COMP273
Introduction

Dr. Mona Elsaadawy

- Office: MC 301
- Email: mona.elsaadawy@mcgill.ca
- Office hours: Thursdays 12:00-2:00pm MC 301
- Zoom: TBD
- Or by appointment (email me)
- Research interest:
  - Distributed systems, cloud computing, networks, and applied ML & DL.
  - Research Lab: Distributed Information System Lab (DISL)

Course Format

- **3-credit course**
  - Lectures Tuesdays & Thursdays from 10:05am to 11:25am
    - Place: ADAMS AUD
  - Lectures recorded by the standard auto-recording system.
  - Attending classes is ***highly recommended***
  - 4 Assignments
  - 3 Class tests (No final)

Course Information – Pre-requisites

- COMP-206: Introduction to Software Systems
- Anyone who has not taken COMP-206 (and is not taking it this term) then you should not take COMP 273, unless you have previous experience with C or C++ programming

Course Outline of Lectures

- Topics include
  - Boolean Algebra/Digital Circuit Design
  - Number Representation
  - Assembly Programming (MIPS)
  - Floating Point
  - I/0 & Interrupts
  - Caches
  - Virtual Memory
  - CPU Organization

Course Information - Textbook

- Patterson and Hennessy "Computer Organization and Design: The Hardware/Software interface"
  - The 4th or 5th edition (6th edition is probably OK too)
- Available at the bookstore, e-book on reserve in library
- This is the main textbook for the course
  - Recommended that you get a copy
- Lecture notes and other handouts will be made available on MyCourses

Course Information - Resources

- MyCourses
  - Discussions on material
  - Questions with respect to assignments
  - Assignment submission
  - Course outline/ tentative schedule (in course content)
  - Office hours (to be posted in my courses calendar)
- Desktop software
  - Logisim Evolution for circuit simulation
  - MARS for MIPS simulation

Course Information - Evaluation

- **Assignments: 50%**
- **Class test 1: 20**% (Tentative date October 5th)
- **Class test 2: 20%** (Tentative date November 2ed)
- **Class test 3: 10%** (Tentative date December 5th)

- No make-up tests or make-up assignments

Course Information - Assignments

- Assignments
  - Four assignments, covering logic, numbers, circuits, MIPS programing
  - Show your work (i.e., circuit design, comments in assembly programs)
  - A1 and A3 worth 10%, A2 and A4 worth 15%
  - **Do your own work**
  - **Must be correctly submitted to MyCourses**
  - **Late deadline is 3 days after due date, with penalty is 10%**
  - **Penalty can be waived once (request this in a README.txt file)**
    - **Use for any personal reason, sickness, etc.**

Special Accommodations

-
  - Students with long term / short term disabilities are encouraged to register with Student Accessibility & Achievement.
  - You can have Student Accessibility&Achievement send the instructors letter at the beginning of the semester for class test accommodation and we can automatically use it for every test.
  - Please keep in mind that accommodations are limited to tests. A registration with Student Accessibility&Achievement does not translate to extensions with assignments.
  - Any special accommodations outside of this need to come directly from the Student Accessibility&Achievement office and not from the students themselves. The office has better understanding of each student's situation/needs and can make proper assessment of the allowances required for individual cases.

Teaching Assistants
Office Hours and Tutorials

- Charlotte Volk (Head TA)
- Sevag Baghdassarian
- Nanditta Rajesh Kumar Vanathi
- Alireza Zahedi
- Ziling Cheng
- Thomas Metaxas
- Brennan King
- Callista Dembegiotis
- Isabelle Champion

- Contacts can be found in MyCourses under << Contents-> Course Outline -> TA information >>

Interacting with TAs

- There are no weekly TA office hours. (Use the instructor weekly office hours if you have questions about lecture topics).

- TA Office hours will be scheduled based on assignment deadlines and will be announced in MyCourses accordingly.

- DO NOT email your TA unless it is a question about the feedback you received for an assignment.

- Any other general questions must be on Ed.

- Questions regarding the class tests have to be sent to the instructor

- Use Ed if you have questions about your class test feedback once the feedback is published. You post it publicly if you wish to.

Who to contact and when

- Problems with marking?
  - Contact TA who graded your assignment
    - You will know who is your grading TA when the grades for the particular assignment are posted.
  - If not satisfied with TA response, then email me
- Problems with course content
  - Check for answers on MyCourses
  - Post your questions on MyCourses
  - Visit TAs or me during the office hours
- Personal Issues
  - Visit me during the office hour
  - Email me with a clear subject prefix [COMP273]

Communication Policy

- McGill University is committed to maintaining teaching and learning spaces that are respectful and inclusive for all. To this end, offensive, violent, or harmful language arising in course contexts may be cause for disciplinary action under the *Article 10 of the Code of Student Conduct and Disciplinary Procedures and Section 2.7 of the Policy on Harassment, Sexual Harassment, and Discrimination Prohibited by Law*.

In case you didn't already know...

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures. See www.mcgill.ca/integrity for more information, as well as www.mcgill.ca/integrity/studentguide, the Student Guide to Avoid Plagiarism.

It should be noted that, in accordance with article 15 of the Charter of Students' Rights, students may submit examination answers in either French or English.

According to Senate regulations, instructors are not permitted to make special arrangements for final exams. Please consult the Calendar, section 4.7.2.1, General University Information and Regulations at www.mcgill.ca. Special arrangements in emergencies may be requested at your Student Affairs Office. If you have a disability, please advise the Office for Students with Disabilities (398-6009) as early in the term as possible so that we can provide appropriate accommodation to support your success.

In the event of circumstances beyond the instructor's control, the evaluation scheme as set out in this document might require change. In such a case, every effort will be made to obtain consensus agreement from the class.

Additional policies governing academic issues which affect students can be found in the [Handbook on Student Rights and Responsibilities, Charter of Students' Rights](.).

Be sure your name and student number is included in your circuit or the top comments section of each of your source files. Submit your source code as a zip file via MyCourses unless otherwise specified. If you have comments about your solution, include a readme.txt or readme.pdf file with your comments. Be sure to check that your submission is correct by downloading your submission from MyCourses. You can not receive any marks for assignments with missing or corrupt files! Note that you are encouraged to discuss assignments with your classmates, but not to the point of sharing code and answers. All code and written answers must be your own.

Do not share your code. Using version control is a good idea, but using a publicly accessible repository is not acceptable.

ALL WORK MUST BE SUBMITTED ON MY COURSES. DO NOT EMAIL YOUR WORK TO THE PROF OR TAs.

ALL DEADLINES ARE HARD!!! DO NOT WAIT TO THE LAST MINUTE TO SUBMIT YOUR WORK!

Use of Generative AI

- Students are encouraged to make use of technology, including generative artificial intelligence tools, to contribute to their understanding of course materials.

- Students are not encouraged, unless otherwise stated, to make use of artificial intelligence tools, including generative AI, to help produce assignments. We believe that working through the assignments on your own will help you gain a better understanding of the course material and will better prepare you not only for the other course examinations, but also for the subsequent CS courses, internships, research opportunities, and jobs.

