CS 535 Object-Oriented Programming & Design
Fall Semester, 2001
Doc 2 Basic Smalltalk Syntax
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References

Ralph Johnson's University of Illinois, Urbana-Champaign CS 497 lecture notes, http://st-www.cs.uiuc.edu/users/cs497/

Reading

Joy of Smalltalk Chapter 1

Procedural Paradigm

Programs consists of data and procedures

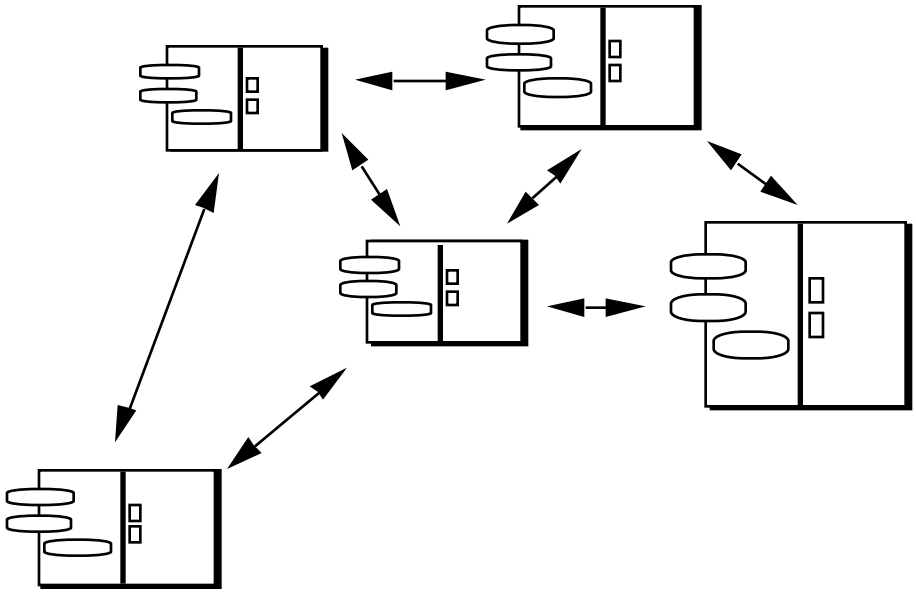
Procedures manipulate data passed to them

Programs organized by

- Functional decomposition
- Dataflow
- Modules

Object-Oriented Paradigm

Program consists of objects interacting



Objects:

- Know things
- Do things
- Collaborate with other objects to perform task

Program are organized by:

- Classes
- Inheritance hierarchies
- Subsystems

Software Development & Modeling

Each stage of software development is modeling

- Analysis

  Modeling the problem

- Design

  Modeling the solution

- Implementation

  Making the model run on a computer

- Maintenance

  Fixing and extending your model

Modeling & Objects

Base system design on structure of problem

Objects are the bases of OO design

- Objects considered more natural
- Match way people think

Objects come from the problem domain

Example Problem

A refrigerator has a motor, a temperature sensor, a light and a door. The motor turns on and off primarily as prescribed by the temperature sensor. However, the motor stops when the door is opened. The motor restarts when the door is closed if the temperature is too high. The light is turned on when the door opens and is turned off when the door is closed.

What are some objects?

What are some relationships between objects?

What are some attributes of the objects?

What are some behaviors of the objects?

Two Views of Objects & Classes

Model View verses Language Syntax View

Object - Modeling Perspective

Abstraction in the domain with both

- Attributes (things it knows)
- Behavior (things it can do)

