



**CS 681 Fall 2008**  
**Designing Expert Systems**

# **Knowledge-Based Reasoning: Part II**

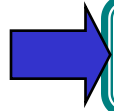
## **Assessment Assistant**

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# Overview

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**Assessment-based Reasoning**

**Reading**

# Assessment Assistant

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An assistant that allows the user and an agent to collaborate in problem solving by each solving different parts of a complex problem.

It also allows a user to solve problems in application domains with incomplete or uncertain information by hypothesizing alternative solutions to subproblems.

# Analyst's Cognitive Assistant: Settings

**Both:** Show both the problems and their solutions

**Solving:** The purpose is to solve problems (as opposed, for instance, to learning)

Mixed-Initiative Reasoner

Reasoning type: **Both** Reasoning mode: **Solving** Plausibility: **medium**

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess whether Al Qaeda has nuclear weapons.  
no solutions available

What factors should I consider to determine whether Al Qaeda has nuclear weapons?  
Characteristics associated with possession of nuclear weapons and current evidence that it has nuclear weapons.  
no solutions available

Assess whether Al Qaeda has nuclear weapons based on the characteristics associated with the possession of nuclear weapons.  
no solutions available

What are the characteristics associated with possession of nuclear weapons?  
Reasons, desire, and ability to obtain nuclear weapons.  
no solutions available

Assess whether Al Qaeda has reasons to obtain nuclear weapons.  
It is **almost certain** that Al Qaeda has reasons to obtain nuclear weapons.

Assess whether Al Qaeda has desire to obtain nuclear weapons.  
It is **an even chance** that Al Qaeda has desire to obtain nuclear weapons.

Assess whether Al Qaeda has the ability to obtain nuclear weapons.  
no solutions available

Evidence Search Assessment Assistant Composition  
Learning External Solutions Formalization Refinement Modeling

**Assessment Assistant:**  
Can be employed by the user to provide solutions to some of the sub-problems.

You can use either the **Reasoning Hierarchy** tool or the **Graphical Viewer** to browse the reasoning tree

The screenshot displays the 'Mixed-Initiative Reasoning System' interface. At the top, there are controls for 'Reasoning type: Both', 'Reasoning mode: Solving', and 'Plausibility: medium'. Below these are tabs for 'Reasoning Hierarchy', 'Reasoning Step', 'Graphical Viewer', and 'Report'. The 'Reasoning Hierarchy' tab is active, showing a tree of reasoning steps. The root node is 'Assess whether Al Qaeda has nuclear weapons.' with a green bar indicating 'no solutions available'. It branches into 'What factors should I consider to determine whether Al Qaeda has nuclear weapons?' (also 'no solutions available'), which further branches into 'Assess whether Al Qaeda has nuclear weapons based on the characteristics associated with the possession of nuclear weapons.' (also 'no solutions available'). This node branches into 'What are the characteristics associated with possession of nuclear weapons?' (also 'no solutions available'), which then branches into three sub-questions: 'Assess whether Al Qaeda has reasons to obtain nuclear weapons.' (solution: 'It is almost certain that Al Qaeda has reasons to obtain nuclear weapons.'), 'Assess whether Al Qaeda has desire to obtain nuclear weapons.' (solution: 'It is an even chance that Al Qaeda has desire to obtain nuclear weapons.'), and 'Assess whether Al Qaeda has the ability to obtain nuclear weapons.' (solution: 'no solutions available'). To the right of the hierarchy is a panel with tabs for 'Evidence', 'Search', 'Assessment Assistant', and 'Composition'. Under 'Assessment Assistant' are sub-tabs for 'Learning', 'External Solutions', 'Formalization', 'Refinement', and 'Modeling'. A 'Find Solution...' button is located below these tabs.

Reasoning type: Both Reasoning mode: Solving Plausibility: medium

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess whether Al Qaeda has nuclear weapons.  
no solutions available

What factors should I consider to determine whether Al Qaeda has nuclear weapons?  
no solutions available

Assess whether Al Qaeda has nuclear weapons based on the characteristics associated with the possession of nuclear weapons.  
no solutions available

What are the characteristics associated with possession of nuclear weapons?  
no solutions available

Assess whether Al Qaeda has reasons to obtain nuclear weapons.  
It is almost certain that Al Qaeda has reasons to obtain nuclear weapons.

Assess whether Al Qaeda has desire to obtain nuclear weapons.  
It is an even chance that Al Qaeda has desire to obtain nuclear weapons.

