An Interdisciplinary Approach to Teaching Computer Animation to Artists and Computer Scientists

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Abstract

Animation has always required a close collaboration between artists and scientists, poets and engineers. Current trends in computer animation have made successful and effective teamwork a necessity. To address these issues, we have developed an interdisciplinary computer animation course for artists and scientists that focuses on contemporary issues in computer animation. This course emphasizes collaborative teams for practical experience, cross-mixing of student expertise, and group-based education: the students learn from each other, as well as the instructors. Student teams produce a professional animation that extends the capabilities of a commercial animation package to gain experience in and exposure to the state-of-the-art research in computer animation and rendering, the complete animation process, and the artistic and aesthetics of computer animation. We describe our approach to teaching this course, the structure of the course, the results, and lessons learned from our experience with the first offering of this course (Spring 1999).
Keywords: *interdisciplinary, computer animation, education, collaborative education.*

1. Introduction

Computer animation has always required a close collaboration between artists and computer scientists. We have developed an interdisciplinary computer animation course that focuses on contemporary issues in computer animation and requires the skills of animators and programmers working in teams. The goals of this course are the following:

- Increase the technical graphics and animation knowledge of computer science students.
- Increase the animation skills and knowledge of advanced computer animation techniques of art students.
- Introduce art students to the technical aspects of rendering and animation, and expose them to research issues in computer animation.
- Introduce computer science students to traditional and computer animation techniques.
- Introduce art students to the creative potential of writing procedural shaders, models, and animation expressions.
- Provide practical animation production experience, using and extending commercial animation software.
- Provide a collaborative learning environment where students will learn from each other, as well as the course instructors.

A key aspect of this course is that students gain experience in participating in interdisciplinary teams. Teams of 4 - 5 visual arts and computer science students work together to produce animations that utilize each member's skills and interests, in a manner similar to commercial animation environments. The computer animation industry requires employees to work in teams on large projects. Traditional educational environments do not teach skills to make students successful in such environments. Computer animation environments pose a further challenge: teams are composed of members from quite disjoint backgrounds. We have structured this course to help students learn how to communicate, work, and even thrive in this environment.

2. Background and Motivation

Animation's history, from its origins in the 1880s to contemporary time, is a continuous line of technological inventions that have allowed animators the ability to achieve higher quality effects with greater ease: Bray/Hurd patented cels, Fleischer Brothers invented and patented rotoscoping, Disney developed the multi-plane camera, and the list goes on [1]. At the heart of each of these developments has been the successful synthesis of artistic and scientific talents. At times, these skills have come together in the unique individual. Normally, however, they have been the result of creative collaborations, especially in today's highly technical computer animation arena.

Equally as important, large scale animation production has always required large teams of variously talented individuals. The Warner Brothers animators of the 1930s through 1950s arguably produced some of the most successful cartoons of this century and historians note that effective collaboration between its directors, animators, writers, technicians, artists, and musicians was one of the prime reasons for its success [1].

Both of these issues point to the fact that a successful and contemporary animation curriculum should not only be interdisciplinary, but also encourage students to develop effective team skills.

Schools, universities and institutions are usually divided into departments to better serve students needs. Crossing the boundaries between areas and departments has always been difficult. A particular school may not be reluctant to develop interdisciplinary courses, but usually mechanisms and incentives to do so are not in place. Thus, many schools are slow to address the industry trend to teach and encourage effective teamwork and collaboration between animators and computer scientists. Currently many animation, special effects, and computer graphics houses are creating their own in-house workshops and programs for addressing these issues.

3. Our Pedagogical Approach

Our pedagogical approach to this course has two key themes: **interdisciplinary work** and **collaborative education**. This is true even in the instruction and design of the course, which is team taught by a visual arts faculty member and a computer science faculty member. Most of our lectures are designed to have sections that both faculty members present, highlighting the technical computer graphics aspects and the art/animation aspects of the material. In every aspect of the course, we encourage students to collaborate and help each other. Initial assignments, described below, are designed to have segments that are easy and segments that are difficult for students from each background, thus encouraging students to begin interacting with their counterparts.

As mentioned above, we are presenting material in the course that extends the backgrounds of both students, while making them familiar with (and even extending) the state-of-the-art in computer animation. Computer science students lead the discussion of computer animation research papers, helping the art students understand the new material. Conversely, art students present profiles and critiques of computer animators and animation techniques that expand the computer science students' appreciation of computer animation as art.

