

601.220 Intermediate Programming

Control flow

Outline

- logical operators
- conditionals (`if` and `switch`)
- assignment and unary operators
- loops
- exercise 2-1

Logical operators

Logical Operators

Following table shows all the logical operators supported by C language. Assume variable **A** holds 1 and variable **B** holds 0, then –

Show Examples 

Operator	Description	Example
&&	Called Logical AND operator. If both the operands are non-zero, then the condition becomes true.	(A && B) is false.
	Called Logical OR Operator. If any of the two operands is non-zero, then the condition becomes true.	(A B) is true.
!	Called Logical NOT Operator. It is used to reverse the logical state of its operand. If a condition is true, then Logical NOT operator will make it false.	!(A && B) is true.

https://www.tutorialspoint.com/cprogramming/c_operators.htm

Logical operators example

```
// logical_op.c:
#include <stdio.h>
int main(void)
{
    int a = 5, b = 5, c = 10, result = 0;
    result = (a == b) && (c > b);
    printf("(a == b) && (c > b) equals to %d \n", result);
    result = (a == b) && (c < b);
    printf("(a == b) && (c < b) equals to %d \n", result);
    result = (a == b) || (c < b);
    printf("(a == b) || (c < b) equals to %d \n", result);
    result = (a != b) || (c < b);
    printf("(a != b) || (c < b) equals to %d \n", result);
    result = !(a != b);
    printf("!(a != b) equals to %d \n", result);
    result = !(a == b);
    printf("!(a == b) equals to %d \n", result);
}
```

```
$ gcc logical_op.c -std=c99 -pedantic -Wall -Wextra
```

```
$ ./a.out
```

```
(a == b) && (c > b) equals to 1
```

```
(a == b) && (c < b) equals to 0
```

```
(a == b) || (c < b) equals to 1
```

```
(a != b) || (c < b) equals to 0
```

```
!(a != b) equals to 1
```

```
!(a == b) equals to 0
```

Conditionals (if)

- Suppose `a` represents some boolean expression (that is, `a` can be interpreted as having either value `true` or value `false`).

```
if (a) printf("a is true\n");  
if (a) {  
    printf("a is true\n");  
}
```

```
if (a) {  
    printf("a is true\n");  
}  
else {  
    printf("a is false\n");  
}
```

```
a ? printf("a is true\n") : printf("a is false\n");
```

Conditionals (switch)

```
switch (integer expr) {  
  
    case c1: stmt1;  // execution starting point for c1  
    case c2: stmt2;  
                break; // exits switch block  
    case c3:  
    case c4: stmt3;  
                stmt4; // executes stmt3, stmt4 and  
                        // stmtlast for matches of c3 or c4  
    default: stmtlast; // if no case matches  
  
}
```

Switch statement example

```
// switch_example.c:
#include <stdio.h>

int main () {
    char grade = 'B';
    switch(grade) {
        case 'A' :
            printf("Excellent!\n");
            break;
        case 'B' :
        case 'C' :
            printf("Well done\n");
            break;
        case 'D' :
            printf("You passed\n");
            break;
        case 'F' :
            printf("Better try again\n");
            break;
        default :
            printf("Invalid grade\n");
    }
    printf("Your grade is  %c\n", grade);
}
```

```
$ gcc switch_example.c -std=c99 -pedantic -Wall -Wextra
```

```
$ ./a.out
```

```
Well done
```

```
Your grade is  B
```

Checkpoint Question!

What output is printed by the following C program if the user enters the input 42?

```
#include <stdio.h>
int main(void) {
    int x;
    printf("Enter an integer: ");
    scanf("%d", &x);
    switch (x) {
        case 1: printf("Ok\n");
                break;
        case 17: printf("Not bad\n");
                 break;
        case 42: printf("Great!\n");
        default: printf("Huh?\n");
    }
    return 0;
}
```

- A. Ok
- B. Not bad
- C. Great!
- D. Great! followed by Huh?
- E. Huh?

Compound assignments

Assignment operator	Sample expression	Explanation	Assigns
<i>Assume: int c = 3, d = 5, e = 4, f = 6, g = 12;</i>			
+=	c += 7	c = c + 7	10 to c
-=	d -= 4	d = d - 4	1 to d
*=	e *= 5	e = e * 5	20 to e
/=	f /= 3	f = f / 3	2 to f
%=	g %= 9	g = g % 9	3 to g

Fig. 3.11 | Arithmetic assignment operators.

Increment and decrement

Operator	Sample expression	Explanation
++	++a	Increment a by 1, then use the new value of a in the expression in which a resides.
++	a++	Use the current value of a in the expression in which a resides, then increment a by 1.
--	--b	Decrement b by 1, then use the new value of b in the expression in which b resides.
--	b--	Use the current value of b in the expression in which b resides, then decrement b by 1.

Fig. 3.12 | Increment and decrement operators

Loop summary

- `while(boolean expression) { statements }`
 - Iterates ≥ 0 times, as long as expression is true
- `do { statements } while(boolean expression);`
 - Iterates ≥ 1 times; always once, then more times as long as expression is true
- `for(initialize; boolean exp; update) { stmts }`
 - initialize happens first; usually declares & assigns “index variable”
 - Iterates ≥ 0 times, as long as boolean expression is true
 - Right after stmts, update is run; often it increments the index variable (`i++`)
- `break` immediately exits loop
- `continue` immediately proceeds to next iteration of loop

An example for loop

```
// for_example.c:
#include <stdio.h>
int main(void) {
    for(int i = 0; i < 10; i++) {
        printf("%d ", i);
    }
}
```

A question for you: why using `i++` but not `++i`? Which one is preferred?

Checkpoint Question!

What output is printed by the following C program?

```
#include <stdio.h>
int main(void) {
    for (int i = 1; i <= 10; i + 2) {
        printf("%d ", i);
    }
    return 0;
}
```

- A. 2 4 6 8
- B. 2 4 6 8 10
- C. 1 3 5 7
- D. 1 3 5 7 9
- E. None of the above

A loop that reads in values until no more are available

```
// sum.c:
#include <stdio.h>
int main(void) {
    int sum = 0;
    int addend; //addend's value is undefined to start
    //read as many integers as we can
    while (scanf("%d", &addend) == 1) {
        //accumulate the sum of all numbers
        sum += addend;
    }
    //output the sum
    printf("%d\n", sum);
    return 0;
}
```

This continues to scan even when you press enter. To signal end-of-input, press Ctrl-D (possibly twice).

Less desirable loop to read in input

```
// sum_less_clean.c:
#include <stdio.h>
int main(void) {
    int sum = 0;
    while (1) {
        int addend = 0;
        if (scanf("%d", &addend) != 1) {
            break; // immediately exit loop
        }
        sum += addend;
    }
    printf("%d\n", sum);
    return 0;
}
```

The loop on the previous slide is preferred, since the loop body is cleaner. The code is more easy to follow, and less prone to errors.

Exercise 2-1

- Find link for Exercise 2-1 on the course website and follow instructions there
- Read note about scanf and look up reference that's linked there!
- Ask for help ...