# APPENDIX C

# Getting Started with Machinations



You can create and simulate Machinations diagrams in the Machinations Tool, a graphical editor and simulator created by Joris Dormans. This tutorial will get you up to speed creating diagrams in the tool. First we'll introduce the user interface, and then we'll show you, step by step, how to create a diagram. However, our tutorial doesn't include a detailed discussion of how and why all the elements of the diagram work. The basic elements of Machinations diagrams are explained in Chapter 5, "Machinations." Chapter 6, "Common Mechanisms," discusses a few more advanced elements, and Chapter 8, "Simulating and Balancing Games," explains how to use charts and artificial players.

You can also download many of the diagrams in this book from our companion website, *www.peachpit.com/gamemechanics*.

## WHERE TO FIND THE MACHINATIONS TOOL

The Machinations Tool is written in Adobe Flash, and the easiest way to use it is to run it in a web browser that has Flash enabled. You can find an online version of the tool, and a wiki with additional information, at *www.jorisdormans.nl/machinations*. You can also download an offline version of the tool there in a Flash format (.swf) file. It does not need to go through an installation process, and you can store it anywhere on your computer. If you want to run the tool offline, simply tell your browser to open Machinations.swf on your own system.

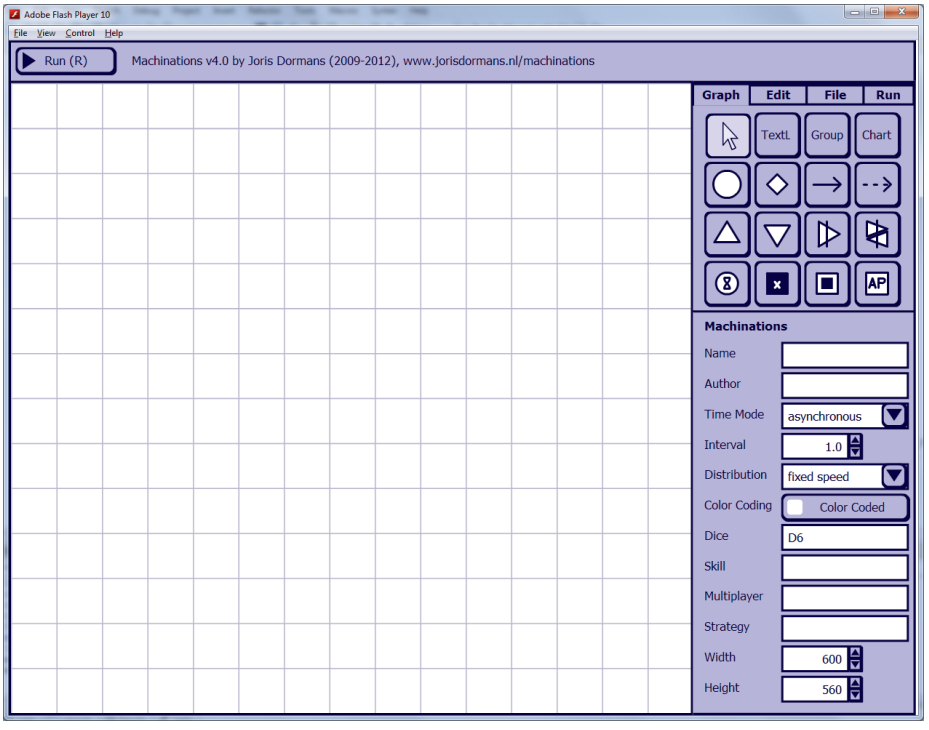
**Using Machinations Without a Browser**

You don't have to have Adobe Flash installed in a web browser to use the Machinations Tool. You can also download the stand-alone Flash Player. It is available for Windows, Macintosh, and Linux. You can download the latest version free on the Adobe website at *www.adobe.com/support/flashplayer/downloads.html* (where it is called the Projector). When you have the Flash Player installed, you can load the Machinations Tool instantly by double-clicking the Machinations.swf file.

The Flash Player also enables you to create an executable program containing the Machinations Tool itself. Start the Flash Player and load the Machinations.swf file. Then select the Create Projector option from the player's File menu (*not* the Machinations Tool's File menu). This will prompt you to save an executable file somewhere on your system. When you have saved the executable, you can run it to start the Machinations Tool in the Flash Player automatically.

# Exploring the Interface

We'll start with an overview of the Machinations interface. It is divided into four parts.




- The **title bar** runs across the top of the interface and contains version information and the **Run** button. Clicking the Run button starts a simulation running; clicking it again stops it.

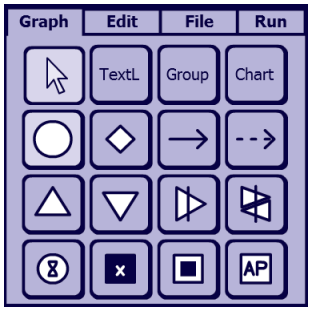
- The **drawing area** is the largest part of the screen. This is where you will draw the diagrams.

- The **Graph**, **Edit**, **File**, and **Run** panels are tabbed on the top right. The Graph panel allows you to select drawing tools; the Edit panel shows options to cut, copy, and paste images; and the File panel allows you to save and open local files and even to export the diagrams to Scalable Vector Graphics (.SVG) files. The Run panel provides additional options for running a simulation.

- The **element panel** is on the bottom right. Here you will find the controls that allow you to change attributes of the nodes and connections in the diagram. The element panel is context-sensitive and changes depending on which type of element is currently selected in the drawing area. When no node or connection is selected, the element panel shows controls that allow you to change the attributes of the diagram as a whole.

## Graph Panel

The Graph panel consists of 16 tool buttons that allow you to select and add elements to the diagram. If you allow the mouse to hover over a tool, a tooltip will pop up to tell you its meaning.




**Select** tool (the arrow) selects elements in the diagram.


**Text Label** inserts text in the diagram for explanatory purposes. Has no effect on the simulation. Not to be used for setting labels on elements of the diagram, which is done in the element panel.


**Group Box** inserts a resizable dotted-line box in the diagram for illustration purposes. Has no effect on the simulation.


**Chart** inserts a resizable chart into the diagram for collecting and displaying data from simulation runs.

**Pool** inserts a pool into the diagram.

**Gate** inserts a gate into the diagram.

**Resource Connection** inserts a resource connection into the diagram. After selecting this tool button, click a node in the diagram that will send resources along the new resource connection you are inserting (the new connection will become an output of the node). Then click another node that will receive the resources.

**State Connection** inserts a state connection into the diagram. After selecting this tool button, click a node in the diagram that will transmit its state along the new state connection. Then click either another node, a resource connection, or a state connection to serve as the target of the state connection.

**Source** inserts a source into the diagram.

**Drain** inserts a drain into the diagram.

**Converter** inserts a converter into the diagram.

**Trader** inserts a trader into the diagram.

**Delay** inserts a delay into the diagram. A delay may be converted into a queue by clicking the Queue button in the delay's element panel.

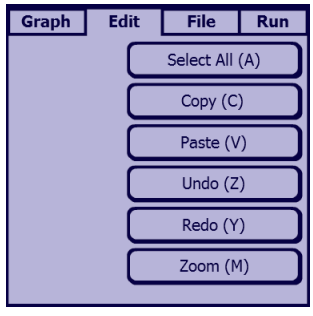
**Register** inserts a register into the diagram.

**End Condition** inserts an end condition into the diagram.


**Artificial Player** inserts an artificial player into the diagram. Because these do not need to be connected to other elements, they can be placed conveniently out of the way.

## Edit Panel

The Edit panel offers buttons to implement the familiar features of any digital editing tool. These features are also available through keyboard shortcuts, which are listed on the buttons. Note that Adobe Flash, which implements the Machinations Tool, does not permit using the Control key, so the keyboard shortcuts are just letters. For example, to copy the currently selected elements in the diagram, simply press C. It is not case-sensitive.




- **Select All (A)** selects and highlights all the elements of the diagram.
- **Copy (C)** copies all selected elements to the clipboard.
- **Paste (V)** pastes all the elements on the clipboard into the diagram, down and to the right of the elements they were copied from.

- **Undo (Z)** will undo previous actions in inverse order. Note that the Undo button can even undo clearing the diagram with the New button and opening a new file with the Open button (both described in the next section).
- **Redo (Y)** will redo previously undone actions.
- **Zoom (M)** toggles between a zoomed-out and a zoomed-in view. If a Machinations diagram is very large, the elements may be too small to work with conveniently. Zoom permits you to zoom into a view where they are all a standard size. Press M again to zoom back out.

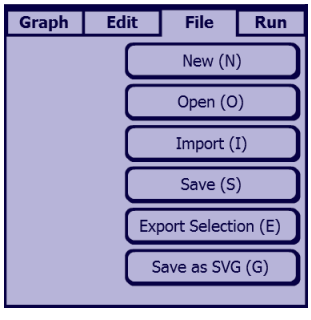
In addition to these commands, the **Backspace** and **Delete** (or **Del**) keys on your keyboard will delete the currently selected elements of the diagram.

