# We Need Something Like "Bell Labs" for the Games Industry

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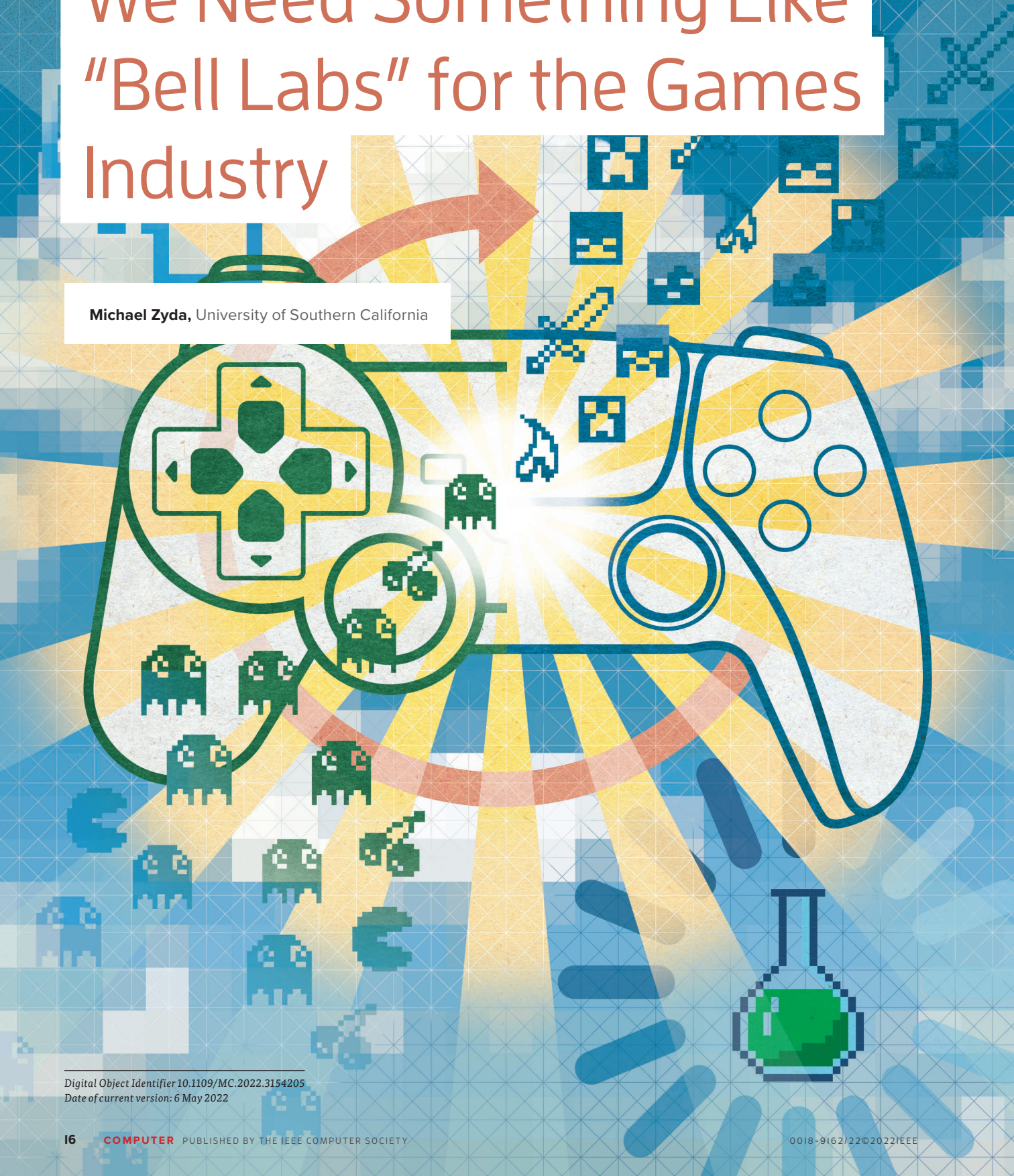

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*A long time ago, Bell Laboratories was the dream research position for many a computer scientist—new technologies were invented daily, with some of them even turning into products. Currently, the games industry has no real research organization developing the next generation technology for building games. In this article, we discuss how we should create such a research entity and some of the topics to research that come immediately to mind.*

In the Games Column #1 for *Computer,*[1] I spoke about the need for a Research Institute for the Games Industry and pointed out how there really wasn't any place at the moment where there was even something close. I pointed out that universities were not really the right place for such an institute, as universities do not do cross-disciplinary well—we wish they did, but universities promote only on your contribution toward your home department's field; so if you focus on cross-disciplinary research in a university on games, you will most likely be looked at as someone who is running at one-third speed with all contribution to the other disciplines disregarded.

