OPERATOR PRECEDENCE, DATA REPRESENTATION

Problem Solving with Computers-I

https://ucsb-cs16-wi17.github.io/

Announcements

- Lab02 – we have found an error in the last exercise (calculate approximate value for pi), please wait for further instructions via Piazza
- Midterm next week –Thursday (02/02)
- Study guide will be posted by tomorrow at this location: https://ucsb-cs16-wi17.github.io/exam/e01/
- Midterm will cover topics from
  - Lectures 1 to 7 (including code covered in class)
  - Labs 0 to 2
  - Homeworks 1 to 6

Note: Slides are not a replacement for the book

Review homework 4, problem 3

What is the output of the following program?

```
int x = 0;
while ( x = 2 && x < 10){
    cout << x << endl;
    x+=2;
}
```

A. Nothing is printed to output
B. Infinitely prints the number 2
C. Infinitely prints the number 1
D. Prints the following numbers to output: 2 4 6 8

Operator Precedence

Paranthesis () does not mean “Do what is inside the parenthesis first” It specifies how to explicitly bind operators to operands

```
w = x*(y+z)+y*z;

w =(x = 2) && (x < 10);
```

Operator precedence: Default binding of operators to operands in the absence of parenthesis

```
w = x * y + z + y * z;
x = a + b * c;
x = a || b && c;
x = a++ + 10;
x = 2 && x < 10;
```

Operator Precedence

```
int w, x(0);
w = (x = (2 && x) < 10));
```

Operator Precedence

```
int w, x(0);

w = (x = 2 && x < 10);
```

Precedence	Operator	Description	Associativity
1	`::`	Scope resolution	Left-to-right
2	`a++ a--`	Suffix/postfix increment and decrement	
	type`()` *type*`{}`	Functional cast	
	`a()`	Function call	
	`a[]`	Subscript	
	`. ->`	Member access	
3	`++a --a`	Prefix increment and decrement	Right-to-left
	`+a -a`	Unary plus and minus	
	`! ~`	Logical NOT and bitwise NOT	
	`(`*type*`)`	C-style cast	
	`*a`	Indirection (dereference)	
	`&a`	Address-of	
	`sizeof`	Size-of[note 1]	
	`new new[]`	Dynamic memory allocation	
	`delete delete[]`	Dynamic memory deallocation	
4	`.* ->*`	Pointer-to-member	Left-to-right
5	`a*b a/b a%b`	Multiplication, division, and remainder	
6	`a+b a-b`	Addition and subtraction	
7	`<< >>`	Bitwise left shift and right shift	
8	`< <=`	For relational operators < and ≤ respectively	
	`> >=`	For relational operators > and ≥ respectively	
9	`== !=`	For relational operators = and ≠ respectively	
10	`a&b`	Bitwise AND	
11	`^`	Bitwise XOR (exclusive or)	
12	`|`	Bitwise OR (inclusive or)	
13	`&&`	Logical AND	
14	`||`	Logical OR	
15	`a?b:c`	Ternary conditional[note 2]	Right-to-left
	`throw`	throw operator	
	`=`	Direct assignment (provided by default for C++ classes)	
	`+= -=`	Compound assignment by sum and difference	
	`*= /= %=`	Compound assignment by product, quotient, and remainder	
	`<<= >>=`	Compound assignment by bitwise left shift and right shift	
	`&= ^= |=`	Compound assignment by bitwise AND, XOR, and OR	
16	`,`	Comma	Left-to-right

Operator Associativity

Operator associativity: Deals with operators that are at the same precedence level or group

- Some groups associate from **left to right** e.g. Arithmetic

  x= a + b – c + d;

- Other groups associate from **right to left** e.g. Assignment

  x= y = z = 50;

Order of evaluation

- Deals with which side of an operator is evaluated first (Lt operand or Rt operand). Java/Python strictly defines Lt->Rt. C/C++ do not define order of evaluation

```
b=3;
b = b +(b=9);

a =5;
x= a + a++;

int i =4;
cout<< i++ * ++i;
```

Review homework 4, problem 3

What is the output of the following program?