## File Panel

The File panel provides buttons to create new empty diagrams and to save and load files containing diagrams.

### CAUTION: CLOSING YOUR BROWSER CAN LOSE YOUR WORK!

Adobe Flash does not provide any means to warn you if you have unsaved work on your diagram. If you close your browser or the stand-alone Flash Player with unsaved work, it will be *lost without warning*. Get in the habit of saving your diagrams frequently.




- **New (N)** clears the current Machinations diagram and starts a new one. **Caution: The Machinations Tool provides *no warning* if you do this without having saved your work.** However, you can undo the effect of the New button using the Undo button on the Edit panel.
- **Open (O)** clears the current Machinations diagram and loads a new one from a Machinations file. **Caution: The Machinations Tool provides** no warning **if you do this without having saved your work.** However, you can undo the effect of the Open button using the Undo button on the Edit panel.

**NOTE** Most computer art tools do not allow the user to undo and redo past a file being opened, so this may be unfamiliar to it you.

**TIP** *Inkscape* is available for download at *www.inkscape.org*. It is available for Linux, Windows, and Mac OS X.

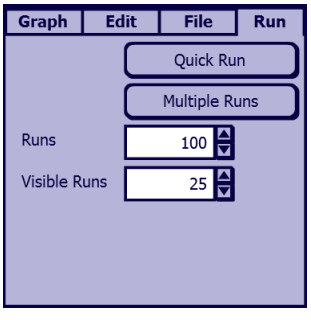
- **Import (I)** imports other diagrams into the one you are currently working on. All the elements of the imported diagram will be selected at the time they are imported, which permits you to move them around as a group.
- **Save (S)** saves your diagram into a Machinations file.
- **Export Selection (E)** exports a subset of your diagram to a new Machinations file. Only the currently selected elements will be exported.
- **Save as SVG (G)** saves your diagram as a Scalable Vector Graphics (SVG) file. These files cannot be reloaded into Machinations later but are convenient for incorporating your diagrams into other documents. All the Machinations diagrams in this book were saved as SVG files. You can edit SVG files in a free, open source editing tool called *Inkscape*.

### ABOUT MACHINATIONS FILES

The Machinations Tool saves diagrams in Extensible Markup Language (XML) files. This is an open standard format for storing any kind of data in text files designed to be readable by computers and humans. However, Machinations does not format its XML files for easy reading by humans. Because we may change the file format in the future, we do not document it here. We also discourage trying to edit your Machinations files in a text editor or any tool other than Machinations itself.

## Run Panel

The Run panel permits you to change how you run your diagram and how much data will be displayed at a time by any charts that it contains. We discuss the Run panel in more detail in the section "Quick Runs and Multiple Runs" later in this appendix. We also described it in the section "Collecting Data from Multiple Runs" in Chapter 8, "Simulating and Balancing Games."



## Element Panels

Each element of the diagram, plus the Machinations diagram as a whole, has its own element panel. When no element is selected, the diagram element panel appears. In this section, we will explain the functions of the boxes and settings that can appear in the element panels. Because many elements share the same boxes, to avoid redundancy we have listed them in alphabetical order and included in parentheses the names of the elements to which they apply.

- **Actions** specifies the number of action points that a node uses in a turn-based diagram. Zero is a legitimate value. *(All node elements except registers.)*

- **Actions/Turn**, when on the diagram panel in a turn-based diagram, specifies the number of action points available to be used before it is time for the next turn. If set to zero, a new turn will never occur unless the player interactively fires a node whose name is *end turn*. When on the artificial player panel, Actions/Turn sets the number of times in a given turn that the artificial player will fire. *(Artificial player nodes and diagram panel only, and visible only when Time Mode is turn-based.)*

- **Activation.** See the section "Activation Modes" later in this appendix and also the section "Activation Modes" in Chapter 5, "Machinations." *(All node elements except registers and end conditions.)*

- **Author** records the name of the author of the diagram. No simulation function. *(Diagram panel only.)*

- **Color Coding** toggles color-coding on and off for the diagram. See the section "Color-Coded Diagrams" in Chapter 6, "Common Mechanisms." *(Diagram panel only.)*

- **Color** sets the color of the element. See the section "Changing Colors" later in this appendix. *(All elements.)*

- **Dice** sets the default randomness for all die symbols in the diagram. *(Diagram panel only.)*

- **Distribution** toggles the visibility of resource movements on or off. The choices are *fixed speed* and *instantaneous*. If instantaneous, resources jump from node to node and are not seen to move along resource connections. *(Diagram panel only.)*

- **Height** sets the height of the drawing area in pixels. *(Diagram panel only.)*

- **Interactive** toggles on and off to determine whether a register is interactive or passive. *(Register nodes only.)*

- **Interval** sets the number of seconds per time step for the diagram. Fractional values are allowed. *(Diagram panel only, and visible only when Time Mode is* not *turn-based.)*

- **Formula** stores the formula by which the value of a noninteractive register is calculated from its inputs. Not available on interactive registers. *(Register nodes only.)*

**TIP** You can make a line break appear in Label text in the diagram by inserting a vertical bar, as in |, where you want the line to break. For example, the text predator|birth rate would be rendered on two lines, with *birth rate* centered *below predator.*

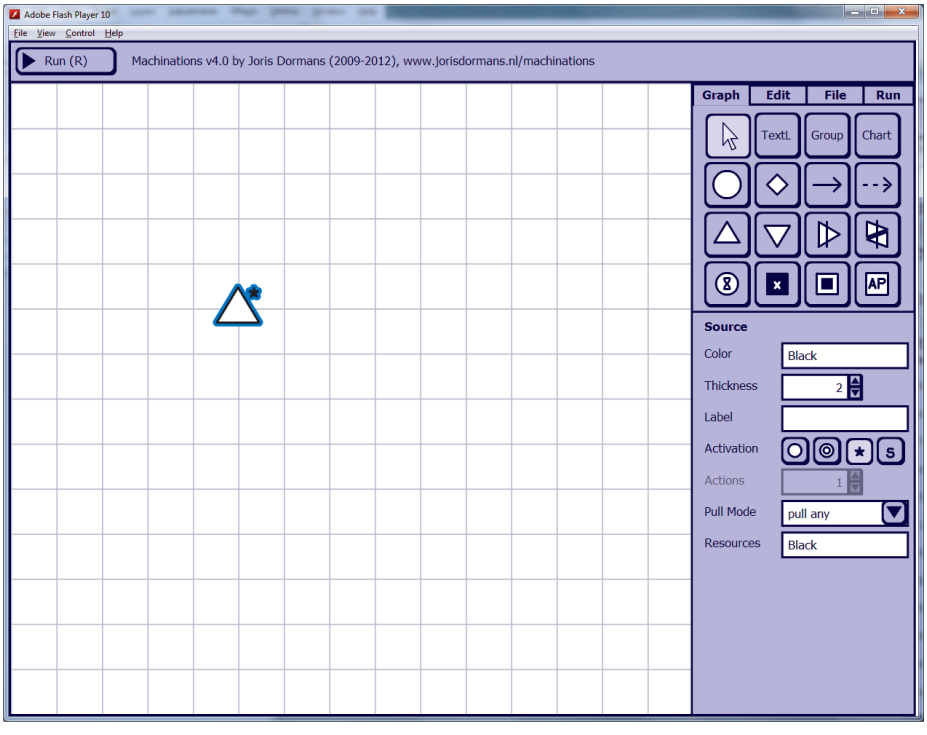
- **Label** names nodes, sets flow rates on resource connections, sets many kinds of values on state connections. See Chapter 5, "Machinations." *(All elements.)*
- **Max** sets the maximum number of resources a pool can hold. The default is -1, meaning unlimited. *(Pool nodes only.)*
- **Max. Value** sets the maximum value that a register can display, whether interactive or passive. *(Register nodes only.)*
- **Min. Value** sets the minimum value that a register can display, whether interactive or passive. *(Register nodes only.)*
- **Multiplayer** sets the default randomness for all multiplayer symbols in the diagram. *(Diagram panel only.)*
- **Name** records the name of the diagram. No simulation function. *(Diagram panel only.)*
- **Number** sets the number of resources already in a pool at the time the simulation starts running. *(Pool nodes only.)*
- **Pull Mode** sets the behavior of most nodes with respect to pulling and pushing resources. See the section "Pulling and Pushing Resources" in Chapter 5, "Machinations." *(All nodes except delays, registers, and artificial players.)*
- **Queue** toggles conversion of a delay node into a queue node. *(Delay nodes only.)*
- **Resources** see the sidebar "Understanding the Resources Box" later in this appendix. *(Pools, sources, and converters only.)*
- **Scale X** fixes the horizontal scale of a chart. *(Charts only.)*
- **Scale Y** fixes the vertical scale of a chart. *(Charts only.)*
- **Script** is the box in which artificial player scripts are entered. See the section "Simulated Playtests" in Chapter 8, "Simulating and Balancing Games."
- **Skill** sets the default randomness for all skill symbols in the diagram. *(Diagram panel only.)*
- **Starting Value** sets initial value of interactive register nodes. *(Register nodes only.)*
- **Step** sets the amount by which an interactive register node changes when its up or down arrows are clicked. *(Register nodes only.)*
- **Strategy** sets the default randomness for all strategy symbols in the diagram. *(Diagram panel only.)*
- **Thickness** sets the line thickness of many elements. Cosmetic; no simulation function. *(All elements except groups, charts, and text labels.)*
- **Time Mode** sets the time mode of the diagram. The choices are *asynchronous, synchronous,* and *turn-based*. See the section "Time Modes" in Chapter 5, "Machinations." *(Diagram panel only.)*

