released in 1995, it was one of the first PC games to use streamed audio, and was the first game to combine streamed audio with an adaptive soundtrack while maintaining a unique style of music.



THE LEGEND OF KAGE.

Most games that used streamed audio at the time (the first was *SPACESHIP WARLOCK* in 1990) relied on music that sounded the same as music released by a major music publisher. *THE DIG* refused to follow this trend and set a completely new style of lilting ambient pieces with bits of Wagner combined with original string section recordings to create an emotionally uplifting soundtrack, which gave the game most of its dramatic presence. No game since has achieved this kind of compositional style while using adaptive seamless transitions.

1. THE LEGEND OF KAGE, HISAYOSHI OGURA. Surprised? Back in 1984 games such as *1942*, and the first incarnation of *MIGHTY BOMB JACK*, along with the first wave of Nintendo Entertainment System (Famicom) titles, were about to overtake the Colecovision and the aging Atari 2600. For computers such as the Apple IIe, PC, and Commodore 64, *KARATEKA*, *ELITE*, and the *ADVENTURE CONSTRUCTION SET* were also gaining momentum. None of these games even slightly approached the soundtrack quality of *THE LEGEND OF KAGE* (pronounced "kah-gay"), which used advanced synthesis to create a soundtrack that might have sounded right at home in the film *Big Trouble in Little China*. It is an extreme rarity that a game soundtrack will rise in quality, both technologically and compositionally, above all others in such a significant way. ❖

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NECESSARY EVIL

GETTING TO YOUR BEST DEAL

YOU'VE WORKED AROUND THE CLOCK, promising your underpaid team a pot of gold at the end of the rainbow. Demo looks great. Publisher loves it. Finally, you agree on the main deal points. Things are moving very slowly. *Visions of Mutiny on the Bounty* haunt you. Finally, you get the publisher's form agreement and 13 of the 17 pages seem irrelevant. The publisher tells you it's "just boilerplate." In your anxiety to sign the deal, you gloss over the seemingly useless 80 percent of the agreement or tell your attorney to do the same. You just want to sign so you can get paid.

Did you strike the best deal possible? Absolutely not.

What exactly is "boilerplate"? Boilerplate is the standard, or non-material provisions in an agreement. Naturally, the publisher is drafting its boilerplate with its own best interests in mind. Quite simply, it's a self-preservation mechanism. Publishers' one-sided agreements are slanted in order for the publisher to best protect its investment. Despite opinions to the contrary, publishers are not out to cheat developers, but standard terms to a publisher are likely not something you ever discussed in your negotiations.

For example, most agreements may have a boilerplate clause that provides for attorney's fees to be paid by the prevailing party. Sounds fair. After all, the clause cuts both ways, right? But keep in mind that this standard provision is written by the party most able to afford payment of these fees. Now, in the event of a dispute, you may have opened up to the threat of paying the publisher's attorney's fees.

Lack of familiarity with the contract process is one of the biggest reasons attention is not given to the boilerplate.

Another is greed. Everyone wants to get the deal signed and get that first big advance payment. The rallying cry here goes like this: "If we don't wrap this up quickly, they're going to move on and go somewhere else!" In reality, this is unlikely to occur. In fact, the opposite is often true. A slow-moving publisher might lose out on your project to a faster-acting publisher swooping in for even higher advances.

This greed/sense of urgency often outweighs the attention that should be paid to the boilerplate. Although some of you may know through experience that a Right of Last Refusal often ties you to your existing publisher for the sequel. Instead, having a Right of First Negotiation could be worth 15–20 percent higher advances for a sequel than a Right of Last Refusal.

Each area of the boilerplate is worth having an entire article devoted to it. For example, agreeing to an arbitration clause seems like a cheaper and faster method to resolve disputes, but have you really evaluated the cost savings or whether arbitration verdicts tend to favor the "little guy" any more than the court system? Would it surprise you to learn that arbitration clauses regarding intellectual property matters may not even be enforceable in certain jurisdictions?

The boilerplate can even cross the line between standard terms and business points. For example, a publisher generally withholds a reserve against negative sales (returns, price protections, etc.). Although it is standard, and a reserve clause should not cause you to lose sleep, there are negotiable business points within that language. How much is being withheld in reserve? How often is the reserve liquidated? These answers are bona fide, negotiable, business points. Publishers should only hold a reserve long enough to accurately protect against negative sales. Beyond that, they're holding your money.

All of these so-called little points, when properly negotiated, could add up to a better deal for you. You could have a deal with:



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- a. smaller reserve percentages and one that is liquidated more often,
- b. a more manageable situation in the event of a dispute (no attorney's fees, arbitration, etc.), and
- c. an open field of publishers for your sequel.

