Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση

Τόμ. 1 (2025)

12ο Συνέδριο ΕΤΠΕ «Διδακτική της Πληροφορικής»

Περιλήψεις Προσκεκλημένων Ομιλιών

Dave Touretzky, Michaeli Tilman , Stergos Afantenos

doi: 10.12681/cetpe.9146

Βιβλιογραφική αναφορά:

Touretzky, D., Tilman , M., & Afantenos, S. (2025). Περιλήψεις Προσκεκλημένων Ομιλιών. *Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση*, *1*, 2–5. https://doi.org/10.12681/cetpe.9146

What Does "Play" Look Like When Your Toys Are Smarter Than You?

Dave Touretzky
dst@cs.cmu.edu
Carnegie Mellon University

Large language models (LLMs) like ChatGPT are non-human intelligences that combine encyclopedic knowledge with complex but imperfect reasoning. When we connect an LLM to an autonomous mobile robot, we conjure up an intelligent agent that shares our physical world and can interact with us in many possible ways. Imagine playing "hospital" with a toy robot that knows enough medicine to pass board licensing exams. My students and I have been building an interface betwween GPT-4o and the VEX AIM robot that allows us to explore this potential of AI-powered robot toys. I will describe our results to date and what the future may hold

Learning and Teaching About AI/ML in K-12 Computing Education: Bridging Research and Practice

Tilman Michaeli
tilman.michaeli@tum.de
Technical University of Munich

Artificial Intelligence (AI) and Machine Learning (ML) methods and systems are transforming the world we live in, influencing numerous aspects of our daily lives. Empowering everyone to understand AI/ML phenomena in their everyday lives, as well as being involved in shaping this "digital world," is a central task for the K-12 subject of computer science. However, AI/ML poses significant challenges for computing education: Given the rapid evolution of the field, what should be taught to prepare students not only for the near future but for the next 30 to 40 years? How should we teach AI/ML, given the lack of empirical evidence and practical classroom experience (to date)? And how do we prepare computer science teachers for this topic, in which they need to develop both content knowledge and pedagogical content knowledge? This keynote will explore these challenges by drawing on insights from different research projects, offering perspectives for research and practice in computing education.

Semantic Analogies: A Computationally Frugal Approach

Stergos Afantenos
stergos.afantenos@irit.fr
Institut de Recherche en Informatique de Toulouse, University of Toulouse

Abstract

In this invited talk, after briefly introducing analogies, we will be presenting a framework in which we exploit the abstract notion of analogies for Machine Learning. More precisely, using Semantic Role Classification for FrameNet as our testbed, we transform that problem into a problem of identifying

analogies, as binary classification. During decoding of this model at inference, we recuperate the classes of semantic roles by creating probability distributions via random sampling. We conclude this talk with some brief remarks on the role of analogies in education.

Keywords: analogies, FrameNet, natural language, semantic roles

Introduction

Analogies are an important phenomenon that has preoccupied humanity at least since Aristotle. Since then, many views of analogies have been presented, including the Structure Mapping Theory of Dedre Gentner (1983), while some influential thinkers have claimed that analogies are at the "core of Cognition" (Hofstadter, 2001). Classically, analogies take the form of quadruplets a:b::c:d which is usually interpreted as a valid analogy if the same transformation (usually taking the form of a relation or function) that happens between a to b also happens from c to d.

In recent years, interest in Analogies has been rekindled with the advent of Large Language Models (LLMs). This interest has mainly focused on Lexical Analogies, although some attempts have also been made to model analogies between sentences or morphology and translation as well. In terms of lexical analogies, a quadruplet of words forms an analogy if the same lexical relation holds between the first two terms and the last two terms of the analogy. Let us take for example the following quadruplet:

flower : petal :: tree leaf

On a lexical level, the relation of meronymy is clear and thus one could argue that this quadruplet does indeed form an analogy. When we place though those four words in a different context, the relation of meronymy becomes completely irrelevant, as is the case in the following example:

(1) Decomposed leaves provide fertilizer for the trees.
(2) Infected petals imperil the lifespan of flowers.

