Abstract - Computer graphics has become a high-profile specialty that is attractive to both computer science and art majors. Each discipline provides relevant skills that are absent in the other. Historically, curricula in art and computer science do not include courses from the other. To provide students with a broad foundation in computer graphics, Shippensburg University has developed a computer graphics concentration that includes components from both art and computer science. This paper discusses the details of this concentration.

Index Terms – Art, computer graphics, computer science, curriculum.

INTRODUCTION

While the term ‘computer graphics’ once implied a computer science background, this is no longer the case. Many fields now fall under the umbrella of computer graphics: e.g., animation, cinematic special effects, and game development. Tomorrow’s practitioners of computer graphics will be artists and computer scientists working hand-in-hand. Artists will need more technical skills (e.g., mathematics and programming), while computer scientists will need artistic background (e.g., theater, modeling, color theory). These additional skills will not only make the computer graphics practitioner more versatile, but will facilitate communication between practitioners with different backgrounds.

Recognizing this need for cross-pollination, the Departments of Art and Computer Science at Shippensburg University have developed an interdisciplinary undergraduate program in computer graphics. It goes far beyond the sole Introduction to Computer Graphics typically offered by most computer science departments, and the one or two computer-oriented art courses offered by many art programs. This paper will describe the concentration’s motivation and current status.

HISTORY AND MOTIVATION

The computer graphics concentration originated in the computer science department. The computer science curriculum consists of a set of core courses and a set of concentrations, or specialty areas. Every computer science major must complete all of the core courses, and the requirements of at least one of the concentrations in order to graduate. Prior to the inception of the graphics concentration (2001), the department offered the following concentrations: Business Programming, Individualized, Information Systems, Scientific Programming, and Software Engineering.

Of particular interest is the individualized concentration, which allows a student – with the support of a faculty advisor – to design a concentration specific to the needs of that student, provided that it is significantly different from those officially sanctioned by the department.

In the mid to late 1990’s, the popularity of computer graphics was growing rapidly, due in part to increasingly realistic cinematic special effects and gaming graphics. At this time, a number of computer science students expressed interest in a concentration in computer graphics that would go beyond the material covered by the sole computer graphics course offered by the department. In response, an individualized concentration was developed consisting of Calculus III, Elementary Linear Algebra, Introduction to Computer Graphics, Independent Study in Computer Graphics, Computer Design I: Page Composition (see below), Computer Design II: Illustration, and Computer Design III: Painting and Photomanipulation.

The mathematics courses were included to provide the necessary mathematical background for computer graphics; the computer design courses were included expose computer science students to computer graphics from the art perspective; the independent study allowed students to explore topics in computer graphics not covered by the sole introductory computer science graphics course offered by the department.

After several students were approved for this individualized concentration, it soon became apparent that there were a sufficient number of interested students to warrant a full-time computer graphics concentration within the department.

The Art Department also offered courses relating to computer graphics. A BA in art consists of a core of 8 courses, and an additional five art courses selected from among a wide range of electives. Of these electives, six are Computer Design courses, which deal with computer graphics from the art perspective. They are

- Computer Design I: Page Composition. Addresses the basic elements of page layout design.
- Computer Design II: Illustration. Introduces the art of computer illustration, drawing and rendering techniques.
• **Computer Design III**: Painting and Photomangement. Introduces the art of photo manipulation, editing, painting, and compositing.
• **Computer Design IV**: Multimedia. Studies animation and multimedia production.
• **Computer Design V**: Web Design.
• **Computer Design VI**: Book and Portfolio Design.

**THE CONCENTRATION**

It was decided from the start that the concentration should be interdisciplinary, not only incorporating courses from both art and computer science, but also making the concentration available to students from both of these disciplines.

The computer graphics concentration includes the following courses:
• Introduction to Computer Graphics (4 cr),
• Computer Graphics Algorithms (4 cr),
• Advanced Computer Graphics (4 cr),
• Computer Design I (3 cr),
• Computer Design II (3 cr),
• Computer Design III (3 cr),
• Computer Design IV (3 cr),
• Computer Design V (3 cr),
• Computer Design VI (3 cr).

The computer design courses required no modification. In computer science, *Introduction to Computer Graphics* – a typical catchall computer science introductory graphics course – was no longer sufficient. Consequently, it was revised, and two new courses were added to the curriculum.

• *Introduction to Computer Graphics*: A non-mathematical, programming-intensive exploration of graphics techniques and hardware.
• *Computer Graphics Algorithms*: A study of the mathematics and algorithmic aspects that underlie the graphics’ API.

**CURRENT STATUS**

While the requirements of the concentration were initially the same for art and computer science majors, the great disparity in these students’ backgrounds mandated a need for two versions of the concentration. The current requirements for computer science majors are *Introduction to Computer Graphics*, *Computer Graphics Algorithms*, *Advanced Computer Graphics*, *Computer Design I*, and any 2 from *Computer Design II*, III, IV, V, VI. Note that the mathematics requirements discussed earlier have migrated into the core courses of the CS curriculum.

A less rigorous version of the concentration has been developed for art students. It consists of *Computer Science I*, *Computer Science II*, *Introduction to Computer Graphics*, *Advanced Computer Graphics*, *Computer Design I*, *Computer Design II*, and *Computer Design III*.

**EVALUATION**

The concentration is constantly being evaluated by a number of means. The primary criterion for success is the number of participating students (see **Discussion**). Of equal importance is the success of our students on graduation. Tracking student employment and surveying graduates will indicate whether the program is meeting their needs. The content of the courses is monitored in several ways. First, students evaluate each course in terms of textbooks, content, assignments, etc. This allows constant assessment of a given course. In addition, we have asked human resources departments of computer graphics firms what backgrounds they look for in new graduates who are seeking employment in the industry.

**DISCUSSION**

That a program such as this is warranted at the undergraduate level is supported by a number of factors.

• Even before the concentration was created, the art and computer science departments received a significant number of queries as to whether we offered such a program.
• Surveys of art and computer science students taken prior to the concentration’s inception indicated strong interest by both types of students.
• Informal surveys of local industry indicated that they would welcome graduates whose backgrounds spanned both art and computer science.
• Panels at SIGGRAPH discussing the job market in computer graphics have noted the desirability of being versed in both the artistic and technical aspects of the field.

The concentration is now entering its fourth year. Participation among computer science students has been high. The introductory computer science course in graphics has been consistently filled to near capacity. The advanced courses have been offered once each, with increasingly more students. Interest among incoming freshmen continues to grow. Participation in the computer graphics concentration rivals that of the others offered by the department.

Unfortunately, there has been little participation among art students. While the computer design courses remain popular among art students, only one student has completed the requirements of the graphics concentration as of this date. This is especially disappointing, given the initial interest expressed by art students prior to the creation of the program. One of the challenges we must address is how to encourage art students to participate.

Overall, we feel that we have a viable and valuable program for undergraduate art and computer science students that has demonstrated initial success and that promises to continue attracting students.