4. Structure and Implementation

We have structured this course to take advantage of a classroom equipped with SGI workstations for interactive instruction and demonstrations, and the open architecture and procedural flexibility of the Maya software package from Alias/Wavefront[1]. The course is 15 weeks in length and the students start working in teams (4-5 students) during the second week of the class. The students may propose the composition of their team, with the restriction that each team must consist of at least two art students and two computer science students. The students have an icebreaker team project to perform in Weeks 3-5 of the class: create a 10-second animation to be composited with the blue-screen filmed sequence of a student performing for 10 seconds. After this initial icebreaker project, we allow the teams to be revised to accommodate any poor group dynamics that were discovered. We also have some initial assignments that expose artists to working with vectors, angles, and simple illumination, expose computer scientists to key-frame animation, and both to the procedural, extensible aspects of the Maya modeling, animation, and rendering package.

To expose students to the power of procedural shading techniques [2] and the challenge of photorealistic image generation, the students' second major project is to generate a photorealistic image/animation with the following specification: it must contain a specific type of light and a specific object element each chosen randomly from a hat. Some example lighting types used in Spring 1999, included sunset light, light from a lava lamp, light from a neon sign, and light from a candle flame. Some example object elements included a cup of cappuccino with froth, icy or

[1] This software was made available through a generous grant from Alias/Wavefront, Inc.

snowy patches on a sidewalk, and fur. Students were given three weeks to complete this assignment.

The main component of the course is a 12-week team project to produce an interesting, professional animation that includes extending the Maya package in a new way. Some proposed extensions include the following:

- Particle dynamics for cloud formation
- Volume rendered implicit primitives for accurate cloud rendering
- Volumetric light sources to model fire
- Volumetric simulations of fire, taking into account simple physical simulations
- Texturing of implicit surfaces with deformations
- Extending Maya's implicit animation capabilities
- Hydrologic simulations of ocean waves
- Underwater simulation of light rays and dispersion
- Simulations of rich, organic, evolving environments
- Flocking simulations for crowd animation

Regardless of the technical and graphic effects that are achieved, a successful animation is only as good as its story, premise, or content. Students must also consider the subject matter of the project. Suggested formats and structures for the animation include the following:

- Narrative (comedy, drama, adventure. etc.)
- Character driven
- Animating directly to sound or music
- Environmental or architectural (a precursor to a VR or interactive space)
- Poetic or text driven piece (using a quotation, journal entry, voice over, or written text)
- Commentary (political, technological, social, theoretical)
- Adaptation of existing works (homage, contrast, contradiction, satire)

Early in the semester each team is required to "pitch" their animation to the instructors and the entire class in a professional presentation with storyboards, charts, and slides. This project also requires a presentation of progress to the class after five weeks of work and a final presentation of results to the class. These are graded both on the presentation, and the artistic and technical merit of the work.

5. Initial Results

The initial offering of the course was very successful and educational for the students and instructors. The students were very enthused about the class and gained valuable experience in computer animation, as well as working in teams. Most of the teams worked successfully together and, to our surprise, each team decided to name itself. The team dynamics varied widely among the 5 teams and also changed greatly from the beginning of the semester to the end. One of the teams that worked the best during the semester started out with very poor group dynamics between the artists and computer scientists. By the end of the semester, they learned how to communicate effectively, to appreciate each other's skills, and work as a team. Only one team (20%) suffered significantly from group dynamics, including one team member dropping the class. Spending more class time on effective team techniques and team building may help eliminate these problems.

5.1. Blue-screen Project

Our icebreaker team project required each team to learn how to composite live-action video (10 seconds of a student using exercise equipment) with computer generated effects for a 10 second animation. They were required to generate both CG foreground and background elements. An example still of the blue-screen video is shown in Figure 1. Two example stills from this project are shown in Figures 2 and 3.

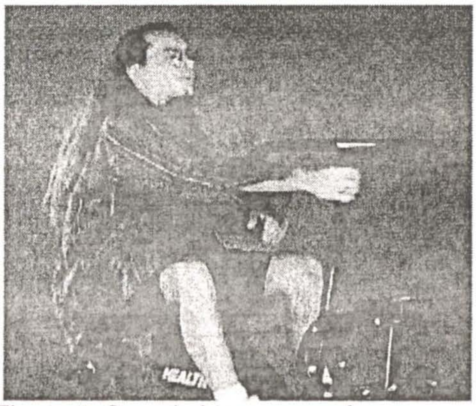

Figure 1: Sample blue-screen frame.

After viewing and critiquing the students' initial animations, we gave them an additional week to improve them. This produced a better product, but also affected the amount of time available for the rest of the semester work. Students spent 5 weeks completing this project. After viewing the final animations, the importance of teaching anti-aliasing techniques became apparent.

