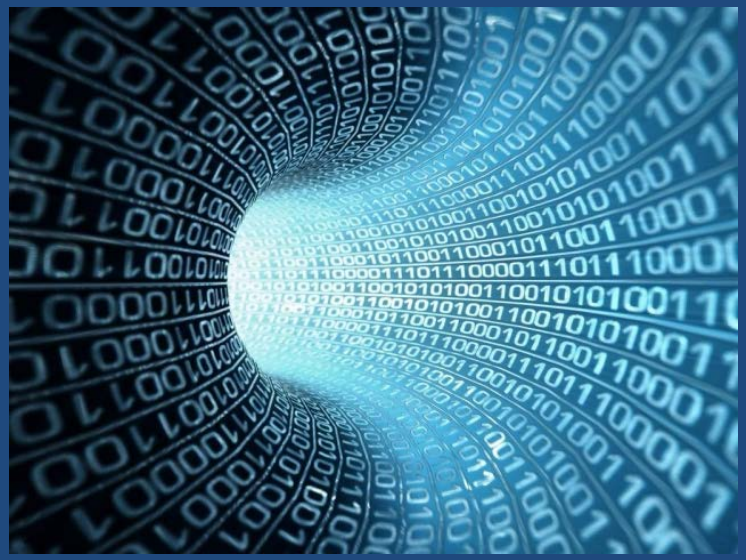
Before we start variables ...

Let's do a quiz!

C Programming

Variables



Variables keep track of data

Variables
vary
in
value

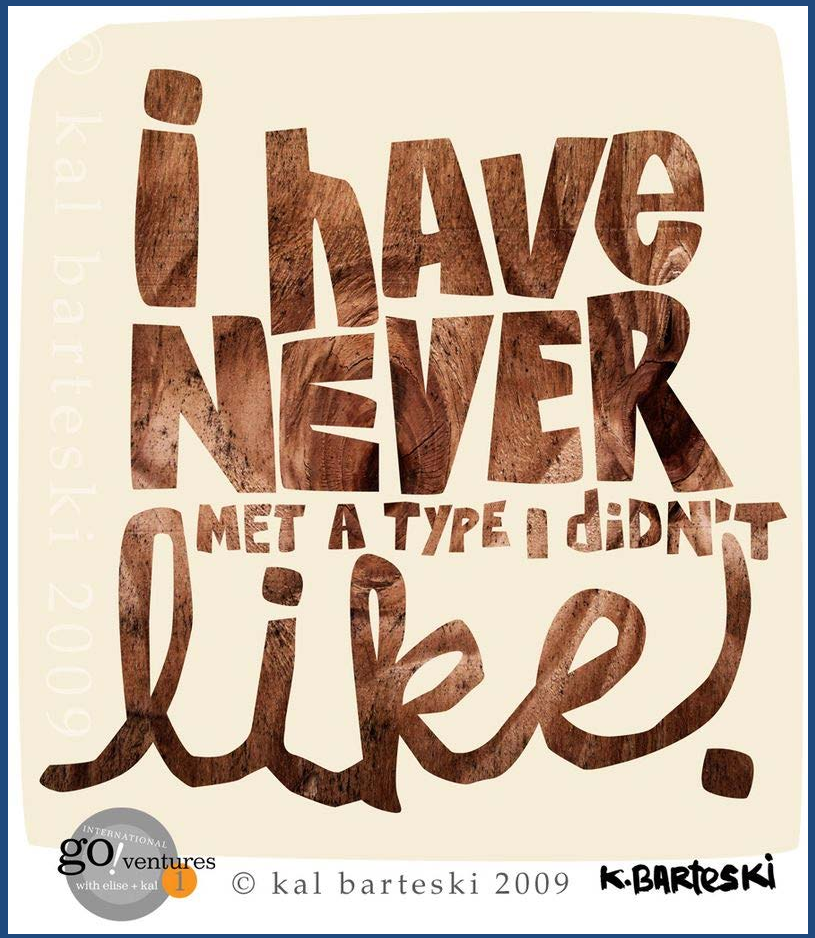
Variables have:

Names ...

Variables have:

Names,

Data Types ...

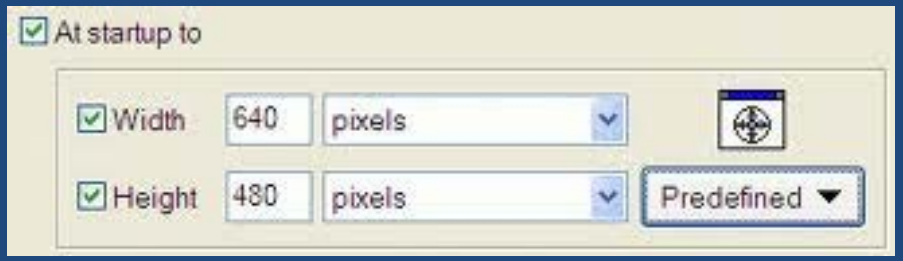


Variables have:

Names,

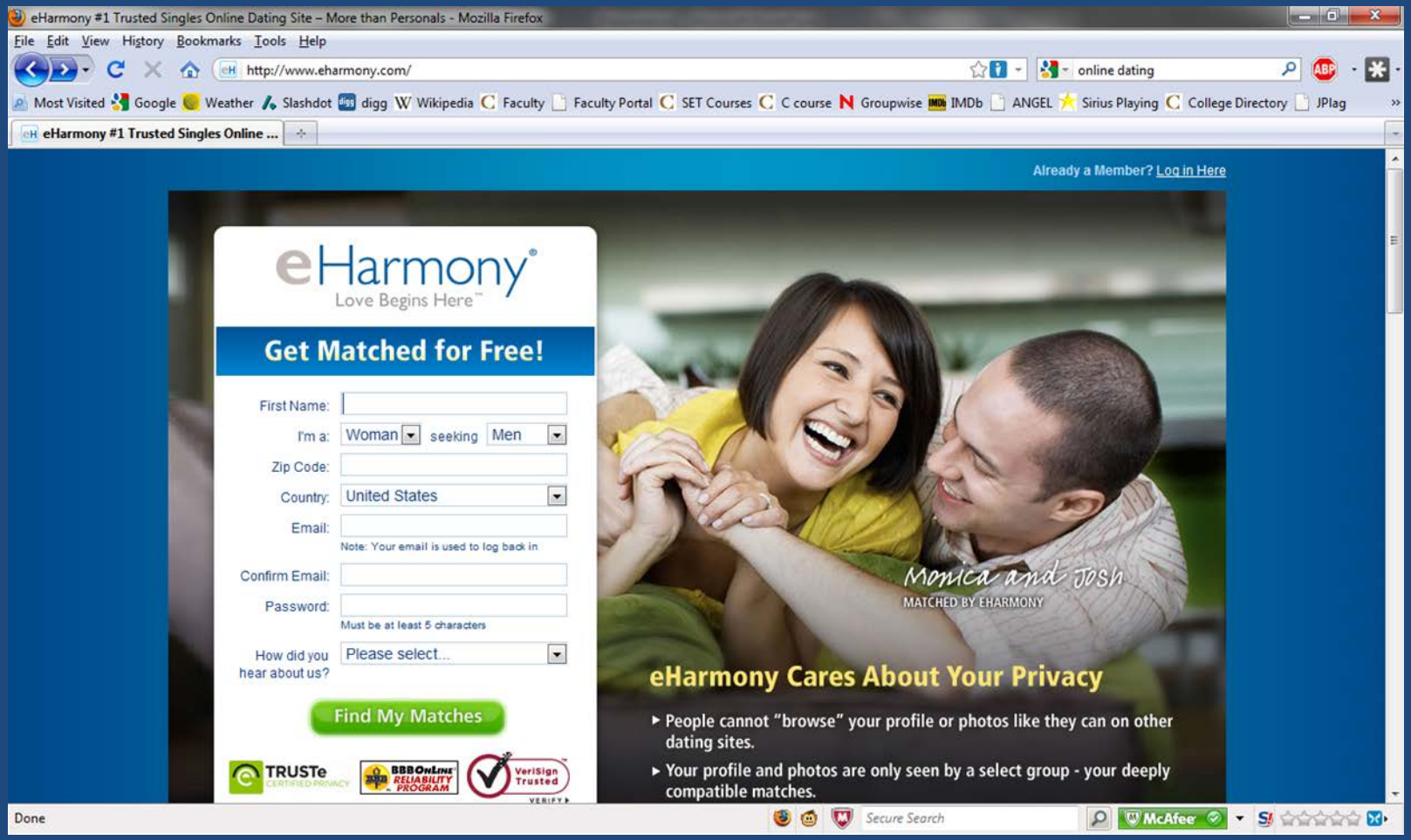
Data Types,

Initial Values



A variable declaration is used to tell the compiler about your variable

It's like an introduction ...