- However, students are ultimately accountable for the work they submit. Any content produced by an artificial intelligence tool must be cited appropriately. Many organizations that publish standard citation formats are now providing information on citing generative AI (e.g., MLA: https://style.mla.org/citing-generative-ai/).

Re-Grading

- You are responsible for raising any concern about your assessment feedback within 7 days of its publication with your TA (in writing, email). You have to be clear to the TA in your email as to what part of the feedback you have concern with and not a "Can you please regrade my submission?".

- If you are not happy with the follow-up feedback from TA (i.e., you still think TA did not evaluate your assessment correctly) you can reach out to the instructors. Forward all the relevant email conversation with your TA.

- TAs provide partial points / point deductions where applicable according to the guidelines given to them.

- The potential re-evaluation by an instructor can include a reevaluation of the complete question (not only the sub-question you have a concern with) and might lead to no change, increase or decrease of points.

- There are multiple TAs grading different students. Because another student did not lose points for a mistake their TA did not notice is not an excuse for you not losing points. If this is brought to our attention, the other student will also lose their points.

Question

- What can you do if you are having trouble?

- Review slides
- Review recordings
- Read corresponding sections of textbook
- Read threads on ED

- Post new question on ED
- Visit TA office hour
- Visit prof office hour

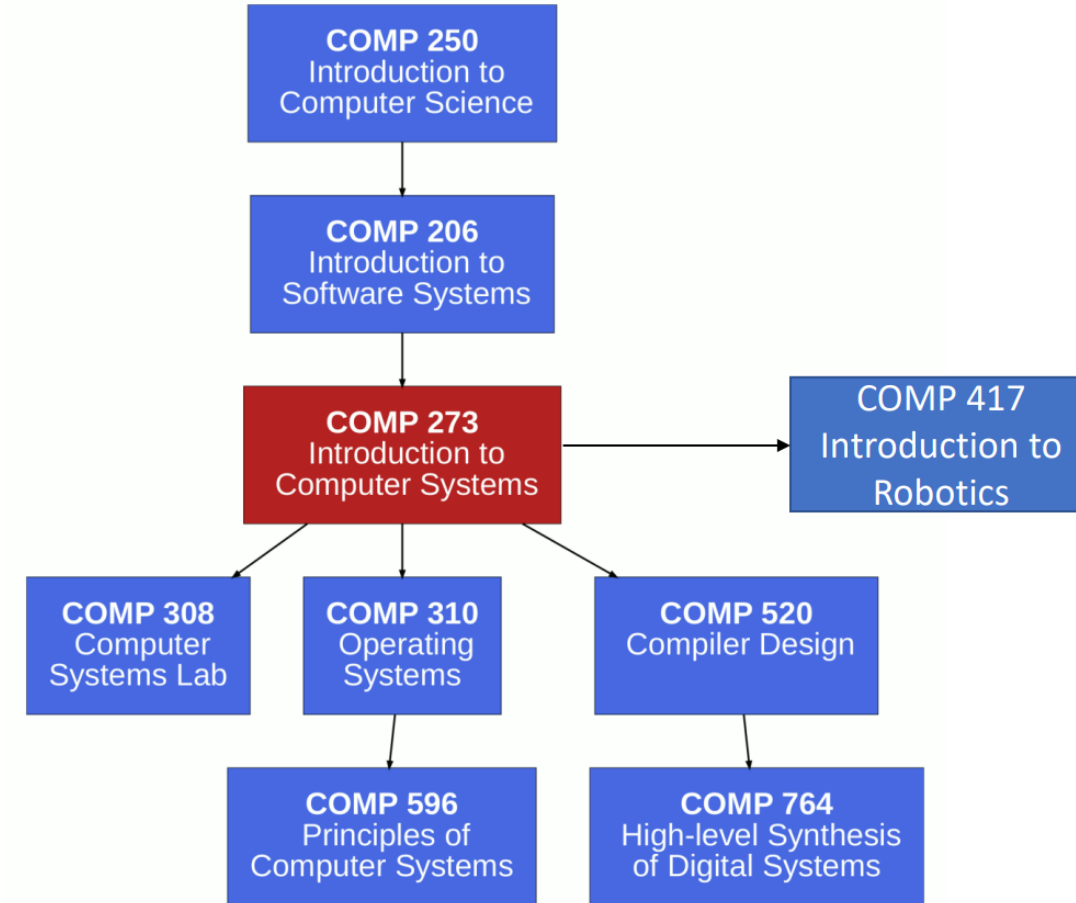- Undergraduate advisor
- Student wellness hub

Rough Schedule

- Available under MyCourses -> Content -> "Course Outline" -> "Running Schedule"

This schedule is not final and is only meant to give you an idea of the high-level load distribution.

Things might move a couple of lecture slots up or down depending on the course progress.

You are still expected to be around and participate in the assessments as they are published.
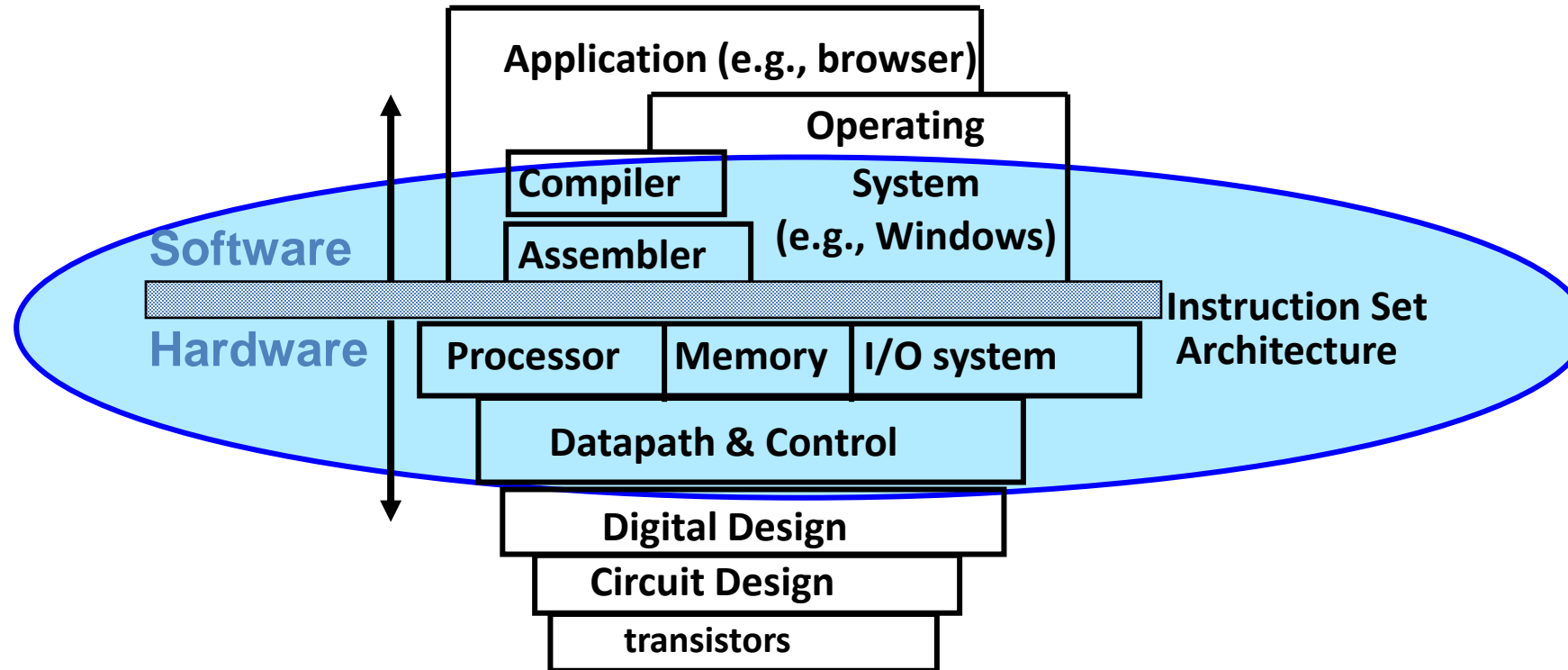
Related courses

