Acme Lab:
Getting to know AcmeStudio

AcmeStudio is an architectural design environment that has been developed at Carnegie Mellon University. It provides a graphical interface that allows you to draw architectures in various styles, and to manipulate and analyze those designs. The terminology used in AcmeStudio is the same as the Acme architecture description language, and in fact AcmeStudio can read and write Acme descriptions.

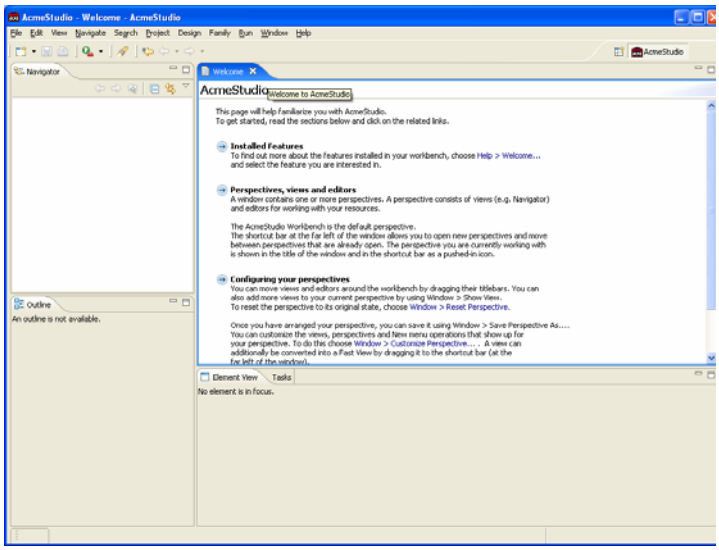
This lab serves as an introduction to AcmeStudio. After completing this assignment, you should be able to create and manipulate designs in AcmeStudio.

Download and install AcmeStudio and the Tutorial files

1. Download and install
2. Download and unzip AcmeStudio-Tutorial1.zip, which contains this file and a beginning project, AcmeLab1.zip.

Load and navigate a pipe and filter design

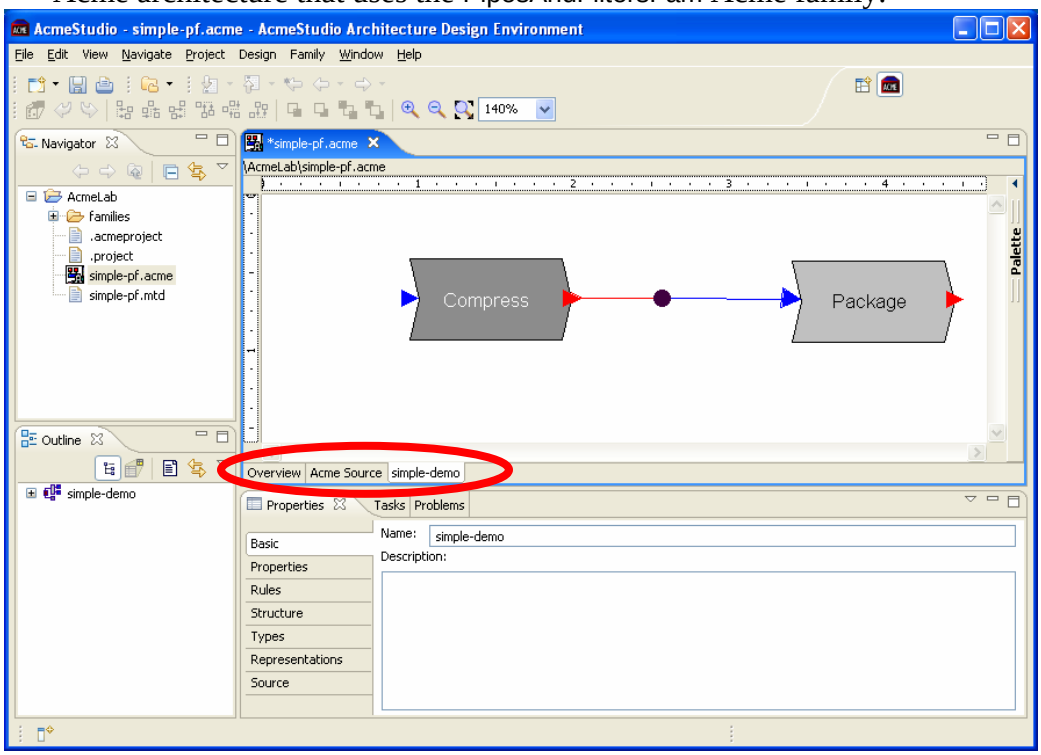
1. Run AcmeStudio.
   If you see the following screen, click the circled button and then select the menu item Window -> Open Perspective -> Other… and select AcmeStudio.



