Extracting Verb Sense Hierarchies from FrameNet

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Keywords: FrameNet, frame, word hierarchy, verb hierarchy

This study extracts verb hierarchies using the frame-to-frame relation of ”inheritance” in FrameNet (FN) and Japanese Framenet (JFN). Hierarchical relationships constitute invaluable information for NLP tasks (Yahya et al., 2013; Hoffart et al., 2014). In particular, verb hierarchies are useful for QA tasks. However, currently not enough data exists for incorporating knowledge of verb hierarchies into intelligent systems. This study extracts verb hierarchy relationships from FN. When two FrameNet frames are linked by an “inheritance” link, we hypothesize that lexical units (LUs) (pairings of lemmas and frames) that evoke those frames exhibit an inheritance relationship too. In other words, a LU that evokes the parent frame is more abstract in meaning than a LU that evokes the daughter frame. In this study we visualized frame hierarchies and created a dataset by extracting English and Japanese verbs from the FN and JFN database respectively. Furthermore, we propose a benchmark task involving verb hierarchical embeddings using the created dataset. The result suggests that the task is of sufficient quantity and quality to train and measure verb embeddings.

For creating word hierarchical representations, two steps are required: getting the hierarchy data and representing words within a vector space. Whereas many datasets/tasks exist for noun hierarchies, only a few such tasks for verb hierarchies are available. As for noun hierarchies, one of the major noun datasets is WordNet (Fellbaum, 1998; Miller, 1995) and a WordNet link prediction task (Ganea et al., 2018) is widely used for measuring noun hierarchy representations.

We used FrameNet to create a verb hierarchy dataset. We hypothesized that when two frames are linked by an inheritance frame-to-frame relation, a LU that evokes the parent frame and another LU that evokes the daughter frame also exhibit an inheritance relation. We call such LUs ”hierarchical LUs.” For example, since `Commerce_buy` frame inherits from `Getting` frame in FN, we assumed that acquire and get are more abstract than buy and purchase. We first extracted hierarchical LUs from frames (See Table 1). We then created a FrameNet-based verb hierarchy prediction task as a verb version of Ganea’s task. This is a binary classification task to decide whether two verb LUs have a hierarchical relationship. We trained Poincaré embeddings (Nickel & Kiela, 2017) in this task and they performed over 70% F1 score. The results show that our task is of sufficiently high quality and quantity for training and measuring verb hierarchical embeddings.

In summary, we extracted verb hierarchies using Inheritance frame-to-frame relations in English FN and JFN and proposed a benchmark task for training and measuring verb hierarchical embeddings. Our verb embeddings represented hierarchies well. The results indicate that our dataset created from FN have extractable structure and are sufficiently large for use in machine learning. Most existing applications do not make use of verb hierarchical information due to lack of resources. Our research is applicable to FrameNets in other languages, and has a potential to stimulate use of verb knowledge in NLP, such as chatbots that can respond intelligently to questions.

Tab. 1: Lexical units (LUs) of frames with inheritance relations, extracted from English/Japanese FrameNet

lang	LU of child frame	LU of parent frame	child frame	parent frame
en	*walk*	*go*	`Self_motion`	`Motion`
en	*yell*	*say*	`Communication_noise`	`Communication`
en	*wash*	*do*	`Grooming`	`Intentionally_affect`
en	*jump*	*do*	`Attack`	`Intentionally_affect`
en	*eat*	*take*	`Ingestion`	`Ingest_substance`
ja	売る (*sell*)	与える (*give*)	`Commerce_sell`	`Giving`
ja	教える (*tell*)	言う (*say*)	`Telling`	`Statement`
ja	飛ぶ (*jump*)	行う (*do*)	`Self_motion`	`Motion`
ja	作り上げる (*make*)	作る (*make*)	`Intentionally_create`	`Creating`
ja	走り去る (*run away*)	動く (*move*)	`Self_motion`	`Motion`

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