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CS 583-01

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Assignment 1

# Theoretical Assignments

1. We are given the random variables , and . Answer the following questions.
   1. Assuming every variable is binary, how many independent parameters are needed to represent ?
   2. Assuming every variable has three possible values, how many independent parameters are needed to represent ?

* 1. Assuming each has *i* possible values and similarly, every has *i* possible values, how many independent parameters are needed to represent ?

* 1. Assuming every variable is binary, how many independent parameters are needed to represent ?
  2. Assuming every variable has three possible values, how many independent parameters are needed to represent ?
  3. Assuming each has *i* possible values and similarly every has *i* possible values, how many independent parameters are needed to represent ?

1. We are given the following Bayesian network. Please answer the following questions.

A diagram of a network

Description automatically generated

* 1. Write down the join distribution as a factorization over this Bayesian network.
  2. Assuming each variable is discrete and can take *n* possible values, how many independent parameters are needed for this Bayesian network?
  3. Are the following independence statements true or false?
     1. A Ʇ B TRUE
     2. A Ʇ B | C FALSE
     3. A Ʇ B | J FALSE
     4. A Ʇ B | G FALSE
     5. A Ʇ B | E TRUE
     6. A Ʇ B | H FALSE
     7. A Ʇ H FALSE
     8. A Ʇ H | J FALSE
     9. A Ʇ H | D, J TRUE
     10. D Ʇ J FALSE
     11. B Ʇ E TRUE
     12. B Ʇ E | J TRUE
     13. B Ʇ E | J, H FALSE

1. We have a distribution P over the variables A, B, C, D, E, and G. We would like to build a Bayesian network that is a minimal I-Map for P. In reality, you have access to P, which you can query for independencies, but for the purposes of this problem, we will assume the following structure is a P-Map for P. Create minimal I-Maps for P, using the following variable orders.

A diagram of a network

Description automatically generated

* 1. C, A, B, E, D, G

A diagram of a diagram

Description automatically generated

* 1. D, B, A, E, C, G

A diagram of a diagram

Description automatically generated with medium confidence

* 1. G, E, D, C, B, A

A diagram of a diagram

Description automatically generated

* 1. G, A, C, E, D, B

A diagram of a diagram

Description automatically generated