Course Description

Number: ENGR 460 (Section 01)

Title: Computing Systems: Organization and Design

Credits: 4 credits

Course Format: Two two-hour lectures per week.

Coordinator: Claudio Talarico, Ph.D., Assistant Professor
Computer Engineering Building, Room 336
e-mail: ctalarico@ewu.edu  Tel.: 509-359-4780

Catalog Description:
The aim of this course is to provide students with the theoretical and practical knowledge required for analyzing and designing complex computing systems. Emphasis is on the impact that the organization and interfacing of hardware/software components have on system performance.

Learning Objectives (and corresponding mapping to ABET Criteria 3):

1. Explain the role of abstraction in the design of large digital systems, and explain the major software and hardware abstractions in contemporary computer systems (ABET 3c, 3j).
2. Design the architecture and organization of the basic components of a computer system (ABET 3e).
3. Analyze the performance of computing systems using measures such as latency and throughput (ABET 3a).
4. Use probabilistic and statistical methods to evaluate the performance of software and/or hardware systems (ABET 3a).
5. Enhance a computer system by modifying its software and hardware components after evaluating the interaction between them (ABET 3e).
6. Design the logic circuits that form the basic building blocks of a computer system using HDLs (ABET 3a, 3c).
7. Design, implement, evaluate and verify the operation of digital systems (ABET 3a, 3c).
8. Model a simple pipelined CPU with a given RISC-based instruction set at the register transfer level (ABET 3j, 3k).
9. Demonstrate independent learning by using unfamiliar software tools to design, evaluate and verify digital computing systems (ABET 3i, 3k).
10. Model and evaluate memory hierarchy and organization (ABET 3a).


Prerequisites: ENGR 260 (Microprocessors), CSCD 255(C Programming for Engineers) or consent of the instructor.
Topics:
- Basic elements of computing systems
- Instruction Set Abstraction
- Reduced instruction set computers vs. complex instruction set computers
- Assessing and Understanding Performance
- Processor organization and design: data path and control unit
- Exploiting parallelism: Pipelining
- Memory Hierarchy

Computer Usage:
2. Homework and open-ended project design project involve writing formal technical reports that requires the use of word processing and graphics software for their presentation.

Laboratory:
Students work in an unsupervised open lab to complete assignments/projects.

Grading:
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\begin{align*}
A &= 3.5\text{–}4.0 \ (90\text{–}100\%), \\
B &= 3.0\text{–}3.4 \ (80\text{–}89\%), \\
C &= 2.0\text{–}2.9 \ (70\text{–}79\%), \\
D &= 1.0\text{–}1.9 \ (60\text{–}69\%), \\
F &= 0.0 \ (0\text{–}59\%)
\end{align*}
\]
- Assignments: 20%
- Midterm exam: 20%
- Final exam: 20%
- Project: 40%

Course Outcomes and mapping to ABET Criteria 3:
- An ability to apply knowledge of mathematics, science, and engineering.
  Students are required to use their background in mathematics, physics and engineering to successfully finish homework, and exams.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
  n/a.
- An ability to design a system component, or process to meet desired needs within realistic constraints.
  Homework, exams and open ended project require students to analyze, design, evaluate, and improve the various components forming a computer with the goal of meeting specified constraints.
- An ability to function effectively on multi-disciplinary teams.
  n/a
- An ability to identify, formulate, and solve engineering problems
  An open-ended project requires students to identity, formulate, model and solve several engineering challenges.
- An understanding of professional and ethical responsibility.
  n/a
- An ability to communicate effectively.
  Each group needs to communicate effectively to successfully specify, develop and document a final open-ended project.
- Understand impact of engineering solutions in a global, economic, environmental and societal context
  Students will be able to understand and explain the many changes and global implications that the development of computing systems had over the past decades.
i. A Recognition of the need for, and an ability to engage in life-long learning
   Students must plan the design and development of an open-ended project and self-learn several
   CAD tools.

j. A Knowledge of contemporary issues
   Homework, exams, and open-ended project focus on current issues and modern developments in the
   field of computer systems

k. An ability to use the techniques, skills and modern engineering tools necessary for engineering
   practice.
   A Final open-ended project requires the use of modern methodologies and CAD tools.

Prepared by: Claudio Talarico
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