CSUS COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
Department of Computer Science

CSc 133 – Object-Oriented Computer Graphics Programming
Spring 2019
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Assignment #1: Class Associations & Interfaces

Due Date: Monday, February 25th (11:59 PM)

Introduction

This semester we will study object-oriented graphics programming and design by developing a simple video game we'll call *Robo-Track.* In this game you will be controlling a robot moving on a track defined by bases, while trying to avoid collisions with drones and other robots and keeping your robot charged with energy.

The goal of this first assignment is to develop a good initial class hierarchy and control structure by designing the program in UML and then implementing it in Codename One (CN1). This version will use keyboard input commands to control and display the contents of a "game world" containing the set of objects in the game. In future assignments many of the keyboard commands will be replaced by interactive GUI operations, and we will add graphics, animation, and sound. For now we will simply simulate the game in "text mode" with user input coming from the keyboard and "output" being lines of text on the screen.

Program Structure

Because you will be working on the same project all semester, it is extremely important to organize it correctly from the beginning. Pay careful attention to the class structure described below and make sure your program follows this structure accurately.

The primary class in the program encapsulates the notion of a ***Game***. A game in turn contains several components, including (1) a ***GameWorld*** which holds a collection of *game objects* and other *state variables*, and (2) a **`play()`** method to accept and execute user commands. Later, we will learn that a component such as *GameWorld* that holds the program's data is often called a *model*.

The top-level *Game* class also manages the *flow of control* in the game (such a class is therefore sometimes called a *controller*). The controller enforces rules such as what actions a player may take and what happens as a result. This class accepts input in the form of keyboard commands from the human player and invokes appropriate methods in the game world to perform the requested commands – that is, to manipulate data in the game model.

In this first version of the program the top-level *Game* class will also be responsible for displaying information about the state of the game. In future assignments we will learn about a separate kind of component called a *view* which will assume that responsibility.

When you create your CN1 project, you should name the main class as ***Starter***. Then you should modify the **`start()`** method of the *Starter* class so that it would construct an instance of the *Game* class. The other methods in *Starter* (i.e., *init(), stop(), destroy()*) should not be altered or deleted. The *Game* class must extend from the build-in **`Form`** class (which lives in **`com.codename1.ui`** package). The *Game* constructor instantiates a *GameWorld*, calls a *GameWorld* method **`init()`** to set the initial state of the game, and then starts the game by calling a *Game* method **`play()`**. The **`play()`** method then accepts keyboard commands from the player and invokes appropriate methods in *GameWorld* to manipulate and display the data and game state values in the game model. Since CN1 does not support getting keyboard input from command prompt (i.e., the standard input stream, **`System.in`**, supported in Java is not available in CN1) the commands will be entered via a text field added to the form (the *Game class)*. Refer to "Appendix – CN1 Notes" for the code that accepts keyboard commands through the text field located on the form.

The following shows the pseudo-code implied by the above description. It is important for things that we will do later that your program follows this organization:

```
class Starter {
//other methods
    public void start() {
        if(current != null){
            current.show();
            return;
        }
        new Game();
    }
//other methods
}
```

```
public class GameWorld {
   public void init(){
      //code here to create the
      //initial game objects/setup
   }
   // additional methods here to
   // manipulate world objects and
   // related game state data
}
```

```
import com.codename1.ui.Form;
public class Game extends Form{
   private GameWorld gw;

   public Game() {
      gw  = new GameWorld();
      gw.init();
      play();
   }

   private void play() {
      // code here to accept and
      // execute user commands that
      // operate on the game world
      //(refer  to  "Appendix  -  CN1
      //Notes" for accepting
      //keyboard  commands  via  a  text
      //field located on the form)
   }
}
```

Game World Objects

For now, assume that the game world size is fixed and covers 1024(width) x 768(height) area (although we are going to change this later). The origin of the "world" (location (0,0)) is the lower left hand corner. The game world contains a collection which aggregates objects of abstract type ***GameObject***. There are two kinds of abstract game objects called: "fixed objects" of type ***Fixed*** with fixed locations (which are fixed in place) and "moveable objects" of type ***Movable*** with changeable locations (which can move or be moved about the world). For this first version of the game there are two concrete types that fixed objects are instantiated from which are called: ***Base*** and ***EnergyStation***; and there are two concrete types that moveable objects are instantiated from which are called: ***Robot*** and ***Drone***. Later we may add other kinds of game objects (both fixed kinds and moveable kinds) as well.

