Lecture 3

Technology

FPGAs

Projects

- See recent posts on Piazza
  - Past projects
  - Project planning

Technology

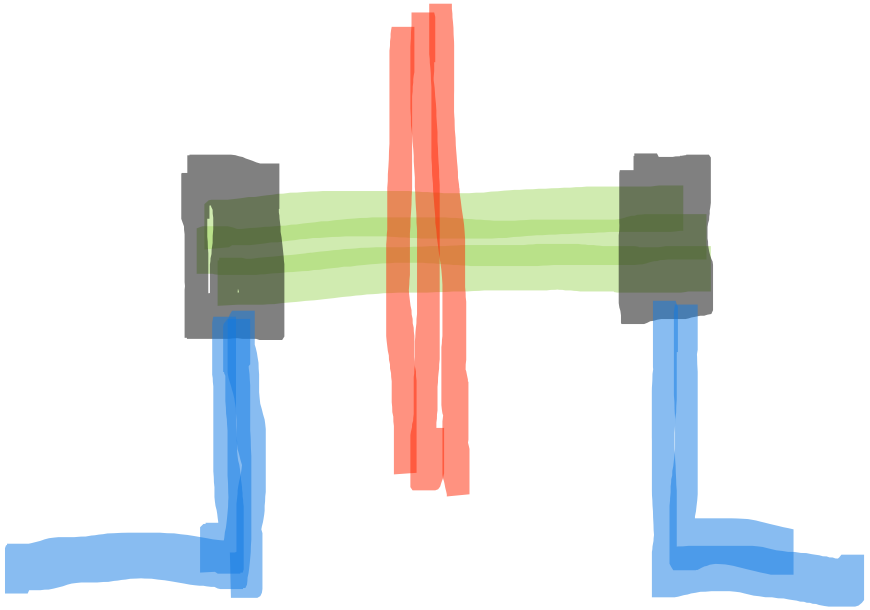
What we can use to build digital systems

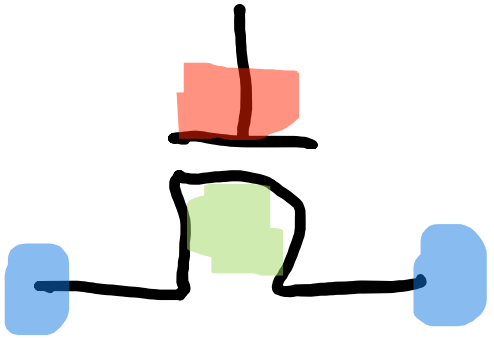
Technology Evolution

- How did we get to FPGAs?
- Drivers
  - Time to market
  - Cost
  - Power

Custom Design

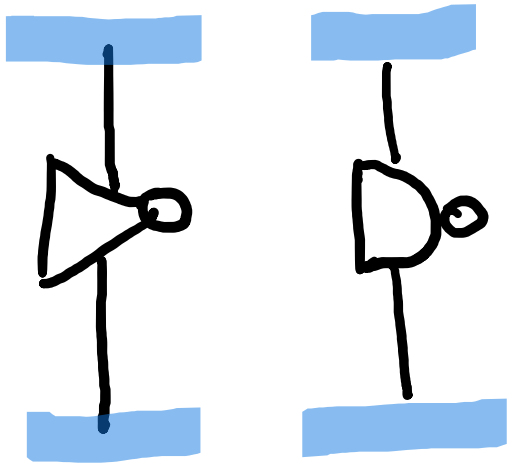
- Drawing rectangles
- Mostly analogue design now

