Inf2C-CS -
Lecture 1
Course overview & the big picture

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Practicalities

- Lectures:
  - In person: Tues & Friday 15:10 – 16:00
  - Lectures recorded and available 24 hours later.
  - Opportunity for questions/interaction!

- Tutorials: weeks 3, 4, 6, 7, 9, 10
  - In person
- Labs: in person drop-in format (starts week 2)
  - Demonstrators available to help
  - Lab exercises (3 in total): tools & concepts to prep for coursework. Not marked

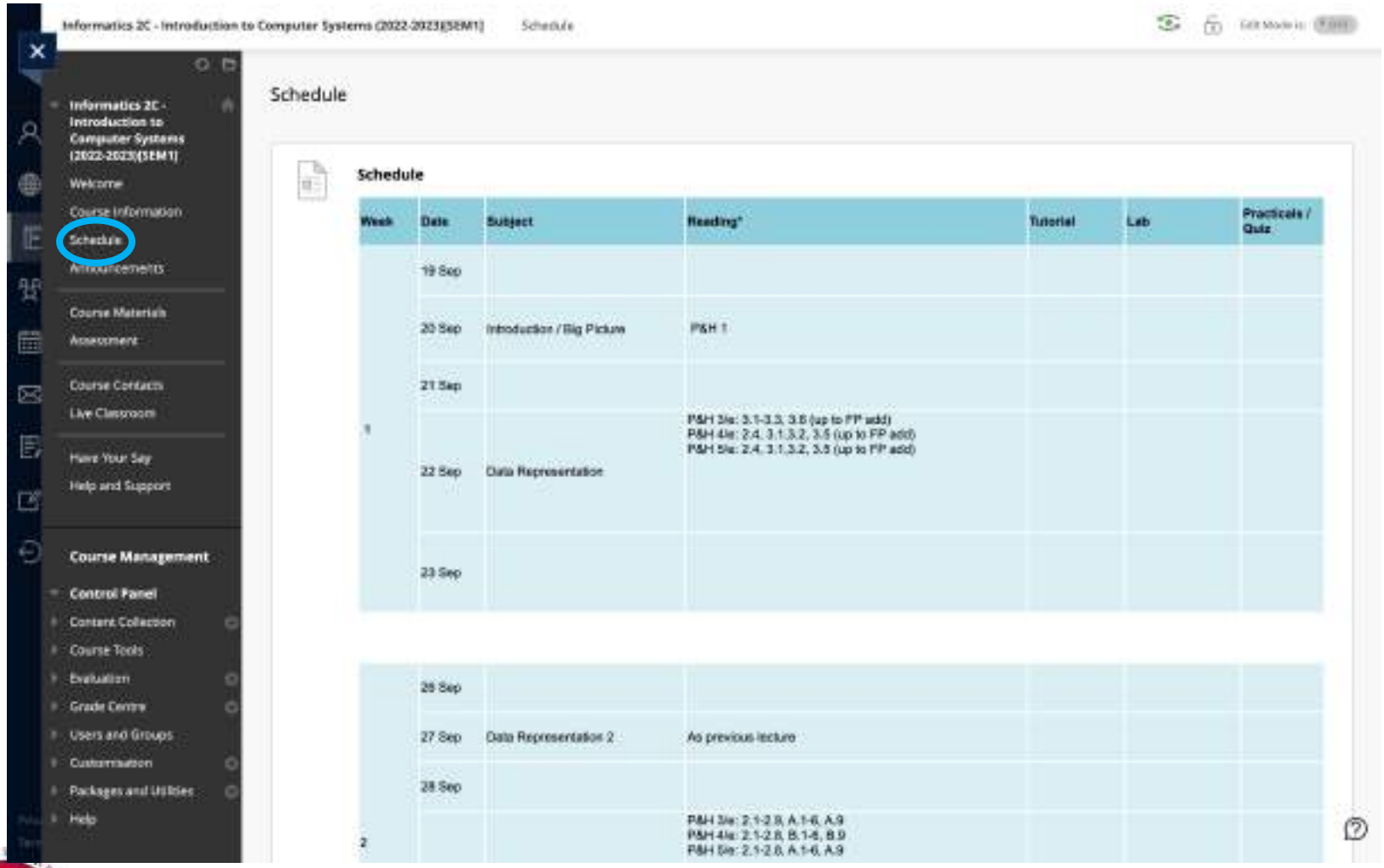
Practicalities (con'd)