The various game objects have attributes (fields) and behaviors (methods) as defined below. These definitions are requirements which must be properly implemented in your program.

- All game objects have an integer attribute *size.* All game objects provide the ability for external code to obtain their size. However, they do not provide the ability to have their size changed once it is created. As will be specified in the later assignments, each type of game object has a different shape which can be bounded by a square. The size attribute provides the length of this bounding square. All bases and all robots have the same size (chosen by you), assigned when they are created (e.g, size of all bases can be 10 and size of all robots can be 40). Sizes of the rest of the game objects are chosen randomly when created, and constrained to a reasonable positive integer value (e.g., between 10 to 50). For instance, size of one of the energy station may be 15 while size of energy station can may be 20.

- All game objects have a *location*, defined by floating point (you can use **`float`** or **`double`** to represent it) non-negative values X and Y which initially should be in the range 0.0 to 1024.0 and 0.0 to 768.0, respectively. The point (X,Y) is the center of the object. Hence, initial locations of all game objects should always be set to values such that the objects' centers are contained in the world. All game objects provide the ability for external code to obtain their location. By default, game objects provide the ability to have their location *changed*, unless it is explicitly stated that a certain type of game object has a location which cannot be changed once it is created. Except bases and robots, initial locations of all the game objects should be assigned randomly when created.

- All game objects have a *color*, defined by a **`int`** value (use static **`rgb()`** method of CN1's built-in **`ColorUtil`** class to generate colors). All objects of the same class have the same color (chosen by you), assigned when the object is created (e.g, bases could be blue, robots could be red, energy stations can be green). All game objects provide the ability for external code to obtain their color. By default, game objects provide the ability to have their color *changed*, unless it is explicitly stated that a certain type of game object has a color which cannot be changed once it is created.

- *Bases* are fixed game objects that have attribute *sequenceNumber*. Each base is a numbered marker that acts as a "waypoint" on the track; following the track is accomplished by moving over the top of bases in sequential order. Bases are not allowed to change color once they are created. All bases should be assigned to locations chosen by you, when they are created.

- *Energy stations* are fixed game objects that have an attribute *capacity* (amount of energy an energy station contains). The initial capacity of the energy station is proportional to its size. If the player robot is running low on energy, it must go to an energy station that is not empty before it runs out of energy; otherwise it cannot move.

- All fixed game objects are not allowed to change location once they are created.

- Moveable game objects have integer attributes *heading* and *speed*. Telling a moveable object to *move()* causes the object to update its location based on its current heading and speed. The movable game objects all move the same way and they move simultaneously according to their individual speed and heading. *Heading* is specified by a *compass angle* in degrees: 0 means heading north (upwards on the screen), 90 means heading east (rightward on the screen), etc. See below for details on updating an movable object's position when its *move()* method is invoked.

- Some movable game objects are *steerable*, meaning that they implement an interface called *ISteerable* that allows other objects to *change* their heading (direction of movement) after they have been created. Note that the difference between *steerable* and *moveable* is that other objects can *request a change in the heading* of *steerable* objects whereas other objects can only request that a *movable* object update its own location according to its current speed and heading.

- *Robots* are moveable and steerable game objects with attributes *steeringDirection, maximumSpeed, energyLevel, energyConsumptionRate, damageLevel,* and *lastBaseReached*.

  The *steeringDirection* of a robot indicates how the steering wheel is turned in relation to the front of the robot. That is, the steering direction of a robot indicates the change the player would *like* to apply to the *heading* along which the robot is moving (the steering direction actually gets applied to the heading when the clock ticks given that the robot moves, e.g., the robot did not run out of energy or does not have the maximum damage or zero speed). The steering mechanism in a robot is such that the steering direction can only be changed in units of 5 degrees at a time, and only up to a maximum of 40 degrees left or right of "straight ahead" (attempts to steer a robot beyond this limit are to be ignored).

