Lecture 14

- Covers
  - Looping statements
  - The while statement
  - The do…while statement
  - Infinite loops

- Reading: Savitch 3.2

Three kinds of loops in Java

- Repetition structures allow us to repeat a group of statements - provided certain condition is satisfied

- Java provided three kinds of loops
  - while
  - do…while
  - for

Repetition

Repeated execution of instructions

(i)

(ii)

Instruction Set

Instruction Set

true

true

Condition

Condition

false

false
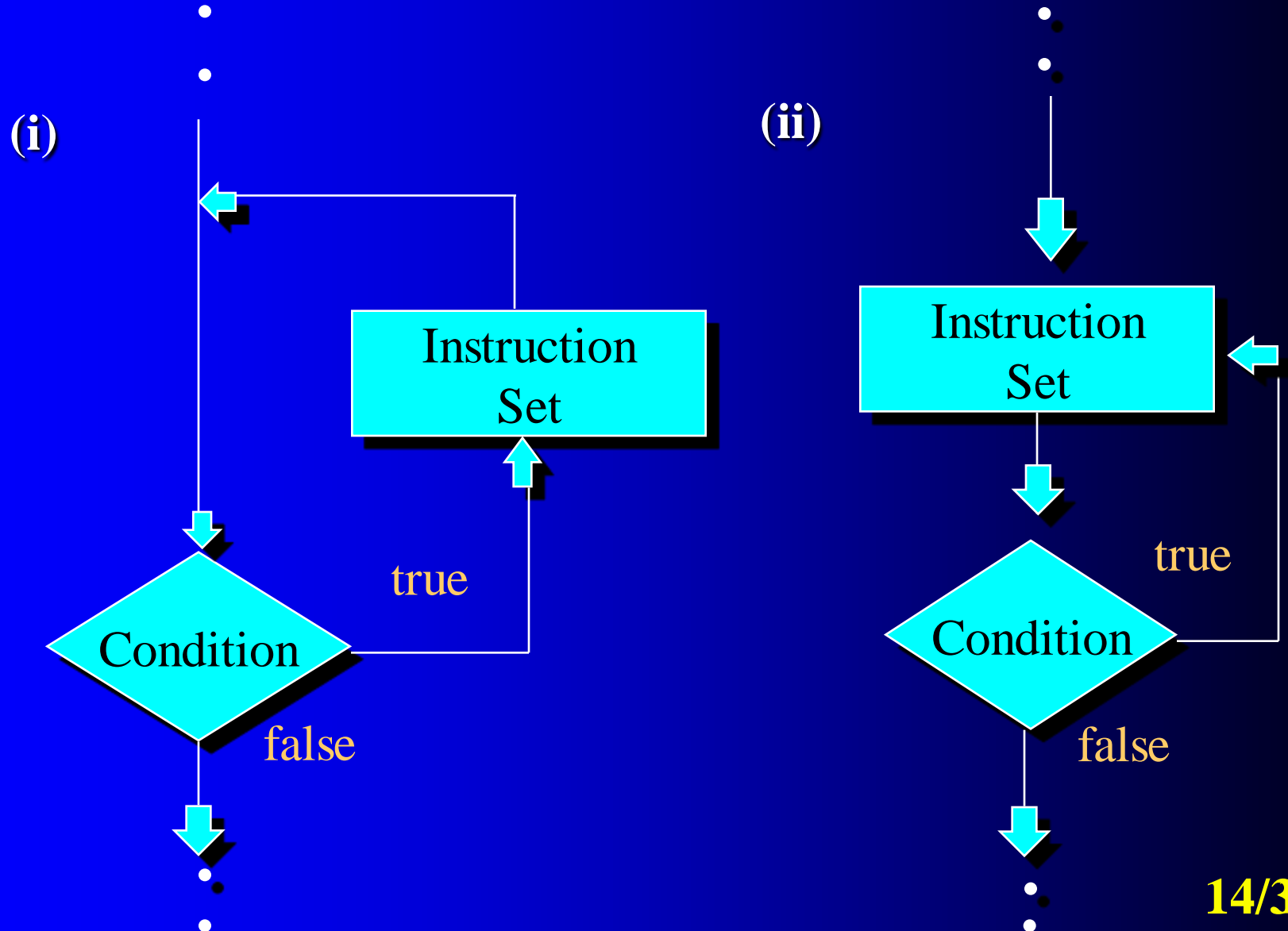
Repetition structures

- Repetition structures enable the program to repeat a group of statements (provided a certain condition is satisfied)

