

740: Computer Architecture

Introduction, Logistics, and Background Assignments

Prof. Onur Mutlu

Carnegie Mellon University

Fall 2013

Agenda

- Syllabus
 - Course logistics, info, requirements
- Online nature of the course
- Introduction
- Background Videos and Lectures to Study

Non-Agenda

- Grading and Policies
- Details on Course Project
- Details on Paper Review Assignments
- Initial Assignments and Homeworks
- These are covered in separate videos.

Course Info: Who Are We?

- Instructor: Prof. Onur Mutlu

- onur@cmu.edu

- Office: CIC 4105

- Office Hours: W 2:30-3:30pm (or by appointment)

- <http://www.ece.cmu.edu/~omutlu>

- PhD from UT-Austin, worked at Microsoft Research, Intel, AMD

- Research interests:

- Computer architecture, hardware/software interaction

- Many-core systems

- Memory and storage systems

- Improving programmer productivity

- Interconnection networks

- Hardware/software interaction and co-design (PL, OS, Architecture)

- Fault tolerance

- Hardware security

- Algorithms and architectures for genomics and embedded systems



Course Info: Who Are We?

■ Teaching Assistants

□ Tyler Huberty

■ thuberty@andrew.cmu.edu

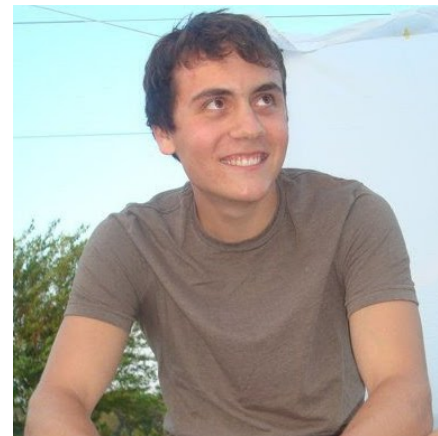
□ Brian Osbun

■ bosbun@andrew.cmu.edu

□ Hongyi Xin

■ hxin@andrew.cmu.edu

□ TBD



Where to Get Up-to-date Course Info?

- Website: <http://www.ece.cmu.edu/~ece740>
 - Syllabus and contact information
 - Links to videos and online education site
 - Lecture notes
 - Readings and link to review website
 - Project information
 - ...
- Blackboard: Linked from website
- Your email
- Email to us: 740-official@ece.cmu.edu

This is a Hybrid Course

- Heavily online
- With in-person recitations and office hours

Lectures, Readings and Recitations

■ Lectures will be **online**

- Purpose: Learn the basics of a topic
- You are expected to watch them fully as assigned by the due date
- Videos and supplemental material will be linked from the website

■ Readings will be **online**

- Purpose: Enhance understanding beyond the lectures
- You are expected to do them before the due date (& enter reviews)

■ Recitations will be **both in-person and online**

- Purpose: Enhance understanding via deeper discussion
- During the specified times in the syllabus and course schedule
- We will announce recitation times and format weekly
- In-person recitations will be recorded and posted online

Office Hours

- Office hours will be both in-person and online
 - Purpose: Clarify unclear points, delve deeper
 - Locations and times will be posted

