BIRZEIT UNIVERSITY

Chapter 4
Selection Structures: if and switch Statements

Computer Science Department

Control Structure

- Three kinds of control structures
  - Sequence structure
    - Programs executed sequentially by default
    - Statements executed in order
  - Selection structures
    - `If`
    - `if…else`
    - `switch`
  - Repetition structures
    - `While`
    - `do…while`
    - `for`

Control Structure

Before,

let us study:
1. **Relational and equality operators**
2. **Logical Operators**

Relational and equality operators

Four different forms:

1. Variable relational-operator Variable
2. Variable relational-operator Constant
3. Variable equality-operator Variable
4. Variable equality-operator Constant

Note:

You can use an expression instead of the variable or constant

Relational and equality operators

Operator	Meaning	Type
<	less than	relational
>	greater than	relational
<=	less than or equal to	relational
>=	greater than or equal to	relational
==	equal to	equality
!=	not equal to	equality

Logical Operators

- Three types of logical operators:

Operator	Meaning
&&	and
||	or
!	not

Operator Precedence

Operator	Precedence
function calls	highest
! + - & (unary operators)	
* / %	
+ -	
< <= >= >	
== !=	
&&	
||	
=	lowest

Example

double x=3.0 , y=4.0, z=2.0;

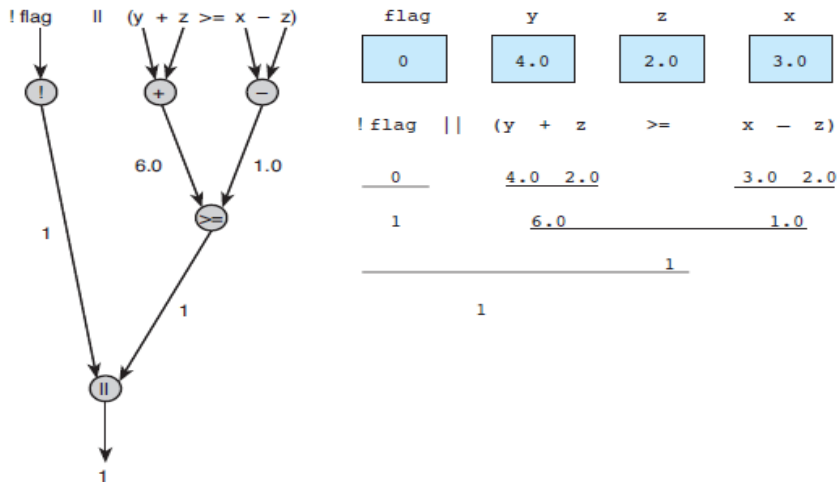
int flag=0;

- What is the value after applying the following expression:

! flag	→ !0 is 1 (true)
x + y / z <= 3.5	→ 5.0 <= 3.5 is 0 (false)
! flag || (y + z >= x - z)	→ 1 || 1 is 1 (true)
!(flag || (y + z >= x - z))	→ !(0 || 1) is 0 (false)

Example

Evaluation for !flag II (y + z >= x - z)



Example: How to convert an English condition into a logical expression

double x = 3.0 , y = 4.0 , z = 2.0 .

English Condition	Logical Expression	Evaluation
x and y are greater than z	x>z && y>z	1 && 1 is 1 (true)
x is equal to 1.0 or 3.0	x==1.0 || x==3.0	0 || 1 is 1 (true)
x is in the range z to y, inclusive	z<=x && x<=y	1 && 1 is 1 (true)
x is outside the range z to y	!(z<=x && x<=y) z>x || x>y	!(1 && 1) is 0 (false) 0 || 0 is 0 (false)

Example: **Comparing Characters**

Expression	Value
	1(true)
	1(true)
	0(false)
	0(false)
	system dependent (**false for ASCII**)
	1(true) if ch is a lowercase letter

Logical Assignment

```
1   #include <stdio.h>
2   #include <stdlib.h>
3
4   int main()
5   {
6       int age, senior;
7       scanf("%d",&age);
8       senior = (age >= 65);
9       printf("Senior Citizen = %d .\n",senior);
10      return 0;
11  }
12
```

```
66
Senior Citizen = 1 .
```

```
43
Senior Citizen = 0 .
```

(Assignment Shorthands)

Simple Assignment Operators	Compound Assignment Operators
x = x + 1;	x += 1;
x= x -1;	x -= 1;
x = x * y;	x *= y;
x= x / y;	x /= y;
n = n % (x+1);	n %= x+1;

