



پردازش زبان طبیعی چرا و چگونه؟

علی مرتضوی

امیراحمد حبیبی



SHRDLU



Terry Winograd

The M.I.T. Artificial Intelligence Lab
1968-70

The BLOCKS world



Person: Pick up a big red block.

Computer: OK.

Person: Grasp the pyramid.

Computer: I DON'T

UNDERSTAND WHICH
PYRAMID YOU MEAN.



Terry Winograd M.I.T. Artificial Intelligence Lab 1968-70



Michael Jordan

University of California, Berkeley



Michael Jordan

National Basketball Association



Learning to Communicate

2017

- با استفاده از Reinforcement Learning
- یک جهان ساده
- توانایی ارتباط عامل ها با یکدیگر
- هدف قابل دستیابی با استفاده از این ارتباط ها



Learning to Communicate

2017



Grounded Language



Grounded Language VS Inferred Language



پیش نیاز سطوح بررسی زبان شناسی

۱. دستور زبان Syntax

۲. معناشناسی Semantics

۳. کاربرد شناسی Pragmatics



پیش نیاز پیچیدگی در Pragmatics

- ابهام
- کنایه
- عدم اطمینان
- معنی‌های مختلف برای کلمه
- ...

رویکردها

نسبت به پردازش زبان طبیعی

۱. براساس توزیع احتمال
۲. براساس چارچوب
۳. براساس نظریه مدل‌ها
۴. براساس یادگیری تعاملی



Percy Liang

Stanford Artificial Intelligence Lab



۱. رویکرد توزیع احتمالی

- یادگیری ماشین
- یادگیری عمیق
- در مقیاس بزرگ





۱. رویکرد توزیع احتمالی

پیشفرض یادگیری

“To be successful, a machine learner needs bias/assumptions; for NLP, that might be linguistic theory/representations.”



Noah Smith

CS, University of Washington



Percy Liang

Stanford Artificial Intelligence Lab

۱. رویکرد توزیع احتمالی

برخی عملیات قابل انجام

- تشخیص اجزاء جمله Part of speech tagging
- تشخیص وابستگی ها Dependency parsing
- تشخیص شباهت های معنایی Semantic relatedness



facebook

```
> read_story('lotr');  
Bilbo travelled to the cave  
Gollum dropped the ring there  
Bilbo took the ring  
Bilbo went back to the Shire  
Bilbo left the ring there  
Frodo got the ring  
Frodo journeyed to Mount-Doom  
Frodo dropped the ring there  
Sauron died  
Frodo went back to the Shire  
Bilbo travelled to the Grey-Havens  
The end  
  
> answer('where is the ring ?');  
where is the ring ?  
- Frodo dropped the ring there  
- Frodo journeyed to Mount-Doom  
Mount-Doom
```

۱. رویکرد توزیع احتمالی سیستم‌های پرسش و پاسخ ساده



۲. رویکرد برپایه چارچوب

"A **frame** is a data-structure for representing a stereotyped situation"



Marvin Minsky

M.I.T. AI Lab, Memo 306, June, 1974



Percy Liang

Stanford Artificial Intelligence Lab

۲. رویکرد برپایه چارچوب

نمونه چارچوب یک تبادل اقتصادی

Commercial transaction

SELLER : *Cynthia*

BUYER : *Bob*

GOODS : *the bike*

PRICE : *\$200*

Input: *Cynthia sold the bike to Bob for \$200*

Output: SELLER **PREDICATE** GOODS BUYER PRICE





۳. رویکرد برپایه نظریه مدل ها

- Model Theory
- Compositionality



۳. رویکرد برپایه نظریه مدل ها

What is the largest city in Europe by population?



semantic parsing

$\text{argmax}(\text{Cities} \cap \text{ContainedBy}(\text{Europe}), \text{Population})$



execute

Istanbul





عمق

در برابر

وسعت



۴. رویکرد برپایه یادگیری تعاملی

زبان یک بازی تعاملی
بین گوینده و شنونده است.



Paul Grice

Philosopher of language



Percy Liang

Stanford Artificial Intelligence Lab



۴. رویکرد برپایه یادگیری تعاملی

SHRDLN

The screenshot shows the SHRDLU environment interface. On the left, a 'start' state is shown with a row of five colored blocks (red, orange, blue, brown, red) and a 'goal' state with a row of four colored blocks (red, orange, blue, red). A checkmark icon is visible between the start and goal states. On the right, a progress list shows the following items:

- 1 basics (0/5)
- 2 babysteps (0/10)
- 3 patterns (0/10)
- 4 notbaby (0/10)
- 5 stacks (0/10)
- 6 house (0/1)
- 7 triangle (0/1)

Below the progress list, keyboard shortcuts are listed:

- ↵: enter
- ✓: shift-enter
- ⌘: ctrl-z
- ↓: next try
- ↑: previous try

The current penalty is 0.0 bits. A red link 'reset ALL progress' is visible. At the bottom, a status message says 'No command, type one!' and a text input field contains 'remove brown block'. Below the input field are five icons: a left arrow, a refresh/circular arrow, a down arrow, an up arrow, and a checkmark.





