School of Computer Science, Sun Yat-sen University

P03 Planning and Uncertainty

November 30, 2021

Contents

1 STRIPS Planner

In this part, you will implement a simple STRIPS planner. The input of your planner is a PDDL domain file and a problem file in the STRIPS restriction, that is, preconditions of actions and the goal are conjunctions of atoms, and effects of actions are conjunctions of literals. The output of your planner is a sequence of actions to achieve the goal.

1. Describe with sentences the main ideas behind computing the heuristic for a state using reachability analysis from lecture notes. (20 points)
2. Implement a STRIPS planner by using A* search and the heuristic function you implemented.(40 points)
3. Explain any ideas you use to speed up the implementation. (20 points)
4. Run you planner on the 5 test cases, and report the returned plans and the running times. Analyse the experimental results. (20 points)

2 Diagnosing by Bayesian Networks

2.1 Variables and their domais

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(1) PatientAge:['0-30','31-65','65+']
(2) CTScanResult:['Ischemic Stroke','Hemmorraghic Stroke']
(3) MRIScanResult: ['Ischemic Stroke','Hemmorraghic Stroke']
(4) StrokeType: ['Ischemic Stroke','Hemmorraghic Stroke', 'Stroke Mimic']
(5) Anticoagulants: ['Used','Not used']
(6) Mortality:['True', 'False']
(7) Disability: ['Negligible', 'Moderate', 'Severe']
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2.2 CPTs

Note: [CTScanResult, MRIScanResult,StrokeType] means:

P(StrokeType='...' | CTScanResult='...' $\wedge$ MRIScanResult='...')

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(1)
[PatientAge]


['0-30', 0.10],
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['31-65', 0.30],
['65+', 0.60]

(2)
[CTScanResult]

['Ischemic Stroke',0.7],
[ 'Hemmorraghic Stroke',0.3]

(3)
[MRIScanResult]

['Ischemic Stroke',0.7],
[ 'Hemmorraghic Stroke',0.3]

(4)
[Anticoagulants]

[Used',0.5],
['Not used',0.5]

(5)
[CTScanResult, MRIScanResult,StrokeType])

['Ischemic Stroke','Ischemic Stroke','Ischemic Stroke',0.8],
['Ischemic Stroke','Hemmorraghic Stroke','Ischemic Stroke',0.5],
[ 'Hemmorraghic Stroke','Ischemic Stroke','Ischemic Stroke',0.5],
[ 'Hemmorraghic Stroke','Hemmorraghic Stroke','Ischemic Stroke',0],

['Ischemic Stroke','Ischemic Stroke','Hemmorraghic Stroke',0],
['Ischemic Stroke','Hemmorraghic Stroke','Hemmorraghic Stroke',0.4],
[ 'Hemmorraghic Stroke','Ischemic Stroke','Hemmorraghic Stroke',0.4],
[ 'Hemmorraghic Stroke','Hemmorraghic Stroke','Hemmorraghic Stroke',0.9],
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['Ischemic Stroke','Ischemic Stroke','Stroke Mimic',0.2],
['Ischemic Stroke','Hemmorraghic Stroke','Stroke Mimic',0.1],
[ 'Hemmorraghic Stroke','Ischemic Stroke','Stroke Mimic',0.1],
[ 'Hemmorraghic Stroke','Hemmorraghic Stroke','Stroke Mimic',0.1],
```

(6)

```
[StrokeType, Anticoagulants, Mortality]

['Ischemic Stroke', 'Used', 'False',0.28],
['Hemmorraghic Stroke', 'Used', 'False',0.99],
['Stroke Mimic', 'Used', 'False',0.1],
['Ischemic Stroke','Not used', 'False',0.56],
['Hemmorraghic Stroke', 'Not used', 'False',0.58],
['Stroke Mimic', 'Not used', 'False',0.05],