- The while loop is used when we wish to test a condition first

- The do…while loop is used when the body of the loop is executed at least once

- Each execution of the statements in a loop is called an iteration
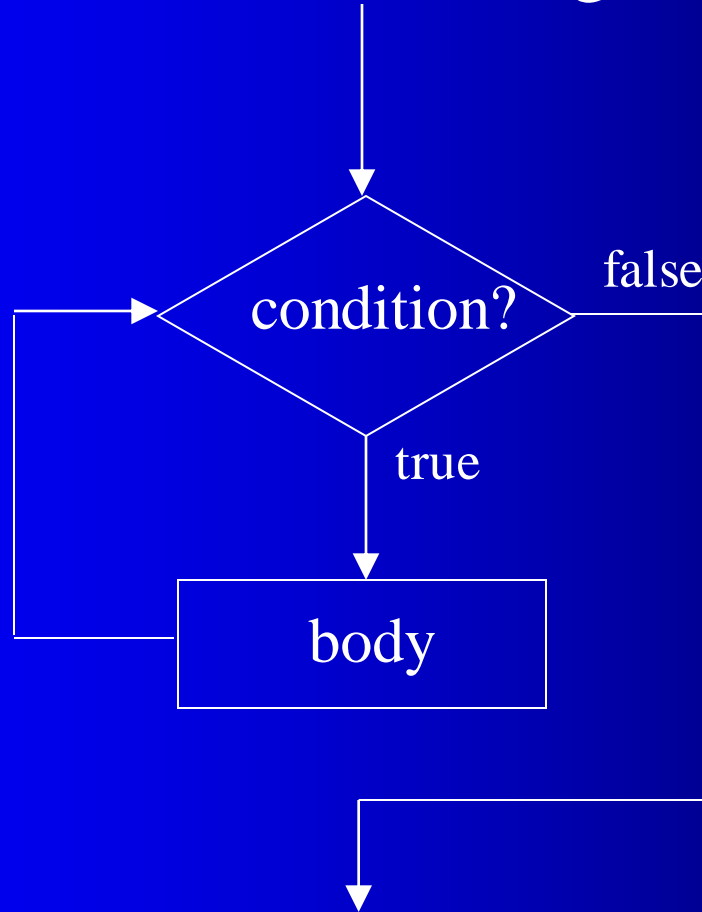
► The while loop

while loop

- Syntax

  while (<condition>)

  <block>

- The block is often referred to as the "loop body" or "body"

- The body of a while loop is executed zero or more times

while loop

- Implements the following logic

condition?

false

true

body

Example 1

- Write a program that displays "Hello!" to the screen 10 times

- Algorithm

    Initialise a counter to 1

    WHILE the counter is less than or equal to 10

       Display "hello"

       Increment the counter

    ENDWHILE

Java solution

initialization

loop-condition

```java
int count = 1;
while (count <= 10)
{
        System.out.println("Hello!");
        count ++;
}
```

update actions

Alternative solution

```
int count = 0;
while (count < 10)
{
        System.out.println("Hello!");
        count ++;
}
```

Example 2

- Write a while loop to display the numbers from 1 to 10 (each on a separate line)

Solution

```
int n = 1;
while(n <= 10)
{
        System.out.println(n);
        n++;
}
```

Alternative solution

```
int n = 0;
while(n < 10)
{
        n++;
        System.out.println(n);
}
```

Example 3

- Write a program to add the first 100 (positive) integers

- Algorithm

  Initialise sum to 0
  Initialise counter to 1
  WHILE counter <= 100
  Add counter to sum
  Increment counter
  ENDWHILE
  Output sum

Java solution

```java
int sum = 0;
int number = 1;
while (number <= 100)
{
        sum = sum + number;
        number ++;
}
System.out.println( "The sum is " + sum );
```

Alternative solution

```
int sum = 0;
int number = 0;
while (number < 100)
{
        number ++;
        sum = sum + number;
}
System.out.println( "The sum is " + sum );
```

Example 4

- Problem *

  – A bank account has an initial balance of $1000

  – The interest rate is 5% per year (compounded yearly)

  – How long will it take for the balance to double itself?

* From Horstmann, *Big Java*, p. 228

Java solution

```
double initialBalance = 1000;
final double RATE = 0.05;
double targetBalance = 2 * initialBalance;

int years = 0;
balance = initialBalance;

while ( balance < targetBalance )
{
        years ++;
        balance = balance + balance * RATE;
}

System.out.println("Balance doubles after " + years + " years");
```

Class exercise

- What is the output from the following code?

```
int x = 10;

 while (x > 0)
 {
     System.out.println(x);
     x = x - 3;
 }
```

Class exercise

- What is the output from the following code?

```
int x = 0;

while (x < 20)
{
    System.out.println(x);
    x = x + 5;
}
```

► The do…while loop

The do…while loop

- The do…while loop is similar to the while loop, but the condition is tested at the end of the loop

