

CENG331 - Computer Organization

Course overview and logistics

Fall 2022

Instructor:

Murat Manguoğlu (Section 1)

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
- Our pledge

Levels of abstractions in computing

- Applications
- Application Software
- System Software
- Programming Language
- Assembly Language
- Machine Language
- Architectural Issues (Cache, Memory, etc.)
- Sequential logic
- Boolean logic
- Transistor (circuit)
- Semiconductors
- Atoms, electrons, physics

Course Theme:

Abstraction Is Good But Reality Matters

■ Most CENG courses emphasize “high level” abstractions

- Abstract data types
- Asymptotic analysis

■ These abstractions have limits

- Especially in the presence of bugs, performance constraints
- Need to understand details of underlying implementations

■ Useful outcomes of CENG331

- Become more effective programmers and computer scientists
 - *Able to find and eliminate bugs efficiently*
 - *Able to **understand** and **tune** your code for **performance***
- Prepare for later “systems” courses in CS/CENG
 - *Intro. to Parallel Computing, Compilers, Operating Systems, Networks, Embedded Systems, etc.*

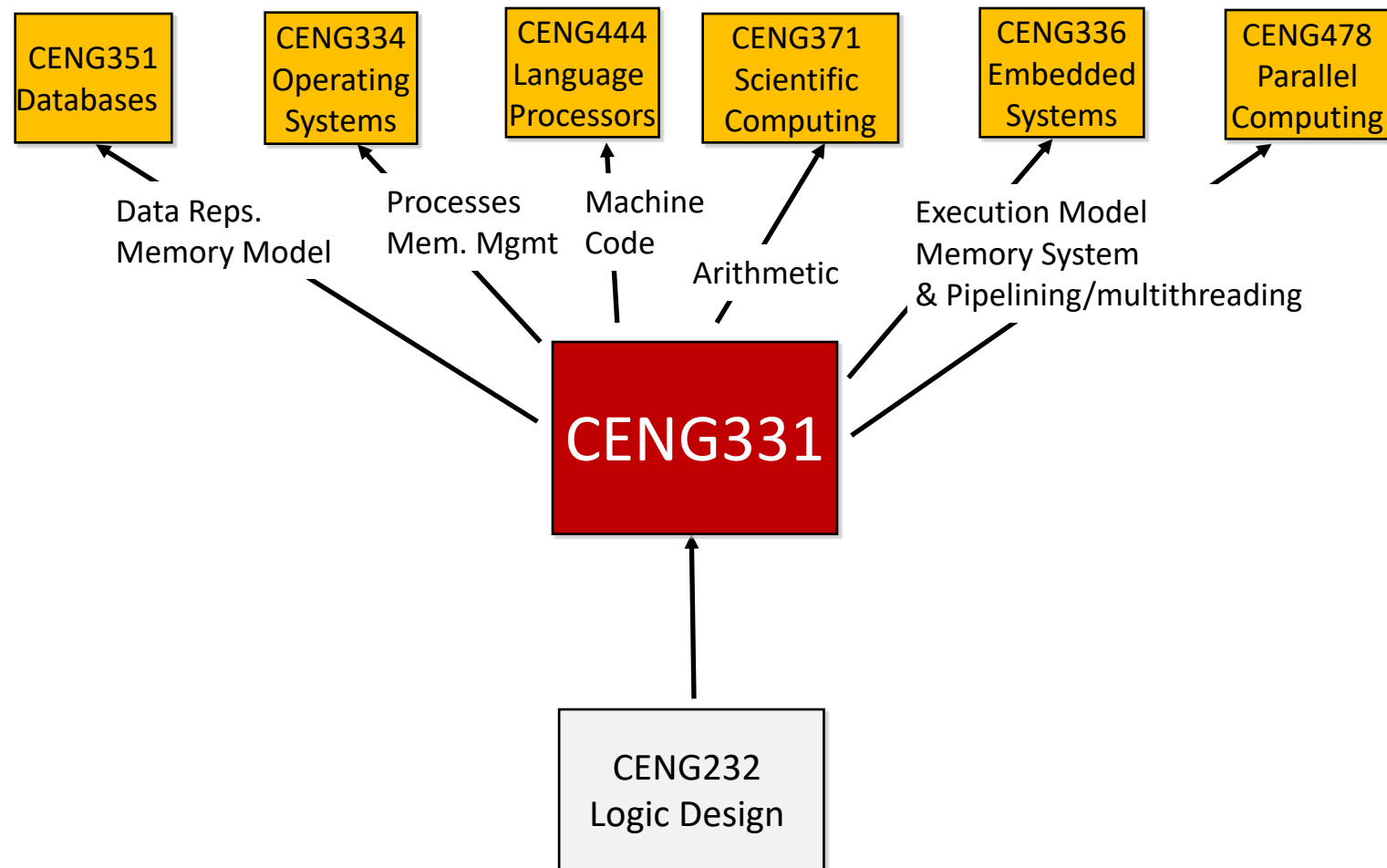
Course Perspective

- 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.)

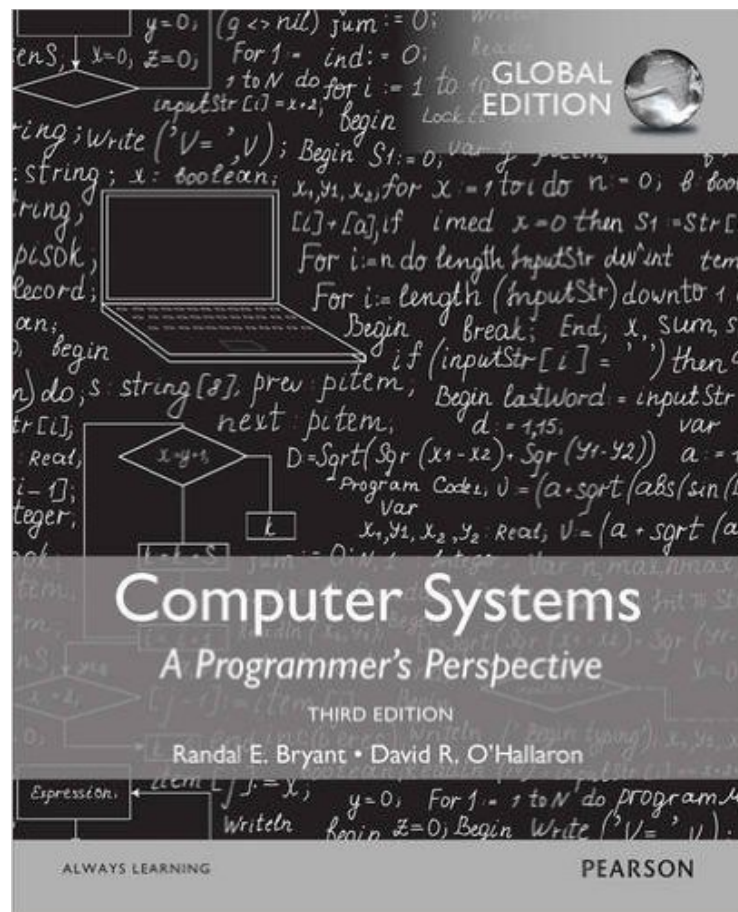
- Our Course is Programmer-Centric
 - Purpose is to show that by knowing more about the underlying system, one can be more effective as a programmer
 - Enable you to write programs that are more reliable and efficient
 - Cover material in this course that you won't see elsewhere
 - Not just a course for dedicated hackers
 - We bring out the hidden hacker in everyone!

