CIS 730 Artificial Intelligence

CIS 530 Principles of Artificial Intelligence

Fall 2013

Homework 6 of 8: Machine Problem (MP6)

Uncertain Reasoning and Learning, Part III:

More Clausal Form, Rule-Based Expert Systems (*CLIPS*), and

Intro to Probabilistic Reasoning (*Hugin/BNJ*)

Assigned: Fri 01 Nov 2013

Due: Fri 08 Nov 2013 (before midnight)

The purpose of this assignment is to develop your basic understanding of reasoning using logical, rule-based, and probabilistic representations. You will use one of the expert system shells *CLIPS* or *JESS* and the probabilistic graphical modeling tool *Hugin.*

This homework assignment is worth a total of 20 points.

Each problem is worth 4 points for CIS 730 students and 7 points for CIS 530 students.

Upload a copy of your solution (scanned or typed) to your K-State drop box before the due date.

1. (530/730) More clausal form. Translate the following English sentences into first-order logic and convert them to clausal form.
   * + 1. *No one who loves himself is a stranger to everyone.*
       2. *There is another Skywalker.*
2. (530/730) Production Systems. Download CLIPS (C Language Integrated Production System) from <http://clipsrules.sourceforge.net> or JESS (Java Expert System Shell) from [http://www.jessrules.com](http://www.jessrules.com/) and install it on your personal computer.
   * + 1. Tutorial. Follow the CLIPS tutorial, parts 1 – 3, at <http://bit.ly/3w6HFr>, or the JESS Demo at <http://www.jessrules.com/jessdemo/> and turn in a solution to the following exercise.

*Write a rule to define fish and bird in terms of properties of animals (cf. Tutorial 2), and apply it to enumerate members of each category.* Add the animals piranha, eagle, giant panda, tiger, snake, crane, mantis, and monkey to the set given, with requisite properties such that piranha are fish and eagles and cranes are birds.

References:

<http://en.wikipedia.org/wiki/Fish>

<http://en.wikipedia.org/wiki/Bird>

Name your solution mp6-2a.clp or mp6-2a.jess and turn in a trace mp6-2a-output.txt*.*

* + - 1. Forward chaining. Consider the following rule base:

*If X has gills, a skull, and no limbs – Then X is a fish*

*If X is black and white and eats bamboo – Then X is a giant panda*

*If X is a fish – Then X is aquatic*

*If X is a giant panda – Then X is terrestrial*

Assert that Dory is blue, has gills, a skull, and no limbs, that Po is black and white and eats bamboo, and that Gwaihir has wings and eats birds and deer. Run the rule base and report the results.

Name your solution mp6-2b.clp and turn in a trace mp6-2b-output.txt*.*

1. (530/730) Conditional Probability and Graphical Models. Download *Hugin Lite* and use it to construct a Bayesian network for the Hugin apple tree example:

Basic Bayesian network: <http://www.hugin.com/technology/getting-started/bns>

Open the network in *Bayesian Network tools in Java (BNJ) v3* from <http://bnj.sourceforge.net> and use it to edit the probabilities. Change the prior distribution of *Sick* to 0.02 / 0.98.

Turn in your *Hugin* network and a screenshot from *BNJ*, showing the inferred posteriors (from *Hugin’s* Compile function or BNJ’s Run tab).

1. (730 only) Influence Diagrams *aka* Utility Networks. Follow the Apple Tree utility network tutorial:

Influence Diagrams (IDs): <http://www.hugin.com/technology/getting-started/ids>

Turn in your *Hugin* ID and a screenshot, showing the inferred expected utility.

1. (730) Rule-Based Analogical Conversation or Problem Solving. Write a set of rules to generate analogy-based discourse in a conversational agent or in your project domain. For example:

*Whenever the user writes “this is… like [pattern]”, look for the noun phrase that matches [pattern] in past sentences that the user has entered and ask “in what way is it like [pattern]?” For example, “Oh, great, this is just like when we started this discussion” should generate the question “In what way is it like when we first started this discussion?” Discuss how the result should be processed to measure the similarity, identify essential and relevant relationships, and modulate further reasoning based on differences.*

Write down the rules, test them in CLIPS or JESS, and turn them in as a file, mp6-5.clp or mp6-5.jess along with a trace mp6-5-output.txt*.* .

Class participation (required).

Post to the KSOL thread for this homework in the Discussions message board CIS530-L or CIS730-L to answer at least two of the following three questions:

1. How might Problem 6-5 apply to your domain? Give a sketch (example paragraph written like the one above).
2. Are you using machine learning in your course project? If so, what is the learning task?
3. Do you have any unclear points about Bayesian networks or BN inference?

Coming Up Next

Problem Set 7 (due Fri 15 Nov 2013): Reasoning and Learning, Part I: Probabilistic Reasoning (Inference and Causality), Version Spaces, and Decision Trees; The Waikato Environment for Knowledge Analysis (WEKA), Artificial Neural Networks (ANNs)

Machine Problem 8 (due Fri 21 Nov 2013) – Reasoning and Learning Part II: Genetic Algorithms (GAs), Natural Language Processing (NLP), and Vision