Answers for Practice Final Examination

1. *Probability: Independence of events*
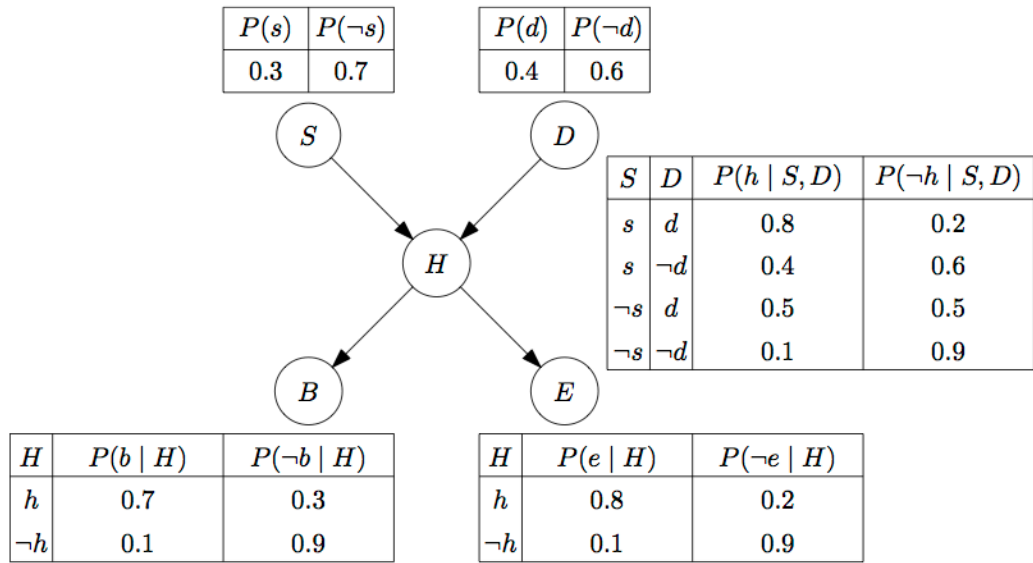
   (a)
        i. 0.85
       ii. 0.475
      iii. 0.316
      iv. 0.375
       v. 0.15
      vi. They are *not* independent because $P(Fever)P(Cold) \neq P(Fever \wedge Cold)$

   (b)
       i. 48
      ii. 16
     iii. 11

2. *Bayesian Networks*

   (a)

$P(s)$	$P(\neg s)$
0.3	0.7

$P(d)$	$P(\neg d)$
0.4	0.6

S   D

S	D	$P(h \mid S, D)$	$P(\neg h \mid S, D)$
s	d	0.8	0.2
s	$\neg d$	0.4	0.6
$\neg s$	d	0.5	0.5
$\neg s$	$\neg d$	0.1	0.9

H

B   E

H	$P(b \mid H)$	$P(\neg b \mid H)$
h	0.7	0.3
$\neg h$	0.1	0.9

H	$P(e \mid H)$	$P(\neg e \mid H)$
h	0.8	0.2
$\neg h$	0.1	0.9

   (b) 0.0288
   (c) 0.471

3. *First-Order Logic*

   (a) $Dog(Pluto)$

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

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

   (d) There is exectly 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).`
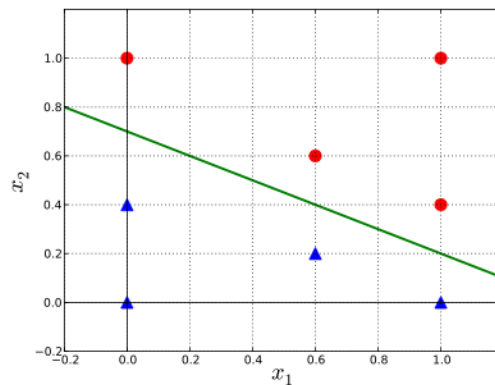   `directed_by(X, Y) :- actress(M, X, _), director(M, Y).`
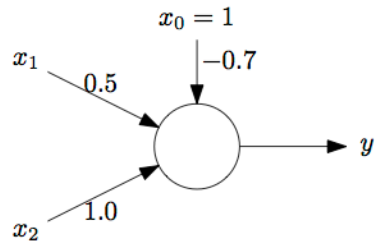
5. *Machine Learning*

   (a) Class 0

   (b) x_3
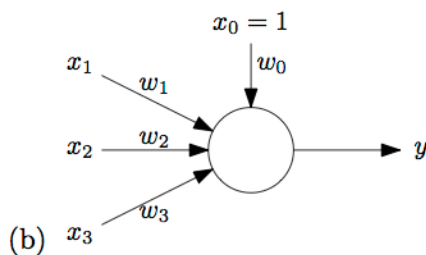
6. *Machine Learning*

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

   (b) *(Errata) Use the following figure for the dataset*

$x_0 = 1$

x_1 0.5

-0.7

x_2 1.0

y

7. *HMM*

$V_1(1) = 0.07$ $V_1(2) = 0.009$ $V_1(3) = 2.55 \times 10^{-3}$

$V_2(1) = 0.1$ $V_2(2) = 0.0243$ $V_2(3) = 8.25 \times 10^{-3}$

$V_3(1) = 0.135$ $V_3(2) = .0275$ $V_3(3) = 6.68 \times 10^{-4}$

y z x

$X = \langle 2, 3, 2 \rangle$

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