2. Locate AcmeLab1.zip that was included in this tutorial. This zip file contains an AcmeStudio project, which needs to be imported into your workspace.
3. To import this project, open the File->Import… dialog, select Existing Project into Workspace (it will be under the General section), and click Next. Select Select archive file, browse to the AcmeLab1.zip file and click Finish. Expand the project in the Navigator view. You should see the new project in the Navigator View of

AcmeStudio. This project contains the file simple-pf.acme, and the directory families. There are also some hidden files in the workspace, which by default you will not be able to see from AcmeStudio. Files in the families directory, and other hidden files, should not be changed in this lab.

4. In the Navigator view, double click the file simple-pf.acme, which contains an Acme architecture that uses the PipesAndFiltersFam Acme family.



5. Notice that this action opens an editor consisting of three sub-editors. These editors are selected using the tabs circled in red in the above picture.
   a) The *Acme Overview* editor contains an overview of the contents of the Acme file, including the systems and families defined in the file, in addition to the files that are imported.
   b) The *Acme Source* editor contains the Acme textual source of the architecture. Although it is possible to edit the Acme source, you will not be editing it in this lab.
   c) An *Acme System* editor, named simple-demo, contains the architectural diagram. Make sure that this editor is open.
6. The example architecture consists of one binary filter (called Compress) and a filter called Package. A pipe connects these two filters.
7. In AcmeStudio, each Acme design is composed of four views.[1] These views are the *Navigator*, the *Outline*, the *System*, and the *Properties* views. Read the User Interface Overview section of the AcmeStudio User's guide to familiarize yourself with each of these windows. The User's guide can be found on the web at http://www.cs.cmu.edu/~acme/AcmeStudio/manual.html. The Users Manual is

[1] Note these "views" are not the same notion of view that we have used when talking about architectural "viewtypes" in class. Here the term "view" refers to a panel in the AcmeStudio editor.

also available using the on-line help, which you can access from the Help->Help Contents…AcmeStudio Users Manual.

8. Select the Compress component in the design. In the Properties View, you will see several tabs you can use to inspect various aspects of the selected element. For example, the Basic tab displays the name of the component, and the Rules tab displays the rules that are associated with that component.[2]
9. Select the Types tab in the Properties View. This shows that the Acme type of the component Compress is BinaryFilter, as well as the type hierarchy associated with the component.
10. Select the Properties tab in the Properties View. You will see that Compress has a string property, binary, that is the name of the executable of a Unix filter that implements the compress component. This property's name and type are defined in the BinaryFilter type (which is in turn defined in the PipesAndFiltersFam Acme family). The value of this property is defined in the Compress component instance. Thus, all BinaryFilters must contain a property called binary, but the value of this property may differ from instance to instance.
11. Try inspecting other elements displayed in the System editor. For example select some ports and the pipe and examine their types and properties.

The system you have been inspecting is an instance of a built-in family that is provided as part of the AcmeStudio distribution. This is a read-only family, and cannot be changed. However, you may be curious to know what exactly is defined by the Filter type. To find out, you will need to use the Type Inspector.