About You

~ 25% CS

Count of Student Name

Total

Major

- Agricultural Economics
- Anatomy and Cell Biology
- Biochemistry
- Biochemistry *
- Bioengineering
- Biology & Mathematics
- Chemical Engineering
- Chemistry
- Cognitive Science -Hon
- Cognitive Science -IFP
- Computer Engineering
- Computer Science
- Computer Science *
- Computer Science and Biology
- Computer Science -Con
- Computer Science -Con *
- Computer Science -Hon
- ComputerScience & Biology -Hon
- Co-op in Materials Engineering
- Economics -Con
- Economics -Con *
- Economics -Hon *
- English -Con *
- Exchange
- Finance
- Freshman Program
- General Management
- Geography (AR)-Con
- Geography (AR)-Con *
- Information Systems
- International Management
- Kinesiology
- Life Sciences (Biol & Agricul)
- Managing for Sustainability
- Marketing
- Math & Computer Science
- Math & Computer Science -Hon
- Mathematics
- Mathematics -Con
- Mathematics -Con *
- Mathematics -Hon *
- Microbiology & Immunology -CSC
- Neuroscience
- Physics
- Physics & Computer Sci -Hon *
- Physics & Computer Science
- Psychology
- Psychology -Con
- Psychology -Con *
- Secondary Mathematics
- Software Engineering
- Software Engineering -Con
- Software Engineering -Con *
- Statistics
- Statistics -Con
- Statistics -Con *
- Stats & Computer Science
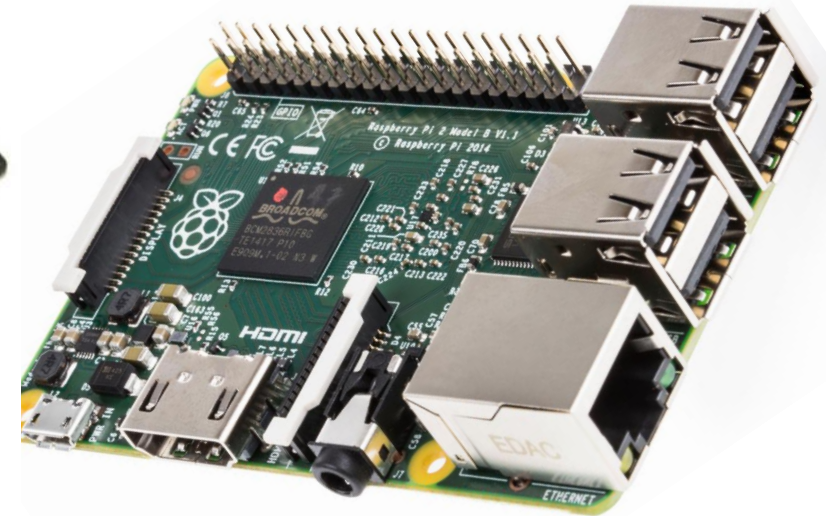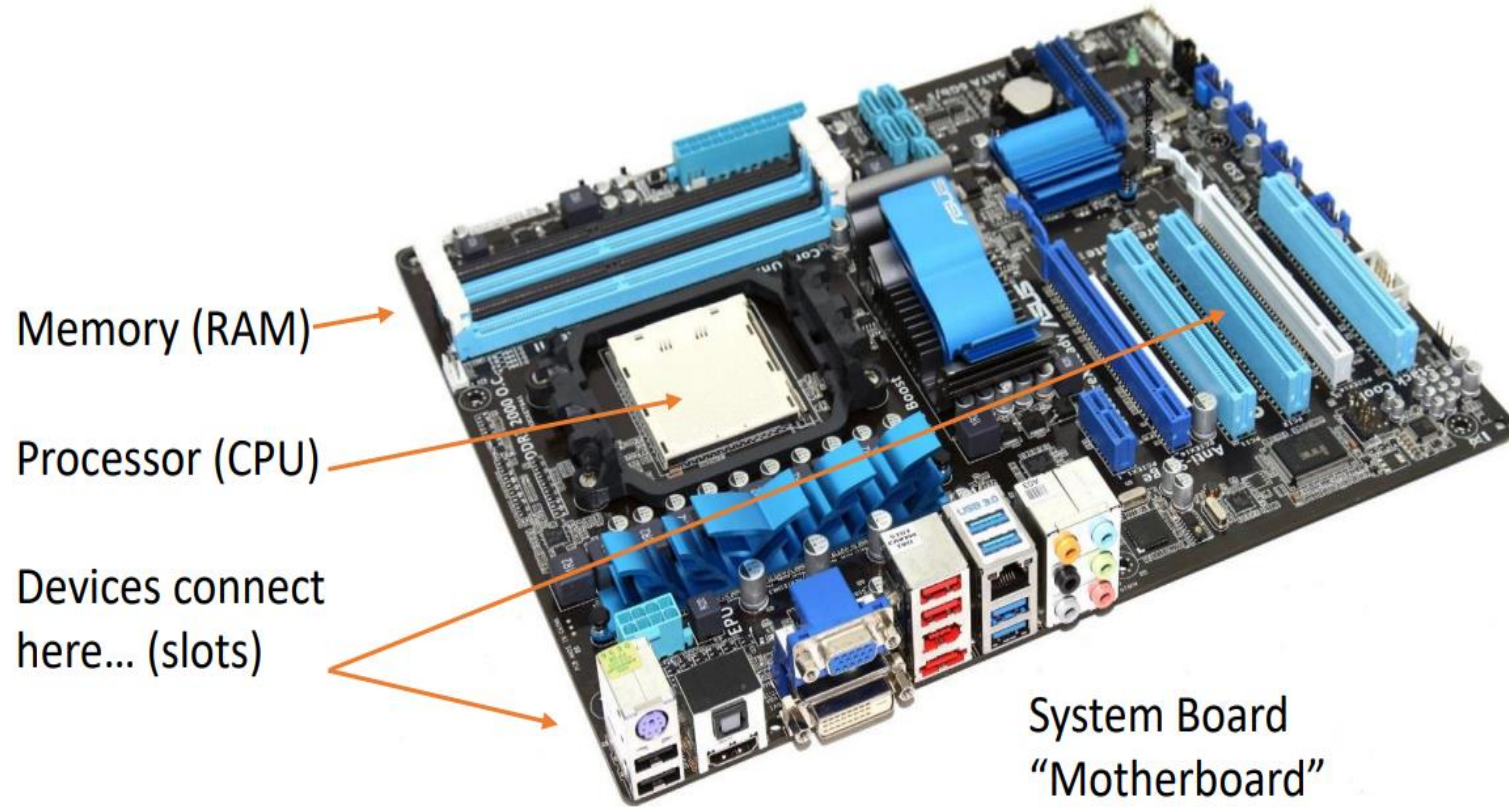- Stats & Computer Science -Hon *

Let's get started

What are "Machine Structures"?

