

CHAPTER TWO – FUNDAMENTALS OF C

2.1 Data Types

- Tell the computer how and in what format the data/information is stored in its _____ (storage).

Basic Storage Unit

- represented by bits (either 0 or 1)
- 8 bits = 1 _____ (produces 256 bit patterns)
- each data type has the largest and the smallest value limit.
- Eg: letter 'A' is represented by value 65 (ASCII value).

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
0	1	0	0	0	0	0	1

Thus, for a computer, letter 'A' in C means _____.

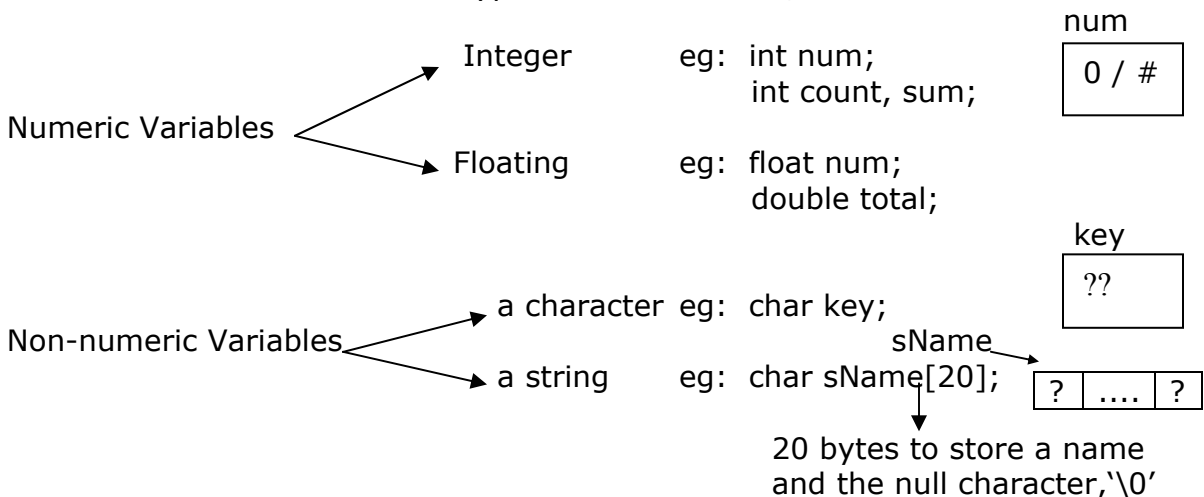
Common Data Types

Data	Type Name	Bytes	Range
• _____	int	2	-2.1 million to 2.1million
• Floating	float	4	3.4E±38 (7 digits)
	double	8	1.7E±308 (15 digits)
• Character	char	1	-128 to 127
• No data	void	-	-

2.2 Variable Declarations

Variables refer to memory locations that are assigned with names or identifiers.

Declaration format: *DataType* *VariableName*;



A compound statement refers to a block of statements within a pair of braces { }. It can consist of expression, compound or/and control statements. For example:

```

{
    total = 2+3;
    printf("%d",total);
}

```

A control statement is a statement that consists of conditional test and decision/loop. For example: if (score > 80)
printf("You get an A\n");

2.4 Constants and Symbolic Constants

Constants

- Are specific values, such as 2, 3.1416, 'a' or "hello".

Symbolic Constants (Constant Variables)

- A pre-processor directive that assigns an identifier to the constant.
- Once defined, the constant value is available to be used anywhere in a C program.

Format for a symbolic constant:

```

#define PI 3.1416           //assign value _____ to variable PI
area = PI * radius * radius ; // here the compiler will treat PI as its value.

```

Note that:

- To distinguish ordinary variables with constant variables, advisable to utilize all letters in uppercase.
- If there are more than one symbolic constants, separate directives are required.
- It does not end with semicolon

2.5 Assignment Statements

An assignment statement is a statement that consists of an assignment operator (=) with the left operand must be a variable and the right operand can be constant, variable or the result of an operation. Assignment statements may involve arithmetic operators, cast operator, and/or increment/decrement operators.

Format: Variable = expression;
For example: sum = 10.5;
value = 3 + sum;
character = 'a';

Arithmetic Operators available in C that can be part of expression are:

- + addition
- subtraction
- * multiplication
- / division
- % modulus (to compute the remainder of two integers)

Note that:

- An expression can involve values of different data types.
- If all operands are *int* type, then the result will be in *int* type.
For example: 18 / 5 will yields _____
- If any of the operand is *float* type or *double precision* type, then the result will be in *double precision* type.
For example: 18 / 5.0 will yields _____

Priority/Precedence of Arithmetic Operators

Precedence	Operator	Associativity
1	Parentheses: ()	Innermost First
2	Unary Operators: + -	Right to left
3	Binary Operators: * / %	Left to right
4	Binary Operators: + -	Left to right

Table 2.1 Precedence and Associativity of Arithmetic Operators

Example: Consider table 2.1 as guideline.

$$\begin{aligned}
 &a * b + b / c * d \\
 &= \frac{\quad}{\quad} \\
 &= (a * b) + (b / c) * d \\
 &= (a * b) + ((b / c) * d) \\
 &= ((a * b) + ((b / c) * d))
 \end{aligned}$$

Cast Operator

A unary operator that allows changing values of data types.

Example: int b = 6;
 float a, c = 18.6;
 a = (int) c / b;

In the example above, the cast is applied to c. Value of c in the third line is no longer 18.6 but _____.

Note that:

Cast operator affects only the value used in the computation. It does not change the value stored the variable.