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FIND JOBS
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Browse jobs | Administrative, Finance, Healthcare, Sales, Trades, More »
Love where you work
Find out what top employers are really like >
In Focus
Employer Spotlight
See all
What would make coming back to work after the summer less stressful?
Adjusted working hours
Fewer meetings
DESSAU
KITCHENER EXECUTIVE CONSULTANT...
SAIT POLYTECHNIC
UNIFIRST CANADA
MOUNT SINAI HOSPITAL
TRANSCONTINENTAL INC.
Done
Secure Search
McAfee

You wouldn't let someone work for you without knowing a bit about them

Declare a variable before or when it's used for the first time

For now,
let's declare variables
at the start of the function

```
int main()
{
int population = 1;
int countries = 1;
```

Example from our sample program

```
int number = 9;
```

Review!

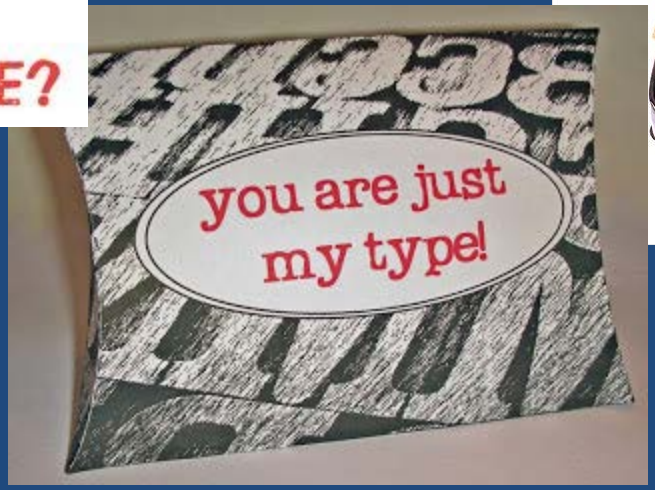
What's a variable declaration?

Review!

What are the three main important parts of a variable declaration?

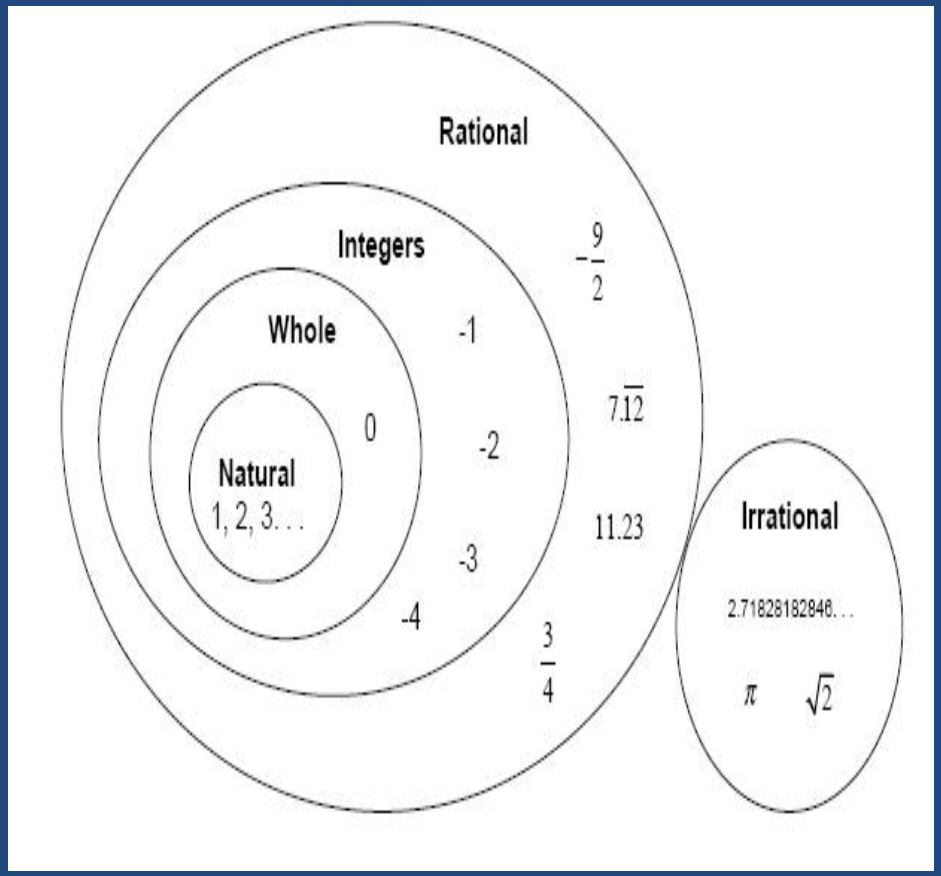
Data Type????


Are you my TYPE?

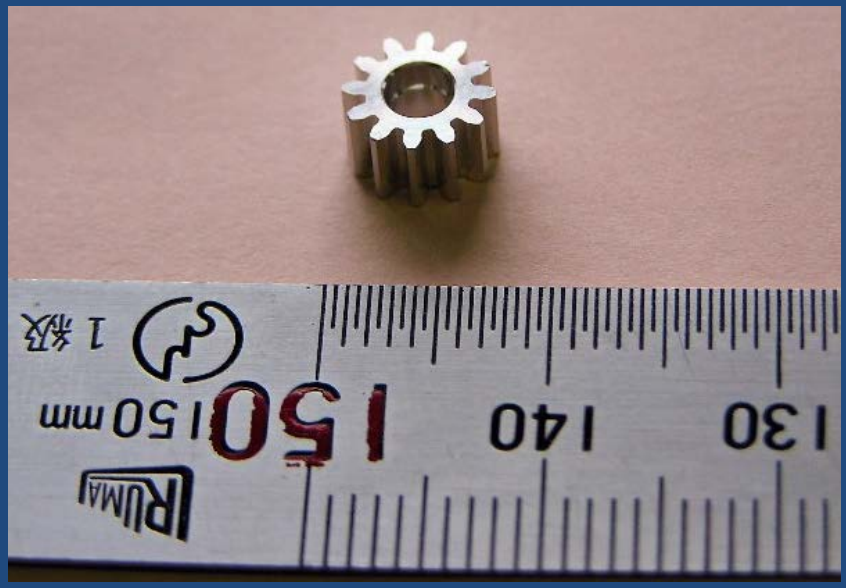

you are just
my type!


You are my type.
CORONA
CORONA TYPEWRITER COMPANY, Inc.

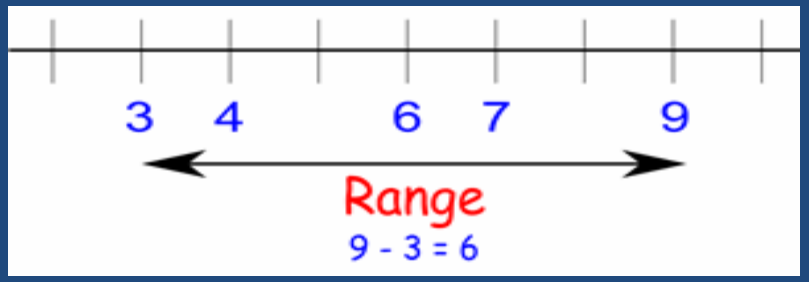
Data Type indicates: format ...



