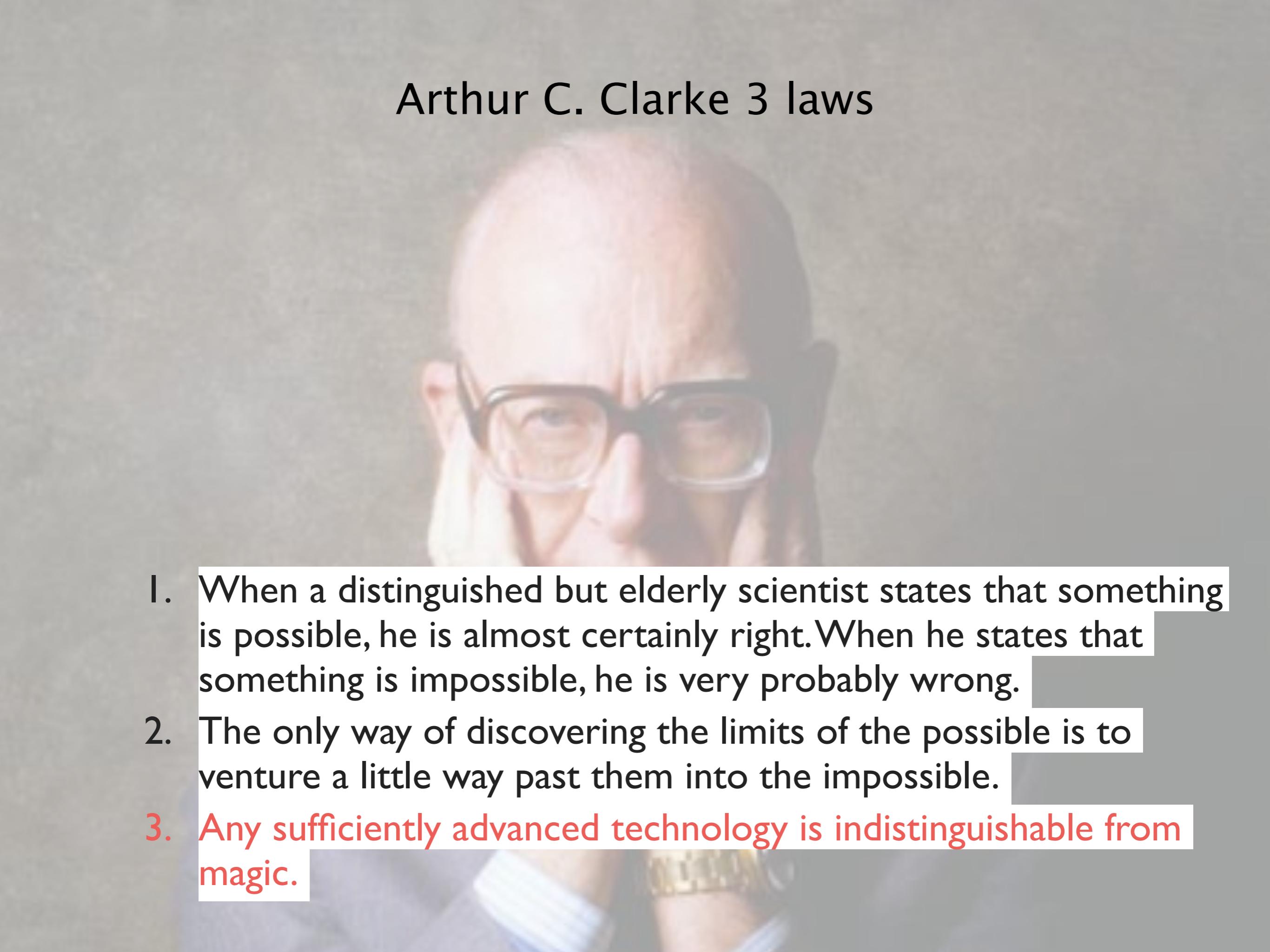


Computer Architecture & Organisation

Dr. Mark Matthews
COMP30660

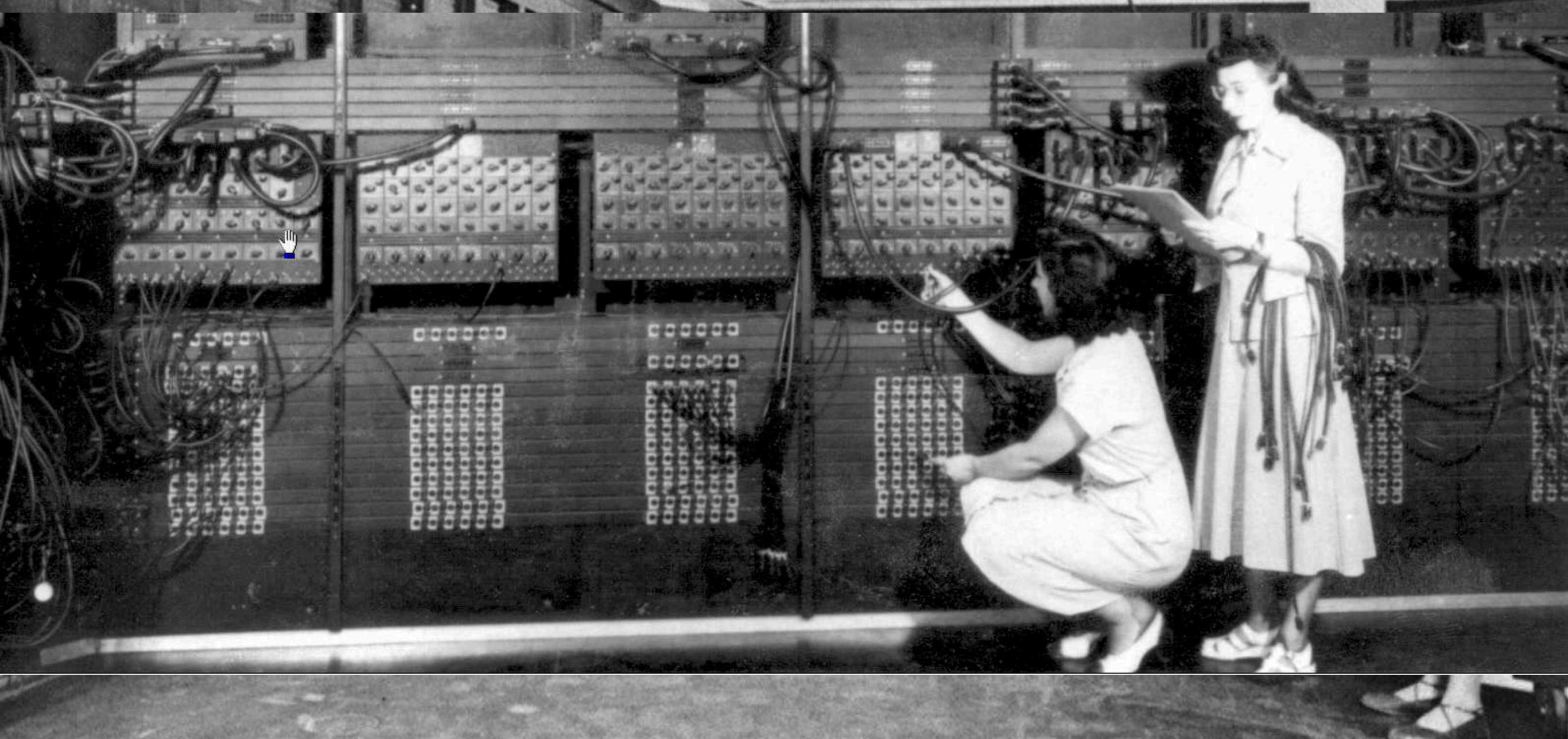
Arthur C. Clarke 3 laws

- 
1. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.
 2. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.
 3. Any sufficiently advanced technology is indistinguishable from magic.