Class - Modeling Perspective

A class is a specification for an arbitrary number of objects

Objects that share the same behavior belong to the same class

An object is an instance of a class

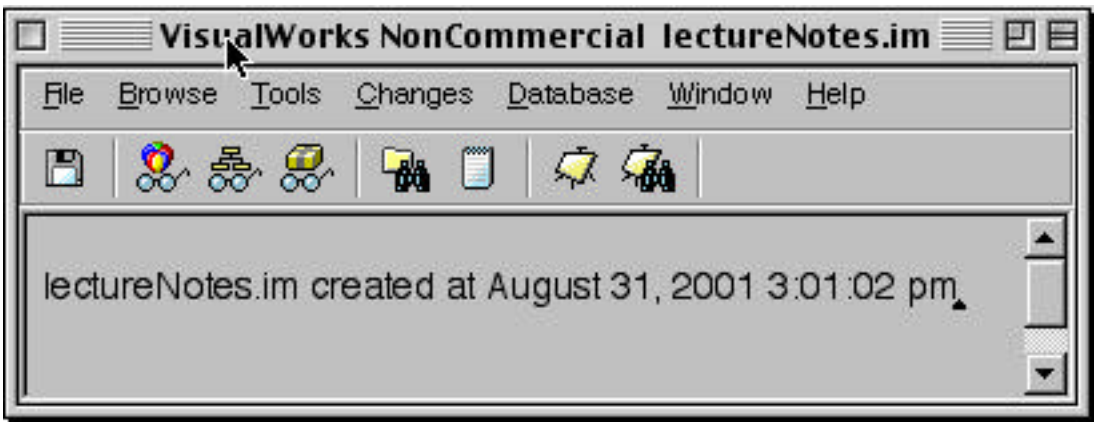
Language View of Smalltalk class

Smalltalk classes are created and viewed with a class browser. As we cover Smalltalk class syntax it will be useful for you to work with a browser. So we will first cover some aspects of the browser, then we will look at the language details. There is a chicken-and-egg problem here. To understand what the browser is showing, you need to know the language details. It helps to use the browser to understand the language details.

Viewing a Class

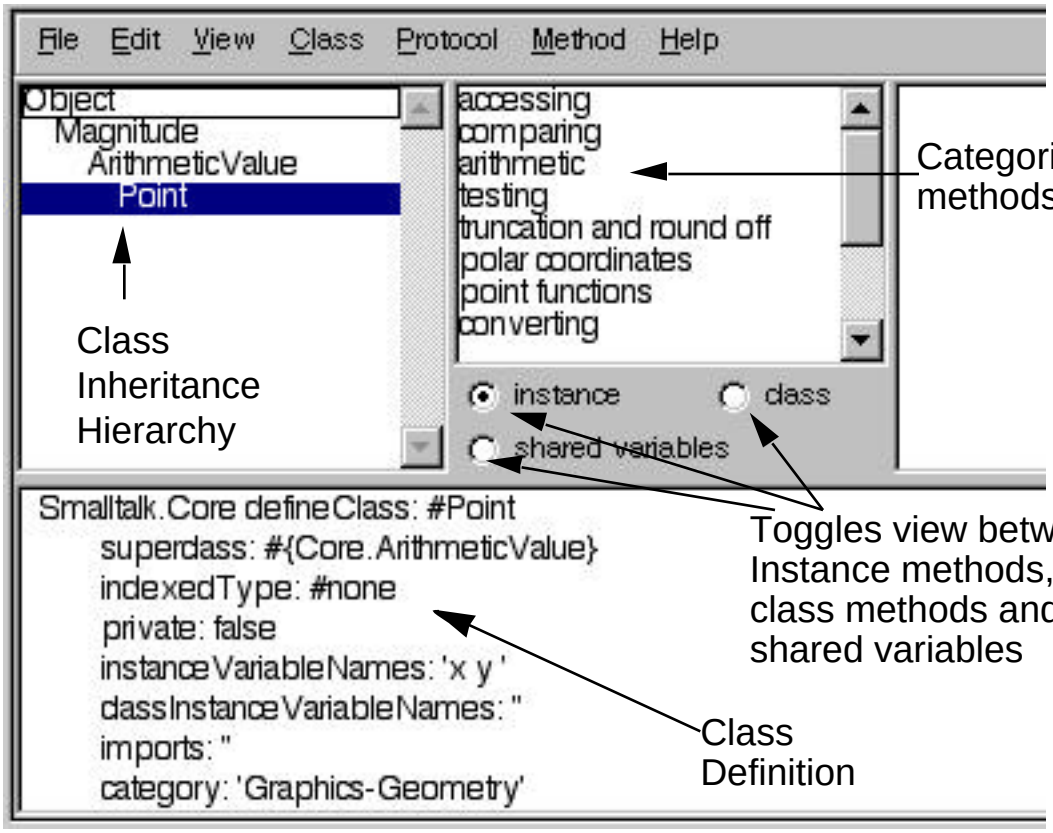
In most languages, source code is stored in a flat file and viewed with a text editor. Smalltalk provides a set of code browsers to view and edit classes. We will look at some of these browsers using the Point class as an example.

