

CSC 222: Object-Oriented Programming

Fall 2017

Objects and classes: a first pass

- software objects, classes, object-oriented design
- BlueJ IDE, compilation & execution, *figures example*
- method calls, parameters
- data types, object state
- other examples: *Die*, *SequenceGenerator*

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Object-oriented programming

the *object-oriented* approach to programming:

- solve problems by modeling real-world objects
e.g., if designing a banking system, model clients, accounts, deposits, ...
- a program is a collection of interacting objects
- in software, objects are created from classes
the class describes the kind of object (its properties and behaviors)
the objects represent individual instantiations of the class

REAL WORLD CLASS: automobiles

REAL WORLD OBJECTS: my 2011 Subaru Outback, the batmobile, ...

- the class encompasses all automobiles
they all have common properties: color, seats, wheels, engine, brakes, ...
they all have common behaviors: can sit in them, start them, accelerate, steer, ...
- each car object has its own specific characteristics and ways of producing behaviors
my car is white & seats 5; the batmobile is black & seats 2
accelerating with V-4 is different than accelerating with jet engine

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Die example

Dice



- what properties do all dice share?
how can these be different for different dice objects?
- what behaviors do all dice share?
how can these be different for different dice objects?

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Shape classes and objects

a slightly more abstract example involves shapes

- class: circles
what properties do all circles share?
what behaviors do all circles exhibit?

- objects:



similarly, could define classes and object instances for other shapes

- squares:



- triangles:



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BlueJ and software shapes

the BlueJ interactive development environment (IDE) is a tool for developing, visualizing, and debugging Java programs

- BlueJ was developed by researchers at Deakin University (Australia), Maersk Institute (Denmark), and University of Kent (UK)
- supported by Oracle (previously Sun Microsystems), the developers of Java
- BlueJ includes an editor, debugger, visualizer, documentation viewer, ...

we will start with a visual example in BlueJ: drawing shapes

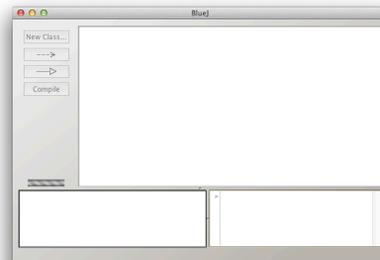
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Starting up BlueJ

to start up the BlueJ IDE, double-click on the BlueJ desktop icon

this opens the BlueJ main window

- in order to create and execute a program, must first create or load a *project*
- a project groups together all the files needed to produce a working program
- e.g., could create a project for the entire semester, or HW by HW



to create a new BlueJ project

- click on the `Project` heading at the top left & select `New Project`
- enter the project name and location

to open an existing BlueJ project

- click on the `Project` heading at the top left & select `Open Project`
- browse to locate and select the project

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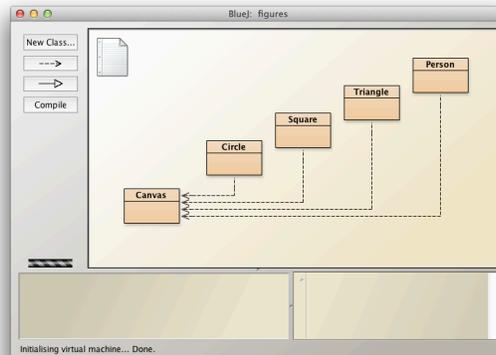
Loading the figures project

download `figures.zip` from the class Code directory

- save it on the Desktop and double-click to unzip
- in BlueJ, select `Open Project`
- browse to select `figures`

when a project loads, its classes are shown in a diagram

- here, there are 5 classes
- Canvas represents a painting area
- Circle, Square, Triangle, and Person represent shapes
- the arrows show that the shapes depend upon the Canvas class



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Editing and compiling classes

you can view/edit a class definition by double-clicking on its box

- this opens the associated file in the BlueJ editor

before anything can be executed, the classes must be compiled

- recall, the Java compiler translates Java source code into Java byte code
- to compile all classes in a project, click on the `Compile` button
(note: non-compiled classes are shaded, compiled classes are not)

IMPORTANT: classes don't act, objects do!

- you can't drive the class of all automobiles
- but you can drive a particular instance of an automobile

in order to draw a circle, must create a circle object

- then, can specify properties of that instance (radius, color, position, ...)

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Example: creating a circle

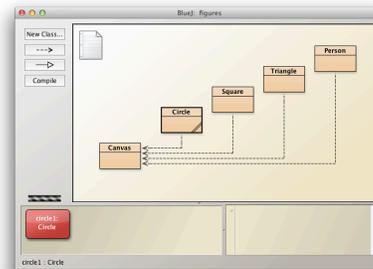
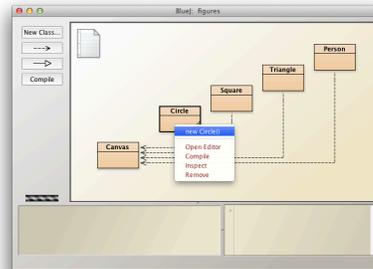
right-click on a class to see all the actions that can be applied

