Topic 11
Scanner objects, conditional execution

" There are only two kinds of languages:
the ones people complain about
and the ones nobody uses."

— Bjarne Stroustroup, creator of C++

Based on slides by Marty Stepp and Stuart Reges
from http://www.buildingjavaprograms.com/

Input and `System.in`

- **interactive program**: Reads input from the console.
  - While the program runs, it asks the user to type input.
  - The input typed by the user is stored in variables in the code.
  - Can be tricky; users are unpredictable and misbehave.
  - But interactive programs have more interesting behavior.

- **`Scanner`**: An object that can read input from many sources.
  - Communicates with `System.in`
  - Can also read from files (Ch. 6), web sites, databases, ...

`Scanner` syntax

- The `Scanner` class is found in the `java.util` package.

```
import java.util.Scanner;
```

- Constructing a `Scanner` object to read console input:

```
Scanner name = new Scanner(System.in);
```

  - Example:

```
Scanner console = new Scanner(System.in);
```

`Scanner` methods

Method	Description
`nextInt()`	reads an `int` from the user and returns it
`nextDouble()`	reads a `double` from the user
`nextLine()`	reads a one-*line* `String` from the user
`next()`	reads a one-word `String` from the user Avoid when Scanner connected to System.in

- Each method waits until the user presses Enter.
- The value typed by the user is returned.

- **prompt**: A message telling the user what input to type.

```
System.out.print("How old are you? ");  // prompt
int age = console.nextInt();
System.out.println("You typed " + age);
```

Scanner example

```
import java.util.Scanner;

public class UserInputExample {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("How old are you? ");
        int age = console.nextInt();

        int years = 65 - age;
        System.out.println(years + " years until retirement!");
    }
}
```

age	29
years	36

- Console (user input underlined):

```
How old are you? 29
36 years until retirement!
```

`Scanner` example 2

- The `Scanner` can read multiple values from one line.

```
import java.util.Scanner;
public class ScannerMultiply {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);

        System.out.print("Please type two numbers: ");
        int num1 = console.nextInt();
        int num2 = console.nextInt();

        int product = num1 * num2;
        System.out.println("The product is " + product);
    }
}
```

- Output (user input underlined):

```
Please type two numbers: 8 6
The product is 48
```

Clicker 1 - Input tokens

- **token**: A unit of user input, as read by the `Scanner`.
  - Tokens are separated by *whitespace* (spaces, tabs, new lines).
  - How many tokens appear on the following line of **input**?

```
23  John Smith   42.0  "Hello world"  $2.50  "  19"
```

A. 2 B. 6 C. 7

D. 8 E. 9

input tokens

- When a token is the wrong type, the program crashes. (runtime error)

```
System.out.print("What is your age? ");
int age = console.nextInt();
```

Output:

```
What is your age? Timmy
java.util.InputMismatchException
 at java.util.Scanner.next(Unknown Source)
 at java.util.Scanner.nextInt(Unknown Source)
        ...
```

