CSE 142

Conditional Statements & Boolean Expressions

Outline

- Conditional statements – *if*
- Boolean expressions
  - Comparisons (<, <=, >, >=, !=, ==)
  - Boolean operators (and, or, not - &&, ||, !)
- Class invariants

withdraw Method for BankAccount

```
/** Withdraw the requested amount from this BankAccount */
public void withdraw(double amount) {
    balance = balance - amount;
}
```

- Critique: is this good/bad/incomplete?

Class Invariants

- In many cases, the state of an object must obey some rules to have a sensible value
  - For a BankAccount, some rules might be:
    - that balance >= 0.0 always
    - that the account must have a non-empty name
- These rules are examples of ***invariants***
  - Things that must always be true, if the program is operating correctly
  - Invariants concerning the state of objects are called class invariants

More About Invariants

- Invariants are *not* syntax rules of Java
- Advice:
  - Write down invariants as comments
  - When you implement methods, double check that you never violate the invariants
- Very powerful bug prevention technique
- Java 1.4 has a special statement to help check invariants
  - *assert* (to be discussed at another time)

A Better *withdraw* Method

- Specification

```
/** Withdraw requested amount from this BankAccount provided that the
 *   balance is at least as large as the amount requested.  Otherwise do nothing */
public void withdraw(double amount) {...
```

  - Comment in the spec. changes, but not the Java (yet)
- We want to say (in Java) something like

  "if the amount is less than or equal to the balance, withdraw the amount"
- Java solution: *if* statement
  - Or "conditional" statement

withdraw Method Implementation

```
/** Withdraw requested amount from this BankAccount provided that the
 *   balance is at least as large as the amount requested.  Otherwise do nothing */
public void withdraw(double amount) {
    if (amount <= balance) {
      balance = balance – amount;
    }
}
```

If Statement Syntax

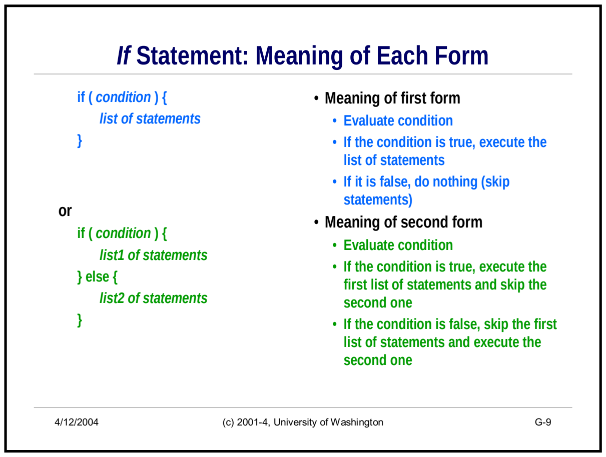
- Syntax

```
if ( condition ) {
    list of statements
}
```

or

```
if ( condition ) {
    list1 of statements
} else {
    list2 of statements
}
```

- *condition* must be a Boolean expression – one that is either true or false
- *list of statements* may contain any Java statements, including if(!)



If Statement: Meaning of Each Form

```
if ( condition ) {
    list of statements
}

or
if ( condition ) {
    list1 of statements
} else {
    list2 of statements
}
```

- Meaning of first form
  - Evaluate condition
  - If the condition is true, execute the list of statements
  - If it is false, do nothing (skip statements)
- Meaning of second form
  - Evaluate condition
  - If the condition is true, execute the first list of statements and skip the second one
  - If the condition is false, skip the first list of statements and execute the second one

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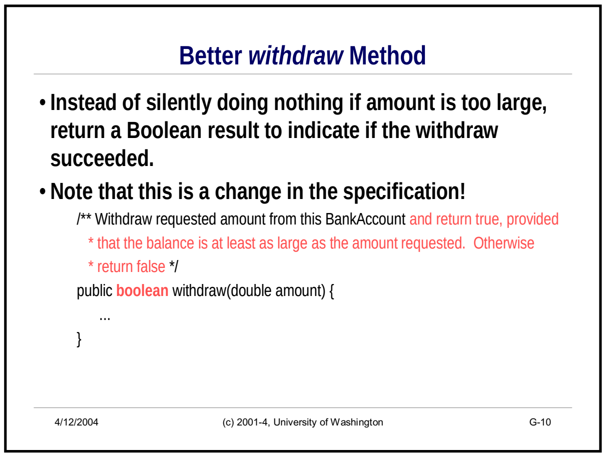

