Assignment 2

CP468 – Artificial Intelligence

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Question 1:

a.

A	B	C	D	B ∨ C
F	F	F	F	F
F	F	F	T	F
F	F	T	F	T
F	F	T	T	T
F	T	F	F	T
F	T	F	T	T
F	T	T	F	T
F	T	T	T	T
T	F	F	F	F
T	F	F	T	F
T	F	T	F	T
T	F	T	T	T
T	T	F	F	T
T	T	F	T	T
T	T	T	F	T
T	T	T	T	T

2^4 = 16 possible models. However, since there is one false conjunction there are **2^4 - 4 = 12** models.

b.

A	B	C	D	¬A ∨ ¬B ∨ ¬C ∨ ¬D
F	F	F	F	T
F	F	F	T	T
F	F	T	F	T
F	F	T	T	T
F	T	F	F	T
F	T	F	T	T
F	T	T	F	T
F	T	T	T	T
T	F	F	F	T
T	F	F	T	T
T	F	T	F	T
T	F	T	T	T
T	T	F	F	T
T	T	F	T	T
T	T	T	F	T
T	T	T	T	F

2^4 = 16 possible models, However, since there is one false conjunction there are **2^4 - 1 = 15** models.

c.

A	B	C	D	(A ⇒ B) ∧ A ∧ ¬B ∧ C ∧ D
F	F	F	F	F
F	F	F	T	F
F	F	T	F	F
F	F	T	T	F

F	T	F	F	F
F	T	F	T	F
F	T	T	F	F
F	T	T	T	F
T	F	F	F	F
T	F	F	T	F
T	F	T	F	F
T	F	T	T	F
T	T	F	F	F
T	T	F	T	F
T	T	T	F	F
T	T	T	T	F

2^4 = 16 possible models. However, since all the conjunctions are false there are **0** models.

d.

A	**B**	**C**	**D**	**(A ∧ B) ∨ (C ∧ D)**
F	F	F	F	F
F	F	F	T	F
F	F	T	F	F
F	F	T	T	T
F	T	F	F	F
F	T	F	T	F
F	T	T	F	F
F	T	T	T	T
T	F	F	F	F
T	F	F	T	F
T	F	T	F	F
T	F	T	T	T
T	T	F	F	T
T	T	F	T	T
T	T	T	F	T
T	T	T	T	T

2^4 = 16 possible models. However, since there are 9 false junctions there are $\mathbf{2^4 - 9 = 5}$ models.

e.

A	**B**	**C**	**D**	**B ⇒ (A ∧ B)**
F	F	F	F	T
F	F	F	T	T
F	F	T	F	F
F	F	T	T	F
F	T	F	F	T
F	T	F	T	T
F	T	T	F	T
F	T	T	T	T
T	F	F	F	T
T	F	F	T	T
T	F	T	F	F
T	F	T	T	F
T	T	F	F	T
T	T	F	T	T

T	T	T	F	T
T	T	T	T	T

2^4 = 16 possible models. However, since there is one false conjunction there are **2^4 - 4 = 12** models.

Question 2:

a. Smoke ⇒ Smoke

Smoke	**Smoke ⇒ Smoke**
T	T
F	F

- T⇒T and F⇒F is valid as it contains only true, so the sentence is Valid

b. Smoke ⇒ Fire

Smoke	**Fire**	**Smoke ⇒ Fire**
T	T	T
T	F	F
F	T	T
F	F	T

- Since it contains both the true and false values, it is neither

c. (Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)

Smoke	**Fire**	**¬Smoke**	**¬Fire**	**Smoke ⇒ Fire**	**(¬Smoke ⇒ ¬Fire**	**(Smoke ⇒ Fire) ⇒ (¬Smoke ⇒ ¬Fire)**
T	T	F	F	T	T	T
T	F	F	T	F	T	T
F	T	T	F	T	F	F
F	F	T	T	T	T	T

- Since it contains both the true and false values, it is neither

a. Smoke ∨ Fire ∨ ¬Fire

Smoke	**Fire**	**Smoke ∨ Fire**	**¬Fire**	**Smoke ∨ Fire ∨ ¬Fire**
T	T	T	F	T
T	F	T	T	T
F	T	T	F	T
F	F	F	T	T

- The statement contains only true, so it is valid

b. ((Smoke ∧ Heat) ⇒ Fire) ⇔ ((Smoke ⇒ Fire) ∨ (Heat ⇒ Fire))

Smoke	**Heat**	**Fire**	**Smoke ∧ Heat**	**Smoke ∧ Heat) ⇒ Fire**	**Smoke ⇒ Fire**	**Heat ⇒ Fire**	**(Smoke ⇒ Fire) ∨ (Heat ⇒ Fire)**	**((Smoke ∧ Heat) ⇒ Fire) ⇔ ((Smoke ⇒ Fire) ∨**

								(Heat ⇒ Fire))
T	T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	F	T
T	F	T	F	T	T	T	T	T
T	F	F	F	T	F	T	T	T
F	T	T	F	T	T	T	T	T
F	T	F	F	T	T	F	T	T
F	F	T	F	T	T	T	T	T
F	F	F	F	T	T	T	T	T

- The statement contains only true, so it is valid

c. (Smoke ⇒ Fire) ⇒ ((Smoke ∧ Heat) ⇒ Fire)

Smoke	**Heat**	**Fire**	**Smoke ⇒ Fire**	**Smoke ∧ Heat**	**(Smoke ∧ Heat) ⇒ Fire**	**(Smoke ⇒ Fire) ⇒ ((Smoke ∧ Heat) ⇒ Fire)**
T	T	T	T	T	T	T
T	T	F	F	T	F	T
T	F	T	T	F	T	T
T	F	F	F	F	T	T
F	T	T	T	F	T	T
F	T	F	T	F	T	T
F	F	T	T	F	T	T
F	F	F	T	F	T	T

- The statement contains only true, so it is valid

d. Big ∨ Dumb ∨ (Big ⇒ Dumb)

Big	**Dumb**	**Big ∨ Dumb**	**Big ⇒ Dumb**	**Big ∨ Dumb ∨ (Big ⇒ Dumb)**
T	T	T	T	T
T	F	T	F	T
F	T	T	T	T
F	F	F	T	T

- The statement contains only true, so it is valid

Question 3:

a. ∃o Occupation(Emily, Surgeon) v Occupation(Emily, Lawyer)
b. Occupation(Joe, Actor) ∧ ∃o (Occupation(Joe,o) ∧ ¬(o=actor)
c. ∀p(Occupation(p,Surgeon) → Occupation(p,Doctor))
d. ∃p (Customer(Joe, p) ∧ Occupation(p, Lawyer))
e. ∃p (Boss(p, Emily) ∧ Occupation(p, Lawyer))

f. $\exists p\ (Occupation(p, Lawyer) \wedge \forall c\ (Customer(c, p) \rightarrow Occupation(c, Doctor)))$
g. $\forall p\ (Occupation(p, Surgeon) \rightarrow \exists l\ (Occupation(l, Lawyer) \wedge Customer(p, l)))$

Question 4:

a. Correct
b. Correct
c. Correct