

# INTRODUCTION AND LOGISTICS

Mahdi Nazm Bojnordi

Assistant Professor

School of Computing

University of Utah

# Overview

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- This lecture
  - Instructor
  - Teaching assistants
  - Course resources and requirements
  - Academic integrity
  - Computer organization
  - Trends and challenges

# Instructor

- Mahdi Nazm Bojnordi
  - ▣ Assistant Professor of School of Computing
  - ▣ PhD degree in Electrical Engineering
  - ▣ Personal webpage: <http://www.cs.utah.edu/~bojnordi/>
- Research in Computer Architecture
  - ▣ Novel Memory Technologies
  - ▣ Energy-Efficient Hardware Accelerators
  - ▣ Research Lab. (MEB 3383)
    - Open positions for research are available!
- Office Hours (MEB 3418)
  - ▣ Please email me for an appointment
- Class webpage: <http://www.cs.utah.edu/~bojnordi/classes/3810/s19/>

# Webpage

Please visit online

## CS/ECE 3810: Computer Organization

### Course Information

- ⌚ Time: Tue/Thu 09:10AM - 10:30AM
- 📍 Location: WEB L104
- 👤 Instructor: Mahdi Nazm Bojnordi, email: lastname@cs.utah.edu, office hours: email me for appointment, MEB 3418
- 👤 Teaching Assistants: Sumanth Sudaparthi, email: sgudapar@cs.utah.edu, office hours: TBD; Lin Jia, email: lin.jia@utah.edu, office hours: TBD; Jacqueline (Jac) MacLardy, email: maccharjk@gmail.com, office hours: TBD; Taylor Smith, email: taysmith16@gmail.com, office hours: TBD
- 👤 TAs will be available in the CADE Lab during their office hours. Please use the [TA Queue](#) to get in line.
- 👤 Pre-Requisite: Knowledge of structured programming languages such as C/Java
- 👤 Textbook: Computer Organization and Design - The Hardware/Software Interface - 5th Edition, David Patterson and John Hennessy
- 👤 Canvas is the main venue for class announcements, homework assignments, and discussions.

### Important Policies

Please refer to the [College of Engineering Guidelines](#) for disabilities, add, drop, appeals, etc. Notice that we have zero tolerance for cheating; as a result, please read the [Policy Statement on Academic Misconduct](#), carefully. Also, you should be aware of the [SoC Policies and Guidelines](#).

Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and please update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected.

### Grading

The following items will be considered for evaluating the performance of students.

	Fraction	Notes
Homework Assignments	30%	as scheduled below
Midterm Exam	30%	In-class, Thu., February 21st
Final Exam	40%	08:00AM - 10:00AM, Mon., April 29th

### Homework Assignments

Homework assignments will be released on Canvas; all submissions must be made through Canvas. Only those submissions made before midnight will be accepted. Any late submission will be considered as no submission.

	Release Date	Submission Deadline
Homework 1	01/10	01/17
Homework 2	01/17	01/24
Homework 3	01/24	01/31
Homework 4	01/31	02/07
Homework 5	02/07	02/14
Homework 6	02/26	03/05
Homework 7	03/05	03/21
Homework 8	03/21	03/28
Homework 9	04/02	04/09
Homework 10	04/11	04/18

### Class Schedule (subject to change)

The following is a tentative class schedule. Updated lecture slides will be posted on the morning before the lecture.

Date	Lecture Topic	Slides/Videos	Required Reading	Assignment Release
01/08	Introduction and Logistics		Chapter 1	

# Teaching Assistants

- Sumanth Gudaparthi
  - ▣ Email: [sgudapar@cs.utah.edu](mailto:sgudapar@cs.utah.edu)



- Lin Jia
  - ▣ Email: [lin.jia@utah.edu](mailto:lin.jia@utah.edu)



- Jac MacHardy
  - ▣ Email: [macharjk@gmail.com](mailto:macharjk@gmail.com)