What should you be doing differently? Maybe nothing. It depends on your particular position and leverage relative to the publisher (a topic for another day). You don't need to be skeptical or mistrusting. But you should always be curious and aware of each term in your agreement. Every bit of language in a publisher's agreement is there for a reason. Ask yourself why and what (if anything) should be done about it.

Also, don't assume your relationship will run smoothly and that you won't need to worry about arbitration or attorney's fees or the rest of that pessimistic language. You should negotiate with the worst-case scenario in mind.

As you know, there many resources available to you designed to give you a better understanding of publisher agreements. The IGDA (www.igda.org) has a Business & Legal link. There are multiple community bulletin boards and business summits that I encourage you to utilize. Share experiences (good and bad) with each other. Your next deal is only as good as the amount of knowledge and wisdom you bring to the table now.

Hiring an experienced game attorney to guide you through this process is highly recommended. Similarly, various agents and consultants may add value to your negotiation. Put best, "Know what you know, but more importantly, know what you don't know!" ❖

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» GAME SHUI

PARADIGM SHIFTS



Mario is still Mario, despite his graphical evolution.



HERACLITUS'S SAYING ABOUT CHANGE

was true 2,500 years ago, and ironically, its truth has remained unchanged. Our industry is particularly susceptible to transformation. Many other entertainment or art forms have changed very slowly over the years. Even the technology-based form of film has been remarkably stable. If you put a modern 16mm print on a working version of Edison's first commercial projector, you would be able to view it today (without sound). Consider the likely consequences of trying to run most modern computer games on a system from even five years ago.

But more important than a technological change are the changes in underlying patterns or methods known as paradigm shifts. Sometimes these shifts happen quickly. When movies finally became audible, they changed substantially, requiring different directing techniques, different actors, and new recording and reproduction technology. The shift to color films was less fundamental and occurred more gradually.

What are the game industry's paradigm shifts? There have been quite a few big ones, some rapid and some slow to come. The lone wolf developer creating games on his own in a few months, then selling

and delivering them through the mail has been replaced by a globe-spanning industry with teams numbering in the hundreds, and games taking years to complete. The move from 2D to 3D games was fairly rapid but is still not universal. Perhaps more profound is the shift from single player or one-on-one games to massively multiplayer epics, or the growing importance of social interaction in multiplayer games and mobile-phone games.

One important truism is that the video game field is not a good one for people who dislike change. Despite all the changes that have come so far, more are in store. Moore's Law continues to apply as technology matures, and we may have paradigm shifts prompted by technological changes such as the availability of voice recognition, universal broadband access, global positioning systems built into mobile platforms, or flex-screen wearable displays. The changing world demographics will also likely shape game trends. In 20 years, the biggest world game market may be China or India. Game markets for corporate training, education, or social change may explode in coming years, demanding new approaches.

How can we be ready? Here are some suggestions.

DON'T OVERSPECIALIZE

Over the years I've seen programmers who only knew 6502 assembly code, or artists who invested all their time in learning 8-bit color cycling become gradually marginalized and drop out of the industry. The antidote to that is:

MAKE LEARNING LIFELONG. At least every few years, pick up some new technique or skill. You don't have to necessarily become an expert in it, but you may well find yourself in a new career, or at least with a revitalized one.

DON'T BET EVERYTHING ON ONE CHANGE.

The first massively multiplayer games I enjoyed convinced me that they were going to be big. I was tempted to try to create my own right away. But this was 1976 and it would have been a bad commercial decision. Conversely, when I saw the Mosaic web browser, I thought it was cool but was sure it would take at least a decade before it really caught on with anyone other than a computer geek. Two years later Netscape was the hottest thing in Silicon Valley. VR headgear, datagloves, brainwave-controlled games, WAP games—lots of people have been wrong about those things. Prediction is a dangerous business.

QUESTION ASSUMPTIONS. This is particularly true for designers entering a new area. If you have only designed games aimed at hardcore game audiences, you probably have acquired many unconscious assumptions about what makes a good game. Those may not apply to games for corporate executives, or casual gamers, or women, or players under 12 or over 60.

That last point deserves a few clarifying examples. In a previous column, I mentioned how the growing field of games for non-entertainment purposes caused me to question my assumption that making the game fun was the primary principle to follow. I've also learned (with theoretical explanations from Sheri Graner Ray, practical examples courtesy of Will Wright, and direct observations of my daughter) that while men tend to like goal-oriented games, women often prefer activity-based designs. "Everyone knows that" is not a valid proof!

Finally, it shouldn't be surprising that we work in an industry in which it is necessary to love change to survive. After all, wasn't the early arcade industry fueled by spare change? ❖

NOAH FALSTEIN is a 24-year veteran of the game industry. His web site, www.theinspiracy.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. You can e-mail Noah at nfalstein@gdmag.com.