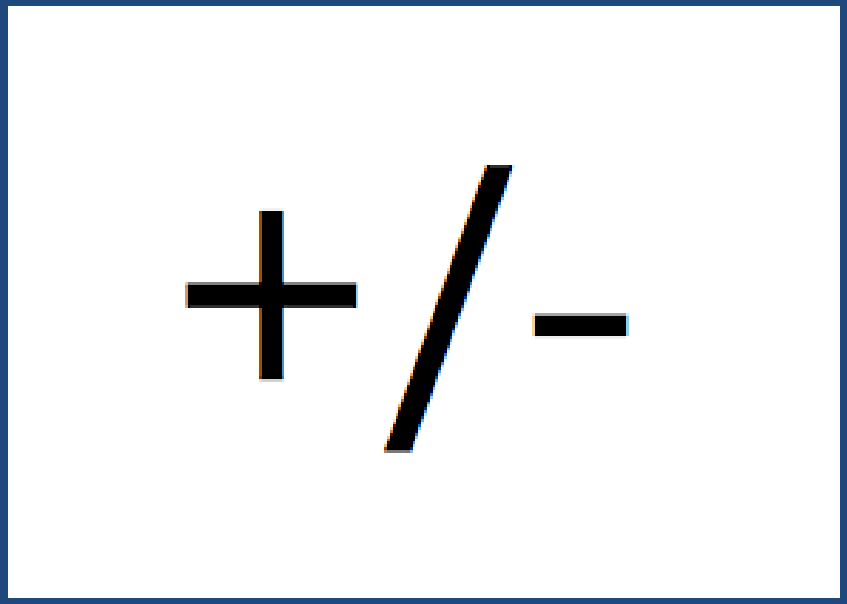
Data Type indicates: format, precision ...



Data Type indicates: format, precision, range ...



Data Type indicates: format, precision, range, sign



Example #1

int

Format: integer

Range: ± 2 billion and change

Precision: 32 bit

Sign: can be positive or negative

Example #2

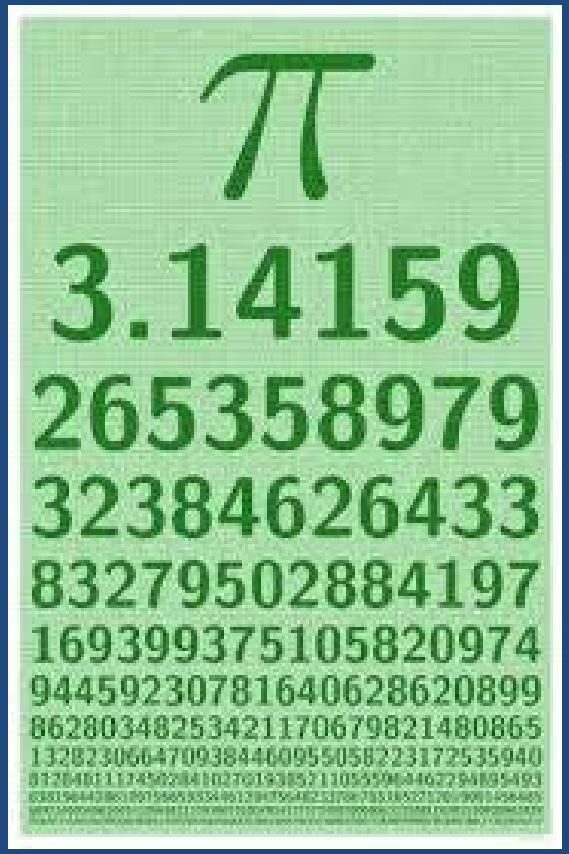
float

Format: floating-point (real)

Range: ± 10^{38}

Precision: 32-bit

Sign: can be positive or negative



Example #3

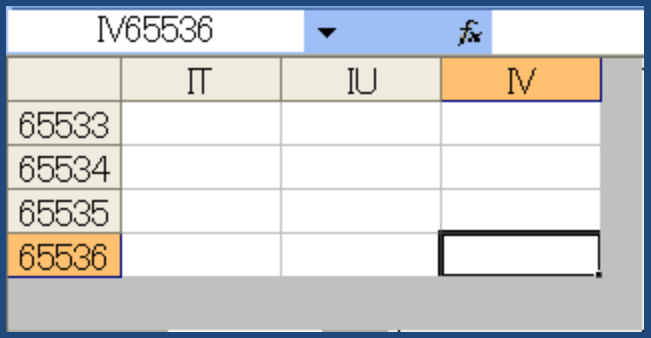
unsigned short

Format: integer

Range: 0 to 65535

Precision: 16-bit

Sign: positive only



Review!

Name a data type.

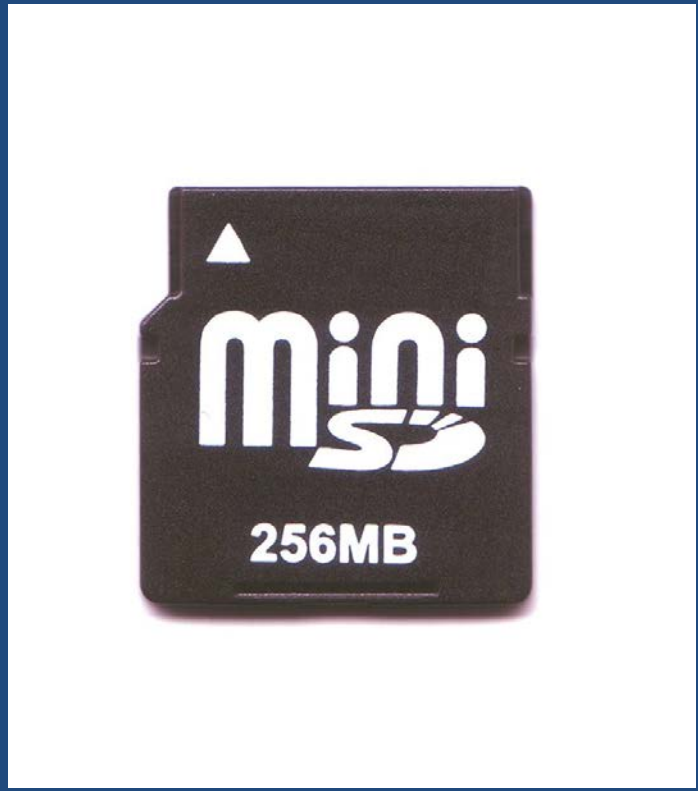
Review!

Name another data type.