ENIAC

1943-1945



Today

von Neumann

Moore's Law

Amdahl's Law

Module Overview

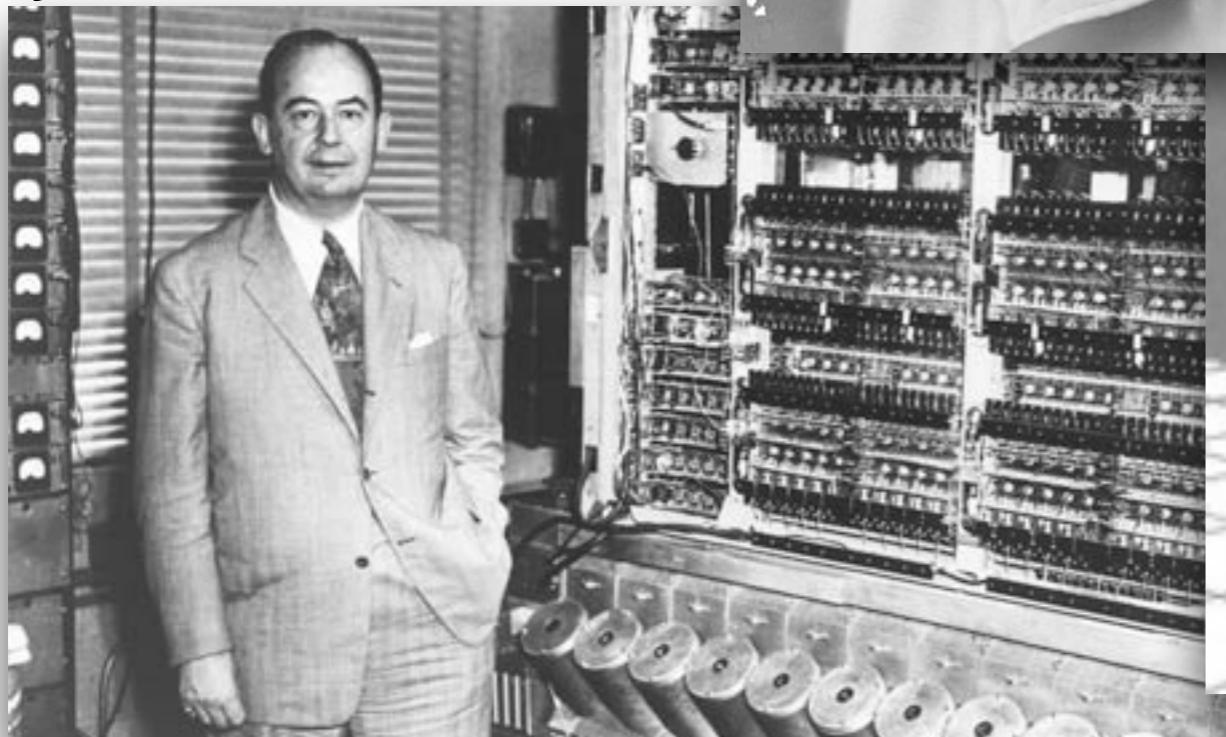
Gordon Moore



Bardeen Shockley & Brattain



John von Neumann



Gene
Amdahl

Computing is too important to be left to men



Ada Lovelace



Grace Hopper
US Navy



Katherine Johnson
NASA

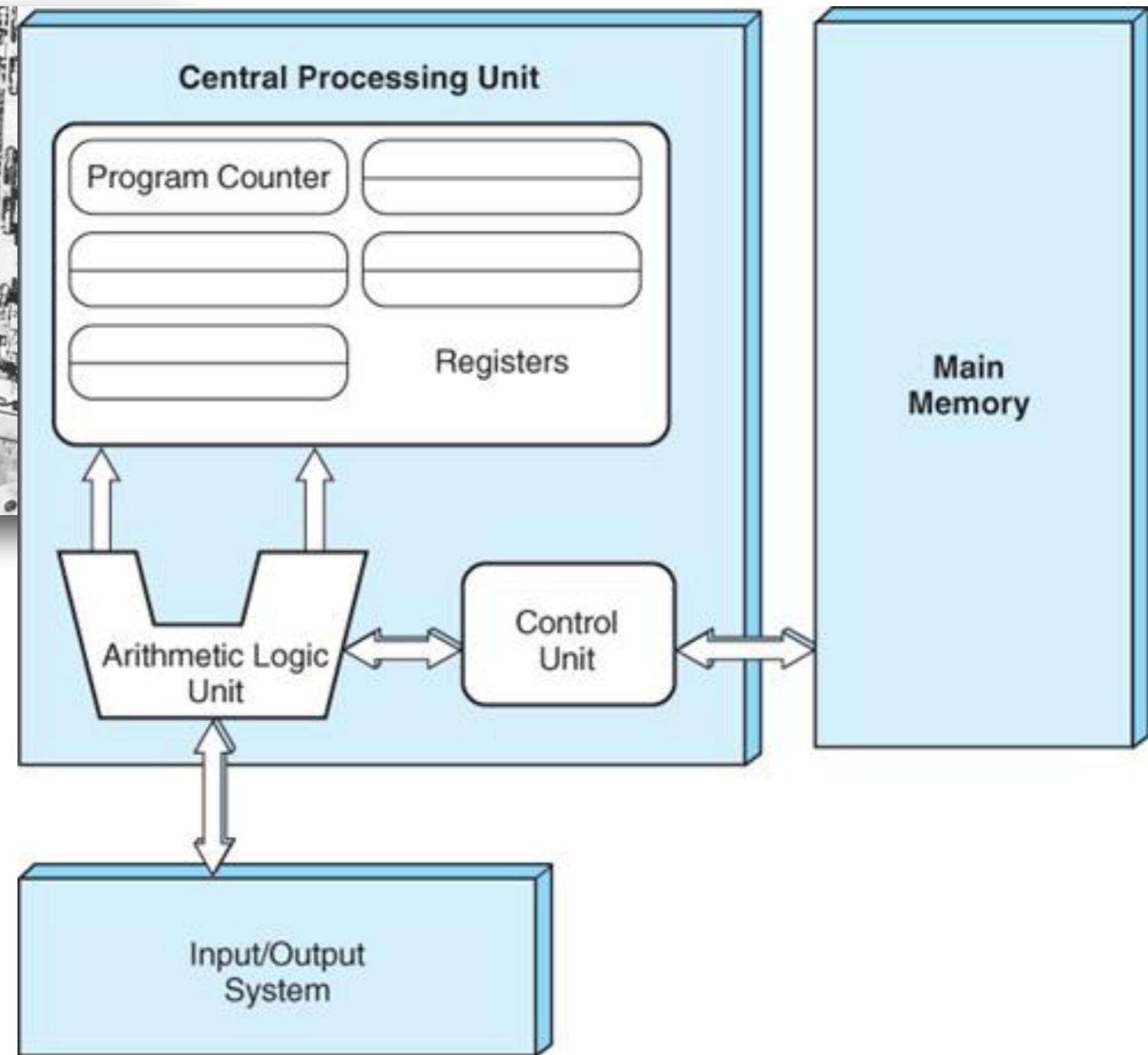
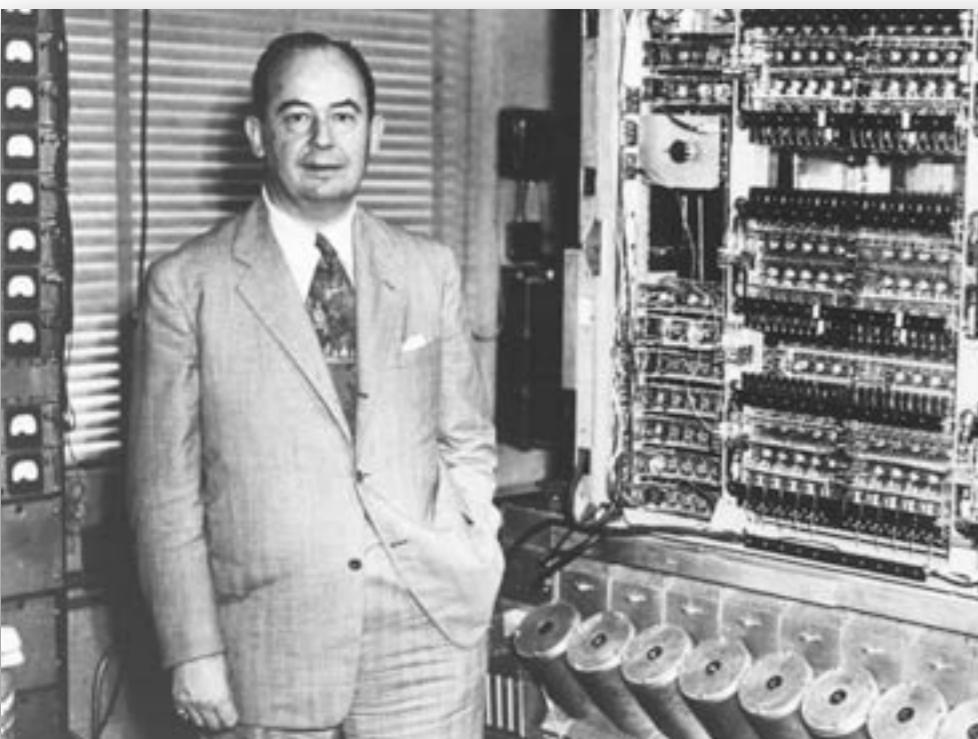


Karen Spärck Jones
Cambridge U

What we will learn today

- Understand the different layers of abstraction in computer systems
- Explain the significance of Moore's Law
- Explain the impact of non-parallelisable code in Amdahl's Law

Von Neumann Architecture



Moore's Law

Gordon Moore 1965

Density of transistors (number per square inch) has doubled every two years since integrated circuits (ICs) invented.