* Coordination of many *levels of abstraction*

What is inside of your Computer?
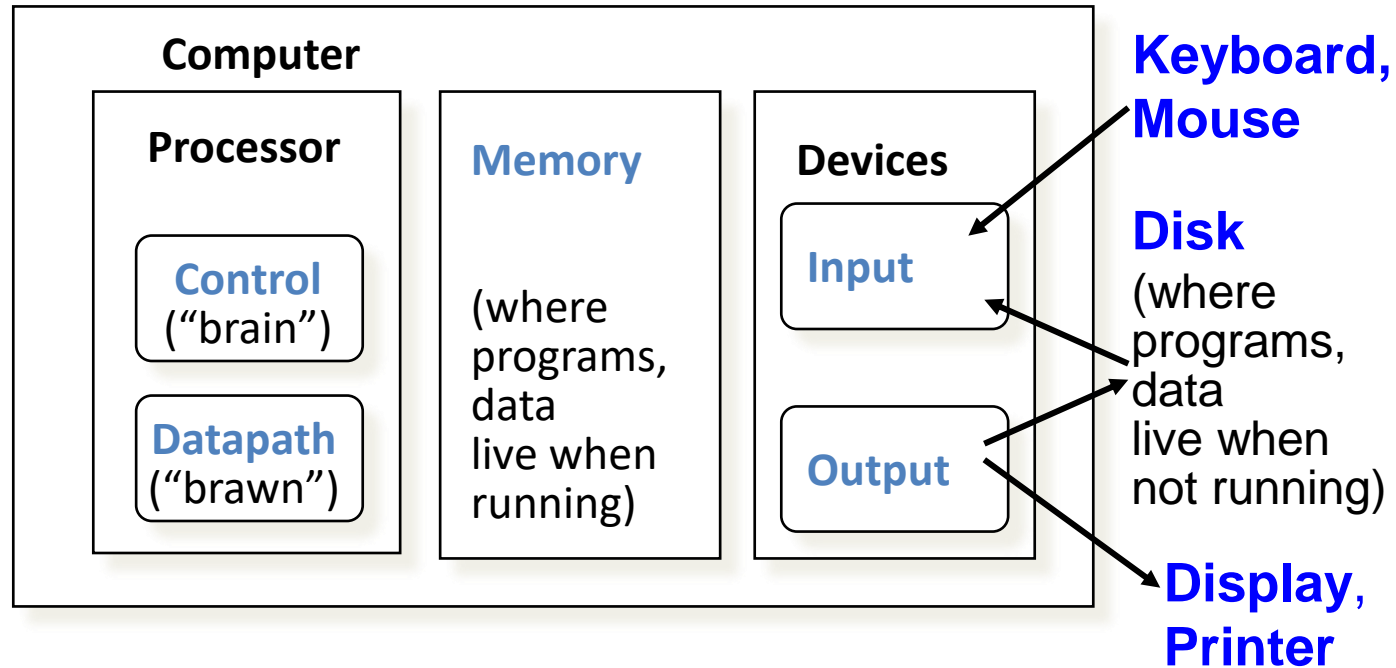
Memory (RAM)

Processor (CPU)

Devices connect
here… (slots)

System Board
"Motherboard"

What is inside of your phone?

Apple
338S00456 PMIC

Apple A12 APL1W81 +
Micron MT53D512M64D4SB-046 XT:E
4GB Mobile LPDDR4x SDRAM

STMicroelectronics
STB601A0 PMIC

Apple
338S00375 PMIC

Texas Instruments
SN2600B1
Battery Charger

Apple 338S00411
Audio Amplifier
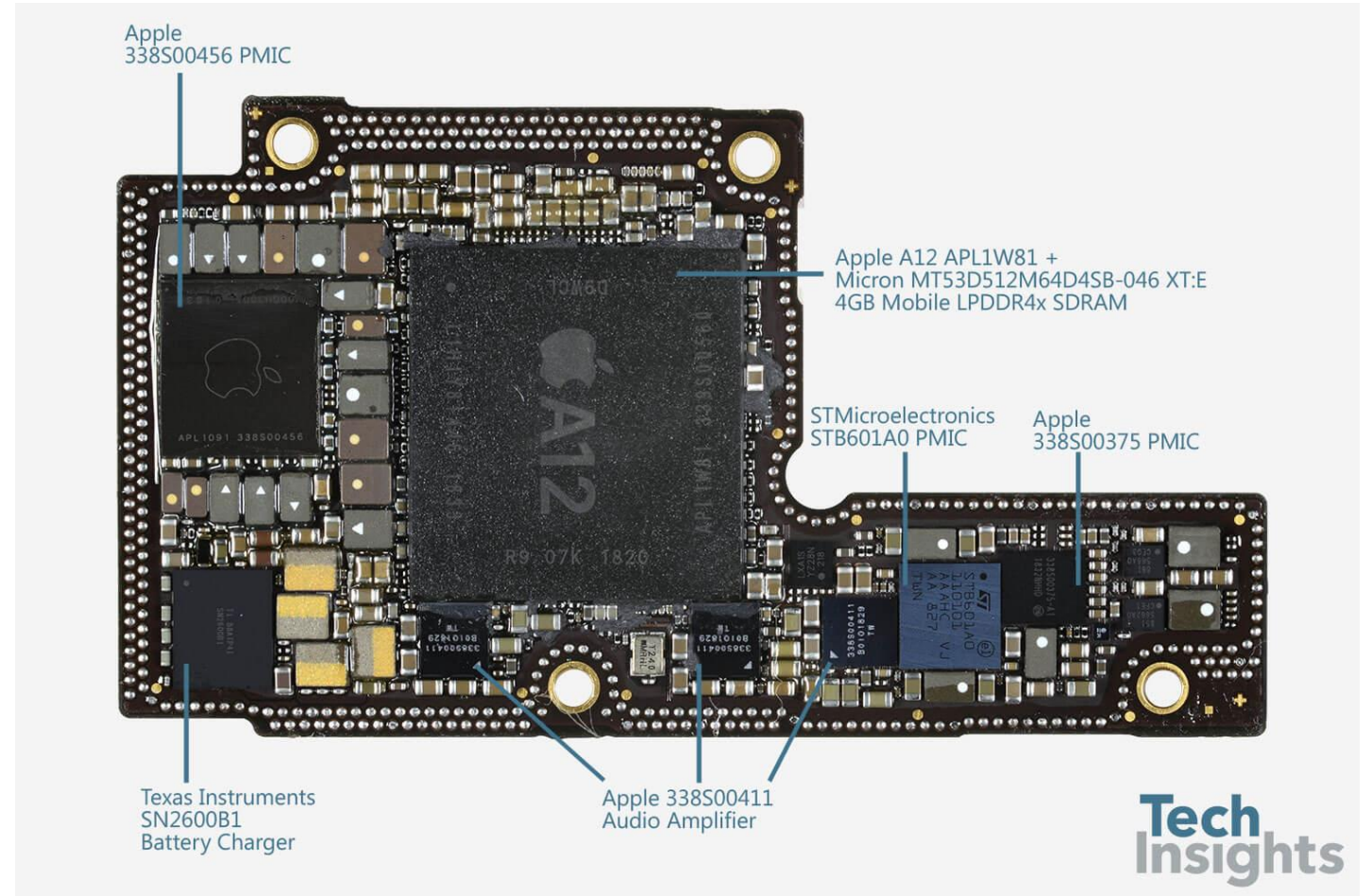
Anatomy: 5 Parts of any Computer

