University of British Columbia
CPSC 111, Intro to Computation
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Objects, Input

Lecture 7, Wed Jan 20 2010

borrowing from slides by Kurt Eiselt

http://www.cs.ubc.ca/~tmm/courses/111-10

News

- Midterm location announced: FSC 1005
  - for both Feb 28 and Mar 22 midterms
- Assignment 1 out
  - due Wed 3 Feb at 5pm, by electronic handin

Recap: Classes, Methods, Objects

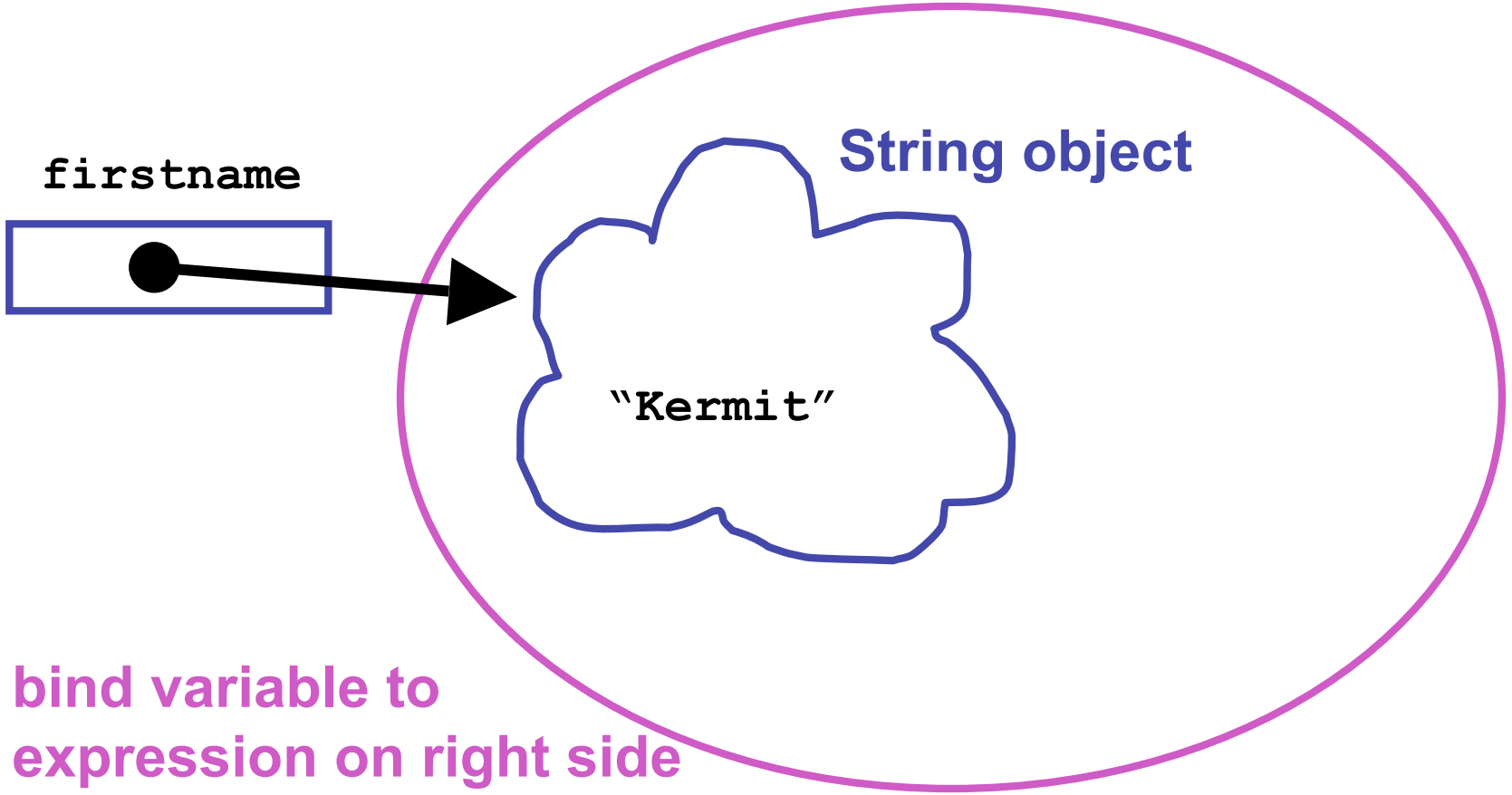
- Class: complex data type
  - includes both data and operations
  - programmers can define new classes
  - many predefined classes in libraries
- Method: operations defined within class
  - internal details hidden, you only know result
- Object: instance of class
  - entity you can manipulate in your program