One way to find a Class in VisualWorks



In the Launcher select the "Class named…" item of the browse menu. You will get a dialog window like:

In this dialog type the name of the class you are interested in. You can use wildcard characters if you do not know the correct spelling of the class. The wildcard character * will match any number of characters. The wildcard character # will match any single character. In our example we will use Point. We get a browser that looks like:


File Edit View Class Protocol Method Help
Object
Magnitude
ArithmeticValue
Point
accessing
comparing
arithmetic
testing
truncation and round off
polar coordinates
point functions
converting
instance
class
shared variables
Smalltalk.Core defineClass: #Point
superclass: #{Core.ArithmeticValue}
indexedType: #none
private: false
instanceVariableNames: 'x y'
classInstanceVariableNames: ''
imports: ''
category: 'Graphics-Geometry'
Class Inheritance Hierarchy
Categories of methods
Toggles view between Instance methods, class methods and shared variables
Class Definition

Point Definition Partially Explained

```
Smalltalk.Core defineClass: #Point
   superclass: #{Core.ArithmeticValue}
   indexedType: #none
   private: false
   instanceVariableNames: 'x y '
   classInstanceVariableNames: ''
   imports: ''
   category: 'Graphics-Geometry'
```

Smalltalk.Core
- Namespace in which Point class is defined

Core.ArithmeticValue
- Parent class of Point

x and y
- Points instance variables
- All methods in Point can access x & y
- No direct access to x & y outside of Point
- Each Point object has separate copy of x & y

Using Point

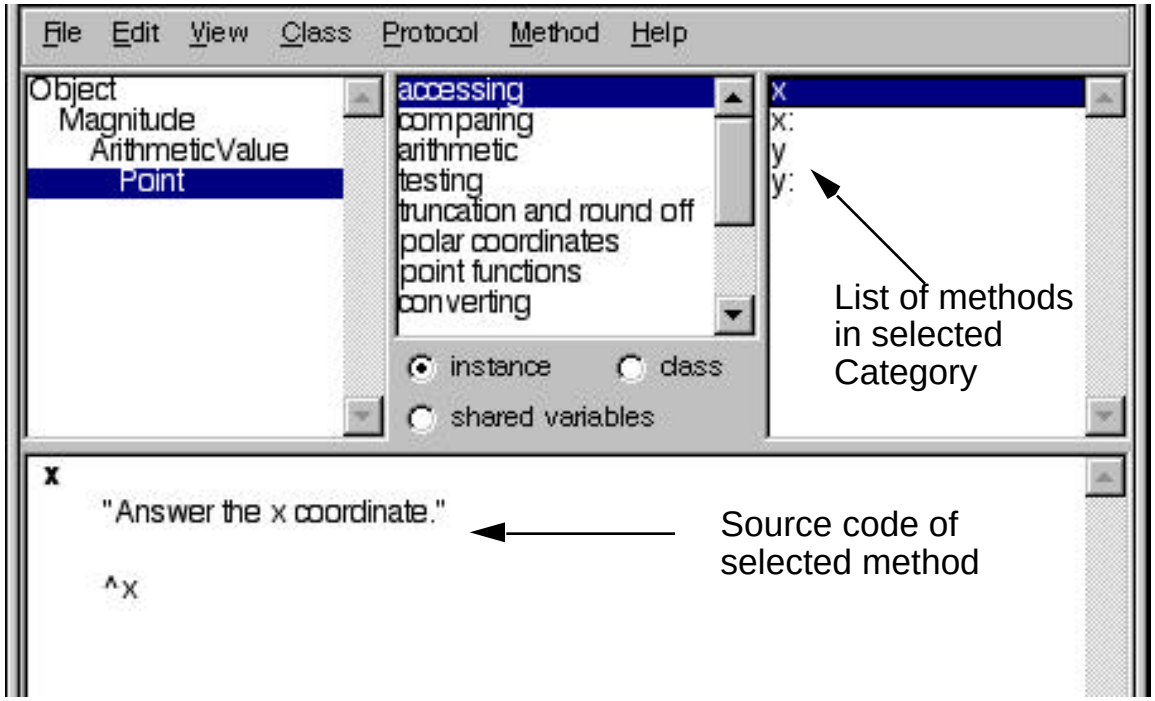
In a workspace type and execute:

```
| a b |
a := Point              "x:y: is a class method that creates a point object"
      x: 1
      y: 1.
b := Point
      x: 3
      y: -1.
Transcript
   show: a x printString;
   cr;
   show: b x printString.
```

