Operators And Expression

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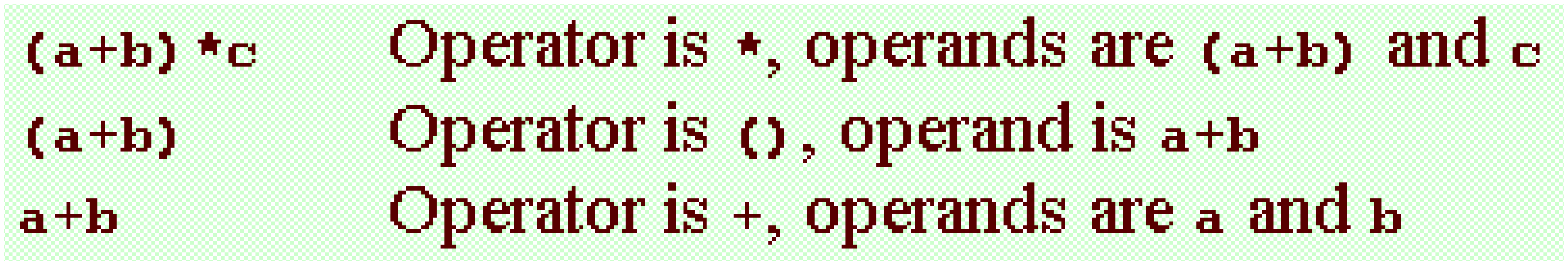
Operators and Expressions

- Consider the expression **A + B * 5** , where,
  - **+** , * are **operators**,
  - A, B are **variables**,
  - 5 is **constant**,
  - A, B and 5 are called **operand**, and
  - A + B * 5 is an **expression**.



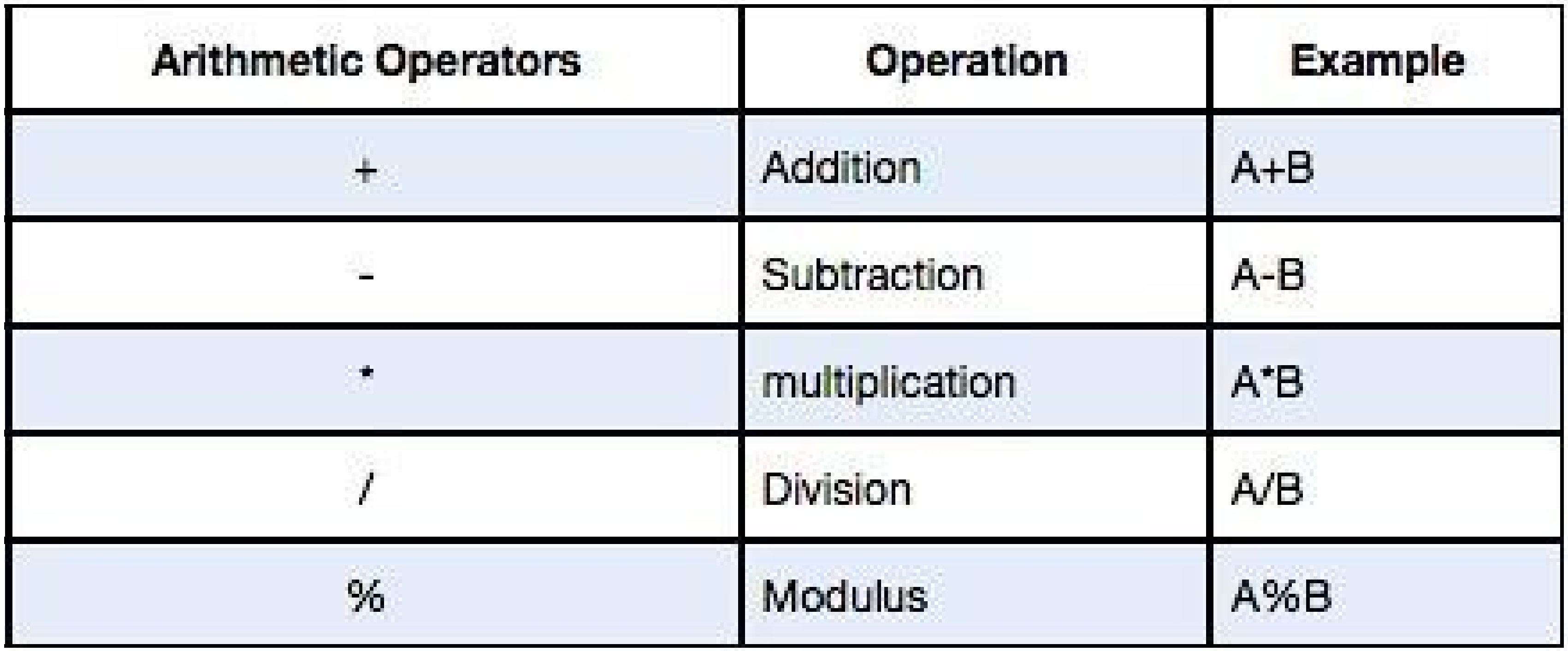
`(a+b)*c`	Operator is `*`, operands are `(a+b)` and `c`
`(a+b)`	Operator is `()`, operand is `a+b`
`a+b`	Operator is `+`, operands are `a` and `b`

Types of C operators

- C language offers many types of operators, such as:
  - Arithmetic operators
  - Assignment operators
  - Increment/decrement operators
  - Relational operators
  - Logical operators
  - Bit wise operators
  - Conditional operators (ternary operators)
  - Special operators

Arithmetic Operators

- C Arithmetic operators are used to perform mathematical calculations like addition, subtraction, multiplication, division and modulus in C programs.