- Online discussion forum: Piazza
  - https://piazza.com/ed.ac.uk/fall2022/infr0802720223sv1sem1
  - Primary means to Q&A outside of class.

- Study resources: slides, textbooks, lecture videos

- All materials are/will be on Learn

Lecture schedule, slides, videos, assignments



Schedule will drift. It's OK.

Books

- **Required:** *Patterson & Hennessy:*
  Computer Organization and Design, Morgan Kaufmann
  - 5th or 4th ed recommended
  - Physical copies on reserve in the library
  - Digital copies online
- *Silberschatz, Galvin, Gagne:*
  Operating Systems Concepts, Wiley 9th ed
  - Library has 9th and 7th editions (both OK)
  - Only a few sections needed for this course
- *Kernighan and Ritchie. The C Programming Language,*
  Prentice Hall 2nd ed
  - Generally useful, but not mandatory for this course

Exam and Coursework

- Practical Courseworks – 40%
  1. MIPS assembly programming
     - Oct 14 → Oct 28
  2. C programming
     - Nov 11 → Nov 25
  - Extensions or Extra Time Adjustments permitted up to a maximum of 6 days but cannot be combined (latest version marked)
- Two quizzes – total 10%
  - Online
  - Due: Oct 11, Nov 5
  - No extensions.
- Final Exam - 50%
  - In December; exact date not available yet.

Must achieve at least 40% in total to pass the course

Academic Misconduct

- How academic misconduct is defined in this course:
  - Any meaningful similarity in the submitted assessed work
- How we check for similarity:
  - Pairwise comparisons between all submissions
  - Two comparison tools: a commercial tool and an internal one
    - For code, rely on sophisticated "fingerprinting" techniques that are rename and reorder proof

DON'T DO IT!!!

How to do well in this class

- Get started on practical coursework early
- Take advantage of labs
  - But don't wait till the last day → demonstrators will be swamped and will not have time for all
- Don't ignore tutorials
  - Advance prep will allow you to focus on nuances
- Keep up with the reading and the lectures
- Piazza

The Team

Prof Vijay Nagarajan: course organizer

Dr. Michel Steuwer: coursework, exam

Dr. Tobias Grosser: labs, coursework

So what is this course about?

Question

What are the different hardware/software components that allow you to stream videos on a mobile phone?

Question

What are the different hardware/software components that allow you to stream videos on a mobile phone?

- Steaming app (programming languages, compilers, computer architecture)
- Communication to cloud (Networking, Operating system, computer architecture)
- Cloud (distributed systems, operating system, comp. arch)
- Decode and display video (parallel computer architecture, operating system)

So what is this course about?

Syllabus Overview

- Hardware:
  - Data representation and operations
  - Design of (very) simple circuits
  - Processor organisation
  - The memory subsystem
  - Input/Output (I/O)
  - Exceptions and interrupts
- Software:
  - Low-level (assembly) programming
  - C programming
  - Operating systems basics

Why study this course?

- Introduction to computer systems
  - Appreciate courses such as computer architecture and design, operating systems, computer networking, database systems, compiling techniques, extreme computing etc.
- Have a career in computer systems

Why study this course?