Computer

Processor

Control ("brain")

Datapath ("brawn")

Memory

(where programs, data live when running)

Devices

Input

Output

Keyboard, Mouse

Disk (where programs, data live when not running)

Display, Printer

What is a Program?

- High-level language program (in C)

```
swap (int v[], int k) {
    int temp = v[k];
    v[k] = v[k+1];
    v[k+1] = temp;
}
```

- Assembly language program (for MIPS)

```
swap:   sll     $2, $5, 2
        add     $2, $4,$2
        lw      $15, 0($2)
        lw      $16, 4($2)
        sw      $16, 0($2)
        sw      $15, 4($2)
        jr      $31
```
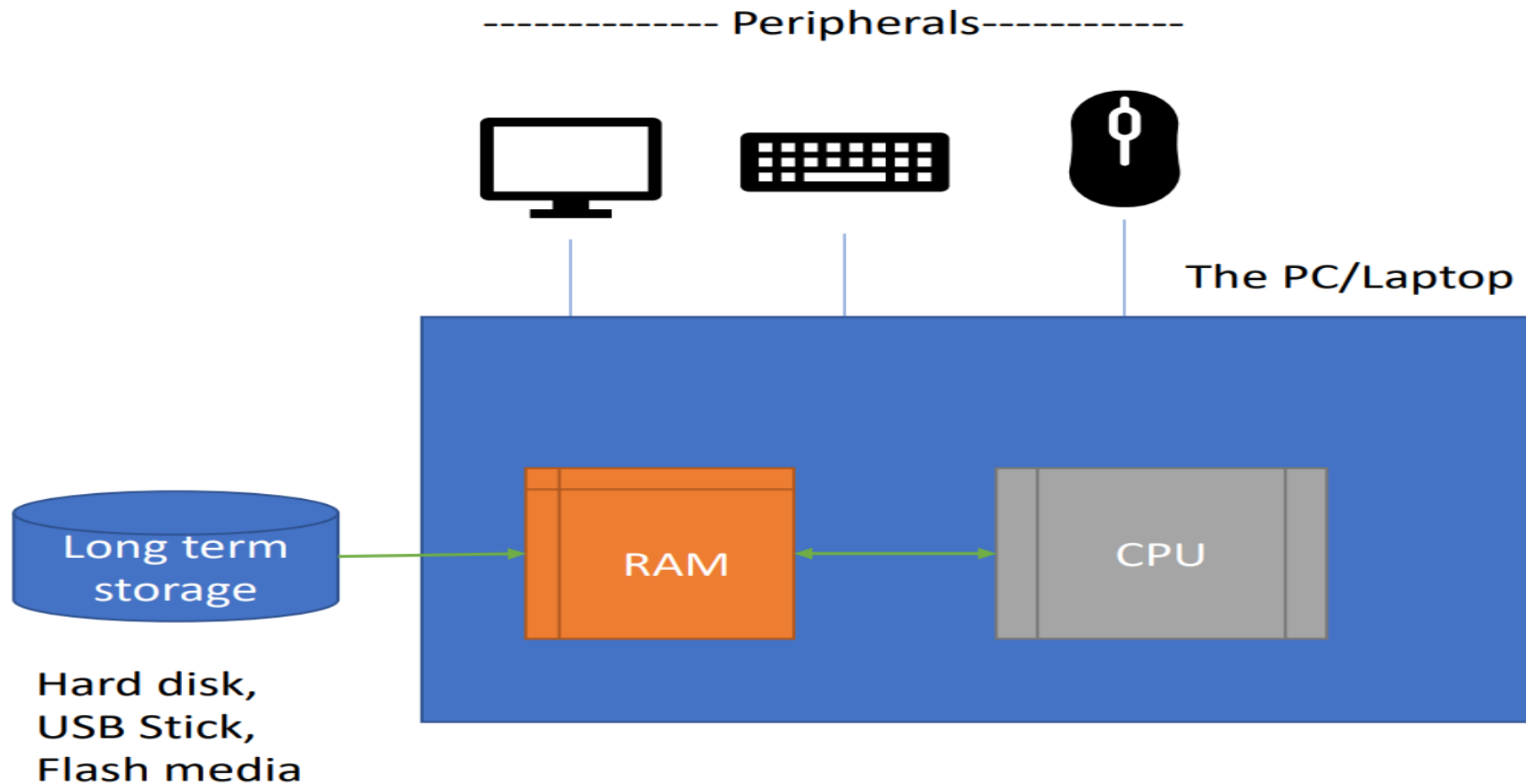
- Machine (object) code (for MIPS)

```
000000 00000 00101 0001000010000000
000000 00100 00010 0001000000100000
  . . .
```
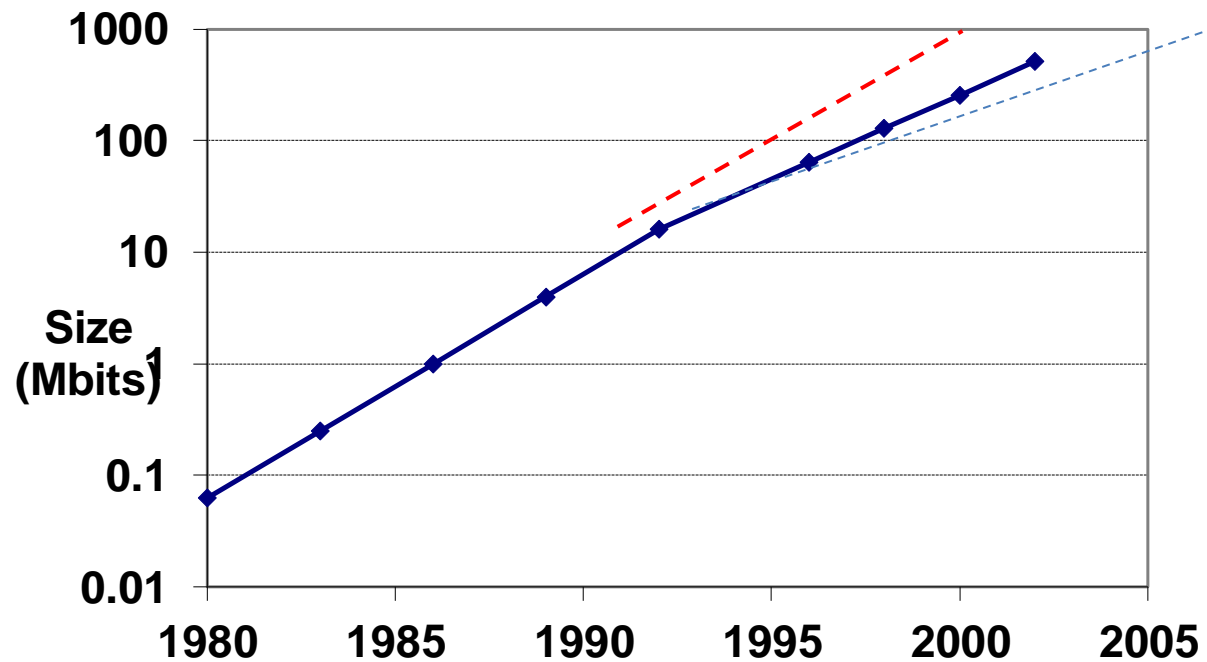
C compiler