Arithmetic Operators	Operation	Example
+	Addition	A+B
-	Subtraction	A-B
*	multiplication	A*B
/	Division	A/B
%	Modulus	A%B

Arithmetic Operators

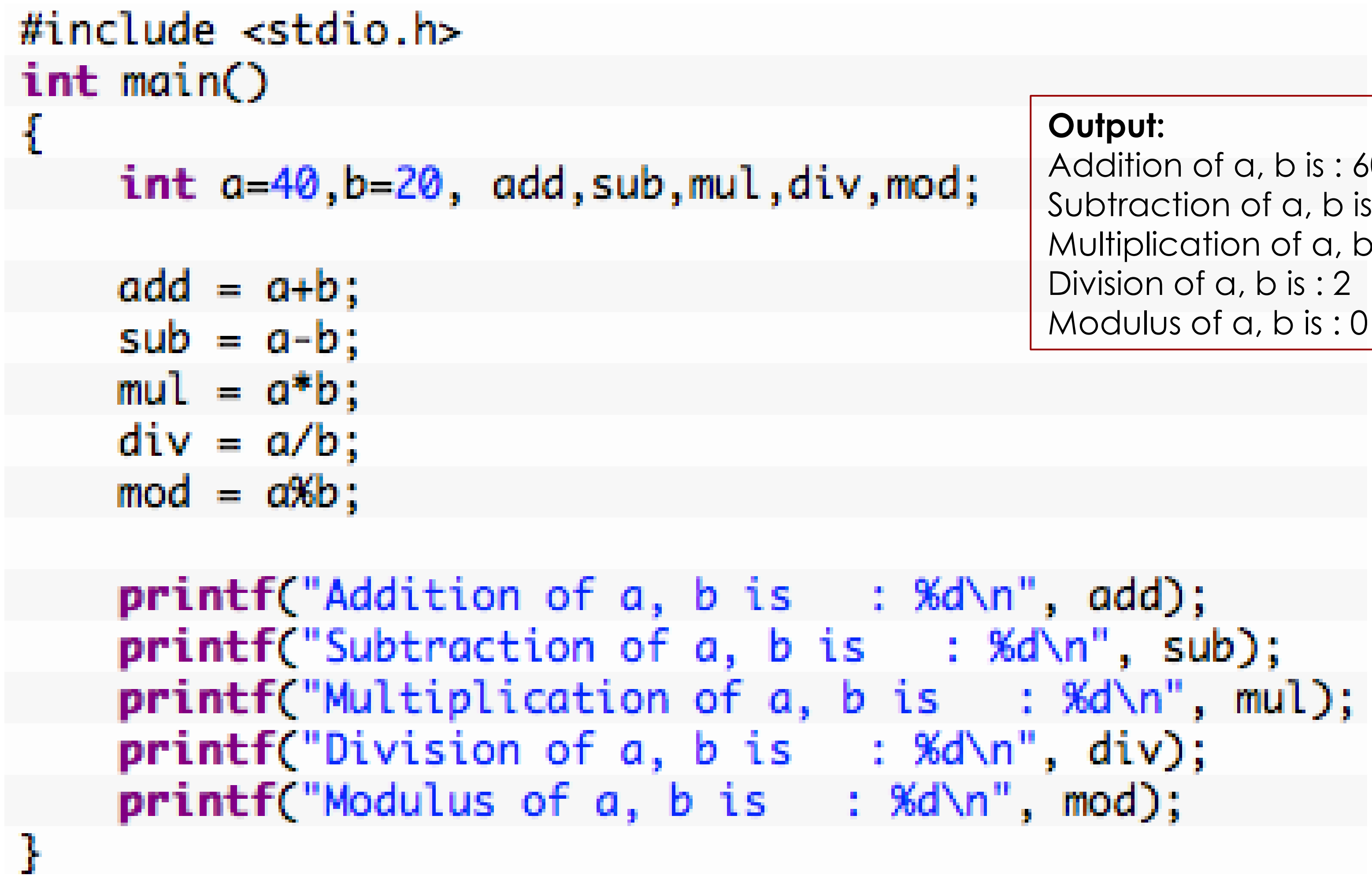
- There are three types of arithmetic operations using arithmetic operators:
  1. **Integer arithmetic :** when all operands are integer. If a=15 , b=10,
     - a + b =25
     - a / b =1 (decimal part)
     - a % b =5 (remainder of division)
  2. **Real arithmetic :** All operands are only real number. If a=15.0 , b=10.0
     - a / b = 1.5
  3. **Mixed model arithmetic :** when one operand is real and another is integer. If a=15 and b= 10.0
     - a / b = 1.5 whereas, 15/10=1
- Note: The modulus operator % gives you the remainder when two integers are divided: 1 % 2 is 1 and 7 % 4 is 3.
- The modulus operator can only be applied to integers.

Arithmetic Operators

1. **Integer arithmetic :**
   - When an arithmetic operation is performed on two whole numbers or integers than such an operation is called as integer arithmetic.
   - It always gives an integer as the result.
   - Let x = 27 and y = 5 be 2 integer numbers. Then the integer operation leads to the following results.
     - x + y = 32
     - x – y = 22
     - x * y = 115
     - x % y = 2
     - x / y = 5

Example program for C arithmetic operators

Arithmetic operators
Assignment operators
Inc/dec operators
Relational operators
Logical operators
Bit wise operators
Conditional operators
Special operators



```c
#include <stdio.h>
int main()
{
    int a=40,b=20, add,sub,mul,div,mod;

    add = a+b;
    sub = a-b;
    mul = a*b;
    div = a/b;
    mod = a%b;

    printf("Addition of a, b is   : %d\n", add);
    printf("Subtraction of a, b is   : %d\n", sub);
    printf("Multiplication of a, b is   : %d\n", mul);
    printf("Division of a, b is   : %d\n", div);
    printf("Modulus of a, b is   : %d\n", mod);
}
```

Output:

```
Addition of a, b is : 60
Subtraction of a, b is : 20
Multiplication of a, b is : 800
Division of a, b is : 2
Modulus of a, b is : 0
```

Arithmetic Operators

2. Real arithmetic :

- When an arithmetic operation is preformed on two real numbers or fraction numbers such an operation is called real or floating point arithmetic.
- The modulus (remainder) operator is not applicable for floating point arithmetic operands.
- Let x = 14.0 and y = 4.0 then
  - x + y = 18.0
  - x – y = 10.0
  - x * y = 56.0
  - x / y = 3.50

