

Filling the Gap: Decoding of Word Embeddings for Generation of Coherent New Words

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M2 — Software Project



- 1 Reminder
- 2 State of the project
- 3 Results
- 4 Software

Reminder of our aim

- Regression task based on transfer

$$A : B :: C : X \xrightarrow{X=?} A : B :: C : D$$

e.g. dog : dogs :: chat : X \rightarrow chats

- Input: A and B in language 1, C in language 2
- Output: D in language 2
- Same transformation for A, B and C, D

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Since the last time ...

- ❶ Run the experiments again
 - ▶ More runs
 - ▶ Typo in our code: two regression models now
- ❷ Improve our software
- ❸ Write the report

Analogy solver model

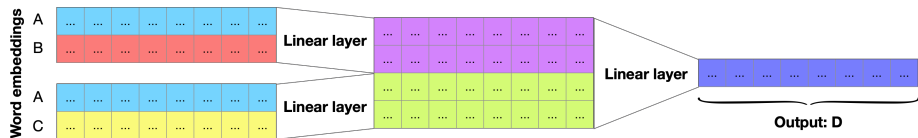


Figure: Analogy solver model

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Regression model

Language	ANNr (previous) (mean \pm std.)	old model (mean \pm std.)	new model (mean \pm std.)
Arabic	77.97 \pm 16.03	59.14 \pm 1.76	61.13 \pm 0.83
Finnish	37.78 \pm 9.28	76.61 \pm 1.15	76.46 \pm 1.58
Georgian	94.66 \pm 1.13	85.51 \pm 2.00	84.67 \pm 2.78
German	86.38 \pm 0.45	89.26 \pm 0.51	88.70 \pm 0.58
Hungarian	53.83 \pm 3.12	78.49 \pm 0.65	78.72 \pm 0.53
Maltese	75.00 \pm 5.08	77.37 \pm 2.27	78.04 \pm 1.44
Navajo	31.74 \pm 0.90	46.14 \pm 0.54	45.74 \pm 0.99
Russian	75.15 \pm 0.44	72.51 \pm 0.46	72.23 \pm 0.44
Spanish	86.27 \pm 0.71	91.18 \pm 0.51	91.72 \pm 0.43
Turkish	61.95 \pm 10.86	80.37 \pm 0.82	80.37 \pm 1.00
Japanese	61.60 \pm 1.33	74.75 \pm 1.33	72.58 \pm 2.47

Table: Accuracy (in %) of 10 runs of the regression models (3 runs for previous results).

Omnilingual model

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	61.85±1.79	3.22±1.73	28.58±2.69	/	55.23±3.85
German	3.15±1.47	64.38±1.27	66.91±4.49	62.07±3.58	/
Hungarian	36.26±4.52	55.25±1.47	73.33±1.31	78.36±1.33	32.00±3.03
Spanish	/	61.16±2.54	74.05±1.77	69.38±1.65	70.67±4.03
Turkish	54.12±1.48	/	25.38±3.94	65.72±6.09	52.23±1.09

Table: Accuracy (in %) of 10 runs of the new omnilingual regression model

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	60.95±1.75	3.34±1.16	30.34±2.02	/	53.82±2.74
German	3.05±1.43	63.78±0.88	60.99±4.86	62.65±3.47	/
Hungarian	35.06±4.49	56.35±1.96	71.69±1.84	70.61±7.90	27.10±3.17
Spanish	/	61.90±2.42	67.32±5.05	67.90±1.97	66.12±6.86
Turkish	54.00±2.41	/	24.19±2.21	64.94±5.61	50.39±1.64

Table: Accuracy (in %) of 10 runs of the old omnilingual regression model

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Last time

Source language: Hungarian Target language: Hungarian Bilingual analogies?

Generate an example What is a valid example?

How is an analogy solved? Get closest result Shuffle the words Does the order matter?

Figure: Preview of our previous software

No answer given

DANNa

[About Us](#) [Our app](#) [More about analogies](#) [More about morphology](#)

Didactics for Analogies and Neural Networks

This website shows you several features of analogies. You can click on ⓘ to get more information.
 Click on *Generate an example* to get a valid example, you can then solve it manually or see what our neural network proposes with *Get closest result*.
 Eventually, *Get the right answer* will give you the right answer if yours was wrong.

ⓘ Source language:

Spanish

Target language:

German

Advanced options ▼

Generate an example ⓘ

Spanish to German: Verb, present tense

olvidar

:

olvidando

::

kremieren

:

ⓘ Get closest result

Get the right answer

Shuffle the words ⓘ

Please write an answer.

Figure: Preview of our software

Valid analogy

The screenshot shows the DANNa website interface. At the top, the title "DANNa" is displayed in a large, white, serif font. Below it, a navigation bar contains links: "About Us", "Our app", "More about analogies", and "More about morphology". The main content area has a dark gray header with the title "Didactics for Analogies and Neural Networks" in white. Below this, a paragraph explains the website's features: "This website shows you several features of analogies. You can click on ⓘ to get more information. Click on *Generate an example* to get a valid example, you can then solve it manually or see what our neural network proposes with *Get closest result*. Eventually, *Get the right answer* will give you the right answer if yours was wrong."

The interface includes a form for generating word analogies. It has two dropdown menus for "Source language" (set to "Spanish") and "Target language" (set to "German"), with an "Advanced options" dropdown to the right. A "Generate an example" button is centered below these. Below the button, the text "Spanish to German: Verb, non-finite" is displayed. The analogy itself is shown as: "sobreestimar : sobreestimar :: sehen : sehen". The word "sehen" is highlighted in a green box. At the bottom, there are three buttons: "Get closest result", "Get the right answer", and "Shuffle the words". Each button has a small ⓘ icon to its left.

