

igence



Banish User Guide

Reference: IR0001091, March 2014

Author: Paul Shepherd

© **Igence Radar Limited**, Wyche Innovation Centre, Walwyn Road, Upper Colwall,
Malvern, Worcs., WR13 6PL
t 01684 252354 e radar@igence.com w www.igenceradar.com
Registered no. 3094523



Issue Record

The content of this document is defined by the issue number and, where appropriate, the revision identifier detailed below.

Issue / Revision	Incorporated by	Date	Comments
1.0	Paul Shepherd	28/03/14	First Version of user guide corresponding to version 2.0 of the software.

Authorisation

Prepared by: Paul Shepherd, Igence Radar Ltd

Approved by: Tom Cooper, Igence Radar Ltd

Contents

	Page
1. Introduction.....	4
2. Version History	5
3. Installing Banish	5
4. System Setup	5
5. Development environment and third party software.	6
6. Modified Uncertainty Yardstick.....	6
7. Using the application	7
8. JBAN Data format	10
9. Potential Upgrades.....	11
10. Support and Customer Feedback	11
11. Index.....	12

1. Introduction

- 1.1.1 Banish (Bayes Net Intelligence Software) is a prototype software tool to demonstrate how Bayesian techniques can be easily included with standard DI practice. The output of this stage of the project is a C++ application that can be run on the Microsoft Windows OS (Windows 7, XP and Vista). The work has focused on the user interface and the user experience. For this phase of the prototype development, a message passing algorithm applied to a discrete Bayes net was deemed sufficient.
- 1.1.2 The requirements of the prototype software were outlined in work package one of the initial proposal [1]. These requirements, and how they have been achieved, are detailed briefly below.
- 1.1.3 **Solution of three example problems.** An initial version of the software (version 1.0) was produced for the project startup meeting. This version of the software was capable of being applied to three example problems (Two jars, diagnostic cards and Red's CW). The application of Banish to these three example problems are described in [2]. The release of version 2 of the software also contains the three example problems for loading into the software.
- 1.1.4 **Iterative development.** Version 1.0 of the software was made available for download to get user feedback. As agreed at the startup meeting, Igence have hosted a github discussion forum (www.github.com/banish), to gather this feedback. Where possible this has been used to implement improvements for version 2.0 of the software. Where it has not been possible to include the suggestions for improvements, these have been added to a list of potential future upgrades.
- 1.1.5 **Import and export of the Bayes nets.** The Bayes nets are persisted in JSON files as requested. It is also possible to export views of the net in both Graph-ML and bitmap files. Third party open source libraries have been used where possible (see section 5).
- 1.1.6 **Project workspace.** The user interface provides a project workspace, and the ability to record supporting information. Modification dates, times, and contributing authors are recorded and saved to the project file.
- 1.1.7 **Use of the uncertainty yardstick.** A key requirement of the software was for the user to populate the probability tables either via numerical values or through the use of the "uncertainty yardstick". Modifications have had to be made to the yardstick provided, to make it suitable for this application, as described in section 6.

2. Version History

2.1 Version 2.0

2.1.1 The following improvements were made to version 2.0.

- Calculation of entropy and mutual information.
- JSON file format.
- Improved data input, including uncertainty yardstick.
- Ability to cut, paste, move and copy groups of nodes and to combine networks from different projects.
- Project style input and recording of meta-data.
- GraphML and BMP file export.

2.2 Version 1.0

2.2.1 Baseline application demonstrated at the project startup meeting, capable of implementing the three example problem and provided as a basis for discussion of the required functionality.

3. Installing Banish

3.1.1 The installation files consist of three files, setup.exe, Banish.msi and a release note. Click on the setup.exe file. If a previous version of the software is found on the system, you will be prompted to have this removed. Follow the on screen instructions. By default, the software will be installed by default in the directory "C:\Program Files\Igence Radar Ltd\Banish" on a 32 bit system. On a 64 bit system, the default directory is "C:\Program Files (x86)\Igence Radar Ltd\Banish". A shortcut will be added to the program menu, which can be used to run the program.