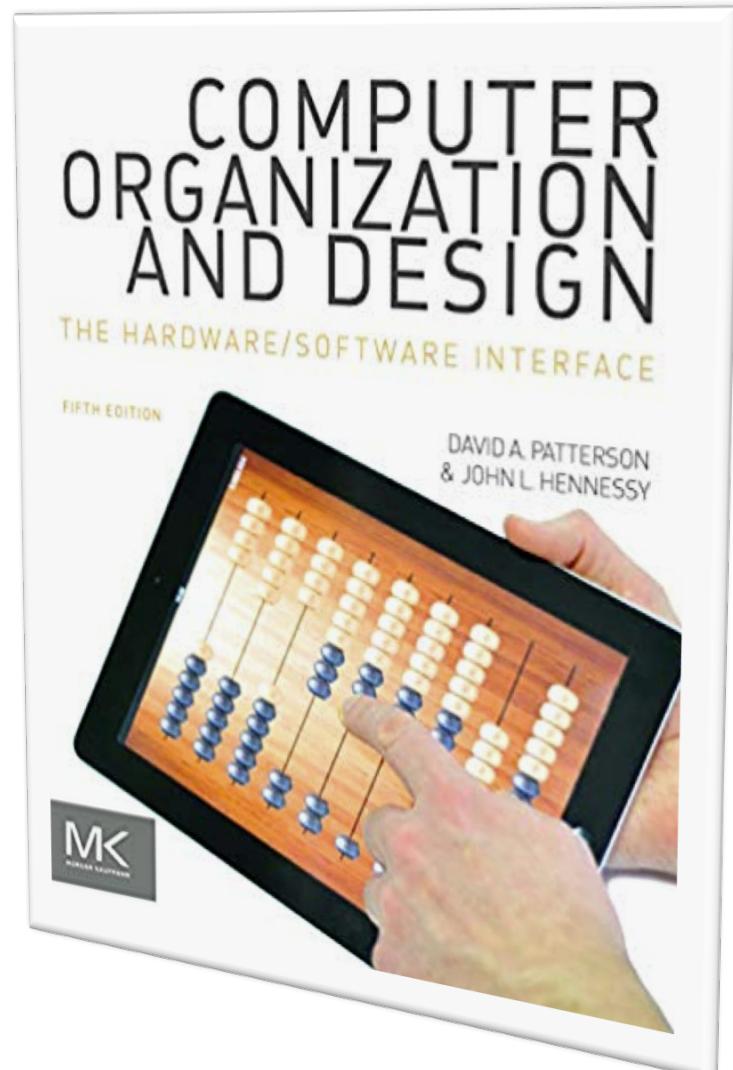


- Taylor Smith
  - ▣ Email: [taysmith16@gmail.com](mailto:taysmith16@gmail.com)



# Resources and Requirements

- Textbook: Computer Organization and Design - The Hardware/Software Interface - 5th Edition, David Patterson and John Hennessy
- Pre-requisite: Knowledge of structured programming languages such as C/Java



# Course Expectation

- We use Canvas for homework submissions, grades, and homework announcements.
- Grading

	Fraction	Notes
Assignments	30%	homework assignments
Midterm Exam	30%	Thursday, February 21st
Final Exam	40%	Monday, April 29th
Class Participation	--%	Questions and answers in class

# Homework Assignments

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- You may skip 1 out of 10 (= we drop one HW with the least score).

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# Academic Integrity

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- For more information, please refer to the important policies on the class webpage.

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- Understand what is inside a computer systems?
- Want to use the knowledge from this course in your own field of study?
- Understand the technology trends and recent developments for future computing?
- ...