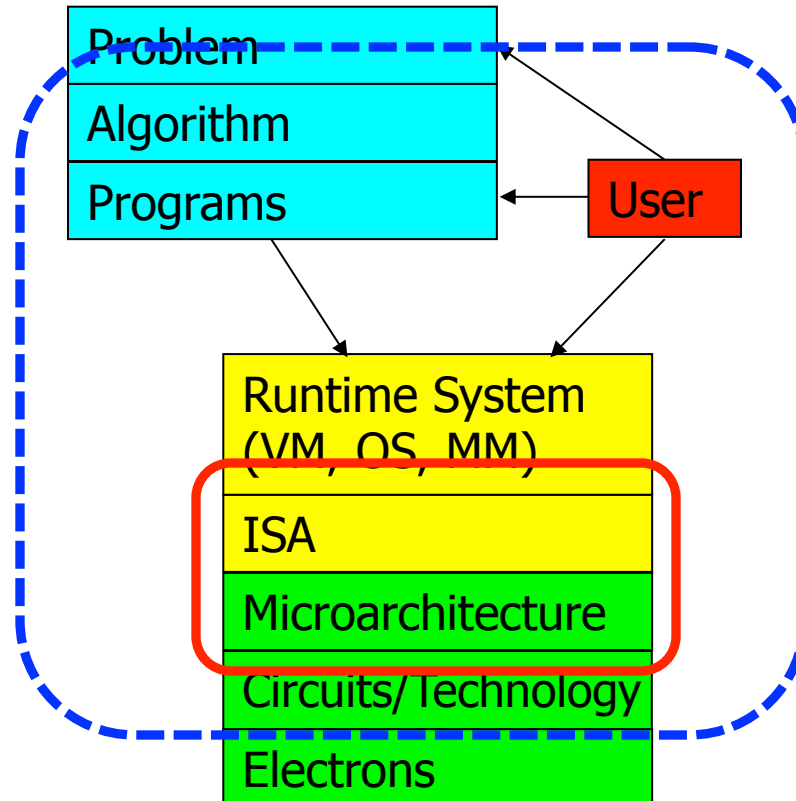
A Note

- Please provide us feedback with the online lectures and quality of the online environment
- If there are issues, we would like to know these early
- Especially true if you are remotely attending the class

What Will You Learn?

- **Computer Architecture:** The science and art of designing, selecting, and interconnecting hardware components and designing the hardware/software interface to create a computing system that meets functional, performance, energy consumption, cost, and other specific goals.
- **Traditional definition:** “The term *architecture* is used here to describe the attributes of a system as seen by the programmer, i.e., the conceptual structure and functional behavior as distinct from the organization of the dataflow and controls, the logic design, and the physical implementation.” *Gene Amdahl*, IBM Journal of R&D, April 1964