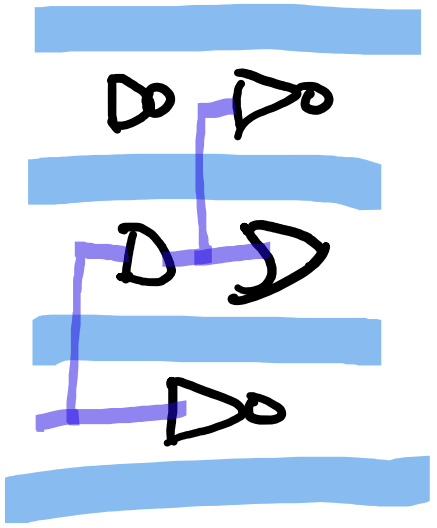




ASIC

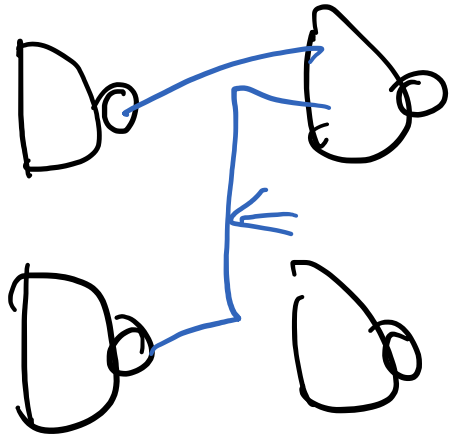
- Standard cells





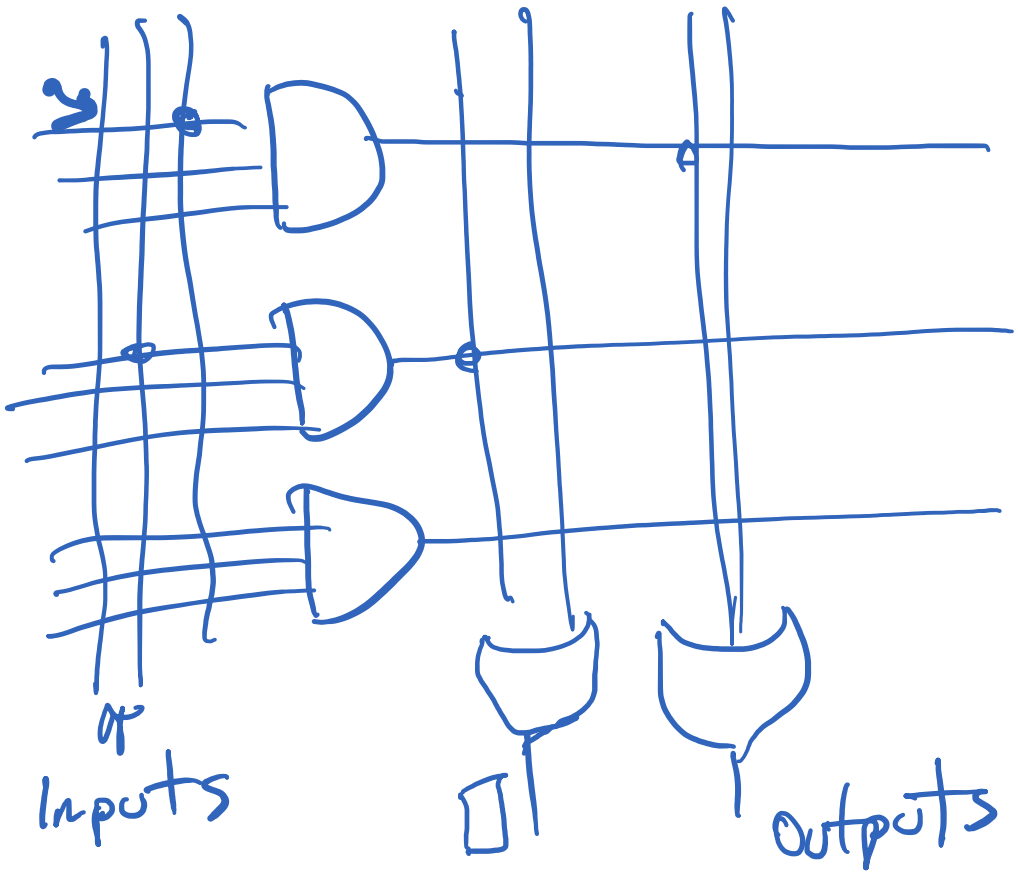
Gate Array

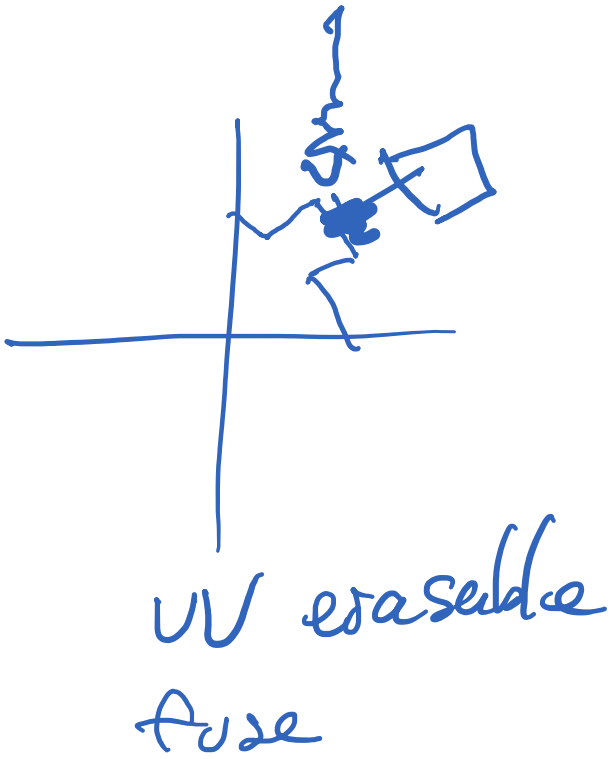
- Address time to market



Programmable Logic

- PLA, PLD





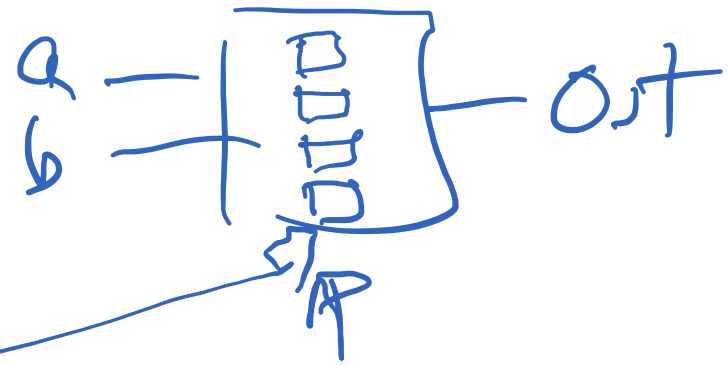
FPGA

- Field-Programmable Gate Array
  - FP – program without fab
  - GA – array, like old gate arrays
- Array of programmable logic cells + programmable routing
- What's a cell?

- What's a LUT?

Look up Table → Truth table

a	b	Out
0	0	1
0	1	1
1	0	0
1	1	1



Structured ASIC

- Hybrid of gate array and FPGA
- FPGA-like gates

Structured ASIC