Recap: Declare vs. Construct Object

```
public static void main (String[] args) {
        String firstname;
        firstname = new String ("Kermit");
}
```

- Variable declaration does not create object
  - creates object reference
- Constructor and new operator creates object somewhere in memory
  - constructors can pass initial data to object
- Assignment binds object reference to created object
  - assigns address of object location to variable

Recap: Declare vs. Construct Object

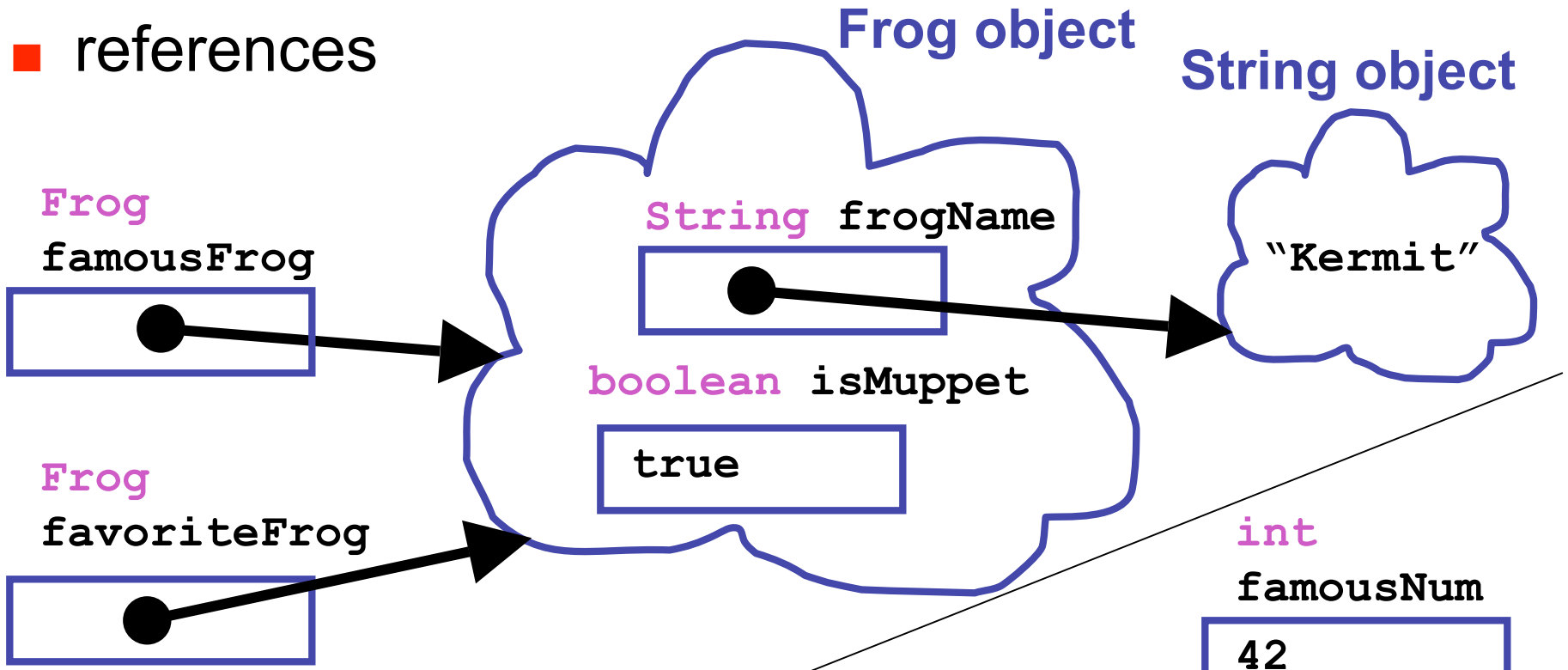


bind variable to expression on right side of assignment operator

expression on right side of assignment operator

Recap: Objects vs. Primitives

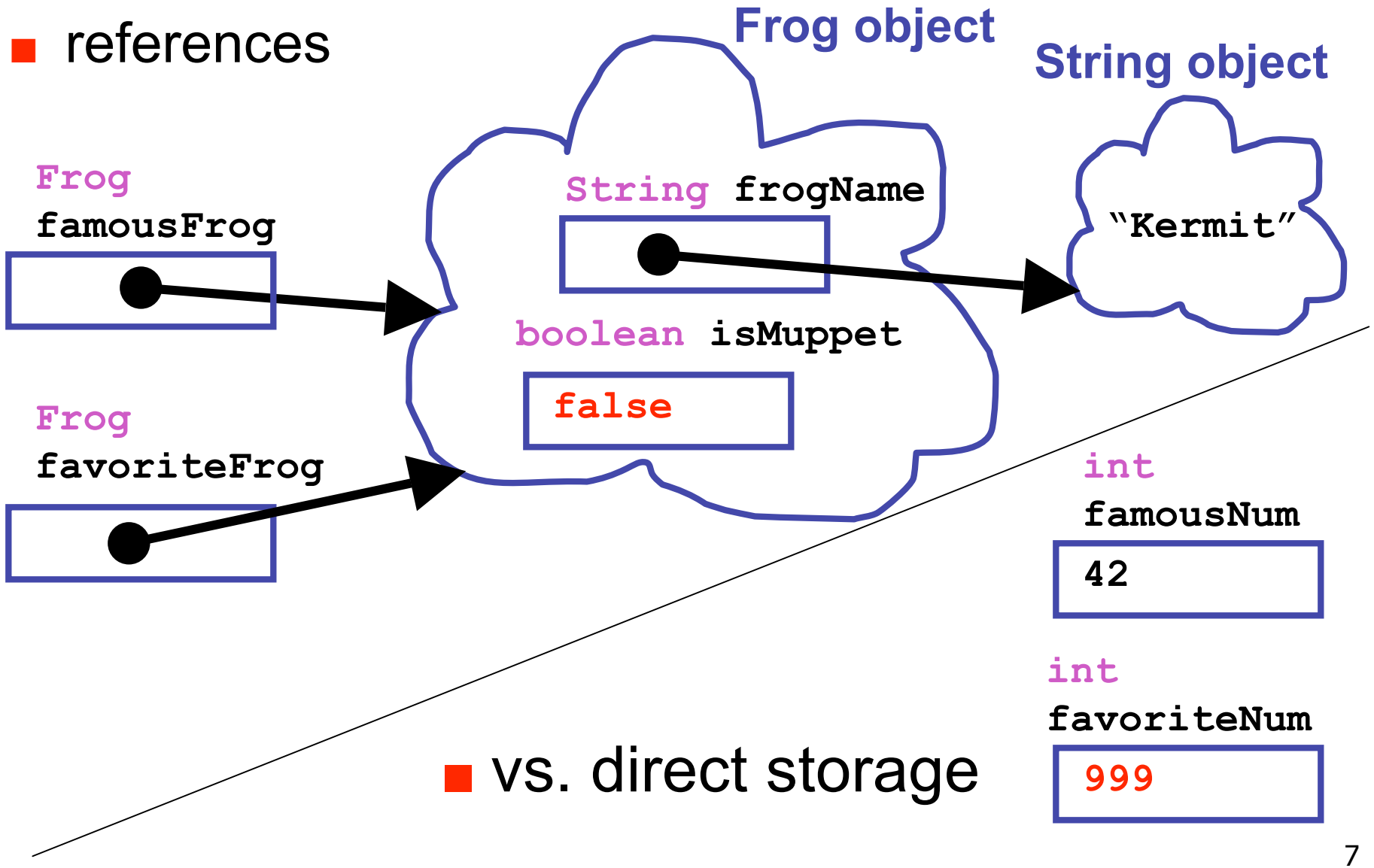
- references



- vs. direct storage

Recap: Objects vs. Primitives

- references



- vs. direct storage

Recap: API Documentation

- Online Java library documentation at http://java.sun.com/javase/6/docs/api/
  - textbook alone is only part of the story
  - let's take a look!

- Everything we need to know: critical details
  - and often many things far beyond current need

- Classes in libraries are often referred to as Application Programming Interfaces
