

Introduction to C Programming

Basics of Programming (2) : Variables • Standard Input/Output (2)

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Today's topics

- How to use variables.
 - double type
- Calculation of mixed data types (int type and double type)
- How to display values of double data type
- How to read values of double data type from the keyboard
- How to use cast operator

Basics of Programming(1) Example(4):

Example(4): reads 3 integers, displays their summation and average

- For example:

Input three integers:

a: 15 【Enter】

b: 23 【Enter】

c: 32 【Enter】

Sum is 70, Average is 23.3.

- Division of int/int is truncated (any fractional part is discarded).
 - ⇒ The double data type is needed.
 - ⇒ Let's use the double data.

Basics of Programming(1) Example(4)

sumave.c

```
#include <stdio.h>
int main(void){
    double a, b, c, Sum, Ave;           /*Declare variables*/
    printf("Input three integers:\n");   /*Output*/
    printf("a:");                        /*Input*/
    scanf("%lf",&a);
    printf("b:");
    scanf("%lf",&b);
    printf("c:");
    scanf("%lf",&c);
    q
    Sum = a + b + c;                     /*Calculation, assignment*/
    Ave = Sum/3;

    printf("Sum is %.0f, Average is %.1f.\n",Sum, Ave);
    return 0;
}
```

Output (double)

printf(): Output routine

- Output variables

```
printf(" Sum is %.0f, Average is %.1f.\n", Sum, Ave);
```

- Output double data type (**Sum, Ave**)
- Use "%f" for double data type
- %.0f print the value without fractional part.
- %.1f print the value with 1 digit after the decimal point .
- For example, %9.2f print the value at least 9 numbers with 2 digit after the decimal point.

Input (double)

scanf(): Input routine

- Input values and characters

```
scanf("%lf",&a);
```

- Input a number to (the double data type) variable **a** from keyboard
- scanf assign the inputted value to the variable according to conversion specification. Conversion specification of double is "**%lf**"
Note that "**%lf**" is not "1 (one) f"
- Write "**&**" before the variable.

double data type

double

- Precision of double data type is about 15 digits. can memory an approximate value of 15 decimal. It is not a correct value.
 - Computers deal with binary (base 2) numbers, for example: 10101110
 - It is approximated value if a binary number is (within 52 digits) not express
 - For example: $0.25=0.01_{(2)}$, $0.1=0.000110\cdots_{(2)}$.

Implicit type conversion

- ```
int a;
double x = 3.14;
a = x; /*Conversion to left hand side data type*/
```
- Fractional part is truncated in order to convert double data type to int data type.

- Example:

```
#include <stdio.h>

int main(void) {
 int a;
 double x = 3.14;
 a = x;
 printf("a=%d\n", a);
 return 0;
}
```

- Results

```
[~/work] $ gcc cast1.c
[~/work] $./a.out
a=3
```

# Implicit type conversion

- In the case of calculation of mixed data type (int and double), int data type is converted to double data type.

$\text{char} < \text{int} < \text{double}$

- Example

```
#include <stdio.h>

int main(void) {
 int a=175, b=100;
 double x = 100.0;
 printf("a/b=%d¥n", a/b);
 printf("a/x=%f¥n", a/x);
 return 0;
}
```

- Results

```
[~/work] $ gcc cast2.c
[~/work] $./a.out
a/b=1
a/x=1.75
```

# Explicit cast (cast operator)

## Remark on division

- $\text{int} = \text{int} / \text{int}$   
 $2 = 5/2$
- $\text{double} = \text{double} / \text{double}$   
 $2.5 = 5.0/2.0$
- Cast operator converts a variable from int type data to double type data.

$2.5 = (\text{double}) 5/2$        $/*$  (Cast operator) equality  $*/$

## Example by using cast operator

```
cast3.c
#include <stdio.h>
int main(void){
 int a=10, b=4;
 double c, d;
 c = a/b;
 d =(double) a/b;
 printf("a/b=%d, c=%f, d=%f\n", a/b, c, d);
 return 0;
}
```

### Results

- [~/work] \$ gcc cast3.c
- [~/work] \$ ./a.out
- a/b=2, c=2.000000, d=2.500000

- **a/b** becomes int data type.
- **c** holds 2.000000 because  $2 = \mathbf{a/b}$  (int/int)

# Summary

- How to use variables.
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- How to display values of double data type
- How to read values of double data type from the keyboard
- How to use cast operator