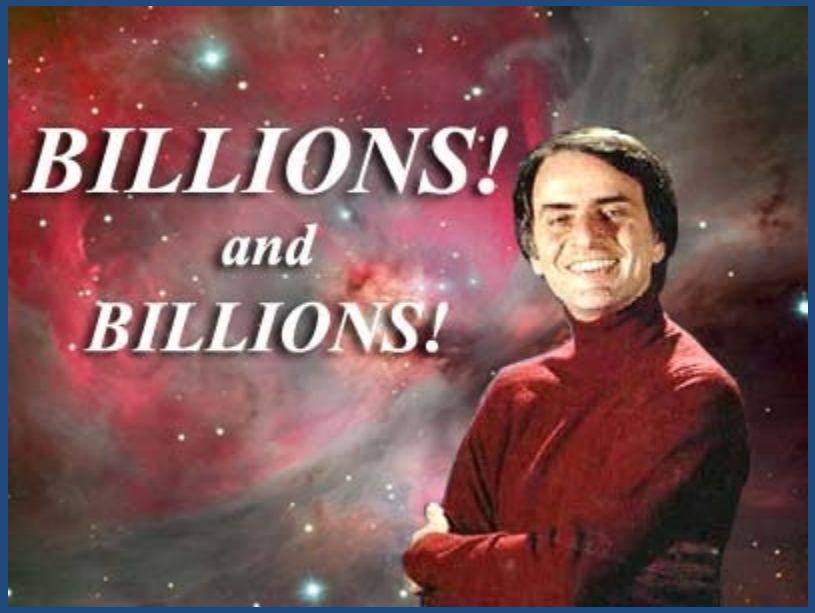
Other Common Data Types

char: single character or integer with small range

unsigned char:
positive-only
integer with
small range



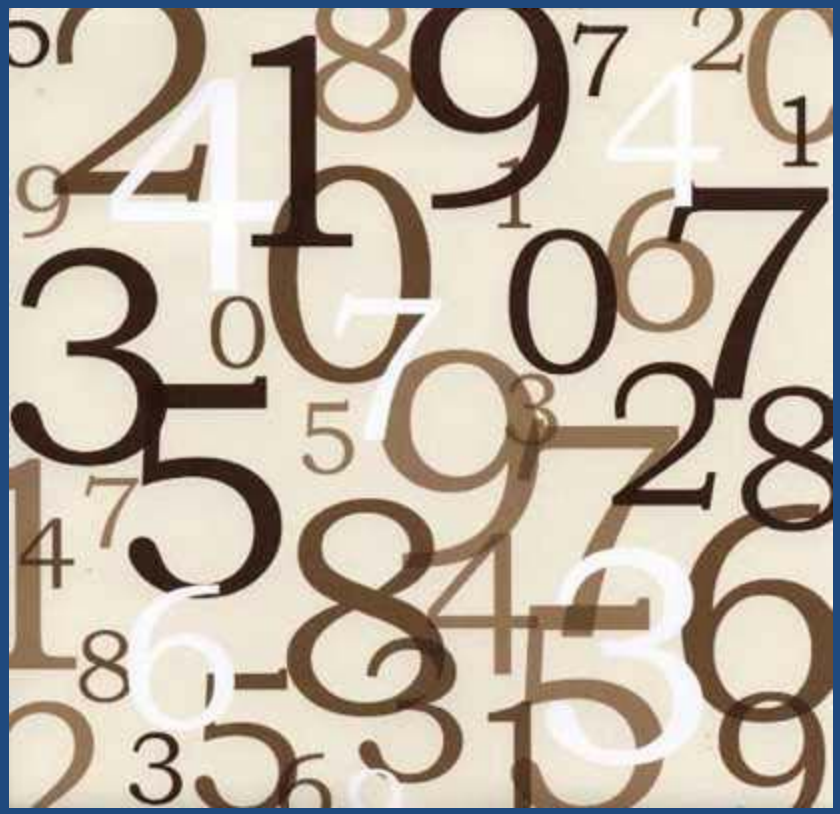
unsigned int: positive-only integer with large range



Review!

Can the number -6 be stored in an unsigned int?

double: floating-point (real) number with greater precision than float

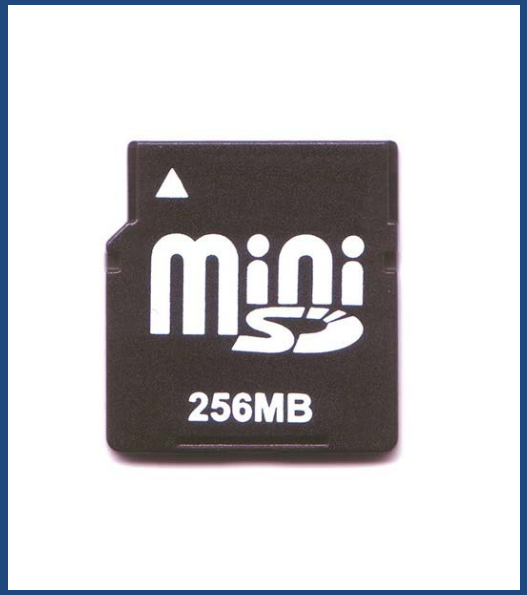


Size determines range

8-bit integers are limited to 256 values

(remember, 1 byte is 8 bits)

`11111111` **plus 1** 



16-bit integers are limited to 65536 values

1111111111111111 plus 1

32-bit integers are limited to 4 billion and change

(don't bother memorizing the actual number)

Review!

Can the number 6 be stored in an int?

Integer ranges

char and unsigned char are 8-bit values

0 TO 255

-128 to 127

short and unsigned short are 16-bit values

-32768 to 32767

0 to 65535

long and unsigned long are 32-bit values

big negative number near -2 billion
to
big positive number near 2 billion

0 to big number near 4 billion

int is a bit different

int is defined as the most efficient integer data type for the processor

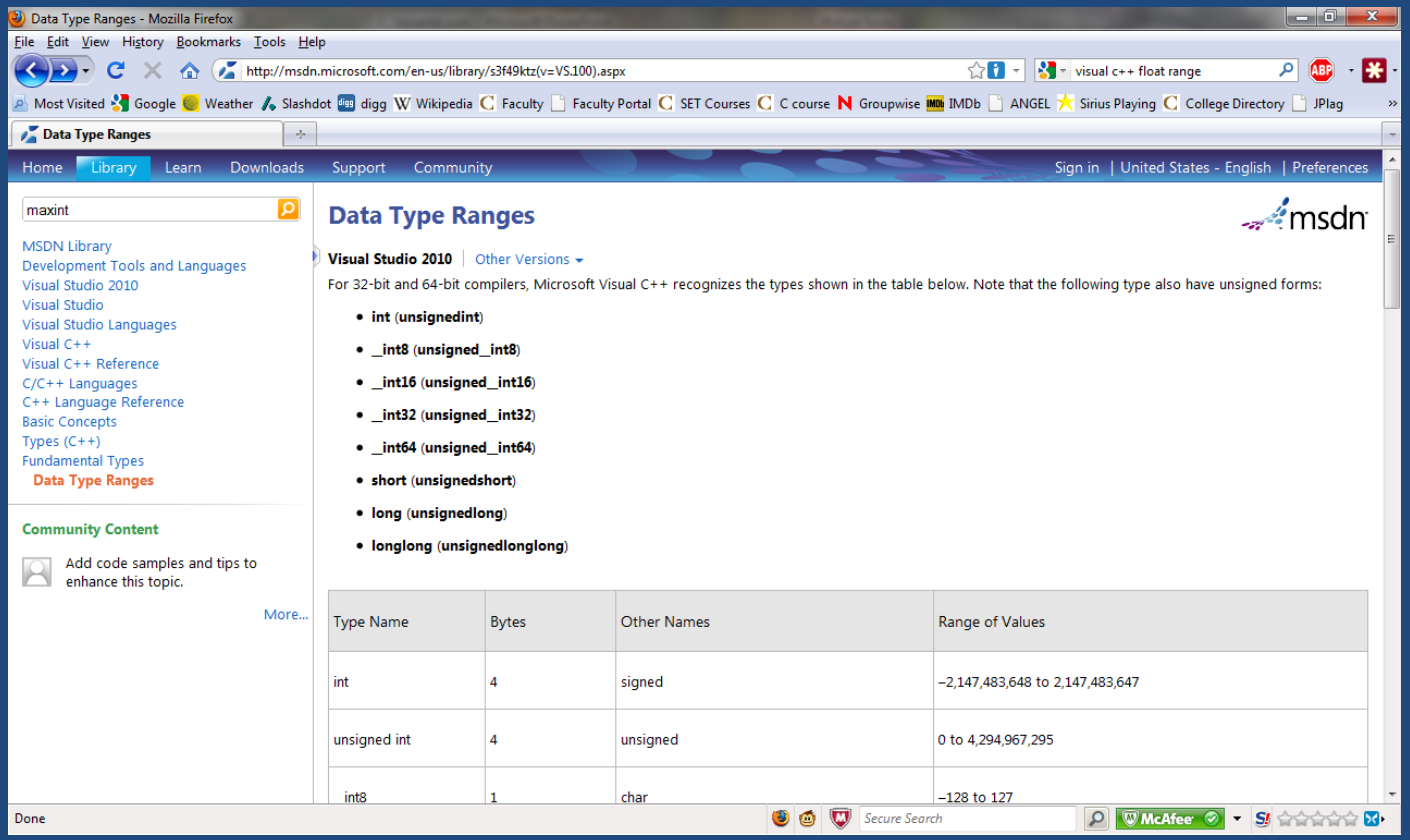
Section 6.2.5 of the ANSI C Standard

"A 'plain' int object has the natural size suggested by the architecture of the execution environment (large enough to contain anyvalue in the range INT_MIN to INT_MAX as defined in the header <limits.h>)."

