C Programming Basics

Ritu Arora

Texas Advanced Computing Center

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Email: rauta@tacc.utexas.edu

Homework 5 (1)

```
1. #include <stdio.h>
2. int main(){
3. int i, j, k;
4. int myA[2][2] = {{1, 2}, {3, 4}};
5. int myB[2][2] = {{5, 6}, {7, 8}};
6. int myC[2][2] = {{0, 0}, {0, 0}};
7. for(i=0; i<2; i++){
8.   for(j=0; j<2; j++){
9.     for(k=0; k <2; k++){
10.      myC[i][j] = myC[i][j] + myA[i][k]*myB[k][j];
11.    }
12.  }
13.}
```

Homework 5 (2)

```
14.   for(i=0; i<2; i++){
15.     for(j=0; j<2; j++){
16.       printf(" %d ", myC[i][j]);
17.     }
18.     printf("\n");
19.   }
20.   return 0;
21.}
```

Overview of the Course

- Writing a Basic C Program
- Understanding Errors
- Comments Keywords, Identifiers, Variables
- Operators
- Standard Input and Output (Basic)
- Control Structures
- Standard Input and Output
- Arrays, Structures
- Functions in C
- Pointers
- Working with Files

All the concepts will be accompanied with examples.

Passing Values to Functions: passValue1.c

```
#include <stdio.h>
void add(int a, int b){<-- Formal Parameters: a, b
   int c;
   c = a + b;
   printf("\n Addition is : %d",c);
}
int main(){
   int a, b;
   printf("\n Enter Any 2 Numbers : ");
   fflush(stdout);
   scanf("%d %d",&a,&b);
   add(a, b); <-- Actual Parameters: a, b
   return 0;
}
```

Note: The variables used as formal and actual parameters can have different names.

Passing Values to Functions: passValue2.c

```
#include <stdio.h>
#include <stdlib.h>
void add(int a, int b){
 //same code as in the previous slide
}
int main(int argc, char *argv[]){
 int a, b;
 if ( argc != 3 ){
  printf("\nInsufficient num. of arguments.\n");
  printf( "\nUsage:%s <firstNum> <secondNum>", argv[0]);
 }else{
    a = atoi(argv[1]);
    b = atoi(argv[2]);
    add(a, b);
 }
 return 0;
}
```

Code Snippet From passValue2.c

Notice that main has two arguments

```
int main(int argc, char *argv[]){
 int a, b;
 if ( argc != 3 ){
  printf("\nInsufficient num. of arguments.\n");
  printf( "\nUsage:%s <firstNum> <secondNum>", argv[0]);
 }else{
    a = atoi(argv[1]);
    b = atoi(argv[2]);
    add(a, b);
 }
 return 0;
}
```

argc is the argument count

argv[1] holds the first number typed in at the command-line. Notice the atoi function.

Returning Values from Functions: passValue4.c

```
#include <stdio.h>
int add(int a, int b){ <-- Notice the return type
   int c;
   c = a + b; a=c; b=c;
   printf("\n Addition is : %d",c);
   return c; <-- Return value: c
}
int main(){
   int a, b, c;
   printf("\n Enter Any 2 Numbers : ");
   scanf("%d %d",&a,&b);
   printf("a is: %d, b is: %d\n", a, b);
   c = add(a, b); <--- Value returned from add stored in c
   printf("a is: %d, b is: %d\n", a, b);
   return 0;
}
```

Returning Values from Functions: passValue4.c

- Output:

```
Enter Any 2 Numbers : 5 6
a is: 5, b is: 6
Addition is : 11
a is: 5, b is: 6
```

Note: the values of `a` and `b` remained the same when accessed from function main.