1. Select an element in the system editor.
2. Select Family->Inspect Type… from the Family menu.
3. Select the type you wish to inspect, for example Filter.
4. Select OK. A dialog displaying the type will appear (similar to the Properties view) that will allow you to browse the properties, rules, etc. that the type defines.

You should now be familiar with loading existing Acme designs and examining them. In the next part of the assignment, you will make some modifications to the design that we loaded in this part.

Modifying and adding detail to the design

In this part of the lab you will make changes to the simple-pf design. These changes include adding components and pipes, as well as expanding the level of detail of a component by adding a representation.

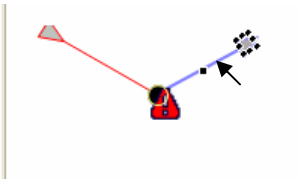
Components and Connectors

Let us assume that in our design, all characters flowing through the pipe-and-filter stream should be capitalized before being compressed. We will add a capitalization component and an associated pipe to the design.

[2] If you hover the mouse over Compress for a moment, you will see several assistants appear adjacent to the component. These will be described in a later section. For the moment, please disregard their presence.

1. First, let's add a new filter called Capitalize to the design. To do this, you must first select the Filter type from the palette. By default, the palette appears on the right of the system editor, and will be closed. To open the palette, either hover over the palette bar, or select the icon ◀ in the palette. Select the Filter type in the Type palette on the left of the System editor and drag it to the desired position in the System editor. This action automatically creates a new component of type Filter, and assigns it a unique default name (Filter0). To change the name, click on the filter to bring up a hovering editor (or, alternatively, change its name in the Acme Detail view). Pressing return commits this change. Because the Capitalize filter should occur before the Compress filter in our design, move Capitalize to the left of Compress, making sure to leave enough space to add a pipe. (You can zoom in or out of the diagram using the zoom tools in the toolbar.)

2. You will notice that two ports are automatically created for you when you construct a new Filter. These ports are defined in the Filter type. The ports are assigned a default position, but can be moved by dragging them around the component.
3. In a similar manner to (1), add a new Pipe to the design between Capitalize and Compress. You will notice that two roles are automatically created for you. Position the pipe between Capitalize and Compress. In most instances, you will select the role by selecting the line of the role rather than the end.[3]



4. You should now connect the roles in the new pipe to ports in the filters. Select the source role from the new pipe. This role is colored blue. You may double check that you have the right role by examining its name in the Element view. Drag this role over the input port in Compress and then release it. (When a port-role attachment is legal the cursor changes to look like a plug, and the port is highlighted.) This action will attach the role to the port. If it attaches correctly, you should no longer be able to see the end of the role.
5. Similarly select the sink role in the new pipe and connect it to the output port of Capitalize.

   To detach a role, click and drag the line leading to the end of the role.

Some Acme families define *connection patterns* that ease the process of creating a connection. The PipesAndFiltersFam is one such family; it has a connection pattern that states that to connect a port of type inputT to a port of type outputT, a connector of type Pipe should be created, and the appropriate roles attached. It essentially encapsulates steps 4-5 above. To use this feature, select Connect in the Type Palette, and click on the two ports you want to connect. (You will notice a dotted line appear after you select the first port). Selecting the second port causes the pipe to be created and connected.[4]

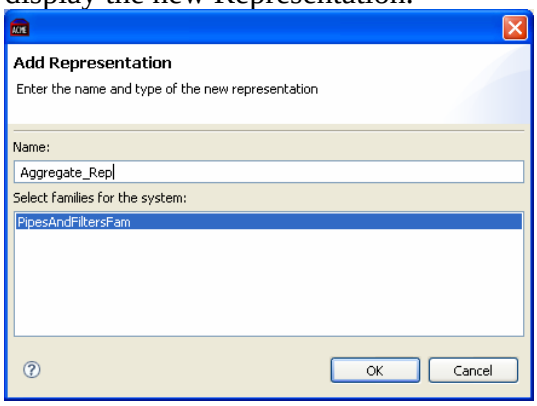
[3] This is because when the role is attached to a port, the port will obscure the role. Clicking and dragging on the line of the role allows you to manipulate (move, select, resize, rename) the role.

