1806ICT
Programming Fundamentals

Selection I

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Topics

- The `if` statement
- The `else` statement
- Cascaded `if`
- Nested `if`
- Common mistakes

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Flow of Control

- *Flow of control* is the order in which a program performs actions.
- Two kinds of statements to regulate flow of control
  - A *selection statement* chooses one action from a list of two or more possible actions.
  - A *loop statement* repeats an action until a stopping condition occurs.

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The `if` statement

- Determines whether a statement or block is executed.
- Decides what to do by evaluating a Boolean expression.
- If the expression is true (non-zero), the statement or block is executed.

if (*expression*)
statement

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What is a statement?

- Statements are lines of instructions in our programs ending with a semicolon (;).
- A compound statement or block is a series of statements surrounded by braces.

E.g.

```
{
    number = number + 1;
    printf("%d\n", number);
}
```

- An empty statement is a single semicolon.

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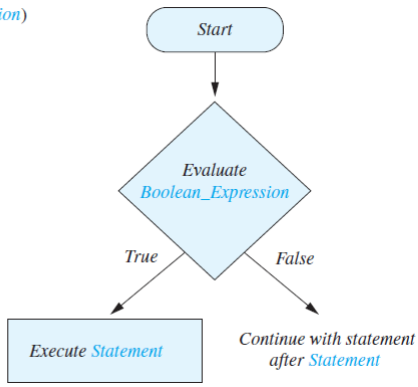
Semantics of an **if** Statement

```
if (Boolean_Expression)
    Statement
```



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Example: oddnum.c

Read in a number, and print it if it is odd.

output "Enter an integer"
input number

if (number is odd)
then
{
  output the number
}

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Example: oddnum.c

Read in a number, and print it if it is odd.

output "Enter an integer"
input number

if (number is odd)
then
{
  output the number
}

```
#include <stdio.h>

/* Read in a number, and echo it
   if it is odd. */

int main()
{

   return 0;
}
```

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Example: oddnum.c

Read in a number, and print it if it is odd.

output "Enter an integer"
input number

if (number is odd)
then
{
  output the number
}

```
#include <stdio.h>

/* Read in a number, and echo it
   if it is odd. */

int main()
{
   int number;

   printf("Enter an integer: ");
   scanf("%d", &number);




   return 0;
}
```

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Example: oddnum.c

Read in a number, and print it if it is odd.

output "Enter an integer"
input number

if (number is odd)
then
{
  output the number
}

```
#include <stdio.h>

/* Read in a number, and echo it
   if it is odd. */

int main()
{
   int number;

   printf("Enter an integer: ");
   scanf("%d", &number);

   if (number % 2 != 0)
   {
      printf("%d\n", number);
   }

   return 0;
}
```

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Example: oddnum.c

Read in a number, and print it if it is odd.

output "Enter an integer"
input number

if (number is odd)
then
{
  output the number
}

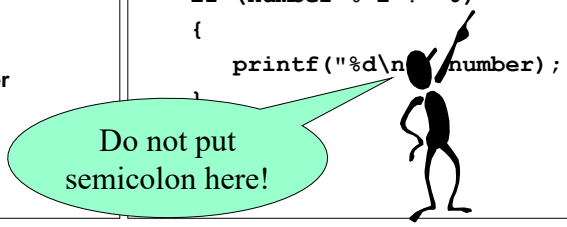
```
#include <stdio.h>

/* Read in a number, and echo it
   if it is odd. */

int main()
{
   int number;

   printf("Enter an integer: ");
   scanf("%d", &number);

   if (number % 2 != 0)
   {
      printf("%d\n", number);
   }
```



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Notes on `if`

- Which of the following code fragments are equivalent?

A

```
if (number % 2 != 0)
{
   printf("%d", number);
}
printf(" is odd\n");
```

B

```
if (number % 2 != 0)
   printf("%d", number);
   printf(" is odd\n");
```

C

```
if (number % 2 != 0)
{
   printf("%d", number);
   printf(" is odd\n");
}
```

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The `else` statement

- Can only occur after an **`if`** statement
- Is only executed when the **`if`** block does not execute

```
if ( expression )
    statement1
else
    statement2
```