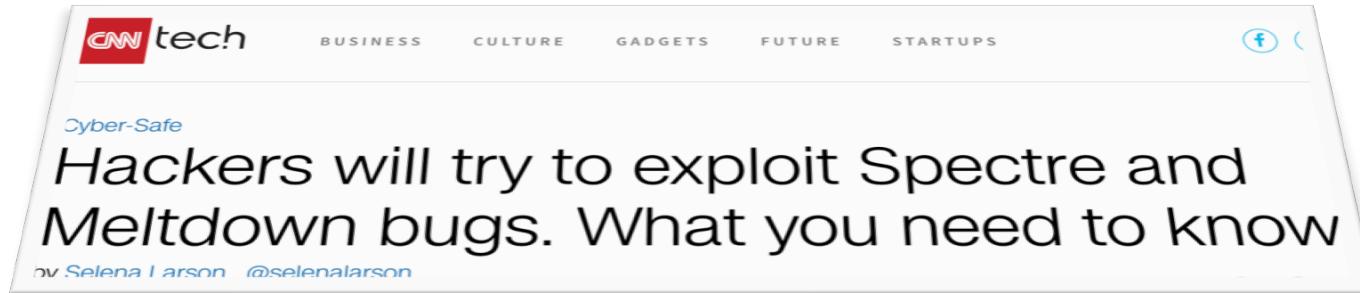
# Why study computer organization?

- Do the conventional computers last forever?
  - ▣ New challenges
  - ▣ New forms of computing



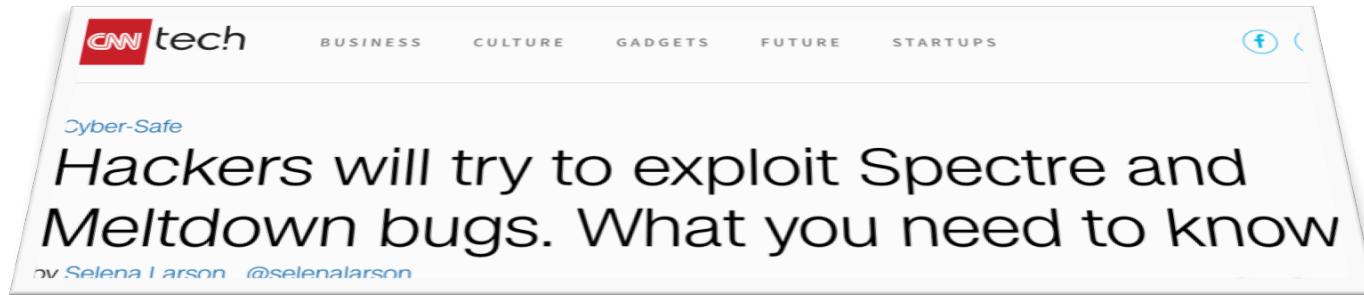
# Why study hardware?

- Better understanding of today's computing problems
- ▣ Security flaw: Spectre and Meltdown



# Why study hardware?

- Better understanding of today's computing problems
- Security flaw: Spectre and Meltdown



- How to fix?

**Warning: Microsoft's Meltdown and Spectre patch is bricking some AMD PCs**



By [Mark Wycislik-Wilson](#)