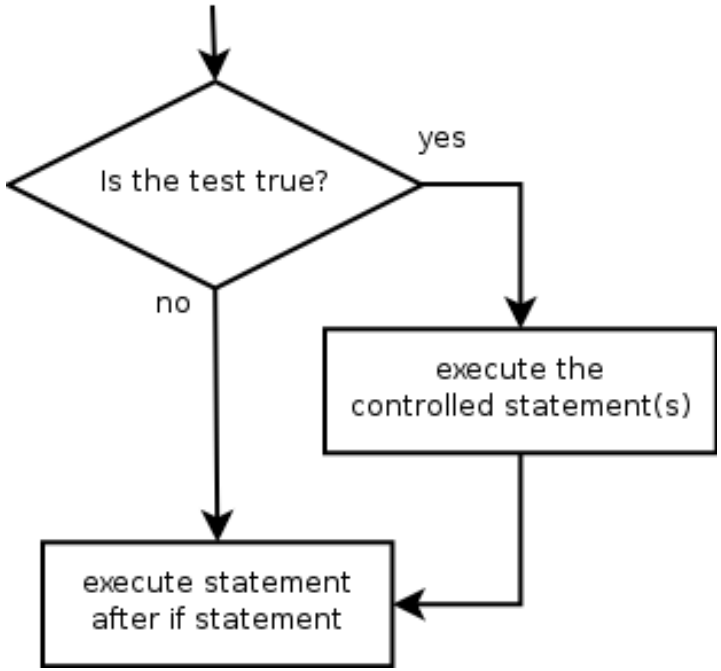
The `if/else` statement

reading: 4.1

The `if` statement

Executes a block of statements only if a test is true

```
if (test) {
    statement;
    ...
    statement;
}
```



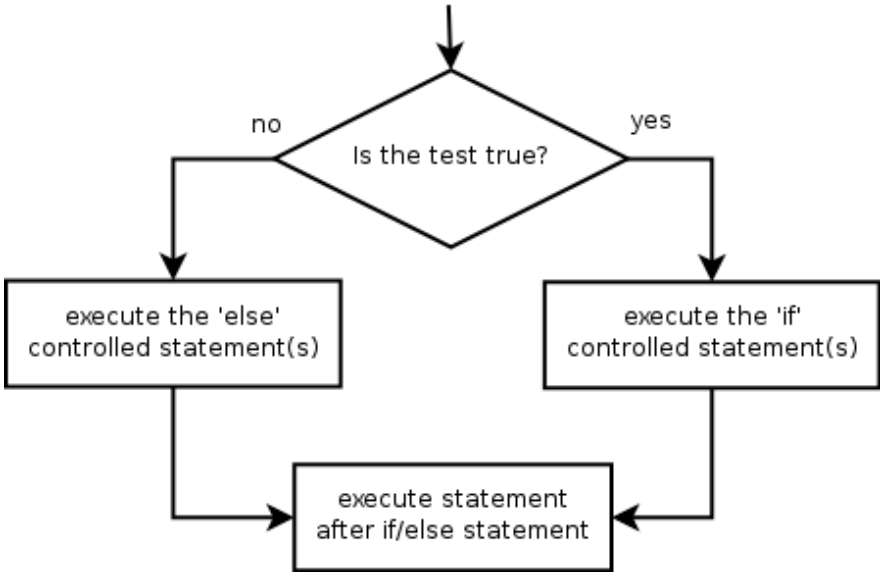
- Example:

```
double gpa = console.nextDouble();
if (gpa >= 2.0) {
    System.out.println("Application accepted.");
}
```

The `if/else` statement

Executes one block if a test is true, another if false

```
if (test) {
    statement(s);
} else {
    statement(s);
}
```



- Example:

```
double gpa = console.nextDouble();
if (gpa >= 2.0) {
    System.out.println("Welcome to Mars University!");
} else {
    System.out.println("Application denied.");
}
```

Relational expressions

- `if` statements and `for` loops both use logical tests.

```
for (int i = 1; i <= 10; i++) { ...
if (i <= 10) { ...
```

  - These are `boolean` expressions, seen in Ch. 5.

- Tests use *relational operators*:

Operator	Meaning	Example	Value
==	equals	1 + 1 == 2	true
!=	does not equal	3.2 != 2.5	true
<	less than	10 < 5	false
>	greater than	10 > 5	true
<=	less than or equal to	126 <= 100	false
>=	greater than or equal to	5.0 >= 5.0	true

Logical operators

- Tests can be combined using *logical operators*:

Operator	Description	Example	Result
`&&`	and	`(2 == 3) && (-1 < 5)`	`false`
`||`	or	`(2 == 3) || (-1 < 5)`	`true`
`!`	not	`!(2 == 3)`	`true`

- "Truth tables" for each, used with logical values *p* and *q*:

