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Flow Control

Raistlin: This alters time.

Astinus: This alters nothing...Time flows on, undisturbed.

Raistlin: And carries me with it?

Astinus: Unless you have the power to change the course of rivers by tossing in a pebble.

Raistlin: Watch, Astinus. Watch for the pebble!

Key Notion

- No control flow = statements are executed by order of text, top to bottom
- Control flow = conditionally break the order:
  - Decision-making
  - Looping
  - Branching
- Conditionally = everything is based on boolean expressions

Statement Categories

- Decision-making:
  - `if, switch, ternary`
- Looping:
  - `while`
  - `do-while`
  - `for`
  - `foreach (future)`
- Branching:
  - `break;`
  - `continue;`
  - `return;`
    `(future)`

Boolean Expressions

- Every expression returns either true or false.
- Compound expressions are evaluated according to precedence.
- Operators:
  - Relational: `==` `!=` `<` `<=` `>` `>=`
  - Logical: `!` `&&` `||`
- Note: you can change variable values within boolean expressions.
- **Study all of them:** http://java.sun.com/docs/books/tutorial/java/nutsandbolts/operators.html

Decision Making: `if, if..else`

- Allows choosing one block over the other.
- Syntax:

```
if (condition) block1
if (condition) block1 else block2
```

- A block can include more flow-control ("nesting")

Decision Making, Example #1

```
if (cd) {
if (--li == 0) {
System.out.println("Insert coin");
if (noc >= 1) {
li += 3;
gameOn();
} else {
endGame();
}
}
else
gameOn();
}
gameOn();
```

Easy to understand?
Do you now comprehend the importance of styling?

Decision Making, Example #1

```
if (characterDied) {
        if (--lives == 0) {
                System.out.println("Insert coin");
                if (numberOfCoins >= 1) {
                        lives += 3;
                        gameOn();
                } else {
                        endGame();
                }
        } else {
                gameOn();
        }
}
gameOn();
```

Indentation.
What a relief!

Ternary operator

- The operator is a combination of an '`if..else`' statement and an expression.
- It evaluates to a value according to the condition:

```
int years = 40;
System.out.println("You are " + (years < 30? "young" : "old"));
int daysInYear =  (years % 4 == 0 && years % 100 != 0) ? 366 :
                  years % 400 == 0 ? 366 : 365;
```

Decision Making: `switch`

- Similar to **`if`**, more suitable in multi-conditional blocks.
- Syntax:

```
switch (byte/short/char/int) {
        case val1: block1 break;
        case val2: block2 break;
                .
                .
        default: default_block break;
}
```

Decision Making, Example #2

```
Scanner s = new Scanner(System.in);
char choice = s.next().toUpperCase().charAt(0);
switch (choice) {
        case 'A': playAgain();    break;
        case 'P': pause();        break;
        case 'N': next();         break;
        case 'Q': quit();         break;
        default: System.out.println("Unsupported" +
                 " command");     break;
}
```

Decision Making, Example #2

```
if (choice == 'A') {
        playAgain();
} else if (choice == 'P') {
        pause();
} else if (choice == 'N') {
        next();
} else if (choice == 'Q') {
        quit();
} else {
        System.out.println("Unsupported command");
}
```

Fall-Through

```
switch (month) {
    case 2: daysInMonth = 28; break;
    case 4:
    case 6: daysInMonth = 40;
    case 9:
    case 11: daysInMonth = 30; break;
    default: daysInMonth = 31; break;
}
```

Looping: `while, do-while`

- As long as ***`condition`*** is true, run the block over and over again.
- **`do-while`** runs at least once then checks
- **`while`** first checks then runs (hence may never run)
- Syntax:

```
while (condition) block
do block while (condition);
```

Looping, Example #1

```
boolean someoneWon = true;
String winner = "";
do {
        game.playRound();
        winner = game.getWinnerName();
        someoneWon = !winner.isEmpty();
} while (!someoneWon);
System.out.println("The winner is: " + winner);
```

```
do {game.playRound();} while (game.getWinnerName().isEmpty());
```

Looping, Example #2

```
int x = 1024;
while (x > 2) {
        x /= 2;
}
```

- Is this the same?

```
while ((x /= 2) > 2) {}
```

- How about this one?

```
do {} while((x /= 2) > 2);
```

Looping: `for`

- Similar to other loops, more suitable for counting steps.
- Syntax:

```
for (initialization; condition; increment) block
```