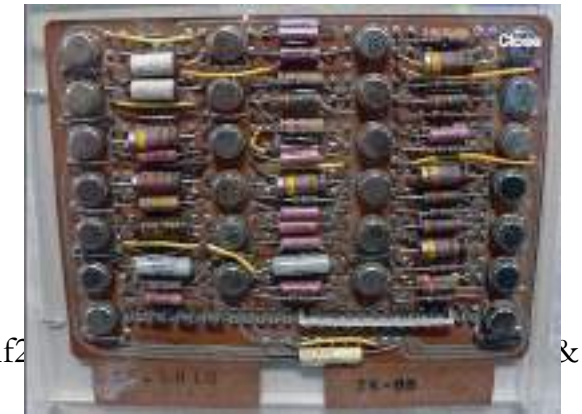
- Isn't machine learning (or anything cool and recent) sufficient?
  - Still need computer systems to realize it!
  - E.g., GPUs critical for deep learning renaissance!

Evolution of computers

- Early computers had their programs set up by plugging cables and setting switches
- John von Neumann (inspired by Alan Turing) first proposed to store the program in the computer's memory
- Most computers since then (~1945) are stored-program machines

Evolution of computers

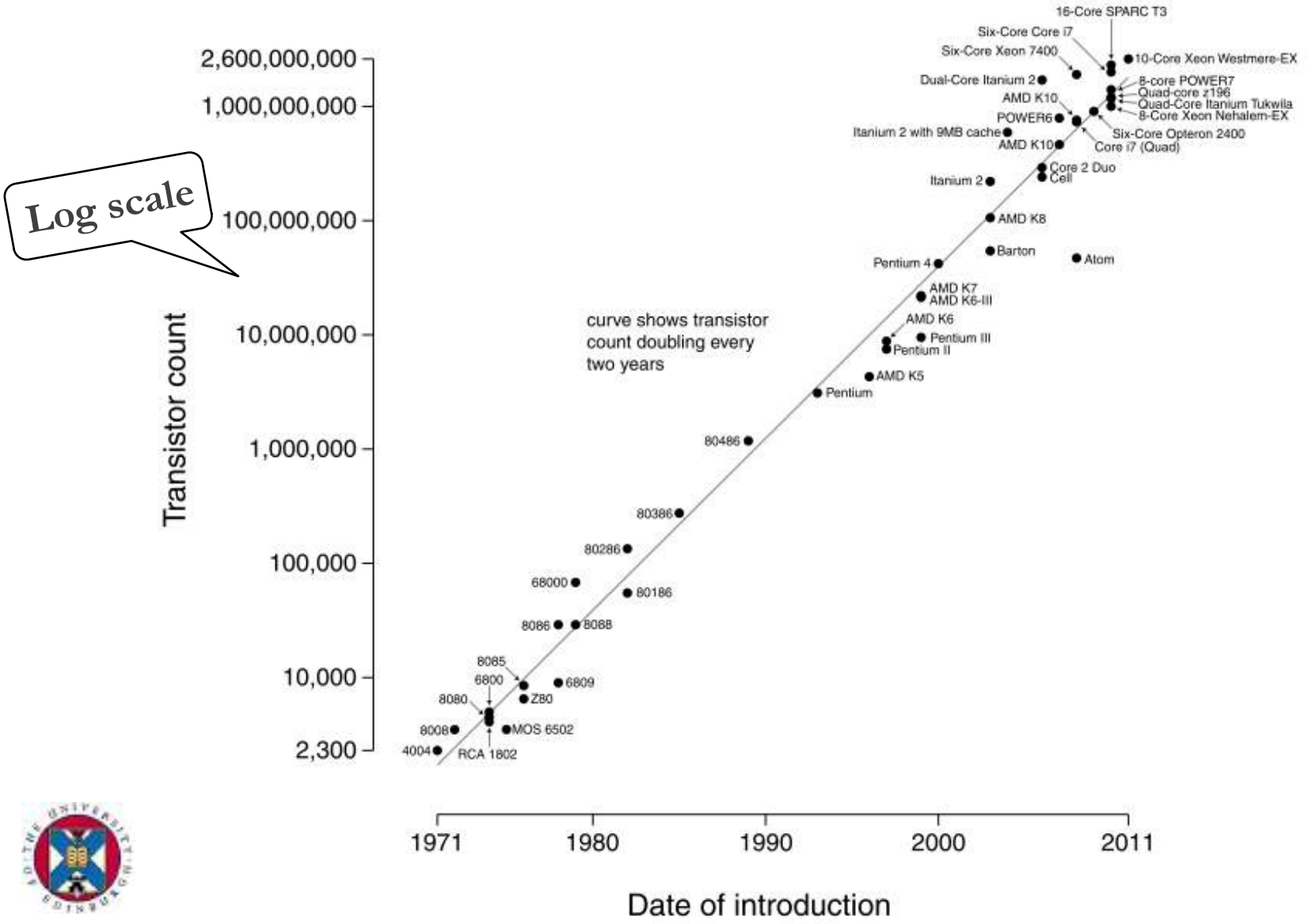
- What has changed is the number of transistors (electronic switches) and their speed
- Implementation technology progressed from vacuum tubes to discrete transistors to (eventually) Integrated Circuits (a.k.a. chips).