| Published 6 hours ago

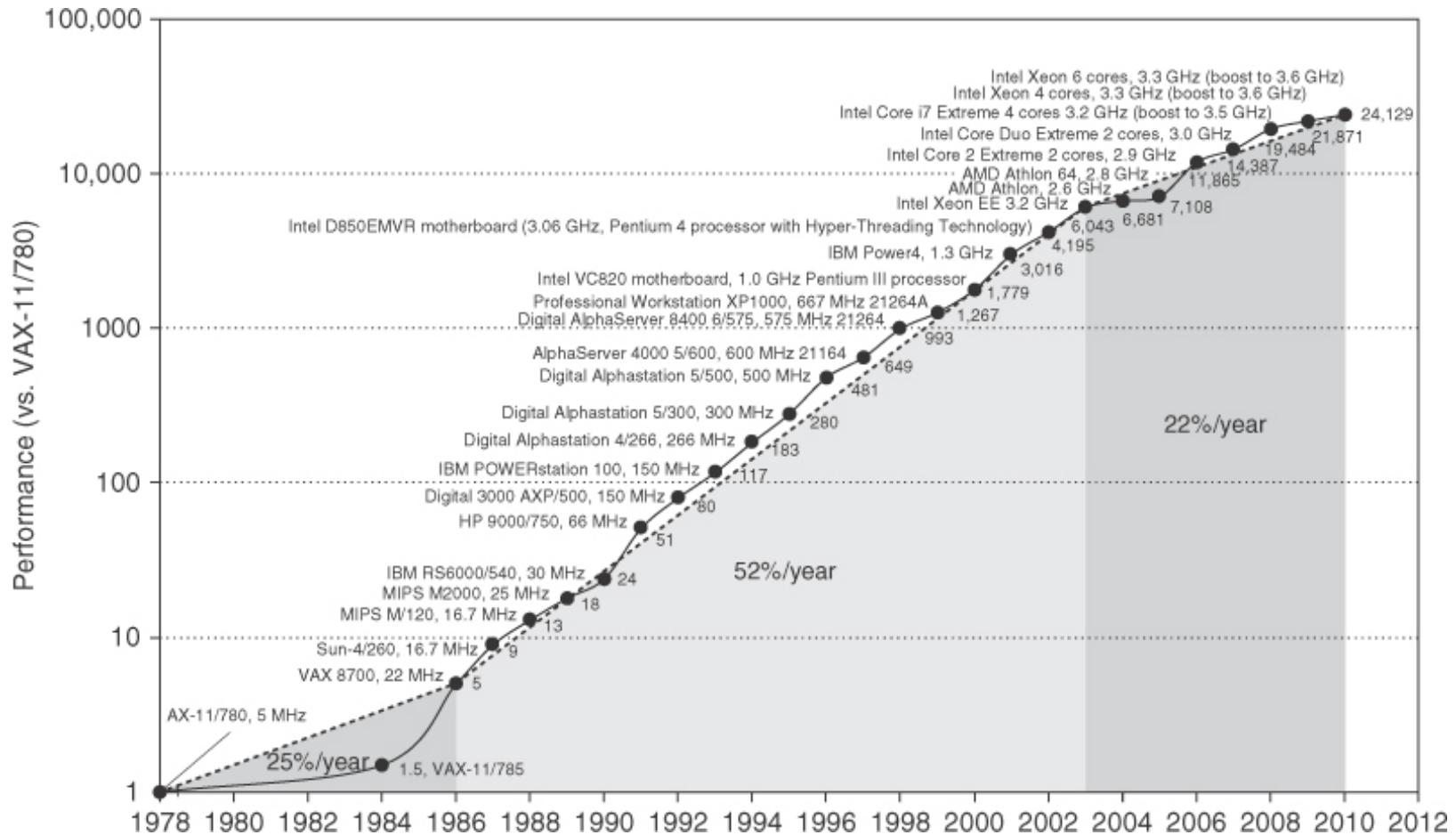
| [Follow @MarkWilsonWords](#)

# Estimated Class Schedule

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- Moore's Law, power wall, bandwidth wall
- Use of abstractions
- Assembly language
- Computer arithmetic
- Pipelining
- Using predictions
- Memory hierarchies
- Reliability and Security