This shows that the instance variables x have different values in

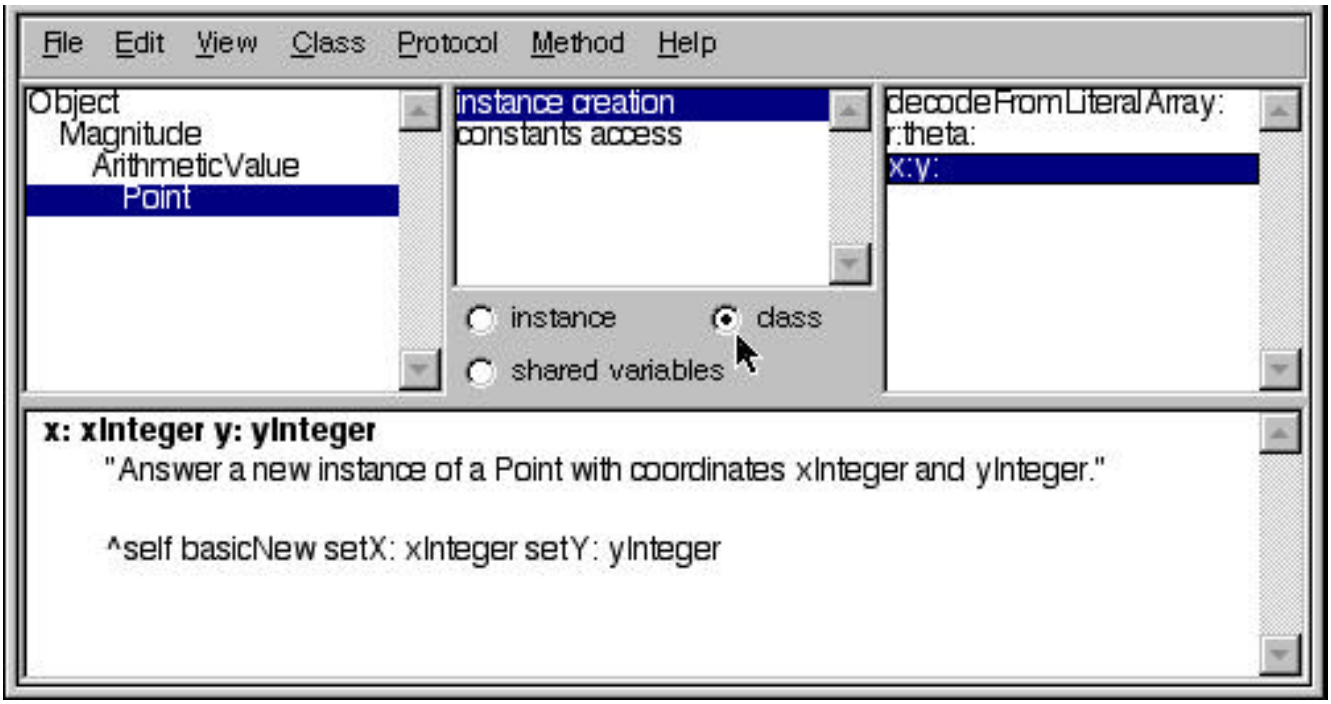
Viewing Point Methods

If you click on a category of methods the browser shows all methods in that category. If you click on a method, the bottom pane will display the source code of the method.