Levels of Transformation

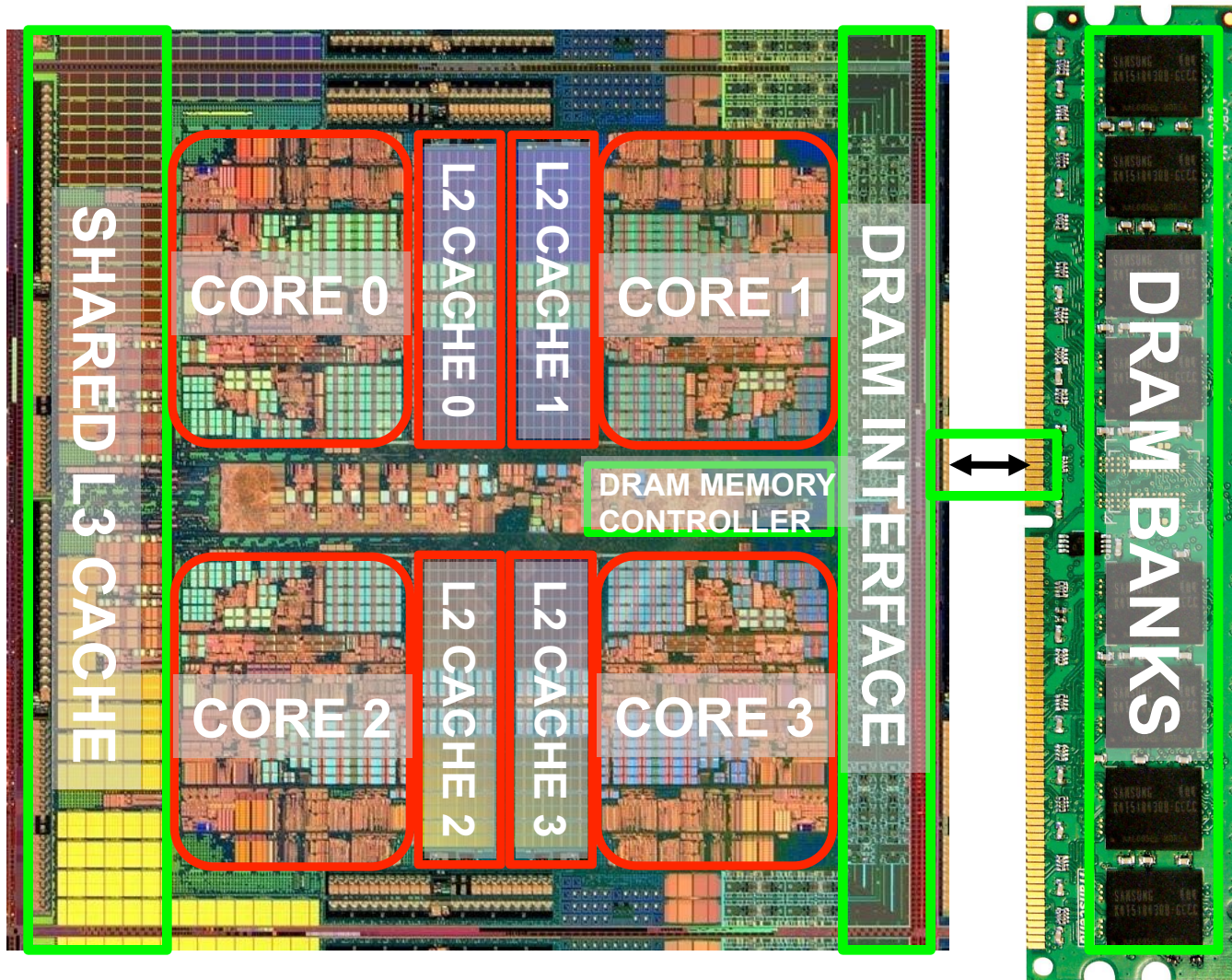


What Will You Learn?

- Hardware/software interface, major components, and programming models of a modern microprocessor
 - State-of-the-art as well as research proposals
 - Tradeoffs and how to make them
 - Emphasis on cutting-edge research
- Hands-on research in a computer architecture topic
 - Semester-long project
 - How to design better architectures (not an intro course)
- How to dig out information
 - No textbook really required
 - But, see the syllabus