  The *maximumSpeed* of a robot is the upper limit of its *speed* attribute; attempts to accelerate a robot beyond its *maximumSpeed* are to be ignored (that is, a robot can never go faster than its *maximumSpeed*). Note that different robots may have different *maximumSpeed* values, although initially they all start out with zero speed value.

  The *energyLevel* of a robot indicates how much energy it has left; robots with no energy would have zero speed and cannot move. You should set this value to the same initial reasonable value for all robots.

  The *energyConsumptionRate* of a robot indicates how much energy the robot would spend each time the clock ticks. You should set this value to the same reasonable value for all robots.

  The *damageLevel* of a robot starts at zero and increases each time the robot collides with another robot or a drone (see below). The program should define an upper limit on the "damage" a robot can sustain. Damage level affects the performance of a robot as follows: a robot with zero damage can accelerate all the way up to its *maximumSpeed*; robots with the maximum amount of damage would have zero speed and thus, cannot move at all; and robots with damage between zero and the maximum damage should be limited in speed to a corresponding percentage of their speed range (for example, a robot with 50% of the maximum damage level can only achieve 50% of its maximum speed). When a robot incurs damage because it is involved in a collision (see below), its speed is reduced (if necessary) so that this speed-limitation rule is enforced.

  The *lastBaseReached* of a robot indicates the sequence number of the last base that the robot has reached in the increasing order.

  Initially, the player robot should be positioned at the location of base #1 (initially *lastBaseReached* is assigned to 1) and its heading and steering direction should be assigned to zero and speed should be assigned to an appropriate positive (non-zero) value.

- Later we may add other kinds of game objects to the game which are steerable.

- Drones are moveable (but not steerable) objects which fly over the track. They add (or subtract) small random values (e.g., 5 degrees) to their heading while they move so as to not run in a straight line. If the drone's center hits a side of the world, it changes heading and does not move out of bounds. If a drone flies directly over a robot it causes damage to the robot; the damage caused by a drone is half the damage caused by colliding with another robot but otherwise affects the performance of the robot in the same way as described above. Drones are not allowed to change color once they are created. Speed of drones should be initialized to a reasonable random value (e.g., ranging between 5 and 10) at the time of instantiation. Heading of drones should be initialized to a random value (ranging between 0 and 359) at the time of instantiation.

The preceding paragraphs imply several *associations* between classes: an inheritance hierarchy, interfaces such as for *steerable* objects, and aggregation associations between objects and where they are held. You are to develop a UML diagram for the relationships, and then implement it in CN1. Appropriate use of encapsulation, inheritance, aggregation, abstract classes, and interfaces are important grading criteria. Note that an additional important criterion is that *another programmer must not be able to misuse your classes*, e.g., if the object is specified to have a fix color, another programmer should not be able to change its color after it is instantiated.

You must use a tool to draw your UML (e.g., Violet or any other UML drawing tool) and output your UML as a pdf file (e.g., print your UML to a pdf file). Your UML must show all important associations between your entities (and important built-in classes that your entities have associations with) and utilize correct graphical notations. For your entities you must use three-box notation and show all the important fields and methods. You must indicate the visibility modifiers of your fields and methods, but you are not required to show parameters in methods and return types of the methods.

Game Play

When the game starts the player has three "lives" (chances to reach the last base). The game has a *clock* which counts up starting from zero; in this first version of the game the objective is to have the player robot complete the track (which starts from the first base and ends at the last base) in the minimum amount of time. Currently, there is only one robot (the player robot) in the game. Later we will add other robots (non-player robots) and the objective will also include completing the track before the other robots do.

The player uses keystroke commands to turn the robot's steering wheel; this can cause the robot's heading to change (turning the steering wheel only effects the robot's heading under certain conditions; see above). The robot moves one unit at its current speed in the direction it is currently heading each time the game clock "ticks" (see below).

The robot starts out at the first base (#1). The player must move the robot so that it intersects the bases in increasing numerical order. Each time the robot reaches the next higher-numbered base, the robot is deemed to have successfully moved that far along the track and its *lastBaseReached* field is updated. Intersecting bases out of order (that is, reaching a base whose number is *more than* one greater than the most recently reached base, or whose number is less than or equal to the most recently reached base) has no effect on the game.