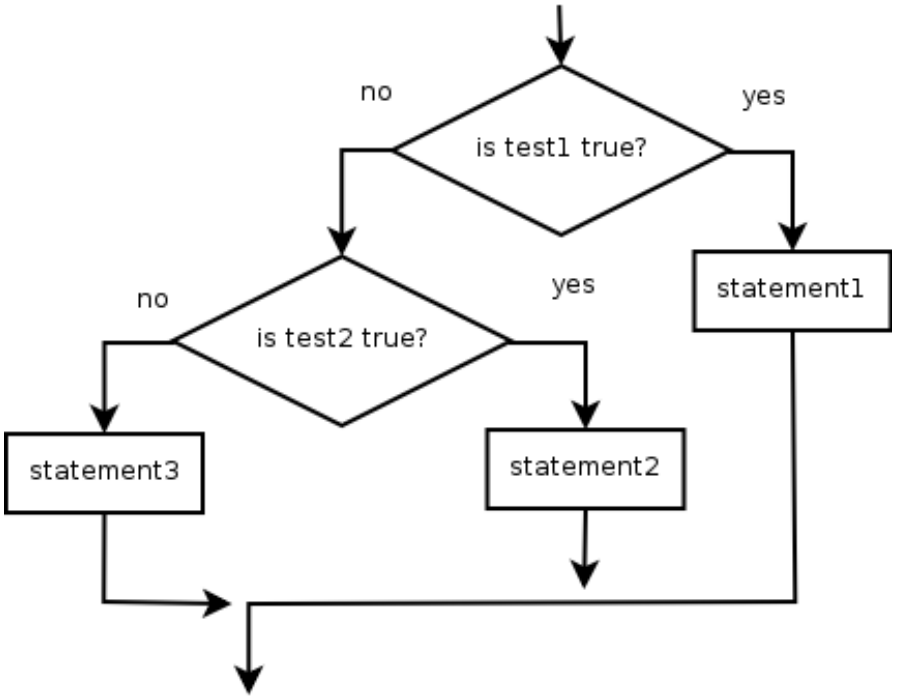
p	q	p && q	p || q
true	true	true	true
true	false	false	true
false	true	false	true
false	false	false	false

p	!p
true	false
false	true

Nested `if/else`

Chooses between outcomes using many tests

```
if (test) {
    statement(s);
} else if (test) {
    statement(s);
} else {
    statement(s);
}
```



- Example:

```
if (x > 0) {
    System.out.println("Positive");
} else if (x < 0) {
    System.out.println("Negative");
} else {
    System.out.println("Zero");
}
```

Exercises

- Write a method that prints out if it is good weather to go for a bike ride. The weather is good if the temperature is between 40 degrees and 100 degrees inclusive unless it is raining, in which case the temperature must be between 70 degrees and 110 degrees inclusive
- Write a method that returns the largest of three numbers using if statements
- Write a method that determines if one day is before another day (given month and day)

Exercise

- Prompt the user to enter two people's heights in inches.
  - Each person should be classified as one of the following:
    - short (under 5'3")
    - medium (5'3" to 5'11")
    - tall (6' or over)
  - The program should end by printing which person is taller.

```
Height in feet and inches: 5 7
You are medium.

Height in feet and inches: 6 1
You are tall.

Person #2 is taller than person #1.
```

Exercises

- Write a method that simulates rolling 2 six sided dice a given number of time and returns the number of times a given value is the sum of the two dice when rolled.
- Write a method that determines if a number is a perfect number. A perfect number equals the sum of its integer divisors, excluding itself

  6 = 1 + 2 + 3, perfect

  8 > 1 + 2 + 4, deficient

  12 < 1 + 2 + 3 + 4 + 6, excessive

Exercises

- Write a method that determines if we have time to go out for lunch. Inputs are distance to restaurant, average walking speed, time required to finish meal, time available, expected cost of meal, and money available
- times are expressed as whole number of minutes
- money is expressed as a double