C1 Artificial Intelligence (25 points)

Planning. (19 points) Consider the following (trivial) planning problem. We have a car in London (L) and we wish to drive it to Paris (P). The car has a key that must be in the ignition in order to drive the car. Initially we have the key in our possession. We have the following grounded operators:

operator	preconditions	add	delete
`Drive(P)`	`At(Car, L)` `InIgnition(Key)`	`At(Car, P)`	`At(Car, L)`
`Insert(Key)`	`Have(Key)`	`InIgnition(Key)`	`Have(Key)`

(a) [11 points] The initial state is `At(Car, L)` $\wedge$ `Have(Key)` and the goal state is `At(Car, P)`. Show how GraphPlan would solve this problem. You must show the propositions and actions at every time slice. For each time slice, show the mutual exclusions.

(b) [8 points] Give one example of each type of mutual exclusion: inconsistent effects, interference, competing needs, and inconsistent support.

Search. (6 points) Suppose that h1 and h2 are both admissible heuristics. You are going to use the A$*$ algorithm. Let *n* refer to a node in the search tree.

Suppose that `h3(s) = min(h1(s),h2(s))`
`h4(s) = max(h1(s),h2(s))`

(a) [4 pts] Are both h3 and h4 admissible? If so, prove it. If not, explain why not.

(b) [2 pts] Which would you prefer to use with the A$*$ algorithm, h1, h3, or h4? Justify your answer.