Viewing Class Methods

To view the class methods click on the class radio button in the browser.



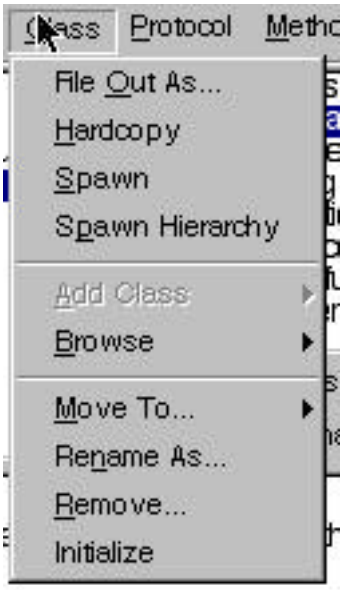
Some Important Features of the Browser

The browser menu provides some useful functionality. You should try the various menu items to see what they do. We will cover a number of them here.

Class Comments

Select the Comment item in the View menu. The lower pane will show the class comment.

Class Menus



File Out As…

Put the source code of the class in a file. The default file format is XML. To change the file format select the "Settings" item of the "File" menu in the Launcher. Then click on the File-out Type" tab.

Hardcopy

Print the source code of the class. Details of printing differ between platforms and settings on your computer. You may need to change the Printing settings by select the "Settings" item of the "File" menu in the Launcher. Then click on the "Printing" tab.

Spawn

Spawn Hierarchy

Open another browser on the selected class. Spawn Hierarchy shows the inheritance hierarchy of the class.

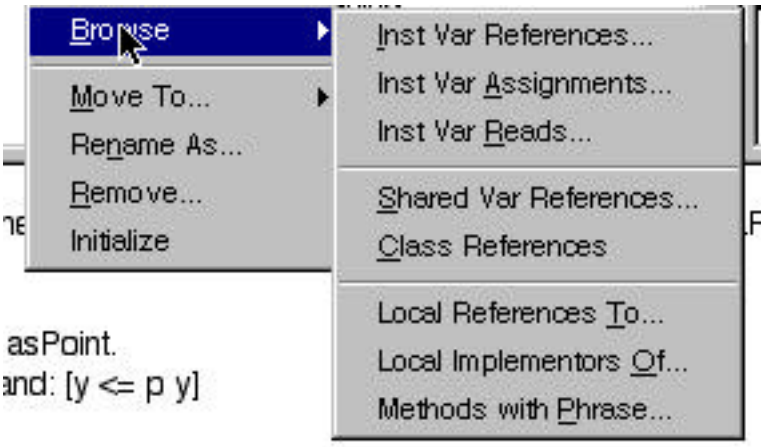
Rename As…

Renames the class. You need to change all the references to the class by hand. You will get a window with a list of all references to the class. The refactoring browser automates this.

Remove

Deletes the class.

Browse Submenu



Inst Var References…

Displays a list of the instance variables in the class. After selecting one, you get a list of all methods that access the variable. When you select one of the methods, you get the source code of the method.

Inst Var Assignments…

Similar to Inst Var References except shows only methods that change the value of the selected variable.

Inst Var Reads…

Similar to Inst Var References except shows only methods that read the value of the selected variable.

Class References

Shows a list of all methods in the system that directly reference the current class. Referencing the class is not the same as referencing an instance of the class.

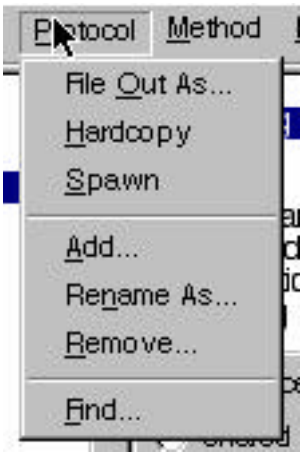
Local References To…

Prompts you for the name of a method or instance variable. Shows all places in the class inheritance hierarchy where the method or instance variable is used.

