Limitations of sequential programming

- Cannot choose whether or not to perform a command/instruction
- Cannot perform the same command more than once
- Such programs are extremely limited!

Control Structures

- Allow a program to base its behavior on certain conditions

- Two kinds:
  - Conditional (If) Statements
  - Loop Structures

Recap: Boolean

- Boolean is one of the eight primitive types
  - Only 2 values: true, or false
  - Booleans are used to make yes or no decisions
  - All control structures use Booleans

- The following expression each give a Boolean result:
  - \( (25 > 24) \text{ && } (12 == 13) \) \text{ results to false}
  - \( (25 > 24) \text{ || } (12 == 13) \) \text{ results to true}

- Thus based on certain conditions we can alter the outcome or flow of the program
Conditionals ("if" statements)

- An “if” statement is a **flow control** statement
- It is also called a **conditional**, or a branch
- We’ll see several “flavors”
  - An “if” all by itself
  - An “if” with an “else” part
  - An “if” with an “else if” part

//Assume x is an integer
if (x > 10) {
    x = x * 2;
    System.out.println("x = " + x);
}

//Assume x is an integer
if (x > 0) {
    System.out.println(x + " is positive");
} else {
    System.out.println(x + " is negative");
}

"if" statement

```java
if (condition) {
    statement(s)
}
```

*If the condition is true, then the statement(s) (i.e. instructions) will be executed. Otherwise, it/they won’t.*

//Assume x is an integer
if(x > 10) {
    x = x * 2;
    System.out.println("x = " + x);
}

"if-else" statement

```java
if (condition) {
    statement(s)
} else {
    statement(s)
}
```

//Assume x is an integer
if(x > 0) {
    System.out.println(x + " is positive");
} else {
    System.out.println(x + " is negative");
}

If statement (contd..)

- {} indicates the block of code that will get executed given the condition is true
- You can avoid the curly brace after condition if only one statement is to be performed
  - If using Dr Java Interaction pane, best to use {}
### If-else Flow chart

- **Condition?**
  - True: Statement(1)
  - False: Statement(s)

### Style Rule: Indentation and Spacing
- Recommended indentation is from 2 to 4 spaces, but **must be consistent** throughout the program.
- In Dr Java you can set the indent level:
  1. **Edit > Preferences >Miscellaneous**
- Single space around every binary operator, including comparisons and assignment (=)

```java
if (x < 10) {
    x = x + 1;
} else {
    x = x - 1;
}
```

### Cascading “if-else”

**Example**

```java
//Assume variable score is entered by user
if (score > 90)
    System.out.println("Grade A");
else if (score > 80)
    System.out.println("Grade B");
else if (score > 65)
    System.out.println("Grade C");
    .
    .
else
    System.out.println("F");

//Note: You can avoid the curly brace after condition if only one statement is to be performed
```

### Nested if-statements

**An if within an if**

```java
if (condition1){
    if (condition2){
        statement(s) A
    } else{
        statement(s) B
    }
} else {
    statement(s) C
}
```

**Truth Table**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What values must the conditions have in order for block A to run? B? C?**

- condition1: T
- condition2: F

---

**Statement(s) A**

```java
//Asume variable score is entered by user
if (score > 90)
    System.out.println("Grade A");
else if (score > 80)
    System.out.println("Grade B");
else if (score > 65)
    System.out.println("Grade C");
    .
    .
else
    System.out.println("F");
```

**Statement(s) B**

```java
if (x < 10) {
    x = x + 1;
} else {
    x = x - 1;
}
```

**Statement(s) C**

```java
if (condition1){
    if (condition2){
        statement(s) A
    } else{
        statement(s) B
    }
} else {
    statement(s) C
}
```
The infamous “dangling else”

<table>
<thead>
<tr>
<th>Code</th>
<th>Notes</th>
</tr>
</thead>
</table>
| if (x > y)  
  if (y < z)  
    statementA;  
  else  
    statementB; | When is statementB executed?  
In other words, which if is the else paired with? |

- An else is paired with the last else-less if, regardless of spacing, unless {} dictate otherwise.

```c
if (x > y) {  
  if (y < z) {  
    statementA;  
  }  
} else {  
  statementB;  
}
```