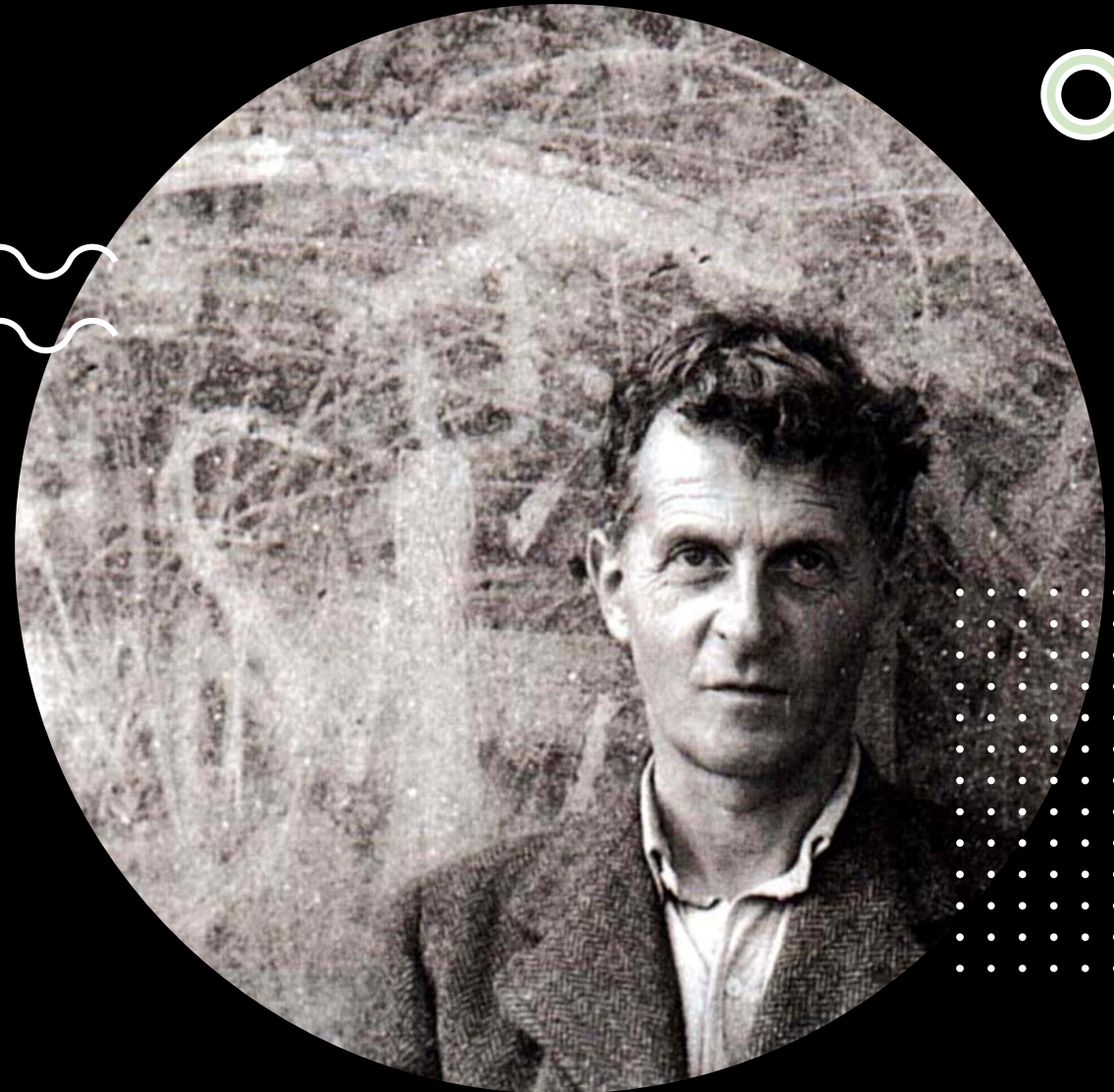


# Languages Network Models: from Wittgenstein to Deep-Learning Systems

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# Agenda

- Word2vec
- Wittgenstein's idea of context
- Firth's ideas of context
- The Beetle in the (black) Box



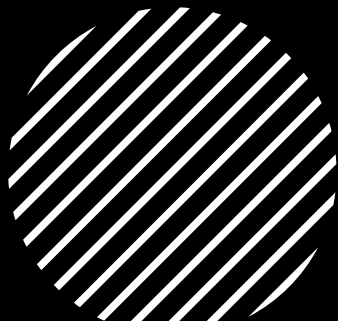


NPL

- Word2vec as a language-game
- The Beetle in the box as defining the limit of a language-game

- Interpretative proposal:

