ECE 120 Midterm 1
HKN Review Session

Exam Time: Tuesday, September 20 (7:00-8:30pm)

Logistics

Exam: Tuesday, September 20, <u>7pm-8:30pm</u>

Conflict exam: <u>5pm-6:30pm</u>

Location: Check Compass for room assignment

UA Review Session: Sunday, September 18, <u>2pm-4pm</u>

Abstraction/Levels of Transformation

- Abstraction - the means to simply events without going into heavy specifics, reducing information to the essentials
- Levels of Transformation
  - Problem Statement
  - Algorithm
  - Program
  - Instruction Set Architecture
  - Microarchitecture
  - Logic gates
  - Devices

Binary Types

- **Unsigned**
  - Can only represent nonnegative integers
  - K = number of bits
  - Total unique representations ➜ 2^k
  - Range ➜ 0 to (2^k-1)

- **Signed - Magnitude**
  - First bit determines if positive or negative ➜ 1 = negative, 0 = positive
  - Rest of bits determine magnitude
  - Range ➜ $--(2^{(k-1)}-1)$ to $(2^{(k-1)}-1)$

- **1's Complement**
  - Positive numbers represented just like unsigned
  - Negative numbers represented by flipping all the bits
  - Range ➜ $--(2^{(k-1)}-1)$ to $(2^{(k-1)}-1)$

Binary Types *

- **2's complement**
  - Positive numbers lead with "0", negative numbers lead with "1"
  - *K* bits ➜ can represent 2^k total numbers, half being positive and half being negative
  - Can represent positive numbers from range $--(2^{(k-1)})$ to $(2^{(k-1)}-1)$
  - **Procedure for 2's complement (PFA):**
    - **<u>P</u>LACEHOLDER BITS**
    - **<u>F</u>LIP ALL BITS**
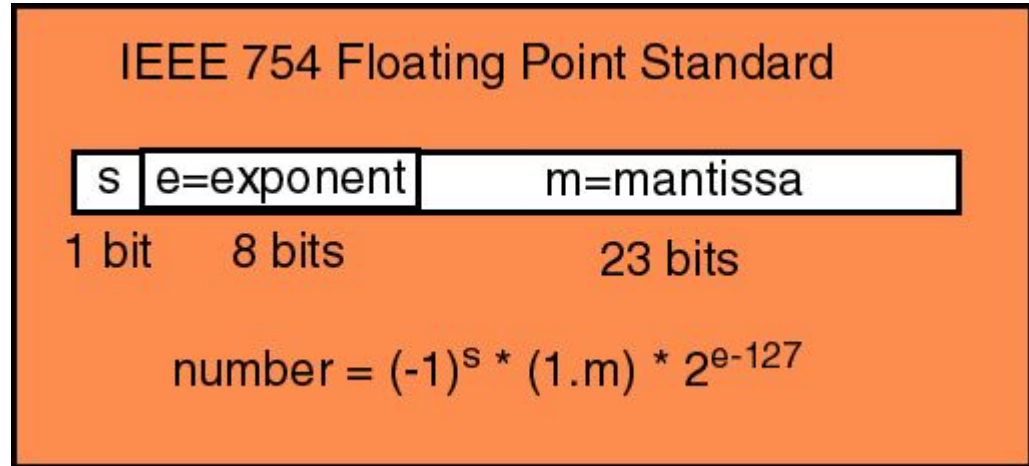   - **<u>A</u>DD 1**

Hexadecimal *

- Base 16, Uses 0-9 and A-F
- Takes groups of 4 bits and represents them as symbols
  - Ex: 0011 1101 0110 1110 ➜ 3 D 6 E
- To go from hex to binary, write out each hex value into 4 bit binary
  - Ex: 4E7F ➜ 0100 1110 0111 1111
- Shortens binary representation by a factor of 4

Overflow in Operations

- 2 primary operations: addition and subtraction
- **Checking for Overflow**
  - Unsigned operations
    - There is a nonzero carry bit (bit carries out of bit range)
  - 2's Complement operations
    - Result has wrong sign if
      - 2 positive numbers sum to negative number
      - 2 negative numbers sum to positive number
      - NOTE: in 2's complement, a positive and negative number added never results in overflow
    - Quick Check- For MSB, does carry in bit = carry out bit (i.e. $C_n = C_{n-1}$)?
      - If not, overflow has occurred

Floating Point

- Use IEEE 754 standard (32 total bits)
  - 1 sign bit
  - 8 exponent bits
  - 23 mantissa bits
- Increased precision
  => decreased range