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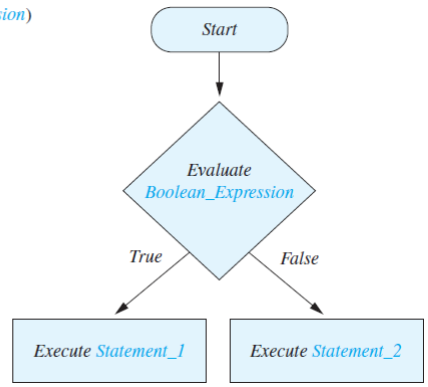
Semantics of the if-else Statement

```
if (Boolean_Expression)
    Statement_1
else
    Statement_2
```



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Example: oddeven.c

Read in a number, and determine if it's odd or even.

output "Enter an integer"
input number

if (number is odd)
then
{
  output: number " is an odd number"
}
else
{
  output: number " is an even number"
}

```
#include <stdio.h>

/* Determine whether an input number
   is odd or even. */

main()
{
  int number;

  printf("Enter an integer: ");
  scanf("%d", &number);

  if (number % 2 != 0)
  {
    printf("%d is an odd number\n",
      number);
  }




}
```

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Example: oddeven.c

Read in a number, and determine if it's odd or even.

output "Enter an integer"
input number

if (number is odd)
then
{
  output: number " is an odd number"
}
else
{
  output: number " is an even number"
}

```
#include <stdio.h>

/* Determine whether an input number
   is odd or even. */

main()
{
  int number;

  printf("Enter an integer: ");
  scanf("%d", &number);

  if (number % 2 != 0)
  {
    printf("%d is an odd number\n",
      number);
  }
  else
  {
    printf("%d is an even number\n",
      number);
  }
}
```

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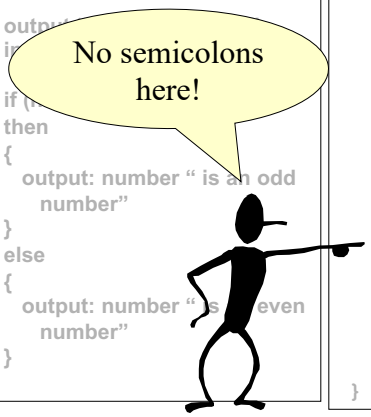
Example: oddeven.c

```
Read in a number, and determine
    if it's odd or even.

output
in
if (
then
{
  output: number " is an odd
    number"
}
else
{
  output: number "
    number"
}
```




```
#include <stdio.h>

/* Determine whether an input number
   is odd or even. */

main()
{
  int number;

  printf("Enter an integer: ");
  scanf("%d", &number);

  if (number % 2 != 0)
  {
    printf("%d is an odd number\n",
      number);
  }
  else;
  {
    printf("%d is an even number\n",
      number);
  }
}
```

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Cascaded `if` statement

- Multiple alternative blocks each with a Boolean expression.
- First expression which evaluates to true causes execution of the associated block.
- At most only one block will be executed.

Syntax

```
if (Boolean_Expression_1)
    Statement_1;
else if (Boolean_Expression_2)
    Statement_2;
else if (Boolean_Expression_3)
    Statement_3;
else if ...
else
    Default_Statement;
```

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Example: months.c

Determine the number of days in a given month:

30 days hath September,
April, June and November.
All the rest hath 31,
Excepting February alone,
Which hath 28 days clear,
And 29 in each leap year.

```
output "Enter an integer"
input month

if (month is September,
            or April,
            or June,
            or November)
then
{
  output "30 days"
}
else if (month is February)
{
  output "28 or 29 days"
}
else
{
  output "31 days"
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{









  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }

  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November
All the rest have 31,
Excepting February
And that has 28 d
And 29 in each
\************
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }
```

Common mistake:

```
if (month==September || April || June || November )
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }
  else if (month==February)
  {
    printf("28 or 29 days\n");
  }



  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }
  else if (month==February)
  {
    printf("28 or 29 days\n");
  }
  else
  {
    printf("31 days\n");
  }
  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

"Default" block.

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }
  else if (month==February)
  {
    printf("28 or 29 days\n");
  }
  else
  {
    printf("31 days\n");
  }
  return 0;
}
```