Assess whether Al Qaeda has the ability to obtain nuclear weapons.  
no solutions available

Evidence Search Assessment Assistant Composition  
Learning External Solutions Formalization Refinement Modeling

Find Solution...

Solutions are associated both with problems and with question/answer pairs.

You should only pay attention to the solutions associated with the problems.

# Selecting a Problem and Invoking Assessment Asst

The screenshot displays the Disciple software interface. The top menu bar includes System, Ontology, Rules, Evidence, Reasoning, KB Reports, and Help. The main window is titled 'repository\PNW-CS681-0.0.1\Al Qaida'. Below the menu bar, there are tabs for Reasoning Hierarchy, Reasoning Step, Graphical Viewer, and Report. The Reasoning Hierarchy tab is active, showing a list of reasoning steps. The first step is 'Assess whether Al Qaeda has the ability to obtain nuclear weapons.' with a status of 'no solutions available'. The second step is 'How could Al Qaeda obtain nuclear weapons?' with a status of 'no solutions available'. The third step is 'Assess whether Al Qaeda might receive nuclear weapons' with a status of 'no solutions available'. The fourth step is 'Assess whether Al Qaeda has the ability to buy nuclear weapons.' with a status of 'It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.' The fifth step is 'Assess whether there are sources willing to sell nuclear weapons to Al Qaeda.' with a status of 'It is a remote possibility that there are sources that will be willing to sell nuclear weapons to Al Qaeda.' The sixth step is 'Assess whether Al Qaeda has resources to buy nuclear weapons.' with a status of 'It is a remote possibility that Al Qaeda has resources to buy nuclear weapons.'

On the right side of the interface, there is a panel titled 'Assessments'. This panel has tabs for Learning, External Solutions, Normalization, Refinement, Modeling, Evidence, Search, Assessment Assistant, and Composition. The 'Assessment Assistant' tab is selected. Below the tabs, there is a large empty area labeled 'Assessments'. To the right of this area is a vertical sidebar with buttons for 'Node', 'Subtree', and 'All'. At the bottom of the 'Assessments' panel, there is a 'New' button.

Three callout boxes provide instructions:

1. Find and select a problem for which you want to define a solution
2. Select Assessment Assistant
3. Click on "New" to define a solution for the selected problem

# Solution Pattern

The screenshot displays the Disciple software interface, which is used for knowledge engineering and reasoning. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The "Reasoning" menu is currently selected, showing a "Mixed-Initiative Reasoner" dialog box. The "Reasoning type" is set to "Both", the "Reasoning mode" is "Solving", and the "Plausibility" is "medium".

The "Reasoning Hierarchy" pane on the left shows a tree of reasoning steps. The top-level goal is "Assess whether Al Qaeda has the ability to obtain nuclear weapons." Below this, several sub-goals are listed, each with a status indicator (e.g., "no solutions available", "It is a remote possibility").

The "Assessments" pane on the right shows a list of assessments. The "Edit Assessment" dialog box is open, displaying a new assessment: "It is almost certain that Al Qaeda will receive nuclear weapons." The justification field is empty, and the "Save" button is visible.

A blue speech bubble points to the reasoning hierarchy, stating: "Disciple displays one or more solution patterns for the selected problem".

# Instantiation of the Solution Pattern

The screenshot displays the Disciple software interface, which is used for knowledge engineering and reasoning. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The "Reasoning" menu is active, showing a "Mixed-Initiative Reasoner" dialog. The "Reasoning type" is set to "Both", "Reasoning mode" is "Solving", and "Plausibility" is "medium".

The "Reasoning Hierarchy" pane on the left shows a tree of reasoning steps. The first step is "Assess whether Al Qaeda has the ability to obtain nuclear weapons." with a status of "no solutions available". The second step is "How could Al Qaeda obtain nuclear weapons?" with a status of "no solutions available". The third step is "Assess whether Al Qaeda might receive nuclear weapons" with a status of "no solutions available". The fourth step is "Assess whether Al Qaeda has the ability to buy nuclear weapons." with a status of "It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons." The fifth step is "Which are the requirements for buying nuclear weapons?" with a status of "There should be sources willing to sell nuclear weapons, and to buy the weapons." The sixth step is "Assess whether there are sources willing to sell nuclear weapons to Al Qaeda." with a status of "It is a remote possibility that there are sources that will be willing to sell nuclear weapons to Al Qaeda." The seventh step is "Assess whether Al Qaeda has resources to buy nuclear weapons." with a status of "It is a remote possibility that Al Qaeda has resources to buy nuclear weapons."

