ITI 1120
Lab #3 - Branching

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Reminder…

- Assignment 2 is available – to be completed individually.
- Questions on lab 2 and assignments 1.

Lab Agenda

- Logical Expressions
- AND versus OR
- Complex Conditions
- Branch Instructions
- Exercises

Boolean Expressions

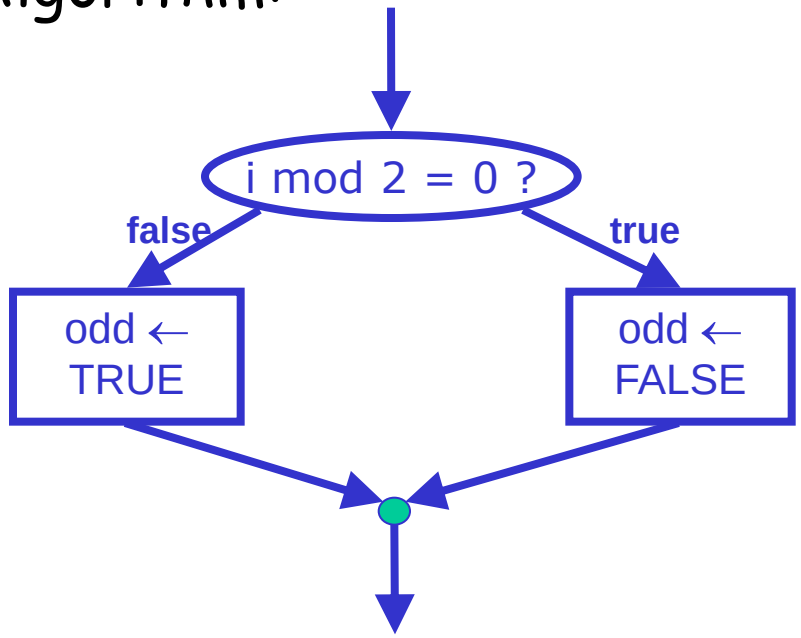
- Evaluate to true or false
- Translations from pseudocode to Java for:

Pseudocode	Java
←	= (not a Boolean expression)
AND	`&&`
OR	`||`
NOT	`!`
A = B	`A == B`
A ≤ B	`A <= B`
A ≥ B	`A >= B`
A ≠ B	`A != B`

Boolean Expressions, Example 1

- Write a test that returns TRUE if integer I is odd; the test should return FALSE otherwise.

Algorithm:



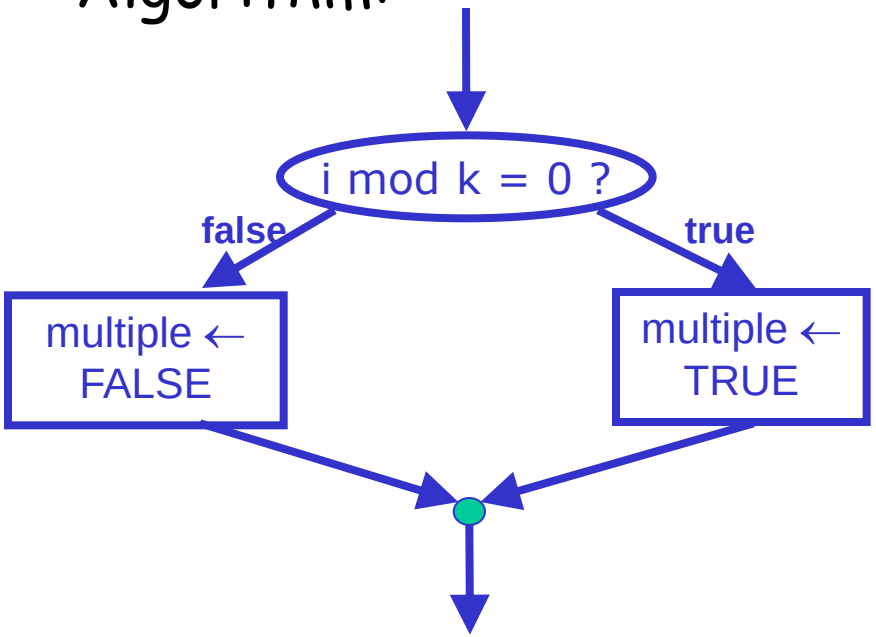
Java:

```
// assume i has a value
boolean odd;
if (i % 2 == 0)
{
    odd = false;
}
else
{
    odd = true;
}
```

Boolean Expressions: Example 2

- Write a test that returns TRUE if integer I is a multiple of positive integer K; the test should return FALSE otherwise.