- select `new Circle()` to create a new object
- you will be prompted to specify a name for that object (circle1 by default)

the new Circle object appears as a box at the bottom of the screen

- note: classes and objects look different

EXERCISE: create 2 circles, a square, and a triangle



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Applying object methods

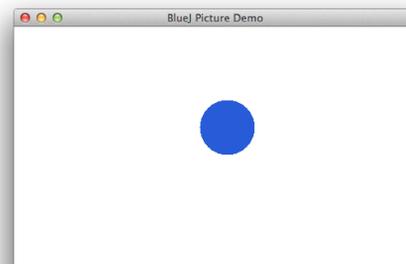
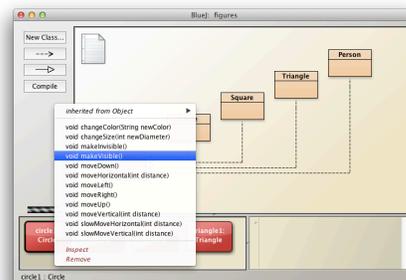
can cause objects to act by right-clicking on the object box, then selecting the action

- the actions that objects can perform are called *methods*
(same as in Python: a method is a function that belongs to an object.)
- here, `void makeVisible()` opens a Canvas in which the shape is displayed

EXERCISE: make the other shapes visible

EXERCISE: select other methods to change the color and size of objects

EXERCISE: play



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Methods and parameters

sometimes an action (i.e., method) requires information to do its job

- the `changeColor` method requires a color ("red", "green", "black", ...)
- the `moveHorizontal` method requires a number (# of pixels to move)
- data values provided to a method are called *parameters*

Java provides for different types of values

- `String` is a sequence of characters, enclosed in double-quotes (e.g., "red")
- `int` is an integer value (e.g., 40)
- `double` is a real value (e.g., 3.14159)
- `char` is a character value (e.g., 'A')
- the parameter to `changeColor` is a `String` representing the new color
- the parameter to `moveHorizontal` is an `int` representing the # of pixels to move

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Objects and state

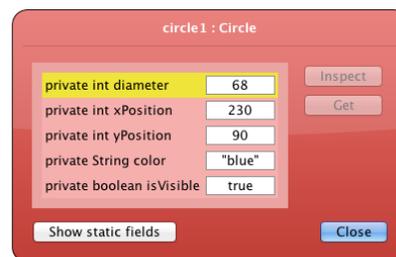
recall that each object has properties and methods associated with it

- when you create a `Circle`, it has an initial size, color, position, ...
- those values are stored internally as part of the object
- as methods are called, the values may change
- at any given point, the property values of an object define its *state*

BlueJ enables you to inspect state of an object

- right-click on the object
- select `Inspect` to see the values of object properties

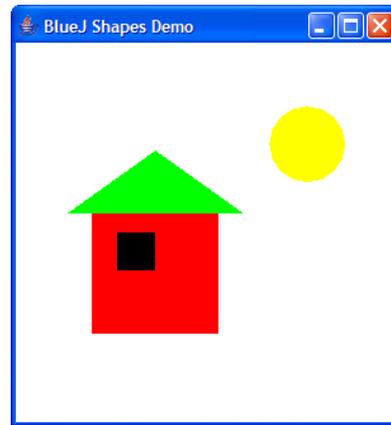
note: objects of the same class have the same properties, but may have different values



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IN-CLASS EXERCISE

create objects and call the appropriate methods to produce a picture like this



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Another example: Die class

can define a Die class to model different (numeric) dice

- properties shared by all dice: number of sides, number of times rolled
- behaviors/methods shared by all dice: roll it, get # of sides, get # of rolls
- the `roll` method generates a random roll and *returns* it
the return value is displayed by BlueJ in a *Method Result* window

```
// Rolls the die, updating the number of rolls.
// @return random number between 1 and getNumSides()
int roll()
```

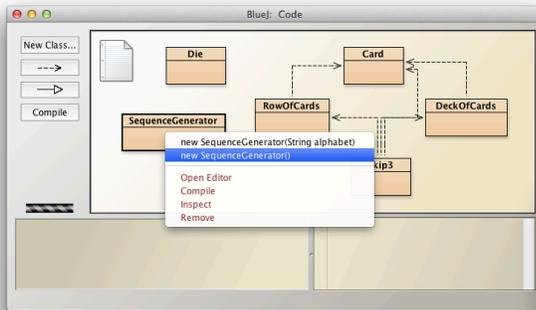
die1.roll()
returned:
int 6

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Another example: SequenceGenerator

there are two options for creating a SequenceGenerator object

- can specify an alphabet to choose from (e.g., "etaoinshrd")
- if nothing specified, will assume "abcdefghijklmnopqrstuvwxyz"



The screenshot shows the BlueJ Method Result window. It contains the following code:

```
// Generates a random letter sequence of the specified length
// @param seqLength the number of letters in the random sequence
// @return the random letter sequence
String randomSequence(int seqLength)
```

Below the code, it shows the method call: `sequence2.randomSequence(6)` and the returned value: `String "giibcc"`. There are buttons for 'Inspect', 'Get', and 'Close'.