The "Assessments" pane on the right shows a list of assessments. The "Edit Assessment" dialog is open, showing a new assessment: "It is almost certain that Al Qaeda will receive nuclear weapons." The "Justification" field is empty. A dropdown menu is open, showing the following options: "almost certain", "likely", "an even chance", "unlikely", "a remote possibility", and "no evidence".

**Click on a value you want to change and select (double-click) the desired one from the list**



# Justification of the Solution

The screenshot displays the Disciple software interface. The main window shows a reasoning hierarchy on the left and an assessment window on the right. The reasoning hierarchy is a tree structure of questions and answers. The assessment window is titled 'Assessments' and contains a list of assessments. A blue callout box points to the 'Assessments' list, and another blue callout box points to the 'Justification' field in the 'New Assessment' dialog.

**Reasoning Hierarchy:**

- Assess whether Al Qaeda has the ability to obtain nuclear weapons.  
no solutions available
  - How could Al Qaeda obtain nuclear weapons?  
Receive, buy or make nuclear weapons.  
no solutions available
    - Assess whether Al Qaeda might receive nuclear weapons  
no solutions available
    - Assess whether Al Qaeda has the ability to buy nuclear weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.
      - Which are the requirements for buying nuclear weapons?  
There should be sources willing to sell nuclear weapons, and resources to buy the weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.
      - Assess whether there are sources willing to sell nuclear weapons to Al Qaeda.  
It is a remote possibility that there are sources that will be willing to sell nuclear weapons to Al Qaeda.

**Assessments:**

Node Subtree All

EVD-WP-Allison01-01  
almost certain  
Allison G  
Al Qaeda  
Al Qaeda-in-EVD-WP-Allison01-01  
Al Haramain  
al Gamat al Islamiya  
Al Agsa Martyrs Brigade

**New Assessment:**

It is a remote possibility that weapons.

Justification: I do not think that Al

Save

Cancel

**1. Optional but recommended: Provide a justification of the solution**

**2. Insert values from the ontology by using the completion tool**

Selecting another node while defining a new solution is equivalent with clicking on “Cancel”

The screenshot displays the Disciple software interface. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. Below the toolbar is a text field showing the repository path: "repository\PNW-CS681-0.0.1\Al Qaida". A tab labeled "Mixed-Initiative Reasoner" is active. The interface is divided into two main panes. The left pane, titled "Reasoning Hierarchy", shows a tree of reasoning steps. The right pane, titled "Assessments", shows a list of assessments and a "New Assessment" dialog box. The "New Assessment" dialog box contains a text field for the assessment statement and a "Justification" field. The "Save" button is highlighted in the dialog box.

Reasoning type: Both Reasoning mode: Solving Plausibility: medium

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess whether Al Qaeda has the ability to obtain nuclear weapons.  
no solutions available

How could Al Qaeda obtain nuclear weapons?  
Receive, buy or make nuclear weapons.  
no solutions available

Assess whether Al Qaeda might receive nuclear weapons  
no solutions available

Assess whether Al Qaeda has the ability to buy nuclear weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.

Which are the requirements for buying nuclear weapons?  
There should be sources willing to sell nuclear weapons, and resources to buy the weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.

Assess whether there are sources willing to sell nuclear weapons to Al Qaeda.  
It is a remote possibility that there are sources that will be willing to sell nuclear weapons to Al Qaeda.

Assess whether Al Qaeda has resources to buy nuclear weapons.  
It is a remote possibility that Al Qaeda has resources to buy nuclear weapons.

Assessments

Learning External Solutions Formalization Refinement Modeling  
Evidence Search Assessment Assistant Composition

New Assessment:

It is a remote possibility that Al Qaeda will receive nuclear weapons.

Justification: I do not think that Al Qaeda will receive nuclear weapons from anywhere.

Save

Cancel

Click on “Save” if you want to keep this solution

Click on “Cancel” if you do not want to keep this solution

# User-defined Solutions

The screenshot displays the Disciple software interface, which is used for knowledge representation and reasoning. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The "Reasoning" menu is open, showing options like "Reasoning type: Both", "Reasoning mode: Solving", and "Plausibility: medium".

The interface is divided into several panes. The left pane, titled "Reasoning Hierarchy", shows a tree of reasoning steps. The right pane, titled "Assessments", shows a list of assessments. The bottom pane, titled "Assessments", shows a list of assessments.