16-bits

8-bits

Visual Studio 2010 and 2012 32-bits



Assumption for Exams

On exams,

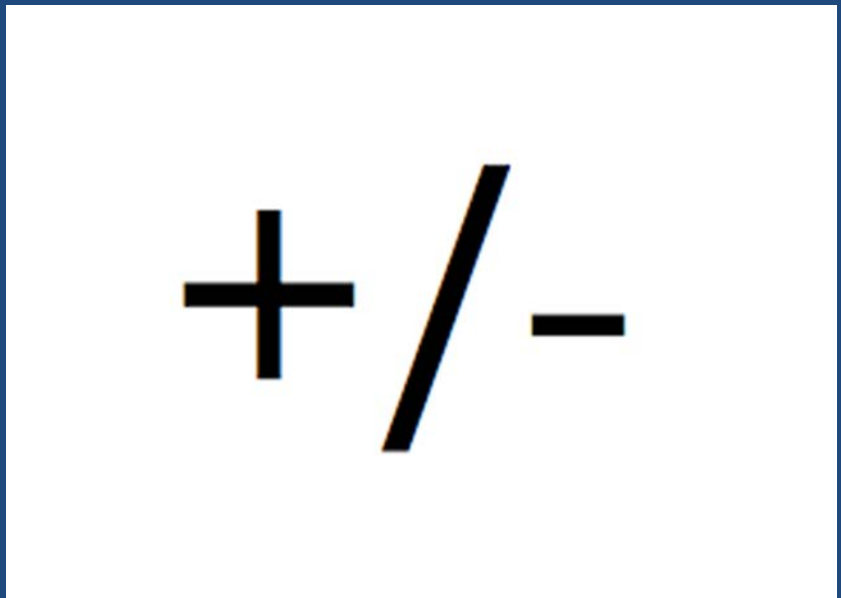
assume that ints are 32-bits in size

Review!

Can the number 6 trillion be stored in an int in this course?

Sign

char, short, long, and int all can have positive and negative values



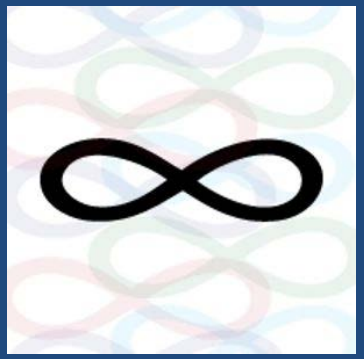
How about
unsigned int?

Starts at 0 and goes up to double the signed upper limit (plus 1)

This doesn't apply to float and double

One weirdity with float and double

float and double have a discontinuity near 0

1 / 

Review!

Can the number 6.4 be stored in an int?

Review!

Can the number 6.4 be stored in a float?

Choosing Data Type

5 criteria

Criterion #1

Do you need floating-point support?

Criterion #2

What are the possible values?

Criterion #3

Do you need to minimize the amount of memory used?

Criterion #4

Do you need to maximize speed?

Criterion #5

Are equality comparisons needed?

Review!

What would be an example of when you would want integers stored in 8 bits?

Initializing Variables

The compiler doesn't require initialized variables

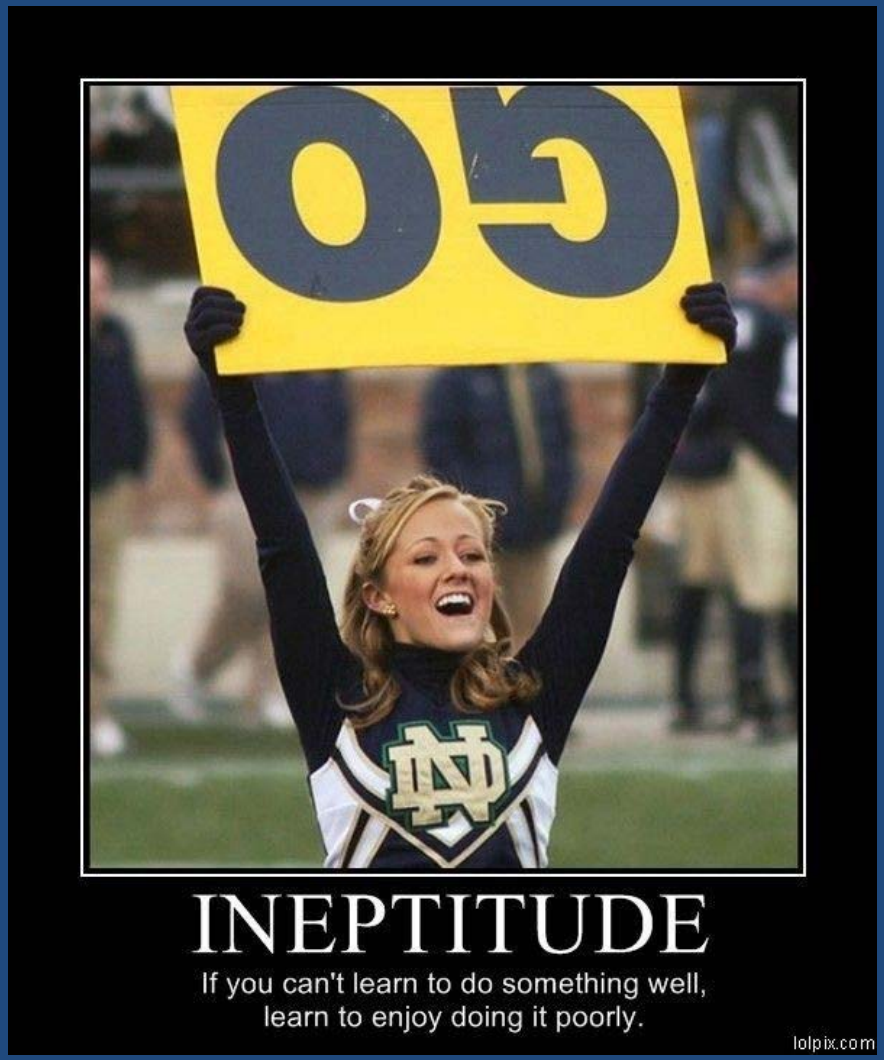
NOT REQUIRED

I do.

Review!

Will you get better marks if you do what I tell you you need to do?

The compiler doesn't care about the quality of your code



I do.

Review!

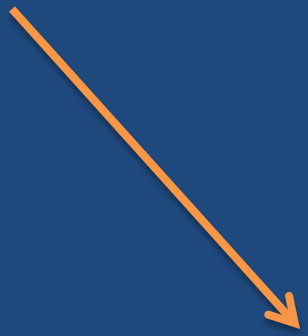
Will you write better software if you do what I tell you you need to do?

The compiler will not give your variables default values

Course Requirement!

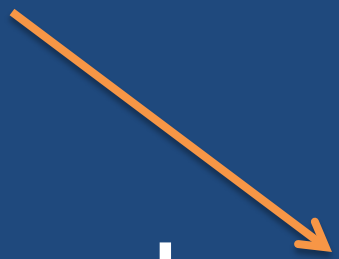
You must initialize your variables upon declaration.

Initializing a variable upon declaration



```
int number = 9;
```

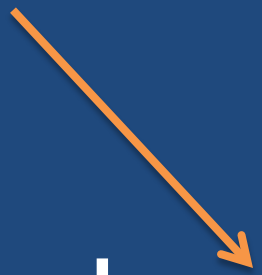
Not initializing a variable upon declaration



```
int number;
```

or ...