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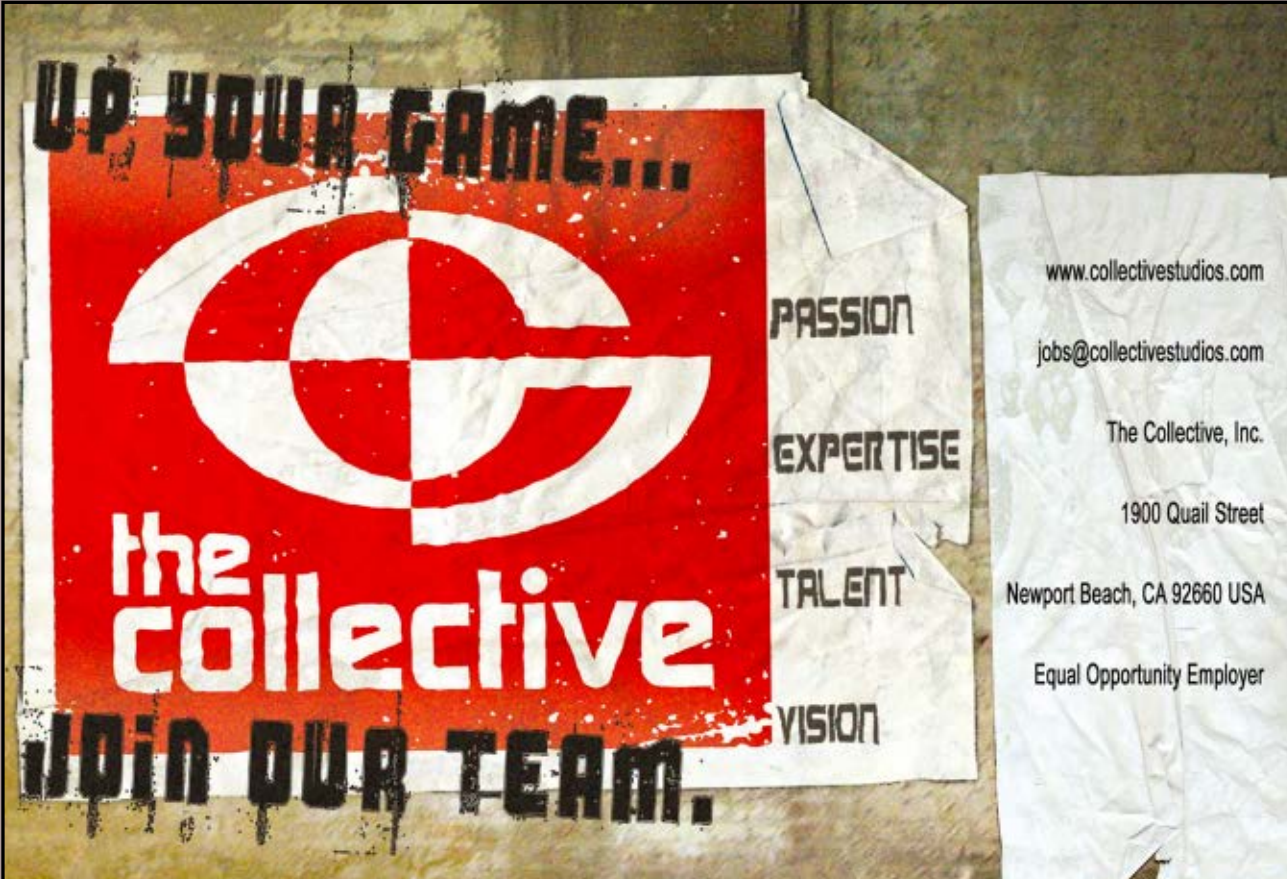
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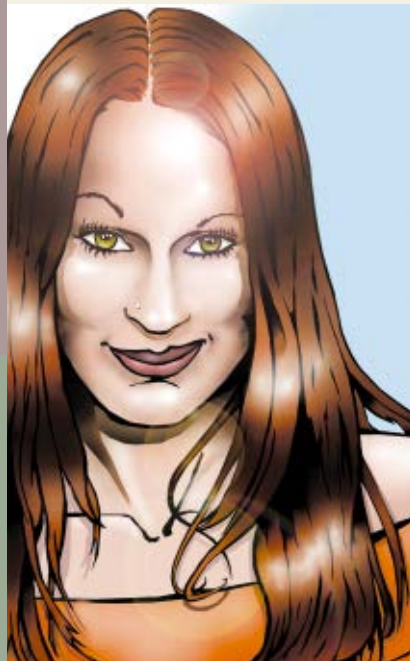
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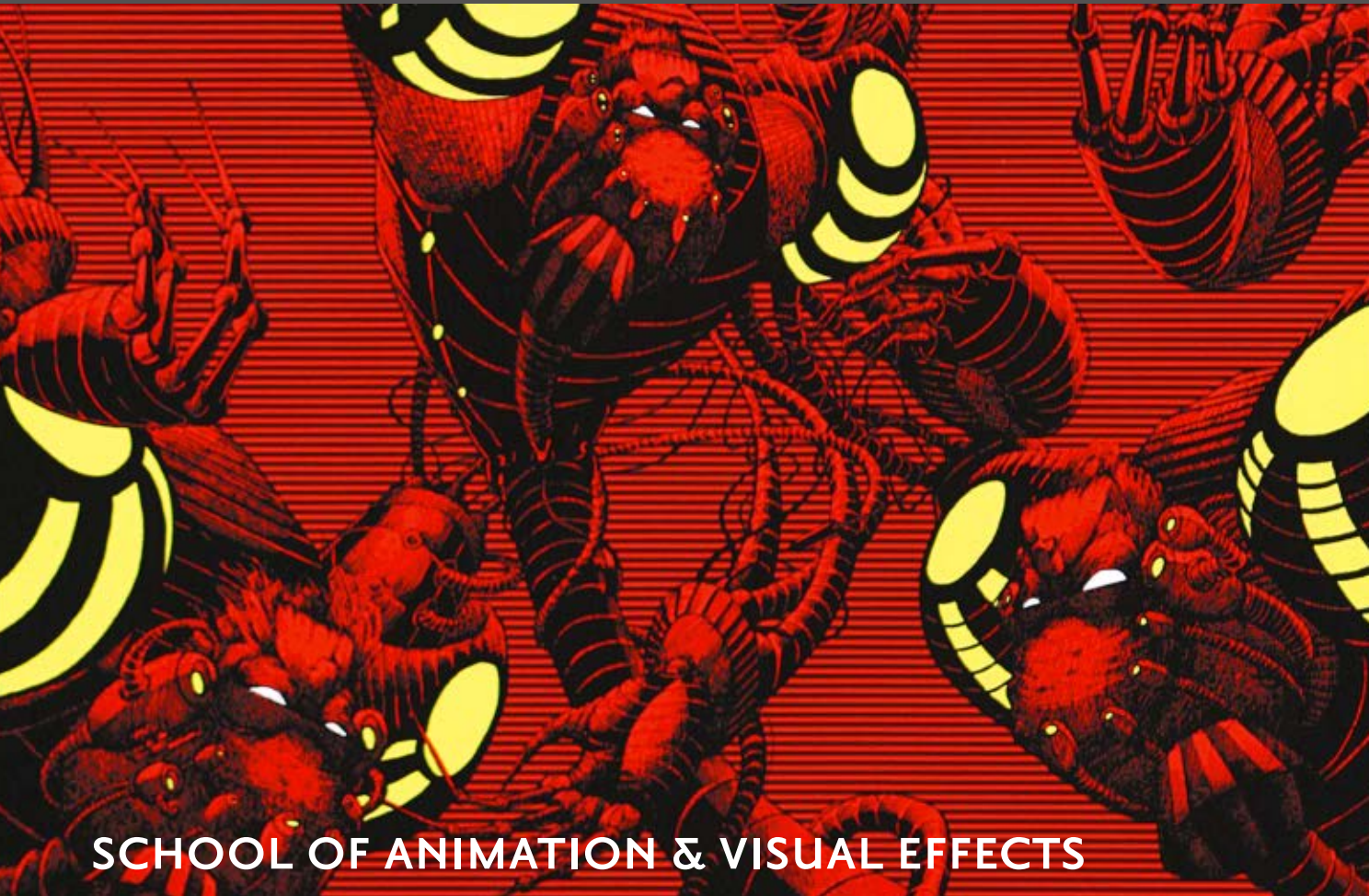
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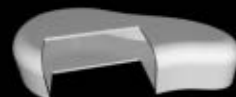
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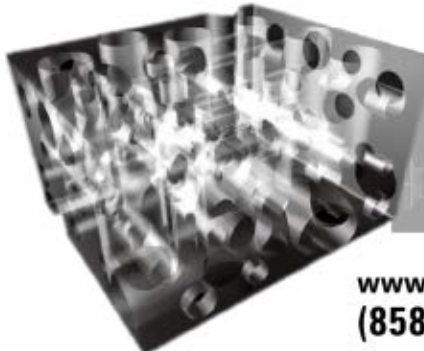


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