3.1.2 The release note gives details of the modification history of the software including known issues.

3.1.3 The application can be uninstalled using the standard Windows Uninstall programme.

3.1.4 A number of example project files are provided with the installation and are put into the installation folder.

4. System Setup

4.1 Recommended System requirements

- Operating System: Windows XP Professional, Vista or Windows 7.
- CPU Type and speed: 2GHz CPU or equivalent.
- Memory: 2GB of RAM (XP) or 3GB of RAM (Vista, Windows 7).
- Graphics Card: nVidia Graphics card e.g. GeForce 8800GT, Quadro FX 1600M or similar.

- Hard drive space: 30MB (minimum).

5. Development environment and third party software.

- 5.1.1 The software has been developed as a 32bit application using Microsoft Visual Studio 2010 Professional, Service Pack One and uses the Microsoft MFC classes.
- 5.1.2 The visualization of the Bayes Net has been implemented in Open-GL.
- 5.1.3 Two third party, open source, libraries have been used:-
- RapidJSON – The rapidjson library (version 0.11) has been used for parsing the input and output data to a json file. The rapidjson library is released under the terms of the MIT licence.
 - OGDF (Open Graph Drawing Framework) library (version 2012.07 (Sakura)) has been used for exporting the Graph-ML output. The OGDF library is released under the terms of the GNU General Public Licence version 2 or 3.
- 5.1.4 The source code for both third party libraries has been included with the source code provided for Banish for ease of compilation.

6. Modified Uncertainty Yardstick

- 6.1.1 The uncertainty yardstick as provided required some small modification to make it suitable for this application. These were to cope both with gaps in the provided yardstick and to make the selections more meaningful. The modified yard stick is provided below.

Qualitative Statement	Associated Probability Range (%)
None	<1e-6
Remote	1e-6 to 12.5
Improbable	12.5 to 22.5
Realistic Possibility	22.5 to 47
Even	47 to 53
Probable	53 to 72.5
Highly Probable	72.5 to 87.5
Almost Certain	87.5 to (100 – 1e-6)
Certain	100 – 1e-6 to 100

- 6.1.2 Note: When a user enters a probability numerically, and then switches to a yardstick view. The value displayed depends on the value, but the value isn't altered. e.g. a probability of 13% would be displayed as improbable. However if the analyst uses the

probability yardstick to select a value, e.g. improbable, the numerical value would be set as the middle of the improbable range i.e. 17.5%.

