Course materials on **Canvas:**

https://utexas.instructure.com/courses/1101483

**Course syllabus and Lecture Notes:**

http://www.cerc.utexas.edu/~jaa/ee306/

Discussion forum for course using **Piazza:**

https://piazza.com/utexas/fall2014/ee306abraham/home
Course Information

Instructor

Jacob A. Abraham, POB 6.124A, 512-471-8983, jaa@cerc.utexas.edu
Office Hours: 10:00 am - 12:00 noon, RLM

Teaching Assistants

- Shahrzad Mirkhani
- Shounak Dhar

Textbook

Course Topics

First 10 chapters in textbook

- Bits, Data Types, and Operations
- Digital Logic Structures
- The Von Neumann Model
- The LC-3
- Programming
- Assembly Language
- I/O
- TRAP Routines and Subroutines
- And, Finally...The Stack
Course details

Class meets MW 8:30 – 10:00 am, CMA 2.306

No attendance taken, but lectures are crucial for understanding the material covered in the class

Discussion sessions on Fridays (attend session of your choice, but can only collect graded assignments from TAs for this class)

Prerequisites

- None, and no programming experience is assumed
- Students need to be highly motivated
- Need to put in the time and energy to support motivation

Homework Policy

- 6 Homework assignments
- Students encouraged to form study groups
  - Turn in only one copy for the group
5 programming assignments

- May discuss structure of the program with other members of group
- However, the detailed algorithm and actual coding must be individual
- See handout, Overview of EE 306 for more information on what constitutes cheating

Exams

- Two exams in class, October 22, November 24
- Final Exam, December 12

Exams are closed book. You may bring in three sheets of paper, on which is written anything you wish, in your own handwriting.
Course Grade

- Homework (problem sets) (2% each, times 6 assignments): 12%
- Programming assignments (4% each, times 5 assignments): 20%
- Two in-class exams (18% each): 36%
- Final exam: 25%
- Other: 7%

Problem sets must be turned in before class on the due date
Programming assignments are due by 11:59 pm on the due date
About the Instructor

- Born in Kerala, India
- Bachelor’s degree in Engineering, University of Kerala, 1970
- M.S. Stanford, 1971
- Wrote production code in Assembly Language for Hewlett-Packard as part of a summer job
- Ph.D., Stanford, 1974
  - Electrical Engineering, with a minor in Computer Science
- Taught at the University of Illinois, 1975 – 1988
- At UT Austin since 1988
- Academic interests: VLSI design, test and verification; fault tolerance; security

Home page: http://www.cerc.utexas.edu/~jaa/
Objectives of the Course

- Serious introduction to the fundamental underpinnings of computing
- Bottom-up approach to understand how computers work
- Understanding of computer hardware
- Sufficient programming methodology to get a computer to do useful work
- Student should gain a deeper understanding of why and how computers work
What is Expected?

Of You

- Read the textbook
- Lectures, discussion sessions, textbook and homework assignments are all different ways to help learn the material
- Work in groups to do the homework problems – learn from each other
- Learn the fundamentals – this will help you greatly in future classes

Of the Instructor

- Help you learn the material – lectures, office hours, special sessions
- Help you get through this class
- Help you to learn to think – a skill which will be useful throughout one’s life
Computers are Everywhere

Google’s autonomous car

Internet map
(source: Wikipedia)
Automobile Electronics

Source: Clemson University
Smart Homes
Universal Computing Device

PDA

Workstation

UT Ranger Supercomputer
One of the First Computers

ENIAC
“Smarter” than Humans?

IBM Watson

Jeopardy Champion
Integrated Circuits of the Future?

Star Fleet Tricorder, 2383

Star Trek Tricorder

X-Prize Challenge

The X PRIZE Foundation and Qualcomm Join Forces to Develop a Competition to Enhance Integrated Digital Health

Playa Vista, CA (May 10, 2011) - The X PRIZE Foundation, the leading nonprofit organization solving the world’s Grand Challenges of our time by creating and managing large-scale, global incentivized competitions, today announced a collaboration with Qualcomm incorporated to design the Tricorder X PRIZE, a $10 million prize to develop a mobile solution that can diagnose patients better than or equal to a panel of board certified physicians. The X PRIZE Foundation and Qualcomm seeks to achieve this by combining advancements in expert systems and medical point of care data such as wireless sensors, advancements in medical imaging and microfluidics.

The Tricorder X PRIZE aims to incentivize consumer empowerment in healthcare by extending the reach of health information and services to more people. This prize will bring understandable, easily accessible health information and metrics to consumers on their mobile devices, pointing them to earlier actions for care.
TURING MACHINE
- MATHEMATICAL MODEL
  OF A DEVICE THAT CAN
  PERFORM ANY COMPUTATION

COMPUTER --- UNIVERSAL TURING
MACHINE
Big Idea #2: Transformations Between Layers

Problems

Algorithms

Language

Instruction Set Architecture

Microarchitecture

Circuits

Devices
Deeper and Deeper...

**Instr Set Architecture**

**Processor Design:**
choose structures to implement ISA

**Microarch**

**Logic/Circuit Design:**
gates and low-level circuits to implement components

**Circuits**

**Process Engineering & Fabrication:**
develop and manufacture lowest-level components

**Devices**
DECIMAL: 0, 1, 2, ..., 8, 9 \rightarrow\text{BASE 10}

3142 \rightarrow\text{BASE 10}

\begin{align*}
10^3 & | 1 \downarrow 1 \\
10^2 & | 1 \downarrow 1 \\
10^1 & | 1 \downarrow 1 \\
10^0 & | 1 \downarrow 1 \\
\end{align*}

WHAT IS THIS IN BASE 5?

\begin{align*}
3142 & _5 \\
\downarrow \downarrow \downarrow \downarrow & _5 \\
5^3 & | 3 \downarrow 1 \\
5^2 & \downarrow 4 \\
5^1 & \downarrow 2 \\
5^0 & \downarrow 0 \\
\end{align*}

= 42210

IN DECIMAL?

\begin{align*}
10^2 & | 4 \downarrow 1 \\
10^1 & | 2 \\
10^0 & | 1 \\
\end{align*}

ROMAN

\underline{IVX}
REPRESENT NUMBERS IN THE PHYSICAL WORLD

CONTROLLING THE FLOW OF ELECTRONS

\( \Rightarrow \) LOOK AT VOLTAGE

\( \Leftarrow \) PRESENCE \( \Rightarrow \) CALL IT "1"

ABSENCE \( \Leftarrow \) CALL IT "0"

ANALOG

\( \text{VOLTS} \) 1 VOLT

BINARY

\( \text{1 VOLTS} \)

"0" 1 ILLEGAL

BINARY DIGIT = BIT: 0, 1

2 BITS: 00, 01, 10, 11

2^2

3 BITS (OCTAL): 000, 001, 010, 011, 100, 101, 110, 111

2^3

n BITS \( \Rightarrow \) 2^n VALUES

CAN REPRESENT

\( \text{NUMBERS} \)

\( \text{TEXT} \)

\( \text{IMAGES} \)

\( \text{SOUND} \)

\( \text{LOGIC} \)