assembler
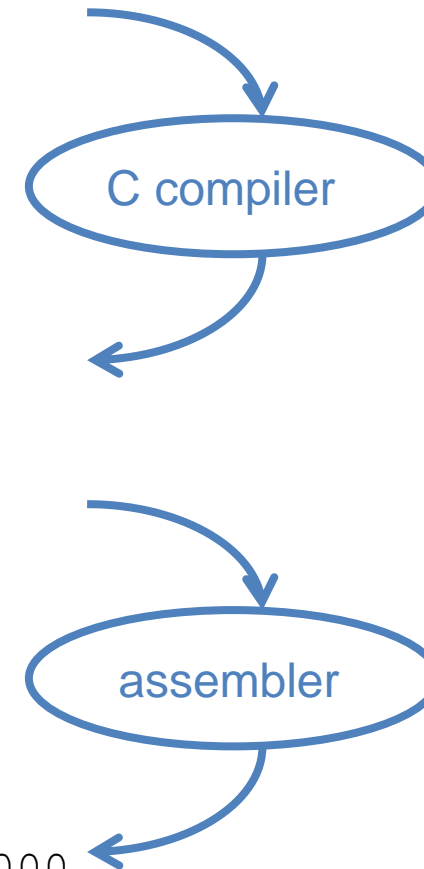
Where the program lives

- LTS is a library
- RAM is "live"
- CPU executes

-------------- Peripherals-----------

The PC/Laptop

Long term storage

RAM

CPU

Hard disk,
USB Stick,
Flash media

Trends and History

Technology Trends: Memory Capacity (Single-Chip DRAM)

year	size (Mbit)
1980	1/16
1983	1/4
1986	1
1989	4
1992	16
1996	64
1998	128
2000	256
2002	512
2009	4096
2014	8192
2018	8192

- **Was 1.4X/yr, or 2X every 2 years.**
- **4000X from 1980 to 2002**

Technology Trends: Microprocessor Complexity

CPU Transistor Counts from 1971 and **Moore's Law**

Curve shows "Moore's Law": transistor count doubling every two years or so

GPUs now part of every machine, arguably more powerful than CPUs *and* programmable
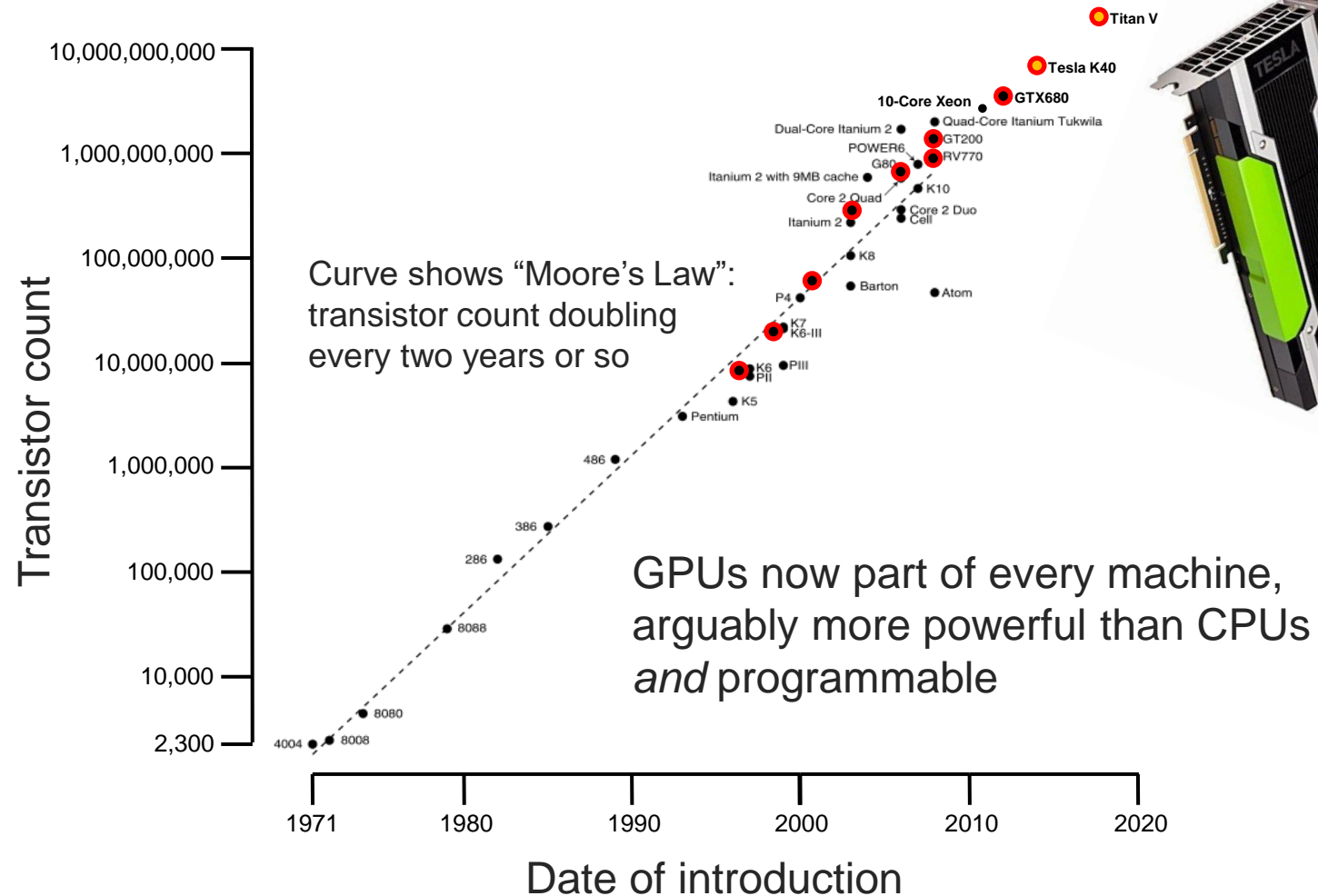
Moore's Law
The Fifth Paradigm

