

# Natural and artificial intelligence; natural and artificial language

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## Presentation

- I have worked in Natural Language Processing since 1985, when I started MSc at Técnico, Lisbon, and was a student of João Pavão Martins, of the first generation of AI in Portugal.
- In 1999 I organized a national session on the Computational Processing of Portuguese for the White Book on R&D in Portugal, and from 1999 to 2010 I was fully dedicated to Linguateca, a resource and evaluation network for Portuguese
- For the last 10 years I have been working at the Faculty of Arts of the University of Oslo, and therefore I will try to bring you a somewhat wider perspective, from philosophy, statistics, medical studies and sociology

My intention in this talk is to call the attention to the issue of values in human language, and to discuss a concrete case (word embeddings) voicing some objections



# A reflection on terminology

*Natural and artificial intelligence, language...*

- In SLATE, there are human languages and computer languages, or better even human-human, human-computer, and computer-computer languages. Interestingly, the only call which mentioned intelligence was CCL (“computer intelligence”).
- However, the term *natural language* is by far the most common when dealing with language, while the most common term of all is obviously *artificial intelligence*
- Curiously, the terms *artificial intelligence* and *natural language* (processing, understanding, etc.) are often considered in a hyponymic pair (being NLP a part of or the hallmark of AI), while *artificial languages* are often just called languages (in the proper context), and *natural intelligence* is only used as a pun. The common concept is human intelligence.

Language is complicated, and evolves. So terms have the irritating property of having a history. They are not defined once and for all.

## What is intelligence?

This is a question for philosophers. I am interested here in how we use the word *intelligence*, and applied to whom. Of course, it depends on the language.

- in English, there is *intelligent* and *clever* and *smart*, *cunny*, ...
- in Portuguese, there is *inteligente* and *esperto* and *sagaz*, *perspicaz*, *astuto*,...

Examples of uses of *intelligent*, not always obvious:

- Another classic example of such parallel communications is the device that we will use as the example in this section, the **intelligent liquid crystal display (LCD) module**. (*Introduction to Mechatronic Design*)
- newspaper parlance: *sistema de semáforos inteligentes*...
- smart phones, smart queries, ... *casas inteligentes*

# Human vs. machine intelligence

English leads us to initially interpret the pair as

- intelligence displayed/owned by humans
- intelligence displayed/owned by computers/machines

But is it the same intelligence? Or are we talking about radically different properties? (as in *human/tropical nature*)



## Some examples

Signs of intelligence? It may depend on who/what does it.

- RoboCup - soccer playing
- Chess or Go playing
- Encyclopaedic answer
- Poetry writing
- Lying to protect other's feelings
- Visually identifying a cancerous cell
- Recognizing people in the street
- Identifying a dialect



# New paradigm: hybrid intelligence

van Harmelen, Frank. "Hybrid Intelligence: AI systems that collaborate with people, instead of replacing them". Keynote at *IC3K 2020*.

- augmenting human intellect and capabilities instead of replacing them
- achieving goals that were unreachable by either humans or machines alone
- AI is unaware of norms and values; reasons; contexts
- Necessary to have explanations, so that decisions can be disputed. Explanations need to be grounded on values, norms, motives, commitments, goals



# Criteria for intelligence

- Learning
- Knowledgeability
- Alternative worlds
- Context awareness

Mimicking a human is different from being a human.



# And language?

- We only talk of **natural language** when we process it with computers, therefore doing AI.
- Humans devise languages (programming languages) for computers (this is called language engineering), with properties very different than those they use in human languages.
- Revisiting my own talk in PROPOR 2006, what characterizes a natural language is
  - 1 Metaphorical nature
  - 2 Context dependency
  - 3 Reference to implicit knowledge
  - 4 Vagueness
  - 5 Dynamic character (evolution and learnability)

I would like to add: 6. it embodies **values**.

# What is human language for?

Heavily inspired by Ellis (1993) and Steiner (1975)

- for humans to understand the world: and thus categorisation
- for humans to do things
- for humans to create a shared community – and to put others outside

(Human) language is power. Human language is human centered.

