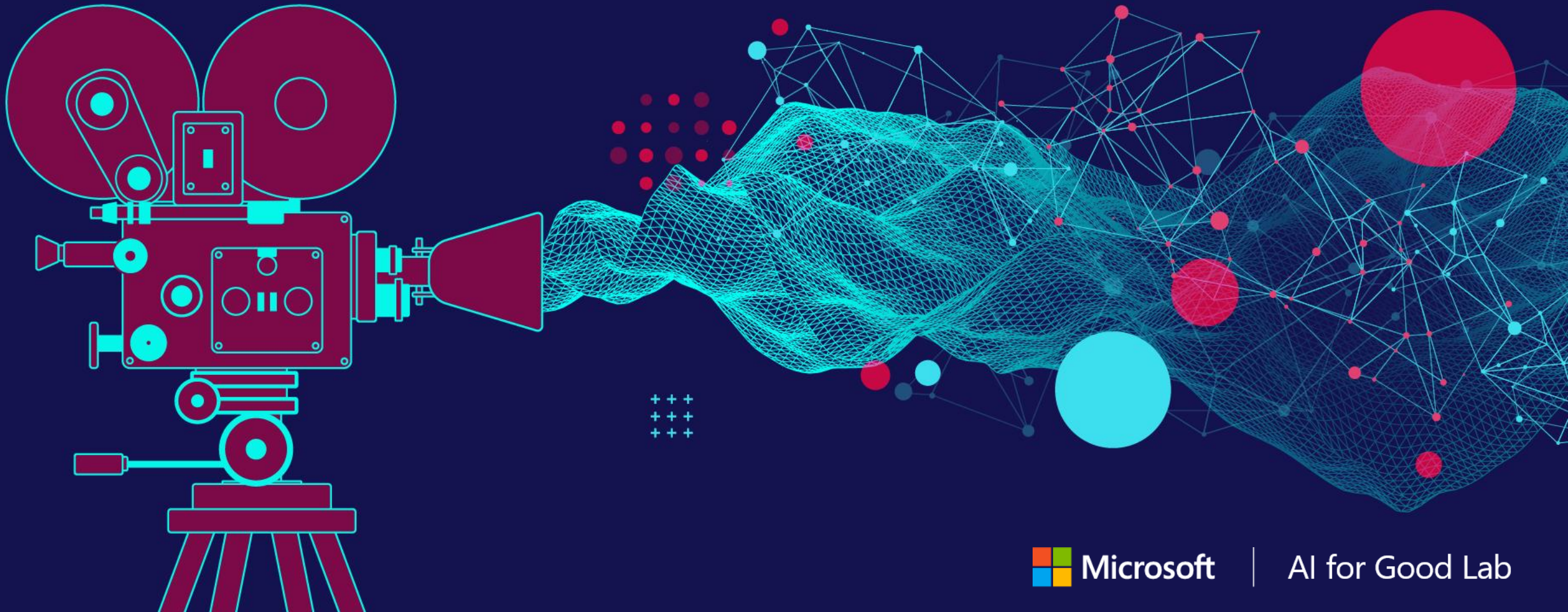


SCIENCE — AND A — MOVIE

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ARRIVAL





Most scientists have stories that inspired
them to “get into science.”
Mine is Contact (1997)

Arrival is careful about science



Learning VERY foreign languages



Arrival's language is composed of logograms



human

ship grounded

The team making the movie wanted to use the same science real scientists would use if the events happened in 2016

Real code was written to analyze the language



<https://github.com/WolframResearch/Arrival-Movie-Live-Coding>

The background of the image is a blurred library with wooden bookshelves filled with books. In the foreground, a stack of several books is shown, with the top one open. Floating around the open book and the text are various white-outlined mathematical symbols and icons, including plus signs, minus signs, multiplication signs, division signs, percentages, question marks, infinity symbols, and some more complex symbols like Σ and γ .