Logarithmic Plot

Not quite the same as Moore's law

Calculations per Second per $1,000

10^{10}
10^{8}
10^{6}
10^{4}
10^{2}
1
10^{-2}
10^{-4}
10^{-6}

Electromechanical   *Relay*   *Vacuum Tube*   *Transistor*   *Integrated Circuit*

1900   1910   1920   1930   1940   1950   1960   1970   1980   1990   2000

Year
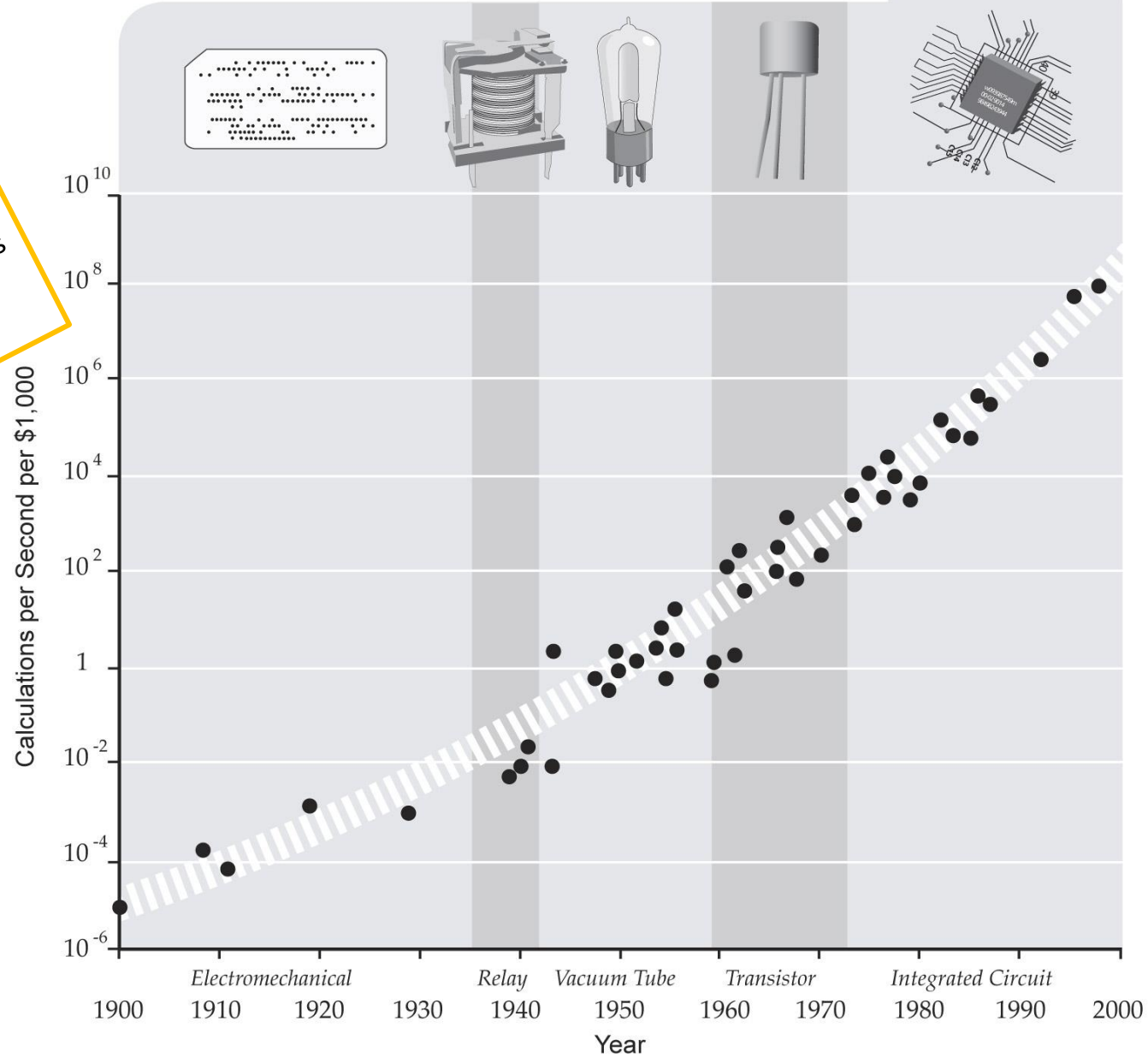
If transportation had kept pace…

ENIAC
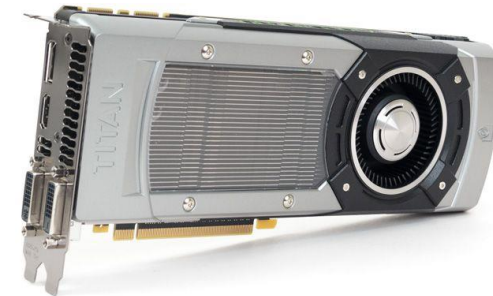
- First general-purpose electronic computer
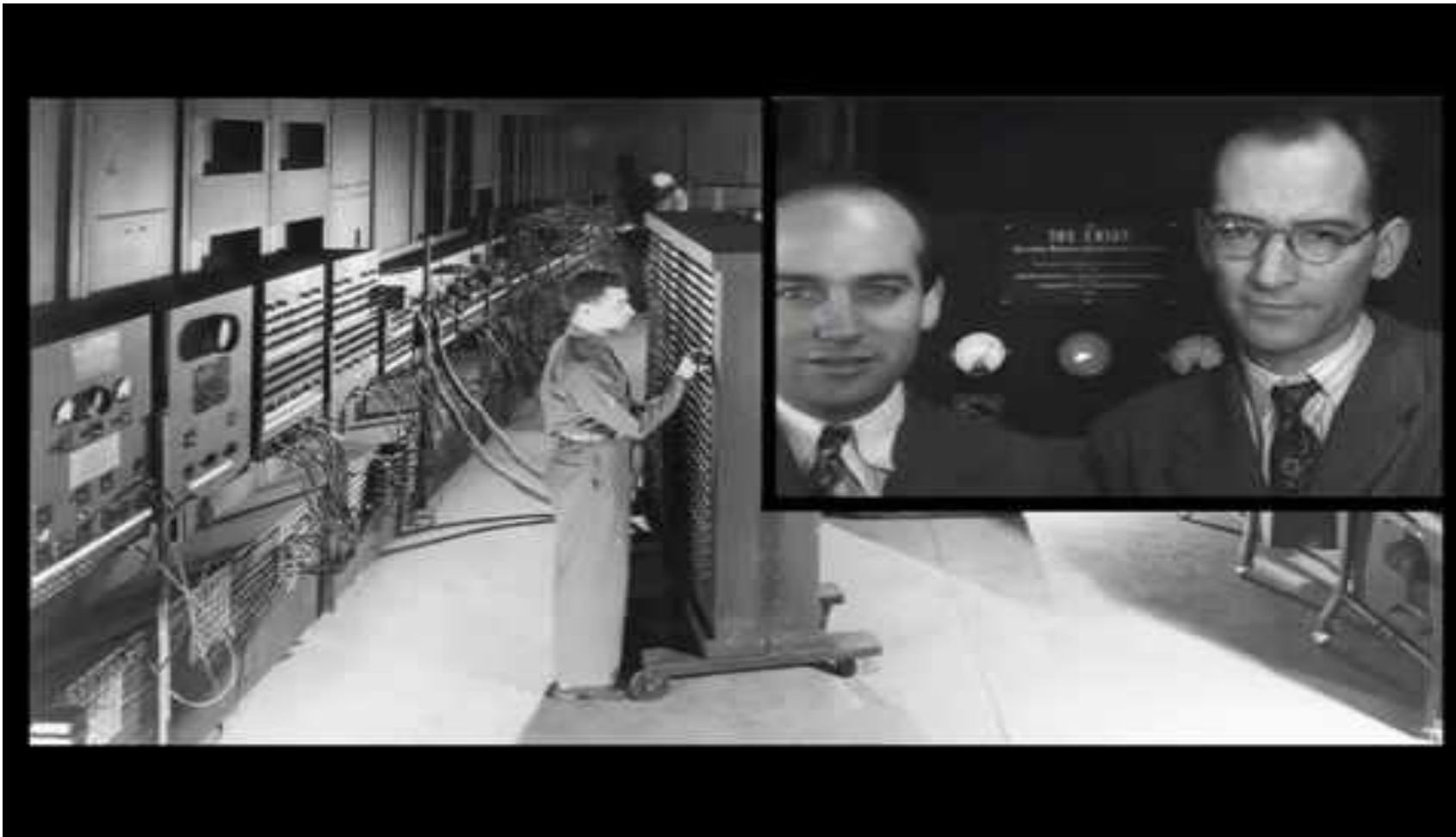
Trending