As I stated before, we kind of need a middle-ground type of organization or laboratory where research ideas can be built out in a more advanced prototype. We need a laboratory that knows how to build games, that can take these new developed technologies and put them into play in an online game. Most of the responses I received when this article appeared indicated that we needed to create something like the "Bell Labs" for the Games Industry. For the younger audience, this would be something like Google Research (Kernel) for the games technology industry. Kernel takes the basic work of Google Research and turns it into advanced prototypes for potential commercialization.

## THE GAMES RESEARCH INSTITUTE

Now, let's talk about the proposed Games Research Institute (Figure 1). The Games Research Institute has a number of different research directions that I think will be helpful for the future of games. I am not going to be comprehensive but just talk about the ones that come immediately to mind.

### Networking

So let's start with networking. One of the big things that's happening now is everyone's trying to build the Metaverse, but we don't really understand how to properly do the Metaverse network infrastructure and how to standardize that network infrastructure so that everyone uses it with all of the different Metaversi, so they can be connected together. We want to be able to walk from one Metaverse to another, bringing our character, our friends list, and any other data that are important.

We also need to think about how to deploy and take advantage of 5G/6G networking in our mobile games. As 5G/6G get deployed, we may find that 5G/6G is maybe going to be faster than Wi-Fi. With those higher speeds, we can then maybe put some of the computation that we're trying to do on our phone right now off onto a server somewhere. Some of that computation could be a large machine learning (ML) computation on a farm of nVidia machines, or some comparable use of processor cycles that we cannot currently fit into our mobile devices.

With such computational offloads, the biggest issue we will have is latency—latency is always an issue with networking. Now, one of the biggest things in latency in most recent years has been game streaming architectures. Game streaming architectures are a big deal and hoped for method for distributing games quickly, while the player is still sitting at the machine. Right now, if I download an update for something as simple as *Dota-2* on Steam, I can find a message that says, "It will take 45 min." Who wants to wait for that? We need to do something better.

Now, Google built its Stadia game streaming architecture for exactly that, attempting to solve the computation offload issue and latency, but unfortunately, they followed the same technological pathway that destroyed others, most notably Gaikai and OnLive. I remember when I first tried Stadia from my office, I basically found it unusable despite that fact that I had a reasonably high-speed network connection. So, Stadia, while still running, is a dead man walking in terms of technological prowess.

Game streaming architectures are very important, both for game distribution and for keeping our players happy while they wait for new content to download and execute. Basically,