Moore predicted in 1965 that this would continue

Still true

So what?

CPU performance depends a lot on number of transistors and clock speed.

The future

Atomic limitations



Gordon Moore



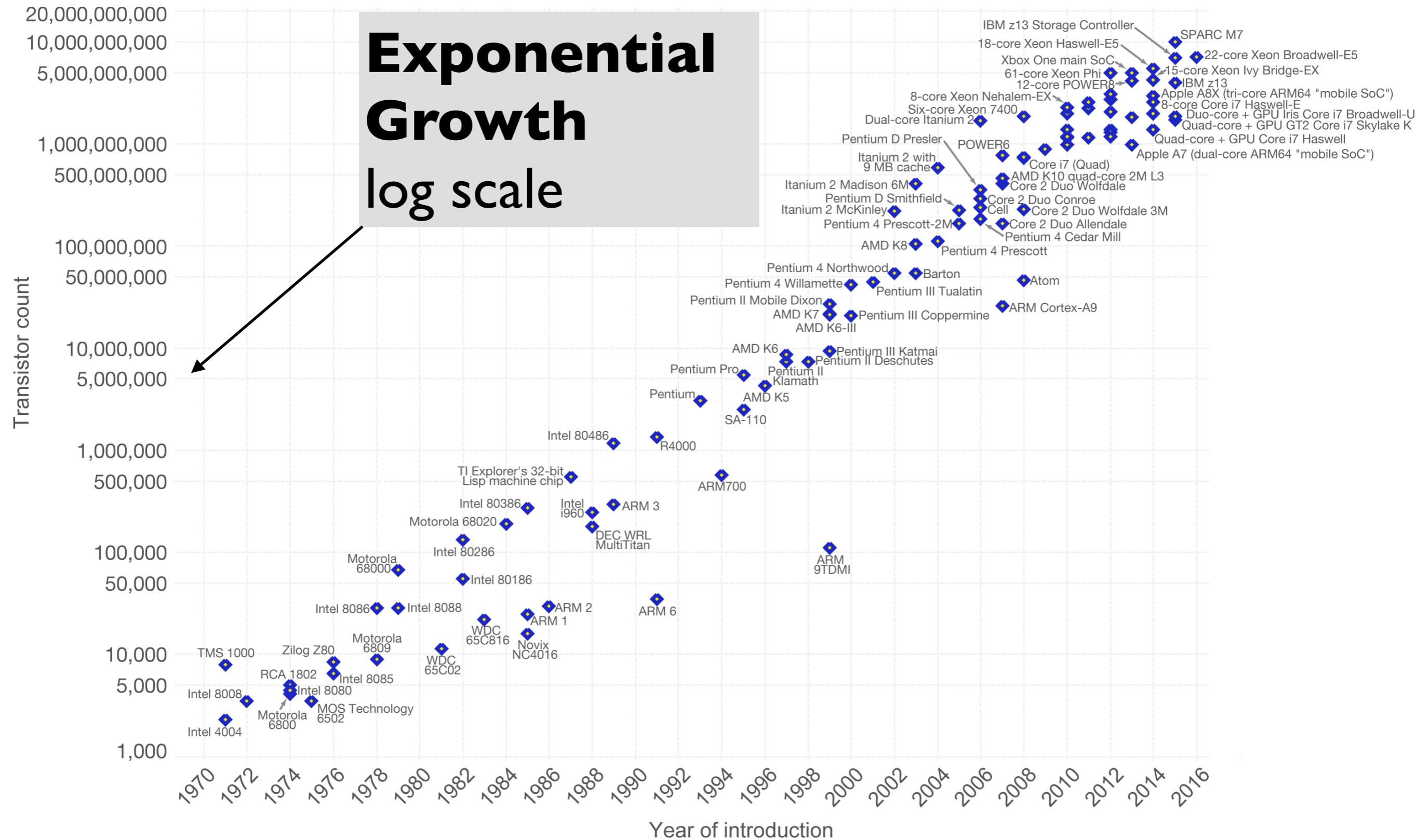
<https://www.youtube.com/watch?v=EzyJxAP6AQo>