# Growth in Processor Performance



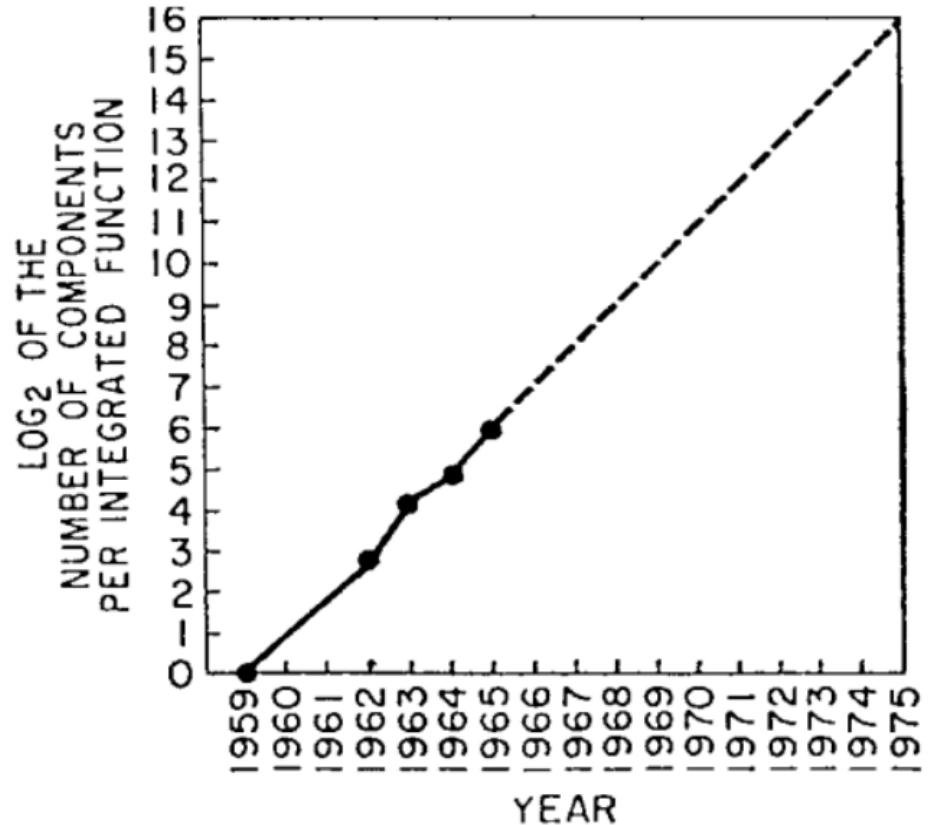
# Growth in Processor Performance

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- Main sources of the performance improvement
  - ▣ Enhanced underlying technology (semiconductor)
    - Faster and smaller transistors (Moore's Law)
  - ▣ Improvements in computer organization/architecture
    - How to better utilize the additional resources to gain more power savings, functionalities, and processing speed.

# Moore's Law

- Moore's Law (1965)
  - Transistor count doubles every year
- Moore's Law (1975)
  - Transistor count doubles every two years



*Source: G.E. Moore, "Cramming more components onto integrated circuits," 1965*

# What are New Challenges?

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- Resources (transistors) on a processor chip?
- Can we use all of the transistors?
- Who is affected?
- .

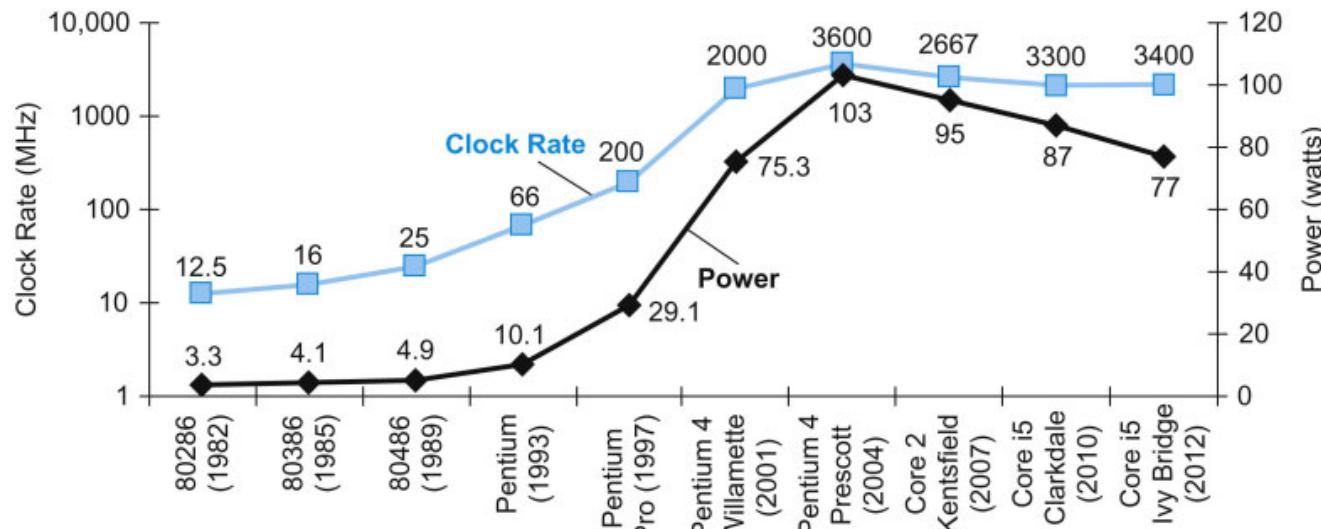
# What are New Challenges?