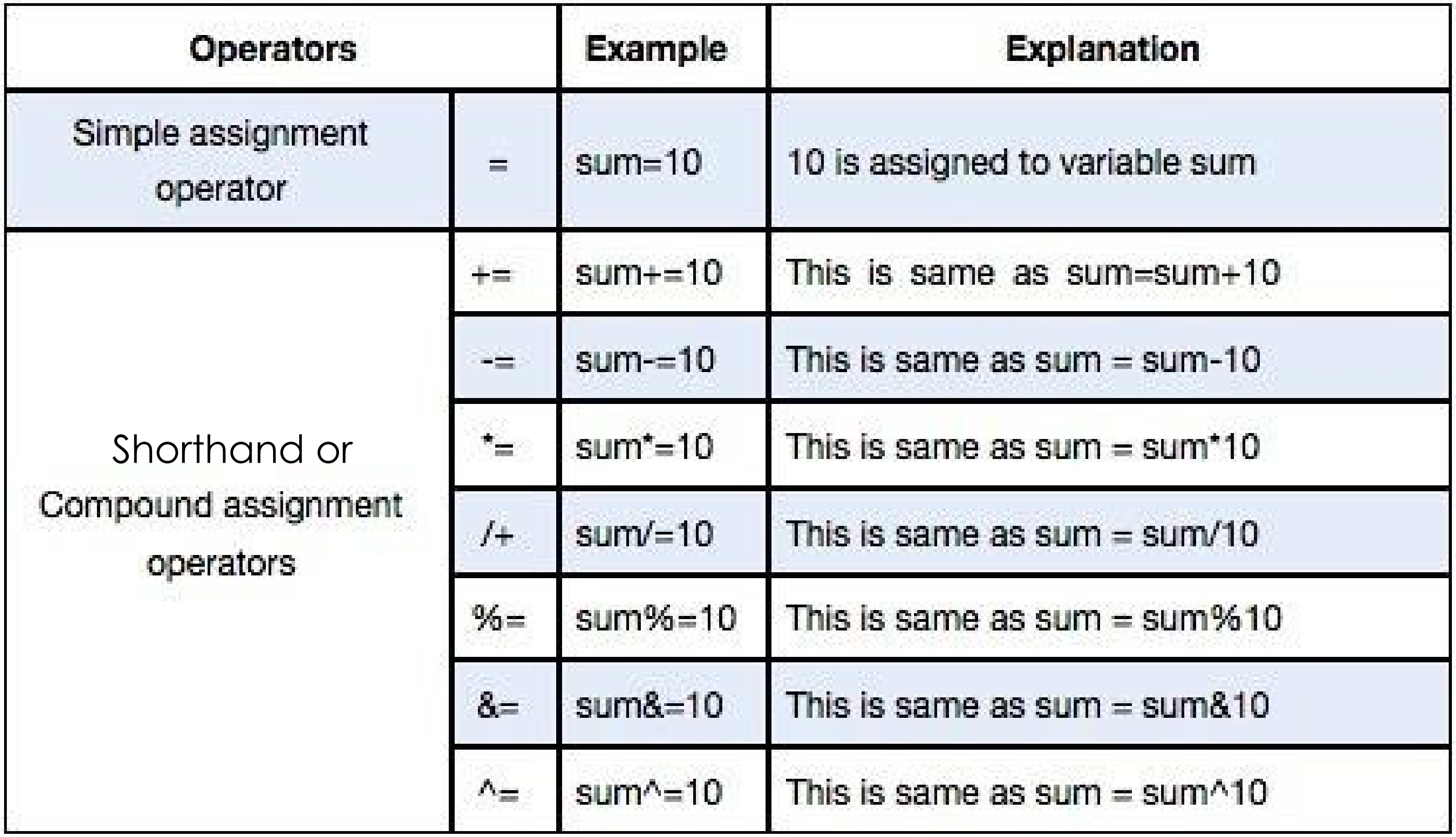
Arithmetic Operators

3. Mixed mode arithmetic :

- When one of the operand is real and other is an integer and if the arithmetic operation is carried out on these 2 operands then it is called as mixed mode arithmetic.
- If any one operand is of real type then the result will always be real
- Let x = 15 and y = 10.0 then
  - x / y = 1.5
- Note that: 15 / 10 = 1 (since both of the operands are integer)

Assignment Operators

- In C programs, values for the variables are assigned using assignment operators.
- For example, if the value “10” is to be assigned for the variable “sum”, it can be assigned as **sum = 10;**



Operators		Example	Explanation
Simple assignment operator	=	sum=10	10 is assigned to variable sum
Shorthand or Compound assignment operators	+=	sum+=10	This is same as sum=sum+10
	-=	sum-=10	This is same as sum = sum-10
	*=	sum*=10	This is same as sum = sum*10
	/+	sum/=10	This is same as sum = sum/10
	%=	sum%=10	This is same as sum = sum%10
	&=	sum&=10	This is same as sum = sum&10
	^=	sum^=10	This is same as sum = sum^10

Increment and Decrement Operators

Arithmetic operators
Assignment operators
Inc/dec operators
Relational operators
Logical operators
Bit wise operators
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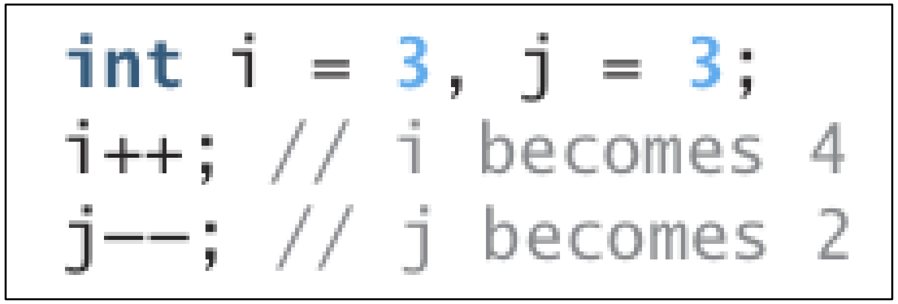
Special operators

- There are two more shorthand operators:
  - Increment ++
  - Decrement - -
- These two operators are for incrementing and decrementing a variable by 1.
- For example, the following code increments *i* by 1 and decrements *j* by 1.



```
int i = 3, j = 3;
i++; // i becomes 4
j--; // j becomes 2
```

Increment and Decrement Operators

- The ++ and - - operators can be used in **prefix** or **suffix** mode, as shown in Table

Operator	*Name*	*Description*	*Example (assume i = 1)*
`++var`	preincrement	Increment `var` by `1` and use the new `var` value	`int j = ++i; // j is 2, // i is 2`
`var++`	postincrement	Increment `var` by `1`, but use the original `var` value	`int j = i++; // j is 1, // i is 2`
`--var`	predecrement	Decrement `var` by `1` and use the new `var` value	`int j = --i; // j is 0, // i is 0`
`var--`	postdecrement	Decrement `var` by `1` and use the original `var` value	`int j = ++i; // j is 1, // i is 0`

Increment and Decrement Operators

- If the operator is *before* (prefixed to) the variable, the variable is incremented or decremented by 1, then the *new* value of the variable is returned.
- If the operator is *after* (suffixed to) the variable, then the variable is incremented or decremented by 1, but the original *old* value of the variable is returned.
- Therefore, the prefixes ++x and --x are referred to, respectively, as the *preincrement* operator and the *predecrement* operator; and the suffixes x++ and x -- are referred to, respectively, as the *postincrement* operator and the *postdecrement* operator.