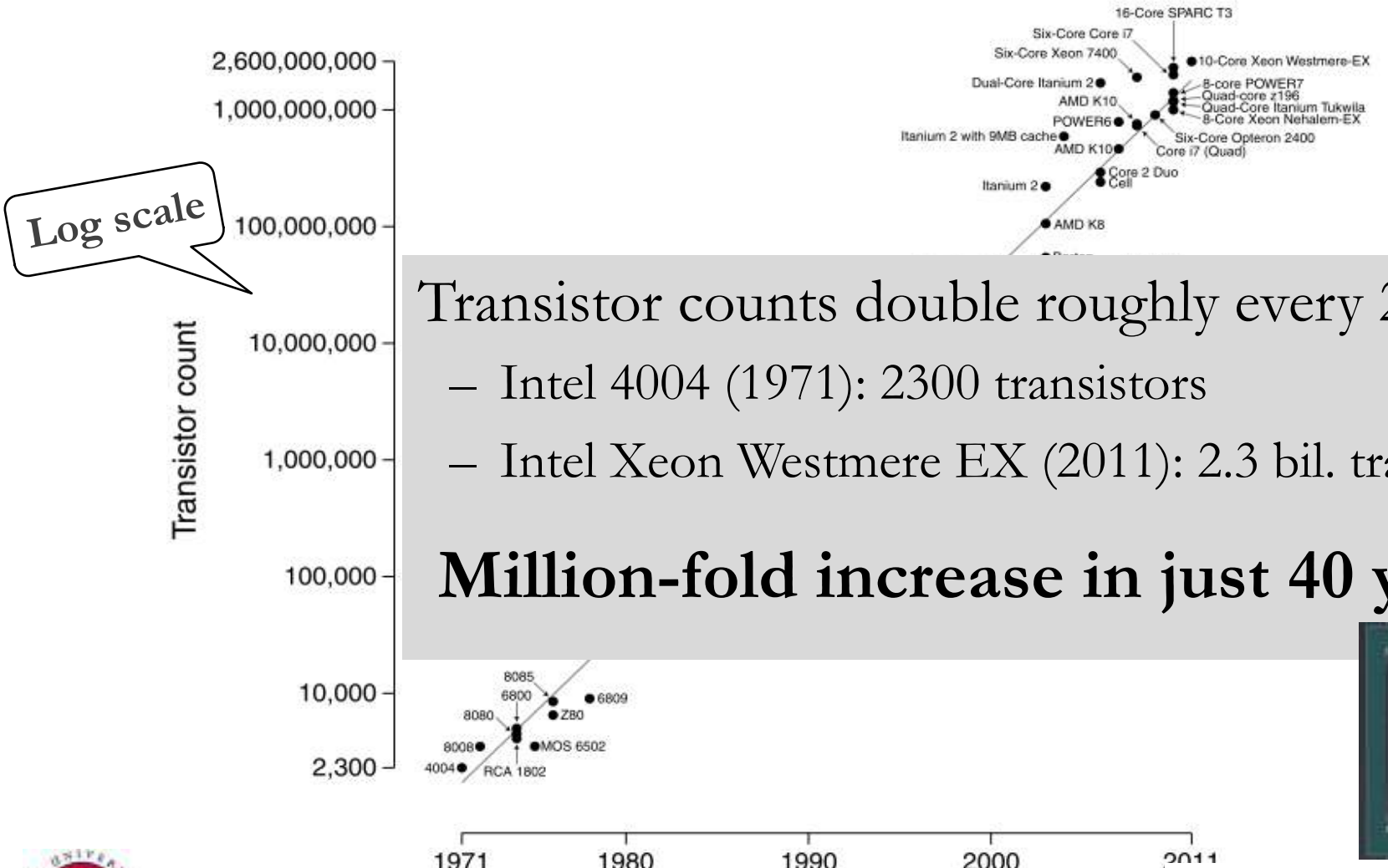
Evolution of computers

- What has changed is the number of transistors (electronic switches) and their speed
- Implementation technology progressed from vacuum tubes to discrete transistors to (eventually) Integrated Circuits (a.k.a. chips).
- At the same time, the cost per transistor has been dropping

Moore's law


Log scale
Transistor count
2,600,000,000
1,000,000,000
100,000,000
10,000,000
1,000,000
100,000
10,000
2,300
curve shows transistor count doubling every two years
16-Core SPARC T3
Six-Core Core i7
Six-Core Xeon 7400
10-Core Xeon Westmere-EX
Dual-Core Itanium 2
8-core POWER7
Quad-core z196
AMD K10
Quad-Core Itanium Tukwila
POWER6
8-Core Xeon Nehalem-EX
Itanium 2 with 9MB cache
Six-Core Opteron 2400
AMD K10
Core i7 (Quad)
Core 2 Duo
Cell
Itanium 2
AMD K8
Barton
Atom
Pentium 4
AMD K7
AMD K6-III
AMD K6
Pentium III
Pentium II
AMD K5
Pentium
80486
80386
80286
68000
80186
8086
8088
8085
6800
6809
8080
Z80
8008
MOS 6502
4004
RCA 1802
1971
1980
1990
2000
2011
Date of introduction

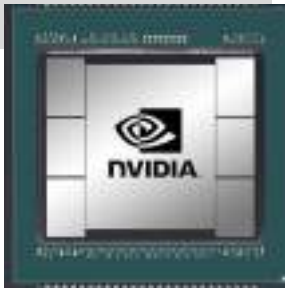
Moore's law



Transistor counts double roughly every 2 years

- Intel 4004 (1971): 2300 transistors
- Intel Xeon Westmere EX (2011): 2.3 bil. transistors

Million-fold increase in just 40 years!



Today: nVidia Ampere: 54.2 Bil transistors

Types of Computers

- Servers
  - Used for either few large tasks (e.g., engineering apps), or many small tasks (e.g., web server, Google)
  - Fast processors, lots of memory
  - Multi-user, multi-program

