Constructive Computer Architecture

Arvind
Computer Science & Artificial Intelligence Lab
Massachusetts Institute of Technology

6.S195: L01 – September 4, 2013
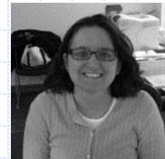

6.s195 Course Staff

Instructor

Arvind
arvind@csail.mit.edu

Teaching Assistant

Andy Wright
acwright@mit.edu

Adminis-tration

Sally Lee
sally@csail.mit.edu

For most up-to-date information and handouts please consult the course website: http://csg.csail.mit.edu/6.S195
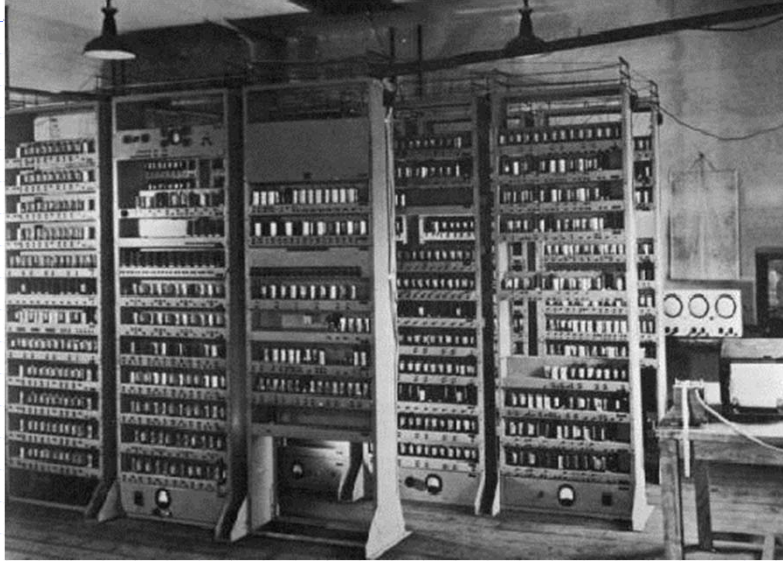
Computing Devices Then...
EDSAC, University of Cambridge, UK, 1949

Computing Devices Now

Dramatic progress in terms of size, speed, cost, reliability

Computer architecture is
about designing machines
to meet some power,
performance, cost and
size constraints

Studying Computer Architecture

A method of constructing machines:
Machine descriptions which can be
simulated in software and
synthesized into hardware

Quantitative evaluation:
To what extent designs
meet various design
criteria

Testing and verification:
Does the machine do what
it is supposed to do

Constructing and Deconstructing

A venerable method of studying any class of artifacts

an example from the art world...

Las Meninas (The Maids of Honour)   Diego Velázquez 1656

Pictures removed for copyright protection. Please visit the following link to view the pictures:

http://en.wikipedia.org/wiki/Diego_Velazquez

Portrait of Infanta Margarita, the daughter of King Philip IV, in Royal Alcazar, Madrid

Different lighting

Pictures removed for copyright protection. Please visit the links to view pictures:

http://en.wikipedia.org/wiki/Diego_Velazquez

Also just type "velasquez maids of honor pictures" in google

It is big!
Museo del Prado, Madrid

Engages the viewer

Pictures removed for copyright protection. Please visit the links to view pictures:

http://en.wikipedia.org/wiki/Diego_Velazquez

Also just type "velasquez maids of honor pictures" in google

The most important painting in Western art history

Spanish tradition

El Greco
1541–1614

Diego Velasquez
1599-1660

Francisco de Goya
1746–1828

Pablo Picasso
1881-1973

Pictures removed for copyright protection. Please visit the links to view pictures:

http://en.wikipedia.org/wiki/Diego_Velazquez

http://en.wikipedia.org/wiki/El_Greco

http://en.wikipedia.org/wiki/Goya

http://en.wikipedia.org/wiki/Picasso

Picasso

In fine arts one is encouraged to copy masters as a way of learning

- In 1956, at the 300th anniversary of Diego Velázquez's Las Meninas, Picasso revisited Madrid to see the painting
- The story goes he came back and locked himself in his studio for three months and painted 58 versions of it – deconstructing and constructing – not copying
  - All can be seen at Museu Picasso in Barcelona
- Why? Picasso was 75 and very aware of his Spanish heritage. Was he trying to improve upon the master's work?

