

### 8.10

分别表示语句的一阶逻辑如下

- a.  $Occupation(Emily, Surgeon) \vee Occupation(Emily, Lawyer)$
- b.  $Occupation(Joe, Actor) \wedge (\exists x (x \neq Actor) \wedge Occupation(Joe, x))$
- c.  $\forall x Occupation(x, Surgeon) \Rightarrow Occupation(x, Doctor)$
- d.  $\neg \exists x Customer(Joe, x) \wedge Occupation(x, Lawyer)$
- e.  $\exists x Boss(x, Emily) \wedge Occupation(x, Lawyer)$
- f.  $\exists x Occupation(x, Lawyer) \wedge \forall y Customer(y, x) \Rightarrow Occupation(y, Doctor)$
- g.  $\forall x Occupation(x, Surgeon) \Rightarrow \exists y Occupation(y, Lawyer) \wedge Customer(x, y)$

### 8.11

假设:  $SpeaksLanguage(x, l)$ 表示 $x$ 说语言 $l$ ,  $Understands(x, y)$ 表示 $x$ 能听懂 $y$

- a. *people who speak the same language can understand each other*
- b. 当任意一组 $x, y, l$ 满足 $SpeaksLanguage(x, l) \wedge SpeaksLanguage(y, l)$ 时

由 a, 可以得到 $Understands(x, y)$ 、 $Understands(y, x)$ 均成立, 即

$$\forall x, y, l SpeaksLanguage(x, l) \wedge SpeaksLanguage(y, l) \Rightarrow Understands(x, y)$$

- c. 假设 $Friend(x, y)$ 表示 $x$ 是 $y$ 的朋友, 则(i)与(ii)分别表示如下

$$\forall x, y Understands(x, y) \wedge Understands(y, x) \Rightarrow (Friend(x, y) \wedge Friend(y, x))$$

$$\forall x, y, z Friend(x, y) \wedge Friend(y, z) \Rightarrow Friend(x, z)$$

### 8.19

假设:  $Parent(p, q)$ 表示 $p$ 是 $q$ 的家长,  $Female(p)$ 表示 $p$ 是女性

- a.  $\exists p Parent(Joan, p) \wedge Female(p)$
- b.  $\exists^1 p Parent(Joan, p) \wedge Female(p)$
- c.  $\exists^1 p Parent(Joan, p) \wedge Female(p) \wedge [\forall x Parent(Joan, x) \Rightarrow x = p]$
- d.  $\exists^1 p Parent(Joan, p) \wedge Parent(Kevin, p)$
- e.  $\exists^1 p Parent(Joan, p) \wedge Parent(Kevin, p) \wedge \exists q, r [Parent(Joan, q) \wedge Parent(r, q) \wedge r \neq Kevin]$

## 8.28

根据语句信息，得到 Gershwin、Joe、McCartney、Billie Holiday 为人名

The Man I Love、Eleanor Rigby 为歌名

Revolver 为专辑名，并且一个专辑可以收录多名歌手的歌

- a.  $Wrote(Gershwin, The\ Man\ I\ Love)$
- b.  $\neg Wrote(Gershwin, Eleanor\ Rigby)$
- c.  $Wrote(Gershwin, The\ Man\ I\ Love) \vee Wrote(McCartney, The\ Man\ I\ Love)$
- d.  $\exists s\ Wrote(Joe, s)$
- e.  $\exists d\ Owns(Joe, d) \wedge CopyOf(d, Revolver)$
- f.  $\forall s\ Sings(McCartney, s, Revolver) \Rightarrow Wrote(McCartney, s)$
- g.  $\neg (\exists s\ Wrote(Gershwin, s) \wedge \exists p\ Sings(p, s, Revolver))$
- h.  $\forall s\ Wrote(Gershwin, s) \Rightarrow \exists p, a\ Sings(p, s, a)$
- i.  $\exists a\ \forall s\ Wrote(Gershwin, s) \Rightarrow \exists p\ Sings(p, s, a)$
- j.  $\exists d, a\ Owns(Joe, d) \wedge CopyOf(d, a) \wedge Sings(Billie\ Holiday, The\ Man\ I\ Love, a)$
- k.  $\forall a\ \exists s\ Sings(McCartney, s, a) \Rightarrow \exists d\ Owns(Joe, d) \wedge CopyOf(d, a)$
- l.  $\forall a[\forall s, p\ Sings(p, s, a) \Rightarrow Sings(Billie\ Holiday, s, a)] \Rightarrow \exists d\ CopyOf(d, a) \wedge Owns(Joe, d)$