# Homework: Logic Programming

**Learning Objectives:**

1. Problem solving using logic programming paradigm
2. Prolog programming

## Instructions:

- Total points 48 pt
- Early deadline: Dec 4 (Wed) 2019 at 11:59 PM; Regular deadline: Dec 6 (Fri) 2019 at 11:59 PM (or till TAs start grading the homework)
- Download and install Swi-prolog `http://www.swi-prolog.org/`
- Please zip .pl files and output files for all the solutions and submit it to Canvas.

## Questions:

1. (3 pt) Understand the following Prolog program:

   Given: $mystery([\,], L2, L2)$.
   $mystery([H|Tail], L2, [R|RTail]) :-$
   $H = R,$
   $mystery(Tail, L2, RTail)$.

   What would $Z$ be in $mystery([1,4,6],[3,6],Z)$.

2. (10 pt) Prolog programming:
   - (4 pt) Compute the nth number in Fibonacci Sequence.
   - (6 pt) Reverses a list and any nested lists. For example: [1,2,[2,4],5] = [5,[4,2],2,1].

3. (15 pt) Write a Prolog program for parsing:

   (a) (8 pt) Consider the grammar we worked in HW1 below. Write a Prolog program that parses strings using this grammar. Your program can be used to check if a given sentence can be generated by the grammar. An example interpreter session is provided below.

   **Grammar:**
   - terminals: $x, y, z, >, <, 0, 1, +, -, =$, if, then, else

- non-terminals: $S, F, B, T, E, N$
- start symbol: $S$
- production rules:
  $S \rightarrow F|T\ N\ T$
  $F \rightarrow$if $B$ then $S$|if $B$ then $S$ else $S$
  $B \rightarrow T\ E\ T$
  $T \rightarrow x|y|z|1|0$
  $E \rightarrow > \mid <$
  $N \rightarrow +|-|=$

**Example:**

```
| ?- sentence([if, x, > , 0, then, [x, =, 1]]).
| true.
| ?- sentence([if, x, > , 0, then, [x, =, 1], else, [x, =, 0]]).
| true.
```

(b) (5 pt) Write the query to generate all possible sentences that can be derived from the grammar. Show the screenshot of 3 sentences.

(c) (2 pt) Does the order of the sub-goals in your rules make a difference?

4. (20 pt) Write a prolog program to solve a constraint satisfaction puzzle: There are five houses, each of a different color and inhabited by men of different nationalities, with different pets, drinks, and cigarettes. Given the facts to the following, who drinks water and who owns the zebra?

   - the englishman lives in the red house
   - the spaniard owns the dog.
   - coffee is drunk in the green house
   - the ukrainian drinks tea.
   - the green house is immediately to the right of the ivory house.
   - the old gold smoker owns snails.
   - kools are being smoked in the yellow house.
   - milk is drunk in the middle house.
   - the norwegian lives in the first house on the left.
   - the camel smoker lives next to the fox owner.
   - kools are smoked in the house next to the house where the horse is kept.
   - the lucky strike smoker drinks orange juice.
   - the japanese smokes parlaiments.
   - the norwegian lives next to the blue house.