MASTER IN ARTIFICIAL INTELLIGENCE (UDC - USC - UVigo)
REASONING AND PLANNING exam. June 17th, 2025

Last Name: _____

First Name: _____

INSTRUCTIONS This exam covers units 1-6 and is weighted with a maximum of **42 points (pt) from a total of 100 pt** in the whole course (Unit 7 is not covered in the exam and weights 8 pt). For the test, use the original statement sheet and avoid corrections or unclear marking (ask for a new blank sheet if needed). **Completion time = 2 hours**.

— EXAM —

Exercise 1 (20pt). Each question has at least one correct answer and its total score depends on whether you check: some incorrect answer = **-3pt**; all the correct answers = **5pt**; only correct answers, but not all = **3pt**; leaving blank = **0pt**. A total negative score in Exercise 1 counts as 0pt in the rest of the exam.

1.1) Mark those formulas below that are equivalent to $p \rightarrow q \vee \neg r$ in classical propositional logic:

- ☐ $p \wedge r \rightarrow q$
- ☐ $\neg p \vee \neg q \vee \neg r$
- ☐ $r \wedge \neg q \rightarrow \neg p$
- ☐ $p \rightarrow (r \rightarrow q)$

1.2) Given the positive logic program P with rules `p :- q, r.  r :- p.  q :- q.  s :- p, r.` mark the correct statements about the direct consequences operator T_P.

- ☐ $T_P(\{\mathtt{p},\mathtt{q},\mathtt{r}\}) = \{\mathtt{p},\mathtt{q},\mathtt{r},\mathtt{s}\}$
- ☐ $T_P(\{\mathtt{p},\mathtt{q}\}) = \{\mathtt{q},\mathtt{r}\}$
- ☐ $T_P(\emptyset) = \{\mathtt{q}\}$
- ☐ $T_P(\emptyset) = \{\mathtt{p},\mathtt{q},\mathtt{r},\mathtt{s}\}$

1.3) Given the following logic program `a :- not b.  b :- not c.  c :- d, not a.`

- ☐ the reduct with respect to $\{\mathtt{a},\mathtt{b}\}$ is the program `b.`
- ☐ the reduct with respect to $\{\mathtt{d}\}$ is the program `a.  b.  c.`
- ☐ the reduct with respect to $\emptyset$ is the program `a.  b.  c :- d.`
- ☐ the reduct with respect to $\{\mathtt{a},\mathtt{b},\mathtt{c}\}$ is the program ` `
- ☐ the reduct with respect to $\{\mathtt{c}\}$ is the program `a :- not b.  c :- d, not a.`

1.4) The rule `a :- not b.` corresponds to the formula $\neg b \rightarrow a$ in the logic of Here-and-There (HT). In classical logic, this formula is equivalent to $\neg a \rightarrow b$, but in HT they have different models. Mark those HT interpretations that are HT models of $\neg b \rightarrow a$ but not of $\neg a \rightarrow b$.

- ☐ $H = \{b\}$, $T = \{b\}$
- ☐ $H = \emptyset$, $T = \{b\}$
- ☐ $H = \{a, b\}$, $T = \{a\}$
- ☐ $H = \{a\}$, $T = \{a, b\}$

Exercise 2 (10pt). A lottery ticket in Spain consists of 5 digits, covering the interval from 00000 to 99999. Write an ASP program that generates one answer set per each lottery number that contains a strictly increasing sequence of (different) digits. Use predicate `ticket(N,D)` to represent that the `N`-th digit in the ticket is `D`.

```
digit(1..9).
position(1..5).
#show ticket/2.
```

Exercise 3 (8pt). A traffic light changes from green to red when a pedestrian pushes a button. The light returns from red to green when an internal clock sends the signal `release`. Model this system in `telingo` using the fluent `light` whose values can be `red` or `green` and the actions `push` (the button), `release` (when the clock sends the signal) and `wait` (that has no effect). Include the inertia law so that the light stays unchanged unless there is evidence on the contrary.

```
#program initial.
h(light,green).
action(release;push;wait).

#program dynamic.




#program initial.  % Example of execution: push, wait 2 situations and release
&tel{  &true ;>  o(push) ;> o(wait) ;> o(wait) ;>  o(release)   }.
```

Exercise 5 (4pt). Write a formula in Description Logic (DL) that describes the set of actors (*Actor*) that have always acted (*acted*) in Spanish movies but have also acted in at least one terror movie (*Terror*).