Stupidly losing 5 marks



```
int number;
```

Review!

Is it OK to declare a variable without an initial value if you give it an initial value in the next line?

long, revisited

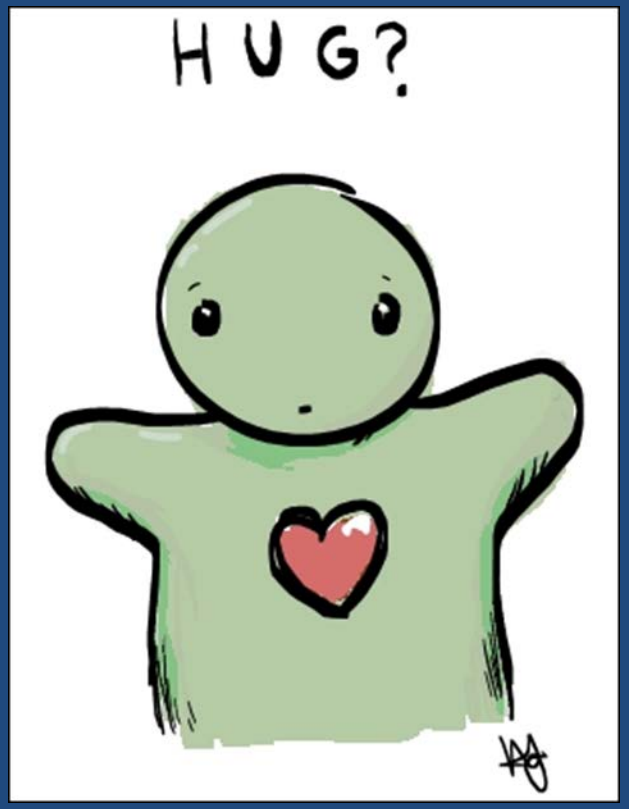
Initializing a long variable is done by putting L at the end of the value

e.g. long population = 40L;

char, revisited

"single character
or integer with
small range"

Relationship between characters and numbers



ASCII Codes are found in the ASCII Table

	0	1	2	3	4	5	6	7
0	NUL	DLE	space	0	@	P	`	p
1	SOH	DC1 XON	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3 XOFF	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	del

http://www.asciitable.com

0 to 255
correspond to
characters

values 65 to 90

are

letters ‘A’ to ‘Z’

A B C D ... X Y Z

values 97 to 122

are

letters ‘a’ to ‘z’

a b c d ... x y z

values 48 to 57

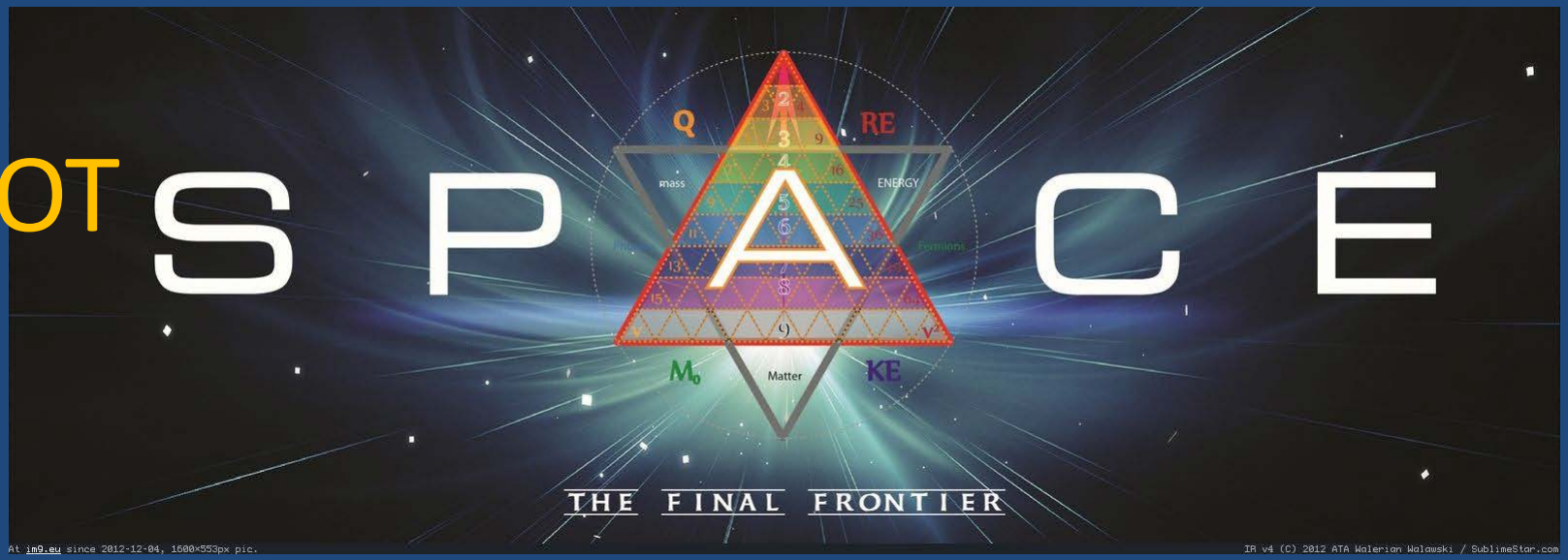
are

digits ‘0’ to ‘9’

0 1 2 3 4 5 6 7 8 9

value 32 is
the SPACE character

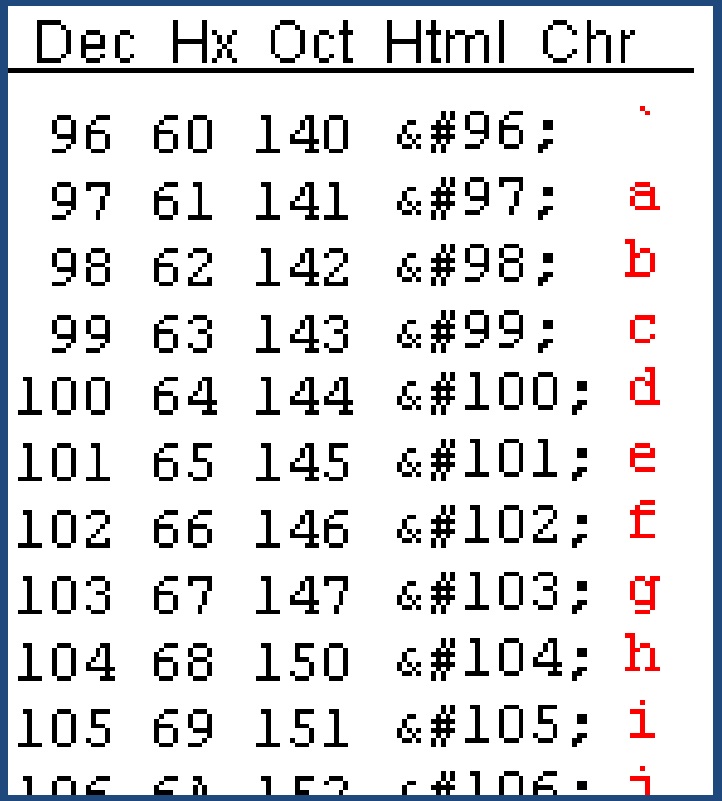
NOT



punctuation, graphical characters, and control characters make up the balance

char duality

that means that lower-case ‘a’ is equivalent to an ASCII value of 97



Dec	Hx	Oct	Html	Chr
96	60	140	`	`
97	61	141	a	a
98	62	142	b	b
99	63	143	c	c
100	64	144	d	d
101	65	145	e	e
102	66	146	f	f
103	67	147	g	g
104	68	150	h	h
105	69	151	i	i

Proof!

printf("%d %c", 97, 97);

and

printf("%d %c", ‘a’, ‘a’);

display the same thing!