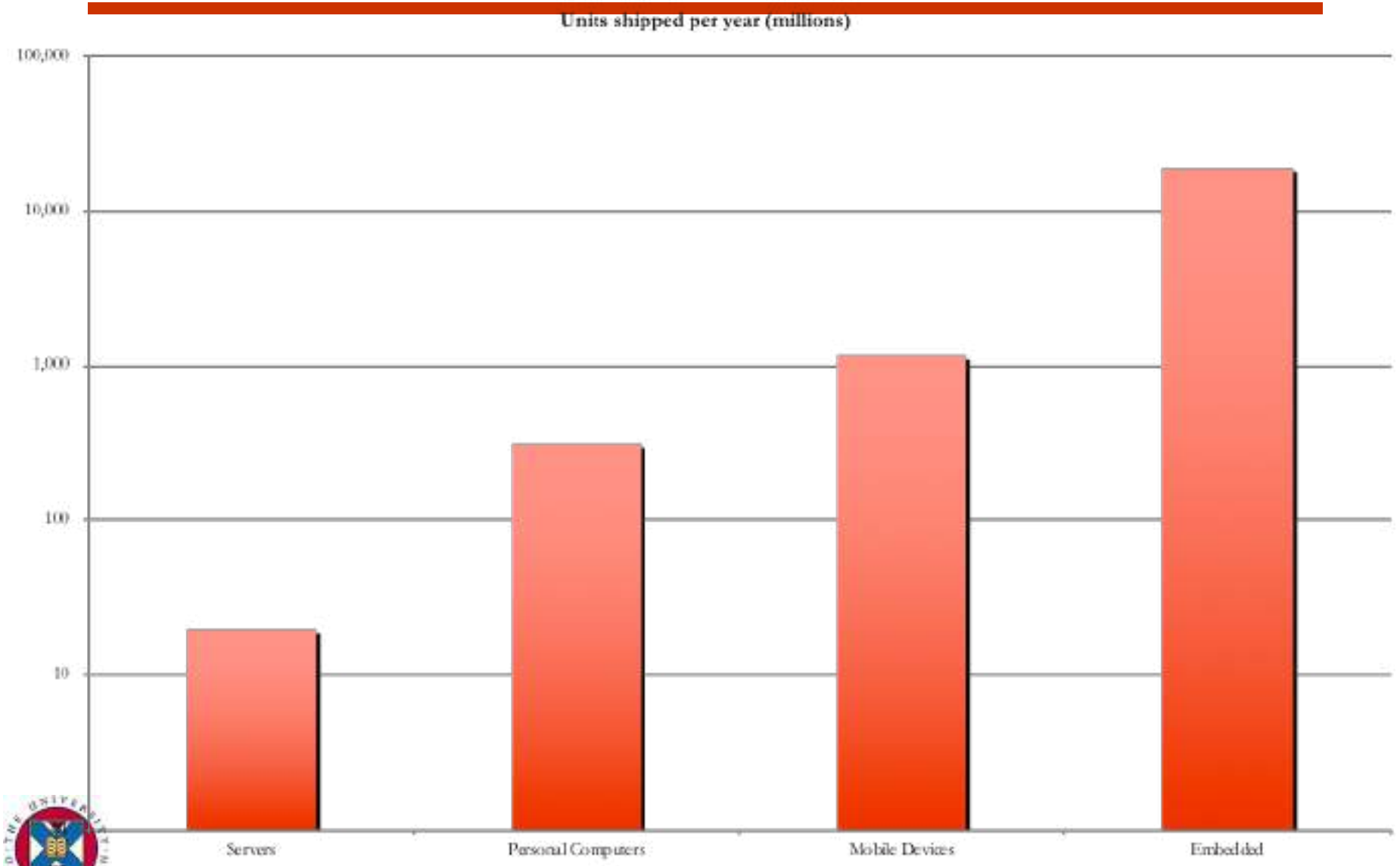
- Personal computers
  - Laptops, desktops
  - Balance cost, processing power
  - Few users, multi-program

Types of Computers (con'd)

- Mobile devices
  - Smart phones, tablets
  - Highly integrated (multiple processors, GPU, GPS, media accelerators, etc), low-power
  - Single-user, multi-program

- Embedded:
  - Task specific: sensing, control, media playback, etc.
  - Low-cost, low-power
  - Single program

Which computer system category is the largest?