The reasoning hierarchy consists of several steps, each with a question and an answer. The steps are:

- Assess whether Al Qaeda has the ability to obtain nuclear weapons.  
It is a remote possibility that Al Qaeda has the ability to obtain nuclear weapons.
- How could Al Qaeda obtain nuclear weapons?  
Receive, buy or make nuclear weapons.  
It is a remote possibility that Al Qaeda has the ability to obtain nuclear weapons.
- Assess whether Al Qaeda might receive nuclear weapons  
It is a remote possibility that Al Qaeda will receive nuclear weapons.
- Assess whether Al Qaeda has the ability to buy nuclear weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.
- Which are the requirements for buying nuclear weapons?  
There should be sources willing to sell nuclear weapons, a to buy the weapons.  
It is a remote possibility that Al Qaeda has the ability to buy nuclear weapons.
- Assess whether there are sources willing to sell nuclear weapons to Al Qaeda.  
It is a remote possibility that there are sources that will be willing to sell nuclear weapons to Al Qaeda.

The assessments pane shows a list of assessments. The first assessment is:

- Enabled S: It is a remote possibility that Al Qaeda will receive nuclear weapons.

Two callouts highlight specific features:

- A callout points to the assessment "It is a remote possibility that Al Qaeda will receive nuclear weapons." with the text: "The problem solver uses the new solution to update its reasoning".
- A callout points to the assessment "It is a remote possibility that Al Qaeda will receive nuclear weapons." with the text: "Yellow background denotes solution provided by you".

# Options to Browse User-defined Solutions

The screenshot displays the Disciple software interface. The top menu bar includes System, Ontology, Rules, Evidence, Reasoning, KB Reports, and Help. The repository path is set to repository\PNW-CS681-0.0.1\Al Qaida. The Mixed-Initiative Reasoner is active. Reasoning settings are set to Both type, Solving mode, and medium plausibility. The Reasoning Hierarchy tab is selected, showing a list of reasoning steps. The first step, 'Assess whether Al Qaeda has nuclear weapons.', is highlighted. The right pane shows the 'Assessments' section with a 'Node' button selected. Three callout boxes provide instructions on how to browse solutions: 'Show user solutions for the current problem "Node"', 'Show user solutions for the "Subtree" of the current problem node', and 'Show "All" the user solutions in the reasoning tree'.

Disciple

System Ontology Rules Evidence Reasoning KB Reports Help

repository\PNW-CS681-0.0.1\Al Qaida

Mixed-Initiative Reasoner

Reasoning type: Both Reasoning mode: Solving Plausibility: medium

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess whether Al Qaeda has nuclear weapons.  
It is likely that Al Qaeda has nuclear weapons.

What factors should I consider to determine whether Al Qaeda has nuclear weapons?

Characteristics associated with possession of nuclear weapons and current evidence that it has nuclear weapons.  
It is likely that Al Qaeda has nuclear weapons.

Assess whether Al Qaeda has nuclear weapons based on the characteristics associated with the possession of nuclear weapons.  
Based on its reason, desire, and ability to obtain nuclear weapons, it is a remote possibility that Al Qaeda has nuclear weapons.

What are the characteristics associated with possession of nuclear weapons?

Reasons, desire, and ability to obtain nuclear weapons.  
Based on its reason, desire, and ability to obtain nuclear weapons, it is a remote possibility that Al Qaeda has nuclear weapons.

Assess whether Al Qaeda has reasons to obtain nuclear weapons.  
It is almost certain that Al Qaeda has reasons to obtain nuclear weapons.

Assess whether Al Qaeda has desire to obtain nuclear weapons.  
It is an even chance that Al Qaeda has desire to obtain nuclear weapons.

Learning External Solutions Formalization Refinement Modeling  
Evidence Search Assessment Assistant Composition

Assessments

Node Subtree All

Show user solutions for the current problem "Node"

Show user solutions for the "Subtree" of the current problem node

Show "All" the user solutions in the reasoning tree

New

# Browsing User-defined Solutions

The screenshot displays the Disciple software interface, which is used for managing knowledge and reasoning. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The "Reasoning" menu is currently selected, showing a "Mixed-Initiative Reasoner" dialog box. The "Reasoning type" is set to "Both", the "Reasoning mode" is "Solving", and the "Plausibility" is "medium".

The interface is divided into two main panes. The left pane, titled "Reasoning Hierarchy", displays a tree of reasoning steps. The right pane, titled "Learning External Sol", displays a list of user-defined solutions.

