CENG331 - Computer Organization

Course overview and logistics

Fall 2020

Instructor:

Murat Manguoglu   (Sections 1-2)

Adapted from slides of the textbook: http://csapp.cs.cmu.edu/

Overview and logistics

- **How the course fits into the CENG curriculum**
- **Syllabus**
- **Academic integrity**

Course Perspective

- **Most Systems Courses are Builder-Centric**
  - Operating Systems
    - Implement sample portions of operating system
  - Compilers
    - Write compiler for simple language
  - Networking
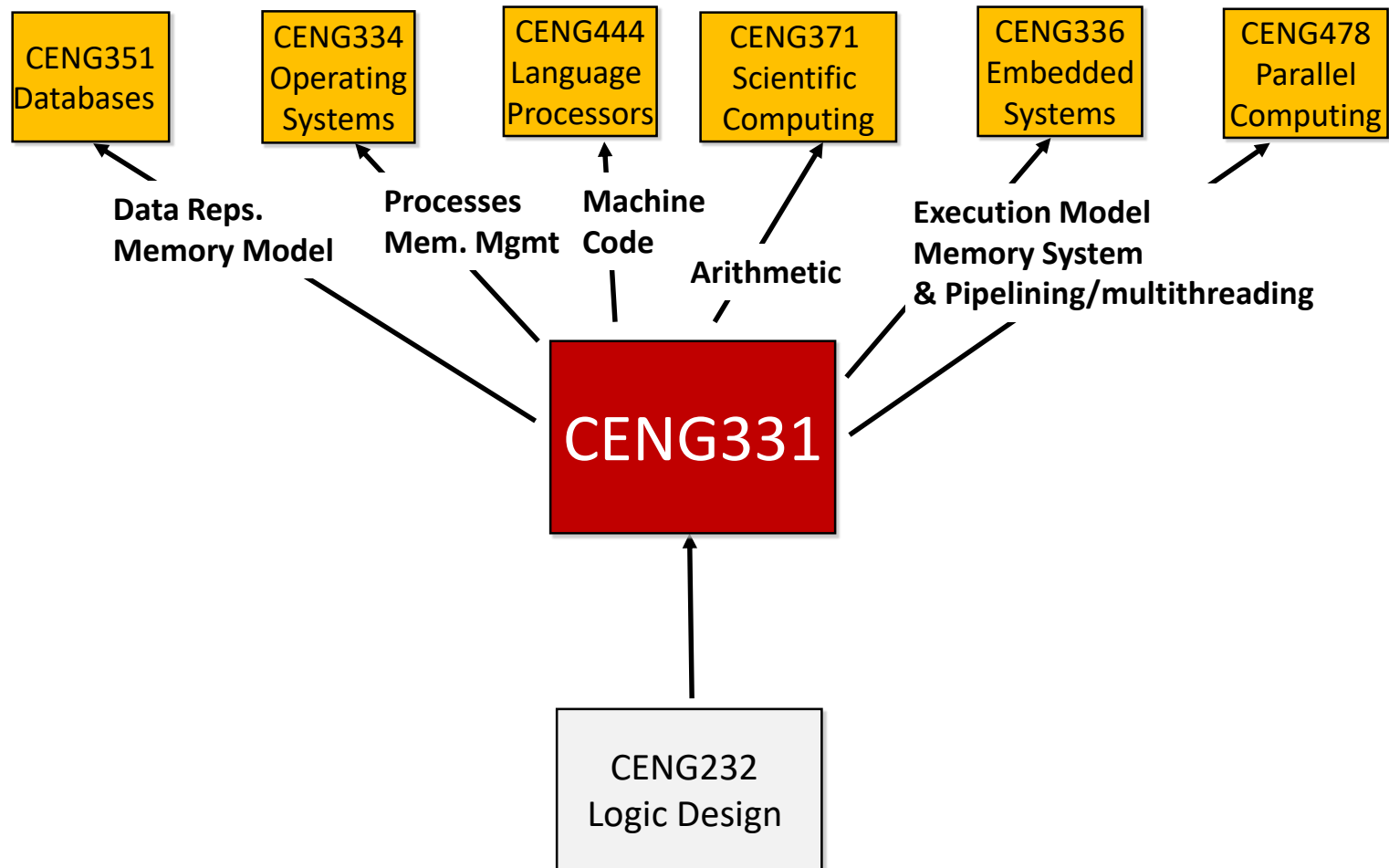   - Implement and simulate network protocols

Course Perspective (Cont.)