How AI learns a language

We train models by obfuscating words

Heartburn is a ■ sensation felt behind the breastbone

NASA contracted for fifteen Saturn V ■ to achieve its goal

Richard III, the final ruler of the Plantagenet dynasty, was ■
on 22 August 1485 in the Battle of Bosworth Field

*The collection of examples is called the **corpus***

Training updates weights and embeddings

1. The (very large) **model** updates its weights when it receives feedback

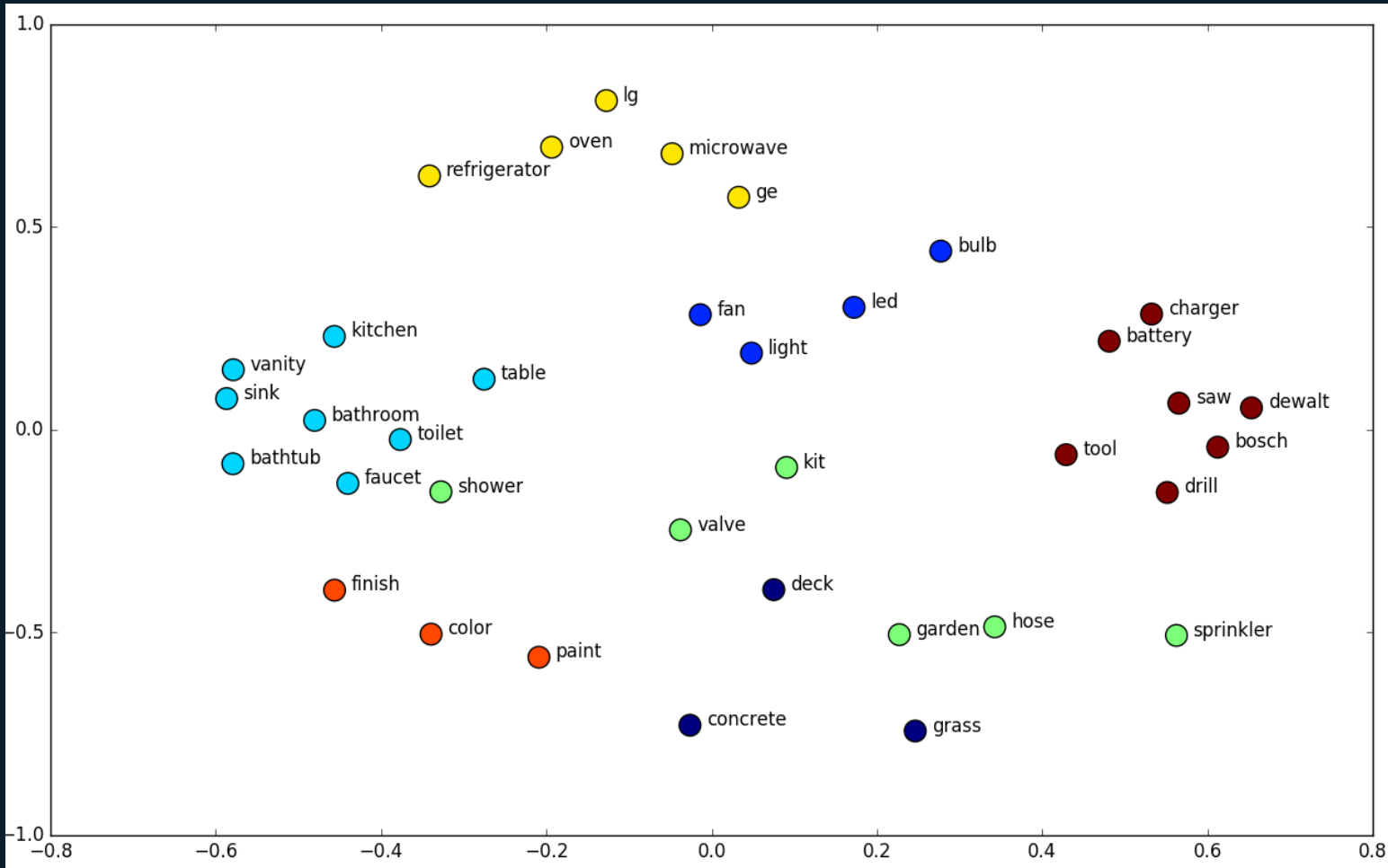
- Common multi-word expressions
- Terms that start and end phrases
- Statistical associations about facts