Pointers

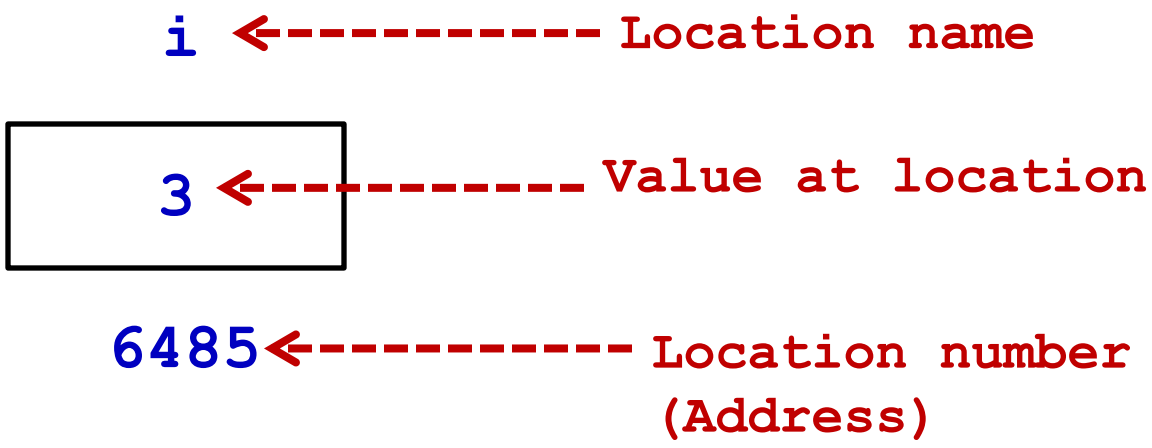
- A pointer is a variable that stores an address in memory - address of another variable
- For instance, the value of a pointer may be 42435. This number is an address in the computer's memory which is the start of some data
- We can dereference the pointer to look at or change the data
- Like variables, you have to declare pointers before you use them
- The data type specified with pointer declaration is the data type of the variable the pointer will point to

Revisiting Variable Declaration

- Consider the declaration

```
int i = 3;
```

- This declaration tells the C compiler to:
  - Reserve space in memory to hold the integer value
  - Associate the name `i` with this memory location
  - Store the value `3` at this location



‘Address of’ Operator

```
#include <stdio.h>
int main(){
   int i=3;
   printf("\nAddress of i = %p" ,&i);
   printf("\nValue of i =  %d", i);
   return 0;
}
```

& operator is ‘address of operator’

Output:

```
Address of i = 0x22ff0c
Value of i = 3
```

Note:

&i Returns the address of variable i

‘Value at Address’ Operator: printAddress.c

```
#include <stdio.h>
int main(){
   int i=3;
   printf("\nAddress of i = %u", &i);
   printf("\nValue of i = %d", i);
   printf("\nValue of i = %d", *(&i));
   return 0;
}
```

& operator is ‘address of’ operator

* operator is ‘value at address of’ operator

Output:

```
Address of i = 2293532
Value of i = 3
Value of i = 3
```

Note:

&i returns the address of variable i

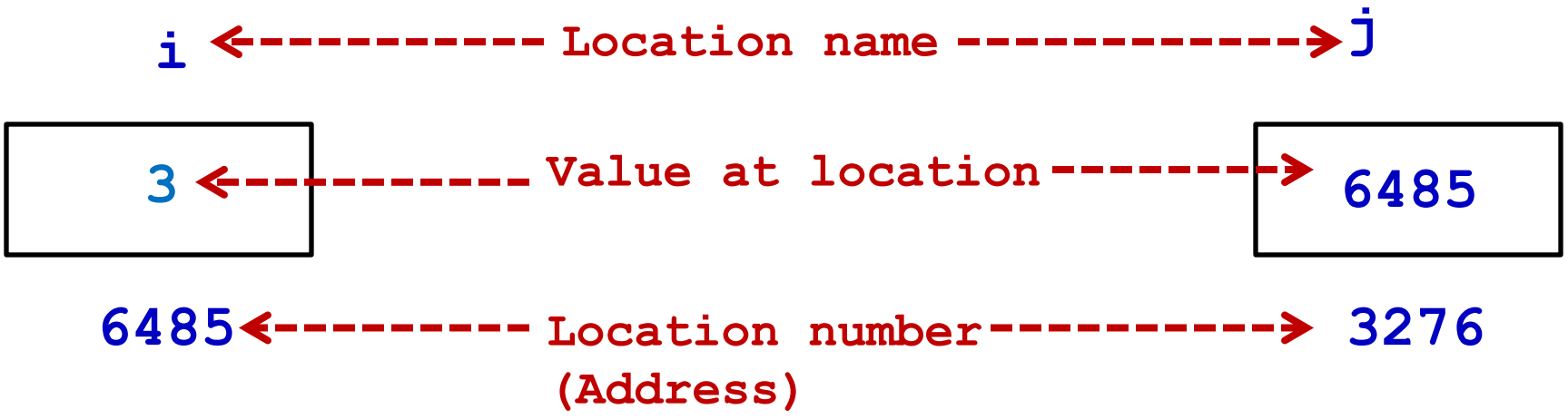
***(&i) returns the value at address of i**

Pointer Expressions

- In the previous example, the expression **`&i`** returns the address of **`i`**.
- This address can be collected in a variable as

```
j = &i;
```

- `j` is a variable which contains the address of another variable and is declared as `int *j;`