**Reasoning Hierarchy (Left Pane):**

- Assess whether Al Qaeda has nuclear weapons.  
It is **likely** that Al Qaeda has nuclear weapons.
- What factors should I consider to determine whether Al Qaeda has nuclear weapons?
- Characteristics associated with possession of nuclear weapons and current evidence that it has nuclear weapons.  
It is **likely** that Al Qaeda has nuclear weapons.
- Assess whether Al Qaeda has nuclear weapons based on the characteristics associated with the possession of nuclear weapons.  
Based on its reason, desire, and ability to obtain nuclear weapons, it is a **remote possibility** that Al Qaeda has nuclear weapons.
- What are the characteristics associated with possession of nuclear weapons?
- Reasons, desire, and ability to obtain nuclear weapons.  
Based on its reason, desire, and ability to obtain nuclear weapons, it is a **remote possibility** that Al Qaeda has nuclear weapons.
- Assess whether Al Qaeda has reasons to obtain nuclear weapons.  
It is **almost certain** that Al Qaeda has reasons to obtain nuclear weapons.
- Assess whether Al Qaeda has desire to obtain nuclear weapons.  
It is an **even chance** that Al Qaeda has desire to obtain nuclear weapons.

**User-defined Solutions (Right Pane):**

The right pane displays a list of user-defined solutions, each with a checkbox, a status indicator, and a description. A blue callout bubble points to the "Subtree" column header, indicating that user solutions are listed in the "Sub-tree".

- ☒ Enabled S: It is a **remote possibility** that Al Qaeda has the ability to make nuclear weapons.
- ☐ X J:
- ☒ Enabled S: It is **almost certain** that Al Qaeda has not used its limited number of nuclear weapons in order to save them for a spectacular operation.
- ☐ X J:
- ☒ Enabled S: It is **almost certain** that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.
- ☐ X J:

A blue callout bubble points to the "X" icon next to the first solution, indicating that clicking it will navigate to the problem with this user solution.



# Operations on a User-defined Solution

The screenshot displays the Disciple software interface. The main window has a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The 'Reasoning' menu is open, showing options like Reasoning type (Both), Reasoning mode (Solving), and Plausibility (met). The 'Reasoning Hierarchy' tab is active, showing a list of reasoning steps. The 'Assessments' panel is also visible, showing a list of assessments. The 'Node' selected is 'It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.' The 'Assessments' panel includes a 'Node' dropdown, a 'Subtree' dropdown, and a 'J:' field. The 'Assessments' panel also has a 'Modify' button, a 'Save' button, and a 'Cancel' button. The 'Assessments' panel also has a 'New' button at the bottom.

Reasoning type: Both Reasoning mode: Solving Plausibility: met

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess whether Al Qaeda had reasons not to use assuming that it has them.  
It is almost certain that Al Qaeda has reasons not weapons, assuming that it has them.

Which is a possible reason?  
To save its limited number of nuclear weapons for a spectacular operation.  
It is almost certain that Al Qaeda has not used its limited number of nuclear weapons in order to save them for a spectacular operation.

Assess whether Al Qaeda has not used its limited number of weapons in order to save them for a spectacular operation  
It is almost certain that Al Qaeda has not used its limited number nuclear weapons in order to save them for a spectacular operation

Which is a possible reason?  
To better prepare their use for achieving absolute success.  
It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.

Assess whether Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success  
It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.

Which is a possible reason?

“Node” selected

You can disable the user solution but keep it to enable it later

You can delete the solution

You can modify the solution

Assessments

It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.

Enabled S: J:

Modify Save Cancel

New



# Browsing User-defined Solutions

The same operations can be performed by using the Graphical Viewer to navigate the tree

The screenshot displays the Disciple software interface. The top menu bar includes 'System', 'Ontology', and 'repository'. Below the menu bar, there are tabs for 'Reasoning Hierarchy', 'Reasoning Step', 'Graphical Viewer', and 'Report'. The 'Graphical Viewer' tab is active, showing a reasoning hierarchy with nodes containing text about assessing whether Al Qaeda has nuclear weapons. A blue callout bubble points to the 'Graphical Viewer' tab, stating: 'The same operations can be performed by using the Graphical Viewer to navigate the tree'.

On the right side of the interface, there are tabs for 'Learning', 'External Solutions', 'Formalization', 'Refinement', and 'Modeling'. Below these, there are tabs for 'Evidence', 'Search', 'Assessment Assistant', and 'Composition'. The 'Assessment Assistant' tab is active, showing a list of assessments. A blue callout bubble points to the 'Assessment Assistant' tab, stating: 'Click to navigate to the problem with this user solution'.

