Lecture 3

Christopher Godley

CSCI 2270 Data Structures

June 6th, 2018

Computer Memory

- Memory on a computer is stored using binary bits.
- Bit
  - is either a 1 or a 0
- Byte
  - group of 8 bits
- Everything is a number
  - Your English paper, your favorite song, the embarrassing picturesof you your Mom posts to Facebook, etc…

Binary Representation

- Endian
  - Binary can be interpreted either reading left->right or right->left depending on the system
  - We will default to reading all binary in this course in the following format:

128	64	32	16	8	4	2	1
0	0	0	1	1	0	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

MSB: Most Significant Bit

LSB: Least Significant Bit

Hexadecimal Representation

- Decimal
  - Base 10
- Binary
  - Base 2
- Hexadecimal
  - Base 16
  - The numerical digits 0-9 are the same as decimal

Hex = Decimal
A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

Conversion

- Binary to Decimal
  - Use powers of two to calculate decimal value
- Decimal to Binary
  - Start binary value Right->Left
  - Divide decimal value by two
  - If there is a remainder (odd), enter a 1, else enter a 0
    - (#/2 is odd) ? 1 : 0
- Hexadecimal

Hexadecimal Conversion

- Easy to/from binary
- More complicated to/from decimal
- Binary to Hex:
  - Split the binary bits into groups of four
  - Map each group of four bits to a hexadecimal value.

Max/Min Values of Binary number

- The largest binary number:
  - for any given number of bits
  - all the bits are set to 1
- The smallest number:
  - For any given number of bits
  - All the bits are set to 0

Variable Types

- Char
  - 1 byte
- Int
  - 4 bytes
- Long
  - 8 bytes
- Float
  - 4 bytes
- Double
  - 8 bytes

Memory

- Variables are stored in discrete locations in memory
- The amount of memory required by a variable depends on the type of variable
- In the figure to the right
  - Each address is 1 byte
  - Variable 0xACAA is stored at ?
    - 0xFF02

Address	Value
0xFF06	
0xFF05	
0xFF04	
0xFF03	
0xFF02	AC
0xFF01	AA
0xFF00	

Memory - Example

Address	Value	Variable
0xFFFF		
0xFFFE		
0xFFFD	0x03	Y
0xFFFC	0x02	
0xFFFB	0xFF	
0xFFFA	0x01	
.		
.		
.		
0xFF04	0xFF	X
0xFF03	0x0A	
0xFF02	0x01	
0xFF01	0x05	
0xFF00		

Variables store data.

How do we store variables?

Pointers

- Regular int variable may be declared as such
  - int X = 4;
- The pointer this variable would be declared as
  - int* ptrX = &X;