

1 DOMAIN

Our ontology wishes to explore the domain of western dress codes and the way in which they govern outfits. Dress codes are written, and more often, unwritten sets of rules that regulate the types of clothing and the specifications of the clothing to be worn to different occasions and events. A classification of these codes is normally made for varying levels of formality of the occasion and times of day the event is held.

Western dress codes, albeit a by-product of Western Culture (which in itself can be perceived as very diverse), will be assumed to relate to the rather sweeping notion of western dress that permeates much of the world today.

As previously mentioned dress codes encompass many unwritten rules. These unwritten rules result from the influences on dress codes by societal norms of the respective time period. We will assume that the dress codes being codified in our axioms are more or less pertinent to present day but acknowledge the chance for their possible antiquity. Some notable instances of arguable rules of dress include the distinction between formal and semi-formal wear and the level of formality of a dress and skirt's hem length.

To exercise the effectiveness of our ontology and to accommodate certain use-cases, our ontology will include a brief selection of occasion instances which will be designated specifically one formality. How certain events and occasions are perceived for their formality is greatly influenced by the cultural norms of the persons hosting the event (which deems worthy an ontology in itself). Therefore, event instances included in our ontology will be extremely general and absent of any cultural specificity.

A distinction must be made between a dress code and what is fashionable. We acknowledge that elements of fashion of any time period do affect a dress code. However, we will largely ignore the elements of an item of clothing that may or may not be fashionable present day. Therefore we will only address rules of dress that go as far as what can be said has been a fashion constant of the past several decades e.g. A dark colored/neutral colored men's suit and it's formality dependent variations have more or less been the norm for men for events ranging from informal to formal for the past several decades.

2 MOTIVATING SCENARIOS

The motivating scenario for the development of the ecommerce outfit assembly ontology is to provide a software agent the knowledge required to assemble acceptable outfits for different events and occasions from clothing available through online product catalogues. Via the ontology a software agent could discern between clothing items in a product catalogue on characteristics of formality and targeted gender. The aggregated product information can subsequently be interpreted to build product sets that form complete and logical outfit selections that match the requirements of the user of the software agent.

The ontology can be extended with other ecommerce ontologies to allow a software agent to pair product catalogue selections with details of product availability (in size), costs and the proximity of origin of shipment of the clothing articles. This would be done for the purposes of building outfit selections that match the customers requirements in size, style, fastest and/or cheapest shipping options, all within his or her specified budget.

2.1 USE CASE 1

A female person receives an invite to a charity ball dinner and would like to search her favorite ecommerce clothing websites to know what are her clothing options available for purchase that she can wear in attendance to the function.

2.2 USE CASE 2

A male diplomat is attending a state dinner and would like to know what are his clothing options and what is the nearest clothing store that sells the required garments to complete the outfit.

2.3 USE CASE 3

A female person has a wardrobe of dresses and skirts she can wear to her first day at work in the downtown bank tower. She is most likely to be introduced to a number of her coworkers and attend a meeting. She wants to know which dresses or skirts are acceptable options that can be included in a business appropriate outfit for the occasion.

2.4 USE CASE 4

The same woman from Use Case 3 realizes that her current wardrobe offers a limited number of clothing options to be worn to work. She fears she won't get through the week without having to wear some outfits to work a second time. She searches her favorite online retailers for new garments that can be purchased to fill the gap that match her requirements.

3 INFORMAL COMPETENCY QUESTIONS

There is a consistent pattern to the types of questions of which the use cases present and the ontology would like to resolve.

1. What is the implied formality of a specified occasion and what type of clothing conform to the rules of the dress code associated with the respective formality of the event and the gender of the person?
 - 1.1. Is an evening gown suitable to a casual dinner party in one is a woman?
 - 1.2. If one is a man, is a tuxedo appropriate when attending the wedding of your best business client's son?
 - 1.3. Is a business suit appropriate when attending a state dinner if a man?
2. Given a selection of clothing, are there rules on how the items of clothing must be paired together governed by the dress code?
 - 2.1. Can the articles of a men's semi-formal suit consist of pieces sewn from different fabrics?
 - 2.2. Can both a a dress and a blouse considered business attire on their own be worn together in the same informal outfit?
3. Given a set of options of clothing by type, what are some unique restrictions on specific types of clothing that would govern their acceptance at a formal occasion, a semiformal occasion or an informal occasion?
 - 3.1. What are the hem lengths acceptable for a woman's dress when attending a formal function.
 - 3.2. What are the hem lengths acceptable for a woman's skirt when worn as a skirt suit when going to work in a traditional office.
 - 3.3. What are the color options for a man's suit at an informal occasion.

Albeit not directly stated in the use cases, there are a number of questions that can be extended from those listed above.

1. What is the absolute minimum required types of clothing to complete any outfit?
2. What parts of the body must be covered to consider an outfit complete?
3. Which types of clothes cover which parts of the body?
4. How and in what sequence are certain types of clothes worn when worn together?

