Master in Computational Logics & Mestrado em Engenharia Informática
Universidade Nova de Lisboa

# Knowledge Representation and Reasoning

Second Test – Closed book – 2h00m

12th December 2017

## Group 1 [7 val.]

Consider the following logic program:

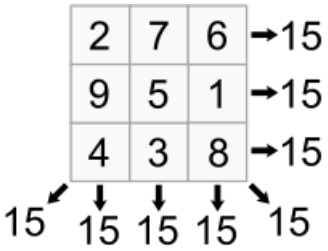
$$man(X) \leftarrow student(X), not\ woman(X). \qquad student(terry).$$
$$woman(X) \leftarrow student(X), not\ man(X). \qquad student(john). \quad man(john).$$
$$human(X) \leftarrow woman(X).$$
$$human(X) \leftarrow man(X).$$

1) What is the well-founded model of this program?
2) Using the SLX proof procedure, show whether $human(terry)$ is true (or not).
3) What are the stable models of this program?
4) Comment on the differences of the results obtained by the stable model semantics and those by the well-founded semantics in this example. How are these results affected if we add the following rule and fact to the program?

$$student(X) \leftarrow not\ student(X). \qquad woman(mary).$$

## Group 2 [5 val.]

A magic square is a $n \times n$ square grid (where $n$ is the number of cells on each side) filled with distinct positive integers in the range $1, 2, ..., n^2$ such that each cell contains a different integer and the sum of the integers in each row, column and diagonal is equal. The sum is called the magic constant or magic sum of the magic square. A square grid with $n$ cells on each side is said to have order $n$.




**Input Format** A particular instance of this problem is described by the number of cells on each side, $n$, and, to facilitate, also by the definition of the magic constant $s$:

```
#const n = 3.               % the size
#const s = n*(n*n + 1) / 2. % the magic constant
```

**Output Format** The output is an assignment of a number `N` to each cell `Row,Col`, encoded as a predicate `x(Row, Col, N)`.

Write an Answer Set Program whose answer sets correspond to the solutions of the problem.

## Group 3 [3 val.]

Contrast, in a clear and concise manner, *First-Order Entailment*, *Entailment with the Closed World Assumption*, and *Minimal Entailment* (aka. *Circumscription*), illustrating with concrete examples.

## Group 4 [5 val.]

Someone in Dreadsbury Mansion killed Aunt Agatha. Agatha, the butler, and Charles live in Dreadsbury Mansion, and are the only ones to live there. A killer always hates his victim, and is no richer than his victim. Charles hates no one that Agatha hates. Agatha hates everybody except the butler. The butler hates everyone not richer than Aunt Agatha. The butler hates everyone whom Agatha hates. No one hates everyone. Who killed Agatha?

Write an Answer Set Program to solve this riddle.

## Group 5 [Bonus: 2 val.]

Consider the following program P with aggregates:

$$P = \left\{ \begin{array}{l} p \leftarrow sum\{2:q, 1:s\} \neq 2. \\ q \leftarrow sum\{1:p, 2:s\} \neq 2. \\ \{s\}. \end{array} \right\}$$

What are the stable models of P?