Pre and Post-Increment

- ++x // Pre-increment x
- x++ // Post-increment x

Example (Pre-increment):

a = ++x * b; →

```
x = x + 1;
a = x * b;
```

Pre and Post-Increment

- ++x // Pre-increment x
- x++ // Post-increment x

Example (Post-increment):

a = x++ * b;→

```
a = x * b;
x = x + 1;
```

Examples

```
int a=2, b=3, c;
c = ++a * b++;

Find a,b,c ?
```

a=2	**b=3**	**c=**
a=3	**b=3**	**c=**
a=3	**b=3**	**c=9**
a=3	**b=4**	**c=9**

```
a = a + 1;
c = a * b;
b = b + 1;
```

a=3 , b=4, and c = 9

Examples

```
int a=2,b=3,c=0;
c += --a * b++;

Find a,b,c ?
```

a = a -1;
c = c + a * b
b = b + 1

a=1 , b=4, and c = 3

Examples

```
int a=4,b=3,c=20;
c /= ++a;
Find a, b, c ?
```

a = a + 1;
c = c / a;

a=5 , b=3, and c = 4

Examples

```
int a=2,b=3,c=4;
c *= ++a * b++;
Find a, b, c ?
```

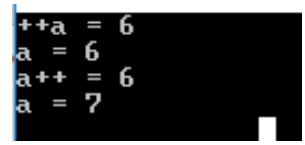
a=3 , b=4, and c = 36

Pre and Post-Increment- Example

```
#include <stdio.h>
#include <stdlib.h>

int main()
{
   int a = 5;
   printf("++a = %d \n",++a);
   printf("a = %d \n",a);
   printf("a++ = %d \n",a++);
   printf("a = %d \n\n",a);

   return 0;
}
```



If Statement

- If statement with **one alternative**

```
if (x!=0)
    product = product * x
```

- If statement with **two alternatives**

```
if (rest_heart_rate >56)
    printf("Your heart is in execellent health!\n");
else
    printf("Keep up your exercise program!\n");
```

if Statements with Compound Statements

```
if (condition)
{
        true action(s)
}
Else
{
        false action(s)
}
```

Examples

- Write a complete c program to find weather a given integer is odd or even.

```c
#include <stdio.h>
int main()
{
     int number;
     printf("Please enter a number");
     scanf("%d", &number);
     if (number%2==0)
        printf("Even Integer");
     else
        printf("Odd Integer");
     return 0;
}
```

Examples

- Write a complete c program to find weather a given integer is divisible by three.

```c
#include <stdio.h>
int main()
{
     int number;
     printf("Please enter a number");
     scanf("%d", &number);
     if (number%3==0)
        printf("Divisible by three");
     else
        printf("Does not divisible by three");
     return 0;
}
```

Multiple-Alternative Decisions

Nested if statement

an if statement with another if statement as its true task or its false task

```
if (x > 0)
        num_pos = num_pos + 1;     //Number of positive numbers
  else if (x < 0)
        num_neg = num_neg +1;    // Number of negative numbers
        else
              num_zero = num_zero +1;  // Number of zeros
```

Multiple-Alternative Decisions

```
#include <stdio.h>
int main()
{
      int number;
      printf("Please enter a number");
      scanf("%d",  &number);
      if  (number>0)
          printf("Positive");
      else if  (number<0)
          printf("Negative");
      else
          printf("Zero");
      return 0;
}
```

Example (if-else)

```c
#include <stdio.h>
int main()
{
    int x=0;
    if (x==1)
    {
        printf ("hello");
        printf  ("welcome");
    }
    else
    printf ("hi");
    return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int x=0;
    if (x==0)
    {
        printf ("hello");
        printf  ("welcome");
    }
    else
    printf ("hi");
    return 0;
}
```

Example (if, if-else)

```c
#include <stdio.h>
int main()
{
    int x=0;
    if (x==0)
    {
        printf ("hello");
        printf  ("welcome");
    }
    else
    {
        printf ("hi");
        printf  ("hi3");
    }
    return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int x=5;
    if (x<0)
      printf ("hello");
    printf  ("welcome");

    return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int x=5;
    if (x>0)
      printf ("hello");
    printf  ("welcome");
    return 0;
}
```

Example

```c
#include <stdio.h>
int main()
{
    int x=5;
    if (x=0)
      printf ("hello");
    printf  ("welcome");
   return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int y=0;
    if (y)
      printf ("hello");
    printf  ("welcome");
  return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int y=8;
    if (y)
      printf ("hello");
    printf  ("welcome");
  return 0;
}
```

```c
#include <stdio.h>
int main()
{
    int y=8,x=0;
    if (y || x)
      printf ("hello");
    printf  ("welcome");
  return 0;
}
```

Let us review the concepts:

1. If grade has the value of 60 , what will the following code display?

```
If (grade >= 60 )
     printf ("Passed");
```

a. nothing.
b. 60
c. Passed
d. printf("Passed“);

The switch Statement

- The switch statement selection is based on the value of a **single** variable or of a **simple** expression.
- Expression may be of type int or char, but not of type double or string.
- The ***multiple selection*** mechanism in C is the **switch** statement.