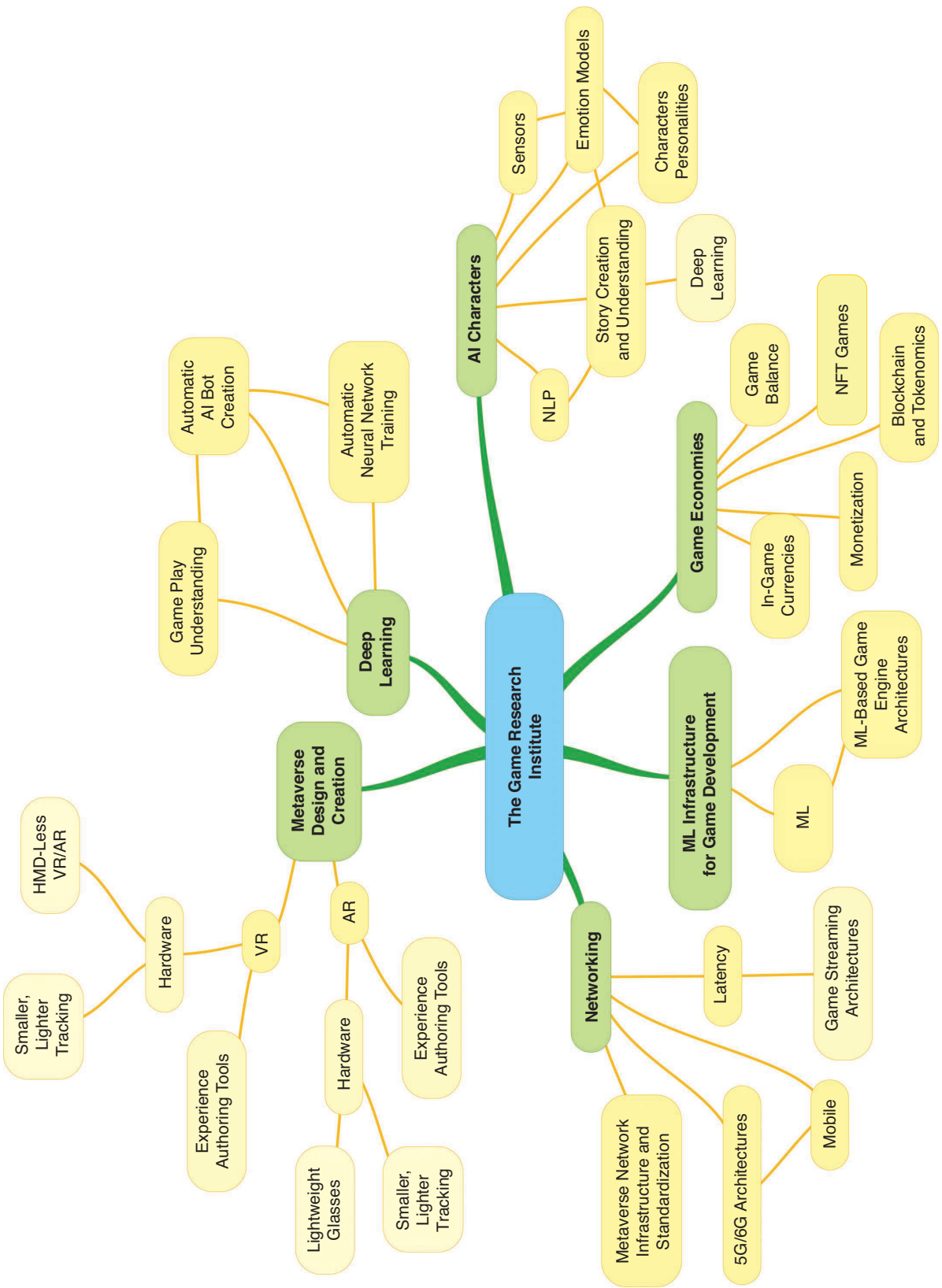


**FIGURE 1.** The Games Research Institute. AI: artificial intelligence; AR: augmented reality; NFT: nonfungible token; NLP: natural language processing; VR: virtual reality.

we need to figure out how to get away from streaming just big bitmaps with the computation of the game being done on a server/GPU combo somewhere on the network to something that can send us instantly executable, small pieces of the game almost immediately, so that we can maybe load a new level of a game in 3–4 s.

## ML infrastructures for game development

ML infrastructures are a big research topic for the future of games. In fact, ML-based games and ML-based game engine architectures are going to be the future. It's going to be the future for game engines, because there's a lot of things that you can do in ML that are critical for games, and that we really need to be able to do well. Game engines with ML slapped on as an afterthought are just not the right way to go. It is an important research topic for us to build a game engine that's fully ML based with that ML built in from the beginning.

## Game economies

Game economies are also an important research topic for the future of games. We start with in-game currencies. In-game currencies are used to purchase in-game objects, such as clothes for our game character, better weapons for our game character, and health potions for our game character. We also earn in-game currencies as we play, and that monetization has to be balanced and perceived as fair in order for us to keep players from leaving the game. We need to understand the dynamics of our in-game economies so that our in-game currency is balanced so that our game is balanced.