- **Display Limit** sets the number of resource tokens that a pool will display before switching to showing digits instead. The default is 25. Cosmetic; no simulation function. *(Pool nodes only.)*
- **Type** controls whether a gate is deterministic or non-deterministic. See the section "Gates" in Chapter 5, "Machinations." *(Gate nodes only.)*
- **Width** sets the height of the drawing area in pixels. *(Diagram panel only.)*

# Creating a Diagram

In the next few sections, we'll take you through the process of actually building a Machinations diagram, explaining a few more details about the Machinations Tool as we go. To use this as a tutorial, open the Machinations Tool and follow these instructions.

## Adding, Selecting, and Deleting Elements



Adding nodes to a diagram is very simple. Select the type of node you want to draw from the Graph panel and click the drawing area to add the node. You can add multiple nodes by clicking multiple times. The Machinations Tool automatically selects the last node you added and shows its attributes in the element panel.

1. Click the Source tool; then click somewhere on the left side of the drawing area.

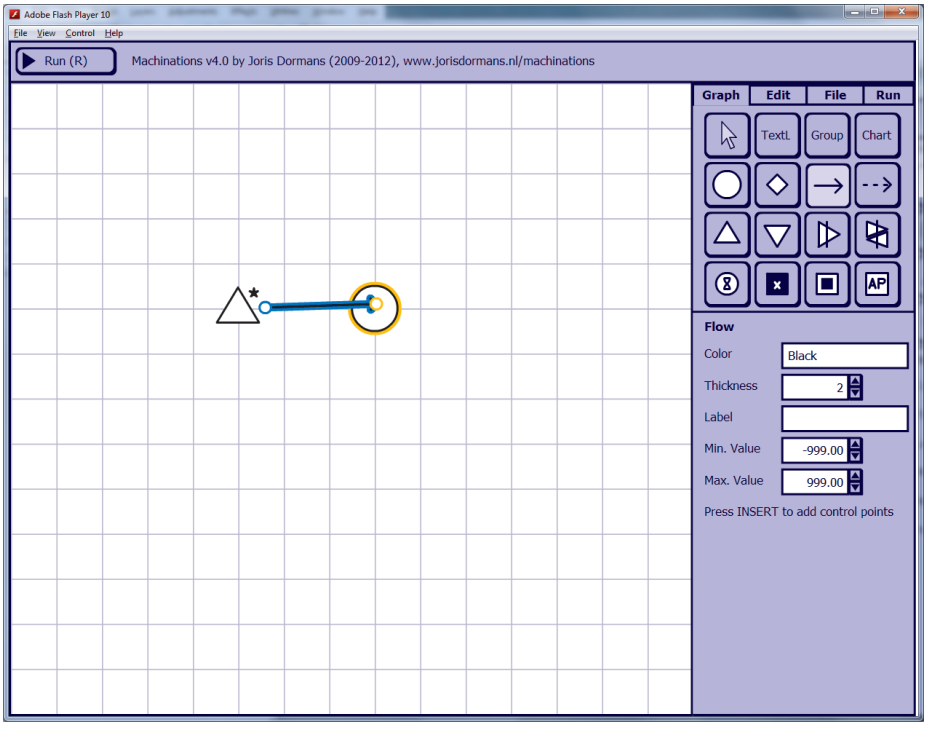
   You can select additional elements by holding down the Shift key as you click. Pressing the Shift key also automatically selects the select tool from the graph panel. You can also draw a box around elements in the diagram to select them, as in most art tools.

   To delete elements, select them with the Select tool from Graph panel and press the Delete or Backspace key on your keyboard.

   To deselect all currently selected elements, single-click an empty space in the diagram.

2. Add a pool to the right of the source by selecting the Pool tool and clicking the drawing area.

## Adding Connections



Connections are added in a similar way. First, select the resource connection tool from the Graph panel. Next, click the node where you want the connection to start and then click the node where you want the connection to end. Resource connections transfer resources in only one direction, so you must enter them in this order. The connection will lock to the nodes at each end and will stretch if you move either node.

3. Select the Resource Connection tool  ; then click first on the source that you entered and then the pool that you entered.

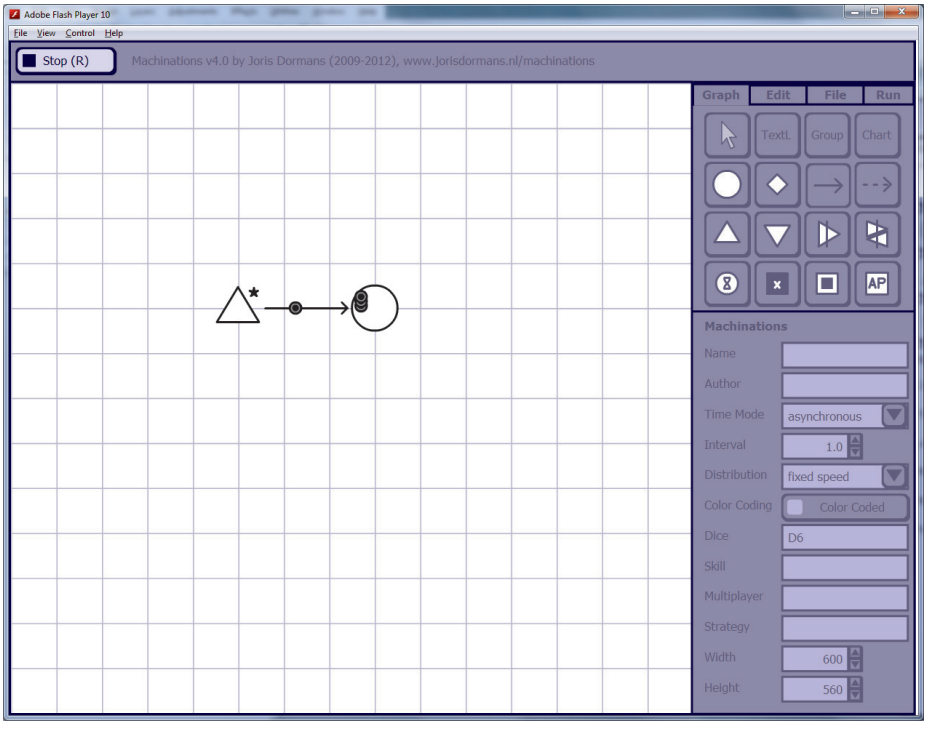
   When you end a connection at an element of the diagram (a node or another connection's label), the element will be highlighted as you move your mouse over it. If no element is highlighted, your new connection will not be connected up properly.

   You can also start and end connections anywhere in the drawing area, assuming that you will connect them later. Simply click an empty spot in the diagram to start a connection and then *double-click* at another empty spot to end the connection there. (Clicking once will only create a way point in your connection, as described in the next paragraph.)

   If you have started drawing a connection and want to add a bend, or *way point* (also called a control point), in the connection to make it look nicer as you draw, move the mouse to an empty spot in the diagram where you want it to bend, and single-click. The connection will continue from that point. You can continue inserting as many way points as you like. Double-click to end the connection. If you have already entered a complete connection, you can insert a way point into it by selecting it and pressing the Insert key or the W key. (Macintosh users will have to use the W key.)

   You can change the start and end points of a connection by selecting them and dragging them to different nodes. You can also move way points around the diagram by dragging them.

