



# DIGITAL DESIGN AND COMPUTER ORGANIZATION

## Introduction

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**Reetinder Sidhu**

Department of Computer Science and  
Engineering

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## What is Engineering?

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Engineering

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### Objective of Engineering?

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



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## What is Engineering?

### Engineering

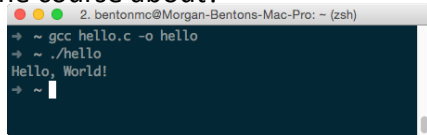
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- To design and build structures and machines (with *skill/art/expertise/ingenuity*)

### 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*

## What is the course about?

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

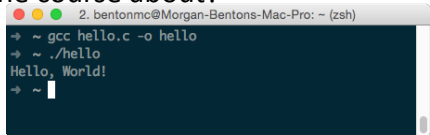


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2. bentonmc@Morgan-Bentons-Mac-Pro: ~ (zsh)
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Hello, World!
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Source: [code4your.life](https://code4your.life)

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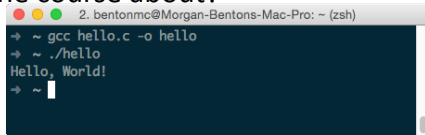


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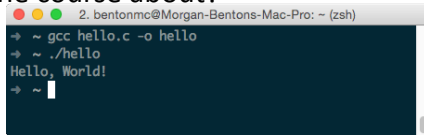


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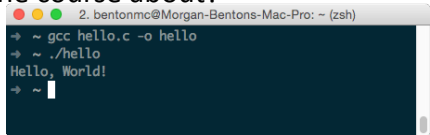


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- From starting a program to the time it displays output...
- What goes on inside your computer?
- That in a nutshell is what DDCO is about
- Design, organization and operation of various components in your computer at different levels of abstractions



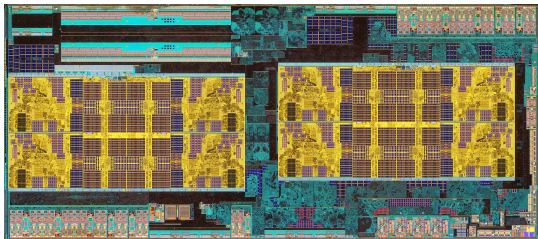
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## Microprocessor Operation

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



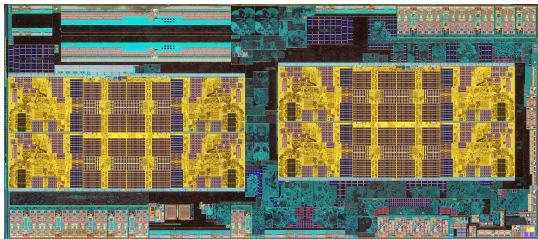
Source: Wikimedia

- ▶ Quad core, 5 billion transistors

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## Microprocessor Operation

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



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



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## Why Study DDCO?

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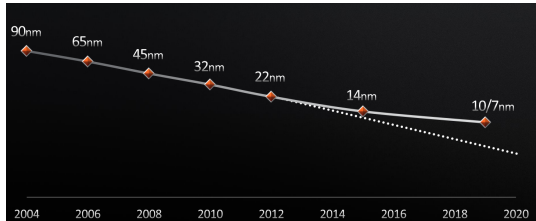
Understanding of hardware essential to design good software

Logic design and implementation roles in industry and academia

Microprocessor performance not increasing as it used to...

## Moore's Law

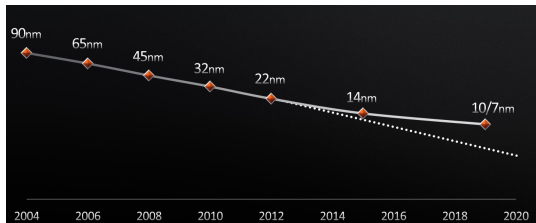
- **Moore's Law** Every 18 months or so:
  - ▶ Number of transistors (per unit chip area) doubles
  - ▶ Transistor speed doubles
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- Moore's law is slowing down:



Source: nextplatform.com

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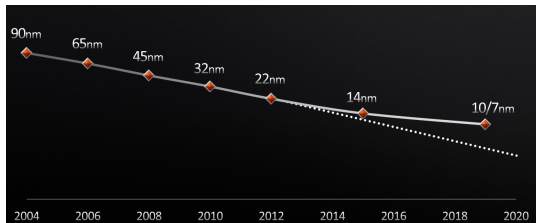


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Source: nextplatform.com

- ▶ 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



- Digital Design
  - ▶ Combinational logic design
  - ▶ Sequential logic design

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  - ▶ Combinational logic design
  - ▶ Sequential logic design
- Computer Organization
  - ▶ Architecture (microprocessor instruction set)
  - ▶ Microarchitecture (microprocessor operation)