That's a wrap

10 weeks, 28 classes, 4 programs, 2 exams, and 1 brutal winter…
Now, the last page of lecture notes for CSC 220, Winter 2014 term. Huzzah!

Last minute

Some last minute tidying:

- I just found these two quotes, and I like them:
  - Temporal locality - "If you used it, you'll use it again" (soon)
  - Spatial locality - "If you used it, you'll use something near it"

- Remember, two important jobs during linking:
  - Relocation problem - update jump addresses
  - Resolve external references - set addresses for all method calls

Do rhymes with New

We learned to **DO** a lot of **NEW** things this term:

- Encode binary numbers, positive and negative… add/subtract using 2's complement
- Convert between Boolean formats: truth table, equations and gates
- Design an ALU and datapath using logic gates and registers
- Describe and simulate hardware designs using Verilog HDL
- Create and encode microcode instructions
- Write Intel assembly code
- Write an assembler to create symbol tables and write object code from assembly code
- Link multiple object code files together to create a single executable
- Apply the Hamming code algorithm to correct bit errors in data transmission

Important themes

#1 - Abstraction is the key.

- ➢ Higher levels of abstraction dramatically improve productivity
- ➢ Examples: Software - Java v. assembly code; hardware - Verilog HDL v. transistor-level design
- ➢ Interface is separated from implementation => hiding complexity
- ➢ Higher levels are translated to lower levels => automation
- ➢ CSC 220: transistor -> logic gate -> latch/flipflop -> register -> datapath -> CPU -> micro-architecture -> instruction set architecture -> assembly language level -> high-level language

Addressing M things takes $\log_2 M$ bits. Or, addressing 2^N words requires N bits.

Hardware is petrified software… regardless of the medium, algorithms are the key!

RISC has beaten CISC because: simpler instructions mean 1) faster clock speed, 2) simpler hardware, 3) easier to pipeline

And Moore's Law marches on!

- The web is now 25 years old and the equipment we use to surf the Internet is exponentially cheaper and faster than in 1989 - This is what your laptop today will look and feel like in 25 years.

- Save more with Google Drive - Google Drive prices are cut 80%. 100GB of cloud storage now costs you $2/month.

- Internet usage How The Internet Has Grown In The Last 25 Years - Internet usage has grown from 14% to 87%.