## Running Your Diagram



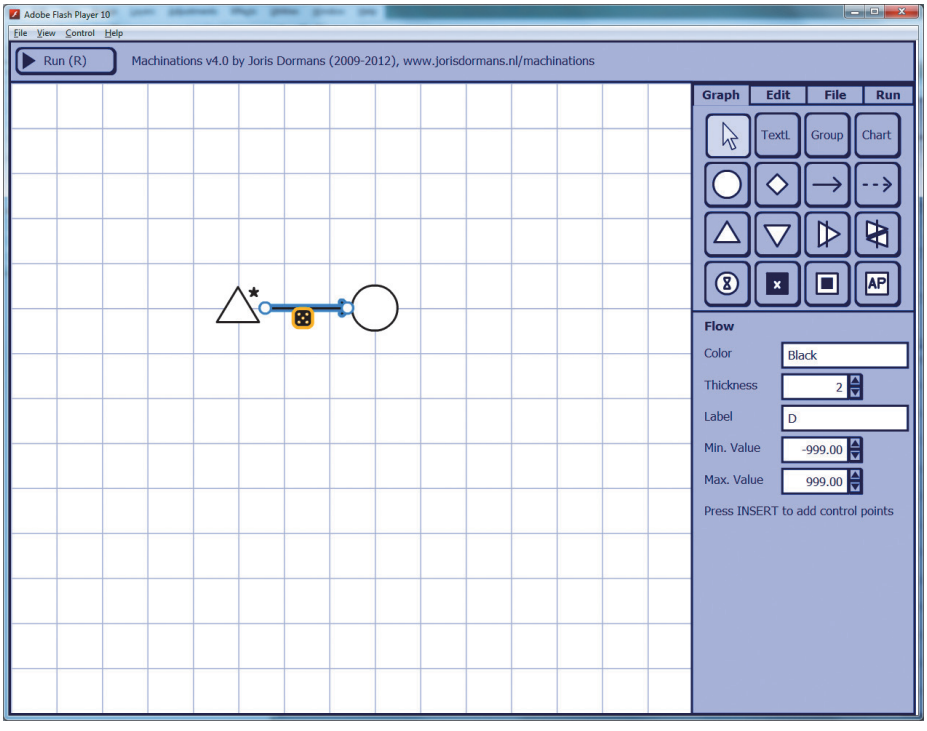

If you've connected the source to the pool, your diagram is ready to run.

4. Click the Run button in the title bar.

   This should cause the source to start producing resources that accumulate in the pool, and the Run button will change into a Stop button. (If you don't see any resources arriving in the pool, your resource connection is not connected up properly.) While running, you cannot edit a diagram, and all the panels will be grayed out.

5. Click the Stop button to stop the simulation running.

## Changing Flow Rates




You can change the flow rate of a resource connection by adding a label to it. In our example, the production rate of a source is governed by the label of its output resource connection.

6. Select your resource connection, and then type the letter **D** into its Label box in the element panel. Press the Run button.

   The source will produce a random number of resources varying between one and six, every time step (by default, one second) instead of the default rate of one.

7. Press the Stop button.

## UNCERTAIN FLOW RATES

To indicate that a resource connection has a random or uncertain flow rate, you can type special one- or two-letter values into the Label box. Different values indicate different types of uncertainty, as follows:

**D** stands for Dice. The label changes to a die symbol. This indicates uncertainty caused by a random number generator: dice or a spinner in a board game or a random number generator in a computer game.

**S** stands for Skill. The label changes to a joystick symbol. This indicates uncertainty caused by the varying level of skill that different players possess.

**M** stands for Multiplayer. The label changes to two pawns. This indicates uncertainty caused by direct tactical interactions among players and a player's inability to predict what the others will do.

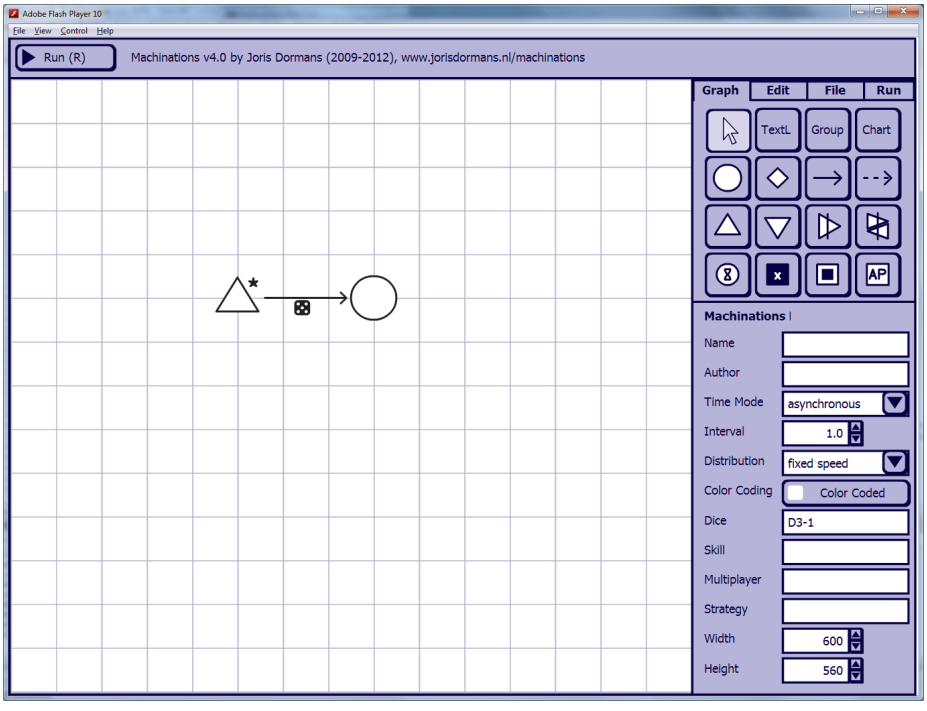
**ST** stands for Strategy. The label changes to a light bulb. This indicates uncertainty caused by strategic interactions among players or variations in one player's strategy.

These different labels are intended for illustration to make your diagram clearer. For example, if you want to indicate that a drain on some of your player's resources is caused by hostile actions by other players, you might use the M (multiplayer) label on the resource connection leading to the drain.

Note that the difference between these symbols is only cosmetic. Functionally, the Machinations Tool implements them all the same way, as a random number generator.

In the next section, we explain what happens when you run a diagram containing any of these symbols.

## CHANGING THE DEFAULT RANDOM VALUES




When you use a symbol to indicate uncertainty and run the diagram, the Machinations Tool generates a random value for it according to the contents of one of the boxes in the diagram's element panel. (This is the element panel visible when nothing is selected in the diagram.) The boxes are labeled Dice, Skill, Multiplayer, and Strategy. Each box defines the behavior of the symbols of its type in the diagram. By default, the Dice box contains D6 (indicating a six-sided die), and the other boxes are empty. If a box is empty, when you run the diagram, any symbols controlled by that box will produce a value of zero, meaning no resources will flow.

You can control the generated values for all the symbols in the diagram by changing the settings in the boxes. The format to use is described in the sidebar "Random Flow Rates" in Chapter 5, "Machinations."

8. Deselect all elements by clicking an empty space in the drawing area and type **D3-1** in the Dice box.

   This will generate a random value by rolling a virtual three-sided die and subtracting 1 from the result; in other words, it generates values from 0 to 2.

9. Run the diagram to observe the effect. Stop it when you are ready.

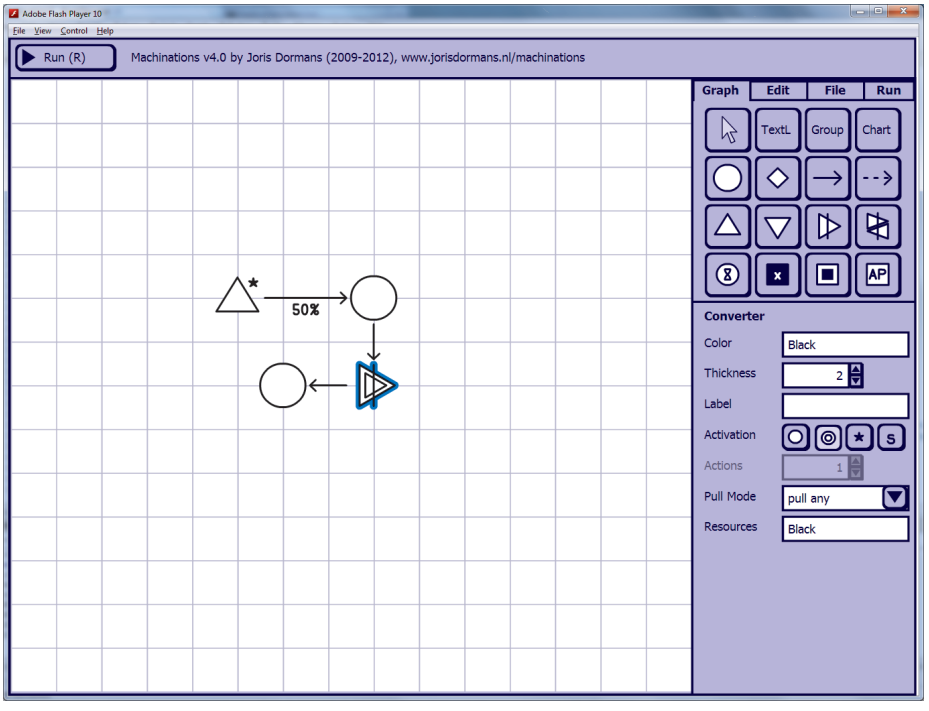
   Every time step (normally one second), zero, one, or two resources will be generated.

