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CS 583-01

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Assignment 3

1. Here is a plate model.

A diagram of a diagram

Description automatically generated

* 1. What probability distributions do we need to specify for this model?

P(A)

P(B | A)

P (C | B)

P(E)

P(F | E)

P(D | B, E)

* 1. Draw an unrolled version of the Bayesian network, where there are three items of type Object1 and two items of Object2 type.

A diagram of a tree

Description automatically generated

1. For the following linear chain, please calculate the requested probabilities using variable elimination. You can use any order you like. Show your work.

A diagram of a number of numbers

Description automatically generated with medium confidence

* 1. P(C)

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **P(A)P(B|A)** | **Ψ(A, B)** |
| T | T | 0.4 × 0.3 | 0.12 |
| T | F | 0.4 × 0.7 | 0.28 |
| F | T | 0.6 × 0.8 | 0.48 |
| F | F | 0.6 × 0.2 | 0.12 |

|  |  |
| --- | --- |
| **B** | **T(B)** |
| T | 0.6 |
| F | 0.4 |

|  |  |  |  |
| --- | --- | --- | --- |
| **B** | **C** | **P(C|B)T(B)** | **Ψ(A, B)** |
| T | T | 0.9 × 0.6 | 0.54 |
| T | F | 0.1 × 0.6 | 0.06 |
| F | T | 0.4 × 0.4 | 0.16 |
| F | F | 0.6 × 0.4 | 0.24 |

|  |  |
| --- | --- |
| **C** | **T(C)** |
| T | 0.7 |
| F | 0.3 |

* 1. P(C | A=T)

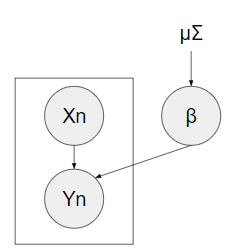
|  |  |  |  |
| --- | --- | --- | --- |
| **B** | **C** | **P(C|B) P(B|A=T)** | **Ψ(A, B, C)** |
| T | T | 0.9 × 0.3 | 0.27 |
| T | F | 0.1 × 0.3 | 0.03 |
| F | T | 0.4 × 0.7 | 0.28 |
| F | F | 0.6 × 0.7 | 0.42 |

|  |  |  |
| --- | --- | --- |
| |  | | --- | | **C** | | **T(C, A=T)** |
| T | 0.55 |
| F | 0.45 |
| **C** | **P(A=T) T(C, A=T)** | **P(C|A=T)** | | |
| T | 0.4 × 0.55 | 0.22 | 0.22 / 0.4 | 0.55 |
| F | 0.4 × 0.45 | 0.18 | 0.18 / 0.4 | 0.45 |

* 1. P(C | A=T, B=T)

|  |  |  |
| --- | --- | --- |
| **C** | **P(A=T)P(B=T│A=T)P(C|B=T)** | **P(C|A=T, B=T)** |
| T | 0.4 × 0.3 × 0.9 | 0.108 |
| F | 0.4 × 0.3 × 0.1 | 0.012 |

1. You are modeling the relationship between a set of N input vectors and a set of N binary outcomes . We assume there is a single vector of parameters which dictates the relationship between each input vector and its associated output variable. In this model, each output is drawn with . Additionally, the vector has a prior, given by . This model is called Bayesian Logistic Regression. Draw its corresponding plate notation.



1. For the following Bayesian network, perform variable elimination to compute P(E). Fill in the table.

A diagram of a graph

Description automatically generated with medium confidence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | All Factors | Participates | New Factor After \* | New Factor After + |
| A |  |  |  |  |
| B |  |  |  |  |
| C |  |  |  |  |
| D |  |  |  |  |