Better *withdraw* Method

- Instead of silently doing nothing if amount is too large, return a Boolean result to indicate if the withdraw succeeded.
- Note that this is a change in the specification!

```
/** Withdraw requested amount from this BankAccount and return true, provided
  * that the balance is at least as large as the amount requested.  Otherwise
  * return false */
public boolean withdraw(double amount) {
    ...
}
```

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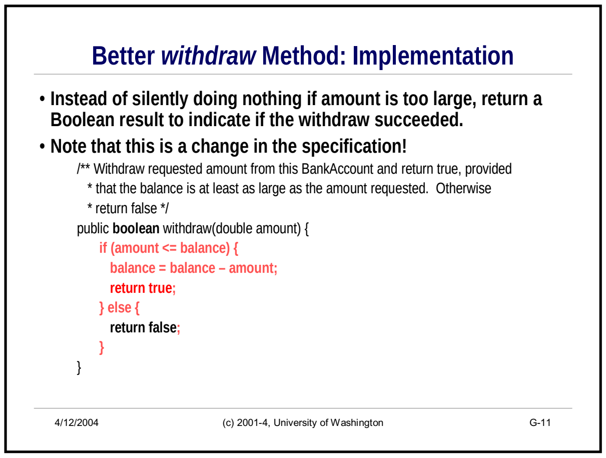

Better *withdraw* Method: Implementation

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```
/** Withdraw requested amount from this BankAccount and return true, provided
  * that the balance is at least as large as the amount requested.  Otherwise
  * return false */
public boolean withdraw(double amount) {
    if (amount <= balance) {
        balance = balance – amount;
        return true;
    } else {
        return false;
    }
}
```

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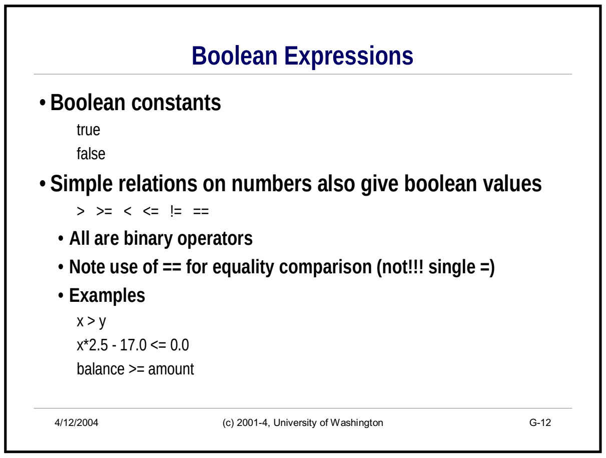

Boolean Expressions

- Boolean constants

  true
  false
- Simple relations on numbers also give boolean values

  > >= < <= != ==
  - All are binary operators
  - Note use of == for equality comparison (not!!! single =)
  - Examples

    x > y
    x*2.5 - 17.0 <= 0.0
    balance >= amount

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Boolean Operators

- Make complex boolean expressions from simpler boolean expressions
- && means "and"
  - true if *both* expressions are true, false otherwise

```
x > 10 && x <= 100
```

    - Can only compare two things at a time; can't do 10 < x <= 100
- || means "or"
  - true if *either* expression is true, false only if both are false

```
x > y || x <= 0
```

- ! means "not"
  - true if expression is false

```
! (x < y)          // means same thing as x >= y
```

Practice With Boolean Expressions

- Suppose x is 10 and y is two. What is the value of each expression?
  - x < 9
  - x == y – 8
  - x >= 0
  - y == 0 || x != 3
  - y != x && x > y
  - !(x < y)

Exercise

- Recall that the statement

```
System.out.println("Hi there!");
```

  will write a message (in this case, "Hi there!")
- Exercise 1: assume that we have a double variable called *temperature* holding the outside temperature. Write the message "Too Hot!" if the temperature is above 80.
- Exercise 2: use the variable *temperature* as above, but this time write "Too Hot!" if the temperature is above 80, "Too Cold!" if it is below 60, and "Just Right" if it is in between.

Solution to Exercise 1

Solution to Exercise 2

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Summary

- Invariants
- Conditional execution – *if* statement
- Boolean expressions
  - Comparisons
  - Operators – and, or, not

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