  - or just API

Recap: Some Available String Methods

`public String toUpperCase();`
Returns a new **`String`** object identical to this object but with all the characters converted to upper case.

`public int length();`
Returns the number of characters in this **`String`** object.

`public boolean equals( String otherString );`
Returns true if this **`String`** object is the same as **`otherString`** and false otherwise.

`public char charAt( int index );`
Returns the character at the given index. Note that the first character in the string is at index 0.

Recap: More String Methods

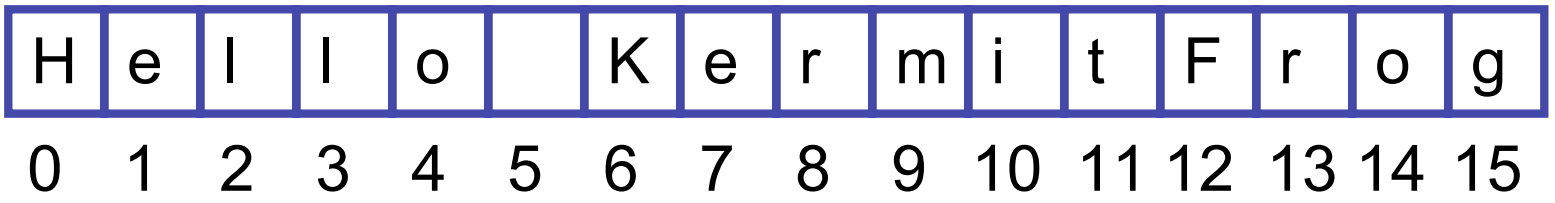
`public String replace(char oldChar, char newChar);`
Returns a new **`String`** object where all instances of **`oldChar`** have been changed into **`newChar`**.

`public String substring(int beginIndex);`
Returns new **`String`** object starting from **`beginIndex`** position

`public String substring( int beginIndex, int endIndex );`
Returns new **`String`** object starting from **`beginIndex`** position and ending at **`endIndex`** position

- up to but not including endIndex char:

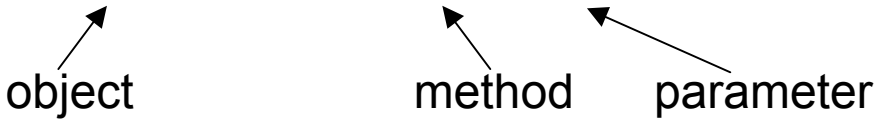
`substring(4, 7)` **`"o K"`**



Recap: Methods and Parameters

- Methods are how objects are manipulated
  - pass information to methods with parameters
    - inputs to method call
    - tell `charAt` method which character in the String object we're interested in
  - methods can have multiple parameters
    - API specifies how many, and what type
  - two types of parameters
    - explicit parameters given between parens
    - implicit parameter is object itself

```
String firstname = "Alphonse";
char thirdchar = firstname.charAt(2);
```



Recap: Return Values

- Methods can have return values
- Example: **`charAt`** method result
  - return value, the character 'n', is stored in **`thirdchar`**

```
String firstname = "kangaroo";
char thirdchar = firstname.charAt(2);
```

return value object method parameter

- Not all methods have return values
  - No return value indicated as `void`

Recap: Constructors and Parameters

- Many classes have more than one constructor, taking different parameters
  - use API docs to pick which one to use based on what initial data you have

Constructor Summary

`String()`
Initializes a newly created `String` object so that it represents an empty character sequence.