Local Implementors Of…

Prompts you for the name of a method. Show all places in the class inheritance hierarchy where the method is implemented.

Protocol Menu Items



File Out As…
Hardcopy
Spawn

Similar like items in the class menu, but act on the protocol

Add…

Allow you to add a new category of methods to the class.

Rename As…

Rename the selected category of methods

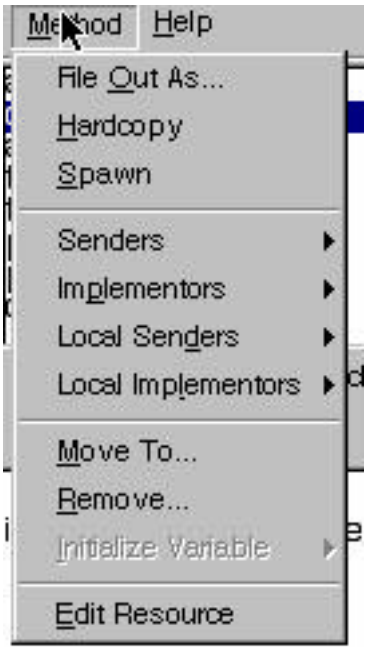
Remove

Remove the selected category of methods

Find…

Shows a list of all methods in the class. When you select a method from the list, the browser shows the source code for the method.

Method Menu Item



Senders

Select a method then look at the Senders submenu. You will see the selected method and all methods used in the selected method. Choosing one of these will result in window with all methods in the system that send the chosen method .

Implementers

Same as Senders but results in a list of places where a method is implemented

Local Senders

Local Implementors

Same as above, but restricts the search to the class inheritance hierarchy

Defining a New Class

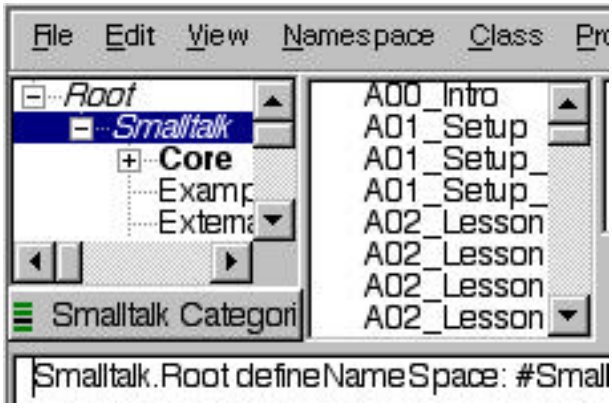
We will go through the steps of creating a new class called SimpleCircle.

Creating a Namespace

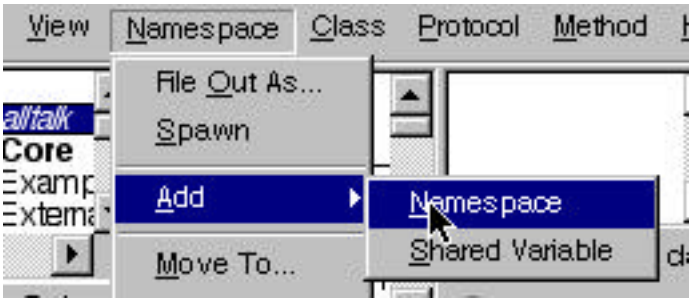
Classes exist in a namespace, so we will create a new namespace for our class. Since a namespace can hold many classes we do not have to create a namespace each time we create a class.

Open a system browser by clicking on the "System Browser" icon in the Launcher.

You will get a browser like:



In the left most pane select the Smalltalk namespace. Now select the "Namespace" item in the Add submenu of the Namespace menu.



