

# ALADDIN

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

**Drawing the GENIEous out of the kid**  
**Empowering the next generation for information technology**

**Pls: J. Michael Wyss (CORD), Jeff Gray (Computer Science), John Mayer (Math), Alan Shih (Engineering), and David Radford (Education)**

**Graduate Assistants: Dixon Shuttleworth, Ross Ptacek, Daniel Mills, Heather McCalley, Jason Adams, Amitesh Kumar**

**Facilitators: Lynn Battle, Dalorion Johnson, Jason Britt, Joel Tully**

**The Birmingham City School/  
Holy Family Cristo Rey Catholic High School**

## Goals and Objectives

### Purpose:

- Funded by a grant from the National Science Foundation in collaboration with UAB CORD, UAB Computer Science, Mathematics, Education, and Mechanical Engineering.
- To increase the computing and linear algebra problem solving skills of participating students.
- Students are equipped with graphics and robotics programming skills and an understanding of the underlying mathematics.
- Aladdin raises awareness about computing and provides participating students with core skills to assist them in college preparation.

### Staff:

- Faculty and assistants are from UAB computer science, medicine, mathematics, engineering, and education departments, and from UAB CORD. Aladdin forms a collaboration between UAB faculty/students and area high school teachers, parent facilitators, and community volunteers.
- UAB graduate/undergraduate students facilitate the programs and become aggressive advocates and volunteers for K-12 science and technology education throughout their careers.

### Target Audience:

- 50 rising sophomores enter the Aladdin pipeline each year. 98% of these students are from minority backgrounds with nearly 30% living below the poverty line. A population greatly underrepresented in the IT, computer science, and mathematics professions.
- Teachers, parents and families of these students learn the potential of these careers and how to facilitate and support the student's progress. Over 50 teachers have participated to date.
- Area teachers are trained each year in one or more program areas. These teachers take to their classrooms inquiry-based lessons providing a foundation for excellence in science and technology education at their schools facilitate the sustainability of the program after funding.

**Figure 1.** Just some of the many teachers and students that have participated and received the rewards of the UAB Aladdin Program including a special appearance by Dr. Wanda Dann (Director of the Alice project).



## Program Elements

### 1. Introduction to Game Programming Using Alice:

- Summer camps/in-school classes introduce students to computer science and programming.
- Students use Alice ([www.alice.org](http://www.alice.org)) and inquiry-based learning to create simple movies and video with special effects, dynamic camera moves, interactive control, and recorded sound.
- Alice teaches the fundamental structure of programming without the distraction of syntax.
- Students use a storytelling metaphor to design their programs; they break down the steps needed to bring about the animation. This approach teaches the students problem solving and to think of desired behavior in an algorithmic manner developing analytic and logic skills.
- A showcase competition at the end of classes, with family members, teachers and administrators attending, gives students a chance to display their work and motivates them to create and achieve.



**Figure 2:** Screen shots from Alice films by Aladdin students, the Alice environment, and Aladdin students working on their creations.

### 2. Linear Algebra: Mathematizing Alice's World:

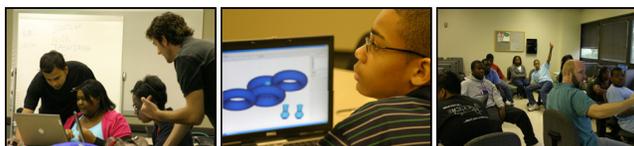
- Semester long discovery-based course taught in the grade 10-12 curriculum.
- Uses the knowledge gained by students in the Alice class to motivate the study of linear algebra, the branch of mathematics that all 3D graphics programs use.
- Students study linear algebra in collaborative groups to master the mathematical fundamentals.
- Students learn elementary linear transformations (translation, scale, projection, and rotation), and learn how to decompose any motion that Alice is capable of as an elementary transformation.
- Emphasis on conceptual understanding and ability to communicate solutions verbally & in writing.
- Traditional linear algebra curriculum including matrix notation, solutions of linear systems, and inverse transformations is also covered in the course.



**Figure 3.** Students and teachers analyzing computer graphics and learning about the linear transformations that allow them to create 3D action in a 2D space.

### 3. Computer Graphics and Visualization I & II

- These two classes are taught during the summer of the student's rising junior and senior years at the UAB ETLab.
- In Workshop-I, students learn about the fundamental principles and applications in computer graphics and scientific visualization. They learn to use existing software tools, such as an open-source tool called "Paraview" ([www.paraview.org](http://www.paraview.org)), to introduce students on how to represent the information in a dataset properly.
- Workshop-II, students apply the skills of programming in visualization, and learn to create different visual effects through programmatic algorithms. They are guided to develop simple visualization algorithms with the provided blackbox codes. They collaborate in the final project in groups of 2-3 students. The students learn higher skills in programming, logical concepts and computer graphics.



**Figure 4.** Students attending the Workshop-I were assisted by faculty, staff and graduate students at ETLab. Various seminars were provided to the students to introduce the fundamental principles and applications to the students.

### 4. Java Programming and Robotics :

- A semester-long in-school course in advanced computing and project design during the junior year that extends the problem solving and programming skills beyond the basics taught in Alice.
- Inquiry-based learning using Dr. Java and Georgia Tech's media computation offers a working knowledge of programming in Java extending the graphics and linear algebra courses.
- Using Java to program real robots, students design and create programs to complete challenges in real-world spatial-temporal contexts rather than just on-screen.
- Students learn problem solving, principles of embedded software, and gain experience in creating programs, which form a skill-set they can exploit in their senior year mentored experience.



**Figure 5:** Students testing their programs and competing in robot challenges. Left: Homing Pigeon, robots travel out-and-back over 10 feet to their exact starting point requiring precise control of the robot. Center: Kick-The-Can challenge, robots must eliminate all the bottles in a timed event. Right: Seek-And-Pop, the robots must seek out balloons and pop them in a timed event. These events demonstrate the student's ability to solve a challenge and control their robot with a program they wrote. Competing against the other students shows the excitement of computer science and the promise of technology education and careers.

## Results

Students and teachers have completed all portions of the Aladdin program. Surveys and exit interviews have shown an increased interest in the 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. The skill-sets learned apply to all forms of disciplines even outside the fields of the sciences. The students have gained knowledge and experiences that they can use for the rest of their lives.



### Lessons Learned from first 2 years.

- After school informal science education is difficult to schedule for high school students, especially for grade 11-12 students.
- Teachers are more interested in participating in professional development courses, if the learned material/course can be offered by them in their regular curriculum.
- More training at the MS level greatly improves performance of HS students
- Libraries and churches appear good venues for informal education for inner-city, minority students (especially K-8).

**Rewards:** Students will be interested in, and competitive for, computer science and math college programs. Activities and incentives are offered throughout the program to inform, excite and prepare students and their families for success in IT and other science programs in college and outstanding CS and STEM careers after graduation. We want them to be leaders in the technology revolution.

### Assessment

Pre-/post-tests (students show about 40% improvement in content knowledge of IT). Pre-/post-interest in IT careers greatly increased (most had little idea about potential careers coming in).

Lessons learned inform their other school subjects (especially advances a systematic approaches to their education and provides analytic skills to them).

Students/teachers/facilitators impacted; 1. HS students = 140; 2. HS teachers = 18; UAB students = 13; UAB faculty = 7

**ALADDIN: POWERED BY NSF ITEST**