(%c in a printf() format string displays a character)

Review!

Can a number and a letter be the same thing?

Review!

How do you pronounce ASCII?

Review!

What website is the easiest to go to if you need to find out what the ASCII value for ‘q’ is?

printf() formatting codes

Highlights from Table 3-3 in the Course Notes:

%d: signed int

%f: floating point

%c: single character

%s: string

%%: just display a percent sign

Example

```
char letter = ‘a’;
printf("%c\n", letter);
printf("%d\n", letter);
```

Arithmetic on char variables

You can do math on chars

$$'A' + 1 = 'B'$$

$$'C' + 3 = 'F'$$

$$'R' - 1 = 'Q'$$

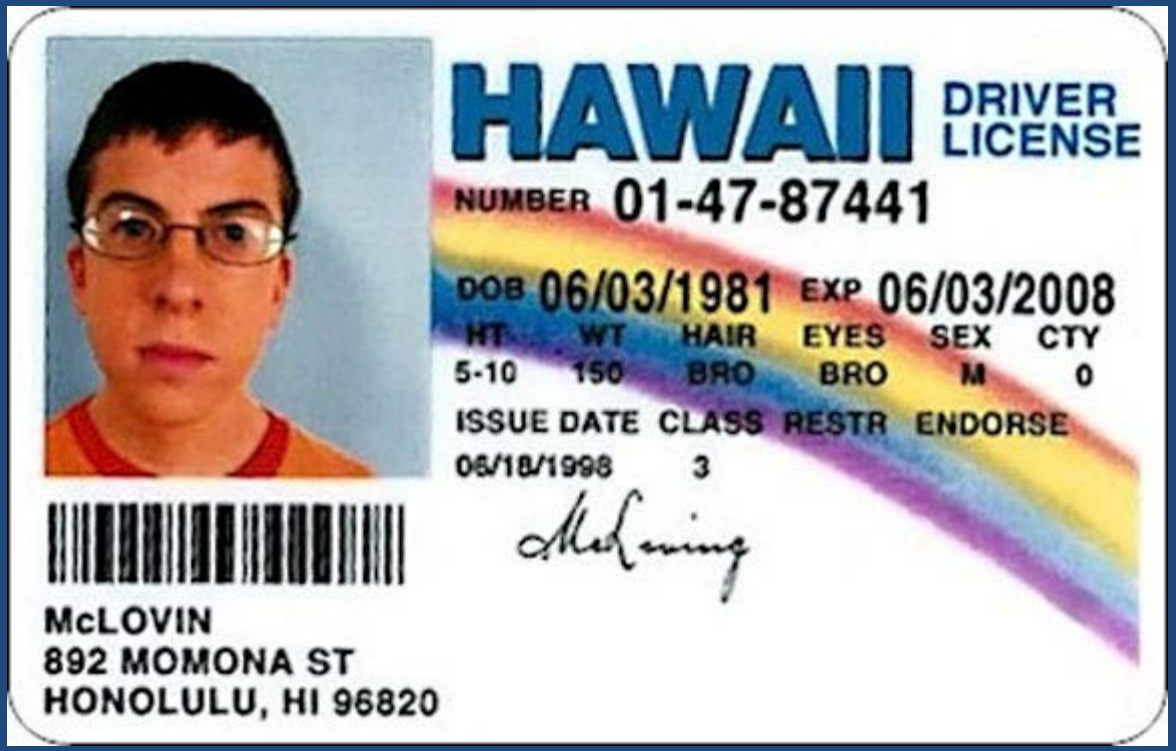
```
char letter = 'a';
letter = letter + 1;
printf("%c\n", letter);
printf("%d\n", letter);
```

You need to use this knowledge for Assignment #1!

Naming

Give variables meaningful names!

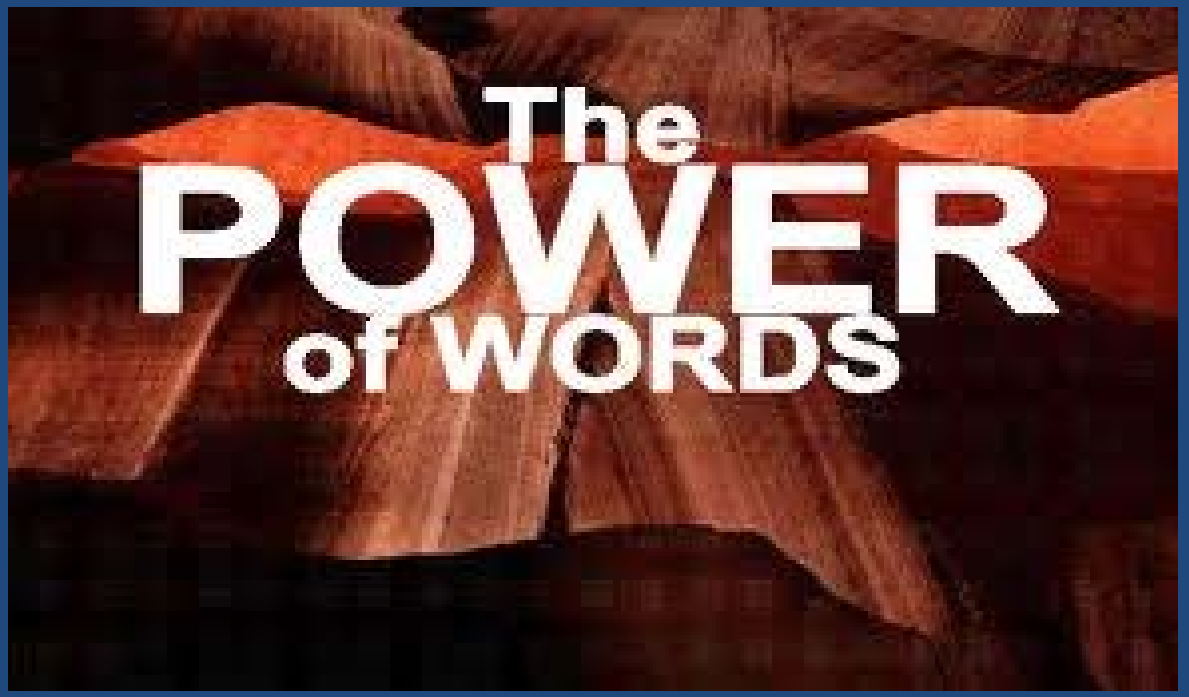
The name of a variable should tell you about what it is used for



```
int weight = 200;
int studentsInClass = 30;
float interestRate = 0.05;
```

Words in names

Distinguish between words in variable names!



Two accepted methods

1) Capitalize words after the first one

or

2) Put an underscore between the words

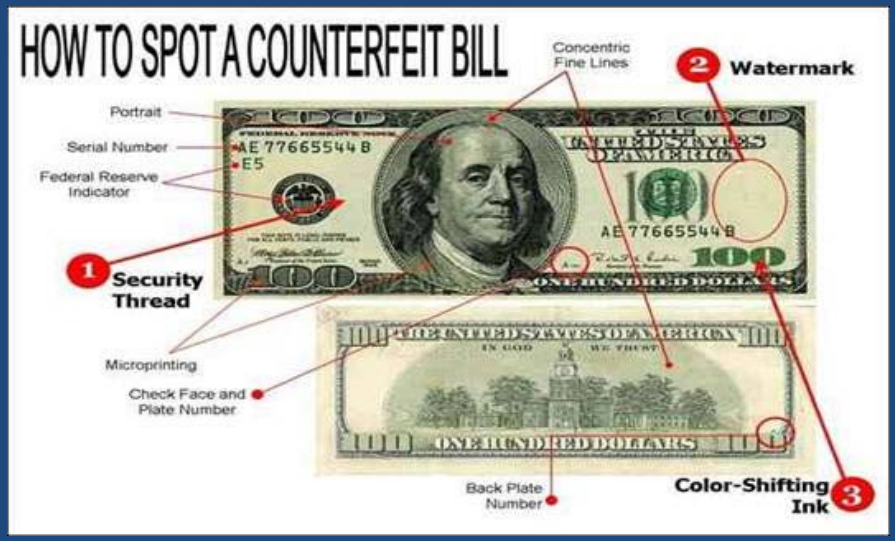
e.g. wheelDiameter or wheel_diameter

Why?