7. Using the application

7.1.1 A screenshot of the main display is shown in figure 1 below.

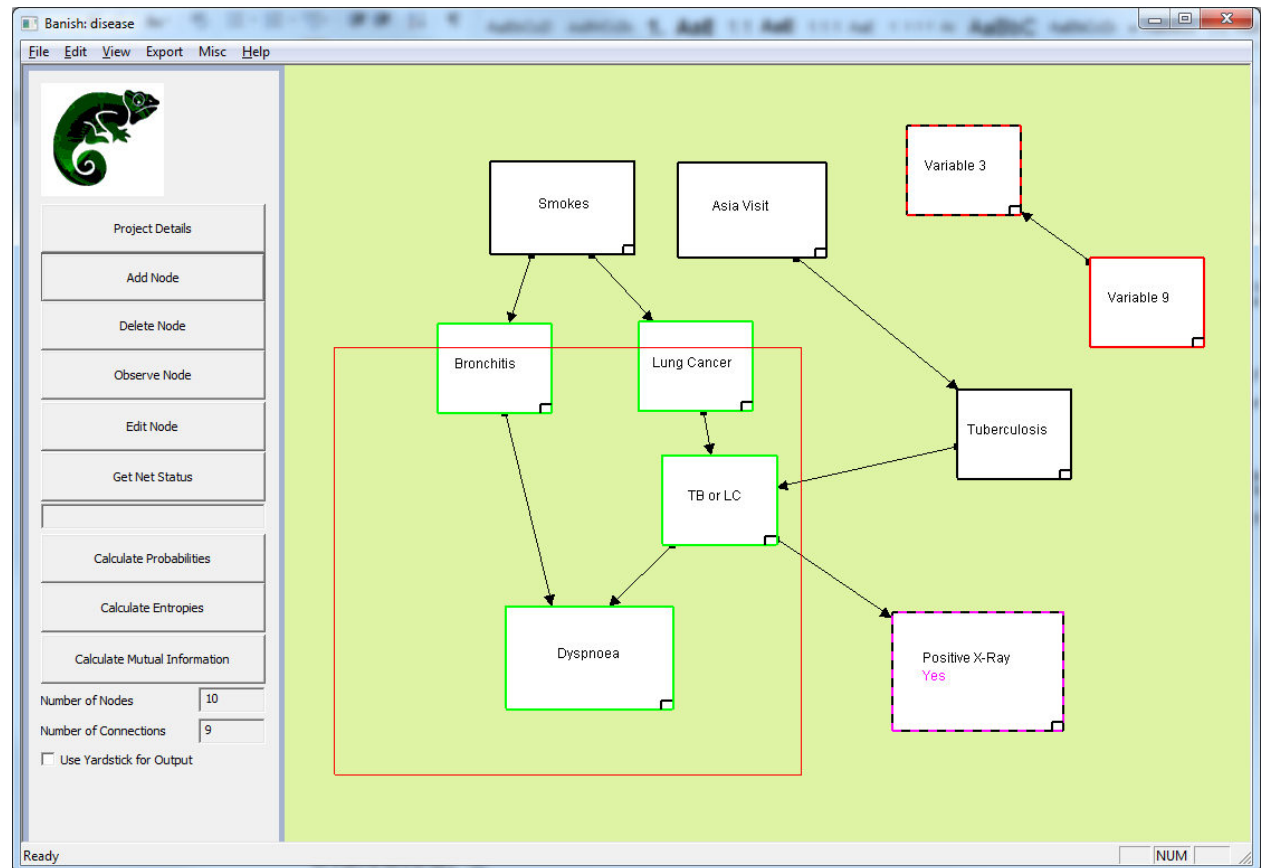


Figure 1: Screen shot of the main Banish display. It consists of a control panel on the LHS with a net display area on the RHS. The nodes are colour coded to indicate their status.

7.2 Creating and manipulating network

7.2.1 **Adding a node.** To add a node, click on the net display area on the right, which will produce a cross on the display and either press the add node button on the control panel or press "a" on the keyboard.

7.2.2 **Deleting a node.** To delete a node, click inside it, press the delete node button or press "d" on the keyboard.

7.2.3 **Moving a single node.** Nodes can be moved around by left clicking and dragging inside a node.

7.2.4 **Resizing a node.** A node can also be resized by left clicking and dragging inside the small box in the lower right corner.

7.2.5 **Connecting two nodes.** To connect two nodes, right click inside the start node and drag to the end node.

- 7.2.6 **Deleting a connection.** To delete a connection between two nodes, repeat the same process as 7.2.5. Keeping the start and end nodes in the same order.
- 7.2.7 **Re-centering the display.** To move the centre position of the whole display, left click and drag on a location outside of a node.
- 7.2.8 **Zoom In and Out.** The display can be zoomed in or out using the mouse wheel.
- 7.2.9 **Selecting groups of nodes.** To select a group of nodes, right click and drag on a location outside of a node. A red box will be drawn. Nodes that are contained within the box will be highlighted with a green border.
- 7.2.10 **Moving a group of nodes.** Select a group of nodes as above, left click and drag inside the red box to move the selected nodes.
- 7.2.11 **Copying, Cutting and pasting a group of nodes.** Select a group of nodes as above. From the menu select Edit->cut or Edit->copy. To paste the selected nodes in a different location, right click on the display to get a cursor and then select Edit->Paste from the menu.
- 7.2.12 **Combining groups of nodes from different projects.** The copying, pasting functionality described above can be used to combine the nets from different projects together. Load project A, select and copy the required nodes, then load project B and paste the nodes into this project.

