Class-level Methods and Inheritance

Alice

Class-level Methods

- Some actions are naturally associated with a specific class of objects.
  - Examples
    - A person walking
    - A wheel rolling
- We can write our own methods to define an action for a specific class of objects -- a **class-level** method.

An example (building technique)

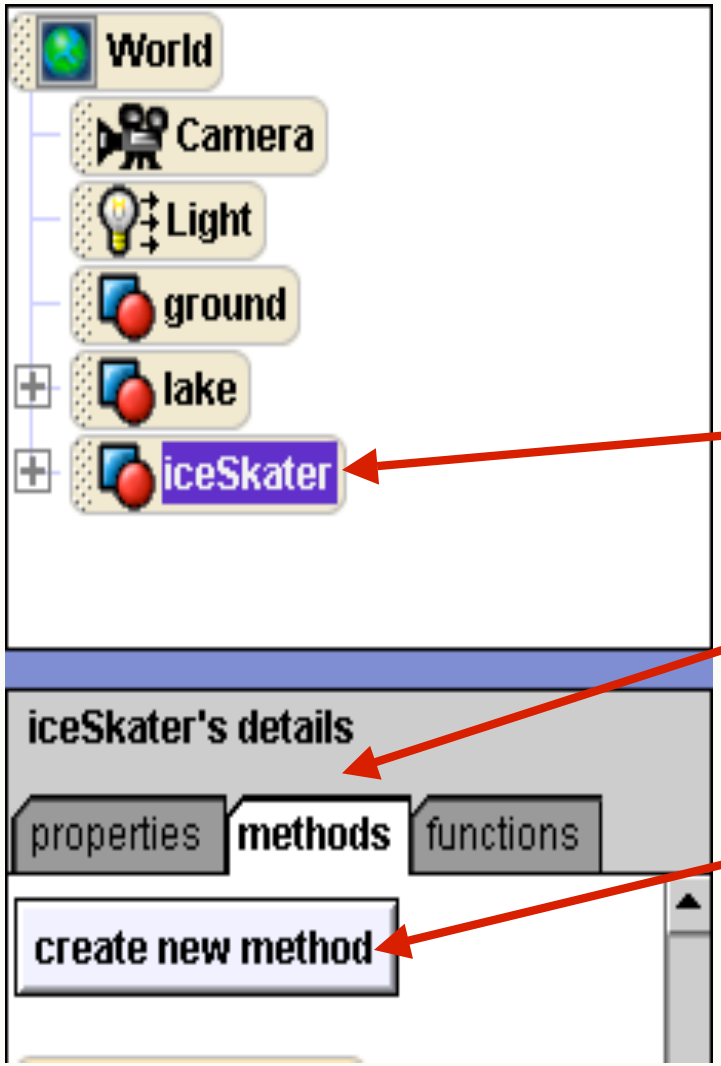
- How can we create a *skate* method for ice skater objects?

We need to:

(1) tell Alice to associate the new method (the one we are about to write) with an ice skater, and

(2) write a new method to animate the ice skater skating.

Demo: The solution



First, to associate the animation with the ice skater

- select the iceSkater tile in the Object Tree
- select the methods tab in the details panel
- click on the **create new method** button

Storyboard for *skate*

Skate:
Do together
move skater forward 2 meters
Do in order
slide on left leg
slide on right leg

- The **slide** actions each require several motion instructions, so we will break down these two actions into smaller steps

Stepwise Refinement

Skate:

Do together
1) move forward 2 meters
2) *Do in order*
    slideLeft
    slideRight

Refinement of *slideLeft*
Do in order
    Lift right leg and turn upper body forward
    Lower right leg and return body upright

Refinement of *slideRight*
Do in order
    Lift left leg and turn upper body forward
    Lower left leg and return body upright

