Basics of C programming

Course: Introduction to Programming and Data Structure

Laltu Sardar

Institute for Advancing Intelligence (IAI),
TCG Centres for Research and Education in Science and Technology (TCG Crest)

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The first C program

```c
//FileName: hello.c
//Printing Hello world
#include <stdio.h>
main()
{
  printf("hello, world\n");

}
```

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

Compiling C program

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

Output your Name

Description

- char: variable type
- name: variable name
- %s : string output format specifier
- Commenting: Not read by the compiler
  - For single line: //
  - For multiple lines: /* your lines */

Basic input/output from/to a file

Input from terminal **during** execution

- printf() : returns total number of Characters Printed, Or negative value if an output error or an encoding error
- scanf() : Reads input of any datatype from (stdin).
    - Stops reading when it encounters **whitespace, newline or EOF**
    - Returns total number of Inputs Scanned successfully, or EOF if input failure occurs before the first receiving argument was assigned.
- gets(): Reads string from standard input.
    - Stops stops reading input when it encounters **newline or EOF**.
    - Returns total number of Inputs Scanned successfully, or EOF if input failure occurs before the first receiving argument was assigned.

Note: gets() does not stop reading input when it encounters whitespace instead it takes whitespace as a string.

```c
// Program to compute average of two float variables
#include<stdio.h>

float average(float a, float b){
    return ((a+b)/2.0);
}

int main(){
    float a, b, avg;

    scanf("%f %f", &a, &b);  // taking input from terminal
    avg = average(a, b);     //Compauting avarage
    printf("%f",avg); //writing on terminal
    return 0;
}
```

```c
// Program to compute average of two float variables
#include<stdio.h>

float average(float a, float b){
    return ((a+b)/2.0);
}

int main(){
    float a, b, avg;

    scanf("%f %f", &a, &b);  // taking input from terminal
    avg = average(a, b);    //Compauting avarage
    printf("%f",avg); //writing on terminal
    return 0;
}
```

- Sometimes input is large–
- Sometime we have many inputs
- embedding data directly into the source code– **a bad idea and Not practical**
- We require to take input data from files.

Input from file **during** execution

- fprintf() : returns total number of bytes Printed from file, Or negative value if an output error or an encoding error
- fscanf() : Reads input of any datatype from stream.
    - Stops reading when it encounters **whitespace, newline or EOF**
    - Returns total number of Inputs Scanned successfully, or EOF if input failure occurs before the first receiving argument was assigned.
- fgets(): Reads string from stream.
    - Stops stops reading input when it encounters **newline or EOF**.
    - Returns total number of Inputs Scanned successfully, or EOF if input failure occurs before the first receiving argument was assigned.

Home Work: Assignment 01

Write details (When to use, formats, return values, terminating conditions, etc.) about the following functions:

1. getchar(), fgetc() and getc(), putchar(), putc()
2. getc(), getchar(), getch() and getche(),
3. fgets()/gets()/scanf().
4. fread()/fseek()

fscanf and fprintf

- fscanf and fprintf works same as scanf and printf

```c
// Program to learn basic file operation
#include<stdio.h>

float average(float a, float b){
    return ((a+b)/2.0);
}

int main(){
    float a, b, avg;

    FILE *inp_file_ptr, *out_file_ptr; //File type pointer must be declared

    inp_file_ptr = fopen("input_file.txt","r"); // Opening input file for reading
    fscanf(inp_file_ptr, "%f %f", &a, &b);  // taking input from file
    fclose(inp_file_ptr);   // closing the input file

    avg = average(a, b);    //Compauting avarage

    out_file_ptr = fopen("output_file.txt","w");
    fprintf(out_file_ptr, "%f",avg); //writing on output file
    fclose(out_file_ptr); //closing the output file

    return 0;
}
```

Command Line Arguments: Input from terminal before execution:

Why inputs from command line

- Another form of input
- Useful when you want to control your program from outside.
- To override defaults and have more direct control over the application

