

Student name: \_\_\_\_\_

Student ID: \_\_\_\_\_

**Note:** The assignment should be submitted via “Assignments >> Bonus” on den.usc.edu

**Note2:** The due date is fixed. No late submissions will be accepted.

**1. First-order inference [25 points]**

Consider the following KB:

1.  $\forall x,y \exists z \text{ Professor}(x) \wedge \text{Teaches}(x,y) \wedge \text{Class}(y) \wedge \text{Student}(z) \wedge \text{HasPassed}(z,y) \wedge \text{Advisor}(x,z) \Rightarrow \text{TA}(z,y)$
2.  $\forall x,y \text{ Teaches}(x,y) \wedge \text{Class}(y) \Rightarrow \text{Professor}(x)$
3.  $\forall x,y \text{ Advisor}(x,y) \wedge \text{Professor}(x) \Rightarrow \text{Student}(y)$
4.  $\text{Class}(\text{CS561})$
5.  $\text{Class}(\text{CS564})$
6.  $\text{Advisor}(\text{Jim},\text{Mary})$
7.  $\text{Advisor}(\text{Jim},\text{Cat})$
8.  $\text{Advisor}(\text{Jim},\text{Paul})$
9.  $\text{HasPassed}(\text{Mary},\text{CS564})$
10.  $\text{HasPassed}(\text{Paul},\text{CS564})$
11.  $\text{HasPassed}(\text{Cat},\text{CS561})$
12.  $\text{Teaches}(\text{Jim},\text{CS561})$
13.  $\text{Teaches}(\text{John},\text{CS564})$

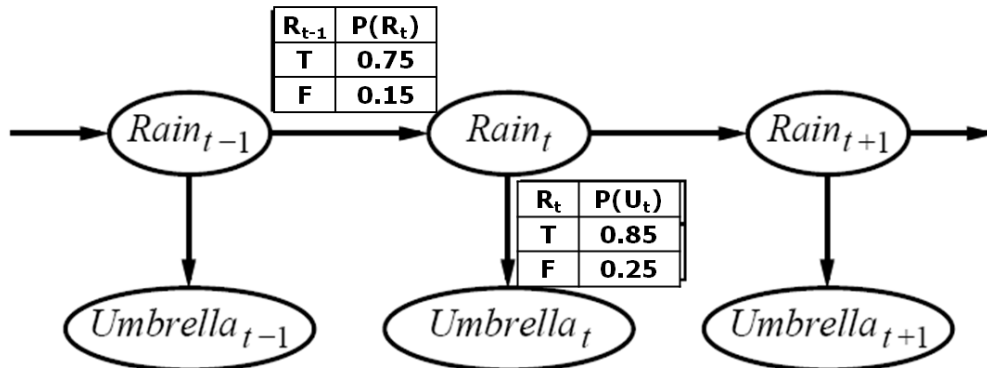
Use forward chaining to **prove whether TA(Cat,CS561)** is true. Draw the proof tree, including all the unifications necessary. Number the edges to show in which order they are introduced in the tree.

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2. [25 points] Reasoning over time

Consider the Umbrella problem described in class (lecture 21). You observe over time whether the umbrella is out or not and you want to infer whether it rains. You have also from past experience computed the appropriate CPTs, as shown in the following figure:



You now observe that  $U_1=T, U_2=F, U_3=F, U_4=T, U_5=T$

- a. [10 points] Assuming that your prior for  $\mathbf{R}_0$  is  $\langle T=0.2, F=0.8 \rangle$ , use filtering to infer the probability that  $\mathbf{R}_1=T$ . Show your computations.
  
- b. [15 points] Assuming that your prior for  $\mathbf{R}_0$  is  $\langle T=0.2, F=0.8 \rangle$ , use the Viterbi algorithm to compute the most likely path  $\mathbf{R}_1 \dots \mathbf{R}_5$  as described in slides 11, 12 and 13 on the Lecture 21 notes. Show your result in the same manner as on the slides (with all computations).