Demo

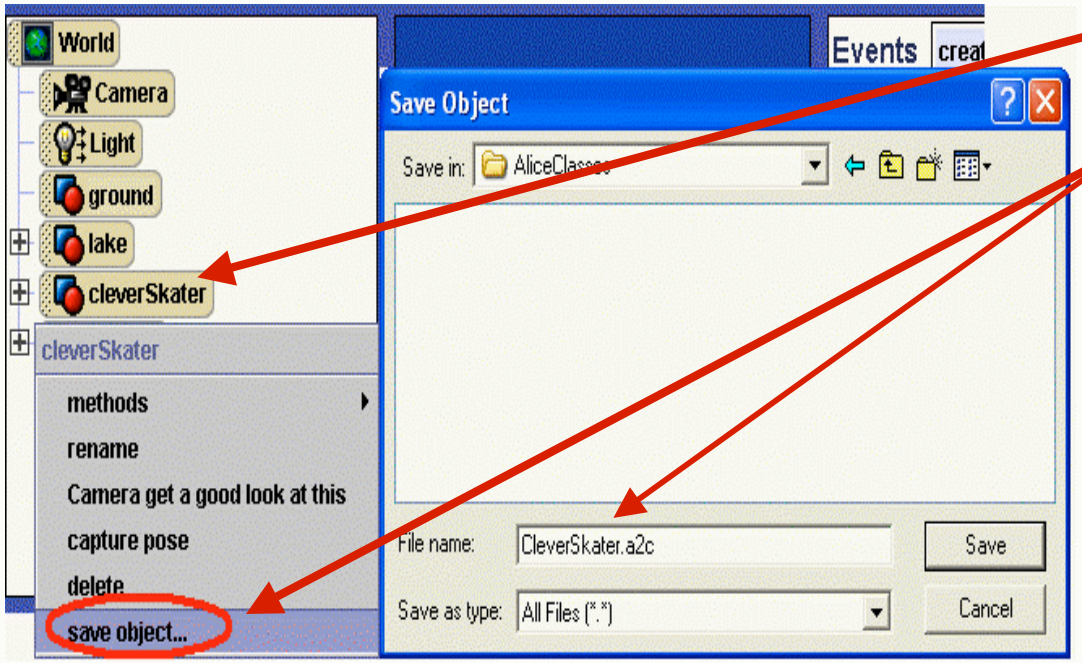
- Ch04Lec3Skater
- Concepts illustrated in this example world
  - A method defined for a specific type of object defines an action for that object.
  - A method can call other methods.

    In this example, the *skate* method calls *slideRight* and *slideLeft*.

Reuse

- Writing methods to make an ice skater perform a skating motion is an intricate task.
- We would like to have the iceSkater skate in other worlds without having to write the methods again.
- The idea of being able to use previously written program code in another program is known as reuse.

A new class



1) Rename iceSkater as **cleverSkater**.

2) Save out as a new class. Alice saves the new class as **CleverSkater.a2c**

Inheritance

- The CleverSkater class
  - **inherits** all the properties and methods from the original IceSkater class, and also
  - has the newly defined methods (*skate, slideLeft, slideRight*)
- In other programming languages, the concept of creating a new class based on a previously defined class is called **inheritance**.