[4] There is also a default rule that connects two typeless ports using a typeless connector. If you try to connect two ports that have types but do not have a rule defined, you are asked to create a rule; this rule will not be saved when you save the system.

Representations

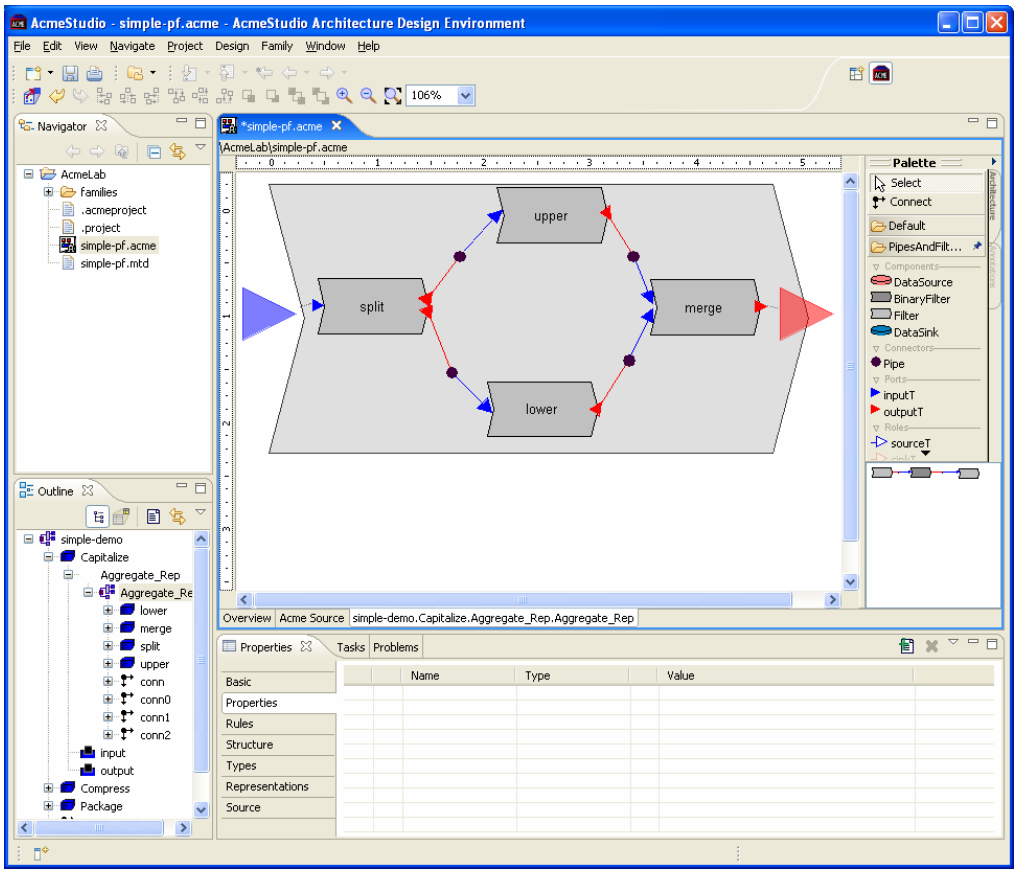
In order to manage complexity in a design it is desirable to use hierarchy so that some levels of detail can be hidden when viewed in an abstract manner, but this detail can be viewed when required. Hierarchy is achieved in Acme using *representations*. In this next part of the assignment, you will add some detail to the new Capitalize component.

1. Right-click on the Capitalize component and select Add Representation… from the menu.
2. In the resulting dialog box, name the new representation Aggregate_Rep and assign it the family PipesAndFiltersFam. Selecting OK will cause the editor to display the new Representation.[5]



3. Add components and pipes to Capitalize to make it look like the following screenshot. Note you will need to add extra ports to split and merge. Also notice that the border of the representation moves as you place elements on the canvas.