   For the next step, we'll switch from a symbol to an explicit percentage notation.

10. Select the resource connection and type **50%** in its Label box, replacing the D3-1 that was there before.

    This means that every time step, there is a 50% chance that the source will produce a resource.

## Activation Modes



When a node performs an action, we say that it *fires*. Each node in a diagram can be set to one of four different activation modes that determines when and why the node fires. To change the activation mode of a node, select the node and then click one of the four small buttons next to the word *Activation* in the node's element panel. The four activation modes of a node of an element are as follows:

**Passive.** The node does not fire unless triggered by an external process.

**Interactive.** The node can be clicked by a player to make it fire.

**Automatic.** The node fires every time step.

**Starting.** The node fires only once, when the diagram first begins to run.

11. Place a converter in the diagram by selecting the Converter tool  and clicking below the pool you inserted earlier. Connect a resource connection from the pool to the converter.

12. Place another pool to the left of the converter. Connect a resource connection from the converter to the new pool.

13. Now change the converter to interactive mode by selecting it and then selecting the interactive mode button  from its element panel.

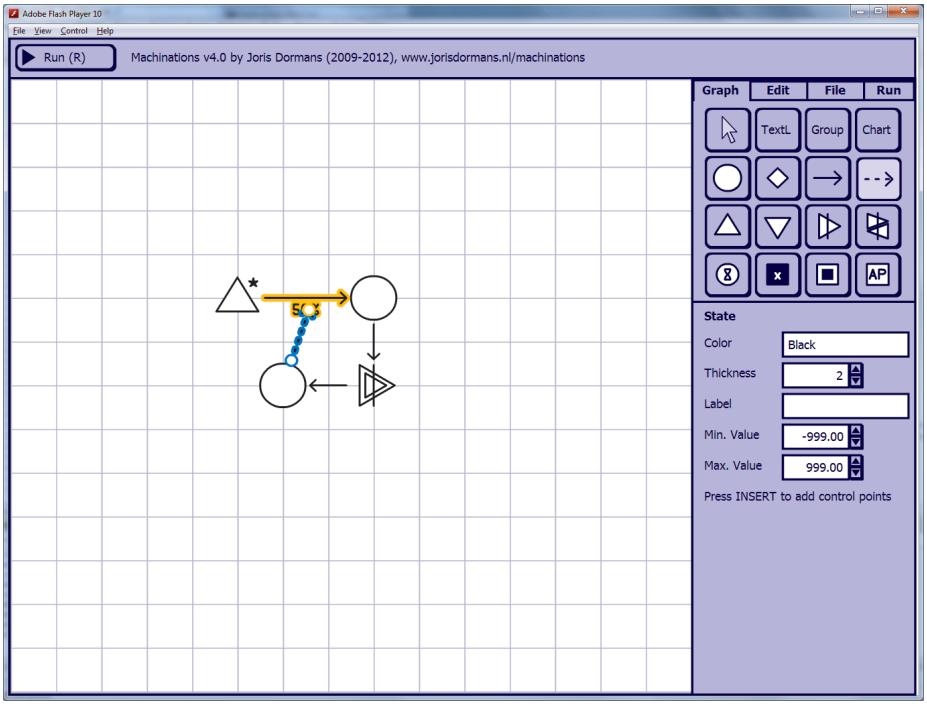
    The converter will change to show a double outline instead of a single one. By changing the converter to interactive mode, you can fire the converter while the diagram is running by clicking it.

14. Run the diagram, wait a few seconds for resources to build up in the upper pool, and then click the converter a few times.

    When a converter fires, it will pull resources through its inputs to create new resources for its outputs.

**NOTE** By default, sources and artificial players are set to the automatic activation mode when you first place them in the diagram. The other nodes are passive by default.

## Adding State Connections



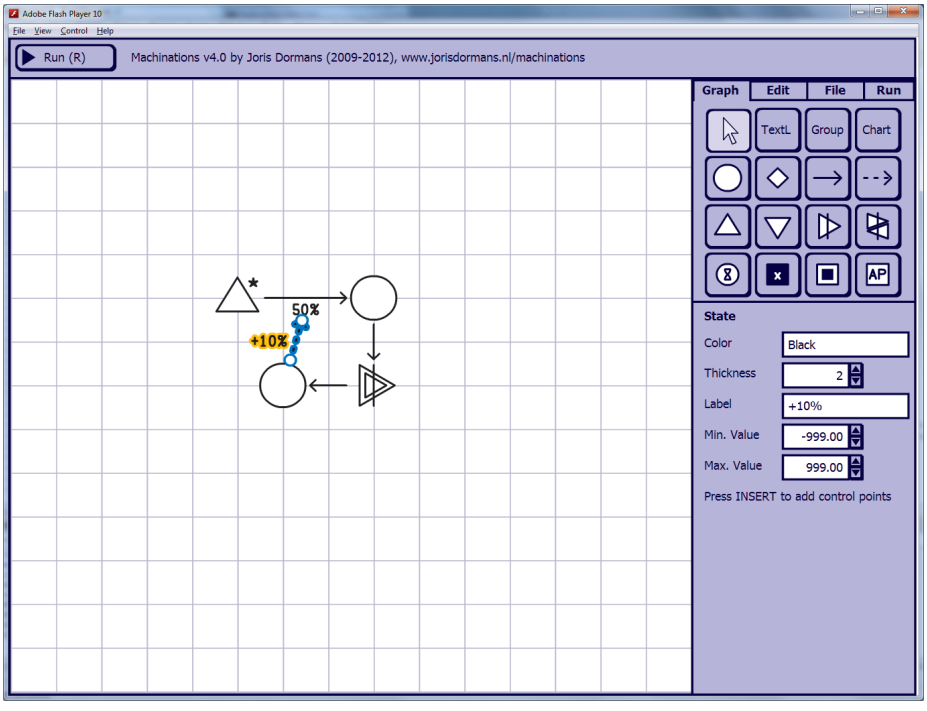

You add state connections in the same way that you add resource connections (including way points). Select the state connection tool from the Graph panel, click the node where you want the state connection to start, and click the element where you want it to end. State connections must always begin at a node, but they may end at a node or at either type of connection.

In our example, we want a new state connection to start from the lower pool and end at the source's output.

15. Select the State Connection tool ⇢; then click the lower pool to start the state connection, and click the upper resource connection (not the pool) to end it.

    State connections often end at resource connections like this. In this way, state connections can affect the flow rate of those resource connections. The state connection you have just added is a *label modifier,* one of the four types of state connections documented in the section "State Changes" in Chapter 5, "Machinations."

## CHANGING THE LABEL




Notice that the label of the state connection is automatically set to +1. This means that for every resource added to the lower pool, the flow rate of the source's output is increased by one. However, as the flow rate is currently 50%, it is better to change the state connection's label to +10%.

16. Select the state connection, and then type **+10%** in its Label box.

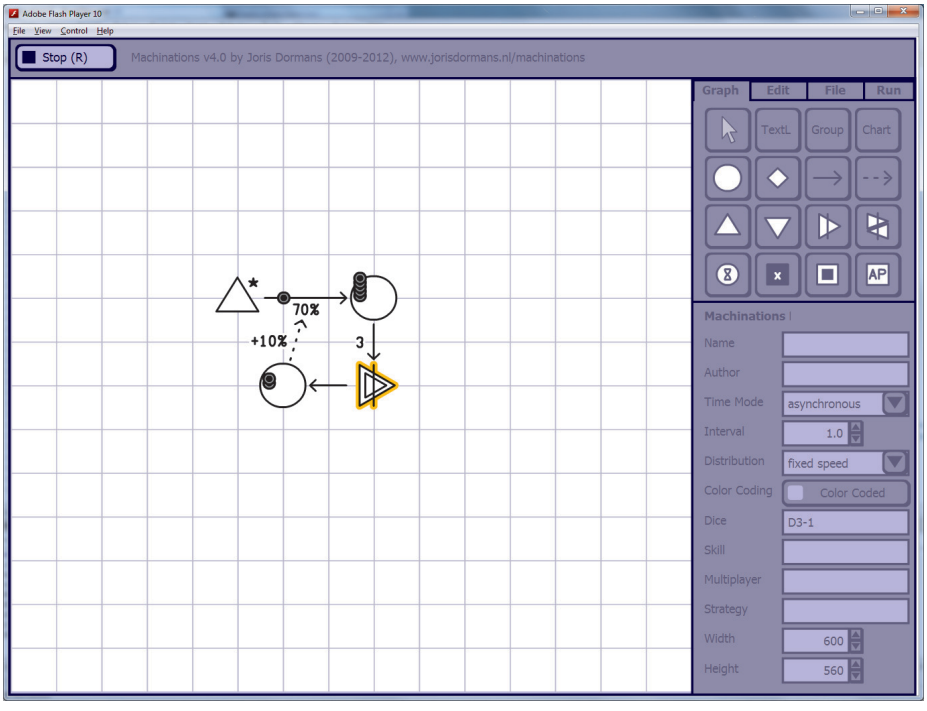
17. Run the diagram, and click the converter occasionally.