نمونه‌هایی از کاربردهای جدید

Analogy task

Queen to King is like Woman to ____ .



Tomas Mikolov

Researcher at Facebook

Linguistic Regularities in Continuous
Space Word Representations 2013

مثال

رابطه Einstein با scientist مثل:

۱. Messi با ...

۲. Mozart با ...

۳. Picasso با ...



Tomas Mikolov Researcher at Facebook

Efficient estimation of word representations in vector space 2013

مثال

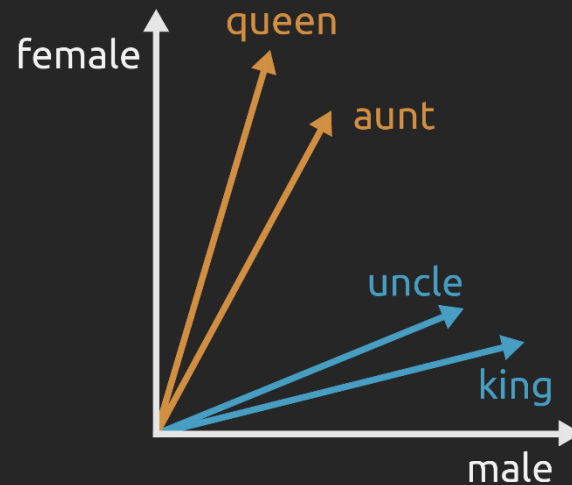
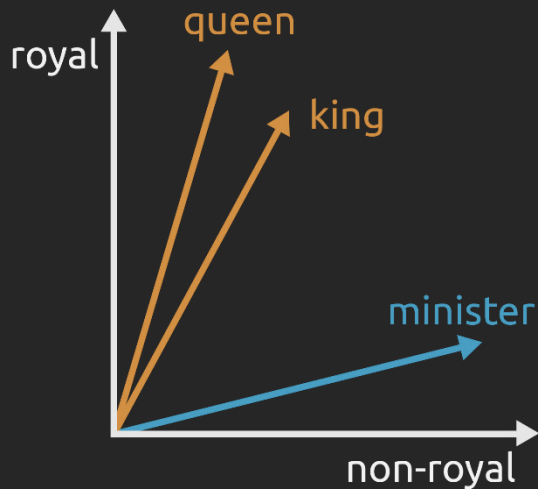
Relationship	Example 1	Example 2	Example 3
France - Paris	Italy: Rome	Japan: Tokyo	Florida: Tallahassee
big - bigger	small: larger	cold: colder	quick: quicker
Miami - Florida	Baltimore: Maryland	Dallas: Texas	Kona: Hawaii
Einstein - scientist	Messi: midfielder	Mozart: violinist	Picasso: painter
Sarkozy - France	Berlusconi: Italy	Merkel: Germany	Koizumi: Japan
copper - Cu	zinc: Zn	gold: Au	uranium: plutonium
Berlusconi - Silvio	Sarkozy: Nicolas	Putin: Medvedev	Obama: Barack
Microsoft - Windows	Google: Android	IBM: Linux	Apple: iPhone
Microsoft - Ballmer	Google: Yahoo	IBM: McNealy	Apple: Jobs
Japan - sushi	Germany: bratwurst	France: tapas	USA: pizza



Tomas Mikolov Researcher at Facebook

Efficient estimation of word representations in vector space 2013

فضای معنایی

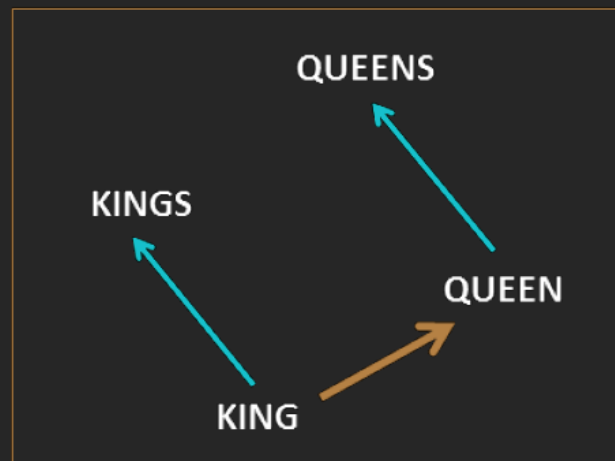
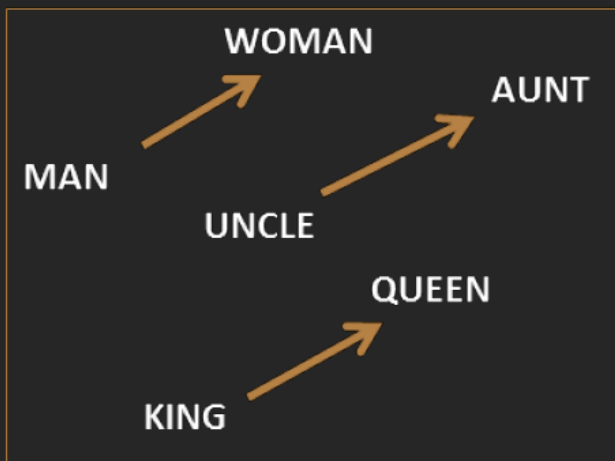