- **Our Course is Programmer-Centric**
  - Purpose is to show that by knowing more about the underlying system, one can be more effective as a programmer
  - Enable you to
    - Write programs that are more reliable and efficient
    - Incorporate features that require hooks into OS
      - E.g., concurrency, signal handlers
  - Cover material in this course that you won't see elsewhere
  - Not just a course for dedicated hackers
   - We bring out the hidden hacker in everyone!

Role within CENG Curriculum

Spring 2021

| CENG351 Databases | CENG334 Operating Systems | CENG444 Language Processors | CENG371 Scientific Computing | CENG336 Embedded Systems | CENG478 Parallel Computing |

Data Reps. Memory Model

Processes Mem. Mgmt

Machine Code

Arithmetic

Execution Model Memory System & Pipelining/multithreading
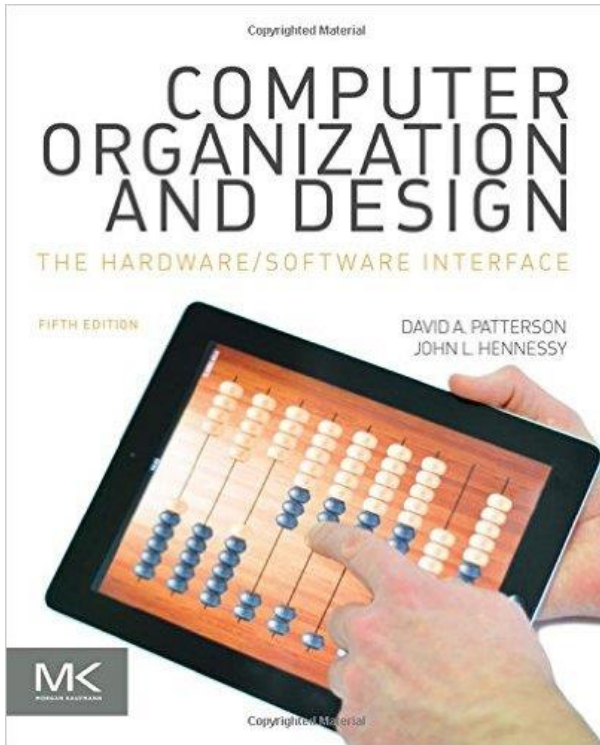
CENG331