`String(String original)`
Initializes a newly created `String` object so that it represents the same sequence of characters as the argument; in other words, the newly created string is a copy of the argument string.

```
animal = new String();
animal = new String("kangaroo");
```

Classes, Continued

- A class has a name.
- A class should describe something intuitively meaningful. Why did someone create this class?
- A class describes the data stored inside objects in the class. (Nouns)
- A class describes the legal operations that can be done to the data. (Verbs)
- Example in Book: `java.awt.Rectangle`

Primitive Types vs. Classes

Primitive Types	Classes
Pre-defined in Java	Written by other programmers or by you
Simplest things, e.g., `int`	Can be arbitrarily complex
Operators: +, -, …	Methods
Values belong to types. E.g., 3 is an `int`, 3.14159 is a `double`	**Objects** belong to classes E.g., you are a UBC Student

Objects Belong to Classes

- Just as 1, 2, and 3 are all integers,
  you are all **objects** of the class UBCStudent!
  - You each have names, ID numbers, etc.
  - Each is unique person, but all are students
- Social organizations example:
  - Ballroom Dance Club
  - Ski Club
  - CSSS
  - Etc.
- Sometimes called “instances” of a class.

Class Libraries

- Before making new class yourself, check to see if someone else did it already
  - libraries written by other programmers
  - many built into Java
- Examples (built into Java)
  - BigInteger (java.math.BigInteger) lets you compute with arbitrarily big integers.
  - Date (java.util.Date) lets you get the current time.
  - Calendar (java.util.Calendar) does fancy date computations.

Example: BigInteger

```
import java.math.BigInteger;
// Tell Java to use standard BigInteger package

public class GetRichQuick {
  public static void main(String[] args) {
    BigInteger salary = new BigInteger("111222333444555666777888999");
    BigInteger stockOptions = new
        BigInteger("1000000000000000000000000000000");
    BigInteger profitPerShare = new BigInteger("314159");

    BigInteger optionCompensation =
   stockOptions.multiply(profitPerShare);
    BigInteger totalCompensation = salary.add(optionCompensation);

    System.out.println("Total Compensation = $" +
        totalCompensation.toString());
  }
}
```

BigInteger Constructors

```
import java.math.BigInteger;
// Tell Java to use standard BigInteger package

public class GetRichQuick {
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    BigInteger optionCompensation =
   stockOptions.multiply(profitPerShare);
    BigInteger totalCompensation = salary.add(optionCompensation);

    System.out.println("Total Compensation = $" +
        totalCompensation.toString());
  }
}
```

Literals

- With the primitive types, how do you create values with that type?

  E.g., how do we create integer values?

  1. You type some digits, like 3, or 42
  2. You combine integer-valued things with operators that work on integers, e.g.,

     3+42*(a-b)

Literals

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  1. **You type some digits, like 3, or 42**
  2. You combine integer-valued things with operators that work on integers, e.g.,

     3+42*(a-b)

- A bunch of digits are an integer **literal**.
  - It's the basic way to create an integer value

More Literals

- How about a value of type double?
    1. You type a bunch of digits with a decimal point, and optionally the letter e or E followed by an exponent
    2. You can combine doubles with operators that work on doubles.

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  2. You can combine doubles with operators that work on doubles.

Those are literals!

Long Literals

- How about values of type long?
  1. You type a bunch of digits followed by the letter l or L
  2. You combine previously created longs

Literals – General Pattern

- To create values of a primitive type:
    1. There's some way to type a **literal**
    2. There are operators that create values of the given type.

Literals for Classes?