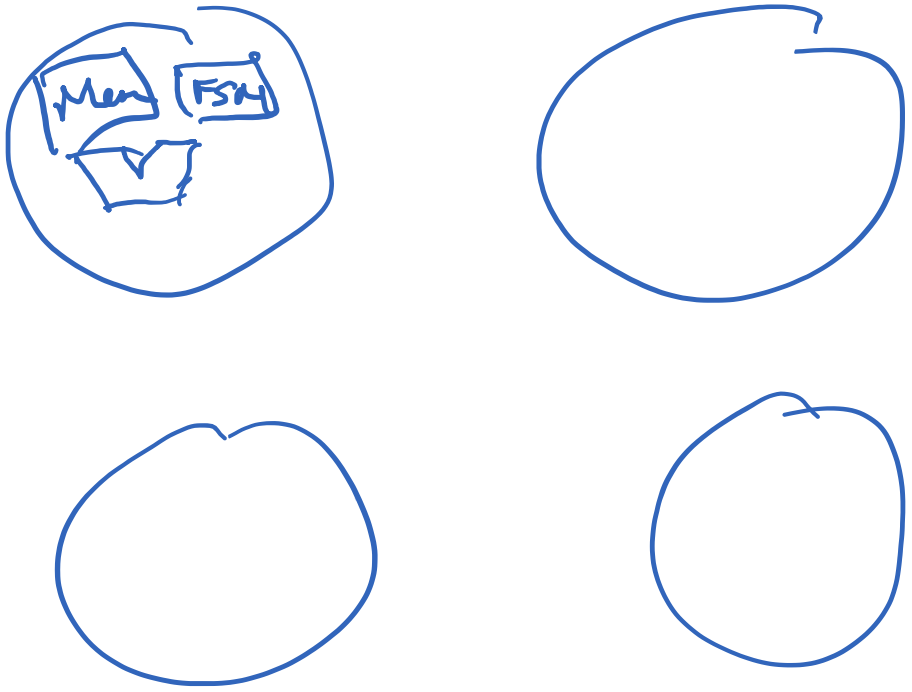
- Altera Hardcopy (no more!)
- Xilinx EasyPath – not really an ASIC
- Cost (area), power, performance
- Many designs end up never cost-reduced
  - Vendor marketing strategy to promise a cost reduction
- Failed startups

Embedded FPGAs

- IP cores of FPGAs
- Several companies today
  - Efinix (UofT founder), Flex Logic
  - Now with an ML flavour

CGRA

- Course-grain reconfigurable array



CGRA

- Samsung phones, TVs
- no other (known to me) successful commercial device
- Huawei – need programmability
- Prof. Jason Anderson – CGRA-ME

Technology Spectrum

FPGAs and Power

- Samsung Galaxy S4
  - Lattice FPGA
  - Used to reduce power!