Deconstructing & Constructing: Las Meninas

Just type "maids of honor Picasso" in google

All of Picasso's copies of Las Meninas are the Picasso Museum in Barcelona

Infanta Margarita

Just type "maids of honor Picasso" in google

All of Picasso's copies of Las Meninas are the Picasso Museum in Barcelona

Perplexed? Distracted by sun light?

Deconstructing & Constructing:
Las Meninas – Infanta Margarita

Just type "maids of honor Picasso" in google

All of Picasso's copies of Las Meninas are the Picasso Museum in Barcelona

Deconstructing & Constructing: Las Meninas

Just type "maids of honor Picasso" in google

All of Picasso's copies of Las Meninas are the Picasso Museum in Barcelona

Deconstructing & Constructing: Las Meninas

Just type "maids of honor Picasso" in google

All of Picasso's copies of Las Meninas are the Picasso Museum in Barcelona

---

Picasso reportedly said that I cannot improve it but these are my Meninas
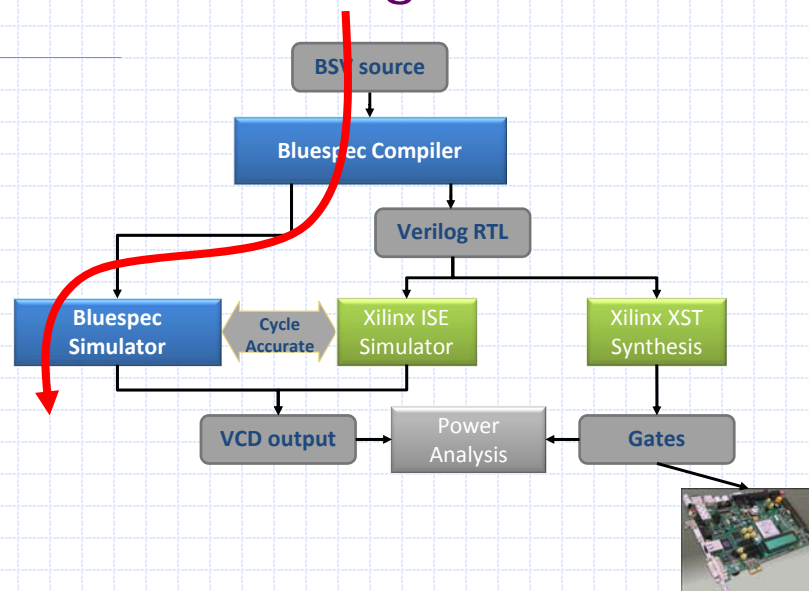
The goals of this subject

- Study computer architecture by *constructing* many different machines
- Learn a new method of describing architectures where there is less emphasis on figures/diagrams and more emphasis on executable descriptions
  - Each architecture and each part of it would be defined as executable code in BSV
  - Learning BSV is about learning a model of parallel programming (all hardware is parallel)
- Learn about test benches, including designing your own
- Learn about quantitative evaluation of designs

BSV Design Flow

11

By the end-of-the-term you will design six or more different computers of increasing complexity and performance, and you will quantitatively evaluate the performance of your C programs on these machines

All the designs you do in this course can be implemented on FPGAs or realized as ASICs without significant additional effort. Time permitting we will explore FPGA implementations of the designs you do in the labs.

Course information

◆ The class will meet three times a week (MWF 3pm to 4pm), accept for a few holidays
- Typically two classes every week are lectures while the third one is a tutorial

◆ Eight lab assignments; to be done individually

◆ A project/competition in the last two weeks to produce the fastest implementation or to try out a new cool architecture idea

◆ Labs + project constitute 10 grade units
- A = >75% on all 10 grade units;
- B = >75% on 7 grade units
- C = >50% on 7 grade units

No Quizzes

Resources

◆ "Computer Architecture: A Constructive Approach", Arvind, Rishiyur Nikhil, Joel Emer and Murali Vijayaraghavan

◆ BSV Reference manual

For most up-to-date information and handouts please consult the course website: http://csg.csail.mit.edu/6.S195