- Classes are like primitive types, except they can be defined any way you like, and they can be much more complex.
- How to create a value (an object) of a given class?
    1. Invent some way to type a literal???
    2. Operators that create objects of that class (methods).

Constructors!

- A **constructor** is the equivalent of a literal for a class. It's how you create a new object that belongs to that class.
- Examples:

  new BigInteger("999999")

  new Rectangle(10, 20, 30, 40)

  new UBCStudent("Joe Smith",12345678,…)

Constructor Syntax

- The reserved word `new`
- Followed by the name of the class
- Followed by an open parenthesis (
- Followed by an parameters (information needed to construct the object)
- Followed by a closing parenthesis)

Using Constructors

- Use a constructor just as you'd use a literal.

Example:

- For the int type:

```
int a = 3;
```

- For the BigInteger class:

```
BigInteger a = new BigInteger("3");
```

Primitive Types vs. Classes

Primitive Types	Classes
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Operators: +, -, …	Methods
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Literals	Constructors

What about `String`?

- Is `String` a primitive type? Is it a class?
- `String` is a class, but it's a special class!
  - Automatically imported
  - Built-in literals, e.g., "This is a String literal."
  - + operator for concatenation
- But it also has many other methods, that you can call, just like for any ordinary class…

String Example – Constructor Syntax

```
public class StringTest
{
    public static void main (String[] args)
    {
        String firstname;
        String lastname;
        firstname = new String ("Kermit");
        lastname = new String ("the Frog");
        System.out.println("I am not " + firstname
                           + " " + lastname);
    }
}
```

String Example - Literal Syntax

```
public class StringTest
{
    public static void main (String[] args)
    {
        String firstname;
        String lastname;
        firstname= "Kermit";
        lastname= "the Frog";
        System.out.println("I am not " + firstname
                           + " " + lastname);
    }
}
```

String is the only class that supports both literals and constructors!

Escape Characters

- How can you make a String that has quotes?
  - `String foo = "oh so cool";`
  - `String bar = "oh so \"cool\", more so";`
- Escape character: backslash
  - general principle

Keyboard Input

- Want to type on keyboard and have Java program read in what we type
  - store it in variable to use later
- Want class to do this
  - build our own?
  - find existing standard Java class library?
  - find existing library distributed by somebody else?

- Scanner class does the trick
  - `java.util.Scanner`
  - nicer than `System.in`, the analog of `System.out`

Scanner Class Example

```
import java.util.Scanner;

public class Echo
{
    public static void main (String[] args)
    {
        String message;
        Scanner scan = new Scanner (System.in);
        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

Scanner Class Example

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        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- Import Scanner class from java.util package

Importing Packages

- Collections of related classes grouped into packages
  - tell Java which packages to keep track of with import statement
  - again, check API to find which package contains desired class
- No need to import String, System.out because core **`java.lang`** packages automatically imported

Scanner Class Example

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        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- Declare string variable to store what user types in

Scanner Class Example

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public class Echo
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    public static void main (String[] args)
    {
        String message;
        Scanner scan = new Scanner (System.in);
        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- Use Scanner constructor method to create new Scanner object named scan
  - could be named anything, like **`keyboardStuff`** or **`foo`**

Scanner Class Example

```
import java.util.Scanner;

public class Echo
{
    public static void main (String[] args)
    {
        String message;
        Scanner scan = new Scanner (System.in);
        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- Prompt user for input

Scanner Class Example

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import java.util.Scanner;

public class Echo
{
    public static void main (String[] args)
    {
        String message;
        Scanner scan = new Scanner (System.in);
        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- `nextLine` method reads all input until end of line
  - returns it as one long string of characters

Scanner Class Example

```
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public class Echo
{
    public static void main (String[] args)
    {
        String message;
        Scanner scan = new Scanner (System.in);
        System.out.println ("Enter a line of text: ");
        message = scan.nextLine();
        System.out.println ("You entered: \""
                            + message + "\"");
    }
}
```

- Print out the message on the display

Scanner Class Example

- Let’s try running it