Increment and Decrement Operators

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The prefix form of ++ (or --) and the suffix form of ++ (or --) are the same if they are used in isolation, but they cause different effects when used in an expression. The following code illustrates this:

```
int i = 10;
int newNum = 10 * i++;
```

Same effect as

```
int newNum = 10 * i;
i = i + 1;
```

In this case, i is incremented by 1, then the *old* value of i is returned and used in the multiplication. So newNum becomes **100**. If i++ is replaced by ++i as follows,

```
int i = 10;
int newNum = 10 * (++i);
```

Same effect as

```
i = i + 1;
int newNum = 10 * i;
```

i is incremented by 1, and the new value of i is returned and used in the multiplication. Thus newNum becomes **110**.

Exercise on ++ and - -

- int x=2 , y = 5;

1. x++ ; y++ ;
2. x=y++ + x++;
3. y=++y + ++x;
4. y=++y + x++;
5. y += ++y;
6. y += 1 + (++x);
7. y += 2 + x++;

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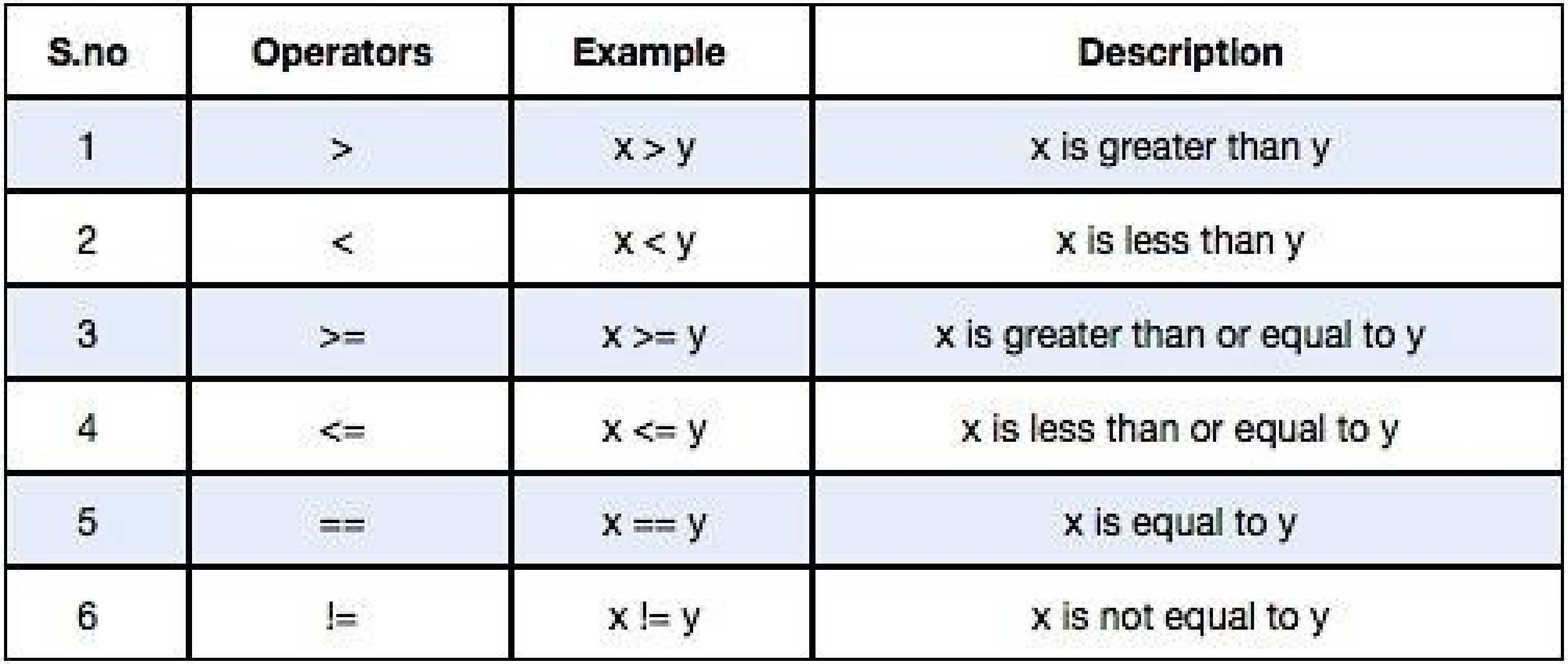
Relational Operators

- Relational operators are used to find the relation between two variables. i.e. to compare the values of two variables.



S.no	Operators	Example	Description
1	>	x > y	x is greater than y
2	<	x < y	x is less than y
3	>=	x >= y	x is greater than or equal to y
4	<=	x <= y	x is less than or equal to y
5	==	x == y	x is equal to y
6	!=	x != y	x is not equal to y