The switch Statement

Before,

let us Recall: **1.** Multiple Selection with if

2. Multiple Selection with if-else

Multiple Selection with if

```
if (day == 0 )
    printf ("Sunday") ;

if (day == 1 )
    printf ("Monday") ;

if (day == 2)
    printf ("Tuesday") ;

if (day == 3)
    printf ("Wednesday") ;
```

```
if (day == 4)
    printf ("Thursday") ;

if (day == 5)
    printf ("Friday") ;

if (day == 6)
    printf ("Saturday") ;

if ((day < 0) || (day > 6))
    printf("Error - invalid day.\n");
```

Multiple Selection with if-else

```
if (day == 0 ) {
    printf ("Sunday") ;
} else if (day == 1 ) {
    printf ("Monday") ;
} else if (day == 2) {  printf
    ("Tuesday") ;
} else if (day == 3) { printf
    ("Wednesday") ;
} else if (day == 4) {
    printf ("Thursday") ;
} else if (day == 5) {
    printf ("Friday") ;
} else if (day = 6) {
    printf ("Saturday") ;
} else {
    printf (“Error - invalid day.\n”) ;
}
```

This if-else structure is more efficient than the corresponding if structure.
Why?

The **switch** Multiple-Selection Structure

```
switch (expression)
{
    case value1:
        statement(s)
        break ;
    case value2:
        statement(s)
        break ;

        . . .
    default: :
        statement(s)
        break ;
}
```

Switch Statement Details

- The last statement of each case in the switch should almost always be a break.
- The break causes program control to jump to the **closing** brace of the switch structure.
- *Without the break*, the code flows into the next case. This is almost never what you want.
- A switch statement will compile without a default case, but always consider using one.

The **switch** Multiple-Selection Structure

```
switch ( day )
{
     case 0: printf ("Sunday\n") ;
              break ;
     case 1: printf ("Monday\n") ;
              break ;
     case 2:  printf ("Tuesday\n") ;
              break ;
     case 3: printf ("Wednesday\n") ;
              break ;
     case 4: printf ("Thursday\n") ;
              break ;
     case 5: printf ("Friday\n") ;
              break ;
     case 6:  printf ("Saturday\n") ;
              break ;
     default: printf ("Error -- invalid day.\n") ;
              break ;
}
```

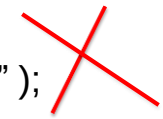
Why Use a switch Statement?

- A nested if-else structure is just as efficient as a switch statement.
- However, a switch statement may be easier to read.
- Also, it is easier to add new cases to a switch statement than to a nested if-else structure.

Common Programming Errors

The following if statement is true for all values of x!

```
if( 0 <= x <= 4)
    printf("Condition is true\n" );
```



Instead, use

```
if( 0 <= x && x <= 4)
```

The following always prints the same thing:

```
if ( x = 10 )
   printf( " x is 10\n" );
```

Common Programming Errors

```
If (x == 10)
        printf(" x is 10');
```

" instead of '

```
If (x == 10)
        printf(" x is 10")
```

semicolon

```
If (x == 10)
        printf(" x is 10'
```

printf(" x is 10 ");

Example (Creating Menus)

```
switch( choice )
{
    case 1: printf( “Do edit\n” );
            break;
    case 2:  printf( “Do delete\n” );
             break;
    case 3:  printf( “Done\n” );
            break;
    default: printf( “Invalid choice!\n” );
            break;
}
```

Example (More Practice)

Write a C program which display color name based on first character of color (small or capital letters).Note: Your program should work with the following colors: white , red and green

```
#include <stdio.h>
int main() {
   char color;
   printf ("Enter the first character of your color: ");
   scanf("%c", &color);
   switch (color) {
    case 'w': case 'W':         // for both ‘w’ and ‘W’, “White” is displayed
                printf("White\n");
                break;
    case 'r': case 'R':              // for both ‘r’ and ‘R’, “Red” is displayed
               printf("Red\n");
               break;
    case 'g': case 'G':            //for both ‘g’ and ‘G’, “Green” is displayed
               printf("Green\n");
               break;
    default :
          printf("Choose among known colors\n");
{
   return 0;
{
```

Example (More Practice)

