HW5

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1.a Neither

Fire	Smoke	Part a
F	F	T
F	T	T
T	F	F
T	T	T

b. Neither

Fire	Heat	Smoke	Part b
F	F	F	T
F	F	T	T
F	T	F	F
F	T	T	T
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T

C. valid

Fire	Heat	Smoke	Part C
F	F	F	T
F	F	T	T
F	T	F	T
F	T	T	T
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T

2.

a, knowledge base

P1 : Mythical → Immortal

P2 : ~ Mythical → ~ Immortal ∧ mammal

P3 : Immortal ∨ mammal → Horned

P4 : Horned → Magical

b, CNF

- ~Mythical ∨ Immortal
- (Mythical ∨ ~ Immortal) ∧ (Mythical ∨ mamal)
- (~ Immortal ∨ Horned) ∧ (~ Mammal ∨ Horned)
- ~ Horned ∨ magical

C. It wouldn't be possible to prove that the unicorn is magical from the knowledge base but we can prove that the unicorn is horned and Mythical

i. ~Immortal → ~Mythical (Cont. of P1)

ii: ~Immortal → ~Immortal ∧ Mamal (hypothetical syllogism to i and P2)

iii, Immortal ∨ (~Immortal ∧ Mamal) From ii

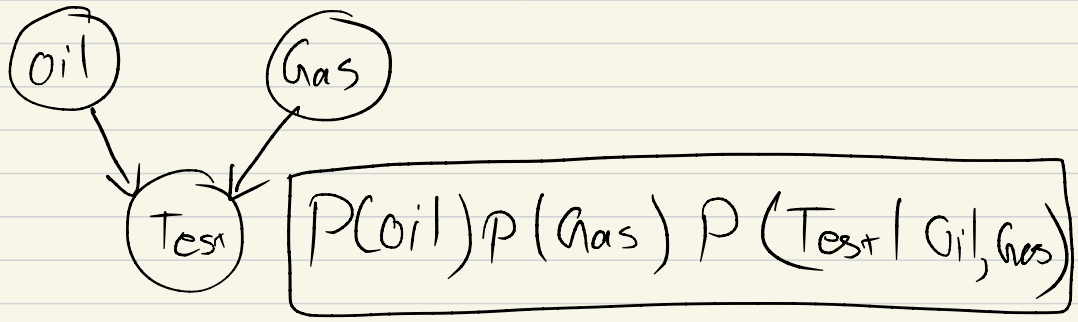
iv: (Immortal ∨ ~Immortal) ∧ (Immortal ∨ Mammal)

v. Immortal ∨ mamal (tautological simplification to iv)

vi, Horned (modus ponens to v and P3)

vii: Mythical (" " " vi and P4)

3. a



b.

Oil	P(oil)
T	0.5
F	0.5

Gas	P(gas)
T	0.2
F	0.8

Test	Oil	Gas	P(Test | Oil, Gas)
T	F	F	0.1
T	F	T	0.3
T	T	F	0.9
T	T	T	0

$$P(Oil \mid Test) = \frac{P(Test \mid Oil)\, P(Oil)}{P(test)}$$

$$= \frac{0.9 \times 0.5}{P(Test)}, \quad P(test) = \sum_{\{Oil, \sim Oil\}} P(Test, \{Oil, \sim Oil\})$$

$$\Rightarrow P(test) = P(test, Oil) + P(test, \sim Oil)$$

$$= P(test, Oil) \times P(Oil) + P(test \mid \sim Oil) \times P(\sim Oil)$$

$$= (0.9 \times 0.5) + (0.4 \times 0.5) = 0.65$$

$$P(Oil \mid Test) = \frac{0.9 \times 0.5}{0.65} = \boxed{0.69}$$

④

a.

$Pr(A, B, C, D, E, F, G, H) =$

$P(A) \times P(B) \times P(C|A) \times P(D|A,B) \times P(E|B) \times P(F|C,D)$

$\times P(G|F) \times P(H|F,E)$

b. $P(E, f, G, H) = P(E|B) \times P(F|C,D) \times P(G,F)$

$\times P(H|F,E)$

C.

$P(a, \sim b, c, d, \sim e, f, \sim g, h)$

$= (0.2) \times (0.3) \times P(C|A) \times 0.6 \times 0.1 \times P(f|C,d) \times$

$P(\sim g|f) \times P(h|f, \sim e)$

$= \boxed{P(C|a) \times P(f|C,d) \times P(\sim g|f) \times P(h, f, \sim e) \times 0.0086}$

d, we know

$P(a, \sim b) = P(a) \times P(b) = 0.2 \times 0.3 = 0.06$

Also 'e' is independent of A

$P(\sim e|a) = \frac{P(\sim e, a)}{P(a)} = \frac{P(\sim e) \cdot P(a)}{P(a)} = P(\sim e)$

However, 'e' is dependent on 'b'

$$P(\sim e) = P(\sim e, b) + P(\sim e, \sim b)$$

$$\Rightarrow P(\sim e) = (\sim e|b) \times P(b) + P(\sim e, \sim b) \times P(\sim b)$$

$$= (0.9 \times 0.7) + (0.1 \times 0.3)$$

$$P(\sim e|a) = 0.66$$

c) (1) $I(A, \emptyset, BE)$

(2) $I(B, \emptyset, AC)$

(3) $I(C, A, DBE)$

(4) $I(D, AB, CE)$

(5) $I(E, B, ACDFG)$

(6) $I(F, CD, ABE)$

(7) $I(G, F, ABCDEH)$

(8) $I(H, EF, ABCDG)$

f. {A, B, C, E}

g)

A	B	D	E	P(D|AB) x P(E|B)
F	F	F	F	0.05
F	F	F	T	0.45
F	F	T	F	0.05
F	F	T	T	0.45
F	T	F	F	0.54
F	T	F	T	0.6
F	T	T	F	0.36
F	T	T	T	0.04
T	F	F	F	0.01
T	F	F	T	0.09
T	F	T	F	0.09
T	F	T	T	0.81
T	T	F	F	0.72
T	T	F	T	0.08
T	T	T	F	0.18
T	T	T	T	0.02

h_1

we can assign

$$x(A, B, D, E) = P(D \mid A, B) \times P(E \mid B)$$

$$x(A, B, E) = x(A, B, d, E) + x(A, B, \sim d, E)$$

A	B	E	$x(A, B, E)$
T	T	T	0.1
T	T	F	0.9
T	F	T	0.9
T	F	F	0.1
F	T	T	0.1
F	T	F	0.9
F	F	T	0.9
F	F	F	0.1