

1 COMPETENCY QUESTIONS

1. Is an evening gown part of an outfit that is appropriate for an opening night theatre performance if one is a female?

$$\forall w \forall x \forall y \forall z \text{ eveningGown}(w) \wedge \text{theatreOpeningNight}(x) \wedge \text{female}(y) \wedge \text{outfit}(z) \\ \wedge \text{garment_of}(w, z) \supset \text{has_genderDes}(w, z) \wedge \text{eventAppropriate}(z, y)$$

```
1 (all w all x all y all z
2 (eveningGown(w) & theatreOpeningNight(x) & female(y) & garment_of(w,z))
3 ->
4 (has_genderDes(x,y) & is_eventAppropriate(z,x))).
```

2. Does a dress and shoes alone complete a business outfit?

$$\forall x \forall y \forall z \text{ dress}(x) \wedge \text{shoes}(y) \wedge \text{outfit}(z) \wedge \text{garment_of}(x, z) \wedge \text{garment_of}(y, z) \supset \\ \text{outfit}(z)$$

```
1 (all x all y all z
2 (dress(x) & shoes(y) & outfit(z) & garment_of(x,z) & garment_of(y,z))
3 ->
4 (businessOutfit(z))).
```

3. Does a jacket, pants and shoes comprise a complete outfit?

4. Is a three piece suit complete without a vest?

5. Can one wear a men's suit without a tie?

6. Must one wear men's neck apparel to a semi-formal event?

7. Is a red colored suit considered formal wear?

8. Is a green ballroom gown suitable for a state dinner?

9. Is a ballroom gown suitable for a dinner party?

2 AXIOMS

2.1 SUBCLASS AXIOMS

1. A dress is a type of garment

$$\forall x \text{ dress}(x) \supset \text{garment}(x)$$

$$1 \quad (\text{all } x \text{ (dress}(x) \rightarrow \text{garment}(x)))$$

2. A evening gown is a type of dress

$$\forall x \text{ eveningGown}(x) \supset \text{garment}(x)$$

$$1 \quad (\text{all } x \text{ (eveningGown}(x) \rightarrow \text{dress}(x)))$$

3. Legs, feet and torso are body segments

$$\forall x \text{ legs}(x) \vee \text{legs}(y) \vee \text{feet}(x) \supset \text{bodySegment}(x)$$

2.2 DISJOINTNESS AXIOMS

1.

2.3 SORT CONSTRAINTS

1. Garment are dyed colors

$$\forall x \forall y \text{ dyed}(x, y) \supset \text{garment}(x) \wedge \text{color}(y)$$

2. Events suggest dress codes

$$\forall x \forall y \text{ suggest}(x, y) \supset \text{event}(x) \wedge \text{dressCode}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (suggest}(x, y) \rightarrow (\text{event}(x) \ \& \ \text{dressCode}(y))) \text{.}$$

3. Outfits conform to dress codes

$$\forall x \forall y \text{ conforms}(x, y) \supset \text{outfit}(x) \wedge \text{dressCode}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (conforms}(x, y) \rightarrow (\text{outfit}(x) \ \& \ \text{dressCode}(y))) \text{.}$$

4. Outfits are suitable for events

$$\forall x \forall y \text{ suitable}(x, y) \supset \text{outfit}(x) \wedge \text{event}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (suitable}(x, y) \rightarrow (\text{outfit}(x) \ \& \ \text{event}(y))) \text{.}$$

5. Dress codes govern outfits

$$\forall x \forall y \text{ governs}(x, y) \supset \text{dressCode}(y, x) \wedge \text{outfit}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (governs}(x, y) \rightarrow (\text{dressCode}(x) \ \& \ \text{outfit}(y))) \text{.}$$

6. Events permit outfits

$$\forall x \forall y \text{ permits}(x, y) \supset \text{event}(x) \wedge \text{outfit}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (permits}(x, y) \rightarrow (\text{event}(x) \ \& \ \text{outfit}(y))) \text{.}$$

7. Garments are a component of outfits

$$\forall x \forall y \text{ component_of}(x, y) \supset \text{garment}(x) \wedge \text{outfit}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (component_of}(x, y) \rightarrow (\text{garment}(x) \ \& \ \text{outfit}(y))) \text{.}$$

