[redacted]

IT1010 – Introduction to Programming

Lecture 2 – Data Types and C Formatted Input/Output

Objectives

- At the end of the Lecture students should be able to
  - Use fundamental data types.
  - Write simple output statements to display values stored in variables.
  - Write simple input statements to read values from the key board.
  - Define and use derived data types.

Variables

- Variable is a location in memory where a value can be stored for use by a program
- Variables must be declared, before they can be given a value. When declaring a variable, its **name** and **data type** should be specified. Every variable has a name, type and a value.
- The declaration allocates the storage location of the appropriate size and associates the name and data type with that location.

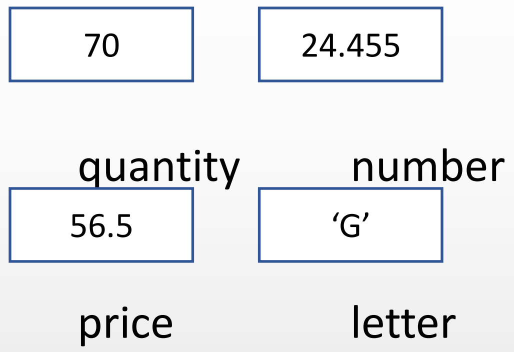
Variable Declaration

- The format for the declaration of a variable

  <data type>   < Name of the variable>;

Example:

```
int quantity;
float price;
double number;
char letter;
```



Variable Names

- Variable name in C is a valid identifier.

An identifier

- can be a series of characters consisting of letters, digits and underscores (_)
- does not begin with a digit
- may not contain embedded blank spaces
- may not be a reserved word (ex: int, return, if, while, for….)

C is case sensitive (uppercase and lowercase letters are different in C)

i.e. total , Total and TOTAL are three different variable names

Quiz

Which of the following can be considered as valid variables?

- *name*
- *Number Of Values*
- *Tax_Rate*
- *DistanceInFeet*
- *2BeOrNot2Be*
- *Number3*
- *Tax%*
- *for*

Data Types

- Integers
  - short
  - int
  - long int

An integer is a whole number without a decimal point or a fractional part.

There is a maximum and a minimum integer that can be stored in the computer

- Real Numbers
  - float
  - double
  - long double

Numbers which contain a decimal point and a fractional part are called floating point or real numbers

- Characters - char

Data types - Examples

- Integers

462 –39 31285

- Real Numbers

-21.73 15.0 6.252e-3

- Characters

‘A’ ‘@’ ‘7’ ‘v’ ‘.’

Exponential Notation

Exponential notation represents a floating point number as a decimal fraction times a power of 10

example,
1.645e2 is 1.645×10^2 or 164.5

Storing values into variables

- The assignment operation can be used to store a value in a variable or to change the value stored in a variable
- The assignment operator is the equal sign =
- An assignment expression has the form

  variable(lvalue) = expression(rvalue)

- It stores the value of the expression (rvalue) into the memory location for the variable (lvalue)

Example:

```
    quantity = 50;
    number = 100.5;
    amount = quantity * 55.25;
```

Quiz

Q1

```
int qty;
qty = 5 + 1;
```

What is the value of qty?

Q2

```
int count = 5;
count = count + 1;
```

What is the value of count?

C Formatted Input and Output

- All input and output is performed with streams(sequence of bytes)

  Input – bytes flow from a device (e.g. keyboard, disk drive) to main memory

  Output – bytes flow from main memory to a device (e.g. screen, disk drive)

- Normally standard input stream is connected to the keyboard and the standard output stream is connected to the screen

Formatting output with printf

- printf function output data to the standard output stream.
- printf call contains a *format control string* that describes the output format.

```
printf( format-control-string, other-arguments);
```

format-control-string describes the output format.

other-arguments correspond to each **conversion specification** in format-control-string.