CENG232 Logic Design

Textbook

- **Randal E. Bryant and David R. O'Hallaron,**
  - *Computer Systems: A Programmer's Perspective*, Third Edition (CS:APP3e), Pearson, 2016
  - *http://csapp.cs.cmu.edu*
  - This book really matters for the course!
    - How to solve labs
    - Practice problems typical of exam problems
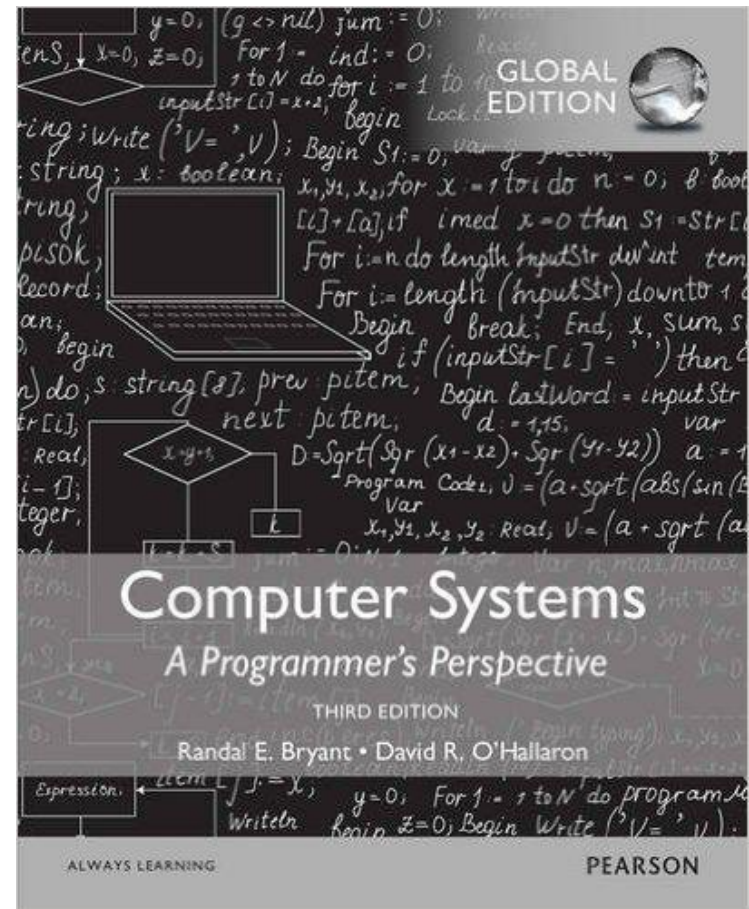
Reference Texts

■ **Computer Organization and Design: Hardware/Software Interface by Patterson and Hennessy**

■ **Computer Architecture: A Quantative Approach by Patterson and Hennessy**
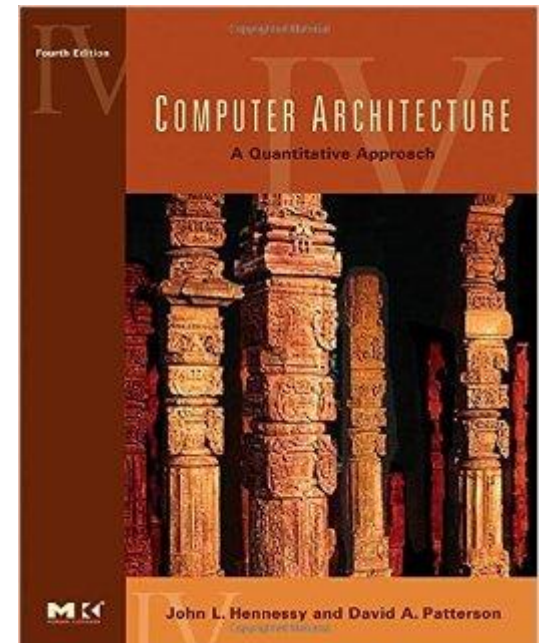
Course Components

- **Lectures**
  - Video Lectures : Posted weekly
  - Online Lectures: During regular lecture hours (I will post the link on ODTUClass)
    - These are <u>discussion hours</u> where you can ask and answer others' questions. I will act as a moderator mostly.

- **Take-home labs (4)**
  - Provide in-depth understanding and hands on experience on an aspect of computing systems; programming and performance measurement

- **Exams (midterm + final)**
  - Test your understanding of concepts & mathematical principles

- **Participation**
  - Participation in discussions and/or random quizzes during online lectures

Technique	Utility
Elaborative interrogation	Moderate
Self-explanation	Moderate
Summarization	Low
Highlighting	Low
The keyword mnemonic	Low
Imagery use for text learning	Low
Rereading	Low
Practice testing	High
Distributed practice	High
Interleaved practice	Moderate

Improving Students' Learning With Effective Learning Techniques Promising Directions From Cognitive and Educational Psychology, John Dunlosky, Katherine A. Rawson, Elizabeth J. Marsh, Mitchell J. Nathan, and Daniel T. Willingham, **Physological Science in the Public Interest**

Tools and Getting Help

- **Odtuclass : http://odtuclass.metu.edu.tr**
  - Course discussion forums, announcements, labs and their grades
  - Links to lecture videos

- **Gradescope: http://www.gradescope.com**
  - Midterm and finals will be conducted through gradescope

- **Email communication:**

  If you have a specific question that is **not beneficial to others**, you can send an e-mail to the instructor or to your teaching assistants. However make sure that the subject line starts with CENG331-Section#, state your first, last name and ID # to get faster reply.

