ALADDIN

(The UAB Alice, Linear Algebra, Dynamic Dimensional Information Network)

Drawing the GENIEous out of the kid empowering the next generation for information technology

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THE GOAL

Purpose Aladdin will greatly increase the computer and linear algebra skills of area students. Participants will learn to create graphics and robotics programming and understand the supporting mathematics. Students successfully completing the two-year program will be highly competitive for admittance into top computer science and math programs in the USA.

Target Audience The experience is led by faculty and students from the UAB computer science, mathematics, and engineering departments in collaboration with area high school teachers, parent facilitators, and community volunteers. The four target audiences are as follows:

1. Each year Aladdin recruits 50 rising sophomores from the Birmingham and Bessemer City Schools. 98% of these students are minorities with about 30% in families living below the poverty line. This population is greatly underrepresented in IT, computer science and mathematics professions. The Aladdin project seeks these outstanding math students and students of great potential to provide further engagement.
2. The families and parents of these students will learn about the promise of these careers and how to facilitate and support the student's progress.
3. Sustainability of the program is provided by area teachers trained as facilitators. 12 teachers are trained each year in one or more of the aspects of the program. These teachers take to their classrooms discovery-based lessons providing a foundation for excellence in science and technology education at their schools.
4. UAB graduate/undergraduate students facilitate the various programs each year. These students become aggressive advocates and participants in K-12 science and technology education throughout their careers expanding the reach of the Aladdin program.

THE PROGRAM

1. Introduction to Game Programming Using Alice These week-long summer camps introduce students to the world of interactive computer visualization. Students use Alice (www.alice.org) to create simple movies and video games of their own design incorporating special effects, dynamic camera moves, interactive control and even recorded sound. Alice teaches the structure of programming without the distraction of syntax. Students are taught to consider the notion of storytelling in designing their programs. In storytelling, the students break down the steps needed to bring about the animation within their program much like an animator constructs the scene of a movie. This approach teaches the students to think of desired behavior in an algorithmic manner developing analytic and logic skills. Following the instructional sessions, each student will be given free time to explore a motivating case study that applies the knowledge learned in the module. For example, during the first day of interaction, students will build a simple movie involving an athlete kicking a ball that moves across the screen, or moving an ice-skater through a series of spins and jumps. A film showcase competition at the end of the week gives students a chance to display their work and helps drive them to create better programs.

Figure 1: Screen shots from Alice films made by high school students visiting UAB. The image in the lower panel illustrates how the student employs to create the animation and manipulate the environment.

2. Linear Algebra: Mathematizing Alice's World Mathematizing Alice's World is a semester long in-curriculum discovery-based experience taught during the sophomore year. In the Alice programming class students created programs in which objects move and interact in 3D space. In this class students will watch a fragment of an Alice program. Breaking up into groups, the students will identify a simple motion in the program and examine the mathematics behind it. The students learned in the Alice class that the motion has duration and occurs in frames (steps). They will represent the steps visually from the beginning to the end of the motion, and evaluate if the motion is one motion, repeated, or a compound motion (e.g., Does the transformation occur in a plane or in three dimensions?). The groups will reconvene to report on the simple planar motion their group has selected. Discussion will center on whether the selected motion is simple and planar, and in what plane it occurs.

Figure 2. Students working on their Alice creations. During the school year, the students learn about the linear transformations that allow them to create 3D action in a 2D space.

3. Computer Graphics and Visualization 1 & 2 These two classes are taught during the summer of the student's rising junior and senior years and are taught at the UAB ETLab. Students will conduct, assess and prepare a presentation for an advanced project in computer visualization. The projects will be collaborations by groups of 2-3 students. The students will learn higher skills in programming, logical concepts and computer graphics. The students will be guided to create geometry in the 3D space for use in their projects. They will then be guided into learning the programming skills of computer visualization. This training will meet the challenges and amplify the opportunities by using an open-source tool called "Paraview" (www.paraview.org) first to introduce students on how to represent the information in a dataset properly, and then guide them with the programming skills to develop simple visualization algorithms with the provided blackbox codes.

Figure 3: A student demonstrating his ability to manipulate in three dimensional space using miniCAD and another summer student finalizing his 3-D model to demonstrate the airflow around the drag racer that he designed. This modeling in 3-D space allows the student to calculate total air drag on the racer and to redesign the racer to minimize such drag.

4. Java Programming and Robotics This is a semester long in-curriculum experience in advanced computing and research design taught during the junior year. The Alice class taught the structure of programming without the distraction of syntax. Now we initiate a working knowledge of computer programming in Java that will offer further appreciation of 3-D object manipulation learned in both previous experiences. The students will learn to use the Java language to control individual robots. The inquiry-based experience will focus on robotics projects that will build on previous knowledge of planar motion. Students will create robotics programs to perform some task in a spatial-temporal context, rather than just on-screen. For instance, they will manipulate position vectors to control the movement of a robot that pushes objects into a proper configuration within a specific time-frame. Students will also learn the principles of embedded software control, this along with experience in creating programs, will form a skill set they will need to exploit in their senior year mentored experience.

Figure 4: Left: Students building their robots; Right: students demonstrating to their parents their ability to control their robot from a program they wrote. Such demonstrations show the parents the excitement of computer science. This helps the parents to understand the promise of technology education and careers and engages the parents in being facilitators of their child's education.

5. Rewards The best rewards are the ones that will be lasting. Aladdin will prepare students for well-paying summer positions and part-time positions during the school year in the computer/IT industry. Students will be competitive for highly sought placement into top computer science and math college programs. For students who decide to delay college entrance, they will be able to secure a reasonably attractive position in the computer/IT industry. Throughout the pipeline of engagement, activities and incentives will be offered to the students and their families to improve the success rate of students progressing to college programs and pursuing a STEM career after graduation.

THE RESULTS

Our first groups of students and teachers have completed the Alice portion of the program. Surveys and exit interviews have shown an increased interest in the IT, computer science and mathematics professions among the students. Aladdin students see their potential and feel confident they can compete with other students in science related fields. Aladdin has fostered a desire to learn more.

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