CSE1301
Computer Programming
Lecture 9
Selection

1

Topics

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

Readings: D&D (2/e or 3/e):
Sections 3.4 to 3.6 and 4.10 to 4.11

2

The **`if`** statement

- Determines whether a statement or block is executed.
- Implements the selection instructions within an algorithm.
- 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
```

3

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.

4

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
}
```

5

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;
}
```

6

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;
}
```

7

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;
}
```

8

Example: oddnum.c

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

output "E
input nu

Do not put "then" here!

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;
}
```

9

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
}

Do not put semicolon here!

```
#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);
```

10

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;
}
```

11

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");
}
```

12

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");
}
```

13

Notes on `if`

- Which of the following code fragments are equivalent?

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

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

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

14

Notes on `if`

- Common mistake

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

15

Notes on `if`

- Common mistake

```
if (number % 2 != 0);
{
   printf("%d is an odd ", number);
}
printf("number\n");
```
No semi-colon here!

The semicolon is an empty statement.

16

Notes on `if`

- Common mistake

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

17

Notes on `if`

- Common mistake

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

18

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
```

19

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);
  }

}
```

20

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);
  }
}
```

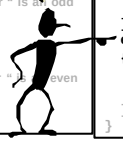
21

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);
  }
}
```

No semicolons here!



22

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);
  }
}
```

23

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.

24

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"
}
```

25

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;
}
```

26

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;
}
```

27

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;
}
```

28

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;
}
```

Common mistake:

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

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;
}
```

30

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;
}
```

31

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;
```

```
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;
}
```

"Default" block.

32

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;
}
```

33

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");
}
```

34

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');
}
```

35

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');
}
```

36

Example: Nested `if`

```
if ( coldWeather )
{
   wearJumper = 1;

   wearRaincoat = wearJacket = wearThermal = 0;

   if ( raining )
      wearRaincoat = 1;
   else
      wearJacket = 1;

   if ( belowZero )
   {
      wearThermal = 1;
   }
}
```

37

Example: Nested `if`

```
if ( coldWeather )
{
   wearJumper = 1;

   wearRaincoat = wearJacket = wearThermal = 0;

   if ( raining )
      wearRaincoat = 1;
   else
      wearJacket = 1;

   if ( belowZero )
   {
      wearThermal = 1;
   }
}
```

38

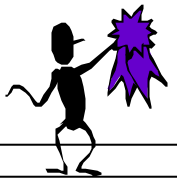
Example: Nested `if`

```
if ( coldWeather )
{
   wearJumper = 1;

   wearRaincoat = wearJacket = wearThermal = 0;

   if ( raining )
      wearRaincoat = 1;
   else
      wearJacket = 1;

   if ( belowZero )
   {
      wearThermal = 1;
   }
}
```

39

Example: Nested `if`

```
if ( coldWeather )
{
   wearJumper = 1;

   wearRaincoat = wearJacket = wearThermal = 0;

   if ( raining )
      wearRaincoat = 1;
   else
      wearJacket = 1;

   if ( belowZero )
   {
      wearThermal = 1;
   }
}
```



40

Summary

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

41

Readings

This Lecture:

- King: Section 5.2
- D&D: Sections 3.7, 4.1 – 4.6, 4.8 – 4.11
- Kernighan & Ritchie: 3.1 – 3.3

42