Email communication:

- **TAs:**

  Çağrı Utku Akpak   (**capaki@ceng.metu.edu.tr**)

  Deniz Sayın   (**sayin@ceng.metu.edu.tr**)

  Merve Taplı   (**tapli@ceng.metu.edu.tr**)

  Hakan Bostan   (**hbostan@ceng.metu.edu.tr**)

Myself:

  Murat Manguoglu   (**manguoglu@ceng.metu.edu.tr**)

Policies: Take-home lab assigments, exams and quizzes

- **Study groups**
  - You are encouraged to study in groups
- **Work groups**
  - You must work alone on 1st, 2nd, and 3rd take-home labs
  - You can work in groups (of at most 3) for the 4th take home lab
- **Midterm and Final Exams**
  - Written exams , will be partly online (synchronous) and offline (take home)
  - Open book, notes, internet but <u>individual work</u>

Makeups

There are no makeups unless:

- Major illness, death in family, …
- Inform and if needed submit an official report to the instructor as soon as possible

Policies: Grading

- **Written Exams (66%):**
  - Midterm   (30%)
    - Online   (5%)
    - Take-home   (25%)
  - Final   (36%)
    - Online   (6%)
    - Take-home   (30%)

- **Lab Assigments (Take-home) (24%)**
  - 4 x 6%   for each lab
  - lower threshold for passing is 10% from the labs
- **Participation   (10%)**

Programs and Data

- **Topics**
  - Bits operations, arithmetic, assembly language programs
  - Representation of C control and data structures
  - Includes aspects of architecture and compilers

- **Take-home Lab Assignments**
  - Bomblab: Defusing a binary bomb (Individual work)
  - Attacklab: The basics of code injection attacks (individual work)

Processor Architecture

- **Topics**
  - Y86-64 architecture
    - Pipelining and hazards
    - Control structures

- **Take-home Lab Assignments**
  - Architecture (Individual Work)

Code optimization and Memory Hierarchy

- **Topics**
  - Code optimization
  - Memory technology, memory hierarchy, caches, disks, locality
  - Includes aspects of architecture and OS

- **Take-home assignments**
  - Performance: Improve the performance of a kernel which is a bottleneck in an application (Group work up to 3 people)

Virtual Memory

- **Topics**
  - Virtual memory, address translation
  - Includes aspects of architecture and OS

Other topics (if time permits)

- **Topics**
  - Tensor Processing Units (TPUs)
  - Graphical Processing Units (GPUs)
  - Quantum Processors
  - Multicore Architectures
  - Multithreading
  - Very Large Instruction Word Machines

Lab exam Rationale

- **Each assignment has a well-defined goal such as solving a puzzle or winning a contest**

- **Doing the lab should result in new skills and concepts**

- **We try to use competition in a fun and healthy way**
  - Set a reasonable threshold for full credit
  - Post intermediate results (anonymized)

Cheating: Description

- **What is cheating?**

  - Sharing take-home exam solutions

  - Sharing code: by copying, retyping, **looking at**, or supplying a file

  - Describing: verbal description of code from one person to another.

  - Coaching: helping your friend to write a lab, line by line

  - Searching the Web for solutions

  - Copying code from a previous course or online solution

    - You are only allowed to use code we supply, or from the CS:APP website

- **What is NOT cheating?**

  - Explaining how to use systems or tools

  - Helping others with high-level design issues

Cheating: Consequences

- **Penalty for cheating:**
  - Disciplinary action

- **Detection of cheating:**
  - We have sophisticated tools for detecting code plagiarism
  - And other forms of cheating

- **Don't do it!**
  - Start early
  - Ask the staff for help when you get stuck

METU Honor Code

Every member of METU community adopts the following honor code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted.

"The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."

METU Academic Integrity Guide for Students:

Welcome and Enjoy!