7.3 Setting/viewing a Project Details.

- 7.3.1 The project details can be viewed by clicking on the project details button on the control panel. The non-editable fields at the top are populated when a file is saved. The project name is obtained from the filename. Every time a file is saved the project file version number is incremented by one. The authors of the net are automatically recorded, along with who was the last person to modify it. The author names are obtained automatically from the login name of the user.
- 7.3.2 A data input field for entering some details about the project is provided. Pressing the edit button will make this area user editable.

7.4 Node colour coding

- 7.4.1 The nodes are colour coded to indicate their status.
- **Red:-** indicates that the states for this node have not been defined.
 - **Black and red:-** has its states defined but has not had its conditional probabilities defined.
 - **Black:-** the states and probabilities defined.
 - **Purple and black:-** the node has been observed.
 - **Green:-** A group of nodes can be selected by right clicking and dragging a region. Nodes within the selection region are highlighted in green. These can be moved, cut and pasted as described earlier.

7.5 Populating a node's probabilities.

Banish User Guide

- 7.5.1 To populate a node, either double click within the node or select the node by left clicking in it and then press the edit node button on the control panel. The user is presented with the control dialog shown below.

The dialog box is titled 'Node Parameters' and has a tab labeled 'Dyspnoea'. It contains a text area for 'Enter Data using Uncertainty Yardstick' and an 'Edit' button. Below this is a large text area for 'This is where you put information about a node...'. On the left, there are three state labels: 'Yes', 'No', and 'New State', each with a red cross icon and a green arrow icon. To the right of these is a table of conditional probabilities. The table has columns for 'Bronchitis' and 'TB or LC', and rows for 'Yes' and 'No'. The values are: Yes/Yes: 0.9, Yes/No: 0.8, No/Yes: 0.7, No/No: 0.1, New State/Yes: 0, New State/No: 0.3. Below the table, there are green checkmarks under the first three columns and a red cross under the last column, with a 'Scale' button next to it. At the bottom right are 'OK' and 'Cancel' buttons.

	Yes		No	
Bronchitis	Yes	No	Yes	No
Yes	0.9	0.8	0.7	0.1
No	0.1	0.2	0.3	0.9
New State	0	0	0	0.3

Figure 2: A node data input dialog.

- 7.5.2 The edit field in the top left corner is the node name. Below this are the states of the node. A new node is automatically populated by default with two states. Additional states can be inserted at the desired position by clicking on the green arrows. If more than two states exist, red crosses are provided to the left of each state to allow them to be deleted.
- 7.5.3 If a node has dependencies on another node, and the states for the parent node have not been defined, then the data input fields for entering the conditional probabilities will not be shown.
- 7.5.4 If the states of the parent node are defined, or the node has no parents, then the probability data input fields will be shown as above. The input data will be displayed either as a set of probabilities or as drop down list of the uncertainty yardstick depending on the users choice. The numbers in each column should add up to one. If two states exist, then adjusting one of the rows to value x , will automatically result in the other row being set to $1-x$.
- 7.5.5 If more than two states exist, then the columns are automatically summed to see if they add up to one. If not, this is indicated with a cross beneath the column. The user can then either adjust the probabilities manually to make them add to one, or they can press the scale button. This will divide the number in each row by the sum of the values across all the states, for that column. A valid set of inputs will be shown by a tick under each column.
- 7.5.6 A data input field for entering some details/justification etc. for the node values is provided. Pressing the edit button will make this area user editable.

