UNIVERSITEIT VAN AMSTERDAM

INDE lab

Conceptual Engineering Using Large Language Models

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2023-12-16

How are philosophy and AI alike?

For the past 400 years, the domain of philosophy has been shrinking. … Physics, geology, chemistry, economics, biology, anthropology, sociology, meteorology, psychology, linguistics, computer science, cognitive science. Each of those subject matters was a part of philosophy a mere 400 years ago.

Kevin Scharp. Philosophy as the study of defective concepts. In Conceptual engineering and conceptual ethics, pages 396–416. Oxford University Press, 2020.

… the promoters of AI may not have delivered exactly what they announced ... but what they delivered is astounding. Many breakthroughs in computer science ... can directly be traced to work in AI. Part of the problem is a phenomenon that I heard John McCarthy himself describe: *"As soon as it works, no one calls it AI anymore*."

Bertrand Meyer. "John McCarthy". https://cacm.acm.org/blogs/blog-cacm/138907-john-mccarthy/fulltext, 2011. Accessed: 2023-03-03.

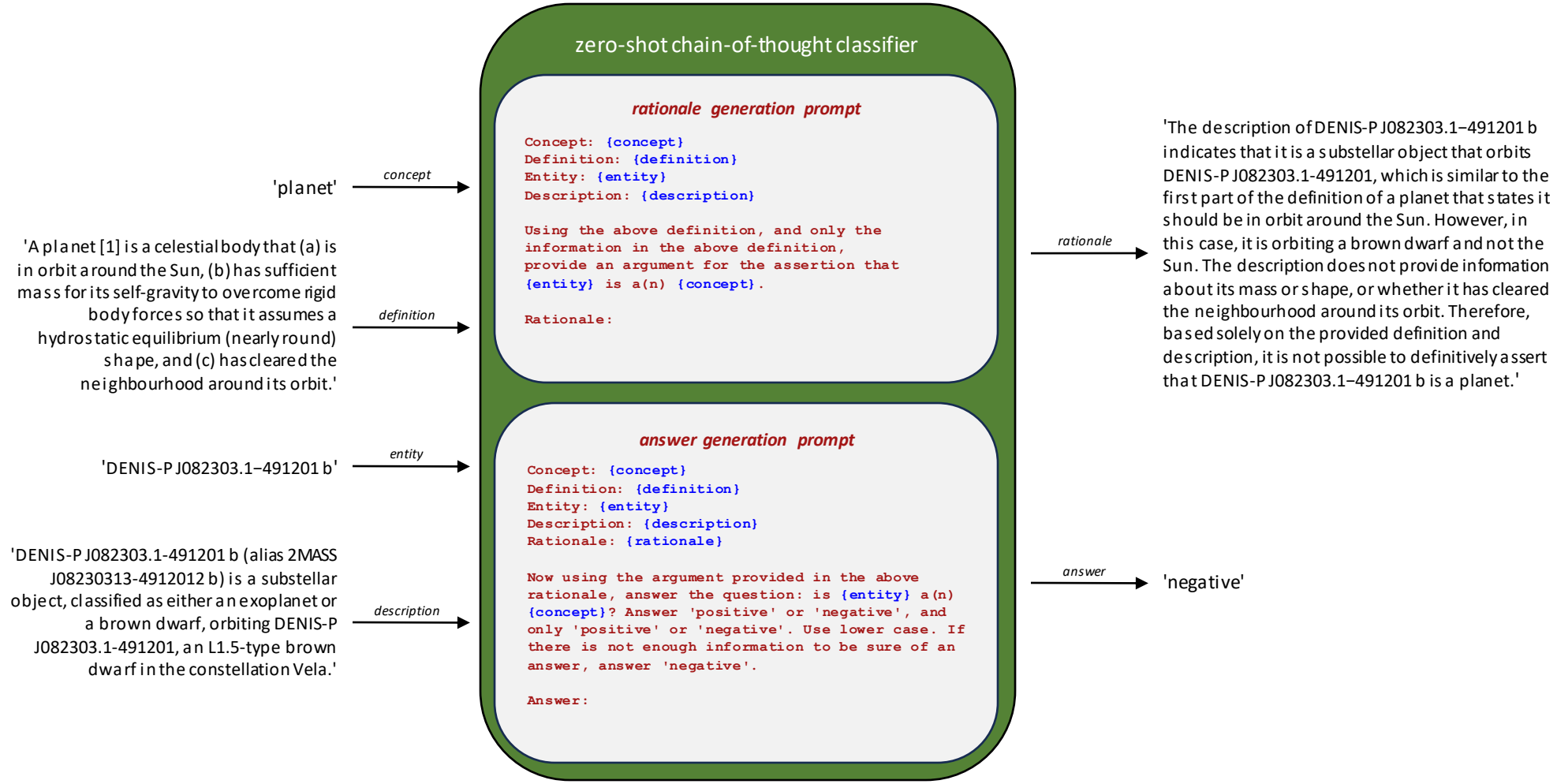
How are conceptual engineering and knowledge engineering alike?