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Example: months.c

```
#include <stdio.h>

/************************\

Determine the number of days
   in a given month:

30 days hath September,
April, June and November;
All the rest have 31,
Excepting February alone,
And that has 28 days clear
And 29 in each leap year.
\************************/

const int September = 9;
const int April = 4;
const int June = 6;
const int November = 11;
const int February = 2;
```

```
int main()
{
  int month;
  printf("Enter number of month: ");
  scanf("%d", &month);

  if (month==September ||
      month==April ||
      month==June ||
      month==November )
  {
    printf("30 days\n");
  }
  else if (month==February)
  {
    printf("28 or 29 days\n");
  }
  else
  {
    printf("31 days\n");
  }
  return 0;
}
```

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Another Cascaded `if` Example

Example

```
if (score >= 90)
    grade = 'A';
else if ((score >= 80) && (score < 90))
    grade = 'B';
else if ((score >= 70) && (score < 80))
    grade = 'C';
else if ((score >= 60) && (score < 70))
    grade = 'D';
else
    grade = 'F';
```

Equivalent code

```
if (score >= 90)
    grade = 'A';
else if (score >= 80)
    grade = 'B';
else if (score >= 70)
    grade = 'C';
else if (score >= 60)
    grade = 'D';
else
    grade = 'F';
```

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Notes on Cascaded `if`

Q:

What is the output if:

- letter is equal to ‘b’
- letter is equal to ‘z’
- letter is equal to ‘A’
- letter is equal to ‘X’

```
if (letter >= 'a')
{
   printf("S1\n");
}
else if (letter <= 'z')
{
   printf("S2\n");
}
else if (letter >= 'A')
{
   printf("S3\n");
}
else if (letter <= 'Z')
{
   printf("S4\n");
}
```

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More Examples

```
if (ch >= 'a' && ch <= 'z')
{
   printf("%c is in lower case.\n", ch);
}
else if (ch >= 'A' && ch <= 'Z')
{
   printf("%c is in upper case.\n". ch);
}
else if (ch >= '0' && ch <= '9')
{
   printf("%c is a digit with value %d.\n", ch, ch - '0');
}
```

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More Examples

```
if (ch >= 'a' && ch <= 'z')
{
   printf("%c is in lower case.\n", ch);
}
else if (ch >= 'A' && ch <= 'Z')
{
   printf("%c is in upper case.\n". ch);
}
else if (ch >= '0' && ch <= '9')
{
   printf("%c is a digit with value %d.\n", ch, ch - '0');
}
```

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Nested if-else Statements

- An **if-else** statement can contain any sort of statement within it.
- In particular, it can contain another **if-else** statement.
  - An **if-else** may be nested within the "if" part.
  - An **if-else** may be nested within the "else" part.
  - An **if-else** may be nested within both parts.

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Nested `if-else` Statements

`if-else` Syntax

```
if (Boolean_Expression)
  Statement_1;
else
  Statement_2;
```

Nested `if-else` Syntax

```
if (Boolean_Expression_1)
{
   if (Boolean_Expression_2)
       Statement_1;
   else
       Statement_2;
}
else
{
   if (Boolean_Expression_3)
       Statement_3;
   else
       Statement_4;
}
```

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Nested if-else Statements

- Each **else** is paired with the nearest unmatched **if**
- **If used properly**, indentation communicates which **if** goes with which **else**
- Braces can be used to group statements.

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Nested `if-else` Statements

Subtly different forms

First Form

```
if (a > b)
{
    if (c > d)
        e = f;
}
else
    g = h;
```

Second Form

```
if (a > b)
   if (c > d)
        e = f;
else
   g = h;

// oops
```

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Common Mistakes

- Putting a semicolon **;** at the end of the **if** statement or **else** statement

Examples

```
int x = 13;
if (x == 100);
   x = 0;
printf("%d", x);
```

displays → 0

```
int x = 13;
if (x == 13)
  x = 0;
else;
  x = x + 1;
printf("%d", x);
```

displays → 1

Remember: The semicolon is an empty statement.

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Common Mistakes

- Mistaking the operator = with the operator ==

Example

```
int score = 75;
if (score = 100)
{
     printf("Well done");
}
else
{
     printf("Please try again");
}
```

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Common Mistakes

- Forgetting to use braces in compound statements.

Example

```
int accBalance = 50000;
if (accBalance > 0) {
    if (accBalance >= 1000000)
      printf("Wow, you're a millionaire!"); }
else
    printf("You have no money!");
```

Missing

displays → You have no money!

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Summary

- The **`if`** statement
- The **`else`** statement
- Cascaded **`if`**
- Nested **`if`**
- Common mistakes

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