

RailSort Instruction Manual

Nathan Lovell, 2010

1. Running RailSort

RailSort can be run straight from the jar package. At a command prompt type “java -jar RailSort.jar.” Alternatively, double-clicking the jar file works in some operating systems.

2. Editing Networks

Types of Bridges

There are three types of bridges. Blue bridges sort larger cows up. Green bridges sort larger cows down. And red bridges always swap cows, regardless of which is larger. You can set the type of a bridge by double clicking on it.

Adding, Removing and Modifying Bridges

Bridges are added and removed from the Network by clicking and dragging. Click and hold on the first rail, then drag to the second. The colour of the line that appears as you drag will tell you the outcome of your action.

Red: You are dragging over the top of an existing bridge, and the existing bridge will be deleted.

Grey: The connection you are attempting to add is not available for addition. Nothing will happen. You cannot add a bridge if either of the rails involved are already occupied at that time slot. You also can not add a bridge that would cause a fixed size network to expand. (See fixed size networks below.)

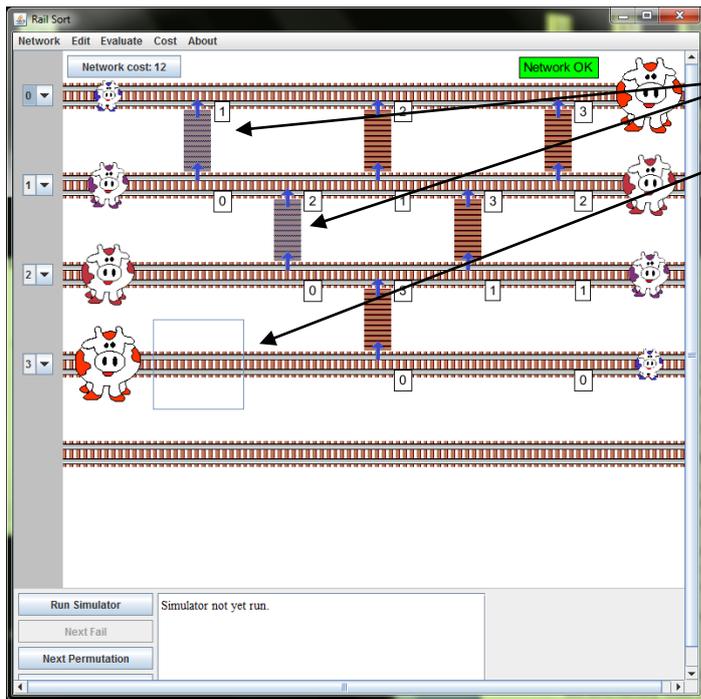
Black: A new bridge will be added between the two rails.

If you drag from the lower rail to the higher one, then a blue bridge will be created. If you drag from the higher rail to the lower one, then a green bridge will be created. You can change the type of bridge after it has been created by double clicking on it (including to a red bridge).

Copying and Pasting Bridges

Bridges can be selected by holding down shift and clicking on them. There is no need to click and drag – they will remain selected until you shift-click them again. You can also select and deselect bridges in the “Edit” menu.

Once some bridges have been selected, the blue box indicates where they will be placed. You can move the blue box by left-clicking anywhere. The pattern of selected bridges will be replicated as close as is possible in the new location.



The selected pattern...

... will be placed here.

Selected bridges can be deleted using the “Edit” menu.

Fixed Size Networks

A network will automatically resize larger if you add a connection to the unused, bottom rail. It will also automatically resize smaller if it detects that the lowermost rail(s) have no bridges. You can fix the network at a given number of rails using the “Network->Fix Network Size...” menu, in which case the network will refuse to resize to either a larger or smaller number of rails.

Any networks will always expand in time (to the right). New rails can be added underneath the pictures of the final cows to expand the network. Rails cannot be added under the pictures of the initial cows.

