Overview and Objectives

- Remember that addictive Nokia game from the '90s?

- Remake it on an FPGA, but do it better:
  - better graphics
  - multiple players
  - nes controllers!
  - power-ups
  - obstacles
Design Architecture

- sram
- sram controller
- nios II cpu
- nes controller
- vga controller
- vga raster
- WM8731 CODEC module
- audio controller
- speakers
- handheld controller

Avalon Bus
Design Architecture

NES Controller Protocol
Design Architecture

Writing to hardware

0000101101101 10101010101010101010101010

- unused
- which snake segment
- increment flag
- sprite select
- add/remove
- y coordinate
- x coordinate
Gameplay

Edibles
- food (rabbits + mice)
- speed power-up
- freeze power-up
- edwards power-up

Obstacles
- bricks + walls
- your own tail
- other players
Controlling Your Snake

- move your snake
- pause
- start
- use freeze power-up
- use edwards power-up
Challenges

- Connecting NES controllers
  - Using universal I/O pins
  - Have their own serial-bit protocol
- Tracking snakes' locations
  - Snakes are just linked lists
  - Software knows where everything is
    - Hardware just draws it
- Efficient storage of sprites
  - Binary encodings, broken up by color
- VGA Raster
  - Unexpected colorings
Summary

Lessons Learned:
● Working with embedded systems is tricky, yet rewarding
  ○ Lots of possibilities and methods of implementation
  ○ ...Which means a lot of learning from your own mistakes

Completed Game:
● Brought Snake into the 21st century
  ○ Added in idea of NES controllers
  ○ Two players (or more)!
Thanks for Listening!