    Now the flow rate is increased by 10% for every resource on the pool. Watch what happens to the label on the source's output as resources arrive in the lower pool. In addition to the resource connection's label changing, you can see the source producing more resources.

    Note that you can drag a label of any connection to a different nearby location to improve the legibility of your diagram.

18. Select the +10% label to the left of the state connection, and try dragging it elsewhere.

## DYNAMIC CHANGES WHILE RUNNING

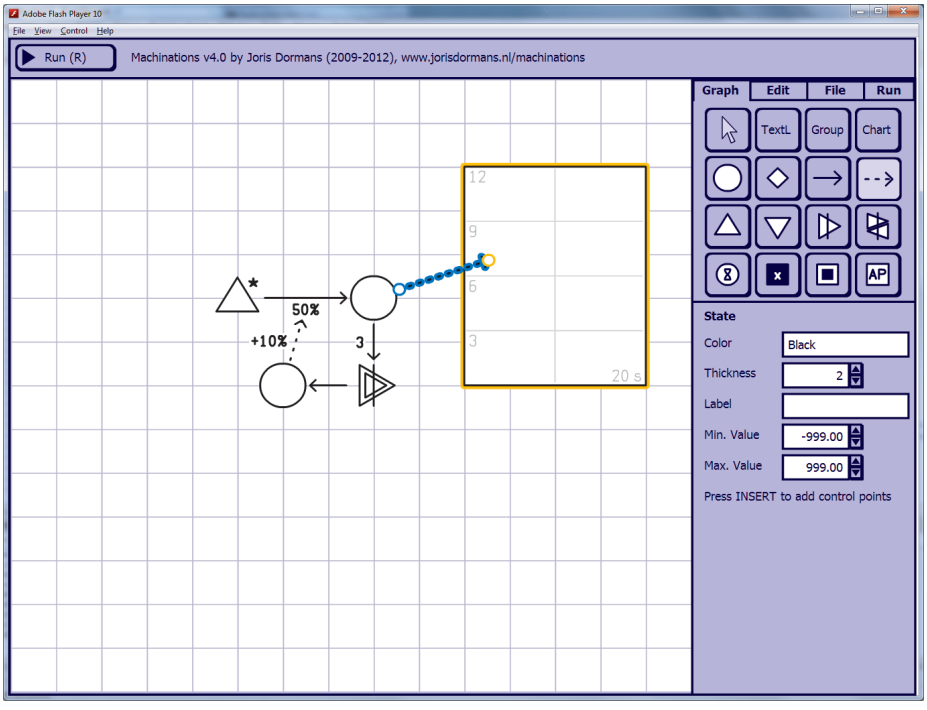



19. Change the label of the converter's input connection to 3. (Select the resource connection going into the converter, and then type **3** in its Label box.)

    This means that the converter changes three resources from the upper pool into one resource going to the lower pool.

20. Run the diagram again, and click the converter occasionally.

## Adding a Chart




Machinations diagrams enable you to keep track of the state of a pool or a register over time in a chart. We discussed charts in detail in the section "Collecting Data From Multiple Runs" in Chapter 8, "Simulating and Balancing Games."

21. Select the chart tool Chart from the Graph panel, and place a chart in the diagram.

    You can drag the chart's corners to change its size.

22. Connect a state connection from the upper pool to the chart.

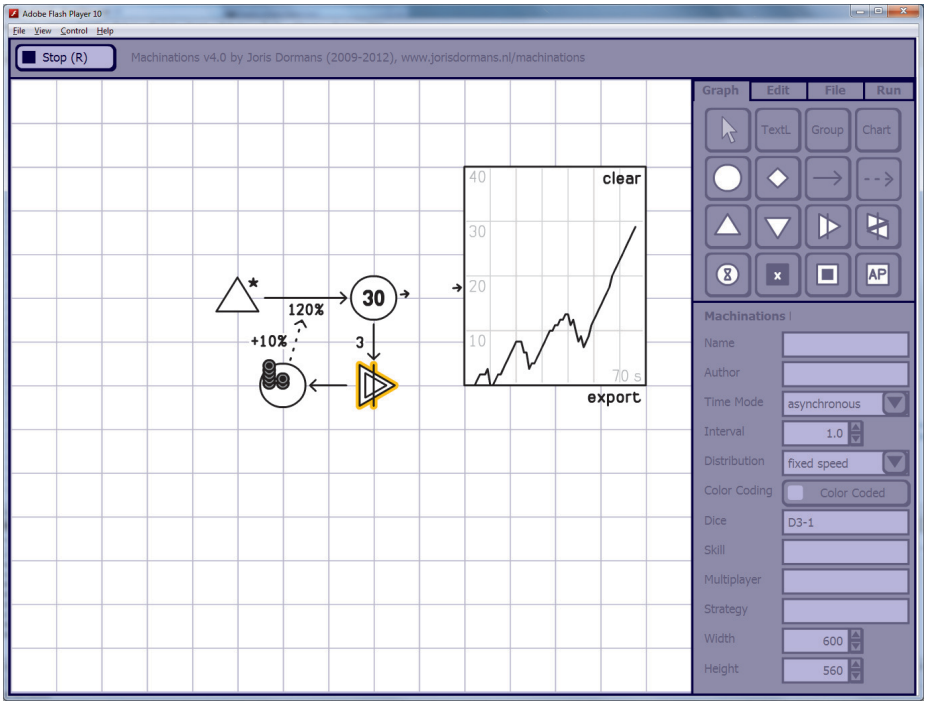
    To avoid visual clutter, state connections between a pool and a chart are represented by two small arrows when they are not selected.

23. Run the diagram again to see how the chart tracks the resources accumulating in the upper pool.

**NOTE** It is theoretically possible to track any element with a chart, but it is only meaningful to track pools and registers because they are the only nodes that store resources (or values).

**TIP** You can hide any state connection if you want. Simply select the state connection and type a 0 in the Thickness box in the connection's element panel. Beware, though: This will effectively hide part of the structure of your diagram. Don't do it unless you really need to reduce clutter and already understand your diagram well.

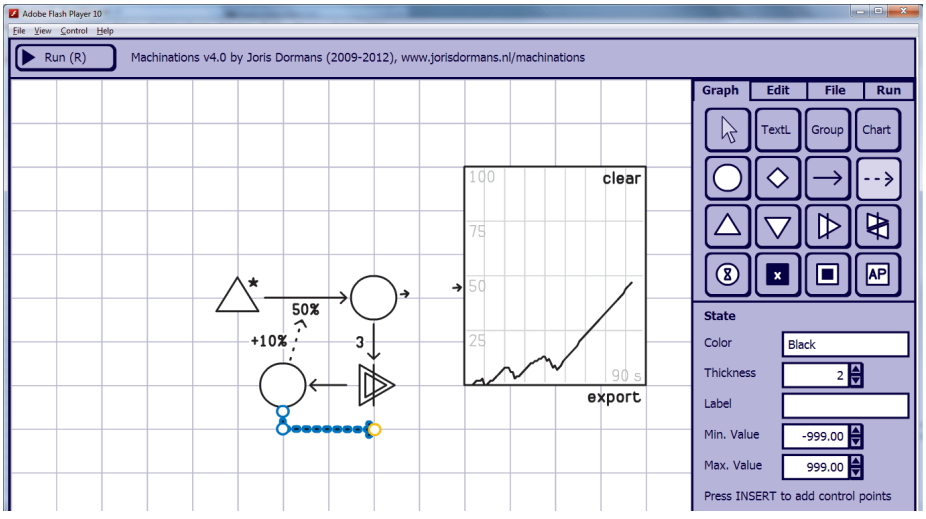
By default the chart will automatically scale the values on its x- and y-axes as the diagram runs. If you want to create a chart with a fixed scale, you can enter numbers in the Scale X and Scale Y boxes on the chart's element panel.