Figure 2: A still from the blue-screen animation by the Screaming Nixons (Eun Baek, Jon Feibelman, Costas Kleopa, Vlad Korolev, Steve Matuszek).

Figure 3: A still from the blue-screen animation by CSmART Allstars (Ava Collins, Alex Eller, Jason Lubawski, Marlin Rowley, Christian Valiente).

5.2 Artistic Shader Assignment

As mentioned above, the goal of this assignment was to create a photorealistic image or animation that contained a specific type of lighting and a specific element. After each team chose a type of light and a scene element from a "hat", the following became the scene specification for each team:

Team1	Kiwi and peach in a bowl	Candle light
Team2	Fur	Mirrored disco ball and strobe light
Team3	Hot tub with steam and bubbles	Neon light with neon tube showing
Team4	Ice patches on a sidewalk	Outdoor sunset or sunrise lighting
Team5	Cappuccino with froth and a cinnamon swirl	Lava lamp light

Figures 4 and 5 show two example stills from this project. Figure 4 contains an image showing snowy patches on a sidewalk at sunrise and Figure 5 contains an image of a cup of cappuccino illuminated by a lava lamp.

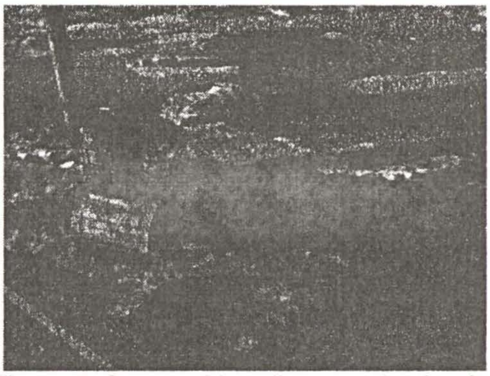

Figure 4: Snowy sidewalk at sunrise by the Screaming Nixons (Eun Baek, Jon Feibelman, Costas Kleopa, Vlad Korolev, Steve Matuszek).

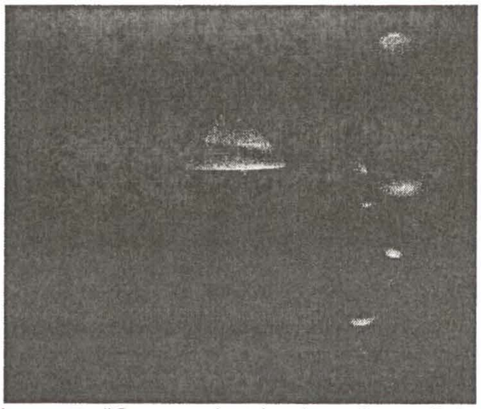

Figure 5: "Cappuccino by lava lamp light," by CsmArt Allstars (Ava Collins, Alex Eller, Jason Lubawski, Marlin Rowley, Christian Valiente).

5.3 Semester Animation Project

The semester animation projects contained a wide variety of technical and artistic styles. Below are summaries of the projects for each team:

- *The Autonomous Chicken Farm* - This team explored the practical application of behavioral animation by developing procedurally animated "Creatures" which are controlled by a customized user interface in Maya. The example "Creatures" chosen were chickens with controllable personality attributes of hunger, beauty, and aggression (based on the 7 deadly sins). The final product of this project was an extension of Maya for creating autonomous "smart" creatures and controlling their movement. This generated input for the inverse-kinematic controls and expressions that the animators used for controlling the motion of the creatures. A short demonstration of the Maya extension was also produced.

- *Gelegant Jammin'* - Animated short in which character movements (blendshapes, joints, and lattices) of a drop of gel were driven by sound file information (wav file). A graphical user interface was created to control which dance movements were driven by particular sound data.
- *Infinity* - This animation was a symbolic projection of life and astral time represented through the juxtaposition of an angel contemplating notions of time, history and evolution, with an icon of modern technology. Plugins for the rendering and modeling of volumetric clouds were developed to set the scene for this animation.
- *Martyr's Playtime Theatre Presents: Joan d'Arc* - The story of Joan of Arc was presented using models resembling the children's toys, the Fisher Price[tm] People. Procedural effects were created for fire, melting, and crowd animation.
- *A Buck Ninety-Nine and Someone Else's Wall* - This project explored the ambiguity of environment by moving between cave formation space and the urban realm of the subway station. The main character was a spelunker who wears a headlight to illuminate the scenes. Initially, he seems to be located alone in a cave somewhere, but as he explores the environment he finds himself to really be in the tunnels of the subway system. In order to create the cave space, a MEL (Maya Embedded Language) script was created for creating turbulent cave walls with varying fractal parameters.