Transistors and the end of Moore's Law



<https://www.youtube.com/watch?v=EzyJxAP6AQo>

Moore's Law



Aside: Exponential relationship

Linear growth

$$X_n \propto n$$

Polynomial growth

$$X_n \propto n^p$$

e.g. quadratic $X_n \propto n^2$

Exponential growth

$$X_n \propto k^n$$

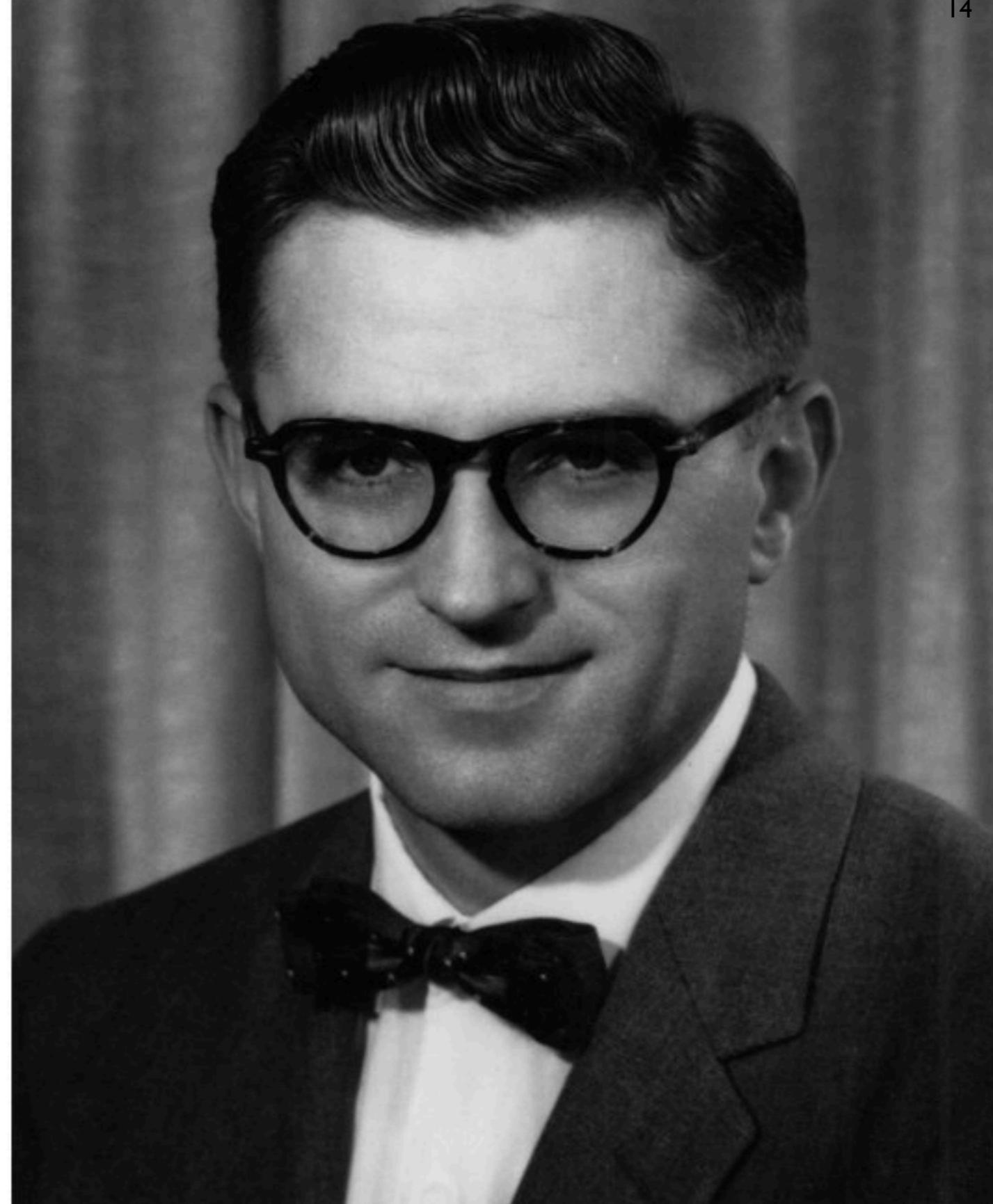
$$X_{n+1} = X_0(1+r)^{n+1}$$

$$X_{n+1} = X_n(1+r)$$

where r is the growth rate



Gene Amdahl 1967



Amdahl's Law

Provides an estimate of the speedup achievable by parallelisation as further resources (CPUs, cores) are added.

$$S_{\text{latency}}(s) = \frac{1}{(1 - p) + \frac{p}{s}}$$

e.g.