['Ischemic Stroke', 'Used' ,'True',0.72],
['Hemmorraghic Stroke', 'Used', 'True',0.01],
['Stroke Mimic', 'Used', 'True',0.9],
['Ischemic Stroke', 'Not used' ,'True',0.44],
['Hemmorraghic Stroke', 'Not used', 'True',0.42 ],
['Stroke Mimic', 'Not used', 'True',0.95]
```

(7)

```
[StrokeType, PatientAge, Disability]

['Ischemic Stroke',   '0-30','Negligible', 0.80],
['Hemmorraghic Stroke', '0-30','Negligible', 0.70],
['Stroke Mimic',        '0-30', 'Negligible',0.9],
['Ischemic Stroke',     '31-65','Negligible', 0.60],
['Hemmorraghic Stroke', '31-65','Negligible', 0.50],
['Stroke Mimic',        '31-65', 'Negligible',0.4],
['Ischemic Stroke',     '65+'  , 'Negligible',0.30],
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['Hemmorraghic Stroke', '65+'   , 'Negligible',0.20],
['Stroke Mimic',        '65+'   , 'Negligible',0.1],

['Ischemic Stroke',     '0-30' ,'Moderate',0.1],
['Hemmorraghic Stroke', '0-30' ,'Moderate',0.2],
['Stroke Mimic',        '0-30' ,'Moderate',0.05],
['Ischemic Stroke',     '31-65','Moderate',0.3],
['Hemmorraghic Stroke', '31-65','Moderate',0.4],
['Stroke Mimic',        '31-65','Moderate',0.3],
['Ischemic Stroke',     '65+'  ,'Moderate',0.4],
['Hemmorraghic Stroke', '65+'  ,'Moderate',0.2],
['Stroke Mimic',        '65+'  ,'Moderate',0.1],

['Ischemic Stroke',     '0-30' ,'Severe',0.1],
['Hemmorraghic Stroke', '0-30' ,'Severe',0.1],
['Stroke Mimic',        '0-30' ,'Severe',0.05],
['Ischemic Stroke',     '31-65','Severe',0.1],
['Hemmorraghic Stroke', '31-65','Severe',0.1],
['Stroke Mimic',        '31-65','Severe',0.3],
['Ischemic Stroke',     '65+'  ,'Severe',0.3],
['Hemmorraghic Stroke', '65+'  ,'Severe',0.6],
['Stroke Mimic',        '65+'  ,'Severe',0.8]
```

2.3 Tasks

1. Briefly describe with sentences the main ideas of the VE algorithm. (20 points)
2. Implement the VE algorithm (C++ or Python) to calculate the following probability values: (20 points)
   (a) p1 = P(Mortality='True' $\wedge$ CTScanResult='Ischemic Stroke' | PatientAge='31-65')
   (b) p2 = P(Disability='Moderate' $\wedge$ CTScanResult='Hemmorraghic Stroke' | PatientAge='65+' $\wedge$ MRIScanResult='Hemmorraghic Stroke')
   (c) p3 = P(StrokeType='Hemmorraghic Stroke' | PatientAge='65+' $\wedge$ CTScanResult='Hemmorraghic Stroke' $\wedge$ MRIScanResult='Ischemic Stroke')

(d) p4 = P(Anticoagulants='Used' | PatientAge='31-65')

(e) p5 = P(Disability='Negligible')

3. Implement an algorithm to select a good order of variable elimination. (20 points)

4. Compare the running times of the VE algorithm for different orders of variable elimination, and fill out the following table: For test cases p4 and p5, for each of the order selected by your algorithm and 5 other orders, report the elimination with, and the total running time of the VE algorithm. For each case, the first order of elimination should be the one chosen by your algorithm. Analyze the results. (40 points)

Test case	Elimination order	Elimination width	Total time
p4			
p4			
p4			
p4			
p4			
p4			
p5			
p5			
p5			
p5			
p5			
p5			

3 Due: 06:59pm, Dec. 14, 2020

Please hand in a file named P03_YourNumber.pdf, and send it to ai_course2021@163.com