New Mexico Adventures in Supercomputing Challenge

Summer Teacher Institute (STI)
Webinar
June 28th – July 9th, 2004

Combined Syllabus and Schedule

Mission Statement

The mission of New Mexico Adventures in Supercomputing Challenge is to improve students' understanding and use of technology by developing their skills in scientific inquiry, modeling, computing, communication, and teamwork.

Summer Teacher Institute Description

> The Summer Teacher Institute (STI) is a two-week institute for teachers sponsored in conjunction with Sante Fe Institute, MIT, LANL/DOE, NASA and the New Mexico Adventures in Supercomputing Challenge. Acquiring skills to support computational science for mid and high school students is the overarching goal of STI. Topics will include problem solving, science, math modeling, technology, programming, research, working with mentors, project management, time management, team management, presentations, gender equity, computer ethics and technical writing

Face to Face

Albuquerque TBA, June 28th and July 9th
Online with NMSU WebCT

Goal of STI

Teachers will learn how to sponsor a New Mexico Adventures in Supercomputing Challenge team and how to help students complete an appropriate computational science project in keeping with the AiS Challenge mission statement.

The computational project incorporates four components, Project Management, Structured Programming and Design, Math Modeling, and Internet Resources:

1. Project Management

> Five areas of project based learning will be a main focus: planning, research, development, refinement and implementation. The creation and maintenance of a year long project involves many responsibilities: topic selection, creating a problem definition, topic research, meeting deadlines,

providing motivation, obtaining a mentor, ethical behavior, technical reports, oral and computer presentations, team development, time management, online responses, etc. Tips for planning this yearlong commitment will be shared!

2. Structured Programming and Design

A. Introduction to Unix

The goal of the online Unix lecture/lab time is to get the student comfortable with several Unix commands that will allow them to manipulate files and directories in support of the programming and HTML modules.

Students will learn how to create and remove files, create organized folders (directories) of files, and see what files exist. They will learn to use editors to create and modify files.

They will also practice using a web based electronic mail client that will be used by all the students in the upcoming AiS Challenge year.

B. Introduction to Computer Programming – JAVA

Computer programming is the process of planning and creating a sequence of steps for a computer to follow. In general, this process will help us resolve a problem, which is either too tedious or difficult to work out otherwise. In this class we will utilize the Java programming language, on PCs running the Windows operating system, to implement the actual steps.

Java is a full-featured programming language similar in functionality to C++ and other “high-level” languages. Once heralded as “the next-best thing” for the web, Java is now regarded as an exceptional language for creating stand-alone applications. This is in no small part due to the relative ease with which Java can create a GUI (Graphical User Interface).

Many Colleges and Universities now teach Java in “Computer Programming 101”. The High School AP (Advanced Placement) test in computer science will also be based on Java starting in 2003.

C. Introduction to StarLogo

The StarLogo language was designed to enable people to build their own models of complex, dynamic systems. Unlike many other modeling tools,

StarLogo supports a tangible process of building, analyzing, and describing models that do not require advanced mathematical or programming skills. Using StarLogo, one can build and explore models and in the process one can develop a deeper understanding of patterns and processes in the world. In StarLogo, one writes simple rules for individual behaviors. For instance, one might create rules for a bird, which describe how fast it should fly and when it should fly towards another bird. When one watches many birds simultaneously following those rules, she can observe how patterns in the system, like flocking, arise out of the individual behaviors. Building up models from the individual, or "bird," level develops a better understanding of the system, or "flock," level behaviors.

D. Prediction with Spreadsheets

Spreadsheets offer the function of predicting a trend from some existing data. Once you are happy with the reliability of the data you have sourced, you can find out what would be the outcome for a dependent variable in the event of the independent variable (usually time) moving in steps. Linear regression is a statistical technique that is often used in business. We are going to look at a kangaroo farm and how we can predict the numbers for the farm.

3. Math Modeling

Mathematical modeling is the process of creating a mathematical representation of some phenomenon in order to gain a better understanding of it; mathematical modeling is an integral component of the computational science project. During the process of building a mathematical model, the modeler must decide what factors are relevant to the problem and what factors can be de-emphasized. Once a model has been developed and used to answer questions, it should be critically examined and often modified to obtain a more accurate reflection of the phenomenon. In this way, mathematical modeling is an evolving process; as new insight is gained, the process begins again as additional factors are considered. Generally the success of a model depends on how easily it can be used and how accurately it predicts.