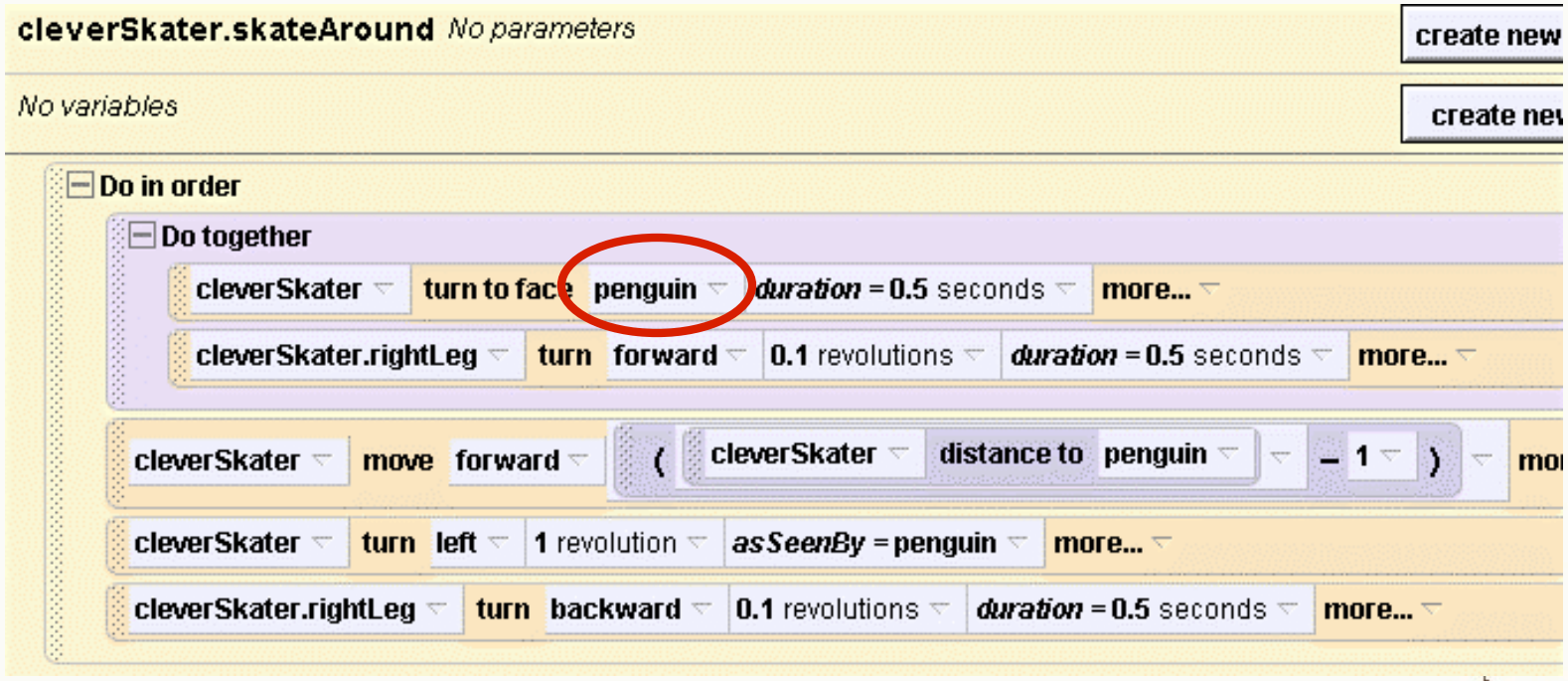
Importing CleverSkater

- An instance of the CleverSkater class can be added to a new world – use File|Import.

Guidelines

- To avoid potential misuse of class-level methods, follow these guidelines:
  - Avoid references to other objects
  - Avoid calls to world-level methods
  - Play a sound only if the sound has been imported and saved out as part of the new class
- If these guidelines are not followed and an instance of the new class is added to another world, Alice will open an Error dialog box to tell you something is wrong.

Bad Example



What if there is no penguin in the new world where a cleverSkater object is imported?

Problem

- Suppose you really want to write a class-level method where another object is involved?
- For example, a method to make the skater skate around another object-- in this scene, the penguin.

Parameter

- A solution is to write a class-level method with an object parameter that allows you to pass in the specific object.

cleverSkater.skateAround

Parameter: *whichObject*

Do in order

Do together

cleverSkater turn to face *whichObject*

cleverSkater lift right leg

cleverSkater move to *whichObject*

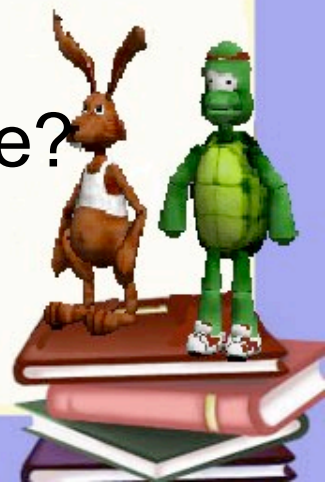
cleverSkater turn around *whichObject*

Translation to Code

- Most of the *skateAround* storyboard design is straightforward and easy to code.
- One step, however, requires some thought:

cleverSkater move to *whichObject* --

what distance should the cleverSkater move?



Calling a built-in function

- The instruction to move the skater to *whichObject* (penguin, in this example) would look like this:

- Unfortunately, the skater will collide with the penguin because the distance between two objects is measured center-to-center.

Expression

- To avoid a collision, use a math operator to create an expression that adjusts the distance.
- Math operators in Alice:

  addition + subtraction –

  multiplication * division /

- Example:

Demo

- **Ch04Lec3SkateAround**
- **Concepts illustrated:**
  - **A parameter acts as a placeholder for the object that will be passed in**
  - **A call to the *distance to* function returns a number value**
  - **A math expression can be created as part of an instruction**

Interactive Programming

Alice

Control of flow

- *Control of flow* -- how the sequence of actions in a program is controlled.
  - What action happens first, what happens next, and then what happens…and so on.
- In movie-style programs (Chapters 1-4) the sequence of actions is determined by the programmer
  - Creating a storyboard design
  - Writing program methods to carry out the designed sequence

Interactive Animations

- In interactive programs, the sequence of actions is determined at runtime when the user provides **input**
  - clicks the mouse
  - presses a key on the keyboard
  - some other source of input
- **In essence, control of flow is now "in the hands of the user!"**

