3d Game Programming as Service-Learning for CS Students

1 Introduction

Several in high performance computing acknowledge that we are “indebted to the gamers" for pushing the envelope on processor speed, graphics resolution and rendering capabilities of the PC hardware that the HPC community uses to build systems. This talk presents the upper division, university curriculum that has been developed over three years of teaching a topics class that engages our current "raised digital" undergraduates to demonstrate their creativity through programming a game that can be used in alternate situations. This has been deployed in a high school physics course to demonstrate "Projectile Motion under Magnetic Force". We propose that a game can be effectively created to aid fire-fighters in San Diego run test scenarios anticipating the next Santa Ana Fire-storm, which have occurred during the fall season too frequently lately.

2 Game Programming as Service Learning

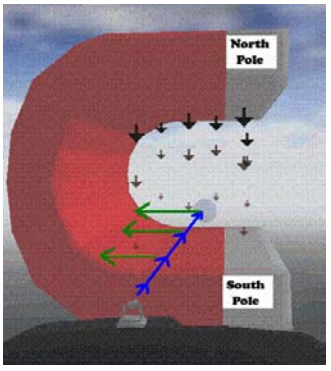
At San Diego State University, an NSF/OCI grant for “Engaging People in Cyberinfrastructure (EPIC)” [1] from the National Science Foundation, supported development of projects to explore how the commercial Game Engines might be used to support Science Education. Our effort resulted in a collaboration with the Visualization Services group at the San Diego Supercomputer Center (SDSC), led by Steve Cutchin, convincing us that the Torque Game Engine (TGE) [2] would be an appropriate cross-platform game development technology. The pricing from the maker, GarageGames of Eugene OR, was also attractive, initially $100 / seat for a license, access to full source code and membership in a vibrant user community that had been growing since 2000. The project is hosted on the SDSC Game Grid [3], where you can download the high school game called “The Physics Game”, as well as SDSC’s Science Exploratorium, the Astronomy Module flying in space, Stonehenge as it looks today, Stonehenge reconstructed, Stonehenge at night and an Exploration to Antarctica,

EPIC funding provided the opportunity to collaborate with two high school science teachers at Hoover High School, geographically near SDSU. We challenged the teachers to identify a concept in their state-specified curriculum that involves 3d which their student have a difficult time with that they felt could benefit from a game-based a learning module to be used in the high school computer lab.

In physics, required topic selected from the California State Standards [4] is 5n.

5n: Electric and Magnetic Phenomena

> Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept: *n Students know* the magnitude of the force on a moving particle (with charge q) in a magnetic field is qvB sin(a), where a is the angle between v and B (v and B are the magnitudes of vectors v and B, respectively), and students use the right-hand rule to find the direction of this force.



Meetings with Mr. Hal Cox of Hoover High, our student game-programmers and the author resulted in a model that used an over-sized C-Magnet to represent the Magnetic Force. The goal is to fire a projectile at a target on the opposite side of the magnet, compensating for the influence of the magnetic force shown above. The undergraduates benefited from the opportunity to develop for a “client” away from campus and learned a valuable lesson to view from the eyes of the client and change their terminology of “First Person Shooter” (FPS, the standard term in the industry) to “First Person Point of View”, showing respect for the 1999 tragedy at Columbine High School. To further remove the scenario from a real-world “shooting”, the “player” is represented by a green alien holding a crossbow. The “projectile” is an arrow launched from this crossbow.

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3 INFLUENCES

Balancing the influences on one's own campus with the vast professional world behind, two individuals whose work has greatly influenced the author need to be mentioned: John Seely Brown and Jean M. Twenge.

3.1 John Seely Brown

3.1.1 The Gamer Disposition (14 February 2008)

John Seely Brown and Douglas Thomas [5] recently described the impact of today's multiplayer games as establishing five key attributes of the gamer disposition:

They are bottom-line oriented
They understand the power of diversity
They thrive on change
They see learning as fun
They marinate on the "edge"

Based on teaching 3d Game Programming for three years now, this also describes the attributes in our current SDSU CS undergraduates and faculty continue to look for ways to capitalize on these traits.

