Introduction to C Programming

Course: Introduction to Programming and Data Structure

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The first C program

```
1 //FileName: hello.c
2 //Printing Hello world
3 #include <stdio.h>
4 main()
5 {
6   printf("hello, world\n");
7
8 }
```

1. Compilation: gcc hello.c /*a.out file will be generated*/
2. Run ./a.out /* default output file*/

Description

- stdio.h: standard input-output library
- printf: a library function
- input string
- \n - newline

Output your Name

```c
//FileName: namePrint.c
//Prints given name
#include <stdio.h>
main()
{
  char name[] = "Your Name"
  printf("hello, %s\n", name);
}
```

1. Compilation: gcc -g -Wall namePrint.c -o prog2.out
   - gcc → GNU Compiler Collection
   - gcc -g → generates debug info to be used by GDB debugger
   - -Wall → Show all warnings
2. Run: ./prog2.out
3. ".out" – not mandatory

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Output your Name

Description

- char: variable type
- name: variable name
- %s : string output format specifier
- Commenting a line with /**/ and //: Not read by the compiler

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Variables and Arithmetic Expressions

```c
/* filenme: FahToCel.c
   print Fahrenheit-Celsius table
   for fahr = 0, 20, ..., 300
*/
#include <stdio.h>
main()
{
  int fahr, celsius;      //variable Declaration
  int lower, upper, step;
  lower = 0; /* lower limit of temperature scale */ // variable assignment
  upper = 300; /* upper limit */
  step = 20; /* step size */
  fahr = lower;
  while (fahr <= upper) {     //while loop
    celsius = 5 * (fahr-32) / 9;
    printf("%d\t%d\n", fahr, celsius);
    fahr = fahr + step;
  }
}
```

Description

- Variable declaration
- Assign value to a variable
- Each variable must have a format specifier in printf

Building block of a Programming Language

1. Memory = space for calculations, rough work, etc.
2. Variables = names given to memory locations for convenience
3. Instructions = each step in the procedure

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Naming rules of variables

Naming Rule of variables

1. Span: letters and digits
2. 1st character must be a letter
3. set of letters = { a, b, . . ., z, A, B, . . ., Z, _ }
4. The underscore "_" is count as letter
5. names are case sensitive.

Traditional C practice

- use lower case for variable names
- use all upper case for symbolic constants.

Variable-Name Examples

- abc_123 $\rightarrow$ valid
- _abc123 $\rightarrow$ valid
- _123 $\rightarrow$ valid
- _123abc $\rightarrow$ valid
- 123_abc $\rightarrow$ invalid

Tips

Variable name should be given in such a way that usage of the variable can be guessed easily from its name.

Should not be unnecessary long

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Output format specifiers

Format Specifiers

- Format specifiers define the type of data to be printed on standard output.
- You need to use format specifiers whether you're printing formatted output with printf() or accepting input with scanf().

Some frequently used format specifiers

1. %d – decimal integer
2. %6d – decimal integer, at least 6 characters wide
3. %f – floating point
4. %6f – floating point, at least 6 characters wide
5. %.2f – floating point, 2 characters after decimal point
6. %6.2f – floating point, at least 6 wide and 2 after decimal point

Symbolic Constants

```
1  #include <stdio.h>
2  #define LOWER 0 /* lower limit of table */
3  #define UPPER 300 /* upper limit */
4  #define STEP 20 /* step size */
5  /* print Fahrenheit-Celsius table */
6  main()
7  {
8    int fahr;
9    for (fahr = LOWER; fahr <= UPPER; fahr = fahr + STEP)
10   printf("%3d %6.1f\n", fahr, (5.0/9.0)*(fahr-32));
11 }
```

```
1  #define name replacement list
```

- symbolic constants are *string of characters*:
- They are not variables
- they do not appear in declarations
- In compiled files, they do not exists
- Conventionally written in upper case only

If

```
1 if (condition) {
2   // block of code to be executed
3   //if the condition is true
4 }
```

Example:

```
1 int a = 10;
2 int b = 2;
3 if (a > b) {
4   printf("a is greater than b");
5 }
```

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If-Else

```
1  if (condition) {
2    // block of code to be executed
3    //if the condition is True
4  }else{
5    // block of code to be executed
6    //if the condition is False
7  }
```

```
1  int a = 10;
2  int b = 2;
3  if (a > b) {
4    printf("a is greater than b");
5  }else{
6    printf("a is less than b");
7  }
```

If-Else in a single line:

```
1    condition ? expression-true : expression-false
```

```
1    int a = 10, b = 2;
2    (a > b)? printf("a is greater than b"): printf("a is less than b");
```

Else-If

```
if (test expression1) {
  // statement(s)
}
else if(test expression2) {
  // statement(s)
}
else if (test expression3) {
  // statement(s)
}
.
.
else {
  // statement(s)
}
```

```
if (marks > 85) {
  printf("First Class with Distinction");
}
else if(marks > 60) {
  printf("First Class");
}
else if (marks>40) {
  print("Passed");
}
else {
  print("Failed");
}
```

Switch: Psudocode

```
1  switch (expression)
2  {
3    case constant1:
4    // statements
5    break;
6
7    case constant2:
8    // statements
9    break;
10   .
11   .
12   .
13   default:
14   // default statements
15 }
```