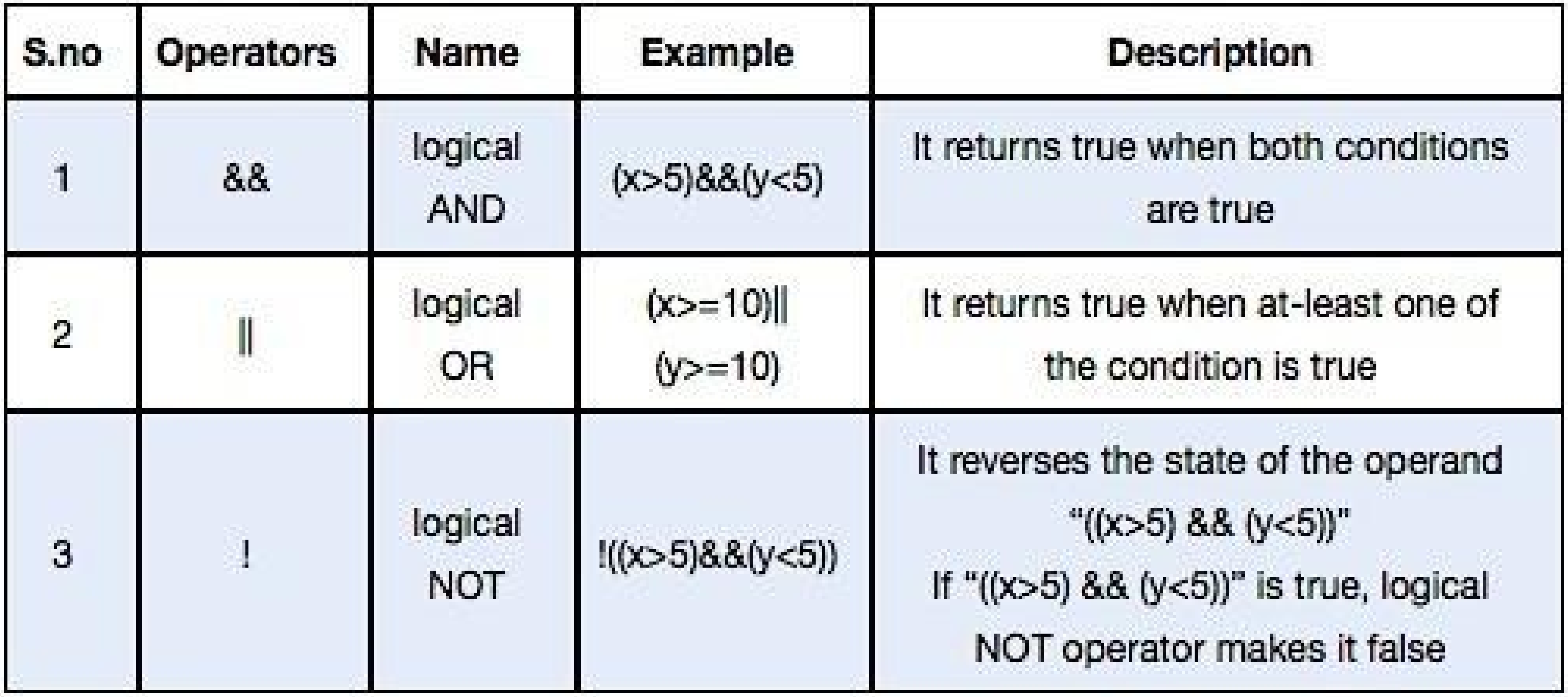
Exercise

- int i=10, j=20, k=30;
- float f=5.5;
- char ch='A';

1) i < j
2) (j+k)>=(i+k)
3) i+f <=10
4) i+(f <=10)
5) ch==65
6) ch >= 10*(i+f)

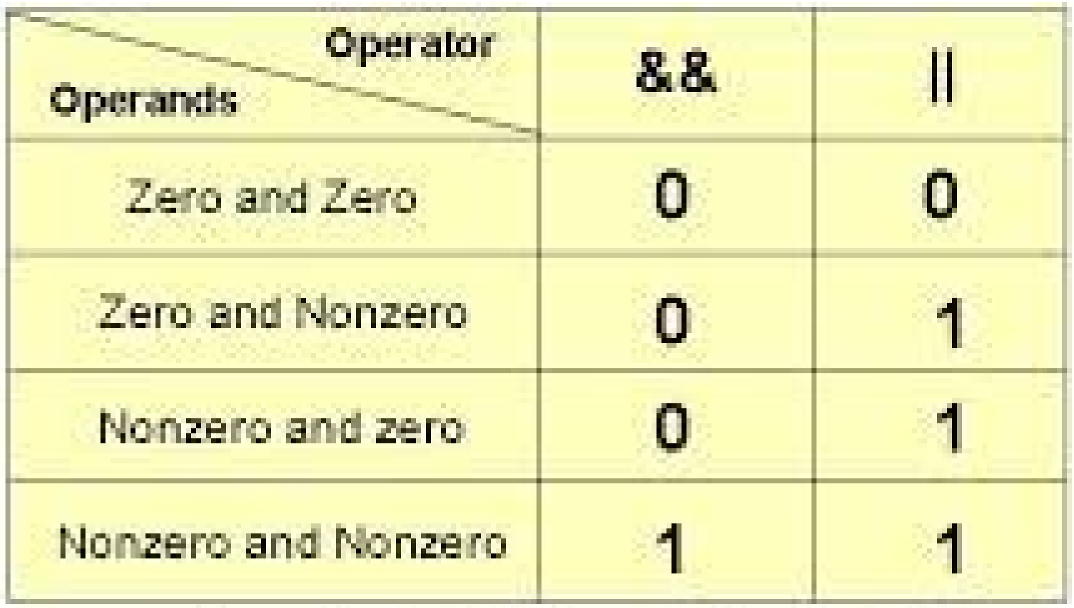
Logical Operators

- These operators are used to perform logical operations on the given expressions.
- There are 3 logical operators in C language. They are, logical AND (&&), logical OR (| |) and logical NOT (!).



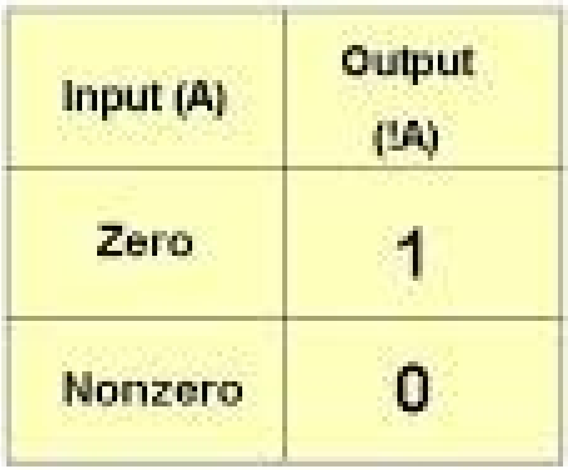
S.no	Operators	Name	Example	Description
1	&&	logical AND	(x>5)&&(y<5)	It returns true when both conditions are true
2	||	logical OR	(x>=10)||(y>=10)	It returns true when at-least one of the condition is true
3	!	logical NOT	!((x>5)&&(y<5))	It reverses the state of the operand "((x>5) && (y<5))" If "((x>5) && (y<5))" is true, logical NOT operator makes it false

Logical Operators



Operator Operands	&&	||
Zero and Zero	0	0
Zero and Nonzero	0	1
Nonzero and zero	0	1
Nonzero and Nonzero	1	1

Logical AND & Logical OR



Input (A)	Output (!A)
Zero	1
Nonzero	0

Logical NOT

Exercise

- Given that: int a = 5, b = 2, c = 4, d = 6,, e = 3 ;
  What is the result of each of the following relational expressions?