Some example resulting images from these projects can be seen in Figures 6, 7 and 8. Most teams completed a significant portion of their project, but didn't complete it. We worked with the teams to complete their animations after the semester so that they had produced a finished animation from the class that they could be satisfied with and include in a demo reel. Teams had difficulties both in terms of the technical programming aspects, as well as animation and production.

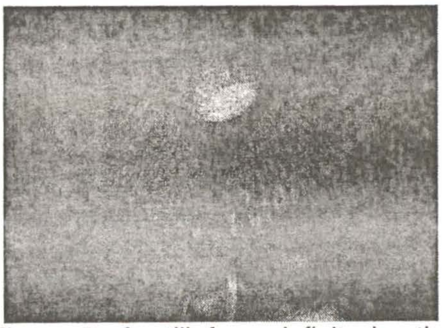

Figure 6: A still from *Infinity* by the CSmART Allstars (Ava Collins, Alex Eller, Jason Lubawski, Marlin Rowley, Christian Valiente) showing an angel in a volumetric procedural clouds.

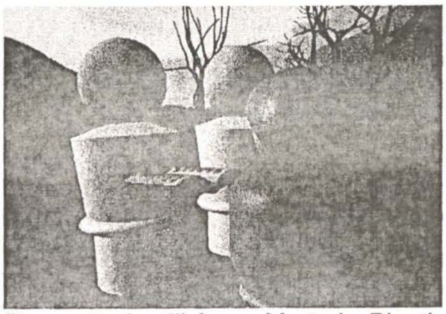

Figure 7: A still from *Martyr's Playtime Theatre Presents: Joan D'Arc* by the Screaming Nixons (Eun Baek, Jon Feibelman, Costas Kleopa, Vlad Korolev, Steve Matuszek).

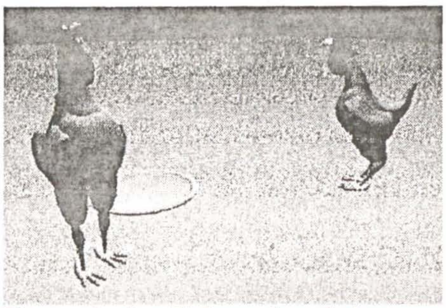

Figure 8: A still from the *Autonomous Chicken Farm* by the A-team (Tracy Corder, Will Gee, Mike Keesey, Joe Romano) showing behavioural procedural animation of articulated skeletons.

6. Conclusions

We have developed a successful interdisciplinary course to teach computer animation to computer scientists and artists based on interdisciplinary collaborative work. This approach for education is very powerful and rewarding; however, it does require a significant amount of effort in teaching not only computer animation, but successful team work techniques and group dynamics.

Our first offering of this course was very successful and we have gained valuable experience to help us improve the course in the future. For the next offering of the course, we will decrease the amount of time students have to complete their first icebreaker assignment so that they can concentrate their efforts on their semester projects. We also will allow for more individual credit in the team projects. Most of a student's grade in Spring 1999 was based on the grade their team received. We made a few exception in extreme cases. We plan on still having most of the work in the class be done with collaborative teams, but will be adjusting the grading scheme to also reflect each individual's contribution. The homepage for the Spring 1999 edition of this class can be found at http://research.umbc.edu/~bailey/courses/CS_ART_Anim/

From our experience, we believe that an interdisciplinary computer animation course provides both types of students with an increased appreciation of, and an improved ability to communicate with, the other community. Students also gain valuable experience in working in collaborative teams and an increased sense of the history and state-of-the-art of computer animation.

We would like to thank the student teams who helped us develop and improve this course:

- The A-Team (Tracy Corder, Will Gee, Mike Keesey, Joe Romano)
- CSmART Allstars (Ava Collins, Alex Eller, Jason Lubawski, Marlin Rowley. Christian Valiente)
- Beasts (Kim Harrington, Mike Madison, Chris Morris, Brian Resurreccion, Shawn Wood)
- Screaming Nixons (Eun Baek, Jon Feibelman, Costas Kleopa, Vlad Korolev, Steve Matuszek)
- Wookie Pimps (Michelle Hunt, Steve Jacobs, Chris Slingluff, Joy Saunders)

References

[1] Maltin, L., *Of Mice and Men,* McGraw-Hill, 1980.

[2] Ebert, D., Musgrave, F., Peachey, D., Perlin, P., Worley, S., *Texturing and Modeling: A Procedural Approach, second edition,* AP Professional, 1998.