CS161 Homework 6

1.

(a)

Oil

Gas

Test

|  |  |
| --- | --- |
| Oil | P(Oil) |
| T | 0.5 |
| F | 0.5 |

|  |  |
| --- | --- |
| Gas | P(Gas) |
| T | 0.2 |
| F | 0.8 |

|  |  |  |  |
| --- | --- | --- | --- |
| Test | P(Oil) | P(Gas) | P(Test | Oil, Gas) |
| T | F | F | 0.1 |
| T | F | T | 0.3 |
| T | T | F | 0.9 |
| T | T | T | 0.0 |

(b)

Using Bayes' Rule,

2.

(a)

P(A, B, C, D, E, F, G, H) = **P(A) \* P(B) \* P(C | A) \* P(D | A, B) \* P(E | B) \* P(F | C, D) \* P(G | H) \* P(H | E, F)**

(b)

P(A, B, C, D, E, F, G, H) = \* \* \* \* \* \* \*

* Factor out D
* Factor out C
* Factor out B
* Finally, factoring out A will get the final result

(c)

(d)

* A and B are independent, so can just apply the definition of independence
* A and E are independent (i.e. E is only dependent on its parent E), so E is conditionally independent of A. We can then apply the Law of Total Probabilities

(e)

Markovian assumptions states that a node X is conditionally independent of its non-descendants given its parents

* A is conditionally independent of all nodes
* B is conditionally independent of all nodes
* C is conditionally independent of all nodes except for its parent A
* D is conditionally independent of all nodes except for its parents A and B
* E is conditionally independent of all nodes except for its parent B
* F is conditionally independent of all nodes except for its parents C and D
* G is conditionally independent of all nodes except for its parent F
* H is conditionally independent of all nodes except for its parents E and F

(f)

Markov blanket states that a node X is conditionally independent of all other nodes in the network given its parents, children, and children's parents

Market blanket for D = **{A, B, C, F}**

(g)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | D | P(D | A, B) | B | E | P(E | B) | A | B | D | E | P(D | A, B) \* P(E | B) |
| F | F | F | 0.2 | F | F | 0.1 | F | F | F | F | 0.2 \* 0.1 = 0.02 |
| F | F | T | 0.8 | F | T | 0.9 | F | F | F | T | 0.2 \* 0.9 = 0.18 |
| F | T | F | 0.9 | T | F | 0.9 | F | F | T | F | 0.8 \* 0.1 = 0.08 |
| F | T | T | 0.4 | T | T | 0.1 | F | F | T | T | 0.8 \* 0.9 = 0.72 |
| T | F | F | 0.1 |  |  |  | F | T | F | F | 0.9 \* 0.9 = 0.81 |
| T | F | T | 0.6 |  |  |  | F | T | F | T | 0.9 \* 0.1 = 0.09 |
| T | T | F | 0.5 |  |  |  | F | T | T | F | 0.1 \* 0.9 = 0.09 |
| T | T | T | 0.5 |  |  |  | F | T | T | T | 0.1 \* 0.1 = 0.01 |
|  |  |  |  |  |  |  | T | F | F | F | 0.4 \* 0.1 = 0.04 |
|  |  |  |  |  |  |  | T | F | F | T | 0.4 \* 0.9 = 0.36 |
|  |  |  |  |  |  |  | T | F | T | F | 0.6 \* 0.1 = 0.06 |
|  |  |  |  |  |  |  | T | F | T | T | 0.6 \* 0.9 = 0.54 |
|  |  |  |  |  |  |  | T | T | F | F | 0.5 \* 0.9 = 0.45 |
|  |  |  |  |  |  |  | T | T | F | T | 0.5 \* 0.1 = 0.05 |
|  |  |  |  |  |  |  | T | T | T | F | 0.5 \* 0.9 = 0.45 |
|  |  |  |  |  |  |  | T | T | T | T | 0.5 \* 0.1 = 0.05 |

(h)

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | E |  |
| F | F | F | 0.08 + 0.02 = 0.1 |
| F | F | T | 0.72 + 0.18 = 0.9 |
| F | T | F | 0.09 + 0.81 = 0.9 |
| F | T | T | 0.01 + 0.09 = 0.1 |
| T | F | F | 0.06 + 0.04 = 0.1 |
| T | F | T | 0.54 + 0.36 = 0.9 |
| T | T | F | 0.45 + 0.45 = 0.9 |
| T | T | T | 0.05 + 0.05 = 0.1 |