## Adding an Activator

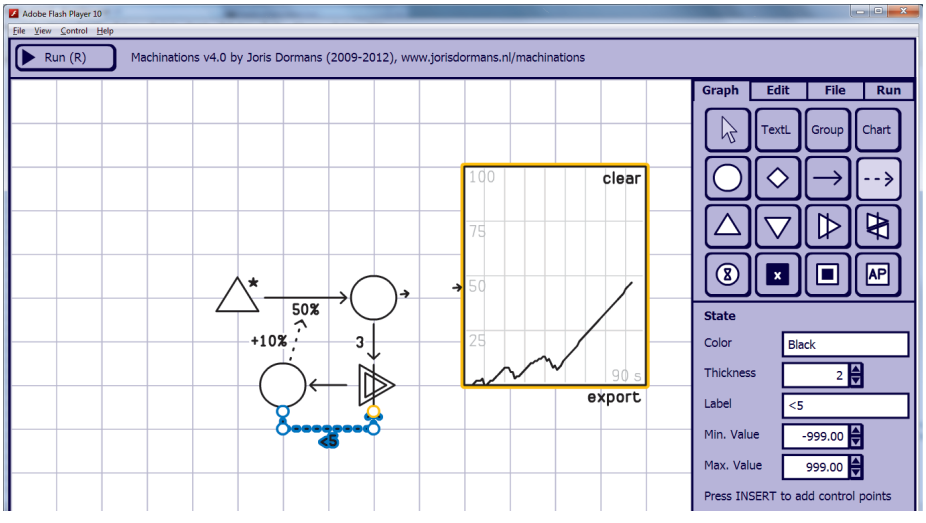
As our diagram is drawn so far, the flow rate from the source can exceed 100%. This is permitted, because in a Machinations diagram percentages higher than 100% are interpreted as meaning that the value is 1 plus a probability of whatever fraction over 100% the label is. In other words, a flow rate on a source's output of 130% means that every time step, the source will generate one resource and has a 30% chance of generating a second one.

However, if we want to prevent the source's flow rate from going over 100%, we have to stop the player from clicking more than five times on the converter. To do this, we have to add an *activator* that will prevent the interactive converter from firing again (even if you click it) after it has done so five times. Remember that an activator is one type of state connection. An activator dictates the circumstances in which its target (the element it points to) may operate and deactivates the target if the conditions are not right.




The activator will connect the lower pool to the converter. However, because there already is a connection between them, it is better to make sure it follows a different route.

**24.** Select the State Connection tool, click the lower pool, and then single-click the empty space in the diagram below the pool to create a way point. Then click the converter to complete the state connection.



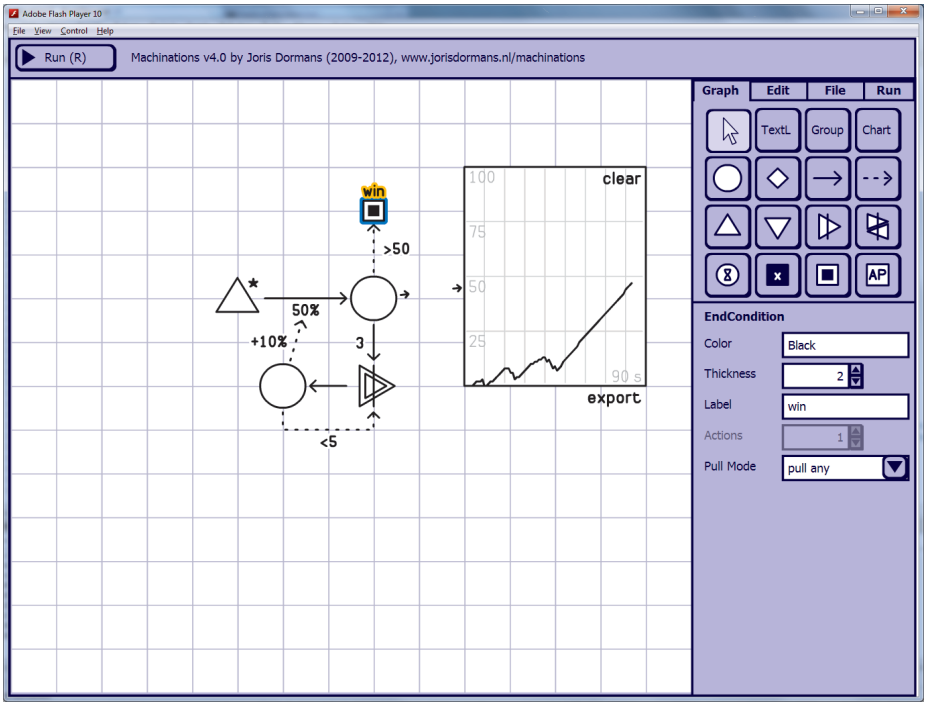

**25.** Finish the activator by changing its label to read **<5**.

26. Run the diagram again to see how it works.

    You will be able to click the converter only when the number of resources in the lower pool is less than five. When it equals or exceeds five, the converter is deactivated.

    Note that deactivated elements are rendered light gray when the diagram is running. This gives you a much better view of the diagram's current state.

## Adding an End Condition




Next we'll add an end condition and an activator to specify what causes the simulation to end.

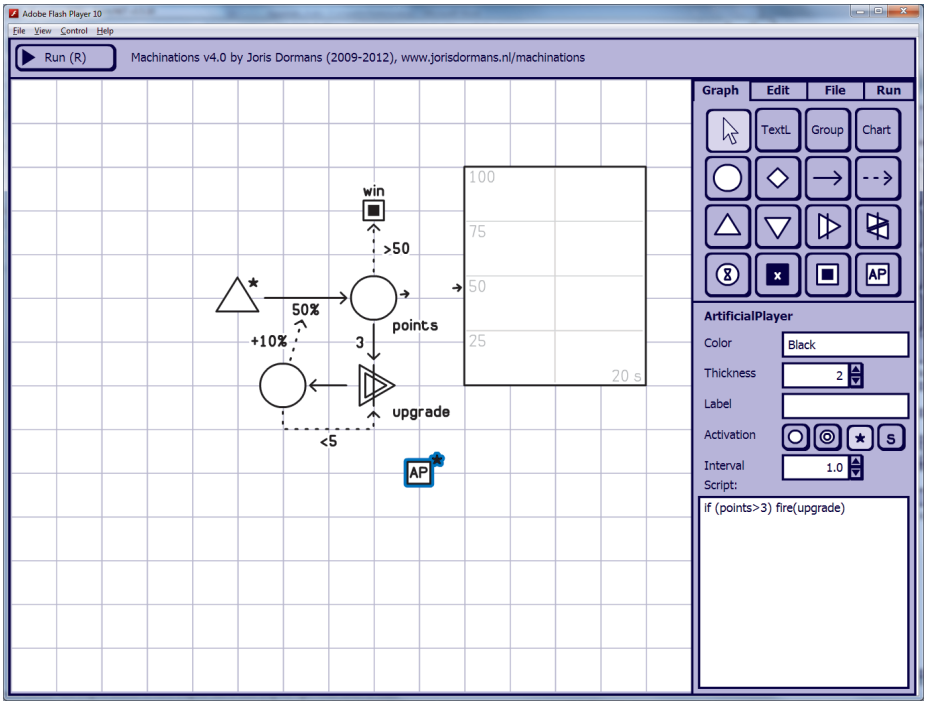
27. Select the End Condition tool, and add an end condition to the diagram above the upper pool. Label it **win**. Connect a state connection from the upper pool to the end condition. Label the new state connection **>50** to indicate that the player wins when she accumulates 50 resources.

    Note that we moved the end condition's label above the end condition node to make the diagram clearer.

28. Run the diagram, clicking the converter if you want, but do not stop it.

    The diagram will stop running by itself when the end condition is fulfilled.

## Adding an Artificial Player




Machinations diagrams allow you to define artificial players. Artificial players are used to automate the process of playing. They work by specifying simple commands and conditions.

29. Select the artificial player tool AP, and place an artificial player somewhere out of the way in the diagram.

    We're going to set up our artificial player to fire the converter every time the upper pool has collected more than five points. To do this, however, both the upper pool and the converter need to have names so that the artificial player can fire them.

30. Select the upper pool, and type **points** in its Label box. Select the converter, and type **upgrade** in its Label box.

31. Now select the artificial player, and type **if(points > 3) fire(upgrade)** in the Script box in the element panel.

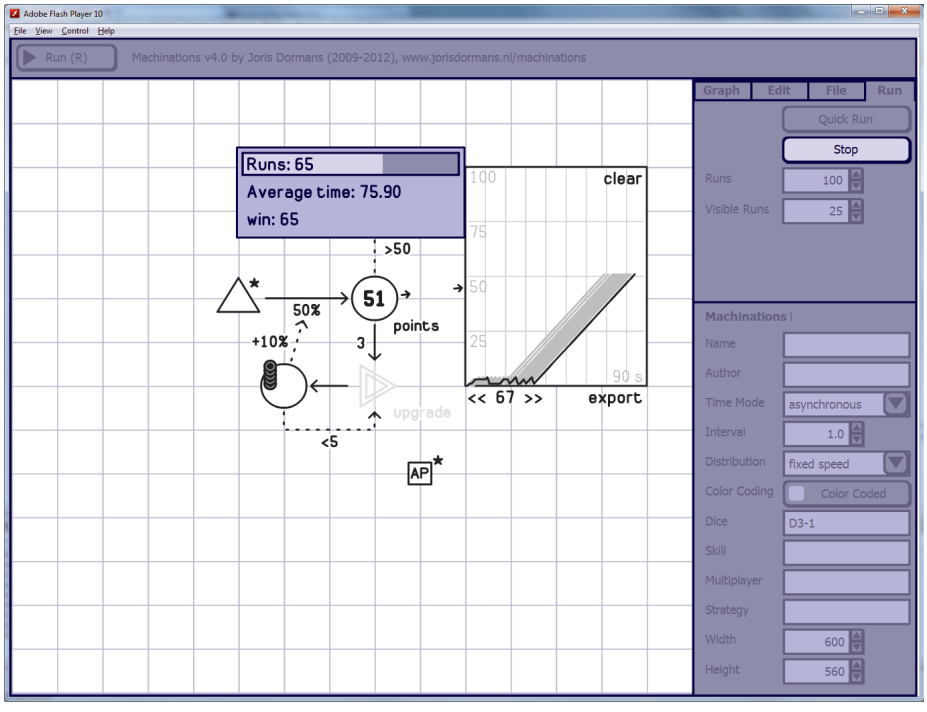
32. Run the diagram again. Do not click the upgrade converter.