Example:

```c
int main(int argc, char *argv[]) {
  /* ... */
}
```

or

```c
int main(int argc, char **argv) {
  /* ... */
}
```

```c
// Program to compute average of two float variables
#include<stdio.h>
#include<stdlib.h> //that contains atof

float average(float a, float b){
     return ((a+b)/2.0);
}
int main(int argc, char *argv[]){
     float a, b, avg;
     if (argc==3){
          a = atof(argv[1]); //converting string to float
          b = atof(argv[2]);
     }else{
          scanf("%f %f", &a, &b);  // taking input from terminal
     }
     avg = average(a, b);     //Compauting avarage
     printf("%.2f",avg); //writing on terminal
     return 0;
}
```

```c
// Program to compute average of two float variables
#include<stdio.h>
#include<stdlib.h> //that contains atof

float average(float a, float b){
    return ((a+b)/2.0);
}
int main(int argc, char *argv[]){
    float a, b, avg;
    if (argc==3){
        a = atof(argv[1]); //converting string to float
        b = atof(argv[2]);
    }else{
        scanf("%f %f", &a, &b);  // taking input from terminal
    }
    avg = average(a, b);    //Compauting avarage
    printf("%.2f",avg); //writing on terminal
    return 0;
}
```

- argc (ARGument Counter): is The number of command-line arguments passed. It includes the name of the program
- argv (ARGument Vector): An array of strings pointers listing all the arguments.
- argv[0] is the name of the program , After that till argv[argc-1] every element is command-line arguments.
- Only strings can be taken from command line.

Basics of C programming:

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

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 → valid
- _abc123 → valid
- _123 → valid
- _123abc → valid
- 123_abc → 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

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

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

```c
#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

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

Example:

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

If-Else

```
if (condition) {
  // block of code to be executed
  //if the condition is True
}else{
  // block of code to be executed
  //if the condition is False
}
```

```
int a = 10;
int b = 2;
if (a > b) {
  printf("a is greater than b");
}else{
  printf("a is less than b");
}
```

If-Else in a single line:

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

```
  int a = 10, b = 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

```
switch (expression)
{
  case constant1:
  // statements
  break;

  case constant2:
  // statements
  break;
  .
  .
  .
  default:
  // default statements
}
```

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

```c
for ( init; condition; increment ) {
  statement(s);
}
```

```c
int i;

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

```c
while(condition) {
  statement(s);
}
```

```c
int i = 1;

/* while loop execution */
while( i < 10 ) {
  printf("value of i: %d\n", i);
  i++;
}
```

for and while loop

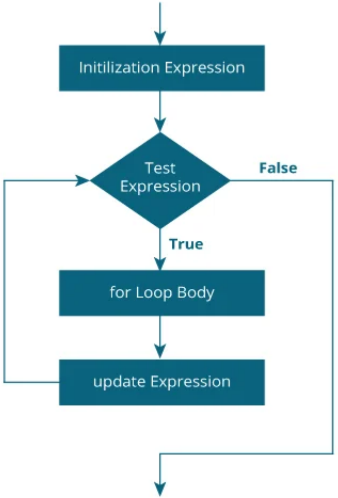
Some frequently used format specifiers

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

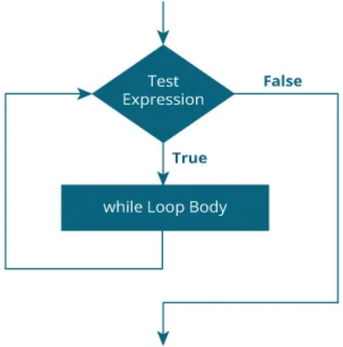
‘For’ or ‘while’: which to use?

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

Flowchart of for

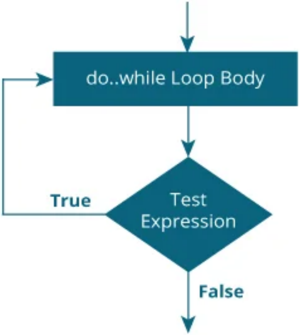


Flowchart of For loop



Flowchart of For while loop

Do-While



Flowchart of Do-while loop

Pseudocode:

```
do {
  // the body of the loop
}
while (testExpression);
```

Example:

```
    int i;

    /* for loop execution */
    i = 1;
    do{
      printf("value of i: %d\n", i);
      i = i + 1 ;
    } while(i < 10);
```

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

Break and Continue

`break` statement **terminates** a loop

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

  }
}
```

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

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

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

Functions

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

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

topics tp be covered in some next class

- Character Arrays
- External Variables and Scope

Character array or String

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