# Syllabus
# Designing Embedded Computing Environments
# COMP 514/ ECE 514

Professor Krishna V. Palem

## Introduction

The well-known Moore's Law, which states that given a fixed cost, microprocessor performance doubles approximately every 18 months, also implies that for a fixed performance, the cost of computing declines by about 35% per year. Over the past decades, this has led to a significant drift in the center of gravity of computing, from mainframes down to the personal computers. Increasingly, it is evident that this shift will move the center of gravity into computing, embedded in numerous small pervasive computers that control processes and environments. All indications are that there will be an explosion of these technologies in diverse application domains ranging across networking, industrial automation, medical electronics, bio-informatics, and practically all areas of our lives. The terms "pervasive" and "ubiquitous" have been used to describe this mode of computing.

Assuming a background in basic digital logic and programming, this course aims to introduce the students to the major advances and challenges faced by the computing end of this growing field. With a core set of knowledge and a broad overview of the embedded computing space, the students can then go on to research specific areas within this space, or engineer solutions that encompass techniques and applications from this field.

## Course Prerequisites

Computer architecture, high-level programming and programming languages, operating systems, and computer algorithms

## Textbooks

- Computers as Components: Principles of Embedded Computing System Design, Wayne Wolf, ISBN 1-55860-541-X (required)

## Additional Reading

- Engineering a Compiler by Keith Cooper and Linda Torczon, ISBN-10: 155860698X
- Embedded Computing: A VLIW Approach to Architecture, Compilers and Tools by Joseph A. Fisher, Paolo Faraboschi, Cliff Young. ISBN-10: 1558607668
- Optimizing Compilers for Modern Architectures: A Dependence-based Approach by Randy Allen and Ken Kennedy, ISBN-10: 1558602860

# Lecture Schedule

| Title | Readings* |
|---|---|
| Overview & Admin | WW-ch 1, 3 |
| Evolution of ILP | WW-ch 1, 3 |
| ISAs | WW – ch 2 & FFY ch 3 |
| Trimaran Introduction | Supp |
| EPIC- HPL-PD | Supp |
| Instruction Scheduling (with emphasis on VLIW) | Supp, CT ch 12 & FFY ch 8 |
| Register Allocation | Supp & CT ch 13, FFY ch 8 |
| Loop and Data Optimizations | Supp & KA ch5 and ch 6 |
| Lego Mindstorms Intro | WW – ch 6 & Supp |
| Real-Time OS | WW - ch 6 |
| ***Project Review*** | ***N/A*** |
| Computer Networks | WW – ch 8 |
| VHDL | Supp & ch 4 |
| FPGAs | Supp |
| HW/SW Codesign | Supp & WW – ch 9 |
| Reconfigurable Embedded Systems | Supp |
| Polymorphic Computing | Supp |
| Architecture Synthesis/Assembly<br>Design Space Exploration | Supp |

- WW: Computers as Components: Principles of Embedded Computing System Design, Wayne Wolf, ISBN 1-55860-541-X
- CT: Engineering a Compiler by Keith Cooper and Linda Torczon, ISBN-10: 155860698X
- FFY: Embedded Computing: A VLIW Approach to Architecture, Compilers and Tools by Joseph A. Fisher, Paolo Faraboschi, Cliff Young. ISBN-10: 1558607668
- KA: Optimizing Compilers for Modern Architectures: A Dependence-based Approach by Randy Allen and Ken Kennedy, ISBN-10: 1558602860
- Supp: supplemental information i.e. web pages, tech reports/papers, online docs, etc.

# Grading Policy

The breakdown of the final grade will be as follows

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|---|---|
| Labs and Homeworks | 30% |
| Term Report and Project | 50% |
| Final | 20% |

# Contact Information and Office Hours

| Professor: Krishna V. Palem | Course Assistant: Lakshmi Chakrapani |
|---|---|
| 3057 | Room: 3051 |
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| Office Hours: W 2-4 | Lab Hours: W 3-4:30 |
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