1. a > b
2. a != b
3. d % b == c % b
4. a * c != d * b
5. d * b == c * e
6. a * b < a % b * c
7. c % b * a == b % c * a
8. b % c * a != a * b
9. d % b * c > 5 | | c % b * d < 7
10. d % b * c > 5 && c % b * d < 7

Exercise

- For each of the following statements, assign variable names for the unknowns and rewrite the statements as relational expressions.

  1. A customer's age is 65 or more.
  2. The temperature is less than 0 degrees and greater than -15 degrees.
  3. A person's height is in between 5.8 to 6 feet.
  4. The current month is 12 (December).
  5. The person's age is 65 or more but less than 100.
  6. A number is evenly divided by 4 or 400 but not with 100
  7. A person is older than 55 or has been at the company for more than 25 years.
  8. A width of a wall is less than 4 meters but more than 3 meters.
  9. An employee's department number is less than 500 but greater than 1, and they've been at the company more than 25 years.

Example program for logical operators in C

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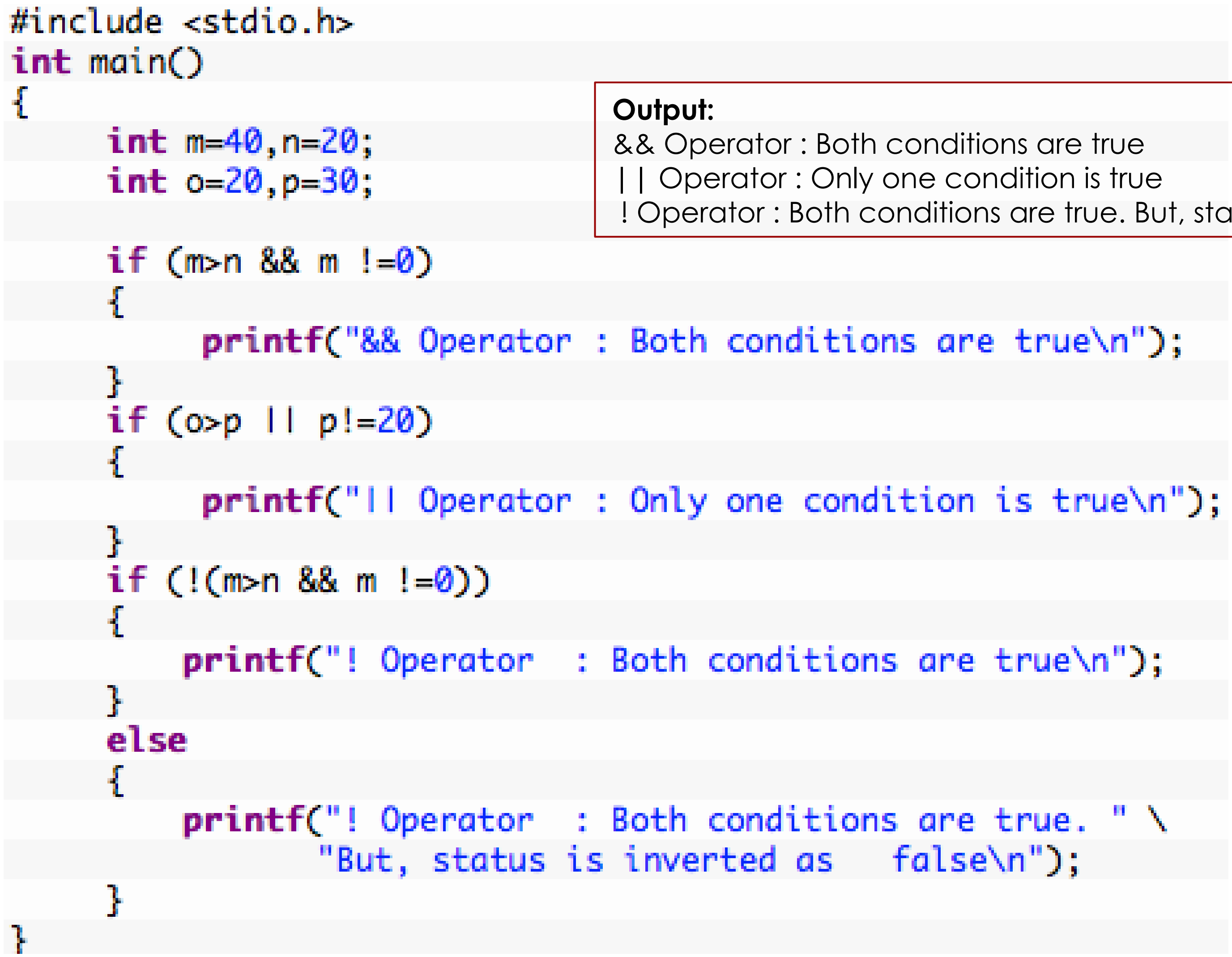


```c
#include <stdio.h>
int main()
{
     int m=40,n=20;
     int o=20,p=30;

     if (m>n && m !=0)
     {
          printf("&& Operator : Both conditions are true\n");
     }
     if (o>p || p!=20)
     {
          printf("|| Operator : Only one condition is true\n");
     }
     if (!(m>n && m !=0))
     {
         printf("! Operator  : Both conditions are true\n");
     }
     else
     {
         printf("! Operator  : Both conditions are true. " \
                "But, status is inverted as   false\n");
     }
}
```

Output:

```
&& Operator : Both conditions are true
|| Operator : Only one condition is true
! Operator : Both conditions are true. But, status is inverted as false
```