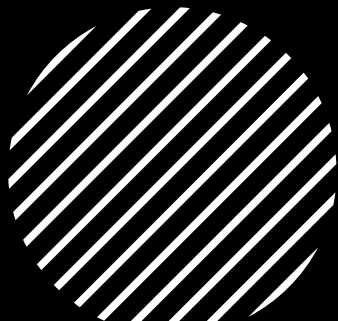
Black Boxes in machine learning and the Beetle in the Box are two limit-cases that define the explanatory boundaries of semantic





# Word2vec

- A group of models based on neural network systems used to produce word embedding
- Word embedding is a process in which semantic structures (words, phrases or similar entities) from a certain vocabulary are mapped to and mathematically modelled as Euclidean vectors of real numbers



# Vectorial distribution

- $\text{vec}(\text{"cat"}) = (0.1, 0.5, 0.9)$   
 $\text{vec}(\text{"wine"}) = (0.6, 0.3, 0.4)$   
 $\text{vec}(\text{"beer"}) = (0.5, 0.3, 0.3)$

0.5 is an alcoholic drink

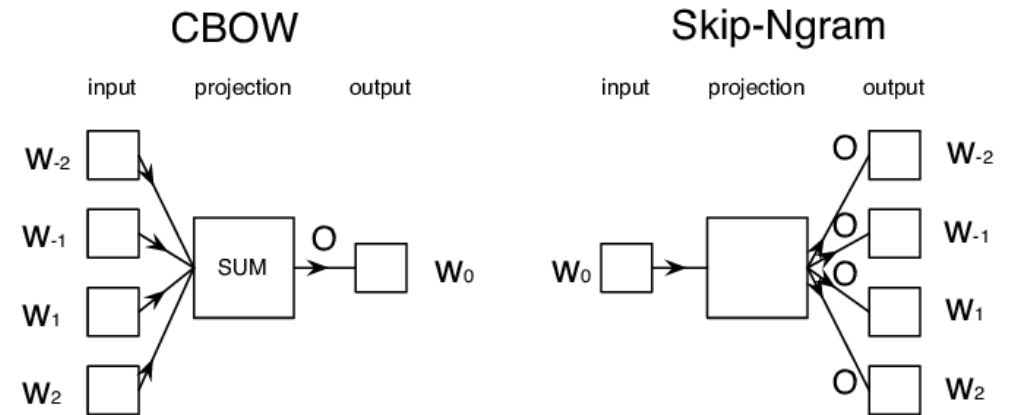
0.6 is an alcoholic drink

0.1 is an alcoholic drink

<b>word</b>	<b>word2vec</b>
apple	apples, pear, fruit berry, pears, strawberry
wood	lumber, timber, softwoods, hardwoods, cedar, birch
bones	skull, femur, skeletons, thighbone, pelvis, molar
glass	hand-blown, glassware, tumbler, Plexiglass, wine-glass, bottle


# The role of context in Word2vec models

- Word2vec can utilize either of two model architectures to produce a distributed representation of words: continuous bag-of-words (CBOW) or continuous skip-gram.
- CBOW: the model predicts the current word from a window of surrounding context words. The order of context words does not influence prediction (bag-of-words assumption).
- Skip-gram: the model uses the current word to predict the surrounding window of context words.



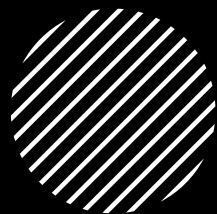


# Wittgensteinian Context

- Transition from TLP via BB to PI
  - BB: language games as primitive forms of language complete in themselves but imagined as evolving in changed circumstances into new and more complex ones.
  - *Satzsystem*: large scale semantic holism embraced – analogy with an axiomatic system
  - *Sprachspiel*: games the meaning of words is inextricably tied to speakers non-linguistic practice - “the whole, consisting of language and actions into which it is woven” (PI, 7)
  - the crucial role of context
- 