*There are no diseases in nature. Only the states which have an undesired effect for the goals Man pursues receive this description. (Sedgwick, 1973)*

# What is language for?

- Knowledge representation
- Communication:
  - to do things with others: collaboration
  - to inform or to disinform others

# Values in programming languages?

Kent Pitman: What Programming Language Design Taught Me About Life, abstract of keynote at SLATE'18

*I came to see languages as much more complex entities than mere functional behavior or stylized syntax. Languages are about community and shared values – and not just the kinds of values that get returned from a function call. The choices a language designer makes will attract certain users and alienate others*

# Computers understanding human language? understanding humans?

Jang Graat: How Humans Succeed While Failing to Communicate, abstract of keynote at SLATE'20

*The task of making a computer understand human communication therefore seems to be the hardest thing to do.*

Maybe we should communicate differently/other things with computers?

## Valuation and evaluation

- To give value is something absolutely human: good and bad do not exist in nature or reality.
- In order to evaluate, you have to compare with something else. Usually, human judgement.
- However, not all judgements are consensual. Ethical paradoxes, different legal opinions, etc.
- Delfim Santos: culture is a ranking of values.

Human language always includes values, human values.

# Word embeddings

Let us now consider a specific technology which has come to dominate NLP in the last years: word embeddings, a form of representing context based on co-occurrence. Based on machine learning over big text collections (the crowd) – see Santos (2021) for looking critically at size.

- Several criticisms have been voiced: unpredictable, unstable, crowd-dependent, human-ununderstandable, climate-unfriendly, corporation-owned (Mihalcea, 2021)
- Use of word embeddings is like *atirar o barro à parede*
- Not taking different languages seriously

How do you evaluate static word embeddings?

- intrinsic: analogies, distance, clustering
- extrinsic: performance in real tasks, like NER, QA, classification, generation

# Underlying assumption

- One learns a lot from large collections of text
- Quantity leads to quality
- From the statistical observation by Galton that the median estimate of a group can be more accurate than estimates of experts, the so-called “wisdom of the crowd”.

But not all crowds!

- What is the meaning of Norwegian *bjørnetjeneste*?
- What is the name of the eldest daughter of Lúcio Lara?

What matters is not how many answer, but the knowledge of who answers. Lorenz et al. (2011) show that social pressure undermines the effect of the wisdom of the crowd.

*Although groups are initially “wise,” knowledge about estimates of others narrows the diversity of opinions to such an extent that it undermines the wisdom of crowd effect in three different ways.*

- *The “social influence effect” diminishes the diversity of the crowd without improvements of its collective error.*
- *The “range reduction effect” moves the position of the truth to peripheral regions of the range of estimates so that the crowd becomes less reliable in providing expertise for external observers.*
- *The “confidence effect” boosts individuals’ confidence after convergence of their estimates despite lack of improved accuracy.*

## How social influence can undermine the wisdom of crowd effect

Jan Lorenz<sup>a,1,2</sup>, Heiko Rauhut<sup>b,1,2</sup>, Frank Schweitzer<sup>a</sup>, and Dirk Helbing<sup>b,c,d</sup>

## Static word embeddings on *inteligência*

300 dimensions, obtained on 1.5 billion words, Linguateca corpora:

- word2vec, words: intuição (0.68), imaginação, sabedoria, criatividade, sagacidade, habilidade, perspicácia, astúcia, intelecto, destreza (0.57)
- glove, lemmas: senso (0.85), habilidade, mente, criatividade, experiência, talento, certo, capaz, imaginação, excelência (0.76)
- fasttext, lemmas and mwes: ininteligência (0.95), contra-inteligência, desinteligência, Inteligência, inteligência-do-cinema, inteligibilidade, inteligXancia, deligência, inteligencia, inteligência (0.85)

300 columns, obtained on 2 billion words, common crawl:

- fasttext, words: inteligencia (0.77), Inteligência, ainteligência, perspicácia, inteligência.A, deinteligência, intelecto, contra-inteligência, intelegência, super-inteligência (0.62)

## Static word embeddings on *inteligência*– contd

300 columns, obtained on ca. 1 billion words, NILC:

- word2vec: inteligencia (0.68), inteligências, astúcia, imint, criptológica, engenhosidade, laboriosidade, sagacidade, intuição, imaginação (0.54)
- glove: habilidade (0.54), intuição, criatividade, força, sabedoria, senso, sensibilidade, imaginação, capacidade, talento (0.44)
- fasttext: inteligênciaX (0.96), geointeligência, super-inteligência, contra-inteligência, desinteligência, ciberinteligência, foto-inteligência, contrainteligência, superinteligência, deligência (0.88)

