CPSC 312
Midterm Examination 1 — Variant A — Fall 2017

Question 1 [8 marks]

Suppose the clauses for atom *r* are

```
r :- s,t.
r :- u.
```

(a) [4 marks] Draw the box model for *r*. You do not need to include the port names, but you need to include the names for the atoms that the boxes represent.

(b) [2 marks] According to the box model, what happens immediately before atom *t* is called?

(c) [2 marks] In Prolog's trace, what is printed immediately after "Redo r"? (You only need to gives as much as can be inferred from the box model.)

Question 2 [8 marks]

Consider the following (partial) derivation of the query ?*w*. Note that the knowledge base is not specified. Fill in the underlined missing answers.

Answer clause	Clause resolved
yes :– w	Query
yes :– s, t	w :– s, t
yes :– r, t	s :– r
yes :– q, z, t	(a) _____
yes :– z, t	(b) _____
(c) _____	z :– u, p
yes :– n, o, p, t	u :– n, o

(d) If the proof then fails, what does this tell us about the knowledge base?

Question 3 [6 marks]

Consider the following knowledge base. (Assume there are dynamic declarations so there are no errors).

```
flies_autonomously :- bird, \+ abfly.
flies :- flies_autonomously, \+ injured.
```

```
flies :- on_plane, \+ plane_broken.
abfly :- emu.
abfly :- penguin.
bird :- emu.
bird :- penguin.
emu.
on_plane.
```

Give the set of all atoms and negations of atoms that are a logical consequence (i.e., the atoms and their negations that would be produced by the bottom-up proof procedure for negation as failure). You do not need to give the derivation.

Question 4 [10 marks]

Suppose that dates are represented as $ce(Y, M, D)$ for dates in the common era, where they year is Y, the month is M and the day in the month is D; these are all integers. For example today's date is $ce(2017, 9, 27)$.

Write a predicate *next_day*$(C1, C2)$ that is true when date $C2$ is the date after $C1$. You can assume the following predicates are predefined:

- $<$ which compares two arithmetic expressions for "less than"
- *is*, where `V is E` is true if arithmetic expression `E` evaluates to number `V`
- *number_days*(M, D) which is true if month M contains D days defined by

```
number_days(M,31) :- member(M,[1,3,5,7,8,10,12]).
number_days(2,28).
number_days(M,30) :- member(M,[4,6,9,11]).
```

You can assume that $C1$ does not contain variables when called.

An example of its use is:

```
?- next_day(ce(2017,12,30),D).
D = ce(2017, 12, 31) .

?- next_day(ce(2017,12,30),D), next_day(D,D1).
D = ce(2017, 12, 31),
D1 = ce(2018, 1, 1) .
```

Question 5 [10 marks]

(a) [6 marks] Write a program *replace*$(Old, New, Lst, Result)$ which is true when *Result* is a list with the same elements as list *Lst* (in the same order) but with all instances of *Old* replaced by *New*. For example, it should have the following behaviour:

```
?- replace(a, w, [a, v, a, t, a, r], R).
R = [w, v, w, t, w, r]
?- replace(w, a, [a, v, a, t, a, r], R).
R = [a, v, a, t, a, r]
```

You may use the predicate $dif(X, Y)$ which is true when X is different to Y, but no other built-in predicates.

(b) [4 marks] What are all of the answers to the query:

```
?- replace(prolog,fun,L,[fun,is,fun]).
```

Question 6 [3 marks]

(a) What do you like about the course so far?

(b) What do you dislike about the course so far?

(c) What should be changed about this course?