3. Importing Networks from Images

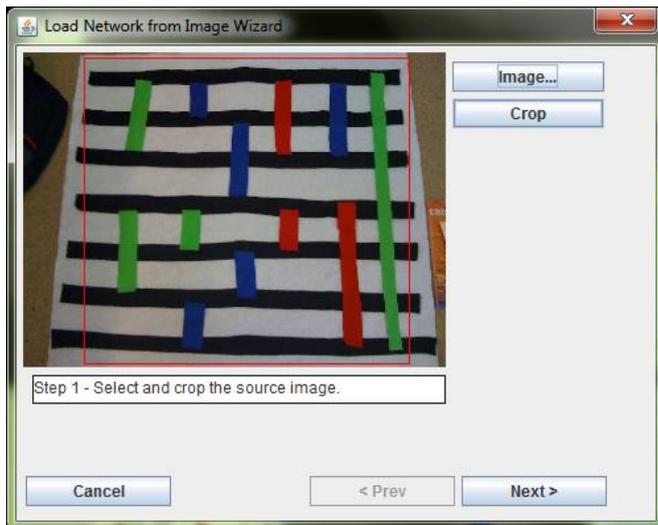
The Import Wizard

Importing a Network from an image can be found in the “File” menu. The process consists of three steps.

Step 1

Firstly, the image is selected and cropped. Load the required image from the “Image...” button. Most common file types (png, bmp, jpg, gif) are supported. You don’t want the image to have anything visible except the network itself (on a white background). To facilitate this, the loaded image can be cropped if desired.

Crop an image by clicking and dragging on it. A red box will appear. Surround the desired area of the image, and click the “Crop” button.



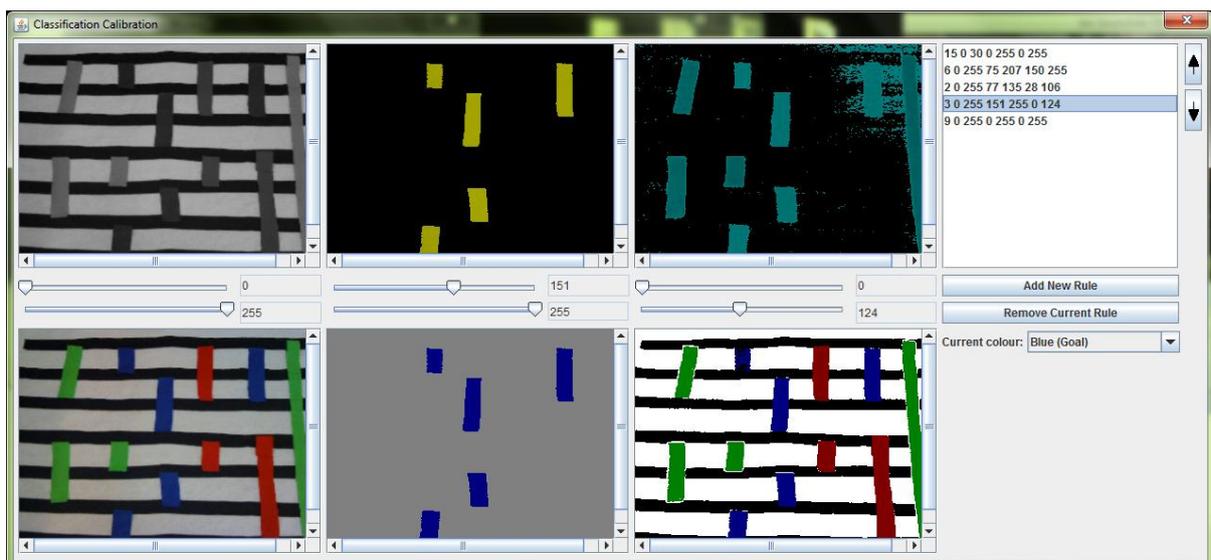
After the image is loaded and cropped, click “Next.”

Step 2

The second step is colour classification. The program will try to load class.dlc (see file formats below for more information about the classifier file format) from whatever directory it was started in. If the file does not exist, it will create it. However the created classifier will classify every pixel as UNKNOWN.

A different classifier can be loaded using the “Classifier...” button. The classifier file format is the same as the robocup code, and images are segmented in YUV colour space.

A manual calibration of the classifier can be done with the “Calibrate” button. The dialog that appears works on one classification rule at a time. A complete list of all rules can be seen in the list box at the right. Rules can be added, modified, or their order changed.



The top three images represent the Y, U and V components respectively. The maximum and minimum values for the selected rule can be set using the sliders underneath them.

The bottom three images represent the original image, the classification of the current rule, and the final classification of all rules respectively.

Your classifier should classify:

WHITE: The background to the rails.

BLACK: The rails.