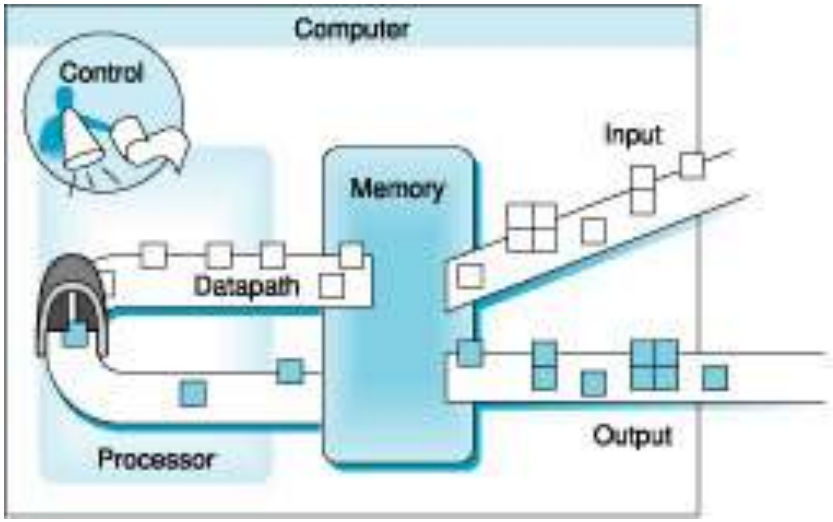


Computer components

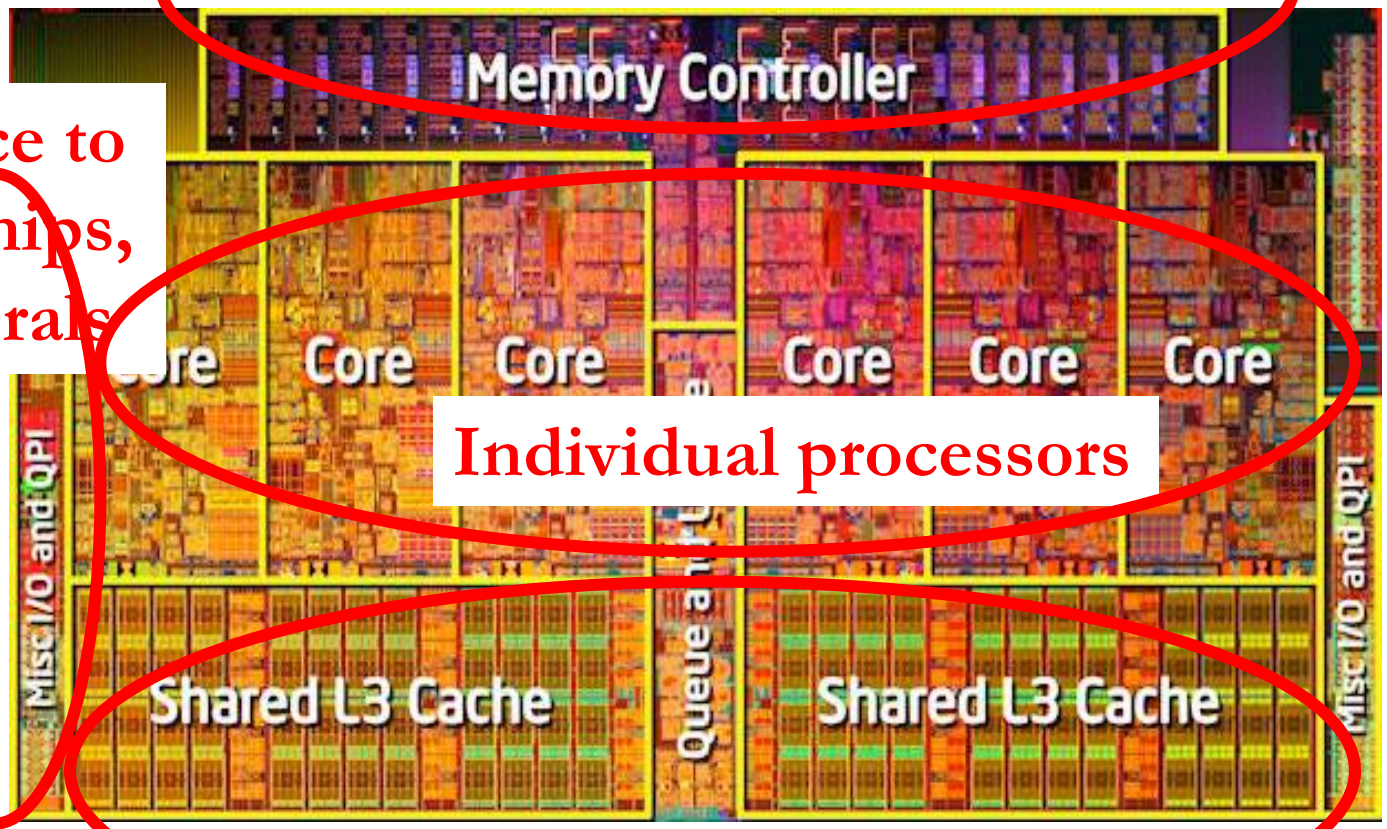
- Data path
  - Performs actual operations on data
- Control path
  - Fetches instructions from program in memory
  - Controls the flow of data through the data path

