**Answer Set Programming (15 marks)**

This question is about answer set programming (ASP). You can use any constructs available in clingo to make your program work.

(a) [3 marks] Write ASP code that generates all subsets of $\{a, b, c, d, e, f\}$ as an answer sets satisfying the following condition: If $a$ is in the subset, then $b$ must not be in it, and if $c$ is in it, then either $d$ or $f$ but not both must be in it.

(b) [12 marks] Consider the ferry problem in Assignment 4. Now let's assume there are two ferries that can transport cars, where each ferry can carry one car at a time.

(i) (4 marks) Complete the attached program file (click the link below the link to this file) by adding the appropriate constraints so that two actions that cannot possibly take place at the same time will not take place at the same time. But note that for this version of the problem, many parallel actions are possible, e.g., the two ferries can both move at the same time, boarding can happen at the same time as long as they are not boarding the same car, etc. Comment on your code.

(ii) (5 marks) Run your program with the following instance by specifying an appropriate value for `steps`.

```
car(car1;car2;car3).

location(loc1;loc2).

ferry(f1;f2).
at(car1,loc2,0).
at(car2,loc1,0).
at(car3,loc2,0).

at(f1,loc1,0).
at(f2,loc2,0).

goal(T):- at(car1,loc1,T), at(car3,loc1,T), at(car2,loc2,T).
```

What is the length of a shortest plan for this instance? Show such a plan. (You can take a screen shot or a picture to show your answer set.) Is your shortest plan unique?

(iii) (3 marks) Back to the original version of the problem where there is one ferry. Now, assume the ferry can hold at most two cars at a time. Briefly comment on how you would handle this problem. Present the rule for the action **board** to illustrate your intended revision. First, determine what parametes would be needed for the predicate **board**.

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