Overview

- First Day Details (web pages)
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- Introduction to Computers
- Checking out & Building Robots
First Day Details

See course webpages.
Opportunities for Students in Technology-Related Majors

• Computer Science & Mathematics Mentorship & Scholarship Program

• Internships (On-Campus & Industry)

• Research Assistantships
Computer Science & Mathematics Mentorship & Scholarship Program

• Provides scholarships, a laptop mentoring and career planning
• Majoring in technology-related field
• Good grades in first year courses
• US Citizen or permanent resident

Funded by the National Science Foundation.
Internships (On-Campus & Industry)

Some recent internships:

- ABC Television
- Einstein School of Medicine
- FAA–La Guardia
- IBM Research
- NYC MTA
- National Medical Library
- New York Public Library
Research Assistantships

A few examples:

| Computational Biology: Tree of Life Project | Wildebeest Cluster (132 processors) | Morphometrics with AMNH |
Course Overview

- Part I: Lego Robots

- Part II: Animation Programming (Alice)
Course Overview

More formally:

- Part I: Structured Programming

- Part II: Object Oriented Programming (Alice)
Introduction to Computers & Robots

• What is a computer?
• What is a program?
• Compiling Programs
What is a computer?

A basic computer has a

- central processing unit (CPU) or “brain”,
- registers to keep track of next instruction & where data is stored
- Two kinds of memory:
  - Read Only Memory (ROM): Often contains directions that programs the CPU and can’t be erased,
  - Random Access Memory (RAM): Used to store firmware and programs the computer runs.
What is a computer?

There’s also input devices:

- keyboard, mouse, scanner,…

and output devices:

- screen, printer, speaker,…
Lego Mindstorm Robot

The lego robot has:
- 8-bit CPU (in bulkly lego block, called the RCX)
- 16K Internal ROM & 32K static RAM (6K for programs)
- Input Devices: 2 touch sensors, 1 light sensor, I/R port
- Output Devices: 2 motors, screen, speaker, I/R port
Lego Mindstorm Internals

(Pictures of RCX internals from: http://graphics.stanford.edu/ kekoa/rcx/)
CPU Directions

• Most CPUs understand directions written in machine language—strings of 0’s and 1’s

• Each instruction corresponds to an “operation code” or opcode that consists of commands like:
  ‘‘Increment value in register AX’’

• Very hard to write program in machine language.

• Most programs are written in a high level language, like Java, Visual Basic, C or C++.
Programming

• The general process is:

You write a program that looks like English (with lots of rules) \( \Rightarrow \) Gives a binary file “compiling” the computer can understand \( \Rightarrow \) You “run” the binary to execute the program

• A program is a set of instructions for the computer to follow.

• Programs implement algorithms—step-by-step directions for performing a task (ex: a recipe to make cookies, directions to make the robot turn 360°).
Not Quite C

• For the robot, we’re going to write programs in a variant of C, called Not Quite C (NQC).

• Legos come with a language called RCX— it’s very simple, but doesn’t allow you to do a lot.

• By using NQC, you can do more sophisticated programs and it will help you learn C/C++ and Java.
A Simple Program

// tankbot1.nqc - drive straight ahead

#define LEFT OUT_A
#define RIGHT OUT_C

task main()
{
    On(LEFT+RIGHT);
    until(false);
}

## Some Useful NQC Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>On(outputs)</code></td>
<td>turn on outputs</td>
<td><code>On(LEFT+RIGHT);</code></td>
</tr>
<tr>
<td><code>Off(outputs)</code></td>
<td>turn off outputs</td>
<td><code>Off(LEFT+RIGHT);</code></td>
</tr>
<tr>
<td><code>Fwd(outputs)</code></td>
<td>sets to forward direction</td>
<td><code>Fwd(LEFT);</code></td>
</tr>
<tr>
<td><code>Rev(outputs)</code></td>
<td>sets to reverse direction</td>
<td><code>Rev(RIGHT);</code></td>
</tr>
<tr>
<td><code>Wait(time)</code></td>
<td>wait for time $\frac{time}{100}$ seconds</td>
<td><code>Wait(100);</code></td>
</tr>
</tbody>
</table>

(Much more on this in the next two lectures.)
Checking Out & Building Robots

- Robots are stored in Gillet 137.
- After a short break, need a few volunteers to help transport them to our classroom.
Checking Out & Building Robots

Each student will get:

- RCX brick
- Small plastic shoebox to store assembled robot
- Labels to place on the robot RCX and the shoebox.
Checking Out & Building Robots

• Everyone will put a robot together and test the 5 built-in programs, described in the Lego instruction manual.

• You need to build a car-like robot with a bumper and light sensor, either of your own design, or the Roverbot or Acrobot from the Constructopedia.

• We will begin cleaning up at 12:15pm and class ends at 12:30pm.

• If you do not finish today, you may come during my office hours (W 11-1, F 1-2) or when Gillet 137 suite is open (most T,W,Th 1-5).