- Philosophers have different ideas about the best way to do conceptual engineering (CE), but it usually involves defining and analyzing concepts using natural language
- Knowledge engineering (KE) focuses on transforming knowledge expressed in natural language into a structured formal language suitable for automated reasoning
- CE and KE share the same task: *defining concepts to achieve a normative goal*
- The emergence of large language models (LLMs) creates an opportunity for a unification of these two practices

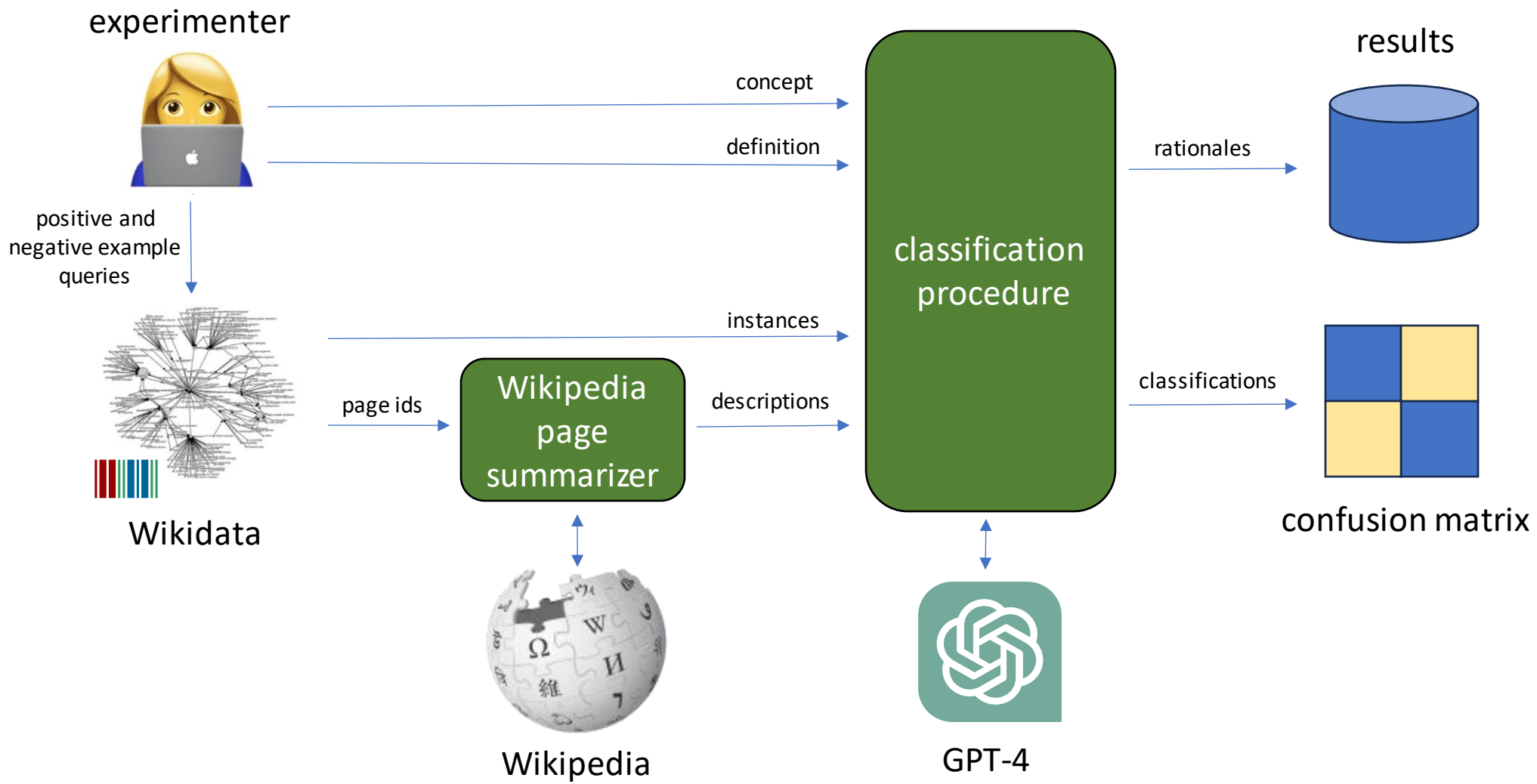
Approach

- An important question for a theory of CE is the nature of its targets, i.e., ”what conceptual engineers are (or should be) trying to engineer”
- Nado proposed as targets *classification procedures* (CPs), defined as abstract ’recipes’ which sort entities ”into an ’in’-group and an ’out’-group”
- We build on this idea by defining a method that uses prompt engineering of LLMs to implement CPs using natural language intensional definitions of concepts
- We then evaluate CPs built using this method by leveraging a *knowledge graph* (KG) as a source of positive and negative examples of elements in the extension of a concept

Example


'planet'
concept
'A planet [1] is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit.'
definition
'DENIS-P J082303.1−491201 b'
entity
'DENIS-P J082303.1-491201 b (alias 2MASS J08230313-4912012 b) is a substellar object, classified as either an exoplanet or a brown dwarf, orbiting DENIS-P J082303.1-491201, an L1.5-type brown dwarf in the constellation Vela.'
description
zero-shot chain-of-thought classifier
rationale generation prompt
Concept: {concept}
Definition: {definition}
Entity: {entity}
Description: {description}
Using the above definition, and only the information in the above definition, provide an argument for the assertion that {entity} is a(n) {concept}.
Rationale:
answer generation prompt
Concept: {concept}
Definition: {definition}
Entity: {entity}
Description: {description}
Rationale: {rationale}
Now using the argument provided in the above rationale, answer the question: is {entity} a(n) {concept}? Answer 'positive' or 'negative', and only 'positive' or 'negative'. Use lower case. If there is not enough information to be sure of an answer, answer 'negative'.
Answer:
rationale
'The description of DENIS-P J082303.1−491201 b indicates that it is a substellar object that orbits DENIS-P J082303.1-491201, which is similar to the first part of the definition of a planet that states it should be in orbit around the Sun. However, in this case, it is orbiting a brown dwarf and not the Sun. The description does not provide information about its mass or shape, or whether it has cleared the neighbourhood around its orbit. Therefore, based solely on the provided definition and description, it is not possible to definitively assert that DENIS-P J082303.1−491201 b is a planet.'
answer
'negative'

