Advanced Design Techniques for FPGA Circuits

Advanced Microelectronics

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Course Overview

- CLB Resources: Logic, Latches and Registers
- CLB Memory and Shift Registers
- Block Memory
- Embedded DSP Blocks
- FPGA Clock Resources
- IO Resources
- Timing closure and Floorplanning
- FPGA Configuration
- Design Flow Automation

Grading

- 25p for 5 applications (weeks 2-6)
  - Implement circuits in FPGA, graded for quality of implementation (top frequency, resources)
- 50p for FPGA project (weeks 7-11)
  - Work on FPGA-based embedded system
- 25p final exam (multiple-choice test)

Why FPGAs

Use cases:

- Prototyping – since 1985 (Xilinx founded)
  - Cheap way to test-drive the design
  - Orders of magnitude faster than the simulator
- Glue logic and high-flexibility design
  - In case that bug isn’t a feature after all

Why FPGAs

Use cases:

- Production in short runs
  - How much does an ASIC run cost?
- High Ops/Watt computing
  - Cryptography
  - Embedded video
  - Anything which is amenable to HW implementation

Case Study

Bitcoin

- Cryptography-based currency
- You make money by hashing – SHA256

- Energy Efficiency determines cost (pay for power at the plug)
- CPUs < GPUs < FPGAs < ASICs

Bitcoin Mining HW