COMsW 1003-1

Introduction to Computer Programming in C

Lecture 6

Spring 2011

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Announcements

Homework 1 is due next Monday

Exercise 2 is out

Today

- Strings
- Control Flow
- Loops (if time permits)

Review - arrays

- Multidimensional arrays

```
int X[4][3];  // a matrix containing 4x3 = 12 integers
```

X[0][0]	X[0][1]	X[0][2]
X[1][0]	X[1][1]	X[1][2]
X[2][0]	X[2][1]	X[2][2]
X[3][0]	X[3][1]	X[3][2]

- Indexing starts at 0 !

```
X[0][0] = 1;
X[3][1] = 7;
```

- Initialize says

```
int arr[4] = { 3, 6, 7, 89};
int arr2[2][4] = { {19, 2, 6, 99}, {55, 5, 555, 0} };
int arr[] = { 3, 6, 77};
```

This automatically allocates memory for an array of 3 integers

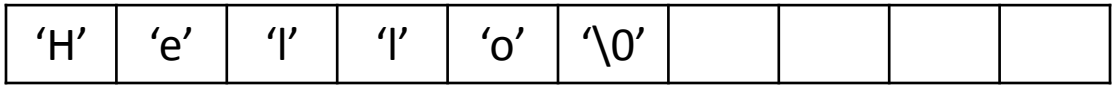
Strings

- Strings are arrays of char
- '\0' is a special character that indicates the end of a string

```
char s[6] = {'H', 'e', 'l', 'l', 'o', '\0'};
```

We need 6 characters because there is '\0'

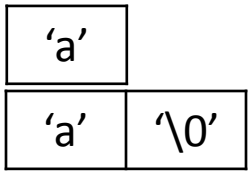

```
char s[10] = "Hello";
```




```
char s[6];
s[0] = 'H';
s[1] = 'e';
s[2] = 'l';
s[3] = 'l';
s[4] = 'o';
s[5] = '\0';
```

- Difference between string and char

```
char c = 'a' ;
char s[2] = "a" ;
```



Strings functions

String specific functions are included in the library string.h

```
#include <string.h>

char s[6];
s = "Hello";
```

Illegal ! String assignment can be done only at declaration!

- strcpy() : copy a string to another

```
strcpy( string1 , string2 );
```

Copy string2 to string1

```
char s[6];
strcpy(s, "Hello");
```

String functions

String specific functions are included in the library string.h

- strcmp() : compare two strings

```
strcmp( string1 , string2 );
```

Returns :
0 if string1 and string2 are the same
value != 0 otherwise

```
char s1[] = "Hi";
char s2[] = "Him";
char s3[3];
strcpy( s3, s1 );
int x = strcmp( s1, s2 );    // x != 0
int y = strcmp( s1, s3 );    // y = 0
```

Strings functions

String specific functions are included in the library string.h

- strcat() : concatenate two strings

```
strcat( string1 , string2);
```

Concatenate *string2* at the end of *string1*

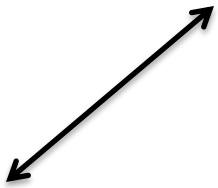
```
char s1[] = "Hello ";
char s2[] = "World!";
strcat(s1, s2);
```

'H'	'e'	'l'	'l'	'o'	' '	'W'	'o'	'r'	'l'	'd'	'\0'

- strlen() : returns the length of a string (does not count '\0')

```
strlen( string );
```

```
char s1[] = "Hello";
int x = strlen(s1);     // x = 5
```



Reading Strings

Use functions from library stdio.h

- fgets() : get string from standard input (command line)

```
fgets( name , sizeof(name), stdin);
```

Reads a maximum of sizeof(*name*) characters of a string from stdin and saves them into string *name*

```
char s1[100];
fgets( s1, sizeof(s1), stdin);
```

NOTE: fgets() reads the newline character '\n', so we should substitute it with '\0';

```
s1[strlen(s1)-1] = '\0';
```

'H'	'e'	'l'	'l'	'o'	'\n'
'H'	'e'	'l'	'l'	'o'	'\0'

- sizeof() : returns the size (number of bytes occupied in memory) of a variable (for strings it counts the number of elements, including '\0')

Reading numbers – Option 1

- First, read a string
- Then, convert string to number
- sscanf() : get string from standard input (command line)

```
sscanf( string, "format", &var1, …, &varN);
```

```
char s1[100];
int x, y;
printf("Please enter two numbers separated by a space\n")
fgets( s1, sizeof(s1), stdin);
```

User enters: 3 18

```
sscanf( s1, "%d %d", &x, &y );

// x = 3; y = 18;
```

Reading numbers – Option 2

- Read directly the number
- scanf() : get string from standard input (command line) and automatically convert into a number

```
scanf( "format", &var1, …, &varN);
```

```
int x, y;
printf("Please enter two numbers separated by a space\n")
```

