Revision Tool

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# Generate a Trust Graph

Generating a basic Trust Graph requires only a vocabulary as a dependency. Once that has been defined, selecting the **Generate Trust Graph** action will generate a graph in the **Trust Graph** pane. The **Generate Trust Graph** action can be found in the **Actions** pane.

Graphical user interface

Description automatically generated

After the **Generate Trust Graph** action has been executed the trust graph will be generated.

Table

Description automatically generated

If the user does not specify a value in the **Initial Trust Value** field, the trust graph will set each value to the default value (5.0). If a value is specified, that value will be set as the initial value of the Trust graph.

Calendar

Description automatically generated with low confidence

## How this works

The generation creates a data structure that stores a distance value for all combinations of states possible. The way these values are stored internally looks like the visualization itself. The constructor iterates through all possible states, given the number of variables, and assigns a default value to all possible combinations.

# Modify the Trust Graph

The trust graph can be modified manually through user input and by adding reports through the **Reports** pane.

## Manual

Each selectable trust graph cell can be modified to custom distance values. Manually inputted distance values must be positive.

## Add Report

There are a few steps that happen behind the scenes when a report is applied to the trust graph.

1. Find all satisfying assignments.
2. Modify distance values between SAT and UNSAT assignments

Graphical user interface, text, application

Description automatically generated

Finding satisfying assignments is done by the ALLSAT solver. The implementation of that algorithm is explained in detail in the **algorithms.docx** document. When that algorithm is complete, all satisfying assignments are compared with all possible assignments to find all unsatisfied assignments.

Once all states have been split into satisfying and unsatisfying, the report modification algorithm can be run. This algorithm runs through all combinations of sat and unsat assignments, modifying the distance value for each state combination.

## Upload Functions

When adding reports, the user can specify specific parameters to change HOW a report is added to the Trust graph. This feature allows the user to change the values that increase or decrease trust graph values. This is done by through a text configuration file which can be uploaded by using the **Upload** **Functions** action.

The format of the file must follow that of the template file.

Text, letter

Description automatically generated

The file has two main sections, the **-defaults-** and **-combinations-** sections. The values in the **defaults** section are applied to all Trust graph edges that do not have an entry in the **combinations** section.

The format for values under the **-defaults-** header follows this format.

**Increase value, decrease value**

The format for values under the **-combinations-** header follows this format.

**State, State, increase value, decrease value**

Specifying how an edge changes in the Trust graph can be done through a plain integer, or through a formula. The input for a formula is very strict. A formula must follow the following example format:

**f(v) = (2 \* v) + 1**

The formula must be a function of ‘v’, and v must be present in the formula. The variable ‘v’ represents the current value in the trust graph before the report is applied. F(v) is the result. Using plain integer format is just a shorthand of formula input. For example:

**00,01,2,1** could also be written as

**00,01, f(v) = v + 2, f(v) = v - 1**

# Specify Beliefs

There are two ways to specify an initial belief set. It can be done manually by selecting the **Hamming Ranking** option in the combo box, or through file input by selectin the **File Ranking** option.

Graphical user interface, text

Description automatically generated

## Manual

Manual input must contain valid propositional variables and valid propositional symbols. Valid symbols include (parenthesis, ~, &, |, ->).

Shape, square

Description automatically generated

Manual input will be converted into a ranking function. The states that satisfy the propositional sentence will have the highest rank of 0. All states that are unsatisfied will be given a score equal to their minimum hamming distance to all satisfiable states.

## File

There is also the option to define an initial belief state through file input. Select the **File Ranking** option from the combo box. Click the **Choose File** action to find a file to upload from your file system.

Graphical user interface, text, application

Description automatically generated

The files must follow a specific type of format. Files can contain any number of valid states, given the number of propositional variables. The first line must contain the default ranking value for any state not specified in the file. Any file not specified will be given this ranking value. All other lines must first have the ranking value separated by a colon. Following the colon must be the states being assigned that specific rank. To place multiple states on a line, separate states with a comma.

**Valid File formatting**

Graphical user interface, text, application

Description automatically generated

Having multiple lines with the same rank value will assign both lines that rank. So states 10 and 11 will both be rank 1.

Graphical user interface, text, application

Description automatically generated

When a state is assigned two ranking values in the file the LAST entry in the file containing this state will be the final rank for that state in the system. The state 00 will be assigned the rank 1.

Graphical user interface, text, application

Description automatically generated

# Revision

There are two types of revision that the system can use to modify a belief state, Naïve and General. Both types of belief revision use minimax distance in the revision process, not the raw distance values found in the grid. Use the **MiniMax Distance Checker** to check accurate minimax distance values from the Trust graph.

## Naïve Revision

Naïve Revision must be selected in the **Actions** pane, and a threshold value must be specified.

Graphical user interface

Description automatically generated

## General Revision

General Revision must be selected in the **Actions** pane.