[5] If you forget to select PipesAndFiltersFam as the family for the representation, you can right-click in the empty representation and selection Assign Family->PipesAndFiltersFam.



4. To connect the representation properly to the design, it is necessary to indicate which ports in the lower level correspond to ports in the upper level. In this design, the input port of Capitalize should correspond to the input port of split; the output port of Capitalize should correspond to the output port of merge. To do this, we must create "bindings." To create a binding, select the Connect tool from the type palette. Click on the outer port and then drag and click on the inner port. For example, after selecting Connect, select the input port of Capitalize by selecting the large blue triangle to the left of Capitalize. Then click on the input port of split. You will notice as you do this that a dotted line is drawn, indicating that you are creating a binding. Once the binding has been created, a solid line will appear between the outer port and inner port.
5. Do the same with the output port of Capitalize, connecting it to the output port of merge.
6. To return to the upper level, you can do any of the following:
   a) Double-click on the parent overview to the left of the system (under the type palette); or
   b) Select the  icon from the tool bar; or
   c) Right-click over the system and select Navigate Up Representation.
7. To return to the representation, you can either:
   a) Double-click on the Capitalize component; or

b) Select Capitalize, then go to the Representations tab in the Element View and double click on Aggregate_Rep in the representation list.

Working with rules

The Acme language provides a language based on first-order predicate logic that allows rules to be defined. These rules can be used to check whether an architectural model is well formed. AcmeStudio automatic checks these rules. Typically rules are defined by the style designer, although you can also define your own rules. For this lab, we will just inspect some rules.

Acme allows the definition of two types of rules: *invariants*, violations of which are errors, and *heuristics*, violations of which lead to warnings.

1. Select the Rules tab in the Properties View.
2. Select Capitalize. Notice that this component has a rule stating the legal types of ports that the component can have (in this case, inputT and output). This rule is defined in the PipesAndFiltersFam. The label used in the Rule View is a short textual description of the rule. The ✔ icon next to the rule indicates that the rule is satisfied by the current design. To inspect the definition of this rule, double-click on the rule. You will see a dialog box appear that has the first-order predicate logic definition of the rule, as well as the labels used to describe the rule.
3. Select the architectural design as a whole by clicking the mouse in an empty space on the diagram. By inspecting the Rules tab you will see that there are a number of system-wide constraints that must be satisfied by the design. As we noted earlier, Acme allows the definition of two types of rules: *invariants*, violations of which are errors, and *heuristics*, violations of which are warnings. If an invariant fails, the icon is placed next to the rule; if a heuristic fails the icon appears.[6] You will notice that one heuristic is violated by the current design (there are dangling ports).
4. Detach a role from its port. Select the system again. Notice that the rule indicating that all roles should be attached now fails.
5. Reconnect the role and notice that the rule is rechecked, and ✔ should appear by the rule.

Further information

For further information about AcmeStudio, you can read the User's Manual. Alternatively, while AcmeStudio is running, select Help->Help Contents menu, and then when the Help browser opens, select the AcmeStudio Users Manual section.

[6] indicates that the rule is running, indicates that there is an evaluation error in the rule, indicates that constraint evaluation has been turned off.