    Sit back and watch how your artificial player saves you from the effort of having to play yourself.

# Using Additional Features

In addition to all of the foregoing, the Machinations Tool offers a few miscellaneous features.

## Making Quick Runs and Multiple Runs




Diagrams with end conditions and artificial players are suitable to run quickly and multiple times, because they can play themselves and stop themselves. This is a useful feature to quickly collect data over many simulated play sessions. In the Run panel, the Runs box controls how many runs the tool will perform, and the Visible Runs box controls how many runs any charts in the diagram will display.

33. Switch to the Run panel, and click the Multiple Runs button to start a multiple run of the diagram.

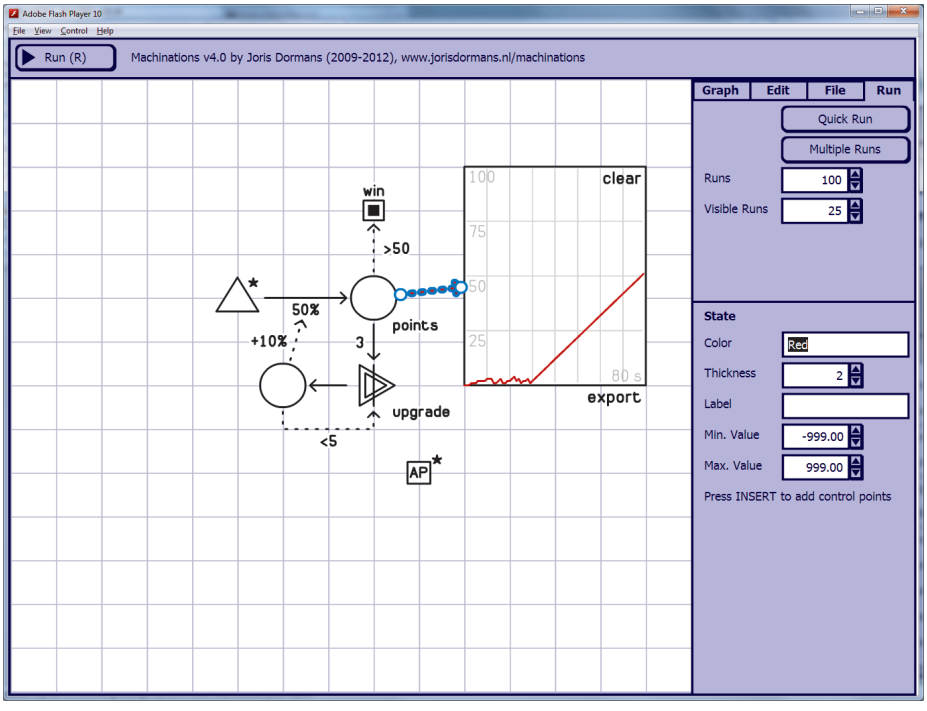
    When you run a diagram multiple times, the tool keeps track of which end condition stopped the diagram and how long it ran on average. A pop-up box shows this information while the runs are being performed. The chart also collects the data for each run for you to review when the runs are done. In our example, there is some randomness in the source's production rate, so the chart looks a little different on each run.

34. Click the Reset button in the Run panel to return the diagram to its normal editable state.

35. Click the word *clear* in the top-right corner of the chart to clear all the collected data.

You can find full details of how to perform quick runs and multiple runs in the section "Collecting Data from Multiple Runs" in Chapter 8, "Simulating and Balancing Games."

## Changing Colors




You can change the colors of the elements in the diagram and also of the resources in the diagram. Simply select the element you want to change and set a new color. Colors can be specified by typing the name of the color into the Color box in the element panel.

The Machinations tool uses the following color names: *Black, White, Red, DarkRed, Orange, OrangeRed, Yellow, Gold, Green, Lime, Blue, LightBlue, DarkBlue, Purple, Violet, Teal, Gray, DarkGray,* and *Brown*. These names are not case-sensitive.

We explained how to use color-coded diagrams in the section "Color-Coded Diagrams" in Chapter 6, "Common Mechanisms."

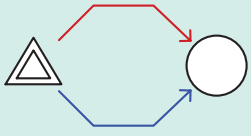
**TIP** You can also use hexadecimal notation for more precise control over your colors. Make sure that the hexadecimal color follows the following format: 0x000000. For example, 0xff0000 is red, 0x00ff00 is green, and so on.

## UNDERSTANDING THE RESOURCES BOX

Pools, sources, and converters all have a special Resources box in their element panels. In a color-coded diagram, it can be used to override the default behavior of these nodes with respect to colored resources.

Normally, if you place a pool in the diagram, then change its color to blue with the Color box, and then use the Number box to place some resources in the pool, those resources will be black, not blue. This is because, by default, the Resources box contains the word *black*. To place blue resources in a blue pool, you must type **blue** into the Resources box.

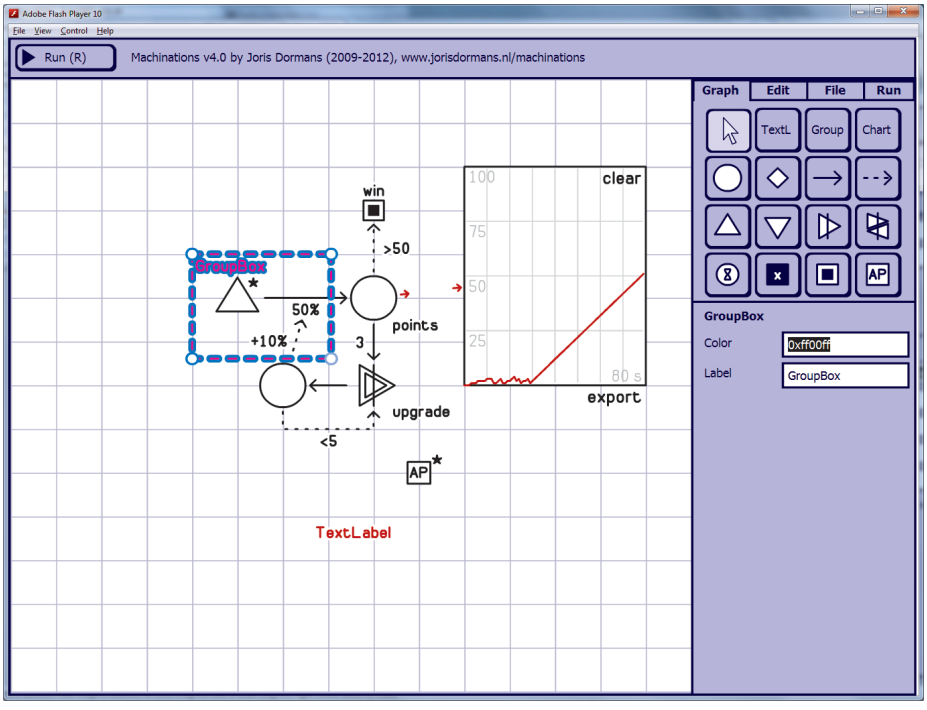
The situation with sources and converters is a bit more complex. The color of the resources that a source or a converter generates is governed by the color of the node's output, *not* by the node's own color. This is what makes it possible for a single source to generate resources of more than one color, as shown here:



The source is black, while the colors of the two resource connections are red and blue. Clicking the source will produce one resource of each color traveling along their respective outputs to the pool.

However, if a source or converter node and its output are the *same* color, the color of the resource that travels along the output will be overridden by the color in the Resource box in the node's element panel (which is black by default). In the previous diagram, if you turn the source red, it will start to send black resources along the red output, but if you type **green** into its Resources box, the source will produce green resources along the red output. It will continue to produce blue resources along the blue output, because the blue output does not match the red source.

## Adding Text Labels and Group Boxes




Finally, Machinations allows you to add text labels with the TextL button TextL and group boxes with the Group button Group. These elements have no effect on how the diagram behaves. However, they can be useful to clarify your diagram by identifying specific mechanisms.