Code clarity!

Example

Variable indicating the quality of a counterfeit banknote ...



int noteQual

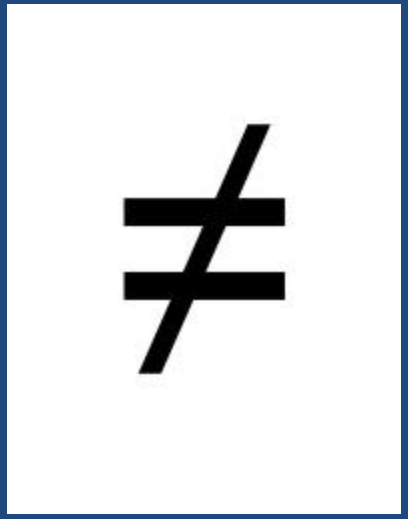
OK!

int note_qual

OK!

int notequal

NO!!!



Of course, a better option would be

int noteQuality

Legal characters in variable names

1) Letters

2) Numbers

3) Underscores

(you can't start a variable name with a number, though)

Review!

What does the variable mfa keep track of?

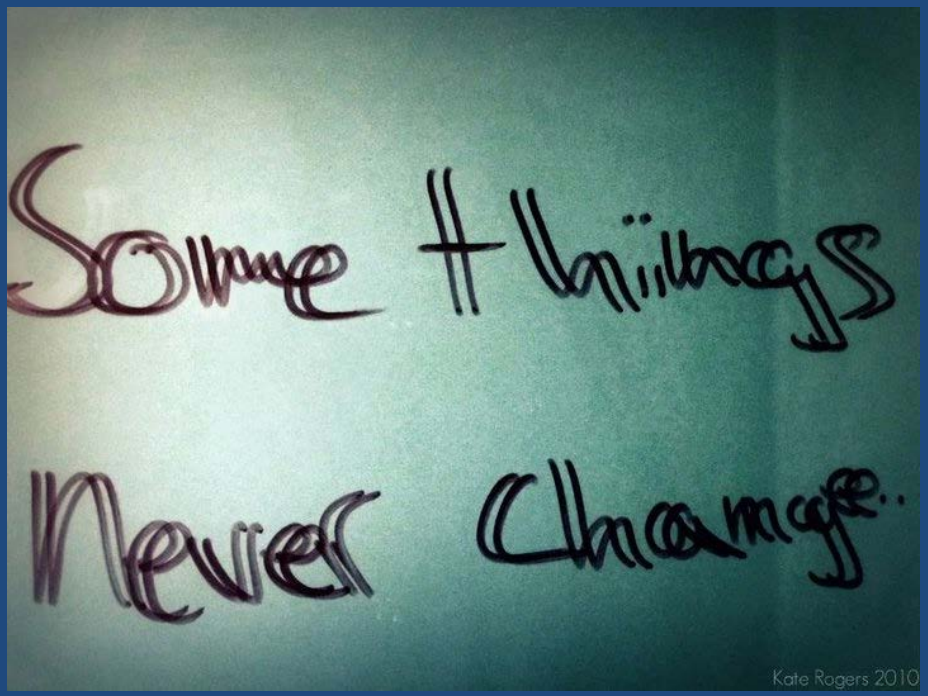
Review!

What does the variable marksForStudents keep track of?

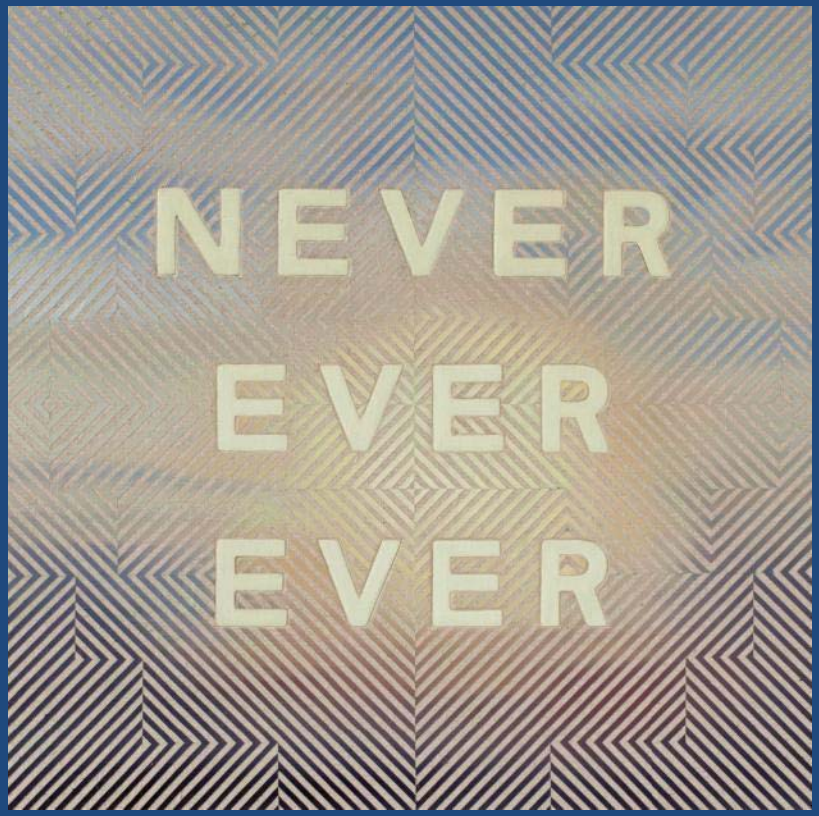
Constants

Variables vary

Use constants when the value will never change



Never ever ever???



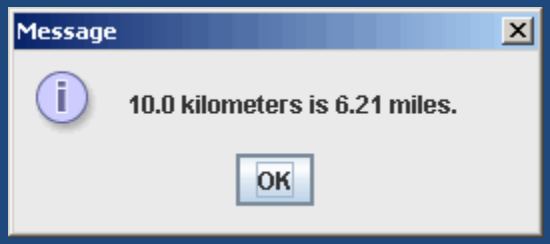
No, when you never want the program to change the value, intentionally or accidentally

Examples

maxNameLength

John Jacob Jingleheimer Schmidt

kmToMiles



No application refused!
28.8% APR

maximumInterestRate

Why?

Easy to make changes later!

Review!

Should a currency exchange rate be a variable or a constant?

Review!

Should a maximum frequency on an FM radio be a variable or a constant?

Review!

Should the maximum number of students allowed in this classroom be a variable or a constant?

One way of making a constant

Put const before a variable declaration

Example

```
const float maximumInterestRate= 0.28;
```

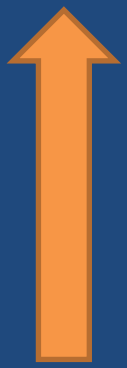
Another way of making a constant

Use #define

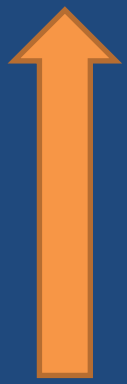
Example

No Semicolon!

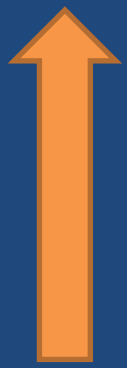
```
#define maximumInterestRate 0.28
```



Preprocessor Directive



Name of Constant



Value

Preferred: const

SET Coding Standard

Start constants with a k

OR

all in UPPERCASE

Example

```
const int kCmInAMeter = 100;
```

Good Rule of Thumb

Use constants whenever you can

Summary

1. Variables have name, data types, and initial values.
2. There's a lot of data types.
3. There's an ASCII table.
4. Name variables clearly.
5. Use constants when needed.