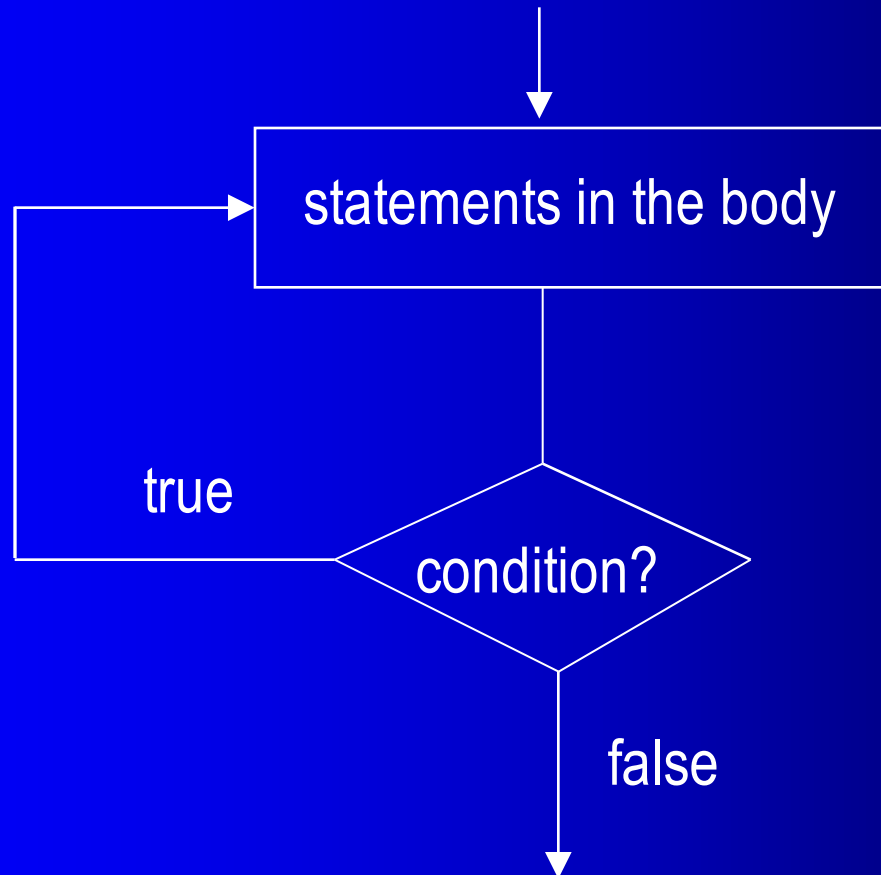- Syntax
  ```
  do
  {
          <statements in the body>
  } while( <condition> );
  ```

- The body of a do...while loop is executed one or more times

do…while loop

- Has the following behaviour

Example 1

- Write a do…while loop to say "Good day!" until the user wants to stop

do…while loop

```
String ansString = "";
char ans;
do
{
    System.out.println("G'day Mate!\n");
    System.out.println("Do you want another greeting? " +
                    "Press  y for yes, n for no, " +
                    "and then press return: ");
    ansString = keyboard.nextLine();
    ans = ansString.charAt(0);
} while (ans == 'y' || ans == 'Y');
```

Example 2

- Simulate crossing the street

  To cross a street

  Look right

  Look left

  Walk across when the traffic is clear

- Working out a solution

  Note that the basic actions are: Look right, Look left, Determine if traffic is clear, Walk across

Java solution

```java
boolean  trafficClear;
do
{
    System.out.println("Look right");
    System.out.println("Look left");

    System.out.print( "Is traffic clear? (y/n): ");
    String answerString = keyboard.nextLine();
    char answer = answerString.charAt(0);
    trafficClear =  ( answer == 'y' ? true : false );
} while( ! trafficClear);

System.out.println("Walk across");
```

Class exercise

- What is the output from the following code?

```
int x = 10;
do
{
    System.out.println(x);
    x = x – 3;
} while (x > 0);
```

Class exercise

- What is the output from the following code?

```
int x = 0;
do
{
    System.out.println(x);
    x = x + 5;
} while (x < 20);
```

► Infinite loops

Infinite loops

- In the previous example, if we forget to increment the variable x, the loop will run forever

- This is an example of an infinite loop

- Infinite loops (theoretically) never terminate as their condition never becomes false

- <ctrl-c> stops a program with an infinite loop (in Unix)

Infinite loops

```
int x = 10;

while (x > 0)
{
    System.out.println(x);
    x = x * 1;
}
```

► Rewriting while loops as do…while loops & vice versa

Rewrite do…while as while

- We can replace do…while loops with while loops

```
statements in the block;
while (condition)
{
        statements in the block;
}
```

Rewrite while as do…while

- We can replace while loops with do…while loops but we also need an if…else statement

```
if (condition)
{
        do
        {
                statements in the block;
        } while (condition)
}
```

Class exercise

- Write a do…while loop that reads in ten integers from the user. The program must output the sum, average, minimum and maximum of the ten numbers.

Solution

Class exercise

- Write a do…while loop that reads in all the integers in the file "myFile.txt". The program must output the sum, average, minimum and maximum of the numbers read in

Solution

Next lecture

- Looping statements
  - The for statement
  - The break statement in loops
  - The exit( ) method