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- Resources (transistors) on a processor chip?
  - ▣ Not really, billions of transistors on a single chip.
- Can we use all of the transistors?
  - ▣ Due to **energy-efficiency** limitations, only a fraction of the transistor can be turned on at the same time!
- Who is affected?
  - ▣ Server computers by the peak power
  - ▣ Mobile and wearables due to energy-efficiency

# Power Consumption Trends

- $\text{Power} = P_{\text{dynamic}} + P_{\text{static}}$
- $P_{\text{dynamic}} = \alpha \times C_x \times V^2 \times f$
- $P_{\text{static}} = V \times I_{\text{static}}$



Source: Hennessy & Patterson Textbook

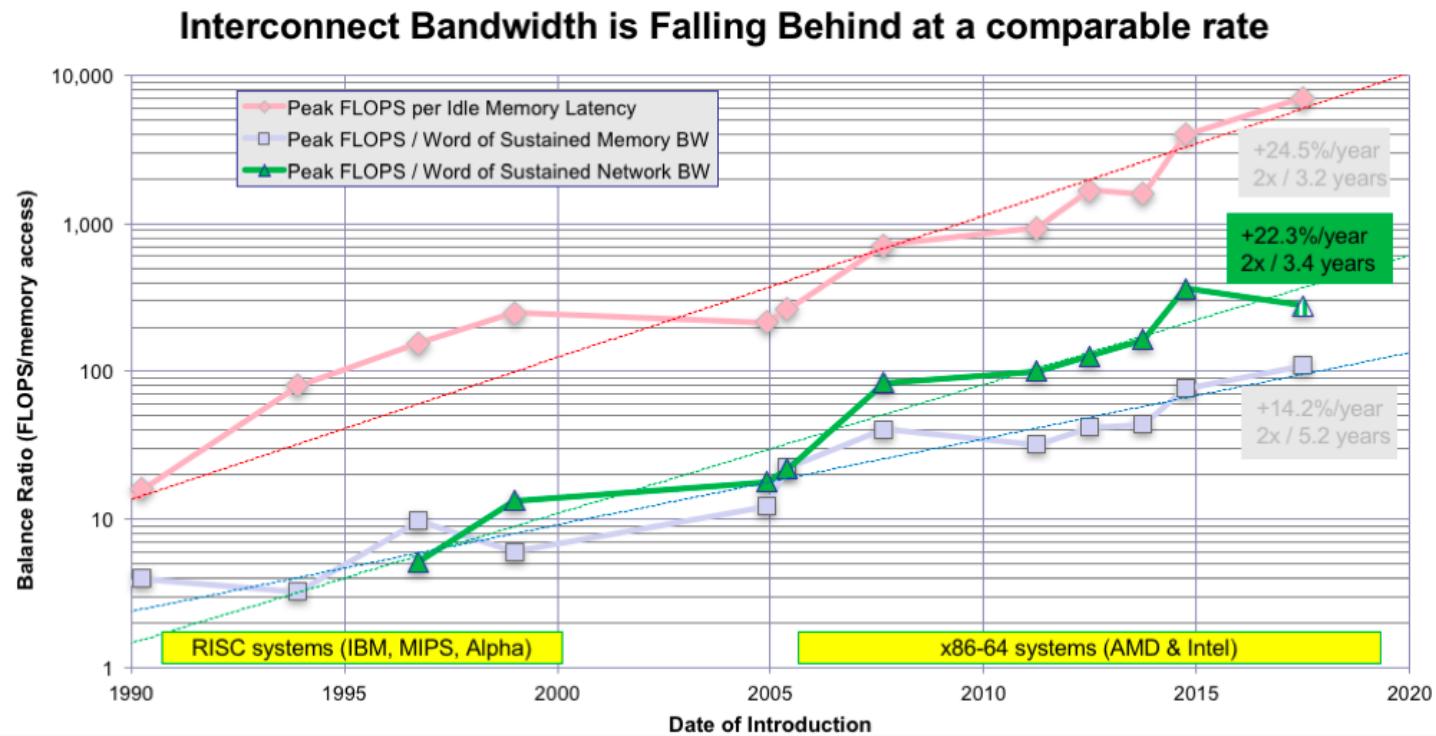
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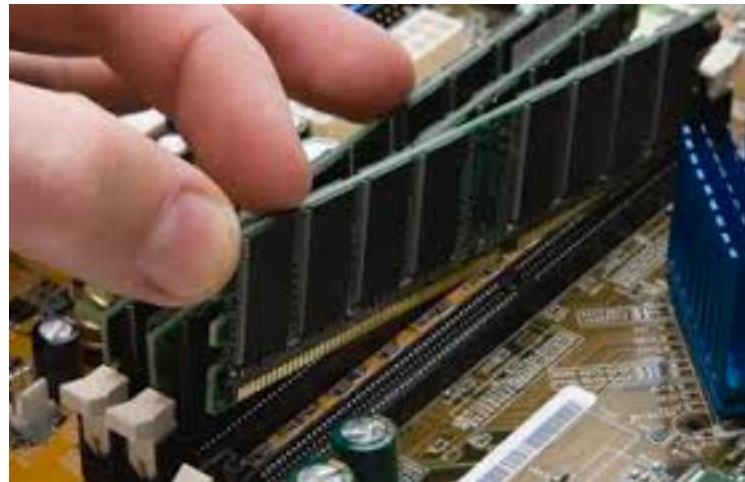
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# What are New Challenges?