Write a C program which takes a character as input from the user. Check whether the character is an alphabet or not.

```c
#include<stdio.h>
int main()
{
    char ch;
    printf("Enter the character to be checked: ");
    scanf("%c",&ch);
     //checking if it is a Alphabet
    if( (ch>='A'&&ch<='Z') || (ch>='a'&&ch<='z') )
    {
        printf("The input character is an alphabet\n");
    }
    else
    {
        printf("The input character is NOT an alphabet\n");
    }
}
```

Example (More Practice)

What will be printed by this carelessly constructed `switch` statement if the value of `color` is `'R'`?

```c
switch (color) { /* break statements missing */
case 'R':
      printf("red\n");
case 'B':
      printf("blue\n");
case 'Y':
      printf("yellow\n");
}
```

Extra Exercises

Write a program that takes three numbers as input from the user and finds out whether one of the three numbers is the arithmetic mean of the other two.

For example: Input: 7,15,11
Output: 11 is the mean of 7 and 15

Extra Exercises

Write a program that takes a positive integer in the range 1 to 365 (which corresponds to the day of the year) as input and outputs the day of the week. Assume that day 1 is Sunday. Make use of the switch statement.

For example: Input: 16
Output: Monday

Extra Exercises

The marks obtained by a student in 5 different subjects are input through the keyboard
The student gets a division as per the following rules:
Percentage above or equal to 60 - First division
Percentage between 50 and 59 - Second division
Percentage between 40 and 49 - Third division
Percentage less than 40 – Fail.

Write a program to calculate the division obtained by the student.

Example (output screen)
Enter marks in five subjects
34 26 35 35 70
Third division

Program to Check Vowel or consonant

```c
#include <stdio.h>
int main()
{
    char c;
    int isLowercaseVowel, isUppercaseVowel;

    printf("Enter an alphabet: ");
    scanf("%c",&c);

    // evaluates to 1 (true) if c is a lowercase vowel
    isLowercaseVowel = (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u');

    // evaluates to 1 (true) if c is an uppercase vowel
    isUppercaseVowel = (c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U');

    // evaluates to 1 (true) if either isLowercaseVowel or isUppercaseVowel is true
    if (isLowercaseVowel || isUppercaseVowel)
        printf("%c is a vowel.", c);
    else
        printf("%c is a consonant.", c);
    return 0;
}
```

A Program uses only if statement to find the largest number among 3 numbers

```c
#include <stdio.h>
int main()
{
    double n1, n2, n3;

    printf("Enter three different numbers: ");
    scanf("%lf %lf %lf", &n1, &n2, &n3);

    if( n1>=n2 && n1>=n3 )
        printf("%.2f is the largest number.", n1);

    if( n2>=n1 && n2>=n3 )
        printf("%.2f is the largest number.", n2);

    if( n3>=n1 && n3>=n2 )
        printf("%.2f is the largest number.", n3);

    return 0;
}
```

A Program uses if...else statement to find the largest number among 3 numbers

```c
#include <stdio.h>
int main()
{
    double n1, n2, n3;

    printf("Enter three numbers: ");
    scanf("%lf %lf %lf", &n1, &n2, &n3);

    if (n1>=n2)
    {
        if(n1>=n3)
            printf("%.2lf is the largest number.", n1);
        else
            printf("%.2lf is the largest number.", n3);
    }
    else
    {
        if(n2>=n3)
            printf("%.2lf is the largest number.", n2);
        else
            printf("%.2lf is the largest number.",n3);
    }

    return 0;
}
```

A Program uses nested if...else statement to find the largest number among 3 numbers

```c
#include <stdio.h>
int main()
{
    double n1, n2, n3;

    printf("Enter three numbers: ");
    scanf("%lf %lf %lf", &n1, &n2, &n3);

    if( n1>=n2 && n1>=n3)
        printf("%.2lf is the largest number.", n1);

    else if (n2>=n1 && n2>=n3)
        printf("%.2lf is the largest number.", n2);

    else
        printf("%.2lf is the largest number.", n3);

    return 0;
}
```

Extra Exercises

2. What will be the value of i after the C statements at the right have been executed?

a. 5	`i = 3;`
b. 6	`j = 10;`
c. 8	`if ((3 * i) < j)`
d. 10	`  i = i + 2;`
e. 15	`i = i + 3;`

3. What is displayed by the C statements at the right if the value input is 3?

a. Equal	`scanf("%d", &n);`
b. Less	`if (n = 5)`
c. Greater	`  printf("Equal\n");`
d. no output	`else if (n < 5)`
	`  printf("Less\n");`
	`else`
	`  printf("Greater\n");`

Switch X and Y example

```
1. if (x > y) {                    /* Switch x and y */
2.       temp = x;                 /* Store old x in temp */
3.       x = y;                    /* Store old y in x */
4.       y = temp;                 /* Store old x in y */
5. }
```