Try this example program and explain the results

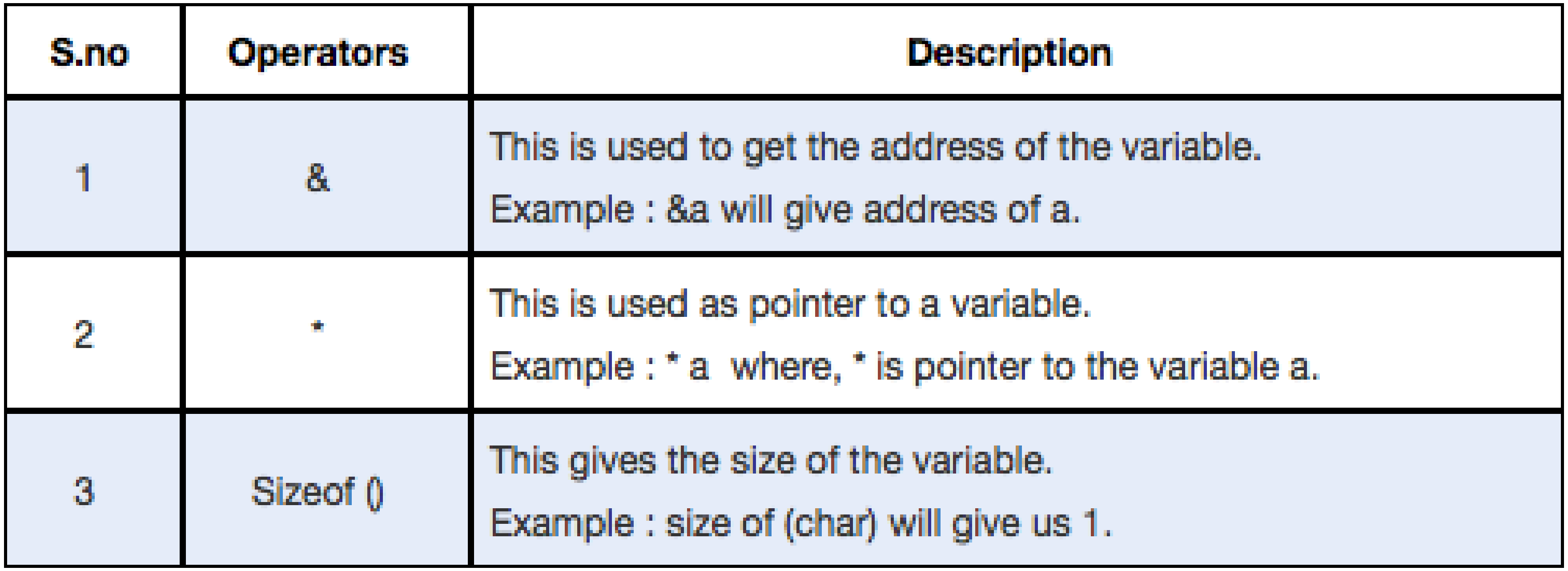
```c
#include<stdio.h>
int main()
{
 int a=5, b=-7, c=0, d;
 d = ++a && ++b || ++c;
 printf("\n %d %d %d %d",a,b,c,d);
}
```

Bit wise Operators

- One of C's powerful features is a set of bit manipulation operators. These permit the programmer to access and manipulate individual bits within a piece of data to perform bit operations. The various Bitwise Operators available in C are shown in Figure
- Decimal values are converted into binary values which are the sequence of bits and bit wise operators work on these bits.
- These operators can operate upon **int**s and **char**s but not on **float**s and **double**s.

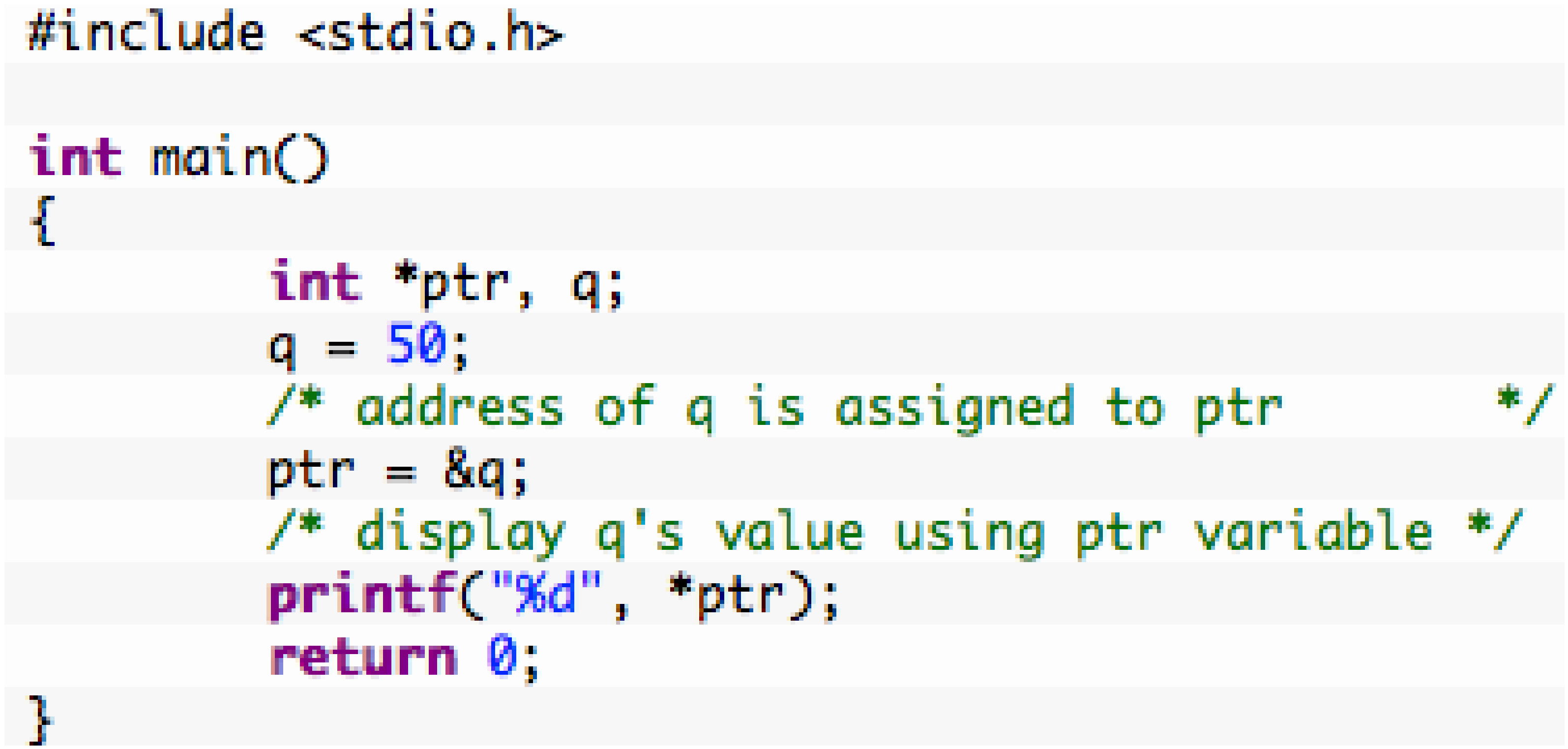
Operator	**Meaning**
~	One's complement
>>	Right shift
<<	Left shift
&	Bitwise AND
|	Bitwise OR
^	Bitwise XOR(Exclusive OR)