Role within CENG curriculum

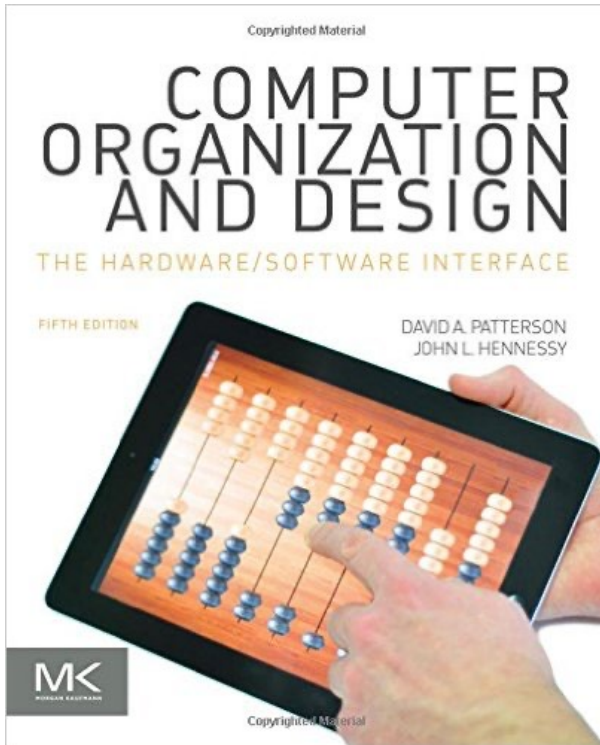


Textbook

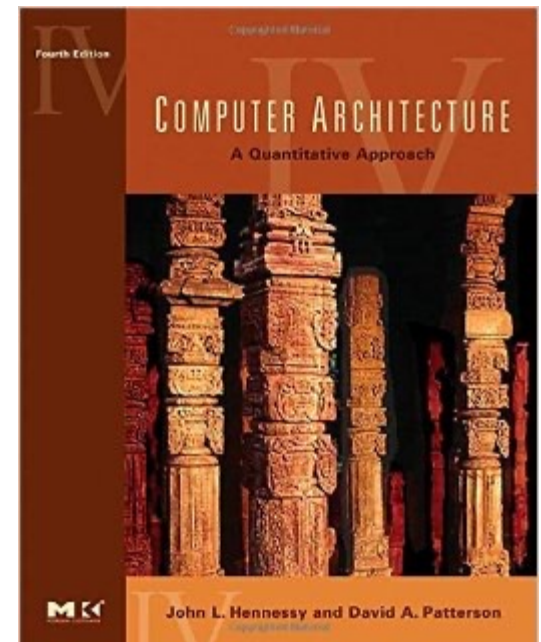
- Randal E. Bryant and David R. O'Hallaron,
 - *Computer Systems: A Programmer's Perspective*, Third Edition (CS:APP3e), Pearson, 2016
 - <http://csapp.cs.cmu.edu>
 - This book really matters for the course!
 - How to solve labs
 - Practice problems typical of exam problems



Reference Texts



- Computer Organization and Design: Hardware/Software Interface by Patterson and Hennessy
- Computer Architecture: A Quantitative Approach by Patterson and Hennessy



Course Components

■ Lectures

- More emphasis on the theoretical concepts
- In-class (& broadcast Lectures via Zoom)

Monday 10:40-13:30 in BMB1

Thursday 11:40-12:30 in BMB1

■ Quizzes

- In-class only (a few short questions at the end of the class)
- Graded in *ternary*

■ 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
- On campus

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, **Physiological Science in
the Public Interest**

Tools and Getting Help

- Odtuclass : <http://odtuclass.metu.edu.tr>

- Course discussion forums, documents, announcements, labs and their grades

- 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.

Our team:

TAs:

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Instructor:

Murat Manguoğlu (manguoglu@ceng.metu.edu.tr)

Policies: Take-home lab assignments and in-class exams

■ 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 on campus
- Closed books, notes, internet but you can bring an A4 size handwritten cheatsheet

Makeups

There are no makeups unless:

- Overlapping exams, Major illness, death in family, ...etc.
 - Inform and if needed submit an official report to the instructor (for the exams) and to the TAs (for the labs) as soon as possible

Policies: Grading

■ Quizzes (10%)

- Random, on campus (in-class, towards the end of the class)
- Approximately ~7-10 quizzes
- Ternary grading scheme (2: correct 1: partially correct 0: completely wrong or not attended)

■ Take-home Lab Assignments (24%)

- 4 x 6% for each lab
- 1st and 2nd lab grades will be $(0.6 * \text{Lab} + 0.4 * \text{Lab-quiz})$, must collect at least half of full lab grade to be able to attend the quiz of the respective lab

■ Written Exams (on campus):

- Midterm (30%)
- Final (36%) [Requirement for attending the final exam: 10% from the labs (i.e. 10/24) , otherwise you will not be able to attend the final and receive NA grade for the course].

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)

- Reliability and fault tolerance

Lab 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 honorable 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."

Our pledge to you

- Lectures are only as long as specified in METU catalog (3 hours/week)
- We are severely resource constrained, we will try our best to:
 - Quick response to questions
 - Fair and timely grading and feedback

Welcome and Enjoy!