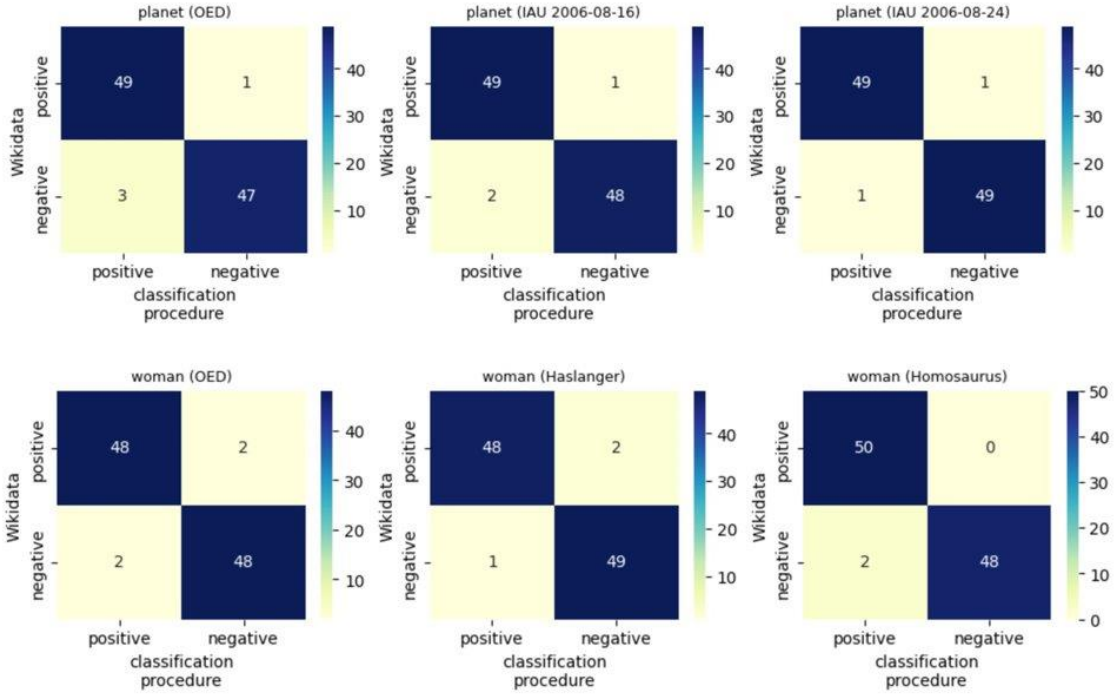
Experimental framework



Results

- PLANET
  - Definitions: OED, Haslanger, Homosaurus
  - Positive examples: 50 instances with sex or gender (P21) either female (Q6581072) or trans woman (Q1052281)
  - Negative examples: 50 instances with sex or gender either male (Q6581097), non-binary (Q48270), or trans man (Q2449503)
- WOMAN
  - Definitions: OED, IAU 2006-08-16, IAU 2006-08-24
  - Positive examples: 50 instances (P31) of planet (Q634)
  - Negative examples: 50 instances of substellar object (Q3132741) that are not instances of planet

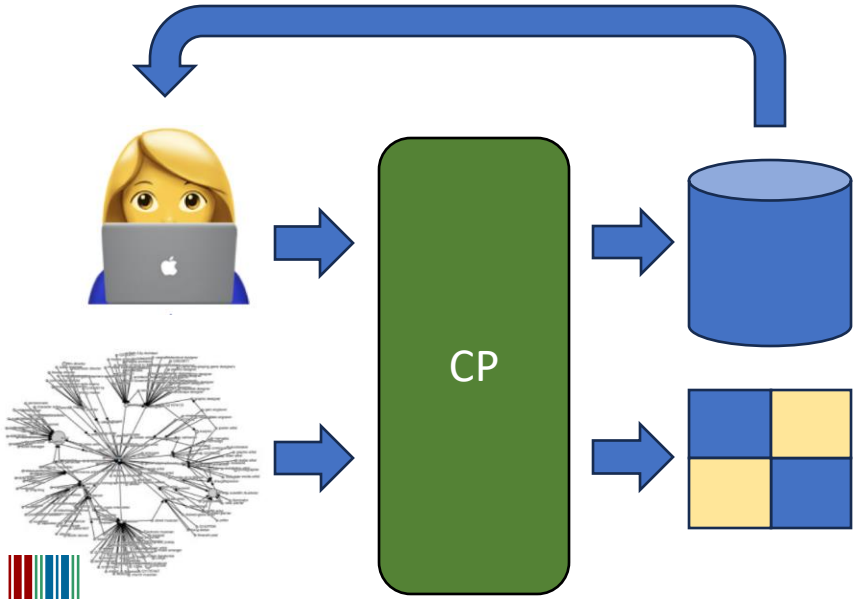
concept	definition	Cohen's kappa	F1 macro	FN	FP
PLANET	IAU 2006-08-24	**0.96**	**0.98**	1	1
	IAU 2006-08-16	0.94	0.97	1	2
	OED	0.92	0.96	1	3
WOMAN	Homosaurus	**0.96**	**0.98**	0	2
	Haslanger	0.94	0.97	2	1
	OED	0.92	0.96	2	2



