Opening Discussion

- Have you come up with any other questions about the course?

- Minute essay comments:
  - Why no creepy military tech?
  - Harvard Architecture
  - Where is Scala used? Why Scala?
  - If computers take over everything, how will non-computer people make money?
  - How long until self-driving cars will be in Texas?
  - What is CES?
More Comments

- How far will we get into coding?
Cutting Edge

http://www.youtube.com/watch?v=6zXOW6v0c8s
Computing Power

Performance Development

1 ERFlops
100 PFlops
10 PFlops
1 PFlop
100 TFlops
10 TFlops
40.19 TF
8.16 PF
58.68 PF

1 GFlops
100 GFlops
10 GFlops
1 GFlop
100 MFlops
100 MFlops


#1
#500
Sum

GPU
CPU
Mobile

16/06/2011
http://www.top500.org/
The Power of Exponential Growth
## Cost/GFLOP

<table>
<thead>
<tr>
<th>Date</th>
<th>Approximate cost per GFLOPS</th>
<th>Technology</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>US $1,100,000,000,000,000   ($1.1 trillion)</td>
<td>About 17 million IBM 1620 units costing $64,000 each</td>
<td>The 1620's multiplication operation takes 17.7 ms. [40]</td>
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<tr>
<td>1984</td>
<td>$15,000,000</td>
<td>Cray X-MP</td>
<td></td>
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<tr>
<td>1997</td>
<td>$30,000</td>
<td>Two 16-processor Beowulf clusters with Pentium Pro microprocessors [41]</td>
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<tr>
<td>April 2000</td>
<td>$1,000</td>
<td>Bunyip Beowulf cluster [8]</td>
<td>Bunyip was the first sub-US$1/MFLOPS computing technology. It won the Gordon Bell Prize in 2000.</td>
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<tr>
<td>May 2000</td>
<td>$640</td>
<td>KLAT2 [8]</td>
<td>KLAT2 was the first computing technology which scaled to large applications while staying under US$1/MFLOPS. [42]</td>
</tr>
<tr>
<td>August 2003</td>
<td>$82</td>
<td>KASY0 [8]</td>
<td>KASY0 was the first sub-US$100/GFLOPS computing technology. [43]</td>
</tr>
<tr>
<td>March 2011</td>
<td>$1.80</td>
<td>HPU4Science [8]</td>
<td>This $30,000 cluster was built using only commercially available &quot;gamer&quot; grade hardware. [45]</td>
</tr>
</tbody>
</table>

[40][en.wikipedia.org/wiki/FLOPS#Hardware_costs](http://en.wikipedia.org/wiki/FLOPS#Hardware_costs)
Linux

- Go ahead and log in.
- Linux is just another OS, like Windows or Mac OS.
- Linux is primarily used in servers. Efforts are being put into making it a desktop OS.
- It has a GUI, but we will focus on doing things through the command line.
- Bring up a terminal.
- Change your password with passwd.
You are likely used to the point and click interface of a GUI.

To run a program you double click on it or a file associated with it. Any other information has to be given after the program opens.

With the command line you type in the name of the program you want to run. You can also specify any other information you want through command line arguments.
What you call folders were originally directories.

Commands:

- `pwd` – See current directory.
- `ls` – List the contents of a directory.
- `mkdir/rmdir` – Make and remove directories.
- `cp/mv/rm` – Copy, move, remove files.
- `less/more/cat` – See contents of files.
Tips

- Tab completion for file/directory names.
- ! - for last matching command.
- Ctrl-r to search your history.
- The man command for manual entries. Use the -k option to search.
Permissions

- Do `ls` with `-l` option to see permissions.
- Sets of `rwx` for user, group, and others.
- Use `whoami` and groups to find identity.
- Use `chmod` and `chown` to change permissions or ownership.
Remote

- Use ssh to login into one machine from another.
- Use scp to copy files from one machine to another.
- The website has a link to Putty which will give you these abilities from Windows. For Windows, consider running a virtual Linux install.
Other

- `du` – Lists disk usage
- `grep` – Searches for something inside of files.
- `find` – Find files.
- `head` – List the first several lines of a file.
- `tail` – List the last several lines of a file.
- `top` – Look at what is running on a machine.
- `w` – Look at who is logged into a machine.
I/O Redirection

- You can send a program's output to a file using `>` or `>>`.
- You can make a program use a file as input using `<`.
- You can do more interesting things by sending the output of one program to another with `|`. 
Have you ever used a command-line interface before? What do you think of them based on what you have seen today?

Try connecting to one of the Xena machines from your room. For example:

- xena08.cs.trinity.edu