Announcements

• Midterm exam on Tuesday
  – Closed book, closed notes, closed neighbor
• Chaps 1-2, Chaps 4-5, html
  – Classes, objects, inheritance
  – Events and event handling
  – Methods, instructions, parameters, properties
  – Storyboards, design
What we will do today

• Lecture on Chap 6, Sec 1 - Functions
• Classwork
Functionality

• A question (or function)
  – Receives value(s)
  – Performs computation on value(s)
  – Returns (sends back) a value

```
input values

question

return the output
```
Types of functions

• The type of a function depends on the type of value it returns
  – a calculated value (a number)
  – a specific object
  – a color
  – etc.
Built-in functions

• Used one of Alice’s built-in functions
  – *skateAround* method for the *cleverSkater*

• Let’s look at another example.
Example

• How do we bounce a ball? Let’s bounce a ball over a net
  – Ball is 1 meter from the net to start
  – Ball should move up and forward, then down and forward

  – Note: Looks easy – but do not be deceived!
Design Storyboard

• Design for a world-level method

<table>
<thead>
<tr>
<th>World.ballOverNet:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do in order</td>
</tr>
<tr>
<td>toyball turn to face the net</td>
</tr>
<tr>
<td>Do together</td>
</tr>
<tr>
<td>toyball move up</td>
</tr>
<tr>
<td>toyball move forward</td>
</tr>
<tr>
<td>Do together</td>
</tr>
<tr>
<td>toyball move down</td>
</tr>
<tr>
<td>toyball move forward</td>
</tr>
</tbody>
</table>

• To reach the top of the net
  – Ball should move forward 1 meter (we positioned it 1 meter in front of the net)
  – How far upward should be ball move to clear the net?
Height

- Can use the built-in height function to determine the height of the net and move the ball up that distance

Demo – ballOverNetWork – what happens?
Problem

• The ball does not bounce over the net
• The problem – cannot tell “which way is up” from the perspective of the ball
Solution

• We think “up” and “down” relative to the ground – so can orient the ball (and net) with the ground

• $(0,0,0)$ 1

• Now, ball will bounce over the net
Rolling the ball

• How do we roll a ball along the ground?
• Want a realistic motion rather than a slide
• The ball must simultaneously move and roll.
Demo: A first attempt
Revising the Approach

• The ball is made to roll 1 revolution.
• What if we want the ball to roll a certain distance?
• How can we make the ball roll the correct number of revolutions to cover a given distance along the ground?
Number of Revolutions

• The number of revolutions depends on the size of the ball
  – The number of revolutions is distance / (Pi * diameter)

• There is no built-in function to return the number of revolutions
  – Must write it!
Parameters

• We want to return the value computed as
  Distance / Pi * diameter

• Obviously, what is needed
  – The ball’s diameter
    • The ball object has a built-in width question
  – The distance the ball is to travel
    • Can be sent as a parameter to the question
`numberOfRevolutions` function
Demo: Calling the function

- Run the animation with several test values
- Make sure it works as expected
- What happens if you use a negative value?
Levels of functions

• As with methods, you can write functions as either class-level or world-level. (what was the function we just wrote?)

• Guidelines for class-level methods apply to class-level functions:
  – No references to other objects
  – No references to world-level functions
  – Built-in world-level functions are ok
Classwork today