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8354
Java from the Very Beginning, Part II

Jezz Kelway – kelwayj@uk.ibm.com
Java Technology Centre, z/OS Service.
IBM Hursley Park Labs, United Kingdom

Objectives

- Learn and understand Java's basic flow of control constructs
- Get some more hands on experience

Agenda

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- Part I recap
- Conditional statements
  - if..then..else
  - switch
- Looping constructs
  - Arrays
  - for
  - while
  - do..while
- Exception handling

Recap

- Which of the following identifiers are valid?
  - A) Big0lLongStringWithMeaninglessName
  - B) $int
  - C) bytes
  - D) $1
  - E) finalist

Recap

- What is the range of values that can be assigned to a variable of type short?
  - A) 0 through 2^{16}-1
  - B) 0 through 2^{32}-1
  - C) -2^{15} through 2^{15}-1
  - D) -2^{31} through 2^{31}-1
  - E) It depends on the underlying hardware

Recap

- What are the values of x,a and b after executing the following code?

```
int x, a=6, b=7;
x = a++ + b++;
```

  - A) x = 15, a = 7, b = 8
  - B) x = 15, a = 6, b = 7
  - C) x = 13, a = 7, b = 8
  - D) x = 13, a = 6, b = 7

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if...then...else

```
if (boolean_expr) {
        then_stmnts;
}
```

```
if (a > 10) {
    System.out.println("a > 10");
}
```

- Tests against *boolean* expression (not integer as in C/C++).
- Curly braces delimit blocks of code { }
- If the condition is true, then the statements in the then block are executed.

if...then...else

```
if (expr) {
    then_stmnts;
}
else {
    else_stmnts;
}
```

```
if (a < 10) {
    System.out.println("a < 10");
}
else {
    System.out.println("a >= 10");
}
```

- If the condition is false, then the statements in the else block are executed.