The energy level of the robot continually goes down as the game continues (energy level goes down even if the robot has zero speed since the electronics on the robot is continually working). If the robot's energy level reaches zero it can no longer move. The player must therefore occasionally move the robot off the track to go to (intersect with) an energy station, which has the effect of increasing the robot's energy level by the capacity of the energy station. After the robot intersects with the energy station, the capacity of that energy station is reduced to zero and a new energy station with randomly-specified size and location is added into the game.

Collisions with other robots or with drones cause damage to the robot; if the robot sustains too much damage it can no longer move. If the robot can no longer move (i.e., due to having maximum damage or no energy), the game stops, the player "loses a life", and the game world is re-initialized (but the number of clock ticks is not set back to zero). When the player loses all three lives the game ends and the program exits by printing the following text message in console: "Game over, you failed!". If the player robot reaches the last base on the track, the game also ends with the following message displayed on the console: "Game over, you win! Total time: #", where # indicates the number of clock ticks it took the player robot to reach the last flag on the track since the start of the game. In later versions of the game, if a non-player robot reaches the last base before the player does, the game will also end with the following message displayed on the console: "Game over, a non-player robot wins!".

The program keeps track of following "game state" values: current clock time and lives remaining. Note that these values are part of the *model* and therefore belong in the *GameWorld* class.

Commands

Once the game world has been created and initialized, the Game constructor is to call a method name **`play()`** to actually begin the game. **`play()`** accepts single-character *commands* from the player via the text field located on the form (the *Game* class) as indicated in the "Appendix – C1 Notes".

Any undefined or illegal input should generate an appropriate error message on the console and ignore the input. Single keystrokes invoke action -- the human hits "enter" after typing each command. The allowable input commands and their meanings are defined below (note that commands are case sensitive):

- 'a' – tell the game world to **a**ccelerate (immediately increase the speed of) the player robot by a small amount. Note that the effect of acceleration is to be limited based on *damage level*, *energy level*, and *maximum speed* as described above.

- 'b' – tell the game world to **b**rake (immediately reduce the speed of) the player robot by a small amount. Note that the minimum speed for a robot is zero.

- 'l' (the letter "ell") – tell the game world to change the *steering direction* of the player robot by 5 degrees to the **l**eft (in the negative direction on the compass). Note that this changes the *direction* of the robot's steering wheel; it does *not* directly (immediately) affect the robot's *heading*. See the "tick" command, below.

- 'r' – tell the game world to change the *steering direction* of the player robot by 5 degrees to the **r**ight (in the positive direction on the compass). As above, this changes the *direction* of the robot's steering wheel, not the robot's *heading*.

- 'c' – **PRETEND** that the player robot has **c**ollided with some other robot; tell the game world that this collision has occurred. (For this version of the program we won't actually have any other robot in the simulation, but we need to provide for testing the effect of such collisions.) Colliding with another robot increases the damage level of the player robot and fades the color of the robot (i.e., the robot color becomes lighter red – throughout the game, the robot will have different shades of red); if the damage results in the player robot not being able to move then the game stops (the player loses a life).

- 'a number between 1-9'– **PRETEND** that the player robot has collided with the base number **x** (which must have a value between 1-9); tell the game world that this collision has occurred. The effect of moving over a base is to check to see whether the number ***x*** is exactly one greater than the base indicated by *lastBaseReached* field of the robot and if so to record *in the robot* the fact that the robot has now reached the next sequential base on the track (update the *lastBaseReached* field of the robot).

- 'e' – **PRETEND** that the player robot has collided with (intersected with) an **e**nergy station; tell the game world that this collision has occurred. The effect of colliding an energy station is to increase the robot's energy level by the capacity of the energy station, reduce the capacity of the energy station to zero, fade the color of the energy station (e.g., change it to light green), and add a new energy station with randomly-specified size and location into the game.

- 'g' – **PRETEND** that a drone has flown over (collided with, ***g****ummed up*) the player robot. The effect of colliding with a drone is to increase the damage to the robot as described above under the description of *drones* and fades the color of the robot (i.e., the robot color becomes lighter red).