IEEE 754 Floating Point Standard

s	e=exponent	m=mantissa
1 bit	8 bits	23 bits

$$number = (-1)^s * (1.m) * 2^{e-127}$$

Floating Point (cont.)
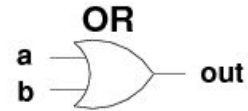
- Special Cases
  - **Denormalized representation**
    - Exponent = 0
    - Mantissa takes any value
    - Formula: $(-1)^s * 0.Mantissa * 2^{-126}$
  - Exponent is all 1s
    - Mantissa = 0
      - **$(-1)^s$ * infinity**
    - Mantissa not equal to 0
      - **NaN**

Boolean Operators *

- NOT
- AND, NAND
- XOR, XNOR
  - A XOR B = A (NOT B) + (NOT A) B
- OR, NOR
- Note:
  - Order of precedence:
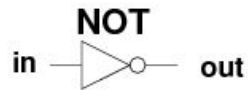   - (), NOT, AND, OR
  - AND, NOT, and OR are **logically complete**

AND
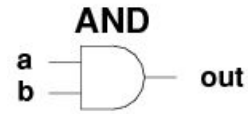
a	b	out
0	0	0
0	1	0
1	0	0
1	1	1

OR

a	b	out
0	0	0
0	1	1
1	0	1
1	1	1

XOR

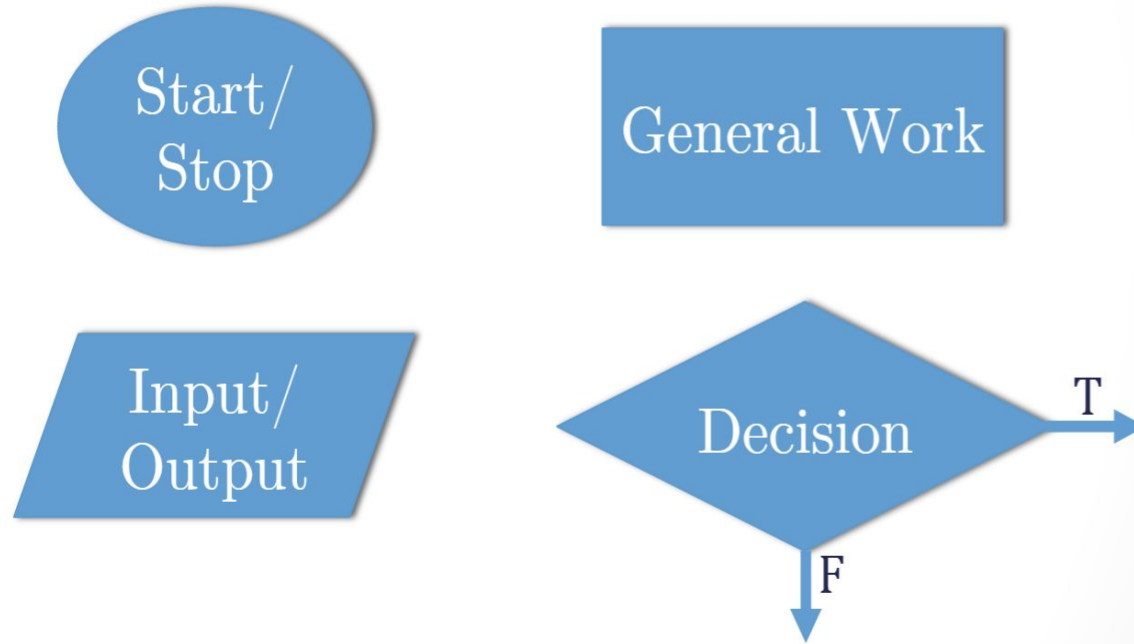| a	b	out
0	0	0
0	1	1
1	0	1
1	1	0

NOT

in	out
0	1
1	0

C Programming

- Basic Characteristics
  - High level/independent (of ISA), procedural, expressive
- Variables
  - Int, double, float, char
  - Note that result is truncated during integer division!
- Operators
  - **Order of precedence: *, /, % and then +, -**
- C Constructs
  - Sequential
  - Conditional (if, else if)
  - Iterative (for, while loops)

Flow Chart Components

Cheat Sheet: Recommendations

- Common powers of 2
- 2's Complement
  - Converting to/from (PFA)
  - Representable range with K bits
- Floating Point
  - Formula for general case
  - Special cases
- Overflow Conditions (both unsigned and 2's complement)
- Harder boolean operators
  - XNOR, XOR, NAND, NOR
- Basic C syntax

General Advice

- Use your Cheat Sheet!
  - Don't memorize
- Read the directions carefully!!!!
- Don't be afraid to ask questions
- Relax and trust what you've learned :)