8. Outfits include garments

$$\forall x \forall y \text{ include}(x, y) \supset \text{garment}(x) \wedge \text{outfit}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (include}(x, y) \rightarrow (\text{outfit}(x) \ \& \ \text{garment}(y))) \text{.}$$

9. Outfits are worn by genders

$$\forall x \forall y \text{ worn_by}(x, y) \supset \text{outfit}(x) \wedge \text{gender}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (worn_by}(x, y) \rightarrow (\text{outfit}(x) \ \& \ \text{gender}(y))) \text{.}$$

10. Garments are targeted to genders

$$\forall x \forall y \text{ worn_by}(x, y) \supset \text{outfit}(x) \wedge \text{gender}(y)$$

$$1 \quad \text{all } x \text{ all } y \text{ (worn_by}(x, y) \rightarrow (\text{outfit}(x) \ \& \ \text{gender}(y))) \text{.}$$

11. Garments are worn over garments

$$\forall x \forall y \text{ worn_over}(x, y) \supset \text{garment}(x) \wedge \text{garment}(y)$$

1 all x all y (worn_over(x,y)) -> (garment(x) & garment(y)).

12. Garments are worn under garments

$$\forall x \forall y \text{ worn_under}(x, y) \supset \text{garment}(x) \wedge \text{garment}(y)$$

1 all x all y (worn_over(x,y)) -> (garment(x) & garment(y)).

13. Garments cover body segments

$$\forall x \forall y \text{ covers}(x, y) \supset \text{garment}(x) \wedge \text{bodySegment}(y)$$

1 all x all y (worn_over(x,y)) -> (garment(x) & garment(y)).

14. Body segments are covered by garments

$$\forall x \forall y \text{ covered_by}(x, y) \supset \text{bodySegment}(x) \wedge \text{garment}(y)$$

1 all x all y (covered_by(x,y)) -> (bodySegment(x) & garment(y)).

2.4 DEPENDENCE AXIOMS

1. All outfits are composed of garments of clothing

$$\forall(x) \text{ outfit}(x) \supset \exists y \text{ garment}(y) \wedge \text{garment_of}(y, x)$$

$$\text{Garment} \sqsubseteq \exists \text{garment-of. Outfit}$$

2. All outfits have a garment that are worn over the torso

$$\forall(x, y) (\text{outfit}(x) \wedge \text{torso}(y) \supset (\exists z \text{ garment}(z) \wedge \text{wornOver}(z, y) \wedge \text{garmentOf}(z, x)))$$

3. All outfits have an garment that cover the legs

$$\forall(x, y) (\text{outfit}(x) \wedge \text{legs}(y) \supset (\exists z \text{ garment}(z) \wedge \text{wornOver}(z, y) \wedge \text{garmentOf}(z, x)))$$

4. All outfits have an garment that cover the feet

$$\forall(x, y) (\text{outfit}(x) \wedge \text{feet}(y) \supset (\exists z \text{ garment}(z) \wedge \text{wornOver}(z, y) \wedge \text{garmentOf}(z, x)))$$

2.5 CARDINALITY

2.6 UNIQUENESS

2.7 DEFINITIONS

1. Women's garments are garments targeted to females

$$\forall x \forall y \text{ womensGarment}(x) \equiv \text{garment}(x) \wedge \text{female}(y) \wedge \text{targeted_to}(x, y)$$

```
1 (all x all y
2 (womensGarment(x)
3 <->
4 (garment(x) & female(y) & targeted_to(x,y))))).
```

2. Men's garments are garments targeted to males

$$\forall x \forall y \text{ mensGarment}(x) \equiv \text{garment}(x) \wedge \text{male}(y) \wedge \text{targeted_to}(x, y)$$

```
1 (all x all y
2 (mensGarment(x)
3 <->
4 (garment(y) & male(z) & targeted_to(y,z))))).
```

3. Men's garments are not women's garments

$$\forall x \text{ mensGarment}(x) \equiv \neg \text{womensGarment}(x)$$

```
1 (all x
2 (mensGarment(x)
3 <->
4 -womensGarments(x))).
```