Algorithm:



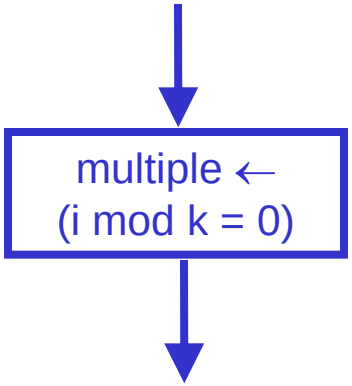
Java:

```
// assume i, k have values
boolean multiple;
if (i % k == 0)
{
   multiple = true;
}
else
{
   multiple = false;
}
```

Boolean Expressions: Example 2

- Another approach…

Algorithm:



Java:

```
// i and k have values…
boolean multiple;
multiple = (i % k == 0);
```

AND and OR

- Used for combining conditions
- Use brackets to make sure compound expressions mean what you want them to mean.
- Anywhere our pseudocode language calls for a "test" you may use ANY Boolean expression
- What is the value of the following expressions?

((room = STE0131) OR (room = STE2052)) AND (lab = ITI1220)

TRUE

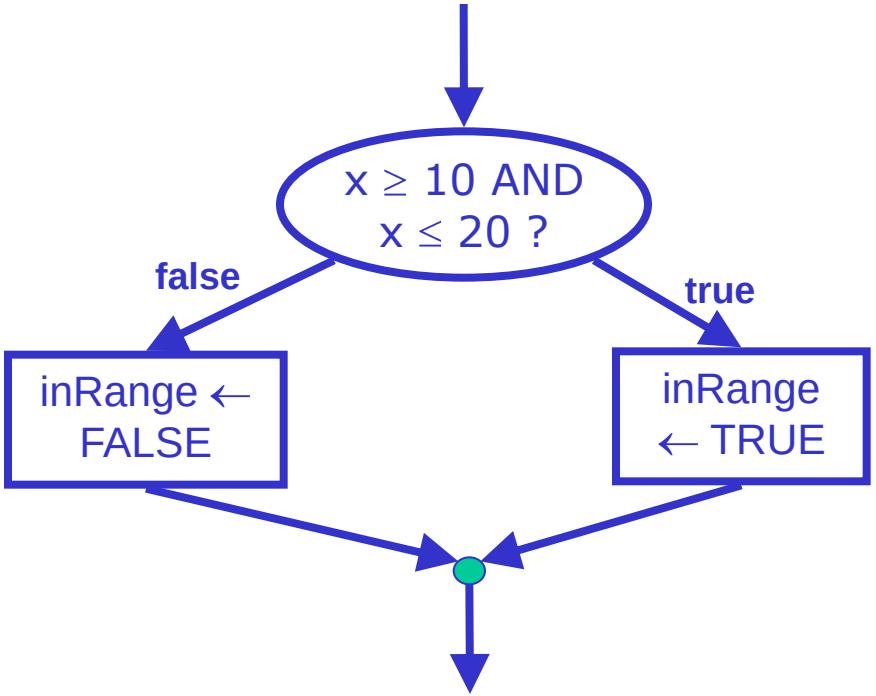
(I am at home) OR (I am in the office) TRUE

(I am at home) AND (I am in the office) FALSE

Boolean Expressions: Example 3

- Write a test that returns TRUE if x is between 10 and 20 (inclusive); the test should return FALSE otherwise

Algorithm:



Java:

```
// assume x has a value
boolean inRange;
if ( (x>=10) && (x<=20) )
{
    inRange = true;
}
else
{
    inRange = false;
}
```

AND versus OR

- In the last slide:
  - We used: `((x>=10) && (x<=20))` to test whether `x` is between 10 and 20.

