

wonder why we are not already running toward a game-based education future. I truly want to augment (even replace) large parts of the education system with immersive games.

To temper my enthusiasm for games for education, I sought out Ralph E. Chatham, a program manager at the Defense Advanced Research Projects Agency, to address the idea of games for military training. His mission is to determine whether games can play a role and, if so, what it should be. He dispels several myths about games for training, including that they are: cheap to create, deploy, and maintain; effective for training for the real world; trainerless, providing unsupervised learning; and work on just about any PC anywhere. Nonetheless, he has persevered and has had great luck with games developed in his program, including the Tactical Language and Cultural Training System and DARWARS Ambush! He learned lesson number one in the games world—that the game wants the whole computer—and more than he could ever want to know about game engine licensing. His experience should be studied by all government program managers thinking of becoming game developers.

In parallel with DARPA's effort, Henry Kelly et al. of the Federation of American Scientists joined with Brown University and the University of Southern California to create Immune Attack, a game designed to teach immunology to high school students and college freshmen. I asked him and his team to detail their experience working with game developers far-removed from their own disciplines, urging them to do it while their thoughts on translating medical science to gameplay were fresh. Funded by the National Science Foundation, Immune Attack appears to be one of the first major NSF forays into game development.

Randy Pausch and Don Marinelli of Carnegie Mellon University's Entertainment Technology Center describe their two-year game-development master's degree program. We include it here because other universities may want to learn how to establish their own game development programs that could further be used as a basis for creating a science of games program. The Center is very different from traditional stovepipe university degree programs. Note, for example, that they view themselves as the Eating and Traveling Club. The network of contacts it generates is enormous, delivering a useful message to universities building such programs not directly associated with the game development industry.

Caitlin Kelleher and Randy Pausch of Carnegie Mellon University reflect on how college freshmen in North America selecting computer science as their major dropped by 70% from 2000 to 2004 [5], dis-

cussing how to motivate children's interest in computer science through storytelling and game technologies. We await the results of their effort but believe it is on the right track to meet future growth projections in the game-development domain or even have a game future at all.

Finally, Nikunj Raghuvanshi et al. of the University of North Carolina at Chapel Hill explore the methodology and techniques they've developed for synthesizing physically based sounds in games and other virtual environments. Rather than using prerecorded, static sound files, the idea is to generate sounds from objects interacting based on their physical properties and on how collisions with the objects move the air around them. Despite this computationally demanding result, it takes only 10% of available CPU cycles. As game technology progresses, providing more and more immersive reality, we will continue to consume all available CPU cycles.

CONCLUSION

We hope these articles influence your personal research in the direction of games, helping you understand why computer science must be willing to support games' R&D and societal missions. It's been great fun for me to waylay these fellow games researchers and educators into sharing their ideas and insight. Their work represents initial steps on the continuum of research and education necessary to create the new science. With them, we position ourselves to begin to understand and repurpose this vibrant interactive medium. ■

REFERENCES

1. Carless, S. Informa predicts \$58.4B game industry in 2007. *Gamasutra* (Oct. 24, 2005); www.gamasutra.com/php-bin/news_index.php?story=6942.
2. Olson, R. Blizzard talks 'World of Warcraft.' *Red Herring* (Jan. 15, 2007); www.redherring.com/Article.aspx?a=20754&xhed=Blizzard+Talks+%E2%80%98World+of+Warcraft%E2%80%99.
3. Prentice, K. Reaching young gamers in the midst of their play. *Media Life Magazine* (Jan. 17, 2006); www.medialifemagazine.com/cgi-bin/artman/exec/view.cgi?archive=170&num=2241.
4. U.S. Office of Management and Budget. *Historical Tables (Table 3.1. Outlays by Superfunction and Function: 1940–2009)*. In Budget of the U.S. Government, Fiscal Year 2005, Washington, D.C., 2004, 45–52; www.whitehouse.gov/omb/budget/fy2005/pdf/hist.pdf.
5. Vegso, J. Drop in CS bachelor's degree production. *Computing Research News* 18, 2 (Mar. 2006), 5.
6. Zyda, M. From visual simulation to virtual reality to games. *IEEE Computer* 38, 9 (Sept. 2005); 25–32.

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