4. A formal outfit is an outfit that conform to a formal dress code

$$\forall x \forall y \text{ formalOutfit}(x) \equiv \text{outfit}(x) \wedge \text{formal}(y) \wedge \text{conforms}(x, y)$$

```
1 (all x all y
2 (formalOutfit(x))
3 <->
4 (outfit(x) & formal(y) & conforms(x,y))).
```

5. A semiformal outfit is an outfit that conform to a semiformal dress code

$$\forall x \forall y \text{ semiformalOutfit}(x) \equiv \text{outfit}(x) \wedge \text{semiFormal}(y) \wedge \text{conforms}(x, y)$$

```
1 all x all y
2 semiFormalOutfit(x))
3 ->
4 outfit(x) & semiFormal(y) & conforms(x,y))).
```

6. An informal outfit is an outfit that conform to an informal dress code

$$\forall x \forall y \text{ informalOutfit}(x) \equiv \text{outfit}(x) \wedge \text{informal}(y) \wedge \text{conforms}(x, y)$$

```
1 all x all y
2 informalOutfit(x))
3 ->
4 outfit(x) & informal(y) & conforms(x,y))).
```

2.8 PROPERTIES OF RELATIONS

2.8.1 INVERSE RELATION

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1 all x all y (include(x,y) <-> components_of(y,x)).
2 all x all y (permits(x,y) <-> suitable(y,x)).
3 all x all y (governs(x,y) <-> components_of(y,x)).
4 all x all y (worn_over(x,y) <-> worn_under(y,x)).
5 all x all y (covers(x,y) <-> covered_by(y,x)).

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2.8.2 SUBPROPERTY OF RELATION CHAIN

1. If an event suggest a dress code and that dress code governs a set of outfits than that event permits those outfits.

$$\forall x \forall y \forall z \text{ suggest}(x, y) \wedge \text{governs}(y, z) \supset \text{permits}(x, z)$$

```

1 (all x all y all z
2 (suggest(x,y) & governs(y,z))
3 ->
4 (permits(x,z))).

```

2. All components of an outfit that is worn by a gender have a target gender of that gender

$$\forall x \forall y \forall z \text{ components_of}(x, y) \wedge \text{worn_by}(y, z) \supset \text{targetGender}(x, z)$$

```

1 (all x all y all z
2 (components_of(x,y) & worn_by(y,z))
3 ->
4 (targetGender(x,z))).

```

2.8.3 INVERSE PROPERTY

1. If a garment is worn over another garment or body segment than then the garment or body segment is wornUnder the garment

$$\forall x \forall y \text{ wornOver}(x, y) \supset \text{wornUnder}(y, x)$$

1. All outfits are composed of garments of clothing

$$\forall(x) \text{ outfit}(x) \supset \exists x \text{ garment}(x) \wedge \text{garment_of}(\text{outfit})$$

$$\text{Garment} \sqsubseteq \exists \text{garment-of.Outfit}$$

2. An outfit must contain some garment that wornOver the legs, some garment that wornOver the feet and some garment that wornOver the torso

$$\text{Outfit} \sqsubseteq \forall(\exists \text{will-cover.Torso} \sqcup \exists \text{will-cover.Legs} \sqcup \exists \text{will-cover.Feet})$$

1. If an outfit consist of a type of clothing then there exists an garment of clothing that is a part of that outfit of that same type

$$\forall(x, y, z) (\text{type}(x) \wedge \text{outfit}(y) \wedge \text{garmentOf}(x, y) \supset (\exists w \text{ garment}(w) \wedge \text{of_type}(w, x) \wedge \text{garmentOf}(w, y)))$$

2. If an outfit consists on an garment of clothing then the outfit consists of that type of clothing

$$\forall(w, x, y, z) (garment(w) \wedge outfit(x) \wedge garmentOf(x, y) \wedge type(z) \wedge of_type(w, z) \supset garmentOf(z, x))$$

3. All garments of clothing must be of a type of clothing

$$\forall(x) (garment(x) \supset (\exists y type(y) \wedge of_type(x, y)))$$

4. Nothing can be both an garment and a type of clothing

$$\forall(x) \neg(garment(x) \wedge type(x))$$

5. No type of clothing can be a type of itself

$$\forall(x, y) (type(x) \wedge type(y) \supset \neg(x = y))$$

6. No outfit can consist of the same two garments of clothing

$$\forall(x, y, z) (garment(x) \wedge garment(y) \wedge outfit(z) \wedge garmentOf(x, z) \wedge garmentOf(y, z) \supset \neg(x = y))$$

