DIGITAL DESIGN AND COMPUTER ORGANIZATION

Introduction

Reetinder Sidhu

Department of Computer Science and Engineering

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Department of Computer Science and Engineering

What is Engineering?

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Engineering

- From latin **ingenium**: innate *talent/capacity/intelligence*

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Objective of Engineering?

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Objective of Engineering?

- Optimize fundamental physical quantities of *time, space and energy*

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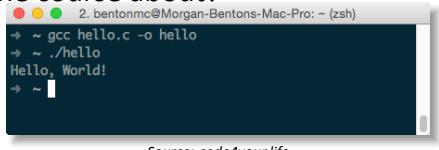
Objective of Engineering?

- Optimize fundamental physical quantities of *time, space and energy*
- In current course, *increase logic circuit speed, decrease logic resources required* and *decrease power consumed*

Digital Design and Computer Organization

What is the course about?

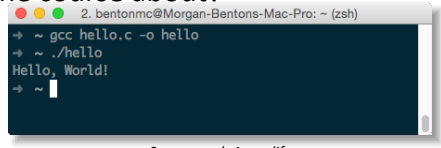
- Digital Design and Computer Organization: What is the course about?



Source: code4your.life

What is the course about?

- Digital Design and Computer Organization: What is the course about?
- You have learnt programming in C
  - Compile hello_world.c
  - Running program outputs “Hello World!”



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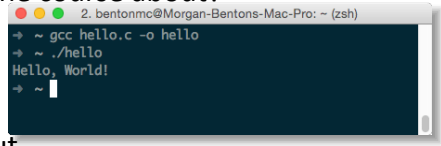

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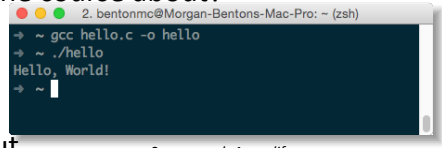

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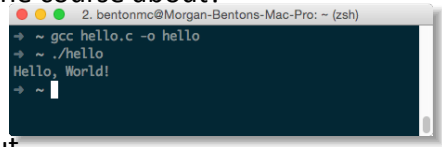

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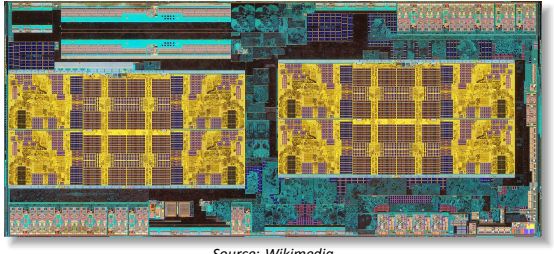
- From starting a program to the time it displays output...
- What goes on inside your computer?
- That in a nutshell is what DDCO is about
- Design, organization and operation of various components in your computer at different levels of abstractions

Microprocessor Operation

- AMD Ryzen 3 1200 (Zen microarchitecture) microprocessor die photo:



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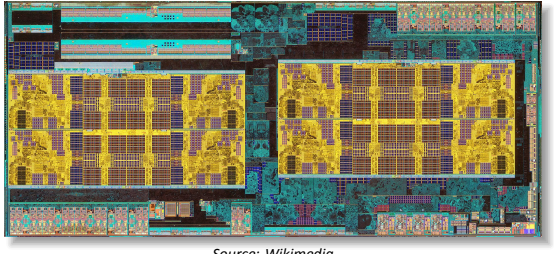

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  - Quad core, 5 billion transistors
  - How does it run hello world?

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Why Study DDCO?

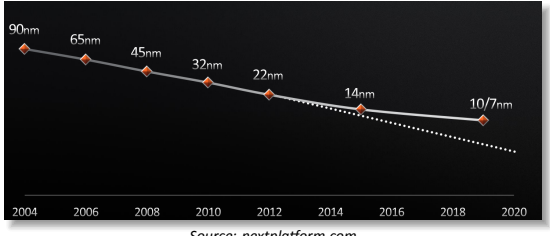
Understanding of hardware essential to design good software

Logic design and implementation roles in industry and academia

Microprocessor performance not increasing as it used to...

Moore's Law

- **Moore's Law** Every 18 months or so:
  - Number of transistors (per unit chip area) doubles
  - Transistor speed doubles
  - Transistor power consumption halves
- Moore's law is slowing down:



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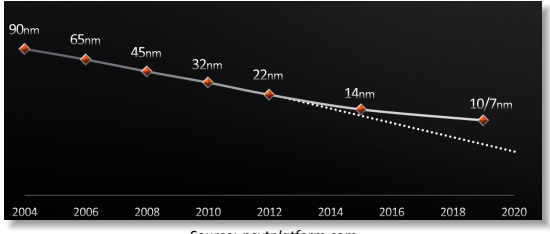

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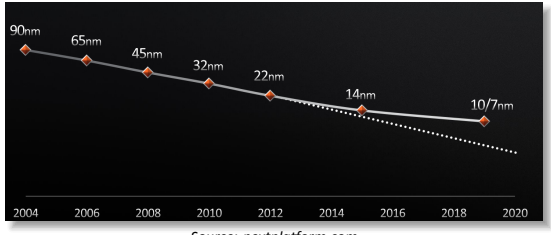

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  - Greater understanding of hardware required to improve performance
  - Increasing importance of custom hardware accelerators (like Google Tensor Processing Units)

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Course Structure

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- Digital Design
  - Combinational logic design
  - Sequential logic design

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Course Structure

- Digital Design
  - Combinational logic design
  - Sequential logic design
- Computer Organization
  - Architecture (microprocessor instruction set)
  - Microarchitecure (microprocessor operation)