

# Course Introduction

Lecture 1

# Course Outline

- Digital Hardware Design
  - Programmable Logic Devices (PLDs)
    - FPGA (Field-Programmable Logic Array) vs. CPLD (Complex Programmable Logic Array)
    - CPLD Architecture
    - LUTs and FPGA Architecture
  - Combinational and Sequential Design
    - Logic Design with LUTs
    - Arithmetic Circuits, Memory, I/O systems
  - Hardware Description Languages
  - Software Tools
    - FPGA Design Flow
    - Timing Analysis
- Mixed Signal Design and More Advanced Topics
- Projects/Labs

# Tentative Timeline

Midterm Project Oct 22

Final Project

- Proposal: Oct 29
- Components list: Nov 12
- Final Presentation/Demo: Dec 3-10

# Hardware & Software Requirements

## **Xilinx Vivado Design Suite**

### **System Requirements for Xilinx Vivado Design Suite**

OS: 64bit Windows or Linux (CentOS)

RAM: Minimum 4GB (recommended 8GB)

Disk space: About 35 GB

### **Target FPGA development board is provided**

Xilinx Zynq®-7000 SoC Evaluation and Development Board or [ZedBoard](#)

[https://reference.digilentinc.com/\\_media/zedboard:zedboard\\_ug.pdf](https://reference.digilentinc.com/_media/zedboard:zedboard_ug.pdf)

# Objectives of this course

- Provide the foundation for FPGA design in embedded systems
  - What is an FPGA?
  - How was the technology developed?
  - How to select the best FPGA architecture for a given application?
  - How to use the software tools
- Learn about the tools for FPGA development for creation of prototypes or products for a variety of applications.
- Solve critical digital design problems using FPGAs.

# Why FPGAs?

- The latest FPGAs have as many as 20 million gates.
- They are displacing **Application Specific Integrated Circuits** (ASIC) in most applications because:
  - time to market is faster and
  - capability is nearly the same.
- Programmable Logic Provides:
  - Design with ultimate flexibility
  - Allowing the part to provide almost any digital function.
  - Combined with Hard Core IP to make a **System on a Chip** (SoC), which
    - Allow quick development of
    - very sophisticated products at
    - relatively low cost.

# Where are FPGAs Used?

- Programmable logic devices (PLDs) are rapidly becoming prevalent in most electronic products constituting a \$6 billion a year business and are expected to grow to \$10 billion a year by 2020.
- They are the key technology enabling many new product developments in the near future, including:
  - Autonomous vehicles
  - The Internet of things
  - Secure data centers and cloud computing
  - Robotics
  - Machine vision and learning
  - Renewable energy
  - Home automation
  - 8K video and video surveillance
  - Facial recognition and bioinformatics
  - 5G cellular networks and
  - Smart medical diagnostics

# Xilinx Software Tools

## Vivado Design Suite Installation and Licensing

- <https://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/vivado-design-tools.html>
- <https://www.xilinx.com/support/documentation-navigation/design-hubs/dh0013-vivado-installation-and-licensing-hub.html>
- [https://www.xilinx.com/support/documentation/sw\\_manuals/xilinx2018\\_1/ug973-vivado-release-notes-install-license.pdf](https://www.xilinx.com/support/documentation/sw_manuals/xilinx2018_1/ug973-vivado-release-notes-install-license.pdf)
- <https://www.xilinx.com/products/design-tools/vivado/memory.html>