Events

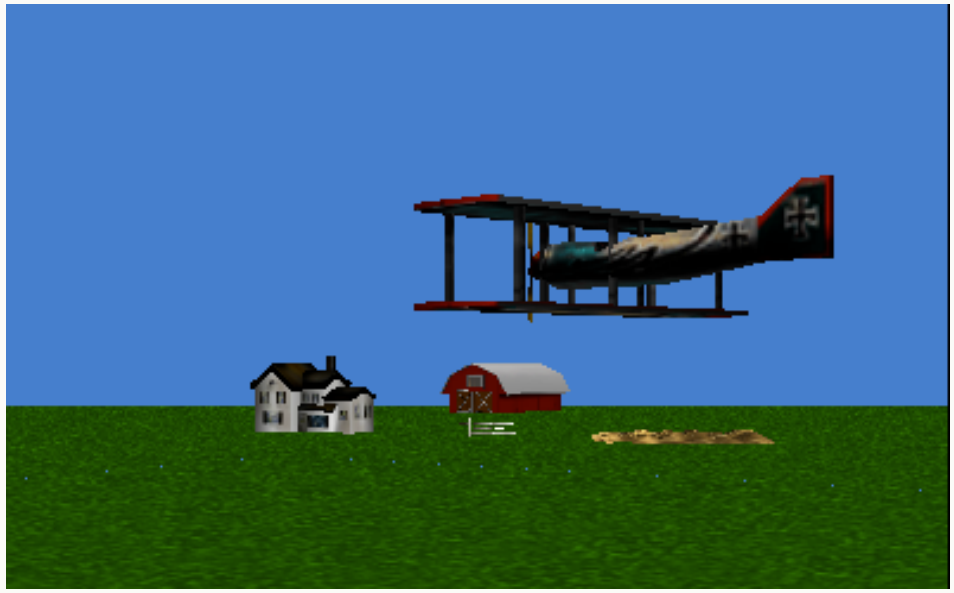
- Each time the user provides some sort of input, we say an event is generated.
  - An event is “something that happens”

Event Handling methods

- An event may
  - Trigger a response, or
  - Move objects into positions that create some condition (e.g., a collision) that triggers a response.
- A method is called to carry out the response. We call this kind of method an **event handling method**.
- When an event is linked to a method that performs an action, a **behavior** is created.

Example

- Build an air show flight simulator. In an air show, the pilot uses biplane controls to perform acrobatic stunts.



Problem

- The whole idea in a flight simulator is to allow the user to control the flight path.
- The problem is: how do we write our program code to provide a guidance system that allows the user to be the pilot?

Solution

- Use keyboard input
  - Up-arrow key to move the biplane forward
  - Spacebar to make the biplane do a barrel turn

    (Note: other sets of keys could be used, we just arbitrarily picked a couple of keys on the keyboard.)
- Write event handler methods that respond to each key press

Storyboards

- Since two keys are used, two events are possible – so two storyboards are needed:

Event: Spacebar press

Response:
Do together
roll biplane a full revolution
play biplane engine sound

Event:: Up Arrow key press

Response:
Do together
move biplane forward
play biplane engine sound

Each storyboard outlines an event handler that responds to a particular event.

Demo

- Ch05Lec1BiplaneAcrobat
- Concepts illustrated:
  - Events are created in the event editor
  - A method is called to handle each event
  - Synchronize the duration of the animation with the length of a sound. To change the length of a sound, use audio editing software.

Parameters and Event-Handler Methods

Alice

Mouse input

- Interactive programs often allow the user to use a mouse to click
  - buttons in a windows-based interface
  - targets in a game
  - a checklist of items on a business form
- In this session, we look at how to use mouse input.

Example

- People are trapped in a burning building and the user will click the mouse cursor on the person to be rescued next.

In setting up this demo world, we positioned the fire truck so the distance of the ladder from the 1st floor is 1 meter, 2nd floor is 2 meters, and 3rd floor is 3 meters.

Storyboard

- Three people are to be rescued. So, we could write three different methods.