The 'Assessments' list includes the following entries:

- ☒ Enabled S: It is a remote possibility that Al Qaeda has the ability to make nuclear weapons.
- ☒ Enabled S: It is almost certain that Al Qaeda has not used its limited number of nuclear weapons in order to save them for a spectacular operation.
- ☒ Enabled S: It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.



# Use of Graphical Viewer with the Assessment Asst

The screenshot displays the Disciple software interface, which is used for knowledge engineering and reasoning. The main window is titled "Disciple" and contains a menu bar (System, Ontology, Rules, Evidence, Reasoning, KB Reports, Help) and a toolbar. The "Reasoning" menu is open, showing options like "Reasoning type: Both", "Reasoning mode: Solving", and "Plausibility: met".

The "Graphical Viewer" tab is active, showing a reasoning hierarchy. A callout points to a node in the hierarchy, stating: "You can disable the solution but keep it to enable it later". Another callout points to a specific problem node, stating: "Selected problem".

The "Assessments" panel is also visible, showing a list of assessments. A callout points to a selected assessment, stating: "Node selected". Another callout points to the "X" button next to the assessment, stating: "You can delete the solution". A third callout points to the "Modify" button, stating: "You can modify the solution".

The interface includes a "Reasoning Hierarchy" tab, a "Reasoning Step" tab, and a "Report" tab. The "Assessments" panel includes a "Node" dropdown, a "Subtree" dropdown, and an "All" button. The "Assessments" list shows a selected assessment with the text: "It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success." The assessment is marked as "Enabled" and has a status of "S".

The "Graphical Viewer" shows a reasoning hierarchy with nodes like "Assess whether Al Qaeda has reasons not to use nuclear weapons, ass...", "It is almost certain that Al Qaeda has reasons not to use its nuclear weapons...", "A: To better prepare their use for achieving absolute success.", "A: To use them as a last resort if cornered and desperate", and "loss of backing was...".

Selecting another node while modifying a solution is equivalent with clicking on "Cancel"

The screenshot shows the Disciple software interface. The top menu bar includes System, Ontology, Rules, Evidence, Reasoning, KB Reports, and Help. The main window is titled "Mixed-Initiative Reasoner" and displays a reasoning hierarchy on the left and a node modification dialog on the right.

**Reasoning Hierarchy:**

- Assess whether Al Qaeda had reasons not to use nuclear weapons, assuming that it has them.
  - It is almost certain that Al Qaeda has reasons not to use its nuclear weapons, assuming that it has them.
    - A: To better prepare their use for achieving absolute success.
    - A: To use them as a last resort -- if cornered and desperate.
    - A: To use them to retaliate against followers if it felt the loss of backing was...
- Assess whether Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.
- Assess whether Al Qaeda used its nuclear weapons in order to use them as a last resort -- if cornered and desperate.

**Node Modification Dialog:**

The dialog shows the selected node: "It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success." The dialog includes a "Modified" checkbox (checked), a "Save" button, a "Cancel" button, and a "New" button.

**Annotations:**

- You can modify values:** Points to the text "It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success."
- You can define or modify the justification:** Points to the "Modified" checkbox.
- Click on "Save" if you want to keep the modifications:** Points to the "Save" button.
- Click on "Cancel" if you do not want to keep the modifications:** Points to the "Cancel" button.
- Selected problem:** Points to the selected node in the reasoning hierarchy.

You can define solutions for any problem

Selected problem

Upper user solutions overwrite lower user solutions

Assess whether Al Qaeda had reasons not to use nuclear weapons, assuming that it has them.

It is unlikely that Al Qaeda has reasons not to use its nuclear weapons, assuming that it has them.

It is almost certain that Al Qaeda has not used its nuclear weapons in order to better prepare their use for achieving absolute success.

It is almost certain that Al Qaeda has not used its nuclear weapons because it wants to use them as a last resort -- if cornered and desperate.

It is almost certain that Al Qaeda has not used its nuclear weapons because it wants to use them as a last resort -- if cornered and desperate.

Plausibility: medium

Formalization Refinement Modeling Composition  
External Solutions Assessment Assistant Learning Search Evidence

The following assumption:

It is unlikely that Al Qaeda has reasons not to use its nuclear weapons, assuming that it has them.

is challenged by the system's solution:

It is almost certain that Al Qaeda has reasons not to use its nuclear weapons, assuming that it has them.

