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Selection Structures:
if and switch Statements

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Comp 230

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`

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Control Structure

Before,

let us study: **1. Relational and equality operators**

2. Logical Operators

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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

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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

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Logical Operators

- Three types of logical operators:

Operator	Meaning
&&	and
||	or
!	not

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Operator Precedence

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

The arrow points downward from highest to lowest.

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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)

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Example

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

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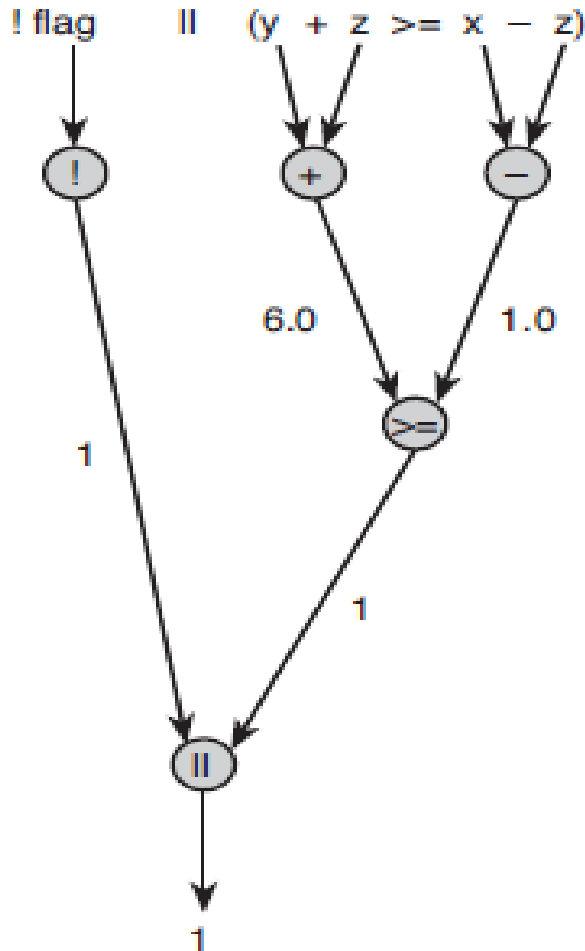
Example: How to convert an English condition into a logical expression

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)

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Example: **Comparing Characters**

Expression	Value
'9' >= '0'	1(true)
'a' < 'e'	1(true)
'B' <= 'A'	0(false)
'Z' == 'z'	0(false)
'a' <= 'A'	system dependent (**false for ASCII**)
'a' <= ch && ch <= 'z'	1(true) if ch is a lowercase letter

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Logical Assignment

- Example:

```c
#include <stdio.h>
int main()
{
    int age, senior_citizen;
    scanf("%d", &age);
    senior_citizen = (age >= 65);
    printf("senior_citizen =  %d",senior_citizen );
    return 0;
}
```

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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");

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if Statements with Compound Statements

if (*condition*)

{

> **true task**

}

Else

{

> **false task**

}

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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;
}
```

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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;
}
```

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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.  }
```

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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
```

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Multiple-Alternative Decisions

```c
#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;
}
```

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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;
}
```

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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;

}
```

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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;
}
```

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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");
```

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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");
```

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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.

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The switch Statement

Before,

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

2. Multiple Selection with if-else

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Multiple Selection with if

```c
if (day == 0 ) {
    printf ("Sunday") ;
}
if (day == 1 ) {
    printf ("Monday") ;
}
if (day == 2) {
    printf ("Tuesday") ;
}
if (day == 3) {
    printf ("Wednesday") ;
}
```