These statistical associations are not the same as understanding

2. Term representations called **embeddings** are updated as the model learns

- Words closer in meaning are represented closer together

A 2D representation of embeddings



Words seen closer in meaning in the **corpus** will appear closer together in the embedding space

Once trained, AI generation uses randomization

The best thing about AI is its ability to ■

Nearby embeddings	Distances (as probabilities)
learn	4.5%
predict	3.5%
create	3.2%
understand	3.1%
generate	2.9%



When AI models generate text, they don't **always** choose the first option — otherwise the output would be boring

AI for Good models for low-resource languages

AI models currently underperform in several Global South language, especially in Africa. Some of these languages have millions of speakers.

The AI for Good Lab is helping collect data for these languages, create new models and improve existing models.

[AI for Good Lab to improve LLMs for underrepresented languages](#)

Challenge: Arrival's language is semasiographic

It conveys meaning without using words representing sound.

*We communicate with semasiographic languages a lot these days:
emojis 😊, traffic signals 🛑, memes...*



Language ↔ Culture

“What is your purpose on Earth?”

“The Sanskrit word for war and its translation”

Gavisti: “a quest for more cows”

गविष्टिः go (cow) + ishti (quest)

In Sanskrit texts, several conflicts are literally described as “quests for cows,” which requires cultural context for understanding.

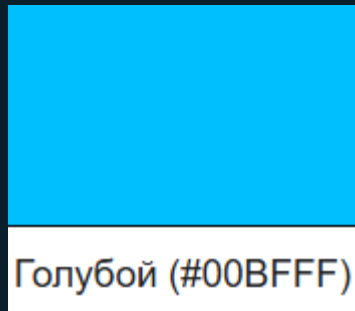
The Sapir-Whorf hypothesis

Strong version (Linguistic Determinism): Language **determines** thought. If you don't have words or structures in your language for a concept, you literally can't think that concept.

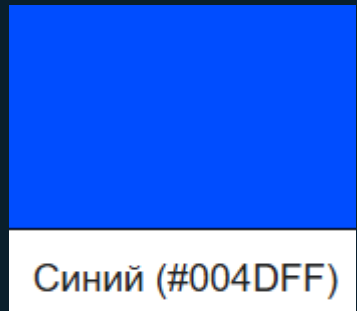
Easy counter-examples: ***schadenfreude (German), saudade (Pt-Br)***

Weak version (Linguistic Relativity): Language **influences** or affects thought and perception but doesn't strictly determine it. Speakers of different languages interpret the world differently because of differences in their languages.