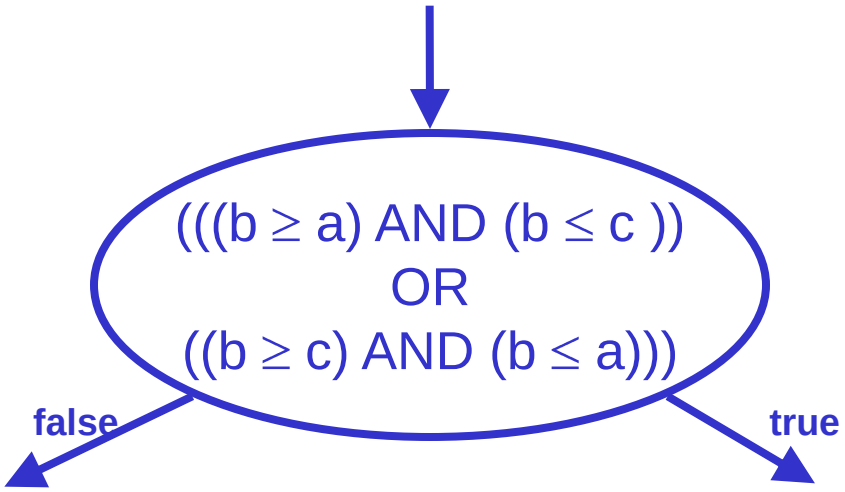
- What if we used OR `||` instead of AND `&&`
  - Suppose `x` is 7.
  - If we had `((x>=10) || (x<=20))`:

    `x<=20` is TRUE, and so the entire expression is TRUE: but `x` is not between 10 and 20.

Boolean Expressions, Example 4

- Write a test that is TRUE if b's value is in between a's value and c's value (but, we don't know whether a is bigger than c or vice versa).

Algorithm:



Java:

```
if (((b>=a) && (b<=c)) ||
    ((b>=c) && (b<=a)))
{
    // b is between a and c
}
else
{
    // b is outside range
}
```

Exercises – A few guidelines

- For these exercises you will develop software by first creating algorithms and then translating them to Java.
  - Create your algorithm in Word and use Visio (or other similar drawing tool) to create the algorithm model. Template files in Word are provided – often part of the work is already done for you.
  - To create the Java program, always start with Template.java.

Exercise 1

- Write a Boolean expression that evaluates true if the age is between 18 and 55 inclusively.
  - Develop a problem solving method with one parameter (GIVEN), the age, and a Boolean result – true if age is in the interval and false otherwise.
  - Complete the program with a main algorithm that request an age from the user and prints "Transaction accepted" if the age is within the interval and "Transaction refused" otherwise.
  - Translate your algorithms to Java.

Exercise 2

- As activity director at Dows Lake in Ottawa, it is your responsibility to suggest appropriate activities to guests based on the temperature (temp):

  temp $\geq$ 80: swimming

  60 $\leq$ temp < 80: soccer

  40 $\leq$ temp < 60: volleyball

  temp < 40: skiing

- The main algorithm will ask the user for a temperature value, call the problem solving algorithm to obtain an activity number and then display the activity (the name, not the number).
- Develop a problem solving algorithm with one GIVEN, the temperature, and one RESULT, an activity number: 1(swimming), 2(soccer), 3 (volleyball) or 4 (skiing).
- Translate your algorithms to Java.

Exercise 3

- Develop a program that determines whether an integer is divisible by 2 and 3, whether it is divisible by 2 or 3 (but not both), or not divisible by either 2 or 3.
  - The **main** algorithm requests an integer value from the user to get the integer number and prints a message giving the result.
  - The **isDivisible** algorithm analyses the integer and returns an integer that indicates the result: 1 (divisible by 2 and by 3), 2 (divisible by 2 or by 3), 0 (not divisible by either 2 or 3).
  - Translate your algorithms to Java.

Exercise 4

- Develop a program that determines the number or real roots that exist for the quadratic equation:

  $ax^2 + bx + c = 0$ (a, b, c are real constants).

- The main algorithm will request from the use the values of the coefficients a, b, and c, and display the results – the number of real roots.
- The problem solving algorithm using the 3 coefficient values (GIVENS) determines the number or real roots as the result.
- Translate your algorithms to Java.

Exercise 4 (continued)

- Some hints:
  - GIVENS: a, b, and c
  - Recall how to calculate the roots of a quadratic equation:

$$\text{roots} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{where } \Delta = b^2 - 4ac \text{ (the discriminant)}$$

  - The value of the discriminant indicates the number of real roots for the equation:
    - Less than 0 – no real roots
    - Equals 0 – a single real root (actually 2 identical roots)
    - Greater than 0 – two distinct roots
  - The algorithm gives one RESULT, the number of real roots.

Exercice 4

- Try your program with the following values for the coefficients:
  - a = 1.23456789
  - b = 2.4691356
  - c = 1.23456789
  - The real answer is 1 root (note that the discriminant is 0 when a = c = $\frac{1}{2}$ b, try with a=1.3, b=2.6, c=1.3).
  - But it is possible (and probable) that your program did not give the right answer
    - The solution does not give the right answer.
  - Can you explain why?