Assessments

☒ Enabled

S: It is unlikely that Al Qaeda has reasons not to use its nuclear weapons, assuming that it has them.

X

J:

Modify

Save

Cancel

New

Node Subtree All

# Web Believability Assessment

Disciple

System Ontology Rules Scenario Reasoning KB Reports Help

repository\WebCr Experiments\WebCr-Lipitor

Mixed-Initiative Reasoner X

Reasoning type: Both Reasoning mode: Solving Plausibility: medium

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess Lipitor - Thief of Memory based on technical quality appearance.

The estimated level of technical quality appearance for Lipitor - Thief of Memory is between lowest and highest.

Q: Which is a criterion for assessing the technical quality appearance?  
A: professionalism appearance

Assess Lipitor - Thief of Memory based on professionalism appearance.

The estimated level of professionalism appearance for Lipitor - Thief of Memory is between lowest and highest.

Q: Which is a criterion for assessing the professionalism appearance?  
A: domain name match

Assess Lipitor - Thief of Memory based on domain name match.

The estimated level of domain name match for Lipitor - Thief of Memory is between lowest and highest.

Assess Lipitor - Thief of Memory based on multiple languages.

The estimated level of multiple languages for Lipitor - Thief of Memory is between lowest and highest.

Assess Lipitor - Thief of Memory based on recent updating.

The estimated level of recent updating for Lipitor - Thief of Memory is between lowest and highest.

**In the Web Believability domain there are 2 solution patterns for each problem node**

Refinement Evidence Formalization Modeling Composition  
External Solutions Assessment Assistant Learning Search

**Assessments**

Node Subtree All

**Edit Assessment**

**New Assessment:**

The estimated level of domain name match for Lipitor - Thief of Memory is highest.

Justification:  Save

**New Assessment:**

The estimated level of domain name match for Lipitor - Thief of Memory is between highest and highest.

Justification:  Save

Cancel

# Selection and Instantiation of a Solution Pattern

The screenshot displays the Disciple software interface. The main window has a menu bar (System, Ontology, Rules, Scenario, Reasoning, KB, Reports, Help) and a toolbar. The 'Reasoning' menu is active, showing a 'Mixed-Initiative Reasoner' window. The 'Reasoning type' is set to 'Both', 'Reasoning mode' to 'Solving', and 'Plausibility' to 'medium'. The 'Reasoning Hierarchy' tab is selected, showing a tree of reasoning steps. A blue speech bubble with three numbered steps is overlaid on the hierarchy:

1. Select the desired pattern of your solution.
2. Modify it.
3. Save it, by clicking on the adjacent "Save" button.

The hierarchy shows several reasoning steps, including:

- Assess Lipitor - Thief of Memory based on technical quality appearance.
  - The estimated level of technical quality appearance for Lipitor - Thief of Memory is between lowest and highest.
    - Q: Which is a criterion for assessing the technical quality appearance?  
A: professionalism appearance
- Assess Lipitor - Thief of Memory based on professionalism appearance.
  - Q: Which is a criterion for assessing the professionalism appearance?  
A: domain name match
- Assess Lipitor - Thief of Memory based on domain name match.
  - The estimated level of domain name match for Lipitor - Thief of Memory is between lowest and highest.
- Assess Lipitor - Thief of Memory based on multiple languages.
  - The estimated level of multiple languages for Lipitor - Thief of Memory is between lowest and highest.
- Assess Lipitor - Thief of Memory based on recent updating.
  - The estimated level of recent updating for Lipitor - Thief of Memory is between lowest and highest.

On the right, the 'Assessments' panel is visible, showing a list of assessments. Two 'New Assessment' entries are highlighted with red boxes:

**New Assessment:**  
The estimated level of domain name match for Lipitor - Thief of Memory is highest.  
Justification:  Save

**New Assessment:**  
The estimated level of domain name match for Lipitor - Thief of Memory is between highest and highest.  
Justification:  Save

A 'Cancel' button is located at the bottom of the 'Assessments' panel.