- Energy efficiency now of major importance (mobile computing)
  - Faster clock speeds use too much energy
- Multi core CPUs now the means to increasing performance.
- Very powerful graphics cards now prevalent

3.5 GHz quad core
32 GB
3 TB
$3000
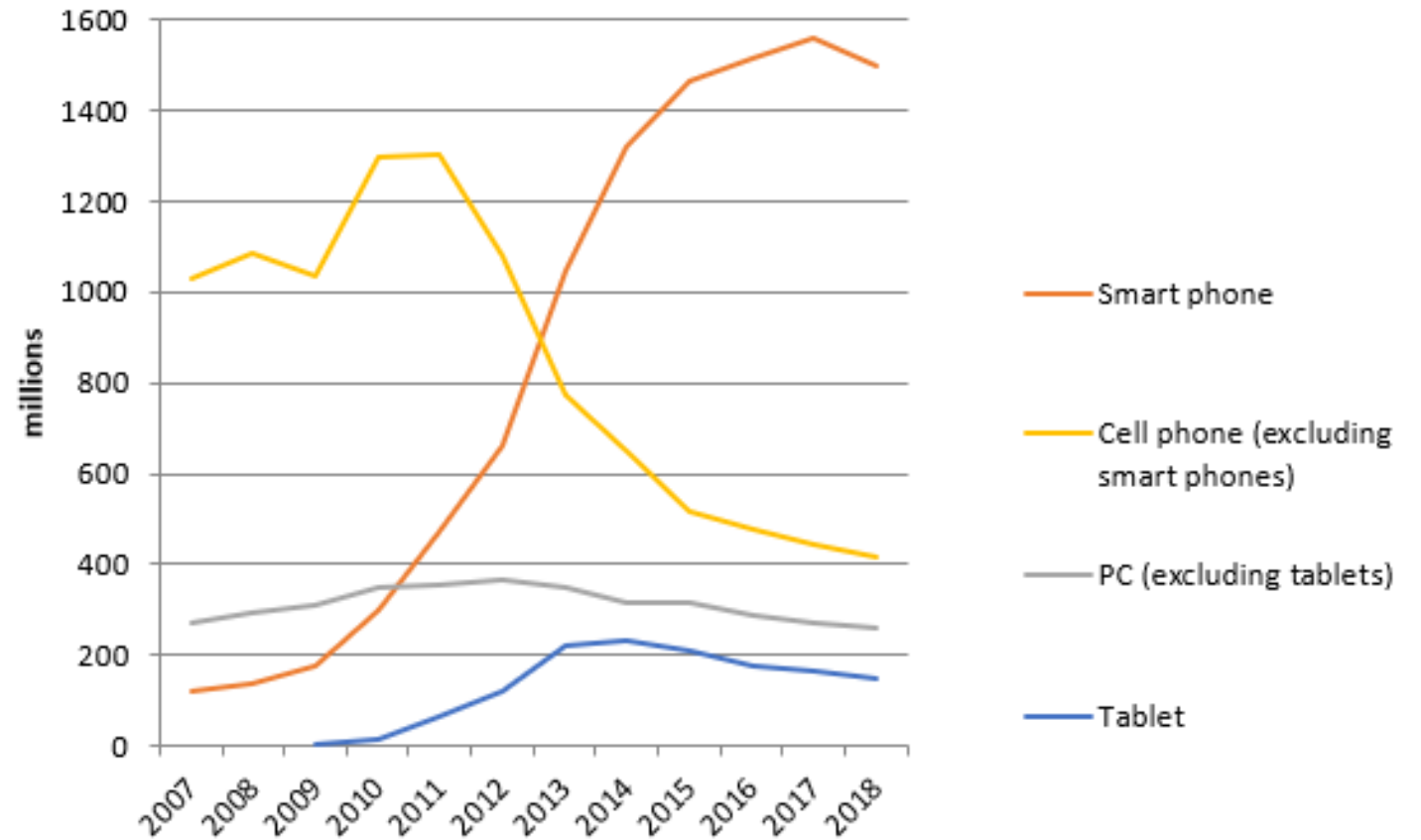

2688 cores, 0.8 GHz, 6 GB
$1000

Other Big Changes

- Smart phones and tablets

Other Big Changes

- Cloud computing and software as a service

In Conclusion

- Hierarchical layers of abstraction

- Continued rapid improvement in technology
  - Moore's Law

- 5 classic components of all computers

Control   Datapath   Memory   Input   Output

Processor

COMP 273 – Course Information

- Learn big ideas in computer science and engineering:
  - 5 Classic components of Computers (Control, Datapath, Memory, Input, Output)
  - Data can be anything (integers, floating point, characters): a program determines what it is
  - Stored program concept: instructions just data
  - Principle of Locality, exploited via a memory hierarchy (cache)
  - Greater performance by exploiting parallelism
  - Principle of abstraction, used to build systems as layers

Course Objectives

- Demystify abstraction layers
  - What is really "under the hood", how does it work?
- Take advantage of new found capabilities
  - Faster programs!
  - Many examples with impact in many domains!!

How is this course important?

There is so much fun hiding in here...

Review and more information

- **Textbook Chapter 1** (section numbers from 5th and 6th edition)

    1.1 Introduction

    1.2 Seven great ideas in computer architecture

    1.3 Below your program

    1.4 Under the covers

    1.5/1.6 Technology and Performance
    (we'll come back to later in the term)

    1.7 The power wall

    1.8 The sea of change: the switch to multiprocessors