- 't' – tell the game world that the "game clock" has **t**icked. A clock tick in the game world has the following effects: (1) if the player robot moves (e.g., did not run out of energy or does not have the maximum damage or zero speed), then the robot's heading should be incremented or decremented by the robot's *steeringDirection* (that is, the steering wheel turns the robot) (2) Drones also update their heading as indicated above. (3) all moveable objects are told to update their positions according to their current heading and speed, and (4) the robot's energy level is reduced by the amount indicated by its *energyConsumptionRate*. (5) the elapsed time "game clock" is incremented by one (the game clock for this assignment is simply a variable which increments with each tick).

- 'd' – generate a **d**isplay by outputting lines of text on the console describing the current game/player-robot state values. The display should include (1) the number of lives left, (2) the current clock value (elapsed time), (3) the highest base number the robot has reached sequentially so far, (4) the robot's current energy level and (5) robot's current damage level. All output should be appropriately labeled in easily readable format.

- 'm' – tell the game world to output a "**m**ap" showing the current world (see below).

- 'x' – e**x**it, by calling the method `System.exit(0)` to terminate the program. Your program should confirm the user's intent (see 'y' and 'n' commands below) to quit before actually exiting.

- 'y' – user has confirmed the exit by saying **y**es.

- 'n' – user has not confirmed the exit by saying **n**o.

Some of commands above indicate that you **PRETEND a collision happens**. Later this semester, your program will determine these collisions automatically[1].

[1] In later assignments we will see how to actually detect on-screen collisions such as this; for now we are simply relying on the user to tell the program via a command when collisions have occurred. Inputting a collision command is deemed to be a statement that the collision occurred; it does not matter where objects involved in the collision actually happen to be for this version of the game as long as they exist in the game.

The code to perform each command must be encapsulated in a <u>separate method</u>. When the *Game* gets a command which requires manipulating the *GameWorld*, the *Game* must invoke a method in the *GameWorld* to perform the manipulation (in other words, it is not appropriate for the *Game* class to be directly manipulating objects in the *GameWorld*; it must do so by calling an appropriate *GameWorld* method). The methods in *GameWorld,* might in turn call other methods that belong to other classes.

When the player enters any of the above commands, an appropriate message should be displayed in console (e.g., after 'b' is entered, print to console something like "breaks are applied").

Additional Details

- The program you are to write is an example of what is called a *discrete simulation*. In such a program there are two basic notions: the ability to *change the simulation state*, and the ability to *advance simulation time*. Changing the state of the simulation has no effect (other than to change the specified values) *until the simulation time is advanced.* For example, entering commands to change the robot's *steering direction* will not actually take effect (that is, will not change the robot's *heading*) until you enter a "tick" command to advance the *time*. On the other hand, entering a *map* command after changing the values *will* show the *new* values even before a tick is entered. You should verify that your program operates like this.

- Method ***init()*** is responsible for creating the initial state of the world. This should include adding to the game world at least the following: a minimum of four *Base* objects, positioned and sized as you choose and numbered sequentially defining the track (you may add more than four initial bases if you like - maximum number of bases you can add is nine); one *Robot*, initially positioned at the base #1 with initial heading, steering direction, of zero, initial positive non-zero speed, and initial size as you choose; at least two *Drone* objects, randomly positioned with a randomly-generated heading and a speed; and at least two *EnergyStation* objects with random location and with random sizes.

- All object initial attributes, including those whose values are not otherwise explicitly specified above, should be assigned such that all aspects of the gameplay can be easily tested (for example, drones should not fly so fast that it is impossible for them to ever cause damage to a robot).

- In this first version of the game, it is possible that some of the abstract classes might not include any abstract methods (or some classes might have fields/methods). Later, we might add such class members to meet the new requirements.

- In order to let a child class set a private field defined in its parent that does not provide a proper public setter for the field, consider having a constructor in the parent that takes in the value to be set as a parameter (**`public MyParentClass(int i) {myField = i;…}`**) and calling this constructor from the child's constructor after generating the value (e.g., **`public MyChildClass() {…;super(value);…}`**). Note that the value could be passed as a parameter to child constructor instead of being generated there. If the field resides in the parent of the parent class, consider having the proper constructor in that class (e.g. **`public MyGrandParentClass(int i) {myField = i;…}`**) and calling it from the constructor of the parent class (e.g., **`public MyParentClass(int i) {super(i);…}`**) to pass the value coming from the child to the grandparent.