Now, one of the things changing how game economies work is the global nature of the game industry—we need to be able to exchange our in-game currencies for currencies throughout the world. We also have the confound of cryptocurrencies supported by blockchain systems and their various tokens. Basically cryptocurrencies are another currency, one not protected by any government regulation, one that may exhibit wild swings in perceived value with respect to traditional, government backed currencies. We also have the problem that many of these cryptocurrencies appear to be dodges of the taxman from whatever currency that flowed into the particular cryptocurrency at hand. We also have their perceived scam-like origin and crypto-theft stories that make us all nervous. We also have the people that missed the Bitcoin run-up that really would like to set themselves up to be instant billionaires with whatever new crypto-coin they create or early adopt. So there is significant, relevant research in architectures, security and socialization that must be performed, so that this all is perceived as a well-designed, organized, and predictable exchange of value.

We also have nonfungible token (NFT) games running around in their infancy making all of us say SCAM games under our breath until what they are all about is significantly organized and clarified. And its not just saying "its all part of the Metaverse" that will make that happen.

## Artificial intelligence characters

Artificial intelligence (AI) characters have always been a big deal in games. Right now, if you want to talk to an AI character, it's usually text based, but we're going to have natural language processing (NLP) any day. Right now, we're getting used to talking to our Alexa and Google Home devices, and to Siri—Siri, so we can have an exemplary of how bad voice recognition can be and still be sold as a component part of an otherwise well-done product.

We would love to be able to use NLP to speak to our game's AI characters, with those characters understanding what we are saying in sufficient rigor so that they can meaningfully answer back. We want that NLP capability to be connected to our AI characters and their understanding of the game story inside of which they reside. This is a big research topic, but one that can start once you have spelled out what you would like to experience.

Once we have a rigorous NLP capability, we then need to instrument our game players with sensors that provide a measured and probabilistic understanding of the human player's physical and emotion state to the AI characters. These AI characters will have a virtual physical and virtual emotion state as well as an authored dynamic personality they perform within the bounds of the story's narrative. This is all big research and software integration and, hopefully, leads us to games with emotional significance similar to or exceeding what we currently see in well-done film.

## Deep learning

Deep learning is a large part of the future of games research. One of the main things that people use deep learning for right now in games is gameplay understanding. Gameplay understanding is so that we can figure out what are the live humans doing in our game? And do they like the pieces and parts of our game? Is there something else that we can provide them or understand that they like so that when we go make changes to this game, we can actually make those changes somewhat automatically with an ML system?

Automatic AI bot creation and automatic neural network training are

related. What we'd like to do is be able to watch master players play a game and understand how they play games such that we can then create an AI bot that can mimic that game play. Those AI bots can then play against live humans using the same/similar decisions as made by the master players.

What we want to do is capture how master players play a game to particular proficiency. And we'd like to make it so that there's automatic neural network training there so that we don't have to author a training set by hand. What we'd really like to have is neural networks that can be trained automatically by watching master players and using a bed of prior game interpretations and understandings such that we can again, rather quickly, create an AI bot that can interact and play inside of our games using deep learning with humans.

### Metaverse design and creation

Right now everyone is just rebranding their game and saying it's a Metaverse portal. What people are expecting is that the Metaverse will be an augmented reality (AR) or virtual reality (VR) experience. There are many research areas for the design and creation of the technology that will support the Metaverse.

Let's start with AR. What we really need are good experience authoring tools that allow us to author such experiences at a high level. Right now, we have crude AR authoring tools that require us to develop our Metaversi at the game engine level. That takes too long and is not as facile as it ought to be.

Better, light AR hardware is something we drastically need to make the Metaverse a success. Right now, we have fairly heavy AR headsets that are not comfortable for long term use. What we really want are lightweight glasses that are about the weight of a pair of sunglasses, maybe a slight bit more to hold the battery, but not a whole lot more. We'd also like smaller and lighter tracking. Right now tracking hardware tends to be pretty big. What we'd like to do is make it small so it can fit inside of the sunglasses for our AR experience.

> **BETTER, LIGHT AR HARDWARE IS SOMETHING WE DRASTICALLY NEED TO MAKE THE METAVERSE A SUCCESS.**

For the VR realm, we also need high level experience authoring tools. Another issue is we need to make the interfaces for VR and AR standardized, so that everybody knows how to get into the Metaverse, move around, interact, and find the settings UI in a standardized place. Right now we don't have that, so if you go into game number one in the Metaverse, and you then jump to game number two, it has a completely different interface. We don't standardize those interfaces. We're not going to get far in the Metaverse if we don't standardize the user interfaces.