Event: Click on guy1 **Responding Method**: Save guy on the first floor	**Event:** Click on girl2 **Responding Method**: Save girl on the second floor	**Event:** Click on girl3 **Responding Method**: Save girl on the third floor

A Better Solution

- A better solution is to write one event handler method and send in the information needed to perform the action.

firetruck.savePerson:

parameters: *whichFloor, whichPerson, howFar*
Do in order
point ladder at *whichFloor*
extend the ladder *howFar* meters
whichPerson slide down the ladder to the fire truck
pull the ladder back *howFar* meters

***whichFloor* and *whichPerson* are Object parameters**

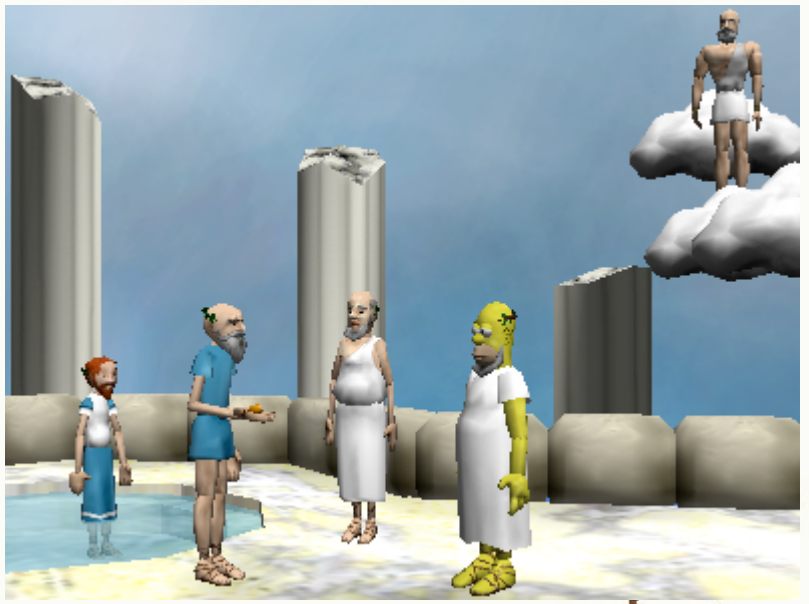
***howFar* is a Number parameter**

Demo

- Ch05Lec2SavePeople
- Concepts illustrated:
  - Parameters allow one event handling method to handle three different events.
  - The fireAnim object has a built-in event and event handling method.

Example 2

- Zeus was a powerful god in Greek mythology. When Zeus was angry, he would shoot a thunderbolt out of the heavens to strike anyone who got in the way.



- The user will choose the philosopher who will be the next target of Zeus's anger.

Storyboard

- A possible design is a method with an Object parameter, named *who*, for the object that was clicked.

Event: An object is mouse-clicked

Event handler: *shootBolt*

Parameter: *who* — the object that was clicked

Do in order

prepare to strike the object that was clicked
thunder plays and lightning strikes the object that was clicked
lightning is repositioned for the next strike

- The actions in this storyboard are complex.
- We can break the actions down into simpler steps using stepwise refinement.

Event: An object is mouse-clicked

Event handler: *shootBolt*

Parameter: *who* — the object that was clicked

Do in order
call *prepareToShoot* method — send *who* as the target
call *lightningAndThunder* method — send *who* as the target
lightning move to cloud's position

prepareToShoot:

Parameter: *target*
Do together
turn Zeus to face the target
make the lightning bolt visible

lightningAndThunder:

Parameter: *target*
Do together
play sound
call *specialEffects* method — send *target*

specialEffects:

Parameter: *target*

Do in order
Do together
lightning bolt move to target
smoke move to target
Do together
set smoke to visible
set lightning to invisible
call *smoke cycle* — built-in method
set target color to black
move target up and down

Demo

- Ch05Lec2Zeus
- Concepts illustrated:
  - The *shootBolt* method is at the top of the storyboard design. This method calls two other methods – a driver method.
  - *object under the mouse cursor* is used in the *When mouse is clicked* event to pass the clicked object as the target

Opacity

- In this example, opacity is used to make the lightning bolt visible and invisible.
  - In setting up the initial scene, the lightning bolt is made invisible by setting its opacity to 0 (0%).
  - In preparing to shoot the lightning bolt, it was made visible by setting its opacity to 1 (100%).

(Review Tips & Techniques 4 for more details about opacity.)

Built-in methods

- *cycleSmoke* is a special built-in method for the smoke object. The duration of *cycleSmoke* is about 2 1/2 seconds.
- Several statements in the *shootBolt* and *specialEffects* methods use a ***move to*** instruction
  - The *move to* instruction moves an object to a particular position in the world. In the example above, the lightening bolt is moved to the position of the cloud.

(The *move to* instruction is described in detail in Tips & Techniques 2.)

Testing

- When parameters are used in interactive programming, it is especially important to test that all possible parameter values work as expected.
  - What happens if you click on each philosopher, one at a time?
- Also try things that shouldn't work.
  - What happens if you click on a column?
  - What happens if you click on a philosopher twice?