User enters: 3 18

```
scanf( "%d %d", &x, &y );

// x = 3; y = 18;
```

sumNums.c

Strings functions - recap

```
char s1[] = "Hello";   char s2[] = "He";   int x;   char c;
```

- strcmp(s1, s2)

```
x = strcmp(s1, s2) // x != 0
```

- strcpy(s1, s2)

```
strcpy( s2, s1 ); // s2 = "Hello"
```

- strcat(s1, s2)

```
strcat( s2, s1 ); //s2 = "HelloHello"
```

- strlen(s)

```
x = strlen(s1);   // x  = 5;
```

- sizeof(s)

```
x = sizeof(s1);   // x = 6;
```

- fgets(s, sizeof(s1), stdin)

```
fgets( s1, sizeof(s1), stdin);
```

- sscanf(s, "%d", &var)

User enters "7R"

```
sscanf( s1, "%d%c", &x, &c);
// x = 7; c = 'R';
```

Example – sumNums.c

Control Flow

- So far we have seen **linear programs**, statements are executed in the order in which they are written
- What if we want to skip some instructions, or execute them only under certain conditions?
- Solution: **control flow**

Control flow – General syntax

```
keyword ( condition ) {

      body statement 1;
            .
            .
            .
      body statement n;

}
```

The body is executed only if the *condition* is true!

If the body of the control flow has only one statement, we can **optionally** not use the { }

```
keyword ( condition )

      body statement 1;
```

Control flow – if

- To execute a particular body of statements only **if** a particular *condition* is satisfied

```
if ( condition ) {

      body statement 1;
            .
            .
            .
      body statement n;

}
```

Example

```
int x = 3, y;

if ( x > 2 ) {

      x++;
      y = x;

}

printf("y = %d\n",y);
```

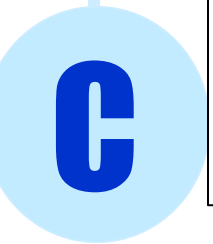
Control flow - else

- To execute a particular body of statements only **if** a particular *condition* is **not** satisfied

```
if ( condition ) {

      body statement 1;
            .
            .
            .
      body statement n;

}
else {

      body statement 1;
            .
            .
            .
      body statement m;

}
```

Example

```
int x = 3, y;

if ( x > 2 ) {

      x++;
      y = x;

}
else {

      y = 2 * x;

}

printf("y = %d\n",y);
```



Control Flow – if/else example

```
int x = 3, y = 1;

if( x > 2 )
      if( x == 4)
            y = x;
else
      y = 2 * x;

printf("y = %d\n",y);
```

Control Flow – if/else example

```
int x = 3, y = 1;

if( x > 2 )
      if( x == 4)
            y = x;
else
      y = 2 * x;

printf("y = %d\n",y);
```

`else` refers always to the last `if` that was not already closed by another `else`

Control Flow – if/else example

```
int x = 3, y = 1;

if( x > 2 ) {

    if( x == 4) {
        y = x;
    }
    else {
        y = 2 * x;
    }
}

printf("y = %d\n",y);
```

This is why we need brackets and indentation!

Control Flow – if/else example

```
int x = 3, y = 1;

if( x > 2 ) {

     if( x == 4) {
          y = x;
     }
}
else {
     y = 2 * x;
}

printf("y = %d\n",y);
```

Using brackets we can change the `if` to which the `else` refers

Control flow - Switch

Equivalent to a series of if/else statements

```
switch ( variable ) {

        case val1:
                statement 1;
                  .
                  .
                  .
                break;

        case val2:
                statement 1;
                  .
                  .
                  .
             /* fall through */
           .
           .
           .
        default:
                statement 1;
                  .
                  .
                  .
                break;
}
```

```
int i,j;

switch( i ) {

 case 1:
      j  = i + 1;
      break;

 case 10:
      j = i - 1;

 default:
      j = 1;

}
```

Control flow - Switch

Equivalent to a series of if/else statements

```
switch ( variable ) {
        case val1:
                statement 1;
                  .
                  .
                  .
                break;
        case val2:
                statement 1;
                  .
                  .
                  .
             /* fall through */
          .
          .
          .
        default:
                statement 1;
                  .
                  .
                  .
                break;
}
```

These values are CONSTANT

If variable has value different from all other cases

```
int i,j;

switch( i ) {

 case 1:
      j  = i + 1;
      break;

 case 10:
      j = i - 1;

 default:
      j = 1;

}
```

i	j
1	2
10	1
Any other number	1

Control flow - Switch

Equivalent to a series of if/else statements

```
switch ( variable ) {
        case val1:
                statement 1;
                  .
                  .
                  .
                break;
        case val2:
                statement 1;
                  .
                  .
                  .
             /* fall through */
          .
          .
          .
        default:
                statement 1;
                  .
                  .
                  .
                break;
}
```