Figure: Preview of our software

Invalid analogy

DANNa

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Didactics for Analogies and Neural Networks

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 Click on *Generate an example* to get a valid example, you can then solve it manually or see what our neural network proposes with *Get closest result*.
 Eventually, *Get the right answer* will give you the right answer if yours was wrong.

ⓘ Source language: Hungarian
Target language: Turkish
Advanced options ▼

Generate an example ⓘ

Hungarian to Turkish: Noun, nominative case, plural

vánkös
:
vánkösök
::
silindir
:
sionisteista

ⓘ Get closest result
Get the right answer
Shuffle the words ⓘ

This result is not the expected one (silindirler).

Figure: Preview of our software

شكرا جزيلا

Thank you

Merci

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Obrigado

Monolingual VS Bilingual (old)

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	/	42.06±2.82	80.13±1.37	/	81.53±1.57
German	94.51±0.60	/	71.94±2.84	71.94±2.84	/
Hungarian	42.99±4.69	84.22±3.33	/	84.22±3.33	40.75±1.89
Spanish	/	93.75±0.38	93.75±0.38	/	96.40±0.42
Turkish	67.43±1.06	/	73.61±0.77	95.17±1.12	/

Table: Accuracy (in %) of 10 runs of the old regression model

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	/	83.24±0.35	35.58±0.74	/	28.14±1.14
German	80.13±0.57	/	30.14±0.29	12.92±6.03	/
Hungarian	51.21±3.09	78.09±0.74	/	94.05±0.12	34.55±0.60
Spanish	/	36.79±11.74	79.11±0.63	/	41.83±0.85
Turkish	47.23±0.91	/	15.29±0.85	70.79±0.06	/

Table: Accuracy (in %) of 5 runs of the old bilingual regression models

Monolingual VS Bilingual (new)

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	/	39.75±2.67	80.33±1.95	/	79.89±2.43
German	94.26±0.63	/	70.55±2.61	70.55±2.61	/
Hungarian	43.93±3.44	85.39±1.76	/	85.39±1.76	40.98±3.42
Spanish	/	94.26±0.53	94.26±0.53	/	95.83±0.24
Turkish	64.98±2.76	/	70.74±2.23	94.03±3.70	/

Table: Accuracy (in %) of 10 runs of the new regression model

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	/	66.01±33.01	36.28±0.76	/	28.34±0.48
German	64.43±32.23	/	30.53±0.57	11.92±3.30	/
Hungarian	50.61±2.26	77.98±1.24	/	94.02±0.29	33.89±0.77
Spanish	/	32.42±17.01	78.99±0.13	/	40.45±1.52
Turkish	46.43±1.24	/	16.07±0.90	70.86±0.04	/

Table: Accuracy (in %) of 5 runs of the new bilingual regression models

Bilingual

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	/	66.01±33.01	36.28±0.76	/	28.34±0.48
German	64.43±32.23	/	30.53±0.57	11.92±3.30	/
Hungarian	50.61±2.26	77.98±1.24	/	94.02±0.29	33.89±0.77
Spanish	/	32.42±17.01	78.99±0.13	/	40.45±1.52
Turkish	46.43±1.24	/	16.07±0.90	70.86±0.04	/

Table: Accuracy (in %) of 5 runs of the new bilingual regression models

	Finnish	German	Hungarian	Spanish	Turkish
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Spanish	/	36.79±11.74	79.11±0.63	/	41.83±0.85
Turkish	47.23±0.91	/	15.29±0.85	70.79±0.06	/

Table: Accuracy (in %) of 5 runs of the old bilingual regression models

Omnilingual model: Full dataset vs Bilingual features only

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	61.85±1.79	3.22±1.73	28.58±2.69	/	55.23±3.85
German	3.15±1.47	64.38±1.27	66.91±4.49	62.07±3.58	/
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Spanish	/	61.16±2.54	74.05±1.77	69.38±1.65	70.67±4.03
Turkish	54.12±1.48	/	25.38±3.94	65.72±6.09	52.23±1.09

Table: Accuracy (in %) of 10 runs of the new omnilingual regression model trained on the full dataset

	Finnish	German	Hungarian	Spanish	Turkish
Finnish	52.41±1.35	24.79±1.89	38.22±2.26	/	48.81±1.33
German	18.40±4.44	31.24±1.25	79.08±1.85	55.48±1.09	/
Hungarian	64.11±2.06	68.52±1.10	10.56±0.37	79.29±1.81	41.26±2.96
Spanish	/	51.27±1.50	80.04±1.64	28.91±0.65	74.57±5.75
Turkish	59.89±1.54	/	26.52±2.69	83.49±2.41	21.86±1.04

Table: Accuracy (in %) of 10 runs of the new omnilingual regression model trained only on the bilingual features

Analogy solver model

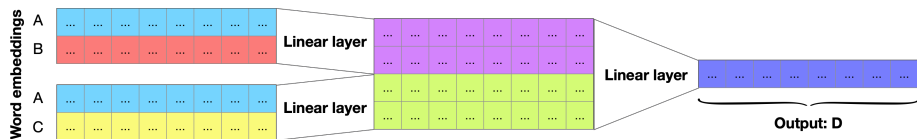


Figure: Analogy solver model