

## 50.021 -AI

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### Week 12: Probabilistic Graphical Models

[The following notes are compiled from various sources such as textbooks, lecture materials, Web resources and are shared for academic purposes only, intended for use by students registered for a specific course. In the interest of brevity, every source is not cited. The compiler of these notes gratefully acknowledges all such sources. ]

#### Part 1

If the weather report says it will rain, then with probability 0.8, Dana brings her umbrella. If the weather report says it won't rain, then with probability 0.3, Dana brings her umbrella. In Singapore, the weather report predicts rain with probability 0.8.

1. Draw a Bayesian network corresponding to this problem, using variables  $U$  (for umbrella) and  $P$  (for predicted rain).
2. Compute (by hand) the joint distribution over  $U$  and  $P$
3. check the code in `gm2.py`. If you have a joint distribution over  $A, B$  with probabilities  $P(A = 0, B = 0) = 0.1, P(A = 0, B = 1) = 0.2$ , then  $n = \text{Potential}(['A', B', \{(0, 0) : 0.1, (0, 1) : 0.2\}])$  defines it.

check what the code for `condition` and `marginalize` does.

4. You see Dana walk by with an umbrella, that is you observe  $U = 1$ . If the joint distribution over  $U$  and  $P$  were represented as an instance of the `Potential` class, what operation(s) would you perform to compute  $P(P|U = 1)$ ?
5. Really, you are not so interested in whether rain was predicted, but whether it will actually rain. You study the prediction accuracy of weather predictions, and decide to add a new node,  $R$ , to your network, modeling whether it will rain today. How will the model look like as Bayesian network? What probabilities do you need? Make up any numbers that you need.
6. Compute (by hand) one or two entries of the joint distribution for this new model.
7. If this joint distribution were represented as an instance of the `Potential` class, what operation(s) would you perform to compute  $P(R|U = 1)$ ?