These values are CONSTANT

If variable has value different from all other cases

```
int i,j;

switch( i ) {

 case 1:
      j  = i + 1;
      break;

 case 10:
      j = i - 1;

 default:
      j = 1;
}
```

After last `case` I can avoid using `break`

Switch

Equivalent to a series of if/else statements

```
switch ( variable ) {

        case val1:
                statement 1;
                  .
                  .
                  .
                break;

        case val2:
                statement 1;
                  .
                  .
                  .
             /* fall through */
           .
           .
           .
        default:
                statement 1;
                  .
                  .
                  .
                break;
}
```

```
int i,j;

switch( i ) {

 case 1:
      j  = i + 1;
      break;

 case 10:
      j = i - 1;

 default:
      j = 1;

}
```

variable can only be `char` or `int` !

```
float i = 2;

switch( i ) {
```

Control Flow - Loops

- What if we want to perform the same operation multiple times?
- Example: we want to initialize all elements in a 100 dimensional array of integers to the value 7

```
int arr[100];

arr[0] = 7;
arr[1] = 7;
arr[2] = 7;
arr[3] = 7;
     .
     .
     .
arr[99] = 7;
```

This is crazy!

Loops - while

- To execute a particular body of statements only **until** a particular *condition* is satisfied

```
while ( condition ) {

      body statement 1;
            .
            .
            .
      body statement n;

}
```

Example

```
int i = 0;
int arr[100];

while( i < 100 ) {

    arr[i] = 7;
    i++;

}
```

Loops – do/while

- **First** execute body statements, **then** check if *condition* is satisfied

```
do {

    body statement 1;
            .
            .
            .
    body statement n;

} while ( condition );
```

Example

```
int i = 10,
int j = 0;

while( i < 10 )
{

    j++;
    i++;

}
```

Example

```
int i = 10;
int j = 0;

do
{

    j++;
    i++;

} while( i < 10 );
```

j = ?

Loops – do/while

- **First** execute body of statements, **then** check if *condition* is satisfied

```
do {

   body statement 1;
          .
          .
          .
   body statement n;

} while ( condition );
```

Example

```
int i = 10,
int j = 0;

while( i < 10 )
{

   j++;
   i++;

}
```

j = 0

Example

```
int i = 10;
int j = 0;

do
{

   j++;
   i++;

} while( i < 10 );
```

j = 1

Loops - break

- To interrupt a loop once a certain condition different from the one in the loop declaration

```
while( condition1 ){

    body statement 1;
          .
          .
          .
    if( condition2 )
      break;
          .
          .
          .
    body statement n;

}
```

When **break** is reached, the statements after it are ignored and the program exits the loop

Example

```
int i = 0;
char s[10] = "hi";

while( i < 10 )
{
    if(s[i]=='\0')
        break;

    printf("%c",s[i]);

    i++;
}
```

Loops - continue

- To ignore the following instructions in a loop

```
while( condition1 ){

    body statement 1;
          .
          .
          .
    if( condition2 )
      continue;
          .
          .
          .
    body statement n;

}
```

When **continue** is reached, the statements after it are ignored, and the loop continues

Example

```
int i = 0, sum = 0;
int s[3] = {7, 5, 9};

while( i < 3 )
{
    if(s[i] < 6)
        continue;

    sum += s[i];
}
```

break vs. continue

```
int  x = 0, y = 0;

while( x < 10) {

     x++;

     if(x == 3) {

         continue;
     }

     y++;
}
```

```
int  x = 0, y = 0;

while( x < 10) {

     x++;

     if(x == 3) {

          break;
     }

     y++;
}
```

y = ?

break vs. continue

```
int  x = 0, y = 0;

while( x < 10) {

     x++;

     if(x == 3) {

        continue;
    }

    y++;
}
```

y = 9

```
int  x = 0, y = 0;

while( x < 10) {

     x++;

     if(x == 3) {

          break;
     }

     y++;
}
```

y = 2

Loops - for

```
for (initial state ; condition ; state change ) {

      body statement 1;
            .
            .
            .
      body statement n;

}
```

Example

```
int i;
int arr[100];

for( i = 0; i < 100 ; i++ ) {

   arr[i] = 7;

}
```

```
int i = 0;
int arr[100];

while( i < 100 ) {

   arr[i] = 7;
   i++;

}
```

Homework 1 review

HOW TO COMPRESS/UNCOMPRESS folders in UNIX

- Compress folder ~/COMS1003/HW1 to HW1.tar.gz

  tar -zcvf HW1.tar.gz ~/COMS1003/HW1

- Uncompress HW1.tar.gz to folder ~/COMS1003/HW1new

  tar -zxvf HW1.tar.gz -C ~/COMS1003/HW1new

  (note: ~/COMS1003/HW1new must exist already)