Pointers: pointerExample2.c

```
#include <stdio.h>
int main(){
 int i=3;
 int *j;
 j = &i;
 printf("\nAddress of i = %u", &i);
 printf("\nAddress of i = %u", j);
 printf("\nAddress of j = %u", &j);
 printf("\nValue of j = %u", j);
 printf("\nValue of i = %d", i);
 printf("\nValue of i = %d", *(&i));
 printf("\nValue of i = %d", *j);
 return 0;
}
```

Output:

```
Address of i = 2293532
Address of i = 2293532
Address of j = 2293528
Value of j = 2293532
Value of i = 3
Value of i = 3
Value of i = 3
```

Key Concepts Related to Pointers

- Declaring a pointer

```
int *myIntPtr;
int* myIntPtr;
```

- Getting the address of a variable

```
int age = 3;
myIntPtr = &age;
```

- Dereferencing a pointer

```
*myIntPtr = 5;
```

Note: We just changed the value of age!

Pointers Example 2: ptrExample.c

```
#include <stdio.h>
int main(){
     int myValue;
     int *myPtr;
     myValue = 15;
     myPtr = &myValue;
     printf("myValue is equal to : %d\n", myValue);
     *myPtr = 25;
     printf("myValue is equal to : %d\n", myValue);
}
```

Output:

```
myValue is equal to : 15
myValue is equal to : 25
```

Pointers and Arrays

The square-bracket array notation is a short cut to prevent you from having to do pointer arithmetic

```
char array[5];
array[2] = 12;
```

`array` is a pointer to **`array[0]`**

`array[2] = 12;` is therefore equivalent to

```
*(array+2) = 12;
```

Passing Address to Function: passValue3.c

```
#include <stdio.h>

void addUpdate(int *a, int *b){
   int c;
   c = *a + *b;
   printf("Addition is : %d\n",c);
   *a = c;
   *b = c;
}
int main(){
   int a, b;
   printf("Enter Any 2 Numbers : ");
   scanf("%d %d",&a,&b);
   printf("a is: %d, b is: %d\n", a, b);
   addUpdate(&a, &b);
   printf("a is: %d, b is: %d\n", a, b);
   return 0;
}
```

Notice the pointer

Notice &a, &b

Note: The values of **a** and **b** changed in **addUpdate** function .

Output of passValue3.c

- **Output:**

```
Enter Any 2 Numbers : 2 8
a is: 2, b is: 8
Addition is : 10
a is: 10, b is: 10
```

Dynamic Memory Allocation

- Dynamic allocation is the automatic allocation of memory at run-time
- It is accomplished by two functions: `malloc` and `free`
- These functions are defined in the library file `stdlib.h`
- `malloc` allocates the specified number of bytes and returns a pointer to the block of memory
- When the memory is no longer needed, the pointer is passed to `free` which deallocates the memory
- Other functions:
  - `calloc` allocates the specified number of bytes and initializes them to zero
  - `realloc` increases the size of the specified chunk of memory

Note: With arrays, static memory allocation takes place, that is at compile-time.

Example: dynMemAlloc.c (1)

```
#include<stdio.h>
#include<stdlib.h>
int main(){
  int numStudents, avg, *ptr, i, sum = 0;
  printf("Enter the num of students :");
  scanf("%d",&numStudents);
  ptr=(int *)malloc(numStudents*sizeof(int));
  if(ptr == NULL){
    printf("\n\nMemory allocation failed!");
    exit(1);
  }
  for (i=0; i<numStudents; i++){
    printf("\nEnter the marks for the student %d\n", i+1);
    scanf("%d",(ptr+i));
  }
```

Example: dynMemAlloc.c (2)

```
    . . .
    for (i=0; i<numStudents; i++){
       sum = sum + *(ptr + i);
    }
    avg = sum/numStudents;
    printf("\nAvg marks = %d ",avg);
    return 0;
} // end of main function
```

```
Output:
Enter the num of students :3
Enter the marks for the student 1
10
Enter the marks for the student 2
20
Enter the marks for the student 3
30
Avg marks = 20
```

Homework 6

- Consider the problem specified in Homework 5. Redo it by writing a user-defined function of your choice. For example,
  - you could write a `printMatrix` function that can print the contents of a two-dimensional matrix of type double, and with any number of rows and columns.
  - You could also write a `myMatMul` function for multiplying matrices. This function can accepts two integer arrays of same size, say P X Q, where P is the number of rows and Q is the number of columns.

References

- C Programming Language, Brian Kernighan and Dennis Ritchie
- Let Us C, Yashavant Kanetkar
- C for Dummies, Dan Gookin
- http://cplusplus.com