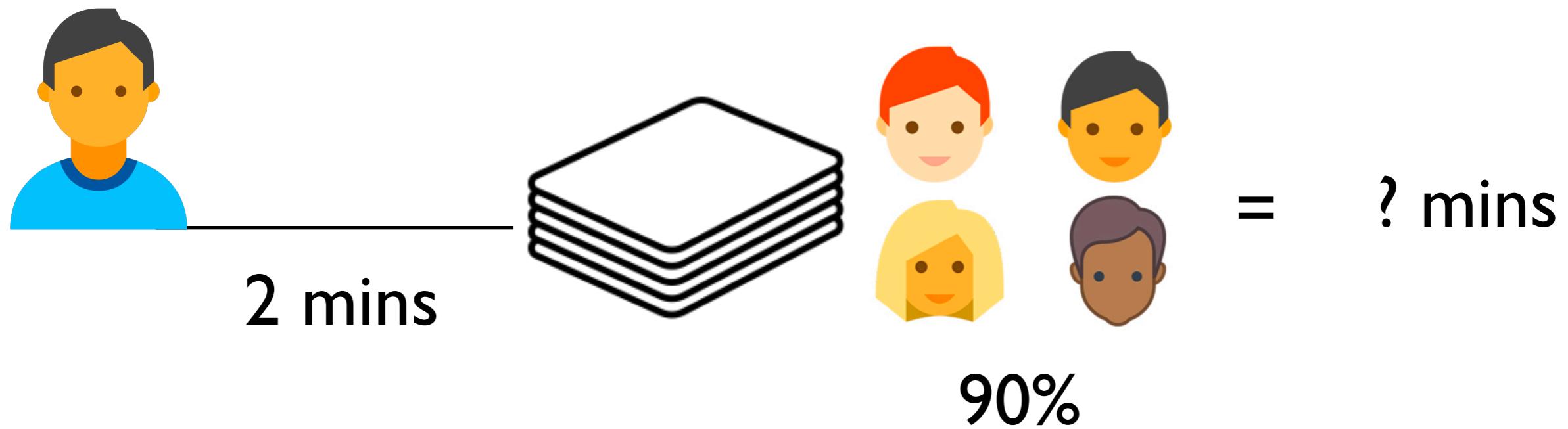
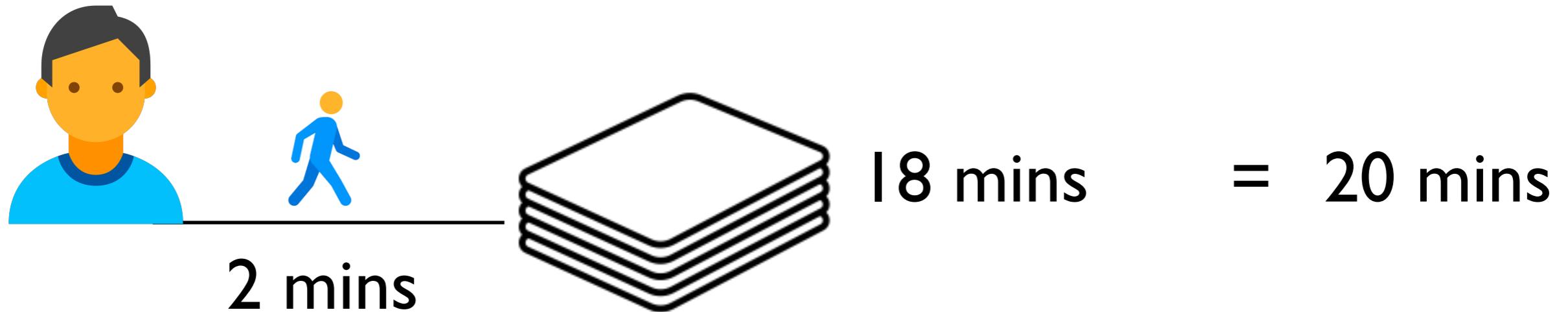
If 90% of a task is parallelisable