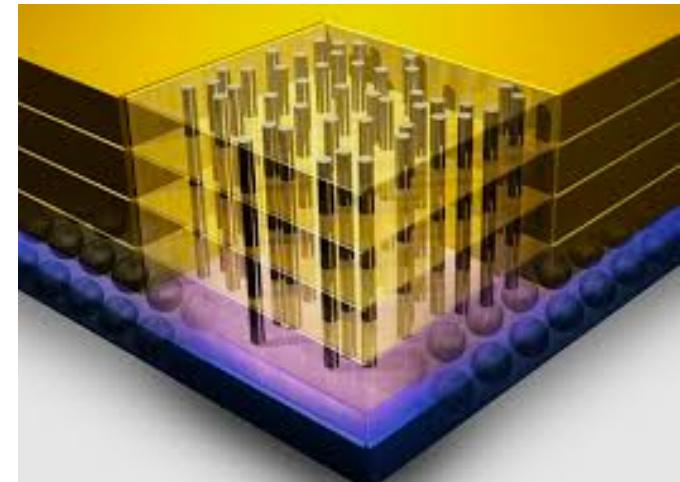
- Can in-package memory solve the problem?

**Off-chip Memory**



Lower Bandwidth  
Lower Costs

**3D Stacked Memory**



Higher Bandwidth  
Higher Costs

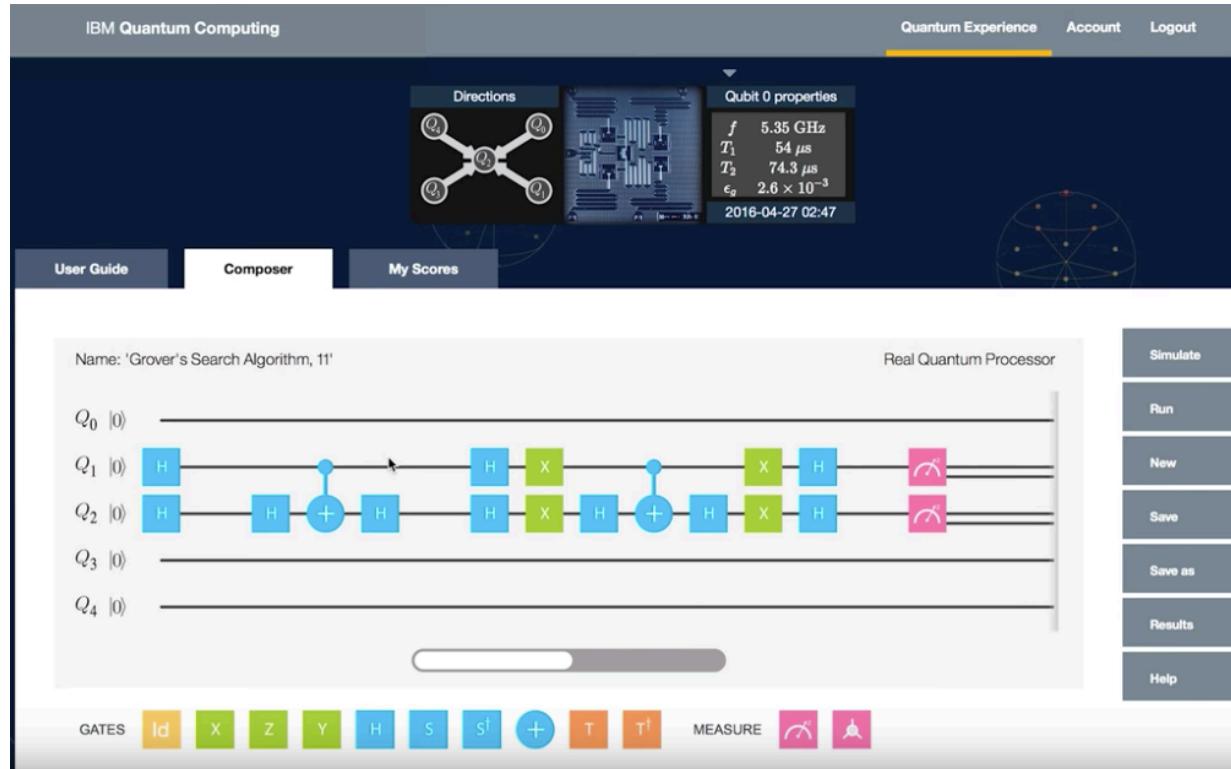
# What are New Challenges?

- Protecting data against side channel attacks is a serious need
- Performance in the past 40 years increased
  - ▣ hardware speculation to exploit more **instruction level parallelism**
  - ▣ shared memories to facilitate **thread-level parallelism**
- What about security?
  - ▣ <https://meltdownattack.com/>



