Knowledge Representation

March 6th, 2020

Exercises from AIMA book chapter 8

8.9a) Paris and Marseilles are both in France:

(i) $In(Paris \wedge Marseilles, France)$

(ii) $In(Paris, France) \wedge In(Marseilles, France)$

(iii) $In(Paris, France) \vee In(Marseilles, France)$

Exercises from AIMA book chapter 8

8.9a) Paris and Marseilles are both in France:

(i) $In(Paris \wedge Marseilles, France)$

(ii) $In(Paris, France) \wedge In(Marseilles, France)$

(iii) $In(Paris, France) \vee In(Marseilles, France)$

Exercises from AIMA book chapter 8

8.9b) There is a country that borders both Iraq and Pakistan:

(i) $\exists c\ Country(c) \wedge Border(c, Iraq) \wedge Border(c, Pakistan)$
(ii) $\exists c\ Country(c) \rightarrow [Border(c, Iraq) \wedge Border(c, Pakistan)]$
(iii) $[\exists c\ Country(c)] \rightarrow [Border(c, Iraq) \wedge Border(c, Pakistan)]$
(iv) $\exists c\ Border(Country(c), Iraq \wedge Pakistan)$

Exercises from AIMA book chapter 8

8.9b) There is a country that borders both Iraq and Pakistan:

(i) $\exists c\ Country(c) \land Border(c, Iraq) \land Border(c, Pakistan)$
(ii) $\exists c\ Country(c) \rightarrow [Border(c, Iraq) \land Border(c, Pakistan)]$
(iii) $[\exists c\ Country(c)] \rightarrow [Border(c, Iraq) \land Border(c, Pakistan)]$
(iv) $\exists c\ Border(Country(c), Iraq \land Pakistan)$

Exercises from AIMA book chapter 8

8.9c) All countries that border Ecuador are in South America:

(i) $\forall c\ Country(c) \land Border(c, Ecuador) \rightarrow In(c, SouthAmerica)$
(ii) $\forall c\ Country(c) \rightarrow [Border(c, Ecuador) \rightarrow In(c, SouthAmerica)]$
(iii) $\forall c\ [Country(c) \rightarrow Border(c, Ecuador)] \rightarrow In(c, SouthAmerica)$
(iv) $\forall c\ Country(c) \land Border(c, Ecuador) \land In(c, SouthAmerica)$

Exercises from AIMA book chapter 8

8.9c) All countries that border Ecuador are in South America:

(i) $\forall c\ Country(c) \wedge Border(c, Ecuador) \rightarrow In(c, SouthAmerica)$
(ii) $\forall c\ Country(c) \rightarrow [Border(c, Ecuador) \rightarrow In(c, SouthAmerica)]$
(iii) $\forall c\ [Country(c) \rightarrow Border(c, Ecuador)] \rightarrow In(c, SouthAmerica)$
(iv) $\forall c\ Country(c) \wedge Border(c, Ecuador) \wedge In(c, SouthAmerica)$

Exercises from AIMA book chapter 8

8.9d) No region in South America borders any region in Europe:

(i) $\neg[\exists c, d \; In(c, SouthAmerica) \wedge In(d, Europe) \wedge Borders(c, d)]$
(ii) $\forall c, d \; [In(c, SouthAmerica) \wedge In(d, Europe)] \rightarrow \neg Borders(c, d)$
(iii) $\neg\forall c \; In(c, SouthAmerica) \rightarrow \exists d \; In(d, Europe) \wedge \neg Borders(c, d)$
(iv) $\forall c \; In(c, SouthAmerica) \rightarrow \forall d \; In(d, Europe) \rightarrow \neg Borders(c, d)$

Exercises from AIMA book chapter 8

8.9d) No region in South America borders any region in Europe:

(i) $\neg[\exists c, d\ In(c, SouthAmerica) \land In(d, Europe) \land Borders(c, d)]$
(ii) $\forall c, d\ [In(c, SouthAmerica) \land In(d, Europe)] \rightarrow \neg Borders(c, d)$
(iii) $\neg\forall c\ In(c, SouthAmerica) \rightarrow \exists d\ In(d, Europe) \land \neg Borders(c, d)$
(iv) $\forall c\ In(c, SouthAmerica) \rightarrow \forall d\ In(d, Europe) \rightarrow \neg Borders(c, d)$

Exercises from AIMA book chapter 8

8.9e) No two adjacent countries have the same map color:

(i) $\forall x, y\ \neg Country(x) \vee \neg Country(y) \vee \neg Borders(x, y) \vee \neg(MapColor(x) = MapColor(y))$
(ii) $\forall x, y\ (Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(x = y)) \rightarrow \neg(MapColor(x) = MapColor(y))$
(iii) $\forall x, y\ Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(MapColor(x) = MapColor(y))$
(iv) $\forall x, y\ (Country(x) \wedge Country(y) \wedge Borders(x, y)) \rightarrow MapColor(x \neq y)$