Graphical user interface

Description automatically generated

# Naïve Revision Example

This will be a basic belief revision example with two variables, using naïve revision.

1. Generate the trust graph following the image below for guidance.

Graphical user interface

Description automatically generated

This will generate the default trust graph for these two variables. The tool should now look like this.

A picture containing calendar

Description automatically generated

1. Modify the trust graph with reports.

Add two reports to the **Report** pane form. Clicking the **Add Reports** action will complete the add report process, modifying the trust graph with these reports.

Graphical user interface, text, application

Description automatically generated

If you added the same reports as in the image above the trust graph should be identical to the trust graph below.

Calendar

Description automatically generated with medium confidence

After the trust graph has been modified enough, and you want belief revision to take place. The Revise action is the next action to take place. There are a couple steps needed before the **Revise** action can be run.

1. Pick the type of revision.

The revision type must be chosen before belief revision can take place. In this example, we are doing Naïve revision. Choose Naïve revision and set the threshold value to 3.

Graphical user interface

Description automatically generated

1. Specify an initial belief state.

Choose a state(s) to represent the agent’s initial beliefs. For now, lets deal with one state (a&b) or 11. Choose **Hamming Ranking** from the combo box to manually input initial beliefs.

A picture containing square

Description automatically generated

1. Specify sentences to revise by

In the sentences input specify the sentences to revise by.

Shape, square

Description automatically generated

1. Revise

The **Revise** action can now be run. Running the action after following all previous steps will produce the following results.

A picture containing text, screenshot, indoor

Description automatically generated

The belief state produced by revision has not changed **( a & b )**.

To visualize WHY that is the result, the table below shows the first step to this revision. They show the distances between possible states and all sentence states.

|  |  |  |
| --- | --- | --- |
|  | 01 | 10 |
| 00 | 6 | 7 |
| 01 | 0 | 6 |
| 10 | 6 | 0 |
| 11 | 6 | 5 |

As you can see from the graph and the cells with the green background, all but one distance value is below or equal to the threshold value specified earlier (3). This means that all possible states are now being considered for revision.

The second aspect of revision uses the hamming distance between all the states produced by step one, to all belief states. The hamming distances are shown below.

|  |  |
| --- | --- |
|  | 11 |
| 00 | 2 |
| 01 | 1 |
| 10 | 1 |
| 11 | 0 |

The result of revision is the minimum hamming distance, so the resulting state is 11 or (a&b). This indicates that the beliefs of the agent have not changed.

# General Revision Example

Start off general revision by creating a trust graph for two variables, the same as in the previous example.

1. Generate the trust graph with an initial trust value of 8.0.

Graphical user interface

Description automatically generated

A picture containing table

Description automatically generated

1. Add some reports to the trust graph

Graphical user interface, application

Description automatically generated

1. Choose **General** as the type of revision.
2. Since ranking functions are an important piece of general revision, we will use the file input option for specifying initial beliefs.
   1. Select **File Ranking** from the combo box below the **Beliefs** pane.
   2. Choose File

We will use this ranking function as file input. Create a file with these contents and upload it to the tool.

Graphical user interface, text, application

Description automatically generated

1. Specify the Sentence to revise by

Shape, square

Description automatically generated

1. Revise

The results for revision should match the output of the tool below.

A picture containing text, screenshot, indoor

Description automatically generated

The revision process is demonstrated in the table below. The rank and min distance value are highlighted to show the values that impacted the results of the returned states.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State | Rank | Distance (01) | Distance (11) | Result |
| 00 | 0 | 9 | 10 | 9 |
| 01 | 2 | 0 | 9 | 2 |
| 10 | 1 | 9 | 8 | 9 |
| 11 | 2 | 9 | 0 | 2 |

We can see that the sentence for revision contained states with the lowest rank in the initial belief state, but since existing beliefs did not have low enough trust values to cement those beliefs, belief change has occurred.

# Using Upload Functions

1. Create a new Trust Graph with the initial value of **10.0**

Graphical user interface

Description automatically generated

1. Upload a file using the **Upload Functions** action. Use these lines as the contents.

Text, letter

Description automatically generated

Using this file, all other edges other than (00,01) and (10,11) will use the default update values.

Graphical user interface, text, application, email

Description automatically generated

1. Apply the **a & b** report to the trust graph. Make it a positive report.

The resulting graph should look like this:

Calendar

Description automatically generated

You can see for the cells (00,11) and (01,11) the default value of 2 was used to increase the Trust graph, since no specific actions were specified for those edges. The (10,11) edge applied the formula defined in the configuration file, which doubled the edge value.

1. Now add the Negative report **a | b**

Graphical user interface, text, application, email

Description automatically generated

The Trust graph will update to match the graph found below.

Calendar

Description automatically generated

Again, you can see that the default value was used when a specific action was not found. The edges (00,10) and (00,11) were updated using the default negative value. The edge (00,01) was updated using the specific value in the configuration file (0.75).