# Firth's Context Notion

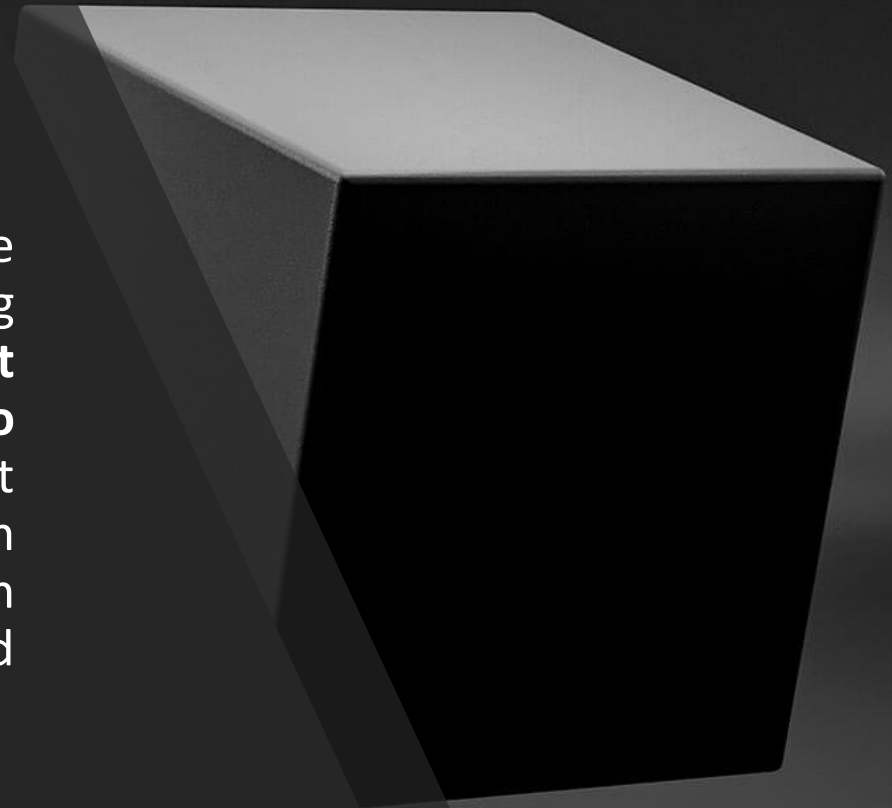


- a complete meaning of a word is always contextual, and no study of meaning apart from context can be taken seriously
- Collocation is “quite simply the mere word accompaniment, the other word-material is which [the word is] most commonly or most characteristically embedded” ([2]: 180).



# Black boxes

- In machine learning, these black box models are created directly from data by an algorithm, meaning that humans, even those who design them, **cannot understand how variables are being combined to make predictions**. Even if one has a list of the input variables, black box predictive models can be such complicated functions of the variables that no human can understand how the variables are jointly related to each other to reach a final prediction.
- (Rudin & Radin, 2019)



# The Beetle in the Box

If I say of myself that it is only from my own case that I know what the word "pain" means - must I not say the same of other people too? And how can I generalize the one case so irresponsibly?

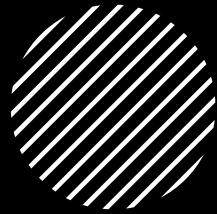
Now someone tells me that he knows what pain is only from his own case! --Suppose everyone had a box with something in it: we call it a "beetle". No one can look into anyone else's box, and everyone says he knows what a beetle is only by looking at his beetle. --Here it would be quite possible for everyone to have something different in his box. One might even imagine such a thing constantly changing. --But suppose the word "beetle" had a use in these people's language? --If so it would not be used as the name of a thing. **The thing in the box has no place in the language-game at all**; not even as a something: for the box might even be empty. --No, one can 'divide through' by the thing in the box; it cancels out, whatever it is.

That is to say: if we construe the grammar of the expression of sensation on the model of 'object and designation' the object drops out of consideration as irrelevant. (PI, 293)





# The publicness of meaning and language games



- The meaning as use is a contextual concept
- Meaning as public and accessible insofar as words are contextualised (in a specific language game)
- According to Skelac and Jandrić “The Wittgensteinian conception of word meaning would be better represented with a function that to every language game (in which the word is used) ascribes the meaning the word has in that particular game: a set of rules governing the use of the word in the game.”



## NPL systems limitations

- In Word2vec, every word is assigned a unique vector which codifies all its collocations and thus represents its meaning. Consequently, if two words are such that there is a context in which one of them cannot be substituted with the other, their Word2vec vectors will, expectedly, be different.
- Cases of synonymy-relative-to-a-context cannot be accounted for in Word2vec, precisely because Word2vec does not operate with the notion of meaning in a particular context, but instead identifies the meaning of a word with a list of contexts (understood as collocations)

# The Beetle in the Black Box


- The Beetle case is a definition of the limit of a language games: the crucial element is the context. Without context, meaning has no use.
- Context has an explanatory role – looking at the context we can understand the words meaning
- Black Boxes limits our ability to understand data processing

# Word2Vec as language game

- Word2Vec as word embedding system is a sophisticated language game some humans created, which cannot satisfy the features open concepts have.
- Xs are all the processes within a Black Box, which seem to behold to the “privacy” of the machine – we cannot understand what is going on there.
- The privacy analogy captures the limitation of “meaning” NPL systems are supposed to catch: Word2Vec as language game lacks all the contextual features of practices and form of life. It is a language game concerning the limit of language game.



# Strong and Weak Priv. language

- Strong: Word2Vec – constrained under wittgensteinian limitations
  - Weak: Vector Symbolic Architecture – can accomplish for the possibility of a weak priv. language
- 



# Use vs Usage

- Word2Vec: representations of usage of a word
- Language game: entailment of words use





Thank you!

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