- If a setter is defined in a parent class and you want to prevent the child to have an ability to set that value, consider overriding the setter in the child with the method that has empty body implementation (e.g., **`public void setX(int i){}`**)

- All classes must be designed and implemented following the guidelines discussed in class, including:
  - *All data fields must be private.*
  - *Accessors / mutators must be provided, but only where the design requires them.*

- Moving objects need to determine their new location when their *move()* method is invoked, at each time tick. The new location can be computed as follows:

  ```
  newLocation(x,y) = oldLocation(x,y) + (deltaX, deltaY), where
  deltaX = cos(θ)*speed,
  deltaY = sin(θ)*speed,
  ```

  and where **θ** = 90 - heading (90 minus the heading). There is a diagram in course notes (look for the slide title "Computed Animated Location (cont.)" in the "Introduction to Animation" chapter) showing the derivation of these calculations for an arbitrary amount of time; in this assignment we are assuming "time" is fixed at one unit per "tick", so "elapsed time" is 1.

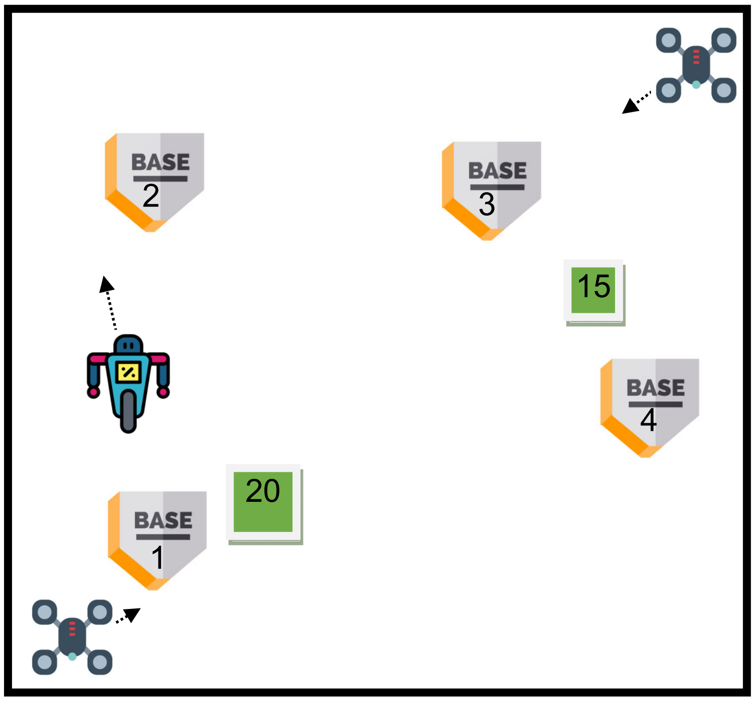
  You can use methods of the built-in CN1 ***Math*** class (e.g., **`Math.cos(), Math.sin()`**) to implement the above-listed calculations in *move()* method. Be aware that these methods expect the angles to be provided in "radians" not "degrees". You can use **`Math.toRadians()`** to convert degrees to radians.

- For this assignment all output will be in text form on the console; no "graphical" output is required. The "map" (generated by the '**m**' command) will simply be a set of lines describing the objects currently in the world, similar to the following:

  ```
  Base: loc=200.0,200.0 color=[0,0,255] size=10 seqNum=1
  Base: loc=200.0,800.0 color=[0,0,255] size=10 seqNum=2
  Base: loc=700.0,800.0 color=[0,0,255] size=10 seqNum=3
  Base: loc=900.0,400.0 color=[0,0,255] size=10 seqNum=4
  Robot: loc=180.2,450.3 color=[255,0,0] heading=355 speed=50 size=40
       maxSpeed=50 steeringDirection=5 energyLevel=5 damageLevel=2
  Drone: loc=70.3,70.7 color=[255,0,255] heading=45 speed=5 size=25
  Drone: loc=950.6,950.3 color=[255,0,255] heading=225 speed=10 size=20
  EnergyStation: loc=350.8,350.6 color=[0,255,0] size=15 capacity=15
  EnergyStation: loc=900.0,700.4 color=[0,255,0] size=20 capacity=20
  ```

  Note that the above "map" describes the game shortly after it has started; the robot has moved northward from its initial position at base #1, the robot is traveling at its maximum speed, the player is trying to apply a 5-degree right turn, and so forth. Note also that the appropriate mechanism for implementing this output is to override the **`toString()`** method in each concrete game object class so that it returns a String describing itself (see the "Appendix – CN1 Notes" below). Please see "Appendix – CN1 Notes" below for also tips on how to print one digit after a decimal point in CN1.

