

Manual: Application for Design of Multi-Agent Systems

Group B14

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1 Introduction

This document details how to use the application designed by group B14 for the course Design of Multi-Agent Systems. The goal of the application is to model the spread of information through a network (such as a social media website), modelled using insights from psychology, where we integrate simulated cognitive dissonance in the decision making of agents.

2 Compiling & running the program

On a linux-based operating system the application can be compiled from the terminal using the provided build shellscript, located in the root of the repository. For this, it is required that the java development kit (JDK) has been already installed on the computer. This can be done by opening up a terminal, navigating to the root directory of the shell script and running it using:

```
./build.sh
```

After creating the jar file, it is advised to run the program from the terminal using:

```
java -jar graph.jar
```

The reason for this, is that it will then treat the location of the jar as the root folder for the application, which then will create a folder there for data output. If it is ran as a standalone application, the file root used will be the default for java on your operating system.

3 Using the program

By default the program opens in headless mode. This mode allows the execution of simulations without requiring a visual representation, which saves some resources.

3.1 Loading in agents

In the file menu, an option can be found to create a set of agents based on parameters specified in a file. Agents have parameters which can be informed by a csv file, which needs to contain a value (and header) for neuroticism, extraversion and openness. Each line then describes the parameters for an agent. Example of such agent parameters files can be found in the folder “data_processing/data_agents”. These files should be given the extension “.csvagents”.

3.2 Showing the simulation & view controls

Headless mode can be toggled via the “Toggle headless” option in the view menu. If toggled, it will switch to a view of the current model present in the simulation. In order to allow the nodes to space out better, the physics can be toggled from the physics menu. This will force the nodes to space out properly by applying varying forces such as a gravitational pull, spring forces on the edges, and a push force in-between nodes. Furthermore, the gravitational pull force can also be changed from the physics menu if so desired.

3.2.1 View control

The following actions are available for interacting with a view of the model itself:

1. *Scrolling*: Zooms in or out on the mouse.
2. *Left-clicking & dragging (on background)*: pans the view
3. *Left-clicking on node*: Displays information about the selected node, and colours it black
4. *Right-clicking on node*: Displays the same information that a left-click would give, but in addition, also isolates the clicked node & its neighbours in the view.

In addition to this, a couple of options are also available in the view menu:

1. *Toggle legend*: Allows the user to start/stop displaying the legend.
2. *Show belief*: Colours nodes based on the belief they currently hold. Dark colours indicate a belief close to 0.5. If the belief is above that threshold, it will become coloured red by default. Below, it will become coloured blue by default. The more intense the colour, the stronger the belief (i.e. closer to the extreme values for belief of 0 and 1). These colours can be changed using the “Choose Colour” option of this menu.
3. *Show dissonance*: Shows the nodes that are experiencing dissonance above their threshold as green nodes, and the nodes that are not experiencing dissonance as black. Note that the edges still retain their regular colour.
4. *Reset zoom*: Resets zoom to default.
5. *Pull camera to node*: In the case of having lost the graph, this option will pull the camera to a node in the graph.
6. *Choose colour*: An accessibility feature. Allows the user to specify the colours used to draw information about nodes in both the dissonance and belief modes.
7. *Reset colours*: Resets the colours to the default colours used by the application

3.2.2 Edge Colours

Let $b(n)$ denote the belief of node n . Given an edge e , which connects nodes n_i and n_j , the colour c is decided as follows:

$$c(e) = \begin{cases} \text{Red} & \text{if } b(n_i) \geq 0.5 \text{ and } b(n_j) \geq 0.5, \\ \text{Blue} & \text{if } b(n_i) < 0.5 \text{ and } b(n_j) < 0.5, \\ \text{Black} & \text{otherwise.} \end{cases}$$

These are the default colours. If the colours for zero and one beliefs are changed using the colour chooser in the view menu, then these colours will change with them,

3.3 Model simulation

Of course, performing simulations is the most important feature of the application. Under the Sim Control menu, the following options are available:

1. *Reset Model*: Allows the user to create a new randomly initialized model. Will ask the user how many nodes the new model needs to have, and creates it accordingly.
2. *Update dissonance network wide*: Applies the same dissonance update to the entire network. Will ask the user to specify what value to add to the dissonance for each agent. Mainly used for testing purposes.

3. *Update recommendation strategy and set size*: Sets the recommendation strategy that should be used to fill every agent's recommendation set. At every step agents consider information not only from other agents directly connected to them but also from agents that are in their recommendation set. Possible strategies are "polarize", "random" and "neutralize". The first fills the recommendation set with agents that have a belief close to the agent's belief for which the recommendation set is currently created. The strategy ensures that the agents to be recommended are neither directly nor indirectly (via another agent) connected to the current agent. The second strategy ("random") selects agents randomly from the network. The last strategy suggests nodes that are similar in belief, but closer to 0.5. This option additionally determines the maximum size of the recommendation set. Note that an agent will also connect to all agents within the recommendation set that have an belief close enough to the belief of the current agent and if doing so does not violate the total number of connections per agent permitted by the connection limit.
4. *Update Dissonance Weight*: Changes the effect of dissonance on the openness of each node.
5. *Update Openness Weight*: Changes how the openness parameter that is read in from a file is weighted.
6. *Update connection limit for nodes*: Sets the maximum number of connections that each node is permitted to have. If it is changed such that the new limit is lower than the old one, nodes above this limit will remove random connections until they fit within the new limit again. It should be noted that this behaviour mainly exists to guarantee that at any point the number of neighbours of each node is less than or equal to the limit, and typically this limit should be kept constant for the entire duration of a simulation.
7. *Step simulation (spacebar)*: Performs 1 simulation step on the network, consisting of spreading information, network pruning and finding new potential nodes to connect with. Can also be performed by pressing the spacebar key.
8. *Perform N steps on network*: Same as above, but will then execute n steps directly, where n is requested from the user when the option is selected.

3.4 Data output

Next to running the model, it may be desirable to collect data for further analysis. Options that deal with this can be found under the Log generation menu. By default, data output is off, to allow the user to play around with the application without generating large data dumps. Data is stored in the data_out folder that is generated in the root of the application.

The data that is generated is stored in a folder whose name is decided by the current time, which houses a csv file with relevant variables, to be analysed further, and an image folder that holds images if image data is generated.

1. *Enable data output*: Will enable data output. When enabled, data will be saved on the simulation step performed.
2. *Disable data output*: Disables data output. Disabling & re-enabling will cause the generation of a new folder for data output.
3. *Enable/configure image output*: Turns on image output generation. The user will be requested to provide per how many frames an image should be captured. When this option is selected, be patient! The image capture logic first waits for the physics to be settled to create a neater image, and in the first time steps this might take quite some time. There is a time-out in place, so it is guaranteed to terminate.
4. *Disable image output*: Stop generating images as output.
5. *Set. max avg. movement (capture)*: As aforementioned, the image capture first waits for the physics to settle a bit before capturing any output. It does this by checking whether or not the average velocity per node in the network falls under a pre-specified threshold. Currently, we have not managed to find a rule to generalize such a rule that works well for each size of network, so the user can change this if need be. The current initial max avg. velocity under which the network must fall has been set to a value that works well with networks of around one thousand nodes. If a larger network is simulated, this threshold needs to increase, and if a smaller network is simulated, decrease.