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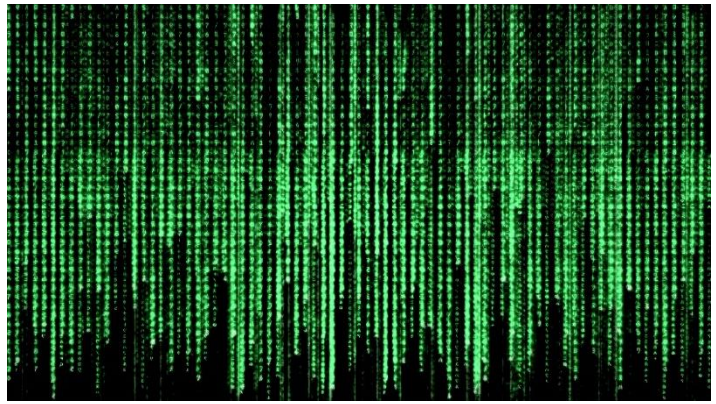
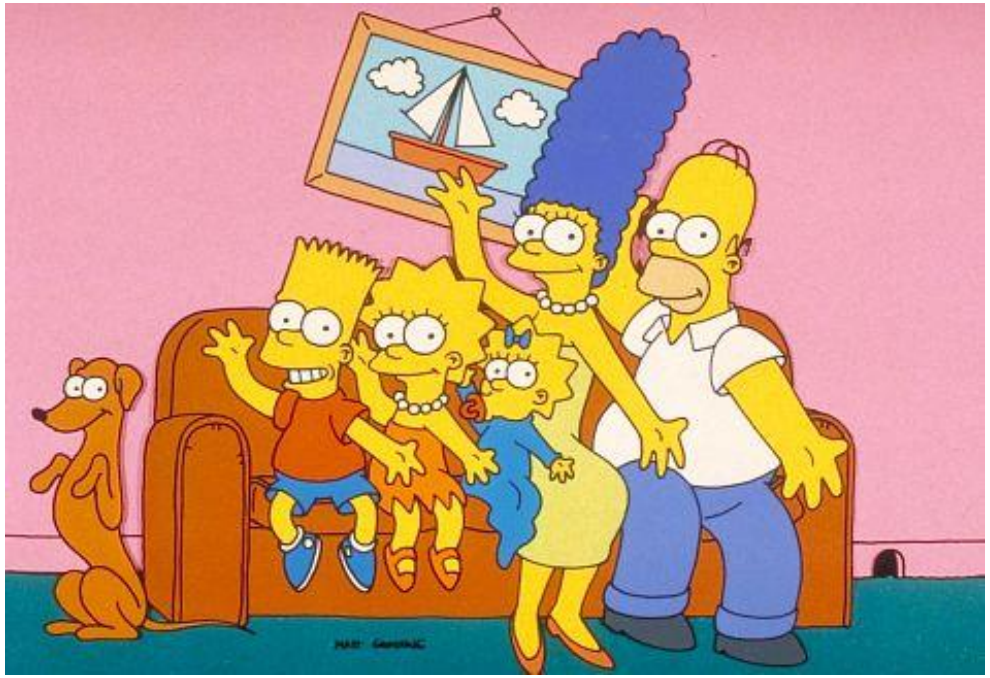
What does ‘data’ on a computer look like?

- Imagine diving deep into a computer
- Expect to see all your data as high and low voltages
- In CS we use the abstraction:
  - High voltage: 1 (true)
  - Low voltage: 0 (false)



Decimal (base ten)

- Why do we count in base ten?
- Which base would the Simpson's use?



Positional encoding for non-negative numbers

- Each position represents some power of the base

Base	Digits	Example

Why is each base important??

Binary representation (base 2)

- On a computer all data is stored in binary
- Only two symbols: 0 and 1
- Each position is called a *bit*
- *For example:*

0 1 0 1

101_5 = ? In decimal

A. 26

B. 51

C. 126

D. 130

External vs. Internal Representation

- External representation:
  - Convenient for programmer

- Internal representation:
  - Actual representation of data in the computer's memory and registers: Always binary (1's and 0's)

Next time

- Conversion between different bases
- Representing other types of data