Just as for AR, we need smaller, lighter tracking for VR. We need a way to not have to wear a big heavy weight on our face that covers our eyes up. What we'd really like to do is use large screen TVs—gamers love large screen TVs and HMDs not so much. The biggest issue with large-screen TVs is how do we turn those large-screen TVs into stereo and track our head with a lightweight tracker and maybe a pair of lightweight US$15 active shutter glasses once we have figured out how to turn stereo back on in the TVs.

## WRAP UP

So these are some of the interesting research topics for our Games Research Institute. And once you build all of this special hardware and invent all of the required software, we then should have some way of passing all that new technology to smart students for trial inside of the games they are building in class. And then when that technology has been proven, it can be sent to a Center for Incubation and Acceleration and turned into a product/technology that can be put into the commercial game pipeline.

## *COMPUTER* THEME ISSUE ON GAMES RESEARCH

Now, with this Games Research Institute in mind, I thought "wouldn't it be neat if we could do a special issue on games research" in *Computer* to get people thinking along the lines of what did we need technologically for the future of games. I thought it was a great idea. I even created a Call for Participation titled "What new tech does the game development industry need/want to have?" I had 31 respondents indicate interest in writing an article for this special issue—I asked each one to send me a title and abstract on what they were thinking. I had eight respond and indicate to me several times that they were definitely writing an article for the special issue. In the end, I received three submissions, and five people indicated

they could not respond with an article. I had one indicate that he was too busy shoveling snow from the new city he had just moved his startup to. I had two ghost me. I had one write an article that needed substantial revision, and then he ghosted me when I sent the request for revision, so the article was rejected. I had one do a great job drafting his article, but then the general counsel for his company indicated that he could not publish the article because it could be used in potential patent litigations against their company—I am going to write about patents soon! I had one university professor who told me multiple times that he would submit an article and, in the end, decided that other people would steal his ideas if he wrote an article for *Computer*!!! Wow!!! A different world then it used to be.

We ended up with two articles.

The two articles we received, which are both excellent, are the remains of the hope for a special issue.

One article is titled "Toward a New Type of Stream for Interactive Content" and is authored by Barry L. Jenkins, John Scott, Francois Malassenet, and Kshitij Patil, all of Concurrents, Inc. Concurrents has invented a new method of streaming games across the Internet that is implemented as a game engine protocol and plug-in called the Geometry Pump Engine Group (GPEG). GPEG streams the game content as subassets and hence, solves many of the problems seen in prior game streaming system that are based on transmitting fully rendered frames. Concurrents has thirteen issued patents over the last eight years and is somewhat less worried about protecting their IP than others without patent protection.

The second article is titled "The Data-Oriented Design Process for Game Development," and is authored by Jessica D. Bayliss of the Rochester Institute of Technology and Unity Technologies. This article discusses how to rearchitect our current game engines for better performance on modern computer hardware architectures. Bayless proposes we "subtract complicated design methods from problem solving and leverage the simplicity of what computer architecture is designed to do: input, transform and output data." This is probably a great idea in the long run, but most current game engines are built on decades of prior code, so rearchitecting them is beyond expensive. I remember Epic Games telling me in the year 2000, they had spent US$65 million so far in developing the Unreal 2.0 game engine—that number is probably somewhere in the US$1–2 billion or more at this point in time. So, rearchitecting an engine like Unreal would be quite hard to justify to stockholders. We are still happy, though, that Dr. Bayless is working on an issue that may eventually have long-term impact.

In this article, we have mostly focused on what research ought to be done to improve the technological foundation of the games we build in the future. Our proposed solution, of course, is to build a Games Research Institute that develops new technologies and freely licenses those technologies and patents to the member companies that fund and support this research institute. An additional component of this research institute might be patent litigation support on historical technologies archived by this institute for use in the defense of companies from nonpracticing entities (NPEs). We will cover what such support might look like in a later issue of the "Games" column.

## ABOUT THE AUTHOR

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