similarity measures, classifiers, function estimators).

We believe that deeper, richer representations of the subjective features of fashion data is possible and would help in many important use cases. In this paper, we propose an architectural augmentation to traditional clothing ontologies that includes the notion of a subjective influence network in a way that may be able to capture subjective semantics that simple categorical features do not. We enumerate a set of potential use cases, and propose types of measurements and applications that can be carried out to measure the usefulness of our approach.

The rest of the paper is organized as follows. Section 2 exhaustively summarizes the state of the art on existing fashion ontologies and frameworks and Section 2.4 describes machine learning applications as motivating use cases for our fashion ontological modelling approach. Section 3 proposes the theoretical foundations of the subjective model of influence, entities, relations and the mechanisms to quantify influence and subjectivity. Section 4 discusses evaluation approaches and utility of the model once populated with empirical data. Section 5 concludes with further insights.

2. RELATED WORK

2.1 Related Fashion Ontologies and Schemas

Ontologies have been used to represent knowledge in a large set of real-life problems, from genetics[1] to decision support systems, optimization, matchmaking and human activity recognition [4]. In the fashion world, ontologies have sporadically been used for recommendation systems. For example, ontologies have been combined with fuzzy logic for personalized garment design, where fuzzy decision trees serve in learning a set of representative samples. Fuzzy cognitive maps model complex relations between sensory descriptors and fashion themes given by consumers to provide more fine grained recommendations as well as the evaluate how much a specific body shape is relevant to a desired emotional fashion theme [16].

An important existing ontology is the Garment Style Advice Ontology SERVIVE (SERVice Oriented Intelligent Value Adding nEtwork for Clothing-SMEs embarking in Mass- Customisation)[2][13]. The Servive Fashion Ontology (SFO) includes relations among different categories of entities such as *colors, companies, garment features, materials*, etc. and provides a similarly structured and unified vocabulary to represent human, fashion and manufacturing concepts. The project includes the design of a Virtual Customer Advisor (VCA) which expresses preferences for a given garment that is evaluated via SWRL rules and Pellet reasoner. Fig. 1 shows the most abstract or top layer classes as well as the highest hierarchical layer of object properties modelled in SERVIVE ontology. Despite being the most complete ontology publicly available to the best of our knowledge, except for the subjective season labels (*hasHumanStyleColour*) and suitability classifications (*isForOccasion*), the ontology consists only of physical object hierarchies.

Ontologies per se act primarily as a modelling tool, and for

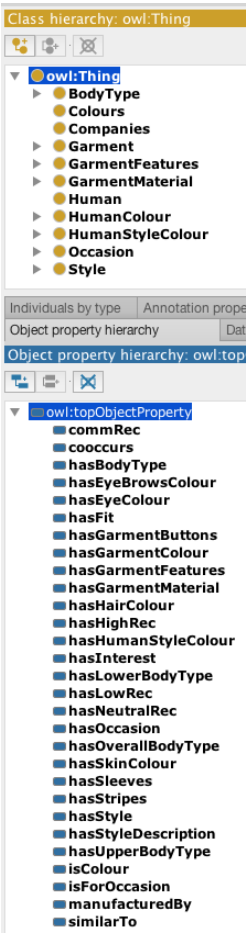

Figure 1: SERVIVE Ontology main entity classes (above) and main object properties (below) [13]

them to be useful, they are to be integrated into some kind of application (be it search, recommendation, classification or decision making applications). For instance, ontologies have also been integrated into probabilistic and media-rich approaches for personalized garment recommendation systems. Expert subjective knowledge from public online media is used to compute compatibility among products and user profiles according to context and probabilistic reasoning. [1] concretely focuses on dresses (*sarees*) and its evaluation of several individuals' fashion preferences and celebrities' actual choices compared with automated recommendations. The format of the ontology is MOWL, that *enables the analysis of visual properties of garments with respect to fashion concepts*, but it is not publicly available.

Another ontology, which considers designers, models, trends, seasons and celebrities is in [9], which exploits lexico-syntactic patterns as NLP tools for ontology learning, relation extraction and curation through domain experts. Table 1 summarizes the main ontologies' concepts and relations modelled.

Considering work that is more general than the fashion do-

[1] `http://geneontology.org/`
[2] SERVIVE EU Project `http://www.servive.eu/`