```c
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")
;
}
```

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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 (*integer expression*)
{
    case *constant$_1$* :
        statement(s)
        break ;
    case *constant$_2$* :
        statement(s)
        break ;

    . . .

    default: :
        statement(s)
        break ;
}

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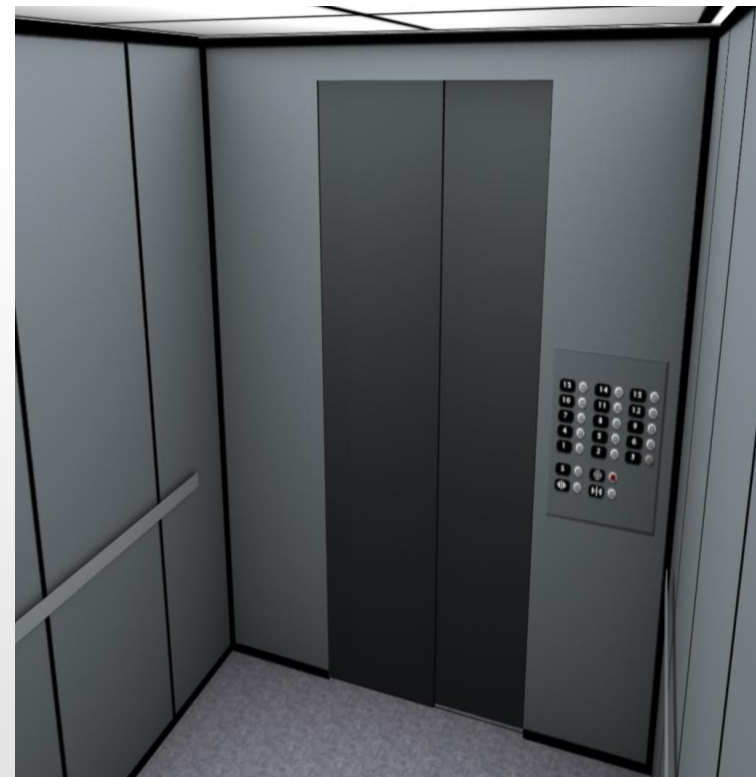
switch Statement Details

- 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.

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The **switch** Multiple-Selection Structure

```c
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 ;
}
```

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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.

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Common Programming Errors

if(0 <= x <= 4)
    printf("Condition is true\n");
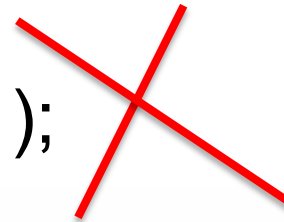
Instead, use
    if(0 <= x && x <= 4)

The following always prints the same thing:

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

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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 ");

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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;
}
```

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Example (More Practice)

Write a C program which takes the 3 sides of a triangle, and print whether the triangle is an equilateral, isosceles or scalene triangle. Your program should include at least one function called triangle_type, this function takes the sides of the triangle and return 1 if the triangle is equilateral, 2 if the triangle is scalene and 3 for isosceles triangle.

NOTE:
Your triangle should be satisfied these conditions   side 1 + side 2 > side 3
                                                        side 1 + side 3 > side 2
                                                        side 2 + side 3 > side 1

Try these sides:
              3 4 5
              1 1 1
              3 3 1

Code

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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

Code

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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");
    }
}
```

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Example (More Practice)

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

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

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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

Code

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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

Code

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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
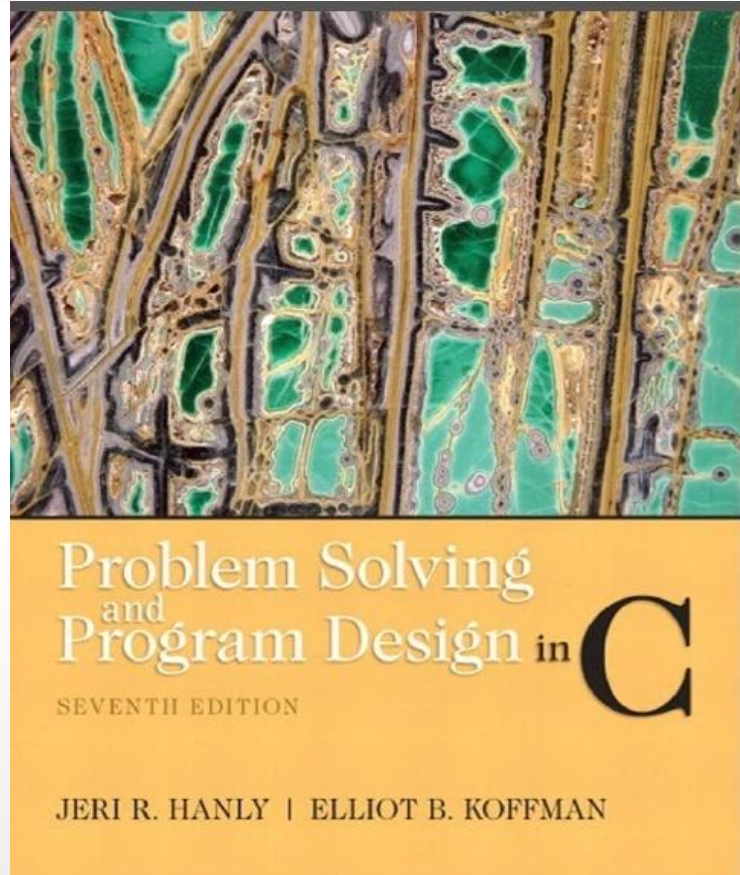Third division

Code

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Question?

"Success is the sum of small efforts, repeated day in and day out."
Robert Collier

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References:

Problem Solving & Program Design in C (main reference)

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