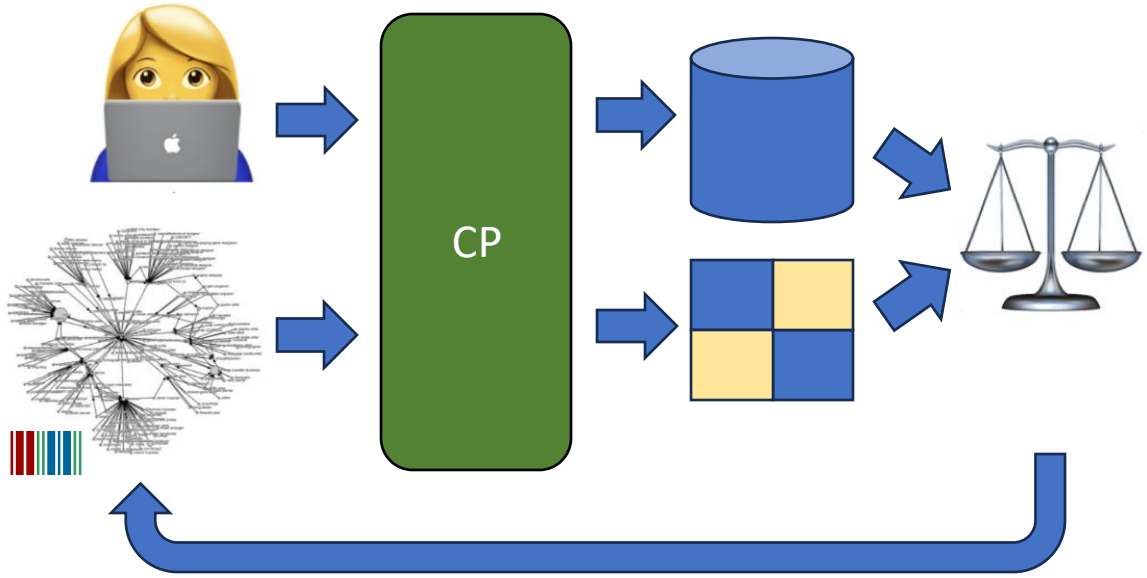
Findings

- Rationales generated by the classification procedures were sound
- Answers were faithful to their rationales
- Rationales frequently contained statements about issues with definitions or descriptions
- For PLANET, most errors were false positives relating to trans-Neptunian objects
- For WOMAN:
  - Homosaurus performed best, possibly because it is the most inclusive definition
  - Haslanger had two false negatives, the rationales of which ascribed to entity descriptions lacking evidence of systematic subordination

Two potential uses



Generative AI assistance
for conceptual engineers



Ameliorative analysis of
knowledge graphs

Discussion

- We've shown how a CE project can incorporate an empirical, data-driven activity using LLMs and KGs
- However, the use of LLMs as they exist today raises transparency, reproducibility and safety concerns
- Further work is needed to evaluate our method with respect to these issues, with a specific focus on evaluating explanation faithfulness

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Thank you!

GitHub repository: https://github.com/bradleypallen/zero-shot-classifiers-for-conceptual-engineering