

## Answers for Practice Final Examination

### 1. Probability: Independence of events

(a)

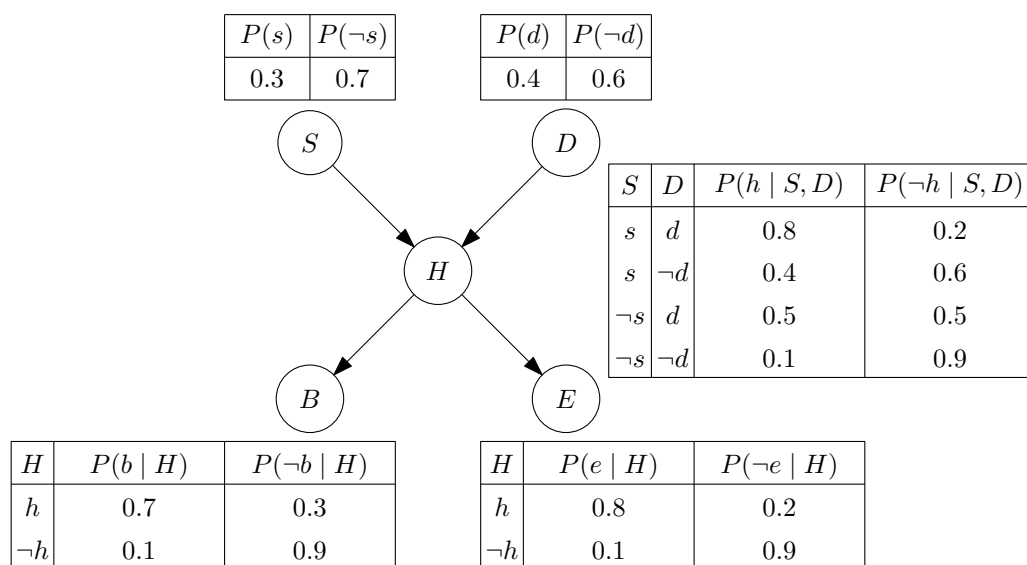
- i. 0.85
- ii. 0.475
- iii. 0.316
- iv. 0.375
- v. 0.15
- vi. They are *not* independent because  $P(\text{Fever})P(\text{Cold}) \neq P(\text{Fever} \wedge \text{Cold})$

(b)

- i. 48
- ii. 16
- iii. 11

### 2. Bayesian Networks

(a)



(b) 0.0288

(c) 0.471

### 3. First-Order Logic

(a)  $Dog(Pluto)$

(b)  $\forall x \forall y \left( \left( Dog(x) \wedge Larger(x, Pluto) \wedge Dog(y) \wedge Larger(y, Pluto) \right) \rightarrow (x = y) \right)$

(c)  $\forall x \left( \neg \left( Dog(x) \wedge Larger(x, Pluto) \right) \right)$

(d) There is exactly one dog that is larger than Pluto.

(e) There are at least two dogs that are larger than Pluto.

#### 4. Prolog

(a) Write Prolog queries

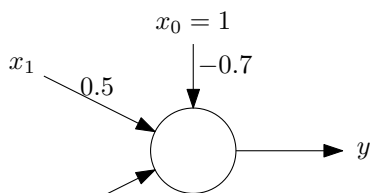
- i. `?- movie(americanBeauty,Y).`
- ii. `?- movie(M, Y), Y < 2000.`
- iii. `?- actor(M, A, _), actor(N, A, _), M \== N.`
- iv. `?- director(M, D), actress(M, A, _), actress(M, B, _), A \== B.`
- v. `?- actor(_, A, _), director(_, A, _).`

(b) Write Prolog rules

- i. `released_since(M, Y) :- movie(M, Z), Z >= Y.`
- ii. `released_between(M, Y1, Y2) :- movie(M, Z), Z >= Y1, Z <= Y2.`
- iii. `same_year_as(M1, M2) :- movie(M1, Y), movie(M2, Y).`
- iv. `newer(M1, M2) :- movie(M1, Y), movie(M2, Z), Y > Z.`
- v. `cast_member(A, M) :- actor(M, A, _).`  
`cast_member(A, M) :- actress(M, A, _).`
- vi. `directed_by(X, Y) :- actor(M, X, _), director(M, Y).`  
`directed_by(X, Y) :- actress(M, X, _), director(M, Y).`

#### 5. Machine Learning

(a)  $y = \text{sgn}(-0.5 + (1.5)(1) + (2.0)(-2)) = 0$



(b)

(c)  $w_{11}^y = -0.0625, w_{01}^x = 0.0039$