Introduction to C
Introduction to C

- A simple C Program
  - Variable Declarations
  - `printf()`
- Compiling and Running a C Program
- `sizeof` Program
  - `#include`
- What is `True` in C?
  - `if` example
- Another C Program
  - `#define`
  - `scanf()`
- Another C Program (continued)
  - **for loop**
  - Promotion

- Other C topics
  - Increment and Decrement Operators
  - Casting
  - Operator Precedence
  - Value of Assignment Operator
- Variable names correspond to memory locations in memory. Every variable has a type, a name and a value.

```c
int i;
32212242  // (the address of i)
i = 4;
4
&i
```
Two components of `printf` statement:
- Formatting template {within quotes}
- Argument list – variables separated by commas.
int main()
{

    ...

    printf("%d %f %c\n", i, fvar, ch);

}

Formatting template:
- Argument list matches up with ‘%’
- Some of the argument types:
  - %d integers
  - %f floating-point numbers
  - %c characters
int main()
{
    ...
    printf("%4d %5f %6.2f\n", i, fvar, f2var);
}

Width of variable printing:

- **%4d** – decimal integers at least 4 digits wide
- **%5f** – floating point at least 5 digits wide
- **%6.2f** – floating point at least 6 digits wide with at least 2 after the decimal point
/* Example of a simple C Program */
#include <stdio.h>
int main()
{
    int i;
    char c, s;
    i = 2303;
    c = 'C';
    s = 'S';
    printf("\nHello");
    printf(" %c%c %d Students!!\n", c, s, i);
    return 0;
}
Compiling and Running simple

%ls
simple.c
%gcc simple.c
%ls
a.out simple.c
%.a.out

Hello CS 2303 Students!!
%

Alternate Version

%ls
simple.c
%gcc -o simple simple.c
%ls
simple simple.c
%.simple
sizeof Operator

/* Fig. 7.17: fig07_17.c
   Demonstrating the sizeof operator */
#include <stdio.h>

int main( void )
{
    char c;
    short s;
    int i;
    long l;
    float f;
    double d;
    long double ld;
    int array[20]; /* create array of 20 int elements */
    int *ptr = array; /* create pointer to array */

Figure 7.17 (part 1)
# sizeof Operator

```c
17    printf("    sizeof c = %d\tsizeof(char)  = %d"
18        \n        sizeof s = %d\tsizeof(short) = %d"
19        \n        sizeof i = %d\tsizeof(int)  = %d"
20        \n        sizeof l = %d\tsizeof(long) = %d"
21        \n        sizeof f = %d\tsizeof(float) = %d"
22        \n        sizeof d = %d\tsizeof(double) = %d"
23        \n        sizeof ld = %d\tsizeof(long double) = %d"
24        \n        sizeof array = %d"
25        \n        sizeof ptr = %d\n",
26        sizeof c, sizeof( char ), sizeof s, sizeof( short ), sizeof i,
27        sizeof( int ), sizeof l, sizeof( long ), sizeof f,
28        sizeof( float ), sizeof d, sizeof( double ), sizeof ld,
29        sizeof( long double ), sizeof array, sizeof ptr);
30
31    return 0; /* indicates successful termination */
32
33 } /* end main */
```

from typelen.c

char 1
short 2
int 4
long 4
long long 8
float 4
double 8
long double 12
/* check to see what conditional does with negative integers */

int main ()
{
    int i = 0;            // zero is the only value for false in C
    if (i)
        printf("%d = true\n", i);
    else
        printf("%d = false\n", i);
    i = 4;
    if (i)
        printf("Positive integer %d = true\n", i);
    else
        printf("Positive integer %d = false\n", i);
    i = -4;
    if (i)
        printf("Negative integer %d = true\n", i);
    else
        printf("Negative integer %d = false\n", i);
    return 0;
}