Tomas Mikolov Researcher at Facebook

Linguistic Regularities in Continuous Space Word Representations 2013

بردار معنایی کلمات

king – man + woman = queen



Tomas Mikolov Researcher at Facebook

Linguistic Regularities in Continuous Space Word Representations 2013

اشتباهات در شباهت معنایی

Relationship	Example 1	Example 2	Example 3
France - Paris	Italy: Rome	Japan: Tokyo	Florida: Tallahassee
big - bigger	small: larger	cold: colder	quick: quicker
Miami - Florida	Baltimore: Maryland	Dallas: Texas	Kona: Hawaii
Einstein - scientist	Messi: midfielder	Mozart: violinist	Picasso: painter
Sarkozy - France	Berlusconi: Italy	Merkel: Germany	Koizumi: Japan
copper - Cu	zinc: Zn	gold: Au	uranium: plutonium
Berlusconi - Silvio	Sarkozy: Nicolas	Putin: Medvedev	Obama: Barack
Microsoft - Windows	Google: Android	IBM: Linux	Apple: iPhone
Microsoft - Ballmer	Google: Yahoo	IBM: McNealy	Apple: Jobs
Japan - sushi	Germany: bratwurst	France: tapas	USA: pizza



Tomas Mikolov Researcher at Facebook

Linguistic Regularities in Continuous Space Word Representations 2013



اشتباهات در شباهت معنایی

cherish

(words)

adore
love
admire
embrace
rejoice

(contexts)

cherish
both
love
pride
thy

quasi-synonyms

tiger

(words)

leopard
dhole
warthog
rhinoceros
lion

(contexts)

tiger
leopard
panthera
woods
puma

co-hyponyms

good

(words)

bad
decent
excellent
lousy
nice

(contexts)

faith
natured
luck
riddance
both

includes antonyms



تولید زبان طبیعی

NLG

The New York Times

1) "A shallow magnitude 4.7 earthquake was reported Monday morning five miles from Westwood, California, according to the U.S. Geological Survey. The temblor occurred at 6:25 a.m. Pacific time at a depth of 5.0 miles."

روبات

2) "Apple's holiday earnings for 2014 were record shattering. The company earned an \$18 billion profit on \$74.6 billion in revenue. That profit was more than any company had ever earned in history."

انسان

“There is a kind of industry in Computational Cognitive Science and Computer Science trying to show that you can get a significant knowledge of language by statistical analysis of text. That’s extremely unlikely to succeed.”



Noam Chomsky

The father of modern linguistics
M.I.T



زبان هم برای شعر هم برای ریاضیات



لینک‌های مرتبط

- <http://www.marekrei.com/blog/linguistic-regularities-word-representations/>
- <http://www.marekrei.com/blog/dont-count-predict/>
- https://scholar.google.com/citations?view_op=view_citation&hl=en&user=oBu8kMMAAAJ&citation_for_view=oBu8kMMAAAJ:UeHWp8X0CEIC
- https://scholar.google.com/citations?view_op=view_citation&hl=en&user=oBu8kMMAAAJ&citation_for_view=oBu8kMMAAAJ:Zph67rFs4hoC
- <http://spectrum.ieee.org/robotics/artificial-intelligence/machinelearning-maestro-michael-jordan-on-the-delusions-of-big-data-and-other-huge-engineering-efforts>
- <http://www.topbots.com/4-different-approaches-natural-language-processing-understanding/>
- <https://www.youtube.com/watch?v=EjoywQq4V44>
- <http://hci.stanford.edu/winograd/shrdlu/name.html>
- <https://blog.openai.com/learning-to-communicate/>
- <https://www.media.mit.edu/projects/grounded-language-learning-and-understanding/overview/>
- <https://arxiv.org/abs/1503.08895>
- <https://newsroom.fb.com/news/2015/03/f8-day-two-2015/>
- <http://web.media.mit.edu/~minsky/papers/Frames/frames.html>
- <https://narrativescience.com/>
- https://www.nytimes.com/interactive/2015/03/08/opinion/sunday/algorithm-human-quiz.html?mcubz=0&_r=0