300 columns, obtained on ca. 1 billion words, NLX:

- word2vec: criatividade (0.71), intuição, imaginação, sagacidade, perspicácia, argúcia, sensibilidade, destreza, lucidez, inventividade (0.66)

## Static word embeddings on *inteligência*– contd

Using a literary corpus with only 50 million words, dealing with words:

- word2vec: ciência (0.57), compreensão, capacidade, penetração, perspicácia, espírito, instrução, intelectual, sensibilidade, concepção (0.47)
- glove: ciência (0.59), sensibilidade, compreensão, espírito, energia, humana, imaginação, capacidade, superior, experiência (0.48)
- fasttext: ininteligência (0.97), desinteligência, Inteligência, intelligência, deligência, inteligências, vigência, desinteligências, consCiência, consciência (0.83)

Using the same corpus but just lemmas

- word2vec: espírito (0.62), intelectual, talento, inteligente, 'pírito, ciência, capacidade, compreensão, aptidão, faculdade (0.50)
- glove: espírito (0.60), talento, 'pírito, entendimento, capacidade, conhecimento, ciência, compreensão, prático, bastante (0.46)
- fasttext: ininteligência (0.96), desinteligência, intelligência, deligência, intelecto, intelectualidade, inteligente, intelectualivo, vigência, intransigência (0.78)

# What is the crowd?

		Size in words	without numbers			
	nilc	929,606	910,215			
	nlx	873,910	752,001			
	pt-lkb	202,001	201,877			
	cc	2,000,000	1,665,247			
	base	1,052,405	984,226			
	lemas	1,613,937	1,374,196			
	nilc	nlx	pt-lkb	cc	todosbase	todoslemas
nilc	-	296,157	75,285	380,252	<b>536,720</b>	158,813
nlx	296,157	-	58,716	<b>596,091</b>	231,931	304,249
pt-lkb	75,286	58,726	-	70,217	<b>75,311</b>	65,900
cc	380,252	<b>596,091</b>	70,217	-	365,048	456,284
base	<b>536,720</b>	233,795	75,301	281,097	-	314,314
lemas	158,813	304,249	65,900	<b>390,415</b>	281,097	-

Who should answer?

- Should one use the crowd, that is, a lot of different people who wrote different texts in different contexts and take the average?

# Who should answer?

- Or: Texts about a particular subject should be used when one is interested in that particular subject?

## LETTER

<https://doi.org/10.1038/s41586-019-1335-8>

Recorte Retangular

### Unsupervised word embeddings capture latent knowledge from materials science literature

Vahe Tshitoyan<sup>1,3\*</sup>, John Dagdelen<sup>1,2</sup>, Leigh Weston<sup>1</sup>, Alexander Dunn<sup>1,2</sup>, Ziqin Rong<sup>1</sup>, Olga Kononova<sup>2</sup>, Kristin A. Persson<sup>1,2</sup>, Gerbrand Ceder<sup>1,2\*</sup> & Anubhav Jain<sup>1\*</sup>

*models trained on the set of all Wikipedia articles (about ten times more text than our corpus) perform substantially worse on materials science analogies. Contrary to what might seem like the conventional machine learning mantra, throwing more data at the problem is not always the solution. Instead, the quality and domain-specificity of the corpus determine the utility of the embeddings for domain-specific tasks.*

But aren't we confusing language knowledge with world knowledge?

Domain vs. general knowledge!

# The question of different languages

Materials for evaluating word embeddings in Portuguese:

- a set of analogies translated from English!
  - only measuring what is common between the two languages
  - bringing concepts that are more important in English than in Portuguese to the fore: American states, queens, ...
  - even committing errors/translationese
- a set of pairs from semantic domains coming from Portuguese lexical ontologies: TALES (Gonçalo Oliveira et al., 2020)
  - preference by number of different ontologies a specific relation occurs in: *entries were selected, first, according to their presence in several lexical resources for Portuguese,*

## Concluding

- Values are essential in human language, which is human-centered.
- Human language and human intelligence do not need to be transferred to machines: cooperation and mutual understanding should be enough.
- To transfer to English all communication instead of allowing many different cultures to think and act is a big mistake (cultural epistemicide, Boaventura Sousa Santos, 2014).



Thank you!

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