$./a.out
0 = false
Positive integer 4 = true
Negative integer -4 = true
```c
#define SIZE 5
int main ()
{
    int i, start, finish;
    float celsius;

    scanf("%d", &start);
    finish = start + SIZE;
    for (i=start; i<finish; i++)
    {
        celsius = (5.0/9.0)*(i - 32.0);
        printf("%3d %6.1f
", i, celsius);
    }
    return 0;
}
```
#define SIZE 5
int main ()
{
    int i, start, finish;
    float celsius;

    scanf("%d", &start);
    finish = start + SIZE;
    for (i=start; i<finish; i++)
    {
        celsius = (5.0/9.0) * (i - 32.0);
        printf("%3d %6.1f\n", i, celsius);
    }
    return 0;
}
```c
#define SIZE 5
int main ()
{
    int i, start, finish;
    float celsius;

    scanf("%d", &start);
    finish = start + SIZE;
    for (i=start; i<finish; i++)
    {
        celsius = (5.0/9.0) * (i - 32.0);
        printf("%3d %6.1f\n", i, celsius);
    }
    return 0;
}
```

```
Another C Program

example of 'promotion'

$ ./a.out
30
30 -1.1
31 -0.6
32  0.0
33  0.6
34  1.1
```

15
Other C Topics

- Increment and decrement operators
- Casting operator `(type)`
- Operator precedence
- **Danger**: the value of the assignment operator
- Variable scope
- **Switch**
- Conditional operator `?:`

Will cover later!!
### Increment and Decrement Operators

<table>
<thead>
<tr>
<th>Operator</th>
<th>Sample expression</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>++</td>
<td>++a</td>
<td>Increment <code>a</code> by 1, then use the new value of <code>a</code> in the expression in which <code>a</code> resides.</td>
</tr>
<tr>
<td>++</td>
<td>a++</td>
<td>Use the current value of <code>a</code> in the expression in which <code>a</code> resides, then increment <code>a</code> by 1.</td>
</tr>
<tr>
<td>--</td>
<td>--b</td>
<td>Decrement <code>b</code> by 1, then use the new value of <code>b</code> in the expression in which <code>b</code> resides.</td>
</tr>
<tr>
<td>--</td>
<td>b--</td>
<td>Use the current value of <code>b</code> in the expression in which <code>b</code> resides, then decrement <code>b</code> by 1.</td>
</tr>
</tbody>
</table>

**Fig. 3.12**  
Increment and decrement operators
Casting

- Cast is a unary operator.
- Cast is often useful when an iteration index is used in mixed type arithmetic.
- Later, it will be important to make sure arguments passed are properly matched between called and calling routines.

Example:

```c
int total, count;
float average;
...
average = (float) total / count;
```

**When in doubt, be conservative and use cast to be sure!**
### Fig 4.16 Operator Precedence

<table>
<thead>
<tr>
<th>Operators</th>
<th>Associativity</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>++ (postfix)</code></td>
<td>right to left</td>
<td>postfix</td>
</tr>
<tr>
<td><code>-- (postfix)</code></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>+</code> <code>--</code> <code>!</code> <code>++ (prefix)</code> <code>-- (prefix)</code> <code>(type)</code></td>
<td>right to left</td>
<td>unary</td>
</tr>
<tr>
<td><code>*</code> <code>/</code> <code>%</code></td>
<td>left to right</td>
<td>multiplicative</td>
</tr>
<tr>
<td><code>+</code> <code>-</code></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>&lt;</code> <code>&lt;=</code> <code>&gt;</code> <code>&gt;=</code></td>
<td>left to right</td>
<td>relational</td>
</tr>
<tr>
<td><code>==</code> <code>!=</code></td>
<td></td>
<td>equality</td>
</tr>
<tr>
<td><code>&amp;&amp;</code></td>
<td>left to right</td>
<td>logical AND</td>
</tr>
<tr>
<td>`</td>
<td></td>
<td>`</td>
</tr>
<tr>
<td><code>?:</code></td>
<td>right to left</td>
<td>conditional</td>
</tr>
<tr>
<td><code>=</code> <code>+=</code> <code>-=</code> <code>*=</code> <code>/=</code> <code>%=</code></td>
<td>right to left</td>
<td>assignment</td>
</tr>
<tr>
<td><code>,</code></td>
<td>left to right</td>
<td>comma</td>
</tr>
</tbody>
</table>
The value of assignment is the same as the contents deposited into the variable type on the left.

Note: There are several potential dangers here – especially when the programmer creates new types!!

Examples (for now):

```c
if ( i = 0 )
if ( i = 4 )
```

What is the problem ??
This presentation covers many important C topics quickly including:

- Declaration of variable types
  - memory allocation by type
  - The address of a variable &
- `printf ( ) , scanf ( )`
- C arithmetic (operators, precedence, casting, promotion, assignment value)
- C booleans (true and false)
- `if`
- Preprocessor directives
  - `#define, #include`
- `for`

You are now ready to due lab 1 and once we cover functions everyone should be able to due Program 1.