Russian Blues



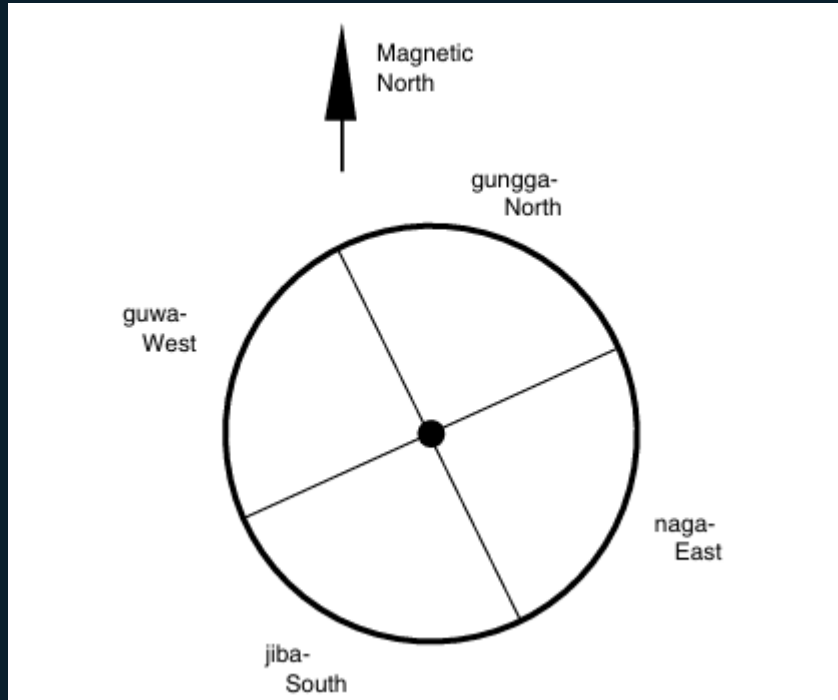
goluboy



siniy

Russian speakers are better at differentiating shades of blue than speakers of languages that don't have two different words for blue.

Guugu Yimithirr



“There’s a spider on your southwest leg”

Speakers are better at wayfinding.

Gendered nouns



English-speaking girl suffering in a French exam because she forgot the gender of "baguette"

Speakers of languages that have gendered nouns tend to describe objects with characteristics often associated with genders:

"A strong (male) bridge"

"A graceful (female) bridge"

Cultural impact on AI learning

Vegetative electron microscopy

which established that the coats contained substrate for the lytic enzyme present in spores. Peptide was also released from spore coats of *B. megaterium* by the action of the enzyme from *B. cereus* spores. The lytic enzyme did not attack intact resting spores.

The spore develops in the vegetative cell, which thus becomes a sporangium. It is by no means certain what happens to the vegetative cell wall when the spore is released. In *Clostridium* species it appears that at least part of this structure is retained as an outer membrane around the spore. It is the opinion of some workers that the wall of the sporulating cell forms the exosporium which exists as an outer to allow release of the spore. It appears likely that the exosporium of *B. cereus* does not have a composition similar to that of the vegetative cell wall, from the results obtained by Dr. J. R. Norris of Leeds University (*personal communication*). He treated spores with a highly active preparation of lytic enzyme from *B. cereus* spores and examined the effect by means of electron microscopy. No evidence of lysis of the exosporium was obtained.

It was not known whether the enzyme present in spores, or another enzyme, was responsible for lysis of the sporangial wall during spore release. When thick suspensions of washed sporulating cells of *B. cereus* were incubated in buffer

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... The authors would like to change "**vegetative electron microscopy**" to "scanning electron microscopy" and "extracellular cells" to "extracellular membrane". A correction has been made ...

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Does AI understand things?

ChatGPT 4o ▾

A dog was in a car accident. It was brought to an operating table. When the doctor saw the patient, it said: "I can't operate on him! It's my son!" What's the gender of the doctor?

The doctor is the boy's mother.

This riddle plays on a common implicit gender bias—the assumption that a doctor must be male. Many people are momentarily confused because they overlook the possibility that the doctor could be the child's mother, revealing how societal stereotypes can subtly influence our thinking.

Does AI understand things?

ChatGPT o4-mini ▾

Temporary Chat ⓘ

Two doors, one leads to heaven, the other leads to hell. Each is guarded. One guard can only tell the **truth**, the other can only tell the **truth**. You're allowed just one question. What question do you ask?

Thought for a couple of seconds >

You point to one of the doors (say, Door A) and ask either guard:

“If I were to ask the *other* guard which door leads to heaven, which door would he point to?”

Then you **choose the opposite door to the one they indicate.**

My takeaway: culture and language are intertwined, and we should be careful with the cultural content of the training we give to AI models.

What are your takeaways?

More AI for Good Lab:

[AI For Good Lab - Microsoft Research](#)

Thank you!

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