It takes 20 minutes to run on a single CPU

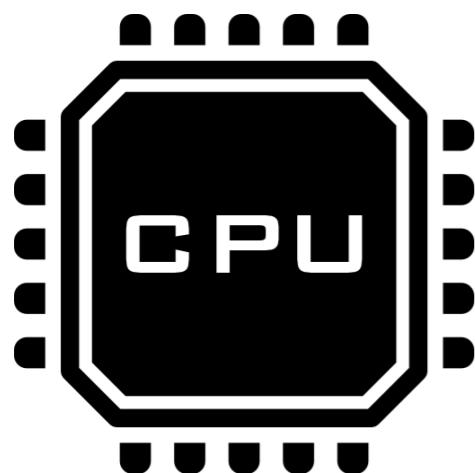
It cannot be speeded up to less than two minutes

More on this later when we look
at multiprocessing in Python

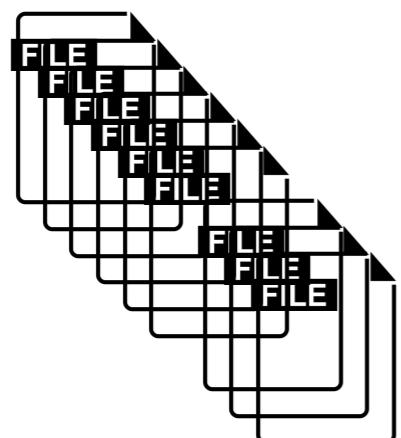
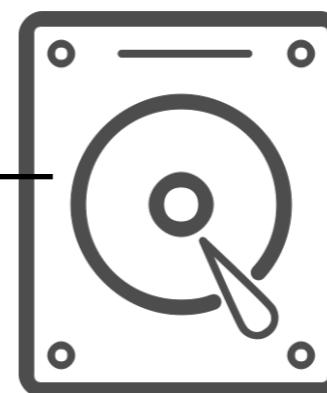
Worked Example



File Processing



Fetch files to
memory



Process

Overview

Introduction

Fundamentals

Number Systems
Logic, Boolean Algebra
Representing Data

The Computer

Processor
Memory Hierarchy
The Software Component
What is a GPU?

Networks & Cloud

TCP/IP Stack
Client Server
Web Services, API
Data Management
Multiprocessing / Threads
Cloud Computing
Virtualisation

Schedule

Two lectures:

Monday 11 - 12pm

Friday 10 - 11am

Tutorials:

Starting Week 2: Wednesday 4pm (Weeks 2-6)

Assessment:

In-class MCQ (Wk6)

2 assignments (Wk8 & Wk10 = 40%)

End of semester exam (60%)

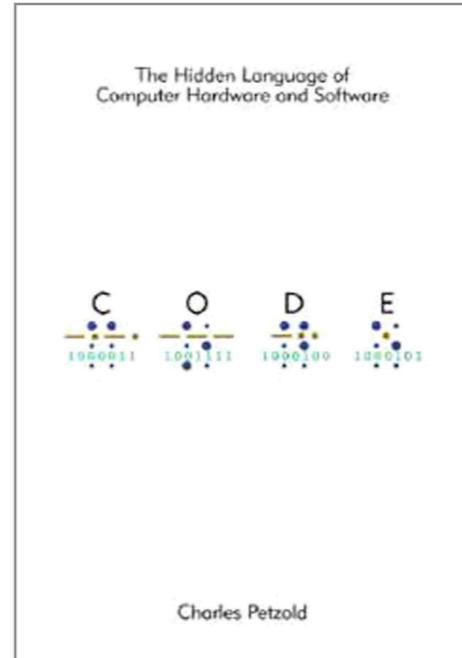
Moodle Page

COMP30660 Computer Architecture Organisation 2018-19

Enrolment Key
“ca2019”

Guides

Books



Code: The Hidden Language of Computer Hardware and Software

The Architecture of Computer Hardware, Systems Software, and Networking:

Video

<computerphile>

<https://www.youtube.com/channel/UC9-y-6csu5WGm29l7JiwpnA>



Plagiarism & UCD Computer Science



Plagiarism is a serious academic offence

[Student Code, section 6.2] or [UCD Registry Plagiarism Policy] or [CS Plagiarism policy and procedures]

Our staff and demonstrators are **proactive** in looking for possible plagiarism in all submitted work

Suspected plagiarism is reported to the CS Plagiarism subcommittee for investigation

Usually includes an interview with student(s) involved

1st offence: **usually** 0 or NG in the affected components

2nd offence: referred to the **University disciplinary committee**

Student who enables plagiarism is equally responsible

http://www.ucd.ie/registry/academicsecretariat/docs/plagiarism_po.pdf

http://www.ucd.ie/registry/academicsecretariat/docs/student_code.pdf

<http://libguides.ucd.ie/academicintegrity>