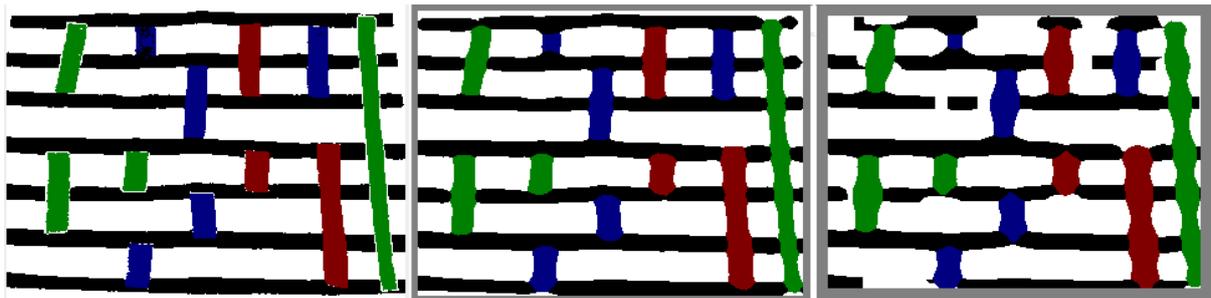
BLUE (Goal): "Up" bridges.

GREEN (Field): "Down" bridges.

RED (Dog): "Always swap" bridges.

Once the calibration is done, the window can just be closed – it will automatically be applied and you will be returned to the second page of the Import Wizard dialog.

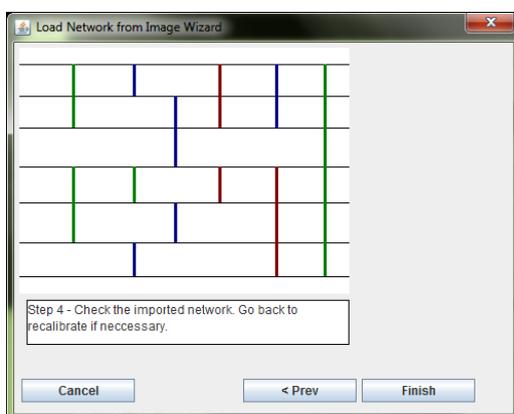
The image processing code for RailSort works better on "thickened" images. This is a smoothing function that gets rid of small areas and splotchy calibrations. The thickening can be adjusted using the slider to the right of the image on the second page of the Import Wizard dialog. The thickened image should not contain, for example, any stray blue pixels on the black rail lines, or white around the edges of the colours. See the images below:



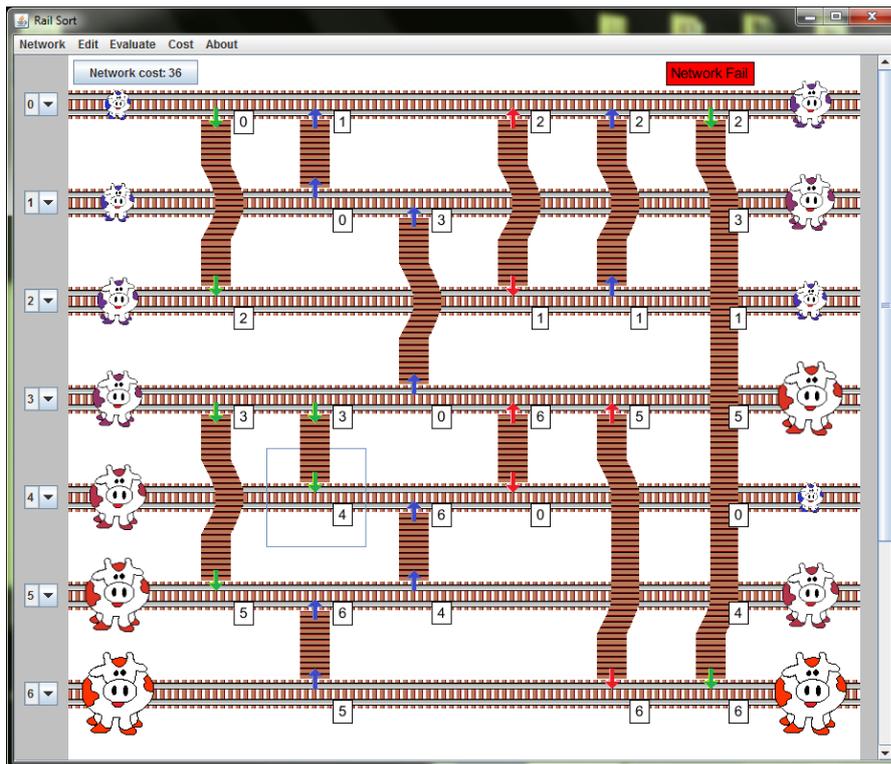
The first of these images has stray white and black pixels. This image needs thickening. The second is correct. The third has been over-thickened.