if..then..else

```
if (expr) {
    then_stmnts;
}
else if (expr_1) {
    else_stmnts;
}
else {
    else_stmnts;
}
```

```
int testscore;
char grade;

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

switch

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- Used to make a choice between multiple alternative execution paths
- Choice must be based on an integer type (byte, short, char or int)

switch

- **switch** (int_expr) {
  - **case** x:
    - case x stmnts;
    - **break;**
  - **case** y:
    - case y stmnts;
    - **break;**
  - **case** z:
    - case z stmnts;
    - **break;**
  - **default:**
    - default case stmnts;
    - **break;**
- }

- **switch** (grade) {
  - **case** 'A':
    - System.out.println("Outstanding!");
    - **break;**
  - **case** 'B':
    - System.out.println("Well done");
    - **break;**
  - **case** 'C':
    - System.out.println("Satisfactory");
    - **break;**
  - **default:**
    - System.out.println("Fail");
    - **break;**
- }

switch

- The "default" case is optional
- The "break" statement is optional, if it is omitted, execution drops through to the next case
  - a common source of errors!

switch

- **switch** (grade) {
  - **case** 'A'**:**
  - **case** 'B'**:**
  - **case** 'C'**:**
    - System.out.println("Pass")**;**
    - **break;**
  - **default:**
    - System.out.println("Fail")**;**
    - **break;**
- **}**

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Arrays

- Declare as *type*[] varName;
  - **int[ ]** myInts;
- Must allocate memory before use:
  - myInts = **new** int[10];

- General form:
  - *f* **elementType[ ]** arrayName = **new elementType[** arraySize **]**;

Arrays

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- Array indices always start at zero.
- Access array elements using []:
  - myArray[0] = 5;
- Special array property *length*
  - myArray.length

Arrays

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- **int** [ ] squares = **new int**[5];

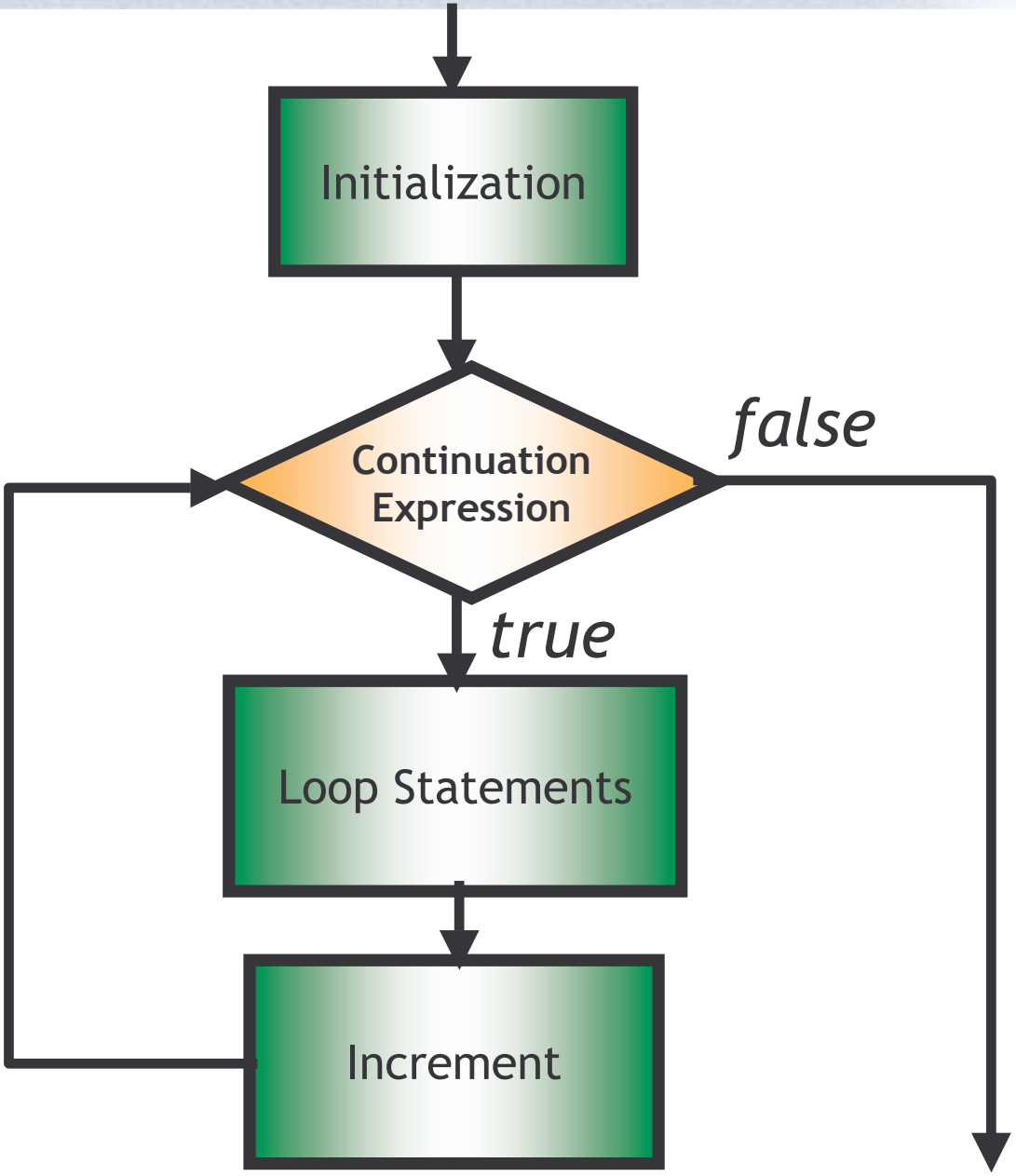
- squares[0] = 0;
- squares[1] = 1;
- squares[2] = 4;
- squares[3] = 9;
- squares[4] = 16;

For loops

```
for (initialisation ; continuation_expr ; increment) {
  loop_stmnts;
}
```

- initialisation executed once at beginning
- increment executed each time round the loop, immediately after the body of the loop
- continuation_expr is evaluated at the top of the loop on every iteration. The loop terminates when continuation_expr is false.

For loops


Initialization
Continuation Expression
false
true
Loop Statements
Increment

For loops

```
int i;

for (i=0 ; i < 10 ; i++) {
  System.out.println("i = " + i);
}
```

- i = 0
- i = 1
- i = 2
- ...
- i = 9

common shorthand:

```
for (int i=0 ; i < 10 ; i++) {
  System.out.println("i = " + i);
}
```

Exercise

- Print out the command line arguments to a Java program

A Solution

```
/**
 * A Java application to list the command line arguments
 */
class CommandLine {

  public static void main(String [] args) {

    for (int i = 0; i < args.length; i++) {
      System.out.println("Argument " + i + " = " + args[i]);
    }