Example:

```
printf( “%d”,  455);
```

printf Conversion Specification

Type	Conversion Specification	Description
Integer	%d	Display as a signed decimal integer
	%i	Display as a signed decimal integer (d and i are same in printf)
Floating-Point	%f	Display floating-point values in fixed-point notation (float or double data type)
Character	%c	Display a character
String	%s	Display a string

Example 01 – How to use different conversion specifier in printf

```
/* using conversion specifiers in c a
program*/
#include <stdio.h>

int main(void)
{
          printf( “%d\n “,  455);
          printf( “%d\n “, -455);
          printf( “%i\n “,  455);
          printf( “%f\n “, 1234567.89);
          printf( “%.2f\n “,  3.446);
          printf( “%c \n”, ‘A’ );
          return 0;

} // end of main function
```

Output

```
455
-455
455
1234567.890000
3.45
A
```

conversion specifier %.2f specifies that a floating point value will be displayed with two digits to the right of the decimal point.

If %f is used without specifying the precision, the default precision of 6 is used.

When floating values are displayed with precision, the value is rounded to the indicated number of decimal positions for display purposes.

Example 02 – How to display the output of a simple calculation

```
/* adding two numbers and display output*/
#include <stdio.h>
int main(void){
        int no1, no2;
        int sum;
        no1 = 25;   //  assign value to no1 variable

        no2 = 12;   //  assign value to no2 variable

        sum = no1 + no2;  // add numbers
        printf( "Sum is %d\n",  sum);    // print sum

        return 0;
} // end of main function
```

output

```
Sum is 37
```

Reading Formatted Input with scanf

- scanf function reads from the standard input stream
- scanf contains a format control string that indicates the type of data that should be entered.

scanf(format-control-string, other-arguments);

format-control-string describes the input format.

other-arguments are pointers to variables in which the input will be stored.

Example:
```
        int a;
        scanf("%d",  &a);
```

scanf Conversion Specification

Conversion Specification	Description
%d	Read signed decimal integer. Argument is a pointer to an int
%i	Read a signed decimal, octal or hexadecimal integer. Argument is a pointer to an int
%f	Reading a floating point value. Argument is a pointer to a float
%lf	Reading a floating point value. Argument is a pointer to a double
%c	Read a character. Argument is a pointer to a char
%s	Read a string. Argument is a pointer to an array of type char

Example 03 – Input two numbers from the keyboard and display the sum

```
/* input two number from the keyboard and add two
numbers*/
#include <stdio.h>
int main(void){
        int no1, no2;
        int sum;
        printf("Enter first number:");   /* prompt */
        scanf("%d", &no1);  /* read the value */
        printf("Enter second number:");    /* prompt*/
        scanf("%d", &no2);  /* read the value */
        sum =  no1  + no2;    /* assign total to sum */
        printf("Sum is %d\n",  sum);    /* print sum */
        return 0;
} // end of main function
```

output

```
Enter first number: 54
Enter second number: 40
Sum is 94
```

C Structures

- Structures are derived data types.
- They are constructed using objects of other data types.
- Simply, a structure is a collection of related variables under one name
- May contain variables of different types.

Structure Definition

- Keyword **struct** is used to declare a structure
- Eg :

Identifier

```
struct employee {

            int empNo;
            int age;
            char gender;
            double salary;
};
```

Members

```
struct book {

            int bookId;
            double price;
            int noOfPages;
            int editionNo;
};
```

Declaring variables of structure type

```
struct employee {

            int empNo;
            int age;
            char gender;
            double salary;
} emp1, emp2 ;
```

emp1 and emp2 are two variables of the structure employee.

Accessing members of a structure

- // Input empNo for emp1

```
scanf(“%d”, &emp1.empNo);
```

- //print the salary of emp1

```
printf(“%.2f”, emp1.salary);
```

- //assign the gender for emp1

```
emp1.gender = ‘M’;
```

Example 04 – How to define and use a structure in C

```
#include <stdio.h>
struct book {
    int bookId;
    double price;
    int noOfPages;
    int editionNo;
} book1;
int main(){
    book1.bookId = 6495407;
    book1.price = 350.00;
    book1.noOfPages = 200;
    book1.editionNo = 8;
    printf("Book 1 book ID : %d\n", book1. bookId);
    printf("Book 1 price : %.2f\n", book1.price);
    printf("Book 1 no Of Pages : %d\n", book1.noOfPages);
    printf("Book 1 edition No : %d\n", book1.editionNo);
    return 0;
}
```

OUTPUT

```
Book 1 book ID : 6495407
Book 1 price : 350.00
Book 1 no Of Pages : 200
Book 1 edition No : 8
```

Summary

- Variables
- Printf statement
- Scanf statement
- Conversion specifier
- Strutures