  For this assignment, the only required depiction of the world is the text output map as shown above. **Later we will learn how to draw a *graphical* depiction of the world, which might look something like the image shown below** (the pictures in the image are not all precisely to scale, and note that this is only to give you an idea of what a map may represent – your program is *not* required to produce any graphical output like this).



- You are not required to use any particular data structure to store the game world objects. However, your program must be able to handle changeable numbers of objects at runtime; this means you can't use a fixed-size array, and you can't use individual variables. Consider either the Java *ArrayList* or *Vector* class for implementing this storage. Note that Java Vectors (and ArrayLists) hold elements of type "Object", but you will need to be able to treat the Objects differently depending on the type of object. You can use the "**instanceof**" operator to determine the type of a given Object, but be sure to use it in a polymorphically-safe way. For example, you can write a loop which runs through all the elements of a world Vector and processes each "movable" object with code like:

```
for (int i=0; i<theWorldVector.size(); i++) {
      if (theWorldVector.elementAt(i) instanceof Movable) {
            Movable mObj = (Movable)theWorldVector.elementAt(i);
            mObj.move();
      }
}
```

- You can utilize **java.util.Random** class (see the "Appendix – CN1 Notes" below) to generate random values specified in the requirements (e.g., to generate initial random sizes and locations of objects).

- It is a requirement for _all_ programs in this class that the source code contain *documentation*, in the form of comments explaining what the program is doing, including comments describing the purpose and organization of each class and comments outlining each of the main steps in the code. Points will be deducted for poorly or incompletely documented programs. Use of JavaDoc-style comments is highly encouraged.

- It is a requirement to follow standard Java coding conventions:
  - *class names always start with an upper case letter,*
  - *variable names always start with a lower case letter,*
  - *compound parts of compound names are capitalized (e.g., myExampleVariable),*
  - *Java interface names should start with the letter "I" (e.g., ISteerable).*

- Your program must be contained in a CN1 project called A1Prj. You must create your project following the instructions given at "2 – Introduction to Mobile App Development and CN1" lecture notes posted at SacCT (Steps for Eclipse: 1) File → New → Project → Codename One Project. 2) Give a project name "A1Prj" and uncheck "Java 8 project" 3) Hit "Next". 4) Give a main class name "Starter", package name "com.mycompany.a1", and select a "native" theme, and "Hello World(Bare Bones)" template (for manual GUI building). 5) Hit "Finish".). Further, ***you must verify that your program works properly from the command prompt*** before submitting it to SacCT: First make sure that the A1Prj.jar file is up-to-date. If not, under eclipse, right click on the *dist* directory and say "Refresh". Then get into the A1Prj directory and type (all in one line): "java -cp dist\A1Prj.jar;JavaSE.jar com.codename1.impl.javase.Simulator com.mycompany.a1.Starter" for Windows machines (for the command line arguments of Mac OS/Linux machines please refer to the class notes). Substantial penalties will be applied to submissions which do not work properly from the command prompt.

Deliverables

There are *four steps* which are required for submitting your program, as follows:

1. Be sure to verify that your program works from the command prompt as explained above.

2. Create a "ZIP" file containing (1) your UML diagram in .PDF format, (2) the entire "src" directory under your CN1 project directory (called A1Prj) which includes source code (".java") for all the classes in your program, and (3) the A1Prj.jar (located under the "A1Prj/dist" directory) which is automatically generated by CN1 and includes the compiled (".class") files for your program in a zipped format. Be sure to name your ZIP file as YourLastName-YourFirstName-a1.zip.