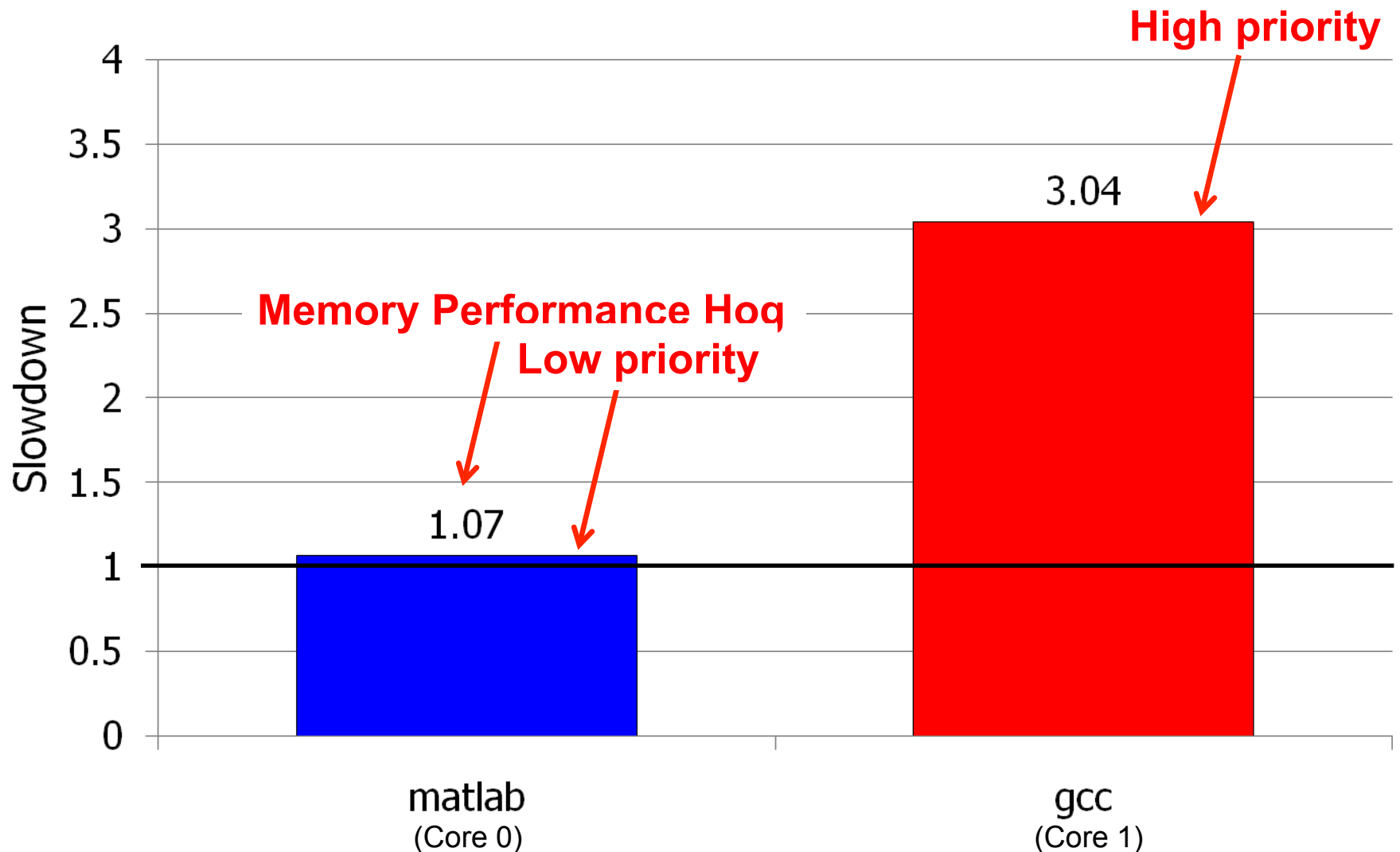
An Example: Multi-Core Systems

Multi-Core Chip

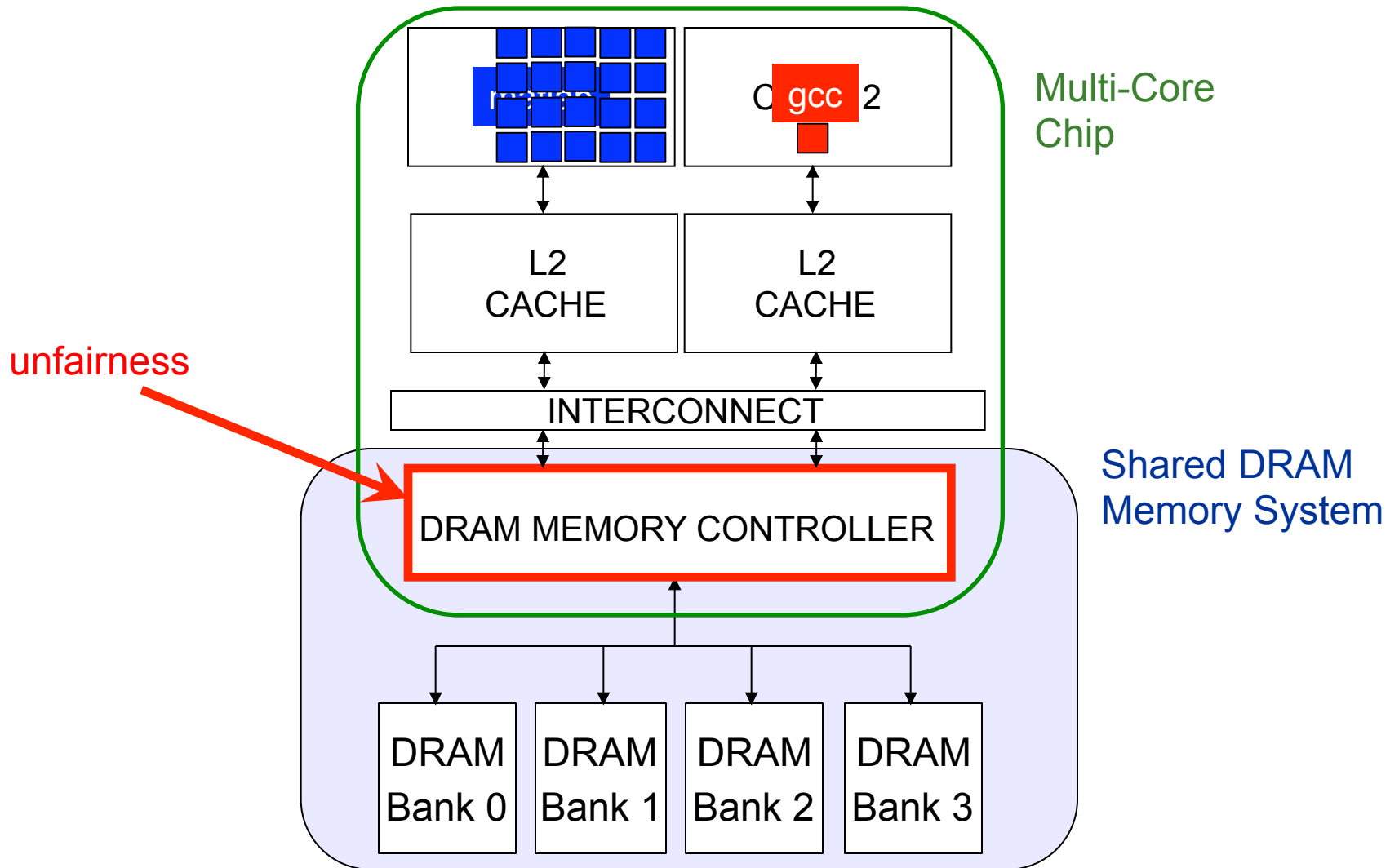


*Die photo credit: AMD Barcelona

Unexpected Slowdowns in Multi-Core



Why the Disparity in Slowdowns?



For More Information, Read

- Mutlu and Moscibroda, “[Memory Performance Attacks: Denial of Memory Service in Multi-Core Systems](#)”, USENIX Security 2007.

Course Goals

- Goal 1: To familiarize computer architecture students and those interested in computer system design with both **fundamental design tradeoffs** and **recent research issues/trends** in **processor, memory, and platform architectures** in today's and future systems.
 - Strong emphasis on fundamentals and design tradeoffs.
- Goal 2: To provide the necessary **background and experience** to advance the state-of-the-art in computer architecture by **performing cutting-edge research**.
 - Strong emphasis on
 - **Critically evaluating research papers** (through literature review assignments)
 - **Developing new mechanisms that advance the state of the art** (through the course research project).

This is a Graduate-Level Class

- Required background:
 - basic architecture (18-447)
 - basic compilers
 - basic OS
 - programming skills
 - spirit, excitement, and dedication for deep exploration of a topic in computer architecture

What Do I Expect From You?

- Learn the material
 - And, research it → find the original source of ideas
- Do the work & **work hard**
- **Ask questions, take notes, participate in discussion**
- Read and review the assigned research papers & readings
 - Discuss/critique them online with peers and us
 - Write your critique/review online
- **Start the research project early and focus on it**
- If you want feedback, come to office hours

Recommended Background Videos and Lectures (I)

- All 447 lecture videos and notes are at:
