

# Project 2

## A Jess-Based Wumpus World Agent

### CSE 663, Advanced Knowledge Representation

### Due Tuesday, March 29, 2011

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## 1 Project Description

You are to implement a Jess version of the Wumpus World agent, similar to the one described in (Shapiro and Kandefer, 2005) and in the Russell and Norvig AI texts (Russell and Norvig, 1995; Russell and Norvig, 2003; Russell and Norvig, 2010). You may also consult the code for the Greenfoot version of the SNePS Wumpus World Agent contained in `/projects/robot/Greenfoot/WumpusWorld/sneps/WWAgent.snepslog`.

You are only to write the GLAIR Knowledge Layer (Shapiro and Bona, 2010) of your agent, the other layers will be provided to you.

The WMEs managed by the PML layers of the agent are:

**(Feel bump):** The agent bumped into a wall the last time it went forward.

**(Feel breeze):** The agent felt a breeze the last time it sensed for one. This means that, at that time, there was at least one pit in one of the 4 adjacent cells.

**(See glitter):** The agent saw the gold bar in the same cell as it was the last time it sensed for it.

**(Smell stench):** The agent smelled the Wumpus the last time it sensed for it. This means that, at that time, the Wumpus was in one of the 4 adjacent cells.

**(Hear scream):** The agent heard the Wumpus scream, meaning that it died.

The Wumpus Agent is capable of performing the following acts, but only if it is alive and hasn't climbed out of the cave.

**(climb):** If the agent is in the home cell, it climbs out of the cave, getting 1,000 points if it has the gold, but costing 1 point if it doesn't. If the agent is not in the home cell, this act has no effect.

**(go d):** If *d* is `left`, turns left by 90°. If *d* is `right`, turns right by 90°. If *d* is `forward`, goes forward one cell, but only if a wall is not in front of it; **(Feel bump)** is either asserted or retracted. However, if the agent goes into a cell containing a pit or the live Wumpus, the agent dies. This act costs 1 point, unless it results in the agent's death, in which case it costs -1,000 points.

**(grab):** If the agent is in the same cell as the gold, it grabs the gold. Otherwise, this act has no effect. This act costs 1 point.

**(senseFor s):** If *s* is `breeze`, **(Feel breeze)** is either asserted or retracted. If *s* is `glitter`, **(See glitter)** is either asserted or retracted. If *s* is `stench`, **(Smell stench)** is either asserted or retracted. This act neither costs nor earns any points.

**(shoot):** If the agent still has its arrow, the arrow is shot in the direction the agent is facing either until it reaches the opposite wall of the cave or it hits the Wumpus. If the Wumpus is shot, (`Hear scream`) is asserted. If the agent already shot its arrow, this act has no effect. This act costs 1 point.

Notice that the only way for this to end is for the agent either to climb out of the cave from its home cell, or for it to die. At that time, the agent's score will be displayed.

You may assume that the Agent always starts in the upper left-hand corner, which is its home cell (the entrance to the cave).

## 2 Defining and Operating Your Agent

You are to create a file named `WWAgent.clp` containing the Knowledge Layer of your Wumpus Agent. The file should begin with comments containing identifying information and the syntax and semantics of the ordered and unordered facts you use. (Do not use shadow facts.) The next line should be

```
(batch "/projects/robot/Greenfoot/WumpusWorld/jess/pmla.clp")
```

This should be followed by a sequence of calls to `deftemplate` and `defrule`. You should not use any other features of Jess nor of Java. Also do not use salience, and do not use any control structures other than the basic Production System techniques we have discussed in class. If you are tempted to violate any of these restrictions, discuss it with me first.

You can operate your agent by following these steps:

1. At the Unix prompt, enter the command

```
/projects/robot/Greenfoot/WumpusWorld/jess/rjess
```

2. At the Jess prompt, enter the expression

```
(batch file), where file is the name, or full path name of your WWAgent.clp file.
```

3. Press the Run button on the `wumpusScenario` GUI.

4. At the Jess prompt, enter the expression

```
(run)
```

5. When you're done, at the Jess prompt, enter the expression

```
(exit)
```

## 3 Deliverables

Submit your `WWAgent.clp` file using the Unix command

```
submit_cse663 WWAgent.clp
```

This is due by one-half hour before the start of class on the date given at the beginning of this document.

