ECE220 Lab3

Brain Teaser – Printing Decimal

Printing in hexadecimal

- Shift 4 bits from MSB into the LSB
- Convert into ASCII
- Repeat 4 times

Printing in decimal

- x24 → 36
- ?!?!

Two Solutions

Brain Teaser – Printing Decimal Solution 1

Printing in decimal
- x24 → 36

Hint: how to extract digits from a string?

Solution
- Divide hex number by 10
  - x0024 / x000A = x0003 R x0006
  - x0003 / x000A = x0000 R x0003
- Store computed results: 6 3
- Print in reverse order

How is division implemented in LC3?
- Subtract dividend by divisor
- Increment subtraction count
- Loop while dividend ≥ 0

Is there another method of converting?

Brain Teaser – Printing Decimal Solution 2

Printing in decimal
- x24 → 36

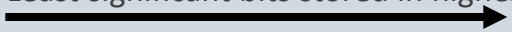
Solution
- Store powers of 10
  - Powers of 10 in hex …, x03E8, x0064, x000A, x0001
- Subtract each power of 10 from hex number
  - 100:
    - x0024 – x0064 = x0000 R x0024; count = 0
  - 10
    - x0024 – x000A = x001A R x0000; count = 0
    - x001A – x000A = x0010 R x0000; count = 1
    - x0010 – x000A = x0006 R x0000; count = 2
    - x0006 – x000A = x0000 R x0006; count = 3
  - 1
    - x0006 – x0001 = …; count = 6
- Print numbers an compute: 0, 3, 6

Which solution is faster, 1 or 2?
- Both use similar amounts of memory
- Solution 2 performs less subtractions

Endianness

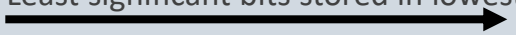
What is endianness?

- Sequential order in which byes are stored in memory
- Given a value of xS010
- Big Endian
  - Least significant bits stored in highest memory address



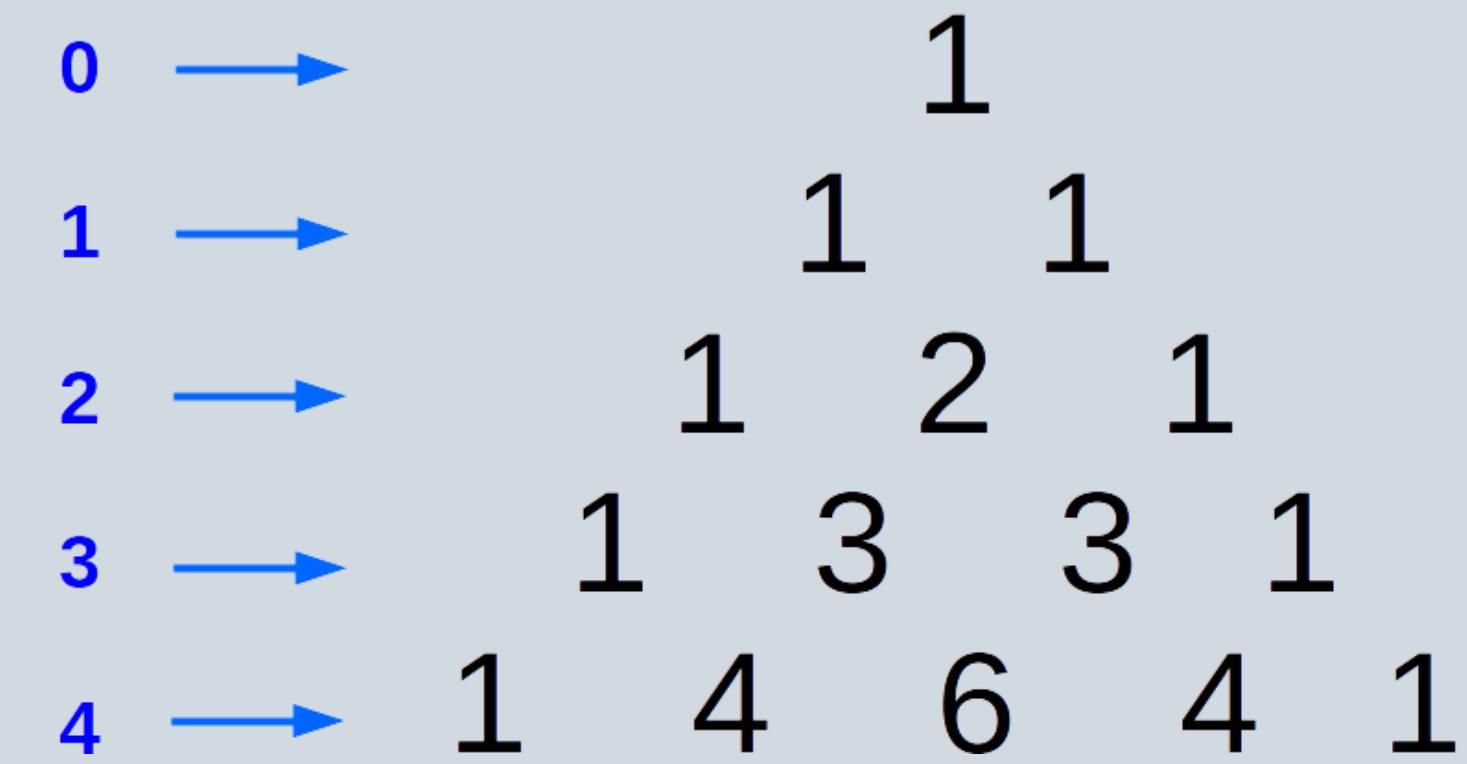
0	1	2	3
S	0	1	0

  - Examples: Internet protocols
- Little Endian
  - Least significant bits stored in lowest memory address



0	1	2	3
0	1	0	S

  - Examples: LC3, x64



MP3 – Pascal's Triangle

Pascal's triangle

- Array of binomial coefficients of $(x+y)^n$
  - $(x+y)^2 = x^2 + 2xy + y^2$
- Combinations $\binom{n}{k} = \frac{(n!)}{k!(n-k)!}$
  - $\binom{3}{0} = 1, \binom{3}{1} = 3, \binom{3}{2} = 3, \binom{3}{3} = 1$
- Problem
  - Compute the nth row of the triangle
- Algorithm
  - For a given n, compute each of the $\binom{n}{k}$ terms

Lab 3 – Computing a math function

Problem

- Implement function: $f(x) = \sin(\omega_1 x) + \frac{1}{2}\sin(\omega_2 x)$ on the interval $x \in [0, \pi)$
- Get n, ω_1, ω_2 from user

Standard streams:

- stdin – standard input stream, stdout – standard output stream, stderr – standard error stream

Useful functions:

- scanf – reads data from STDIN and stores them into locations pointed by additional arguments
  - int x;
  - scanf("%d", &x);
- printf – writes a string to STDOUT
  - int x = 5;
  - printf("%d\n", x);
- sin – returns sine of angle of x radians
  - double rad = sin(x);