Special Operators



S.no	Operators	Description
1	&	This is used to get the address of the variable. Example : &a will give address of a.
2	*	This is used as pointer to a variable. Example : * a where, * is pointer to the variable a.
3	Sizeof ()	This gives the size of the variable. Example : size of (char) will give us 1.

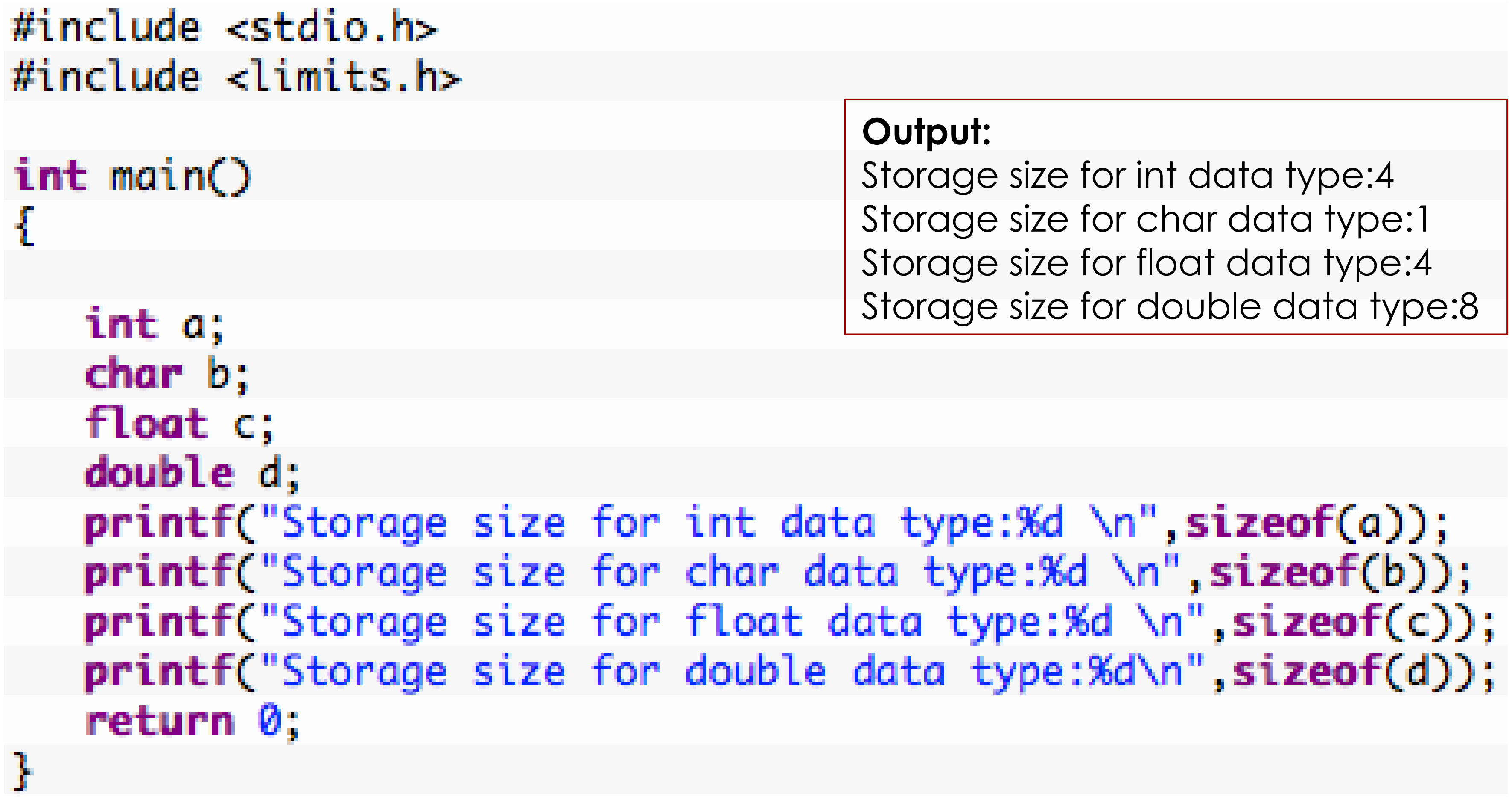
Example program for Special operators in C



```c
#include <stdio.h>

int main()
{
        int *ptr, q;
        q = 50;
        /* address of q is assigned to ptr       */
        ptr = &q;
        /* display q's value using ptr variable */
        printf("%d", *ptr);
        return 0;
}
```

Example program for sizeof() operator in C



```c
#include <stdio.h>
#include <limits.h>

int main()
{

    int a;
    char b;
    float c;
    double d;
    printf("Storage size for int data type:%d \n",sizeof(a));
    printf("Storage size for char data type:%d \n",sizeof(b));
    printf("Storage size for float data type:%d \n",sizeof(c));
    printf("Storage size for double data type:%d\n",sizeof(d));
    return 0;
}
```

Output:

```
Storage size for int data type:4
Storage size for char data type:1
Storage size for float data type:4
Storage size for double data type:8
```