  } // end of main method

} // end of class
```

While Loops

```
while ( boolean_expr ) {
  stmnts;
}
```

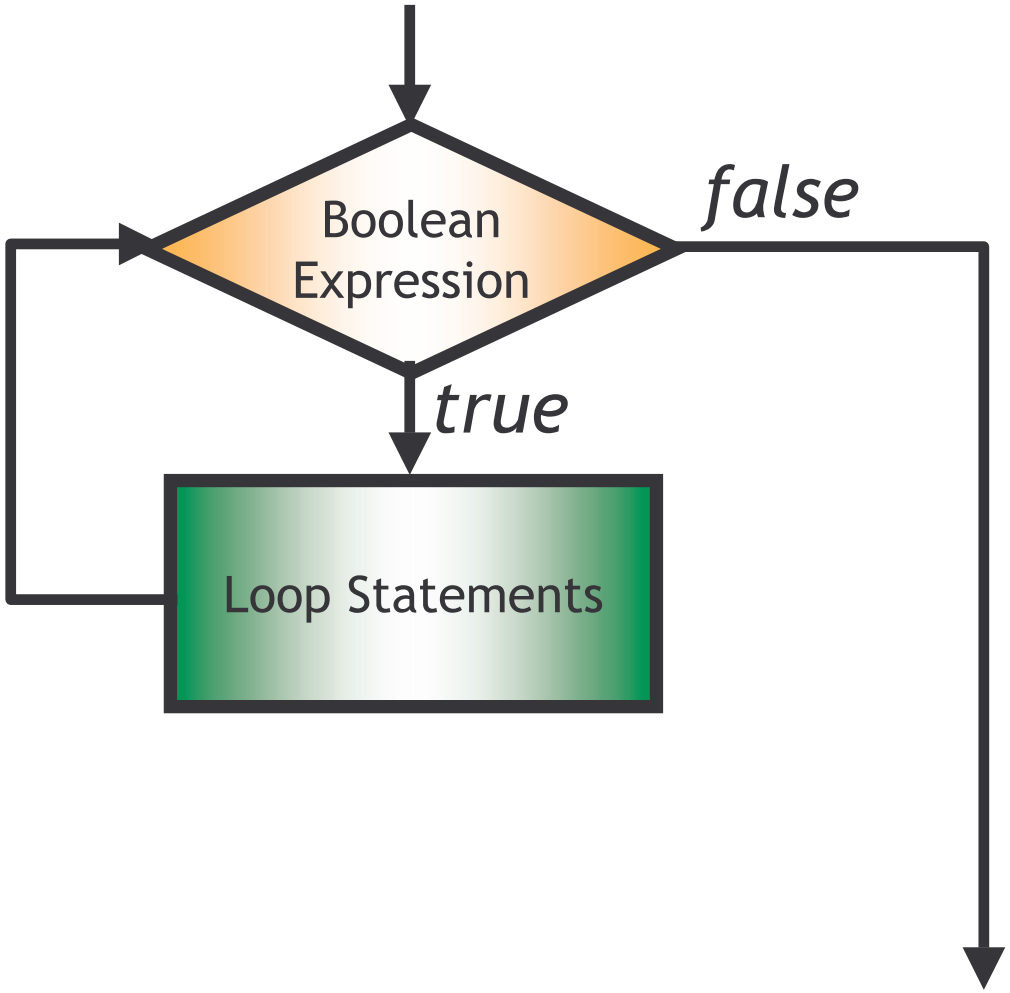
- expr evaluated at top of each loop
- body executed if expr evaluates to true
- make sure your loop terminates!

```
int i = 0;

while (i < 10) {
  System.out.println("i = " + i);
  i++;
}
```

- i = 0
- i = 1
- i = 2
- ...
- i = 9

While Loops



Do Loops