1

2
5
8

4
7

3
6

Looping, Example

```
for (int x = 1; x <= 20; ++x) {
        System.out.print(x + ":");
        for (int y = 1; y <= x; ++y) {
                if (x % y == 0)
                        System.out.print(" " +
        }
        System.out.println();
}
```

```
1: 1
2: 1 2
3: 1 3
4: 1 2 4
5: 1 5
6: 1 2 3 6
7: 1 7
8: 1 2 4 8
9: 1 3 9
10: 1 2 5 10
11: 1 11
12: 1 2 3 4 6 12
13: 1 13
14: 1 2 7 14
15: 1 3 5 15
.
Etc..
```

Branching: `break`, `continue`, `return`

- `break` stops the execution of the current `switch`, `for`, `while`, `do-while`
- `continue` stops the execution of the current iteration of the loop
- `return` stops the execution of the current method (future material)

Flow Control, Overall Example

```
private static final int M = 100;
public static void main(String[] args) {
        boolean hd = false; int t = 0;
        for (int n = 3; n <= M; n++) {
                if (0 == n % 2) continue;
                hd = false;
                for (int d = 3; d <= Math.ceil(Math.sqrt(n)); ++d) {
                        if (n % d == 0) {
                                hd = true;
                                break;
                        }
                }
                if (!hd) t++;
        }
        System.out.println(t);
}
```

http://java.sun.com/docs/books/tutorial/java/nutsandbolts/operators.html

http://java.sun.com/docs/books/tutorial/java/nutsandbolts/flow.html

TUTORIALS

Following slides:

- Styling conventions
- Best practices

Styling conventions
'if', 'while', 'for'

'if', general format:

```
if (condition) {
    block1
}
--------------------------
if (condition) {
    block1
} else  {
    block2
}
--------------------------
if (condition1) {
    block1
} else if (condition2) {
    block2
}
```

'while', general format:

```
while (condition);
--------------------------
while (condition) {
    block1
}
--------------------------
do {
    block1
} while (condition);
```

Styling conventions

'if', 'while', 'for'

'for', general format:

```
for (init; condition; step;) {
    block1
}
--------------------------
for (init; condition; step;);
--------------------------
for (init1, init2; condition; step1, step2;) {
    block1
}
--------------------------
```

Always use braces for controlled blocks, even if they include a single row.

- Bad:

```
While (i % 2 == 0) i++;
if (i % 2 == 0)
    i++;
--------------------------
```

- Good:

```
if (i % 2 == 0) {
    i++;
}
```

Styling conventions
'if', 'while'

- If the boolean condition is too long, prefer breaking after logical operators, then indent twice to differentiate from block code:

```
if (a > b + 1000 &&
        c > d.someLongMethodName() ||
        e.someMethod().someBooleanMethod()) {
    i++;
}
```

Styling conventions

all boolean conditions

- In a boolean expression, use nothing or ! Instead of == true or == false:
  - Good:

```
if (!a.someMethod()) {
if (a > b) {
```

  - Bad:

```
if (a.someMethod() == false) {
if (a > b == true) {
```

Styling conventions
'for'

- If the condition is too long, prefer breaking after logical operators, and indent twice to differentiate from block code:

```
for (init; a > b &&
            c > d.someLongMethod() ||
            e < f + 50000 / g.otherMethod;
            step;) {
    block1
}
```

Styling conventions

'switch'

'switch', general format:

```
switch (value) {
case value1: block1; break;
case value2: block1; break;
        .
        .
default: block1; break;
}
```

Prefer writing cases in a single line, where possible

```
switch (x) {
case 1: x++; break;
case 2: x++; y = x; break;
case 3: {
    x++;
    y = x;
    z = someStaticMethod;
    break;
}
default: block1; break;
}
```

Styling conventions

ternary operator ('?')

'?', general format:

```
condition ? block1; : block2;
```

If nested, prefer differentiating with parentheses

```
condition1 ? (condition2 ? block1 : block2) : block3;
```

Best practices

- Prefer using `'else if'` over nesting.
- Use `'break'` even in the `default` case.
- Prefer `'break'` over boolean flags
- Prefer writing blocks shorter than 10 lines. If longer, consider writing a separate method.

Best practices

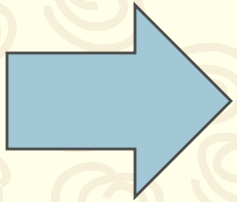
- Prefer writing the shorter blocks first:

```
if (condition) {
        line1;
} else {
        line1;
        line2;
        line3;
        line4;
}
```

Best practices

- If an ‘if’ block exits the method, omit the ‘else’ block:

```
if (condition) {
        line1;
        return true;
} else {
        line2;
        return false;
}
```



```
if (condition) {
        line1;
        return true;
}
line2;
return false;
```