4 SIGNATURE

4.1 CLASSES

- DomainConcepts

4.2 RELATIONS

dyed

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

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

```
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))).
```

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

$$\forall x \forall y \forall z \text{ vest}(x) \wedge \neg \text{component_of}(x, y) \supset \text{threePieceSuit}(y)$$

```
1 (all x all y
2 (vest(x) & -component_of(x,y))
3 ->
4 (threePieceSuit(y))).
```

5. Can a man wear a men's suit without a tie to a business meeting?
6. Must a man wear men's neck apparel to a semi-formal event?
7. Is a red colored suit suitable to worn to a charity ball?
8. Is a green ballroom gown suitable for a state dinner?

$$\forall x \forall y \forall z \text{ ballroomGown}(x) \wedge \text{green}(c) \wedge \text{dyed}(x, c) \supset \\ \text{suitable}(y, z)$$

```

1 (all x all y all z
2 (ballroomGown(x) & outfit(y) & dinnerParty(z) & garment_of(x,y)
3 ->
4 (suitable(y,z)).

```

9. Is an evening gown part of an outfit suitable for a dinner party?

$$\forall x \forall y \forall z \forall c \text{ eveningGown}(x) \wedge \text{dinnerParty}(z) \wedge \text{garment_of}(x, y) \supset \text{suitable}(y, z)$$

```

1 (all x all y all z
2 (eveningGown(x) & outfit(y) & dinnerParty(z) & garment_of(x,y)
3 ->
4 (suitable(y,z)).

```

10. Can a woman wear a dress above the knee hemline to a semi-formal event?

11. Can an evening gown be included in a dress suit?

12. Can a skirt suit include a skirt with a mid thigh hemline to a business meeting?

6 AXIOMS

6.1 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

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

6.2 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 (covers(x,y)) -> (garment(x) & bodySegment(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)).

6.3 DEPENDENCE AXIOMS

1. All outfits include a garment that is worn over the torso and is not an accompaniment garment

$$\forall(x, y) (outfit(x) \wedge torso(y) \supset (\exists z garment(z) \wedge worn_over(z, y) \wedge component_of(z, x) \wedge \neg accompanimentGarment(z)))$$

```

1 (all x all y
2 (outfit(x) & torso(y))
3 ->
4 (exists z (garment(z) & worn_over(z,y) & component_of(z,x)
5 & -accompanimentGarment(z)))) .

```

2. All outfits include a garment that is worn over the legs and is not an accompaniment garment

$$\forall(x, y) (outfit(x) \wedge legs(y) \supset (\exists z garment(z) \wedge worn_over(z, y) \wedge component_of(z, x) \wedge \neg accompanimentGarment(z)))$$

```

1 (all x all y
2 (outfit(x) & legs(y))
3 ->
4 (exists z (garment(z) & worn_over(z,y) & component_of(z,x)
5 & -accompanimentGarment(z)))) .

```

3. All outfits include a garment that is worn over the feet and is not an accompaniment garment

$$\forall(x, y) (outfit(x) \wedge feet(y) \supset (\exists z garment(z) \wedge worn_over(z, y) \wedge component_of(z, x) \wedge \neg accompanimentGarment(z)))$$

```

1 (all x all y
2 (outfit(x) & feet(y))
3 ->
4 (exists z (garment(z) & worn_over(z,y) & component_of(z,x)
5 & -accompanimentGarment(z)))) .

```

4. All mens suits consist of pants and a jacket of the same color

$$\forall x mensSuit(x) \supset \exists y \exists z \exists c mensPants(y) \wedge mensJacket(z) \wedge color(c) \wedge dyed(y, c) \wedge dyed(z, c)$$

```

1 (all x
2 (mensSuit(x)
3 ->
4 (exists y exists z (mensPants(y) & mensJacket(z) & color(c) & dyed(y,c)
5 & dyed(z,c)))) .

```

5. All garments are dyed a color

$$\forall x garment(x) \supset \exists c color(c) \wedge dyed(x, c)$$

```

1 (all x
2 (garment(x)
3 ->
4 (exists c (color(c) & dyed(x,c)))) .

```

6.4 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(x) & male(y) & targeted_to(x,y))))).

```

3. Lower garments are garment worn over the legs

$$\forall x \forall y \text{ lowerGarment}(x) \equiv \text{garment}(x) \wedge \text{legs}(y) \wedge \text{worn_over}(x, y)$$

```

1 (all x all y
2 (lowerGarment(x)
3 <->
4 (garment(x) & legs(y) & worn_over(x,y))))).

```

4. Upper garments are garments worn over the torso

$$\forall x \forall y \text{ upperGarment}(x) \equiv \text{garment}(x) \wedge \text{torso}(y) \wedge \text{worn_over}(x, y)$$

```

1 (all x all y
2 (upperGarment(x)
3 <->
4 (garment(x) & torso(y) & worn_over(x,y))))).

```

5. Footwear are garments worn over the feet

$$\forall x \forall y \text{ footwear}(x) \equiv \text{garment}(x) \wedge \text{feet}(y) \wedge \text{worn_over}(x, y)$$

```

1 (all x all y
2 (upperGarment(x)
3 <->
4 (garment(x) & feet(y) & worn_over(x,y))))).

```

6. 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))) .

```

7. 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))) .

```

8. 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))) .

```

9. 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))) .

```

6.5 PROPERTIES OF RELATIONS

6.5.1 INVERSE RELATION

```
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)).
```

6.5.2 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 are targeted to 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 (targeted_to(x,z))).
```

6.6 UNSORTED OR REJECTED

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

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

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. No type of clothing can be a type of itself

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

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

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

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

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

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

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

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

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

8. Dresses cover the legs and torso

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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