```
do {
  stmnts;
} while ( boolean_expr );
```

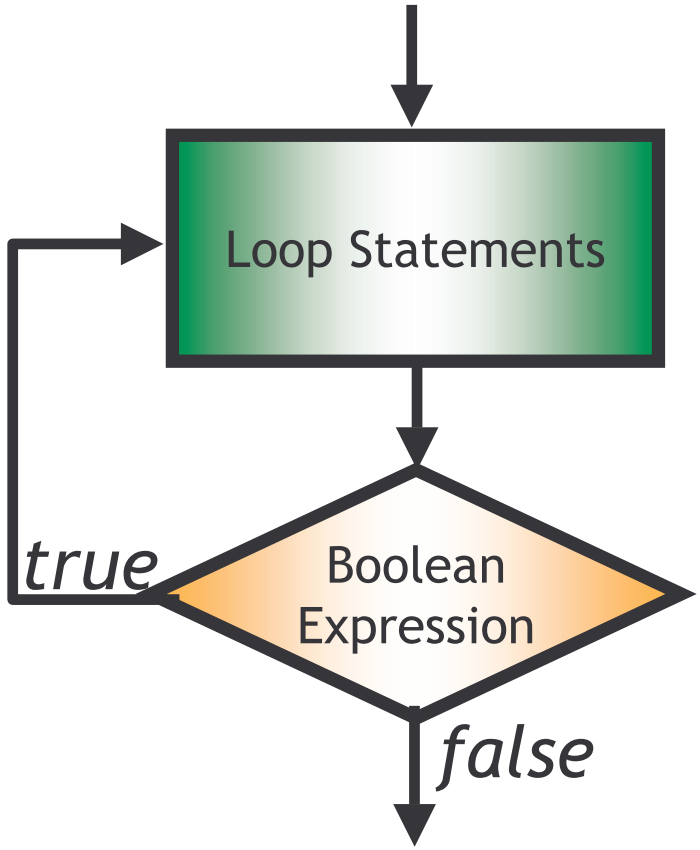
- body executed each time through the loop
- boolean_expr is evaluated at the end of the loop
- body of the loop is always executed at least once

```
int i = 0;

do  {
  System.out.println("i = " + i);
  i++;
} while ( i < 10 );
```

- i = 0
- i = 1
- i = 2
- ...
- i = 9

Do Loops



Continue

- Used to abandon execution of the body of a loop, or a number of nested loops
- A "structured" form of goto...

```
for ( int i = 0; i < array.length; i++ ) {
   if ( !array[ i ].needsProcessing( ) ) {
      continue;
   }
   // process element...
}
```

Continue

- Use labels for nested loops
- Can label opening statement of do, while and for loops

```
mainLoop: for ( int i = 0; i < array.length; i++ ) {
  for ( int j =0; j < array[ i ].length; j++ ) {
    if ( !array[ i ][ j ].needsProcessing( ) ) {
      continue mainLoop;
    }
    // process element...
  }
}
```

Break

- Like continue, but abandons entire loop instead of current iteration
- Can also use labels on break statements

```
for ( int i = 0; i < array.length; i++ ) {
  if ( array[ i ] == 0 ) {
    break;   // stop processing at first zero entry
  }
  // process element...
}
```

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➔ Exception handling

Exceptions and Error Handling

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- "An *exception* is an event that occurs during the execution of a program that disrupts the normal flow of instructions".

- When an error occurs within a block of code:
  - ➔ An exception is created containing information about the error
  - ➔ The exception is passed to the runtime system
  - ➔ The runtime system searches backwards through the call stack to find an exception *handler*
  - ➔ if a handler is found, control passes to the handler, else the program exits

Catching Exceptions

- Surround code which may cause an error in a try block, and place one or more catch blocks after it

```
FileReader fileReader;
try {
        fileReader = new FileReader("input.txt");
        // read from file etc...
        ...
        fileReader.close();  // done!
}
catch (FileNotFoundException notFoundEx) {
        // handle file not found
}
catch (IOException ioEx) {
        // handle error closing file
}
```

And Finally

- A finally block may follow a try and its associated catch blocks
- The code in the finally block will always be executed

```
try {
    ...
}
catch (...) { }
catch (...) { }
finally {
    // tidy up code...
}
```

Exercise

- Improve the "FilePrinter" program so that it handles errors gracefully.

A Solution

```
FileReader fileReader = null; // declare outside of the scope of the try block
try {
  fileReader = new FileReader(fileName);
  int c;
  while ( (c = fileReader.read()) != -1) {
    System.out.print((char)c);
  }
}
catch (FileNotFoundException notFoundEx) {
  System.out.println("Could not open " + fileName);
}
catch (IOException ioEx) {
  System.out.println("Error reading from " + fileName);
}
finally {
  System.out.println();
  if (fileReader != null) {
    try { fileReader.close(); }
    catch (IOException ioEx) { ; } // nothing we can do now!
  }
```

Summary

- Two main forms of conditional constructs:
  - if..then...else
  - switch
- Three looping constructs
  - for, do, while
- Error handling via try, catch, finally