In the lower pane of the browser you will see the template:

```
Smalltalk defineNameSpace: #NameOfPool
    private: false
    imports: '
            OtherNameSpace.*
            private Smalltalk.*
            '
    category: 'As yet unclassified'
```

To create a namespace called CS535 edit the template so it looks like:

```
Smalltalk defineNameSpace: #CS535
    private: false
    imports: '
            private Smalltalk.*
            '
    category: 'Course-Examples'
```

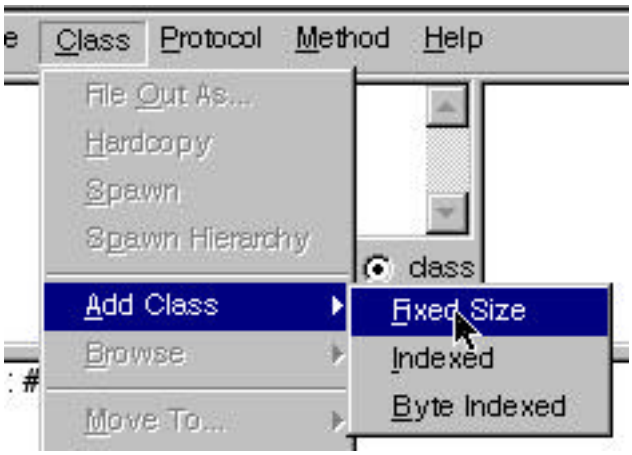
Now accept the changes in the lower pane. This can be done on a PC using right mouse button to get a pop-menu that contains "Accept". Or you can use the browser's "Edit" menu. Once you have accepted the text, you will see the CS535 namespace listed under Smalltalk.

The imports: 'private Smalltalk' allows all classes in the new namespace to use short names to reference all classes in the standard Smalltalk library.

The category: 'Course-Examples' allows us to find the class in the given category when we use the category browser.

Creating a Class in the new Namespace

Select the CS535 namespace in the left most pane. Now select the "Fixed Size" item in the "Add Class" submenu of the "Class" menu of the browser.



In the lower pane you will the template:

```
Smalltalk.CS535 defineClass: #NameOfClass
    superclass: #{NameOfSuperclass}
    indexedType: #none
    private: false
    instanceVariableNames: 'instVarName1 instVarName2'
    classInstanceVariableNames: ''
    imports: ''
    category: 'As yet unclassified'
```

Edit the template to look like:

```
Smalltalk.CS535 defineClass: #SimpleCircle
    superclass: #{Object}
    indexedType: #none
    private: false
    instanceVariableNames: 'origin radius '
    classInstanceVariableNames: ''
    imports: ''
    category: 'Course-Examples'
```

Accept the changes. When you do this, you will see the class listed in one of the upper level panes.

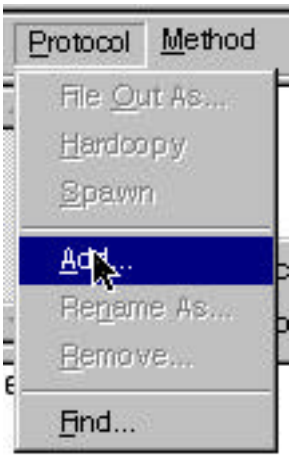
Using the Class

The class SimpleCircle does not do much, but we can still create an instance. In a workspace evaluate the following code with "Print it". What happens? Evaluate the code with "Inspect it". What happens?

```
SimpleCircle new
```

Adding Methods

Now to add a method to the class. Make sure the class is selected in the browser. Select the "Add…" item in the Protocol menu.



You will be prompted to enter a category name. Enter "accessing". Once this is done the lower pane will contain the template:

```
message selector and argument names
    "comment stating purpose of message"

    | temporary variable names |
    statements
```

Edit this code to be:

```
radius: aNumber
    radius := aNumber
```

Accept these changes. After accepting these changes select all the text in the lower pane and replace it with:

```
area
    ^radius * radius * Float pi
```

Accept these changes. Your class now has two methods: area and radius. In a workspace evaluate the following code with "Print it". Is your result reasonable?

```
| circle |
circle := SimpleCircle new.
circle radius: 2.0.
circle area
```

You may wish to save your image so you do not lose these changes.