3.1.2 Growing Up Digital (March/April 2000)

John Seely Brown's article "Growing Up Digital: How the Web Changes Work, Education and the Ways People Learn" [6] had a profound impact on this author. January 18, 2005, Dr. Brown was invited to speak at San Diego State University by the Qualcomm Institute for Innovation and Educational Success [7]. Based on Dr. Brown's background as Chief Scientist of Xerox PARC until April 2002, it looked to be useful to hear him speak, though his 2000 article was not known to the author beforehand. The lecture was profound and transcripts are still available from our campus, see reference above. This led to the discovery of other articles Dr. Brown authored that caused the author to discover that although many faculty, this author included, may be of the "analog generation", our current students "grew up digital" and this background must be acknowledged and built-upon in our pedagogy. Having a PhD based on research in Numerical Analysis and having built an IMSAI 8080 computer kit [8] in 1979 to do Masters degree research with BASIC software for problem solving [9,10], only gives the author a Green-card into this digital universe. The author acknowledges that she still speaks with an analog accent.

Key points learned from Dr. Brown are to learn to capitalize on our students' creativity by honoring the vernacular of this "multimedia-literate" generation. We need to ensure we communicate complexity in a simple fashion and, by this example, encourage our students to develop this skill. Their future workplace is likely to have them working in multidisciplinary teams and their individual expertise will need to be communicated, and valued, by other team members whose expertise may well be deep, but specialized to another skill set and vocabulary. Brown also stressed the benefit of "learning in situ", modeling the team approach for development and critique within our classrooms. The SDSU 3d game programming course benefits from being scheduled in our Learning Research Studio [11] which has tables seating 6 students, wirelessly connected PC notebook or tablet computers for each student checked out at each class meeting, two projector screens and an interactive, touch-sensitive whiteboard that can be easily configured to take input from the instructor's console or, using the remote-video/audio feed at each of the student tables, from a student's notebook computer. This models MIT's architecture studio promoted by Dr. Brown where all work is done in public with many opportunities for critique and collaboration.

3.2 Jean M. Twenge – Generation Me (2006)

Professor of Psychology at San Diego State University, Dr. Jean Twenge's book Generation Me: Why Today's Young Americans are More Confident, Assertive, Entitled – and more Miserable Than Ever Before is based on extensive studies of categorical (survey) data examining the differences in generations. The members of Generation Me are the children of the Baby Boomers, defined as the post World War II / pre Vietnan war generation. They have been raised to have high self-esteem, though surveys reveal they feel their lives are controlled by outside forces, yielding apathy and cynicism. In the United States, this generation has grown up with the Equality Revolution legally in place after four decades of marches, such as the 1965 Selma marches, which finally brought the Civil Rights Act of 1964. Members of Generation Me have been taught "equality". They feel entitled, but without a strong sense of duty.

Consider these findings and compare with the thoughts of John Seely Bown, especially from Section 3.1 on "Game Disposition".

4 GAME PROGRAMMING IN CS CURRICULUM

There is a growing recognition in the CS field that Game Programming can be targeted to serve as a large example of object-oriented programming and used as a basis for teaching a course in Software Engineering, a required course at San Diego State Univeristy for all CS majors. There is even textbook support for such curriculum [12] and colleagues have curricula in place.

At San Diego State an undergraduate curriculum was developed and taught three times as a topics course, which CS majors can use as an upper-division elective. The formal curriculum for CS 583 3d Game Programming has been approved by all levels at the university and will appear in the 2009/2010 General Catalog.

To provide some background on this curriculum, we focus on the student Learning Outcomes, below.

1. Students use the large, complex software environment provided by the game engine to develop their Object Oriented Programming skills through scripting.

2. Students develop communication skills through course exercises and assignments to be able to describe a complex software project to a variety of audiences.

3. Students work effectively as a member of a group to create a software product.

4. Students learn the capabilities and responsibilities of using the campus computer network and computer labs.

5 Proposal

Our next plan is to use the Microsoft XNA 2.0 game environment to create a 3d representation of San Diego county. We will overlay this with the road system and collaborate with fire-fighters to develop an on-line environment to help plan for first-responders actions during our next Santa Ana fire-storm event.

Acknowledgment

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