} Processor

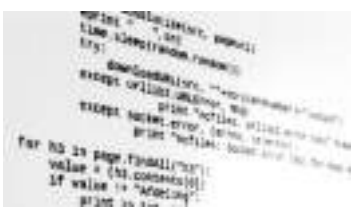
- Memory
  - Stores data and instructions
- Input/Output
  - Interfaces with other devices for getting/giving data



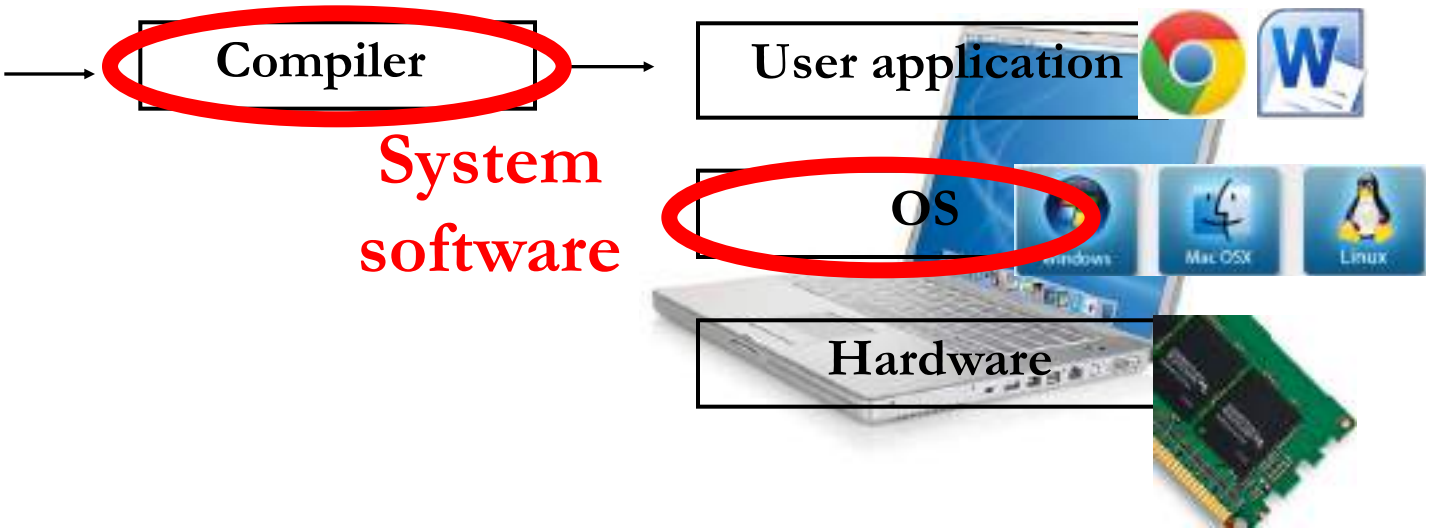
A modern processor



Modern computer system



Source code



- Compiler
  - Translates **High Level Language** (**HLL**) into **machine language** or **byte code**
- Operating System (OS)
  - Mediates access to hardware resources (CPU, Memory, I/O)
  - Schedules applications

Summary

- This class covers a lot of material
  - Keeping up will require effort on your part
- Follow all lectures and participate in tutorials
- Get started on assignments early
- ASK QUESTIONS (PIAZZA)!

Reward: you will learn a lot!