Step 3

A sample network is shown. This should diagrammatically represent the image. If it doesn't you may need to go back and recalibrate or re-thicken.



When you click "Finish" the resulting network should resemble the original image:



4. Running and Understanding Simulations

Network Inputs

The numerical inputs to the network are shown in the drop-down boxes to the left of it, and graphically displayed by cow size and colour. (The larger the numerical input, the larger and redder the cow.) Each rail is assigned a unique number.

As well as modifying the drop down menus, network inputs can be modified using three of the buttons at the bottom of the screen. The “Random Permutation” button selects a random set of input values. “Next Permutation” systematically cycles through every possible set of input values. “Next Fail” is only available after the simulator has been run (see below). Once it has been run, it keeps track of every set of inputs that did not succeed, and cycles through them.

Evaluation Criteria

The network is evaluated based on a particular criteria, which you can select from the “Evaluate” menu. The options are:

Largest on 1st Rail: The network is correct for a particular input if the largest cow ends up on the top rail.

Median on 1st Rail: For an odd number of rails, the median cow must end up on the top rail. For an even number of rails, either of the two median numbers will be accepted.

Smallest on 1st Rail: The network is correct for a particular input if the smallest cow ends up on the top rail.

Smallest on 1st Rail, Largest on 2nd Rail: The network is correct for a particular input if the smallest cow ends up on the top rail, and the largest on the second from the top.

Kth Largest on 1st Rail: A popup box will appear asking you to select a number k . The network is correct for a particular input if the k th largest cow ends up on the first rail.

Largest K at top: A popup box will appear asking you to select a number k . The network is correct for a particular input if the largest k cows end up on the top k lines, in any order.

Sorted – Ascending: The network will be correct for a particular input if the cows are sorted in ascending order (smallest at the top).

Sorted – Descending: The network will be correct for a particular input if the cows are sorted in descending order (largest at the top).

If the network is correct for its current set of inputs then “Network OK” will appear printed above it. If it is not, then “Network Fail” will be printed instead.

Network Costs

Exhaustive information about the Network cost can be found by clicking on the “Network Cost” button, above the top rail.

It is possible to set the relative weight of each type of cost by selecting “Configure Network Cost...” from the “Cost” menu.

Running a Simulation

When “Run Simulator” is clicked it will attempt every permutation of inputs for the current network, up to a preset maximum of $9!$. If there are more than 9 rails in the network then $9!$ random permutations of inputs will be tried.

The simulator will then provide the following information:

Simulator Run: <Whether all inputs were tested or not.>

Overall Network Score: <A measure of the success of this network.>

---- SUCCESS ----

Runs: <The total number of inputs tested.>

Success: <The number of inputs that the network succeeded on, based on its current evaluation measure.>

Fails: <The number of inputs that the network failed on, based on its current evaluation measure.>

---- COST ----

Cost of this network: 10

- time: 5

- operations: 5

- parallel: 0

- bridges: 0

(More information about network cost is available by clicking on the "Network cost" button above.)

The overall network score is calculated by comparing the cost of this network to the cost of a standard network that works for the current evaluation criteria. As well as this the percentage success of the network is taken into account. A score of 100 means that it measured up precisely to the standard. A score over 100 means that it beat it in cost. A network can not score higher than its percentage success. This means that a network that fails for even one input permutation will score less than 100.

5. Files used by RailSort

RailSort uses two files, located in the same directory as the .jar file. Both of these files will be created on first use if they don't exist.

The classifier file (default name class.dlc) is a colour classifier of the same format as our Robocup code. Its pixel values are in YUV and the colour assignment Ids are the same.

The rail file (default name rails.n) is an XML file describing the rail network. Networks can be saved and loaded from the "File" menu.