Increment and Decrement Operators

Prefix

- Unary operator that applies before identifier, ++count or -count.

Postfix

- Unary operator that applies after identifier, count++ or count--.

If an increment or decrement operator is used by itself, it is equivalent to an assignment that increments or decrements the variable.

Example: `y--;` is equivalent to the statement `y= y-1;`

Prefix in an Expression

Increment or decrement by 1 and use the new value in the expression.

```
count = 2;
num = 10;
++count;
num = ++count;
printf("%d", ++count);
```

count
2
3
4
5

num
10
4

output:
5

Postfix in an Expression

Use current value in expression and then increment or decrement by 1.

```
count = 2;
num = 10;
count++;
num = count++;
printf("%d", count++);
```

count
2
3
4
5

num
10
3

output:
4

Abbreviated Assignment Operators

Example: `x = x + 3` equivalent with `x += 3`
`y = y * 2` equivalent with `y *= 2`
`r = r %2` equivalent with _____

Precedence of Arithmetic and Assignment Operators

Precedence	Operator	Associativity
1	Parentheses: ()	Innermost First
2	Unary Operators: + -	Right to left
3	Binary Operators: * / %	Left to right
4	Binary Operators: + -	Left to right
5	Assignment Operators: = += -= *= /= %=	Right to left

Table 2.2 Precedence of Arithmetic and Assignment Operators

Example: Use Table 2.2 as guideline

```
a = b += c + d;
a = b += (c + d);
a =( b += (c + d));
```

2.6 Standard Input and Output

printf Function

printf function allows to print values and text to the computer screen monitor. It consists of control string and arguments.

Format:

```
printf(control string , argument);
```

- A control string is text, conversion specifiers or both that is/are enclosed in a double quotation mark "".
- Arguments refer to data to be printed. It comprises of variables, constants, and/or expressions. A comma is used to separate between two arguments.

To print pure message:

```
printf("Assalamualaikum\n");
```

output:

```
Assalamualaikum
Press any key to continue
```

To print integers:

```
printf("%d ",20);
num = 10;
printf("%d + %d = %d\n", num, 20, num+20);
printf("%10d\n%-10d?", num+20, num+20);
```

num output:

```
10
```

```
20 10 + 20 = 30
          30
30      ?
Press any key to continue
```

%10d – 10 position written from the right (right justification).

%-10d – 10 position written from the left (left justification).

To print floating numbers:

```
printf("%f ",20.0);
num = 10.5;
printf("%f + %d = %f\n", num, 20, num+20);
printf("%15f\n%-15f?\n", num+20, num+20);
printf("%10.2f %0.3f\n", 20.75, num);
```


<code>\v</code>	vertical tab
<code>\\</code>	backslash
<code>\?</code>	question mark
<code>\'</code>	single quote
<code>\"</code>	double quote

scanf Function

scanf function allows users to enter values from keyboard.

Format: `scanf(control string, &arguments);`

How to use `scanf()` for different data types?

- `int inum;`
`scanf("%d", &inum);`
- `float fnum;`
`scanf("%f", &fnum);`
- `double dnum;`
`scanf("%lf", &dnum);`
- `char ckey;`
`scanf("%c", &ckey);`
- `char sname[20];`
`scanf("%s", sname);`

Note that it is a common mistake done by students to forget writing address operator (&) before arguments.

scanf() function returns the integer number that is equal to the number of successful conversions.

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

Assuming user enters 30.

Since 30 can be converted as an integer, `scanf()` will have value 1.

Assuming user enters 30.9,

30 is considered as an integer whereas .9 is left for next user input, `scanf()` will have value ____.

Example: `scanf ("%d %c %f", &num1, &key, &distance);`

Assuming user enters 30, 'A', 90.8.

Since 30 can be converted as an integer, 'A' can be converted as a character, and 90.8 can be converted as a float number, `scanf()` will have value _____.

Assuming user enters 'A', 12.4.

Since 'A' cannot be converted as an integer, `scanf()` will have value 0. Execution for the whole statement is ignored.

IN CLASS TUTORIAL

1. Assume $a = 1$, $b = 50$, $c = 10$ and $d = 5$, evaluate the following expressions:
 - a) $c/d + 3$ _____
 - b) $b - 3 * c + 4 * a$ _____
 - c) $18 \% d + 1$ _____

2. Write the declaration statements for the following data:
 - a) the average of four grades

 - b) the number of days in a month

 - c) the length of the Penang Bridge

 - d) the numbers in a stadium's seat

 - e) the distance from KL to JB

 - f) the 3-letter code for a cat

3. Given in ASCII code, value 65 is for 'A' and end value 90 for 'Z'. Similarly, value 97 for 'a' and end value 122 for 'z'. Determine the character value for expressions: 'A' + 32 and 'a' - 'A'.

4. Determine the output of the following program.

```
#include <stdio.h>
int main( )
{
    printf("answer1 is %d", 27/5);
    printf("\nanswer2 is %d", 16%6);
}
```

output:

5. If a human heart beats on the average of once a second, how many times does the heart beat in a lifetime of 78 years? (Use 365.25 for days in a year). Write a program to count the number of heart beat.

6. Subang Jaya City Planners propose that a community develop a new water supply by replacing all the community's toilets with low-flush models that use only 2 liters per flush. Assume that there is about 1 toilet for every 3 persons, that existing toilets use an average of 15 liters per flush, that a toilet is flushed on average 14 times per day, and that the cost to install each new toilet is RM100. Write a program that would estimate the magnitude of the water saved (liters/day) and the cost of this new water supply based on 10000 community's population.