7.6 Querying the Bayes Net.

- 7.6.1 Once the nodes, connections and probabilities for all nodes have been defined it is possible to query the node. To determine whether a net is ready for querying, press the get net status button on the control panel. This will return one of the following:-

- Some nodes have no states
- Some nodes have no distribution
- Success

7.6.2 If all the nodes are shown with black borders, the Bayes net will be ready for calculating probabilities. It is then possible to perform the following options:-

7.6.3 **Calculate Probabilities.** In each node, the probability of each state is displayed.

7.6.4 **Calculate Entropies.** In each node, the entropy value is displayed.

7.6.5 **Calculate mutual information.** To calculate the mutual information, select a node for which you require the mutual information. The mutual information between this node and all the other nodes are then displayed within each node, along with the entropy.

7.6.6 Details of the calculations are described in [2].

7.7 Observing a Node.

7.7.1 To observe a node, left click in the node and then either press the “o” key, or press the observe node button on the control panel. Alternatively right click inside a node. The user will then be presented with a list of states for that node, to select the observed state.

7.8 Exporting the display to Graph-ML or BMP.

7.8.1 The graph display can be exported to either Graph-ML or bitmap file by selecting the appropriate option from the export menu. The user will be prompted for a filename.

7.9 Loading an “old” BAN file.

7.9.1 The old format BAN file files from version 1.0 can still be loaded into the application via the Misc->Load Old Format File option.

8. JBAN Data format

8.1.1 The Banish application writes/reads data to a .jban file. This is a JSON format file. The data fields are as follows:-

```
{
  "project": "disease", // name of the project
  "version": 1,         // version number of the project file
  "authors": [          // contributors to the project.
    "Tom",
    "Paul"
  ],
  "creation date": "Thursday 27 March 2014 16:20:59 GMT",
  "modification date": "Friday 28 March 2014 13:11:22 GMT",
  "last modified by": "Paul",
  "project details": "A brief description of the project",
  "file version": 1,    // specifies the version of the file format
  "zoom": 1,           // layout controls for the net display
  "xoffset": -0.189358,
  "yoffset": -0.0149626,
  "nodes": [           // an array for each of the nodes..
    {
      "id": 0,          // identifier for each node
```

Banish User Guide

```
"name": "Smokes",          // node name
"xpos": -0.644757,        // node layout on the display
"ypos": 0.620948,
"xsf": 1.52734,           // size of box on the display
"ysf": 1.075,
"use yardstick": false,   // use yardstick display for input
"node description": "",   // meta data for node
"state names": [
    "Yes",
    "No"
],
"population": [
    [
        0.5,
        0.5
    ]
]
},
{
    ... Repeated for next node.
}
],
"connections": [
    {
        "startnode": 0,
        "endnode": 2
    },
    {
        "startnode": 8,
        "endnode": 7
    }
]
```

9. Potential Upgrades

9.1.1 The following is a list of potential upgrades or modifications to the software. Note these upgrades refer only to the user interface/implementation of the application. Details on potential improvements to the algorithms are provided in [2].

- Adding the ability to import and export Bayes Nets to and from other applications. These include Hugin, BNIF and Genie/Smile DSL. This would allow nets to be exchanged between Banish and other similar applications, including SAMIAM, BNT and Genie/Smile.
- Integrating the application with a mongoDB data base. The current implementation of Banish works rather like a word document. One user can create a net and pass it on for further development to another party. An alternative, more flexible approach, would be for a number of users to work on different aspects of a project simultaneously in remote locations, with the changes coordinated via a mongoDB server.
- Implementing Banish as a web-based application. The current Windows application implementation of Banish could be complemented, or replaced by a web based application, which again would assist in the development and sharing of projects by remotely located users.

10. Support and Customer Feedback

10.1.1 If you have any problems, comments or queries regarding this software, please send your enquiries to radar@igence.com.

- 10.1.2 As part of our commitment to our customers, and to the ISO 9001:2008 quality standard, we would welcome feedback on any aspect of our work, good or bad.

11. Index

1. IR0001056 Proposal for ICE – Bayesian Belief Networks for Intelligence Analysis, December 2013.
2. IR0001090 Banish Prototype description and Roadmap, March 2014.