 - <http://www.youtube.com/playlist?list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ>
 - <http://www.ece.cmu.edu/~ece447/s13/doku.php?id=schedule>
- Please watch as many as you can, to brush up on background material
- I would especially encourage everyone to watch:
 - **Lecture 1: Basics of Computer Architecture**
 - <http://www.youtube.com/watch?v=BJ87rZCGWU0&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=1>

Recommended Background Videos and Lectures (II)

- Lectures 2-3: Fundamental Concepts and ISA, ISA Tradeoffs
 - <http://www.youtube.com/watch?v=BqJgYN6S6Qw&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=2>
 - <http://www.youtube.com/watch?v=BqJgYN6S6Qw&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=3>
- Lecture 8: Pipelining
 - http://www.youtube.com/watch?v=5E_W7EeNs8U&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=8
- Lecture 9: Data Dependence Handling
 - <http://www.youtube.com/watch?v=Gpz1I47LfDo&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=9>
- Lecture 10-11: Branch Prediction
 - <http://www.youtube.com/watch?v=XkerLktFtJg&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=11>
- Lecture 16: Virtual Memory
 - <http://www.youtube.com/watch?v=ppPq-ntaAWU&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=16>

Recommended Background Videos and Lectures (II)

■ Lecture 22: Memory Hierarchy

- <http://www.youtube.com/watch?v=JBdfZ5i21cs&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=22>

■ Lecture 23-24: Caches

- <http://www.youtube.com/watch?v=TpMdBrM1hVc&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=23>
- <http://www.youtube.com/watch?v=TboaFbjTd-E&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=24>

■ Lecture 30B: Multiprocessors

- http://www.youtube.com/watch?v=7ozCK_Mgxfk&list=PL5PHm2jkkXmidJOd59REog9jDnPDTG6IJ&index=31

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