3. Create a "TEXT" (i.e., not a pdf, doc etc.) file called "readme.txt" that indicates the system info you have used to generate the .jar file (under dist dir) and test your assignment. List OS, Java, Eclipse, and CN1 versions of your personal machine or list the lab number and machine name if you have used a lab machine. You may also include additional information you want to share with the grader in this text file. You will receive the grader comments on your text file when grades are posted.

4. Login to ***Canvas***, select "Assignment#1", and upload your ZIP file and TEXT file separately (do **NOT** place this TEXT file inside the ZIP file). Also, be sure to take note of the requirement stated in the course syllabus for keeping a *backup copy* of all submitted work (save a copy of your ZIP and TEXT files).

All submitted work must be strictly your own!

Appendix – CN1 Notes

Input Commands

In CN1, since **`System.in`** is not supported, we will use a text field located on the form (i.e. the *Game* class) to enter keyboard commands. The **`play()`** method of *Game* will look like this (we will discuss the details of the GUI and event-handling concepts used in the below code later in the semester):

```
import com.codename1.ui.events.ActionListener;
import com.codename1.ui.Label;
import com.codename1.ui.TextField;
import com.codename1.ui.events.ActionEvent;
import java.lang.String;
private void play()
      {
      Label myLabel=new Label("Enter a Command:");
      this.addComponent(myLabel);
      final TextField myTextField=new TextField();
      this.addComponent(myTextField);
      this.show();

      myTextField.addActionListener(new ActionListener(){

            public void actionPerformed(ActionEvent evt) {

            String sCommand=myTextField.getText().toString();
            myTextField.clear();
            switch (sCommand.charAt(0)) {
                  case 'x':
                        gw.exit();
                        break;
                  //add code to handle rest of the commands
            } //switch
      } //actionPerformed
      } //new ActionListener()
      ); //addActionListener
      } //play
```

Random Number Generation

The class used to create random numbers in CN1 is **`java.util.Random`**. This class contains several methods including **`nextInt()`**, which returns a random integer from the entire range of integers, **`nextInt(int)`**, which returns a random number between zero (inclusive) and the specified integer parameter (exclusive), and **`nextFloat()`**, which returns float value (between 0.0 and 1.0). For instance, if you like to generate a random integer value between **`X`** and **`X+Y`**, you can call **`X + nextInt(Y)`**.

Output Strings

The routine **`System.out.println()`** can be used to display text. It accepts a parameter of type String, which can be concatenated from several strings using the "+"

operator. If you include a variable which is not a String, it will convert it to a String by invoking its *toString()* method. For example, the following statements print out "The value of I is 3":

```
int i = 3 ;
System.out.println ("The value of I is " + i);
```

Every CN1 class provides a *toString()* method inherited from **`Object`**. Sometimes the result is descriptive. However, if the *toString()* method inherited from **`Object`** isn't very descriptive, your own classes should override *toString()* and provide their own String descriptions – including the *toString()* output provided by the parent class if that class was also implemented by you.

For example, suppose there is a class **`Book`**, and a subclass of **`Book`** named **`ColoredBook`** with attribute *myColor* of type **`int`**. An appropriate *toString()* method in **`ColoredBook`** might return a description of a colored book as follows:

```
public String toString() {
      String parentDesc = super.toString();
      String myDesc = "color: " + "["  + ColorUtil.red(myColor) + ","
                                       + ColorUtil.green(myColor) + ","
                                       + ColorUtil.blue(myColor) + "]";
      return parentDesc + myDesc ;
}
```

(Abovementioned static methods of the **`ColorUtil`** class return the red, green, and blue components of a given integer value that represents a color.)

A program containing a **`ColoredBook`** called "**`myBook`**" could then display it as follows:

```
System.out.println ("myBook = " + myBook.toString());
```

or simply:

```
System.out.println ("myBook = " + myBook);
```

Number Formatting

The **`System.out.format()`** and **`String.format()`** methods supported in Java are not available in CN1. Hence, in order to display only one digit after the decimal point you can use **`Math.round()`** function:

```
double dVal = 100/3.0;

double rdVal = Math.round(dVal*10.0)/10.0;

System.out.println("original value: " + dVal);

System.out.println("rounded value: " + rdVal);
```

Above prints the following to the standard output stream:

```
original value: 33.333333333333336

rounded value: 33.3
```