Switch: Example

```c
char operation;
double n1, n2;
printf("Enter an operator (+, -, *, /): ");
scanf("%c", &operation);
printf("Enter two operands: ");
scanf("%lf %lf",&n1, &n2);

switch(operation)
{
  case '+':
  printf("%.1lf + %.1lf = %.1lf",n1, n2, n1+n2);
  break;

  case '-':
  printf("%.1lf - %.1lf = %.1lf",n1, n2, n1-n2);
  break;

  case '*':
  printf("%.1lf * %.1lf = %.1lf",n1, n2, n1*n2);
  break;

  case '/':
  printf("%.1lf / %.1lf = %.1lf",n1, n2, n1/n2);
  break;

  // operator doesn't match any case constant +, -, *, /
  default:
    printf("Error! operator is not correct");
}
```

For and While

```
1 for ( init; condition; increment ) {
2   statement(s);
3 }
```

```
1 int i;
2
3 /* for loop execution */
4 for( i = 1; i < 10; i = i + 1 ){
5   printf("value of i: %d\n", i);
6 }
```

```
1 while(condition) {
2   statement(s);
3 }
```

```
1 int i = 1;
2
3 /* while loop execution */
4 while( i < 10 ) {
5   printf("value of i: %d\n", i);
6   i++;
7 }
```

for and while loop

Some frequently used format specifiers

1. The for statement is a loop– a generalization of the while.
2. Three parts— separated by semicolons.
3. The first part– the initialization
4. The second part– Loop controller/ loop terminator
5. The third part– condition re-evaluation

'For' or 'while': which to use?

- whatever you want
- 'for' is more compact. It keeps the loop control statements together in one place

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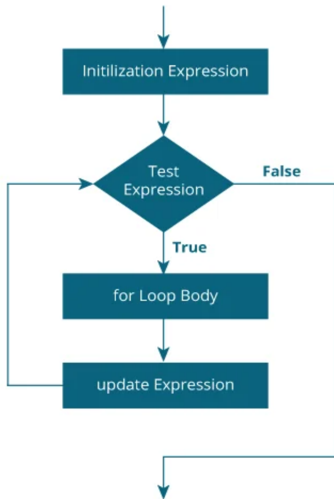
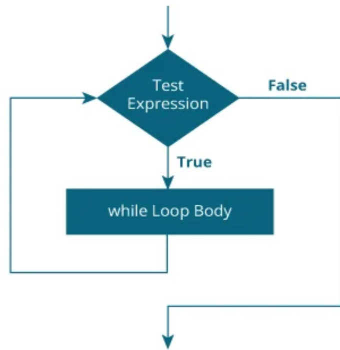
Flowchart of for



Flowchart of For loop



Flowchart of For while loop

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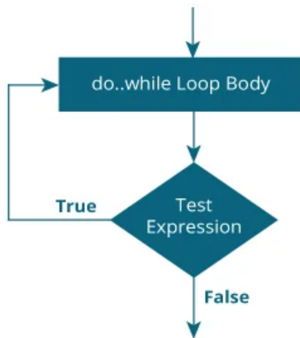
Do-While



Flowchart of Do-while loop

Pseudocode:

```
1 do {
2   // the body of the loop
3 }
4 while (testExpression);
```

Example:

```
1     int i;
2
3     /* for loop execution */
4     i = 1;
5     do{
6       printf("value of i: %d\n", i);
7       i = i + 1 ;
8     } while(i < 10);
```

Question: What to use For or While or Do-While?

Break and Continue

`break` statement **terminates** a loop

```
1 for (int i = 1; i <= 40; i++) {
2   printf("value of i: %d\n", i);
3   if (i == 10) {
4     break;  // terminates the loop
5
6   }
7 }
```

`continue` **skips** a current iteration of a loop.

```
1 for (int i = 1; i <= 10; i++{
2   printf("value of i: %d\n", i);
3   if (i == 3) {
4     continue;
5   }
6 }
```

Functions

- So far, we have used printf, open, etc
- We know, we have to pass some parameter, it returns some values
- We don't have to know *how* it is defined
- We only have to know what is defined, and whats are its outputs

Why?

When we do same things with different values, we keep it in functions

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Functions

```
1 return-type function-name(parameter declarations, if any)
2 {
3   declarations
4   statements
5 }
```

Functions

```
return-type function-name(parameter declarations, if any)
{
  declarations
  statements
}
```

```
#include <stdio.h>
int power(int m, int n); //declaration needed
/* test power function */
main()
{
  int i;
  for (i = 0; i < 10; ++i)
  printf("%d %d %d\n", i, power(2,i), power(-3,i));
  return 0;
}
/* power: raise base to n-th power; n >= 0 */
int power(int base, int n)
{
  int i, p;
  p = 1;
  for (i = 1; i <= n; ++i)
  p = p * base;
  return p;
}
```

TOP Secret to be an Expert in programming

Only Secret: Practice!

- Practice code/program writing
- Practice to solve daily eligible problems with coding
- Practice to take new coding challenges

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topics tp be covered in some next class

- Character Arrays
- External Variables and Scope

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Character array or String

```
1 char str[]    = "TCG_Crest";
2 char str[50]  = "TCG_Crest";
3 char str[]    = {'T','C','G','_','C','r','e','s','t','\0'};
4 char str[14]  = {'T','C','G','_','C','r','e','s','t','\0'};
```

str =

T	C	G	_	C	r	e	s	t	\0
0x12345	0x12346	0x12347	0x12348	0x12349	0x12350	0x12351	0x12352	0x12353	0x12356

- Accessing characters: str[0] = T, str[2] = G, etc
- '\0' is null character, terminating character

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