# Solution Pattern with Interval

The screenshot displays the Disciple software interface, which is used for knowledge engineering and reasoning. The main window shows a reasoning hierarchy for assessing the technical quality appearance of Lipitor - Thief of Memory. The hierarchy is structured as follows:

- Assess Lipitor - Thief of Memory based on technical quality appearance.
  - The estimated level of technical quality appearance for Lipitor - Thief of Memory is between lowest and highest.
    - Q: Which is a criterion for assessing the technical quality appearance?  
A: professionalism appearance
- Assess Lipitor - Thief of Memory based on professionalism appearance.
  - The estimated level of professionalism appearance for Lipitor - Thief of Memory is between lowest and highest.
    - Q: Which is a criterion for assessing the professionalism appearance?  
A: domain name match
    - Q: Which is a criterion for assessing the professionalism appearance?  
A: multiple languages
    - Q: Which is a criterion for assessing the professionalism appearance?  
A: recent updating
- Assess Lipitor - Thief of Memory based on domain name match.
  - The estimated level of domain name match for Lipitor - Thief of Memory is between lowest and highest.
- Assess Lipitor - Thief of Memory based on multiple languages.
  - The estimated level of multiple languages for Lipitor - Thief of Memory is between lowest and highest.
- Assess Lipitor - Thief of Memory based on recent updating.
  - The estimated level of recent updating for Lipitor - Thief of Memory is between lowest and highest.

The right-hand pane shows the **Assessments** section, which includes a table for **Assessments** and a **Edit Assessment** section. The **Edit Assessment** section shows two new assessments:

- New Assessment:**  
The estimated level of domain name match for Lipitor - Thief of Memory is highest.  
Justification:  Save
- New Assessment:**  
The estimated level of domain name match for Lipitor - Thief of Memory is between medium and very high.  
Justification:  Save

A blue callout box at the bottom right states: **In the interval pattern, the left value must be strictly smaller than the right value**.

# Alternative Solutions

The screenshot displays the Disciple software interface. The main window shows a reasoning hierarchy with several nodes. A central blue callout bubble states: "More than one solution can be defined for a problem, but **at most one** can be enabled at a time". To the right, a panel titled "Assessments" lists several domain name match assessments. The second assessment, "The estimated level of domain name match for Lipitor - Thief of Memory is between medium and very high.", is highlighted with a red border and has its "Enabled" checkbox checked. The top of the interface includes a menu bar (System, Ontology, Rules, Scenario, Reasoning, KB, Reports, Help) and a toolbar. The bottom of the interface shows a status bar with a "New" button.

Disciple

System Ontology Rules Scenario Reasoning KB Reports Help

repository\WebCr Experiments\WebCr-Lipitor

Mixed-Initiative Reasoner X

Reasoning type: Both Reasoning mode: Solving Plausibility: medium

Reasoning Hierarchy Reasoning Step Graphical Viewer Report

Assess Lipitor - Thief of Memory based on technical quality appearance.

The estimated level of technical quality appearance for Lipitor - Thief of Memory is between very low and very high.

Q: Which is a criterion for assessing the technical quality appearance?

A: professionalism appearance

Assess Lipitor - Thief of Memory based on professionalism appearance.

The estimated level of professionalism appearance for Lipitor - Thief of Memory is between very low and very high.

Q: Which is a criterion for assessing the professionalism appearance?

A: domain name match

Assess Lipitor - Thief of Memory based on domain name match.

The estimated level of domain name match for Lipitor - Thief of Memory is between medium and very high.

Assess Lipitor - Thief of Memory based on multiple languages.

The estimated level of multiple languages for Lipitor - Thief of Memory is between lowest and highest.

Assess Lipitor - Thief of Memory based on recent updating.

The estimated level of recent updating for Lipitor - Thief of Memory is between lowest and highest.

More than one solution can be defined for a problem, but **at most one** can be enabled at a time

Refinement Evidence Formalization Modeling Composition

External Solutions Assessment Assistant Learning Search

The following assumption:

The estimated level of domain name match for Lipitor - Thief of Memory is between medium and very high.

**is challenged by the system's solution:**

The estimated level of domain name match for Lipitor - Thief of Memory is between lowest and highest.

Assessments

Node Subtree All

☐ Enabled S: The estimated level of domain name match for Lipitor - Thief of Memory is high.

X ☐ J:

☒ Enabled S: The estimated level of domain name match for Lipitor - Thief of Memory is between medium and very high.

X ☐ J:

Modify Save Cancel

New



# Reading

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Tecuci G., Lecture Notes on Knowledge-Based Reasoning - Part II, 2008  
(required).

Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, Vu Le, Mixed-Initiative Assumption-Based Reasoning for Complex Decision-Making, *Studies in Informatics and Control*, December 2007, Volume 16, Number 4, pp. 459-468. (required).  
<http://lac.gmu.edu/publications/2007/DSS%20paper.pdf>