In this context the relation of meronymy between the four words becomes irrelevant and we cannot claim any more that an analogy holds. This change of perspective which makes the analogy irrelevant becomes clearer when we annotate the sentences with semantic roles, using FrameNet (Baker et al., 1998) frame semantics, as we can see below (Figure 1).

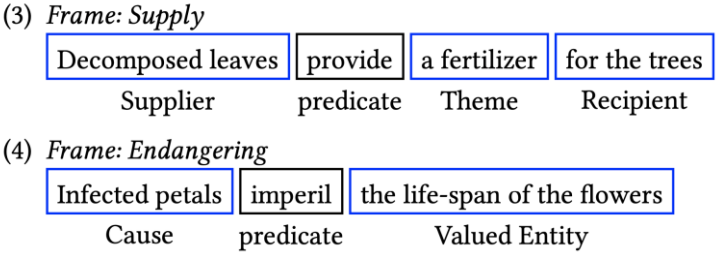

Figure 1. Sentences annotated with semantic roles

Let us now consider the following quadruplet:

leaves : trees :: lentils : humans

Evidently no analogy can be attributed to this, since the two pairs do not share any obvious common relation. When we put those four words though in a different context, we can see that an analogy holds (Figure 2).

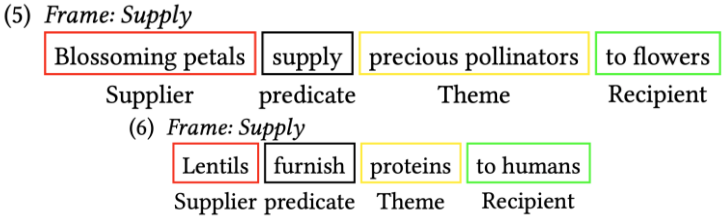

Figure 2. Attributing meaning to an analogy through context

Defining analogies in the context of FrameNet

The above observations allow us to construct appropriate quadruplets that represent analogies in the context of FrameNet semantic roles. In order to formally define what an analogy is in this context, we define the following formal relation:

$$(p_1, a_1, p_2, a_2) \in A_1 \Leftrightarrow ft(p_1) = ft(p_2) \wedge sr(a_1) = sr(a_2)$$

Where p_1, a_1, p_2, a_2 represent predicates and arguments for the first and second sentences respectively. In other words, a quadruplet of two pairs of predicates and arguments forms an analogy if and only if the two predicates trigger the same frame, while the two arguments belong to the same semantic role. In the same way we can also define the set of quadruplets which do not form analogies:

$$(p_1, a_1, p_2, a_2) \in A_0 \Leftrightarrow ft(p_1) = ft(p_2) \wedge sr(a_1) \neq sr(a_2)$$

In other words, all quadruplets of two pairs of predicate arguments for which the predicates trigger the same frame type while the arguments belong to different semantic roles.

This definition of two formal relations allows us to construct a dataset of positive and negative instances that we can provide as input to a Machine Learning algorithm, in order to fit a model which, given a new instance not previously seen, can classify it as an analogy or not an analogy.

A computationally frugal approach to analogies

Using data from FrameNet we have trained a simple Feed-Forward Neural Network involving a small number of parameters which achieved an F1 score 91.07% on the negative instances and 86.45% on the positive instances. In this talk we will show how our approach to identifying semantic analogies in the context of FrameNet can provide results that are competitive to the state of art while at the same time remaining computationally frugal.

We will conclude this talk with some words on the importance of analogies for education.

References

Baker, C. F., Fillmore, C. J., & Lowe, J. B. (1998). The Berkeley FrameNet project. *Proceedings of the 17th International Conference on Computational Linguistics (COLING 1998)* (Vol. 1, pp. 86–90). Association for Computational Linguistics. https://doi.org/10.3115/980451.980860

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science, 7*(2), 155–170. https://doi.org/10.1207/s15516709cog0702_3

Hofstadter, D. R. (2001). Analogy as the core of cognition. In D. Gentner, K. J. Holyoak, & B. N. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 499–538). MIT Press.