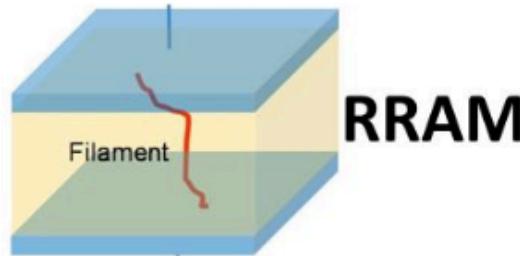
# Unconventional Computing Systems

- How to program a Quantum computer?
  - ▣ Qbit vs. bit

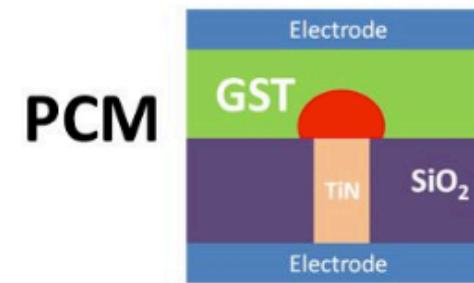


# Emerging Non-volatile Memories

- Use resistive states to represent info.
  - ▣ Can we build non-von Neumann machines?
    - In-Memory and In-situ computers



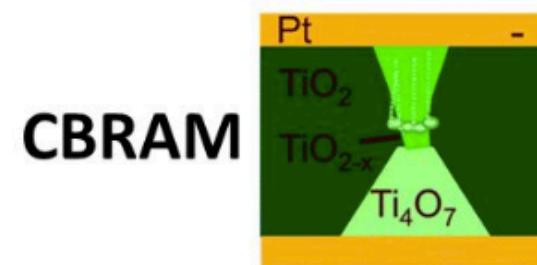
**RRAM**



**PCM**



**STT MRAM**



**CBRAM**

# Next Class

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- Lecture: Measuring Performance
- Todo: order the textbook