Hand in a paper, produced using a document formatting program such as  $\text{\LaTeX}$ , or Microsoft Word, and printed on 8.5 by 11 inch paper, stapled in the upper left-hand corner. The paper must explain your solution to the Wumpus World Agent problem, similar to the style in (Shapiro and Kandefer, 2005). The paper is due at the beginning of class on the date given at the beginning of this document.

The paper should include the following sections:

- A description of the problem in your own words, although you may do this largely by citing this or other documents, as is done in the Project Description section above. Use quotations and citations appropriately, but quotes should only form a small percentage of this section.

- The syntax and semantics of all the ordered and unordered facts you use, except for those given in Section 1 of this document.
- A series of subsections where you describe how you solved each of the following problems. (Or saying that you didn't solve that problem.) This should be in English, perhaps illustrated by code. It should not be done just by copying your commented code.
  - How the agent searches for the gold.
  - How the agent avoids bumping into walls.
  - How the agent avoids falling into pits.
  - How the agent avoids getting eaten by the Wumpus.
  - How the agent shoots the Wumpus.
  - What the agent does differently once it has killed the Wumpus.
  - How the agent gets the gold.
  - How the agents finds its way back to the cave entrance after grabbing the gold.
- A discussion of any particularly noteworthy techniques you used.
- A discussion of any problems your agent still has.
- Acknowledgments
- References
- Appendix containing a listing of your `WWAgent.clp`

Remember, you will be graded only on the paper. If you don't explain how you solved any of the problems, I will assume that you didn't do that one. Nevertheless, if your program differs from the claims you make about it in your paper, you will be guilty of a violation of academic (and scientific) integrity.

## Acknowledgments

The Java programs implementing the Greenfoot Wumpus World were provided by Jonathan P. Bona.

## 4 Grading

The project will be graded according to the following table. Remember, just as (Shapiro and Kandefer, 2005) can be read and appreciated by someone without access to the Wumpus World agent program, your performance on this project will be assessed by reading your paper without reference to your program.

	Points
<b>Implementation</b>	
Not bumping into walls	7
Not falling into pits	7
Not being eaten by the Wumpus	7
Shooting the Wumpus	4
Modification of behavior once the Wumpus is dead	4
Finding the gold	11
Getting to the cave entrance with the gold	10
Proper use of Production System techniques	20
<b>Implementation Subtotal</b>	<b>70</b>
<b>Paper</b>	
Paper format	5
General project description	5
Syntax/Semantics of facts used	12
Correct use of quotation and citations	4
Acknowledgments and References	4
<b>Paper Subtotal</b>	<b>30</b>
<b>Project Total</b>	<b>100</b>

## References

- Russell, S. J. and Norvig, P. (1995). *Artificial Intelligence: A Modern Approach*. Prentice Hall, Upper Saddle River, NJ.
- Russell, S. J. and Norvig, P. (2003). *Artificial Intelligence: A Modern Approach*. Prentice Hall, Upper Saddle River, NJ, second edition.
- Russell, S. J. and Norvig, P. (2010). *Artificial Intelligence: A Modern Approach*. Prentice Hall, Upper Saddle River, NJ, third edition.
- Shapiro, S. C. and Bona, J. P. (2010). The GLAIR cognitive architecture. *International Journal of Machine Consciousness*, 2(2):307–332.
- Shapiro, S. C. and Kandefer, M. (2005). A SNePS approach to the wumpus world agent or Cassie meets the wumpus. In Morgenstern, L. and Pagnucco, M., editors, *IJCAI-05 Workshop on Nonmonotonic Reasoning, Action, and Change (NRAC'05): Working Notes*, pages 96–103. IJCAI, Edinburgh, Scotland. Available as <http://www.cse.buffalo.edu/~shapiro/Papers/shakan05a.pdf>.