Welcome to CSE 502

Introduction
Today’s Lecture

• Course Overview
• Course Topics
• Grading
• Logistics
• Academic Integrity Policy
• Homework
Course Overview (1/2)

• Computer Architecture is...
  ... the *science* and *art* of selecting and interconnecting hardware and software components to *create computers* ...

• Computer Architecture is an umbrella term
  – *Architecture*: software-visible interface
  – *Micro-architecture*: internal organization of components

• This course is mostly about *micro-architecture*
  – What’s inside the processor (CPU)
  – What implications this has on software
Course Overview (2/2)

• This course is hard, roughly like CSE 506
  – In CSE 506, you learn what’s inside an OS
  – In CSE 502, you learn what’s inside a CPU

• This is a project course
  – Learn why things are the way they are, first hand
  – We will “build” emulators of CPU components

• “Hard” doesn’t mean what you think it means
  – Especially for PhD students: don’t listen to “seniors”
Why Study CompArch (1/3)

• You need one more qualifier/graduation requirement
  ✗ Bad answer!

• You want to become a computer architect
• You want to learn what’s inside a processor
  – Because you’re curios (and there is no computer w/o a processor)
  – To write better/faster application code
  – To write system software (OS, compiler, etc.)
• Computer architecture is cool and intellectually fascinating
  – What is the most complex man-made device?
    • There are billions of transistors in a modern processor chip
  ✓ Better answer!
Why Study CompArch (2/3)
Why Study CompArch (3/3)

• Sources of performance improvement
  – Improvements in semi-conductor technology
    • Faster transistors
    • More transistors
  – Improvements in computer architecture
    • Architects turn resources into speed/power savings/features

This class is about how this is possible
Moore’s Law

- **1\textsuperscript{st} Moore’s Law (1965)**
  “The complexity for minimum component costs has increased at a rate of roughly a factor of two per year. Certainly over the short term this rate can be expected to continue, if not to increase.”

- **2\textsuperscript{nd} Moore’s Law (1975)**
  “The new slope might approximate a doubling every two years, rather than every year”

Moore’s law now used to describe exponential tech. growth
Hardware Design Process

Conceptual Design → Behavioral Implementation → Evaluation

Packaging → Manufacturing → Layout → Structural Implementation
Course Topics

• Intro/Review
• Instruction Decode
• Pipelining
• Memory Hierarchy
• Processor Front-end
• Execution Core
• Multi-[socket(SMP, DSM) | thread(SMT, CMT) | core(CMP)]
• Vector Processing and GPUs

Will devote most attention to items in **bold**
## Grading (Standard Option)

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Due Date</th>
<th>Points</th>
<th>Grading</th>
<th>Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Homework</td>
<td>Mar 26</td>
<td>10</td>
<td>Curve 0 to 100</td>
<td>No</td>
</tr>
<tr>
<td>2 Warm-up Projects</td>
<td>Feb 14/Mar 7</td>
<td>20</td>
<td>Absolute Value</td>
<td>No</td>
</tr>
<tr>
<td>1 Course Project</td>
<td>Last class</td>
<td>100</td>
<td>See below</td>
<td>Yes</td>
</tr>
<tr>
<td>1 Final Exam</td>
<td></td>
<td>40</td>
<td>Absolute value</td>
<td>No</td>
</tr>
<tr>
<td>Participation</td>
<td></td>
<td>10</td>
<td>Curve 0 to 100</td>
<td>No</td>
</tr>
</tbody>
</table>

### Course Project Points

<table>
<thead>
<tr>
<th>Course Project</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5+ stage, Direct-mapped Caches</td>
<td>50</td>
</tr>
<tr>
<td>5+ stage, Set-Associative Caches</td>
<td>60</td>
</tr>
<tr>
<td>Super-Scalar, Set-Associative Caches</td>
<td>70</td>
</tr>
<tr>
<td>Super-Scalar, Out-of-order, Set-Associative Caches</td>
<td>80</td>
</tr>
<tr>
<td>Any of the above +TLBs</td>
<td>+10</td>
</tr>
<tr>
<td>Any of the above +Branch predictor</td>
<td>+10</td>
</tr>
</tbody>
</table>

Without curve, need 100 points to get an A
Grading (Research Option)

• If you are...
  – Pursuing a PhD
  – Pursuing an MS thesis
  – Planning to take 523/524 with me

• You may select a research option for the grade
  – Only available with instructor’s approval

• When selecting this option...
  – Must work alone on everything
  – Attain at least 60 points of the Standard Option
  – Grade will be based on subjective research progress

Note: Of the two, this is the harder option
Logistics (1/3)

• Project milestones
  – There are *no* official project milestones
  – If *you* need milestones, send me a milestone schedule
    • I will deduct 5 points for each milestone you miss

• Books
  – Recommended for reference, not required
    • Does not mean you shouldn’t get them
    • Do not pirate books
  – Computer Architecture (Hennessy & Patterson)
Logistics (2/3)

• Working in groups
  – Permitted on everything except Final
  – Groups may be of any size
    • Points deducted on group work are multiplied by group size
    • Great opportunity or Rope to hang yourself – you pick

• Attendance
  – Optional (but highly advised)
  – No laptop, tablet, or phone use in class
    • Don’t test me - I will deduct grade points
Logistics (3/3)

• Blackboard
  – Grades will be posted there, nothing else

• Course Mailing List
  – Subscription is **required**
    http://piazza.com/stonybrook/spring2019/cse502/home
Academic Integrity Policy

• You may...
  – Discuss assignment, design, techniques

• You may **not**...
  – Share code outside your group
  – Use any code not distributed as part of project handouts
    • Exceptions are possible, but must receive explicit permission

• You **must** declare group composition...
  – Explicitly via email to TA and instructor
  – Explicitly for each assignment
  – At most **five** days after assignment handout
Homework

• Independent hacking projects

• If interested...
  – “Pick up” assignment during office hours
    • Come with all group members
  – If can’t make it during office hours
    • Schedule an appointment
Questions?