The mathematical modeling/computational science module will include an overview of the role of mathematical modeling in the computational science project, modeling sites and resources, some examples of models (compartmental models, population models, epidemic models, one- and two-dimensional heat flow models, etc.), and an introduction to some basic numerical methods (Gaussian elimination and iteration). Examples will be implemented in Excel, but can be programmed in JAVA or any other procedural computer language.

4. Internet Resources

The AiS Challenge website, http://challenge.nm.org, will link to all important resources: Technical Guide, teacher resources on gender equity, ethics, computational science, mentors, research, presentations, technical writing, grants, programming, etc. Links to science, math, technology and computational science standards and ways to integrate technology into the curriculum will be utilized. The Big Six Information Problem Solving research framework will be shared. These sites will be shared throughout the two weeks.

Course Requirements

Students will attend two full weeks of classes, two face to face days and seven days online with mini lectures, threaded discussions, chats, video and audio demonstrations, covering core components of computational science: project development, programming, math modeling, and Internet resources.

Students will

- participate in a creating a team supercomputing computational project.
- present the project to a team of judges.
- learn about the 2004-05 Challenge timetable, milestones and expectations.
- learn programming skills: JAVA programming, Star Logo and Excel programming
- learn math modeling and computational techniques, project management tips, and research aides.

Grading

Grading will be based on creating a teamed computational science project. Students will complete a collaborative digital portfolio by posting a web page on the Mode computer at Los Alamos.

Stipends

Participants will receive a webcam, headphones and microphone on June 28th. They will receive a $100 honorarium on July 9th.

Instructors

Richard Allen, UNM, rcallen@unm.edu
Nick Bennett, Grass Roots Consulting, nickbenn@g-r-c.com
Celia Einhorn, Adventures in Supercomputing Challenge, celia@nm.net
Betsy Frederick, Adventures in Supercomputing Challenge, betsy@nm.net

David Kratzer, LANL, dhk@lanl.gov
Irene Lee, SFT/MIT, lee@elf.org
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Schedule

Face to Face, Monday, June 28th, 9 – 5
Online, June 29th – July 8th
Vacation, July 5th
Face to Face, Friday, July 9th, 9 - 5

Free Resources

Hands On! Newsletter on math and science learning – TERC – http://www.terc.edu

Teaching Tolerance Magazine from the Southern Poverty Law Center – http://teachingtolerance.org

T.H.E Journal (Technological Horizons in Education) – Professional Development, Distance Learning, Curriculum - http://www.thejournal.com

The Magazine of Design & Technology Education, ties – Resources, Multimedia, Literature – good ideas for projects – http://www.tcnj.edu/~ties

Web Resources

Bad Science http://www.ems.psu.edu/~fraser/BadScience.html

Challenge Acceptable Use Policy
http://www.challenge.nm.org/Archive/99-00/aup.stm

Good Projects –

Waiter! There is a Message in My Soup
http://www.challenge.nm.org/archive/02-03/FinalReports/022.pdf

Centralized Emergency Response
http://www.challenge.nm.org/archive/02-03/FinalReports/012.pdf

Atomistic Modeling of Biomolecular Interactions
http://www.challenge.nm.org/archive/03-04/finalreports/26.pdf

Who said that?
http://www.challenge.nm.org/archive/03-04/finalreports/48.pdf

Mathematical Models
http://www.krellinst.org/AiS/textbook/unit2/projdev2.3.5.html
http://www.math.montana.edu/frankw/ccp/modeling/topic.htm#optimization

Model of Modeling
http://www.nsca.uiue.edu/Edu/SuperQuest/sqt/modeling.html

Non-software Teacher Resources to Support Modeling
http://www.ecsu.k12.mn.us/envision/gradrule/additional.html

New Mexico Adventures in Supercomputing Challenge
http://www.challenge.nm.org

Siemens Westinghouse Competition
http://www.siemens-foundation.org/science/science_and_technology.htm

Technical Guide – StarLogo, JAVA, Unix, etc.
http://www.challenge.nm.org/ctg/

Writing the Final Report
http://www.challenge.nm.org/FinalReports/writing.shtml

Gender Equity - http://www.holtsoft.com/chris/CASCONEquity.pdf

Research – http://big6.com

NASA Math Models and Data - http://geo.arc.nasa.gov/sge/landsat/l7.html.