7. garments of clothing that are of the same type and part of the same outfit are the same garment of clothing

$$\begin{aligned} \forall(t, x, y, z) (garment(x) \wedge garment(y) \wedge outfit(z) \wedge type(t) \\ \wedge garmentOf(x, z) \wedge garmentOf(y, z) \wedge of_type(x, t) \wedge of_type(y, t) \supset (x = y)) \end{aligned}$$

8. No outfit can consist of the same two types of clothing

$$\forall(x, y, z) (type(x) \wedge type(y) \wedge outfit(z) \wedge garmentOf(x, z) \wedge garmentOf(y, z) \supset \neg(x = y))$$

9. All garments that cover feet are of type shoes or of type socks

$$\begin{aligned} \forall(x, y, z) (garment(x) \wedge feet(y) \wedge cover(x, y) \supset (shoes(z) \wedge of_type(x, z)) \\ \vee (socks(z) \wedge of_type(x, z))) \end{aligned}$$

10. All outfits with socks must have shoes

$$\forall(x, y) (socks(x) \wedge outfit(y) \wedge garmentOf(x, y) \supset (\exists z shoes(z) \wedge garmentOf(x, z)))$$

11. All outfits with jackets must be accompanied with another garment of clothing covering the torso

$$\begin{aligned} \forall(x, y, z) (jacket(x) \wedge outfit(y) \wedge garmentOf(x, y) \wedge torso(z) \supset \\ (\exists w garment(w) \wedge wornOver(w, z) \wedge garmentOf(w, y))) \end{aligned}$$

12. All garments of clothing have a color.

$$\forall(x) (clothing(x) \supset \exists y color(y) \wedge has_color(x, y))$$

13. Dresses cover the legs and torso

$$\forall(x, y, z) (dress(x) \wedge torso(y) \wedge legs(z) \supset wornOver(x, y) \wedge wornOver(x, z))$$

14. An garment of clothing is appropriate for only one gender

$$\begin{aligned} \forall(x, y, z) (garment(x) \wedge male(y) \wedge female(z) \wedge gender_appr(x, y) \\ \supset \neg gender_appr(x, z)) \end{aligned}$$

15. All garments of clothing of type dress are appropriate for women.

$$\forall(x, y, z) (garment(x) \wedge dress(y) \wedge of_type(x, y) \wedge female(z) \supset gender_appr(x, z))$$

16. All garments of clothing of type skirt are appropriate for women.

$$\forall(x, y, z) (garment(x) \wedge skirt(y) \wedge of_type(x, y) \wedge female(z) \supset gender_appr(x, z))$$

17. All garments of clothing of type women's shoes are appropriate for women.

$$\forall(x, y, z) (garment(x) \wedge womens_shoes(y) \wedge of_type(x, y) \wedge female(z) \supset gender_appr(x, z))$$

18. All garments of clothing of type men's shoes are appropriate for men.

$$\forall(x, y, z) (garment(x) \wedge mens_shoes(y) \wedge of_type(x, y) \wedge men(z) \supset gender_appr(x, z))$$

19. All garments of clothing of type blouse are appropriate for women.

$$\forall(x, y, z) (garment(x) \wedge blouse(y) \wedge of_type(x, y) \wedge women(z) \supset gender_appr(x, z))$$

20. All two-piece suits consist of pants and a jacket of the same color

$$\forall(x) twoPieceSuit(x) \supset \exists y \exists z \exists c pants(y) \wedge jacket(z) \wedge color(c) \wedge has_color(y, c) \wedge has_color(z, c)$$

21. All combinations of skirts, women's jackets and blouses make a skirt suit.

$$\forall(w, x, y, z) skirtSuit(w) \supset skirt(x) \wedge womens_jacket(y) \wedge blouse(z)$$

22. All combinations of dresses and women's jackets make a dress suit

$$\forall(x, y, z) skirtSuit(x) \supset dress(y) \wedge womens_jacket(z)$$