Appendix: Advanced topics

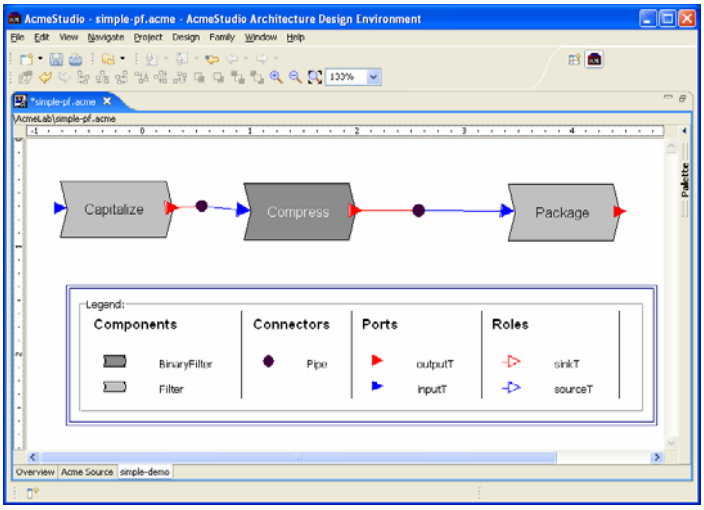
Exporting to Image

To include your diagrams as part of architecture documentation, you will need to be able to paste images of the architecture into, for example, Microsoft Word. You can do this in AcmeStudio by exporting the diagram to either JPEG, PNG, or BMP image formats.[7] To export, choose File -> Export to Image from the menu, and follow the directions. On Windows, it is also possible to copy the diagram to the clipboard, for pasting into other applications. To do this, select Edit->Copy Image.

Diagram Assistants

As mentioned earlier, if you hover over elements in the diagram, assistants will present themselves adjacent to elements in the diagram. Assistants are intended to give quick access to common commands – for example, adding ports to components, assigning types to elements, creating connections. These assistants are initially transparent; when you move your mouse into them they become solid and active and you can issue commands.

Legends



When developing architectural diagrams, it is always a good idea to have a legend that can be used to describe what images in the diagram mean. A legend can be automatically generated by AcmeStudio using the View -> Generate Legend menu item. This action generates a legend containing an entry for each of the types that are used in the diagram, and allows you to edit the text describing each entry. To do this, you click twice on the text and describe enter the new text. Unfocussing from the editor causes the entry to be changed.

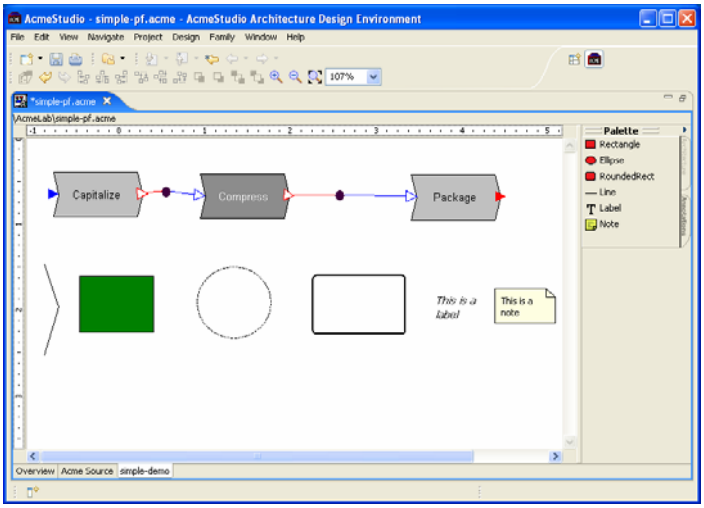
Furthermore, you can delete items that are unnecessary by selecting the entry and pressing delete. You may also change the size of columns by clicking and dragging the column separator.

By default, the legend is centered at the bottom of your diagram. You may move the legend around by clicking and dragging.

[7] If you are using AcmeStudio on the Windows platform, the best quality image seems to be BMP format.

Annotations

When drawing an architectural diagram it is often desirable to add annotations to the diagram that do not have any architectural significance, but can be used to clarify parts of the diagram. A new feature in AcmeStudio allows these annotations to be added to the diagram. The types of annotations that can be added are Rectangles, Ellipses, Rounded Rectangles, Labels, and Notes. The tools for creating annotations are accessible from the Annotation section of the Palette, and the annotations are created in the same manner as other elements in the diagram.



You change the colors, fonts, and styles of annotations using the Properties view.