Exercises from AIMA book chapter 8

8.9e) No two adjacent countries have the same map color:

(i) $\forall x, y\ \neg Country(x) \vee \neg Country(y) \vee \neg Borders(x, y) \vee \neg(MapColor(x) = MapColor(y))$
(ii) $\forall x, y\ (Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(x = y)) \rightarrow \neg(MapColor(x) = MapColor(y))$
(iii) $\forall x, y\ Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(MapColor(x) = MapColor(y))$
(iv) $\forall x, y\ (Country(x) \wedge Country(y) \wedge Borders(x, y)) \rightarrow MapColor(x \neq y)$

Exercises from AIMA book chapter 8

8.10a) Emily is either a surgeon or a lawyer.

Exercises from AIMA book chapter 8

8.10a) Emily is either a surgeon or a lawyer.

$$Occupation(Emily, Surgeon) \vee Occupation(Emily, Lawyer)$$

Exercises from AIMA book chapter 8

8.10a) Joe is an actor, but he also holds another job.

Exercises from AIMA book chapter 8

8.10b) Joe is an actor, but he also holds another job.

$$Occupation(Joe, Actor) \land \exists x\ x \neq Actor \land Occupation(Joe, x)$$

Exercises from AIMA book chapter 8

8.10c) All surgeons are doctors.

Exercises from AIMA book chapter 8

8.10c) All surgeons are doctors.

$$\forall x \; Occupation(x, Surgeon) \rightarrow Occupation(x, Doctor)$$

Exercises from AIMA book chapter 8

8.10d) Joe does not have a lawyer (i.e., is not a customer of any lawyer).

Exercises from AIMA book chapter 8

8.10d) Joe does not have a lawyer (i.e., is not a customer of any lawyer).

$$\neg \exists x \; Occupation(x, Lawyer) \wedge Customer(Joe, x)$$

Exercises from AIMA book chapter 8

8.10e) Emily has a boss who is a lawyer.

Exercises from AIMA book chapter 8

8.10e) Emily has a boss who is a lawyer.

$$\exists x \; Boss(x, Emily) \wedge Occupation(x, Lawyer)$$

Exercises from AIMA book chapter 8

8.10f) There exists a lawyer all of whose customers are doctors.

Exercises from AIMA book chapter 8

8.10f) There exists a lawyer all of whose customers are doctors.

$$\exists x \; Occupation(x, Lawyer) \wedge \forall x \; Customer(x, y) \rightarrow Occupation(y, Doctor)$$

Exercises from AIMA book chapter 8

8.10g) Every surgeon has a lawyer.

Exercises from AIMA book chapter 8

8.10g) Every surgeon has a lawyer.

$$\forall x\ Occupation(x, Surgeon) \rightarrow$$
$$\exists y\ Occupation(y, Lawyer) \wedge Customer(y, x)$$

Exercises from AIMA book chapter 8

8.19a) Joan has a daughter (possibly more than one, and possibly sons as well).

Exercises from AIMA book chapter 8

8.19a) Joan has a daughter (possibly more than one, and possibly sons as well).

$\exists x\ Female(x) \land Paren(Joan, x)$

Exercises from AIMA book chapter 8

8.19b) Joan has exactly one daughter (but may have sons as well).

Exercises from AIMA book chapter 8

8.19b) Joan has exactly one daughter (but may have sons as well).

$\exists^1 x\ Female(x) \land Paren(Joan, x)$

Exercises from AIMA book chapter 8

8.19c) Joan has exactly one child, a daughter.

Exercises from AIMA book chapter 8

8.19c) Joan has exactly one child, a daughter.

$$\exists x\ Parent(Joan, x) \wedge Female(x) \wedge [\forall y\ Parent(Joan, y) \rightarrow y = x$$

Exercises from AIMA book chapter 8

8.19d) Joan and Kevin have exactly one child together.

Exercises from AIMA book chapter 8

8.19d) Joan and Kevin have exactly one child together.

$\exists^1 x\ Parent(Joan, x) \land Parent(Kevin, x)$

Exercises from AIMA book chapter 8

8.19e) Joan has at least one child with Kevin, and no children with anyone else.

Exercises from AIMA book chapter 8

8.19e) Joan has at least one child with Kevin, and no children with anyone else.

$$\exists x\ Parent(Joan, x) \land Parent(Kevin, x) \land$$
$$\forall p, c\ [Parent(Joan, c) \land Parent(p, c)] \rightarrow [p = Joan \lor p = Kevin]$$

Exercises from AIMA book chapter 8

8.23a) No two people have the same social security number.

$\neg\exists x, y, n\; Person(x) \wedge Person(y) \rightarrow [HasSS(x, n) \wedge HasSS(y, n)]$