How AI Cured Coronavirus and Delivered Universal Translation, and Other MT Myths and Magic

Martin Benjamin

18 November 2020 Translating and the Computer

ASLING TC42 online

Keynote Address

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kamusi is Swahili for *dictionary*

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Goal: A complete matrix of human expression across time and space

- As a knowledge resource
- As a data resource
- As a basis for any-to-any translation

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In service since 1994 - originally at **Yale Council on African Studies**
International NGO since 2009

- Registered non-profit in 🇺🇸 and 🇨🇭

Academic Home since 2013:
EPFL - Swiss Federal Institute of Technology in Lausanne
First at **LSIR** - Distributed Systems Information Laboratory
Now at the **Swiss EdTech Collider**

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White House Big Data Initiative (2013):

Launch Partner for Building the Data Innovation Ecosystem

Networking and Information Technology R&D Program

Office of Science and Technology Policy

ACALAN (Intergovernmental language agency for 55 member states of the African Union):

Platform for African Language Empowerment development partner

AFRICAN UNION

AFRICAN ACADEMY OF LANGUAGES

Artificial Intelligence (AI) & Machine Translation (MT) on the Road toward Universal Translation

1. AI facts and fantasies
2. Myths about AI and MT
3. Realistic fantasies about computation and translation

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Chapter 1: AI Facts and Fantasies

1. What is AI?
2. AI and COVID-19
3. AI and the weather
4. AI and online dating
5. AI and language

AI Facts and Fantasies: What is Artificial Intelligence?

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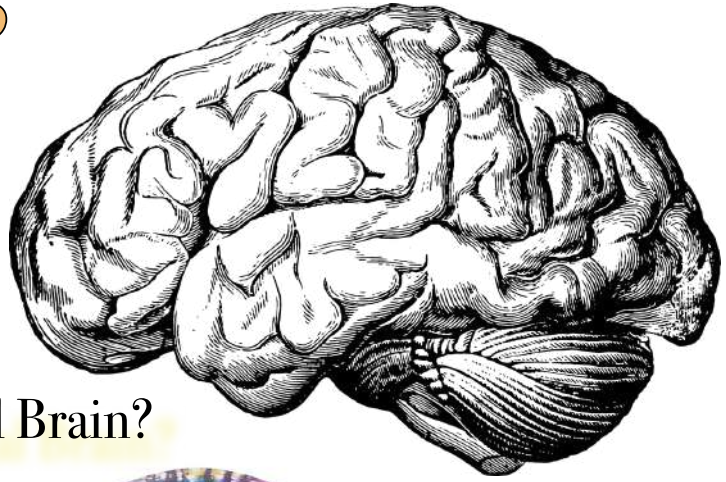
AI Facts and Fantasies: What is AI?

Artificial Muscle?



Artificial Brain?

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AI Facts and Fantasies: What is Artificial Intelligence?

Artificial Muscle

- Brute force calculations
- Faster than a human
- Instructed by a human

Example:

Calculate π to a million digits

3.14159265358979323846264338327950288419716939937510582097494459
23078164062862089986280348253421170679821480865132823066470938 4
46095505822317253594081284811174502841027019385211055596446229 4
89549303819644288109756659334461284756482337867831652712019091 4
56485669234603486104543266482133936072602491412737245870066063 1
55881748815209209628292540917153643678925903600113305305488204 6
65213841469519415116094330572703657595919530921861173819326117 9
31051185480744623799627495673518857527248912279381830119491298 3
36733624406566430860213949463952247371907021798609437027705392 1
71762931767523846748184676694051320005681271452635608277857713 4
27577896091736371787214684409012249534301465495853710507922796 8
92589235420199561121290219608640344181598136297747713099605187 0
72113499999983729780499510597317328160963185950244594553469083 0
26425223082533446850352619311881710100031378387528865875332083 8
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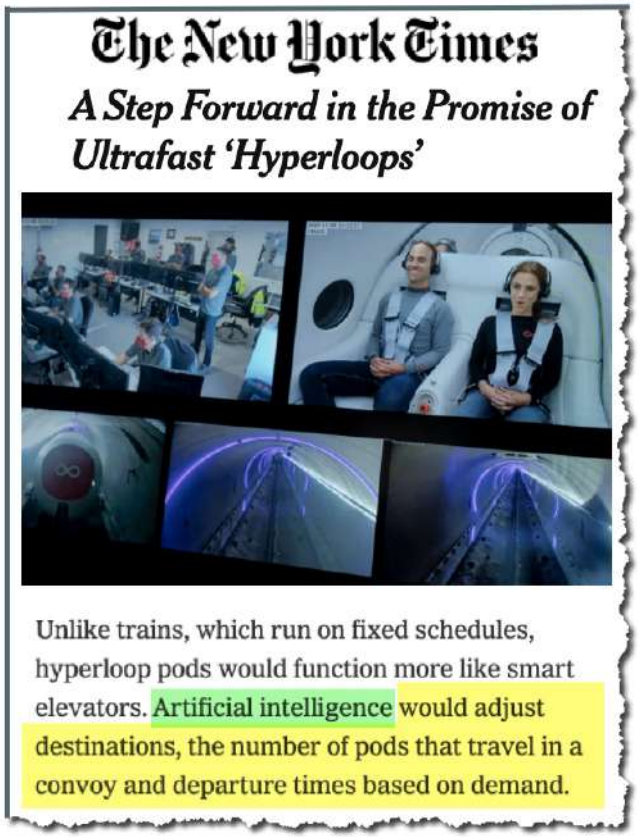
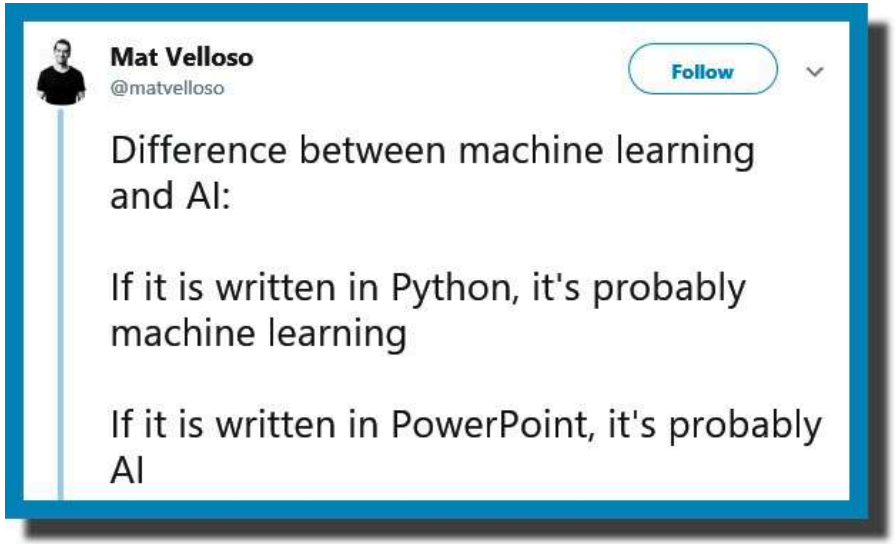
AI Facts and Fantasies: What is AI?



The New York Times

A Step Forward in the Promise of Ultrafast 'Hyperloops'

Unlike trains, which run on fixed schedules, hyperloop pods would function more like smart elevators. Artificial intelligence would adjust destinations, the number of pods that travel in a convoy and departure times based on demand.



Mat Velloso
@matvelloso
Follow

Difference between machine learning and AI:

If it is written in Python, it's probably machine learning

If it is written in PowerPoint, it's probably AI

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AI Facts and Fantasies: COVID-19

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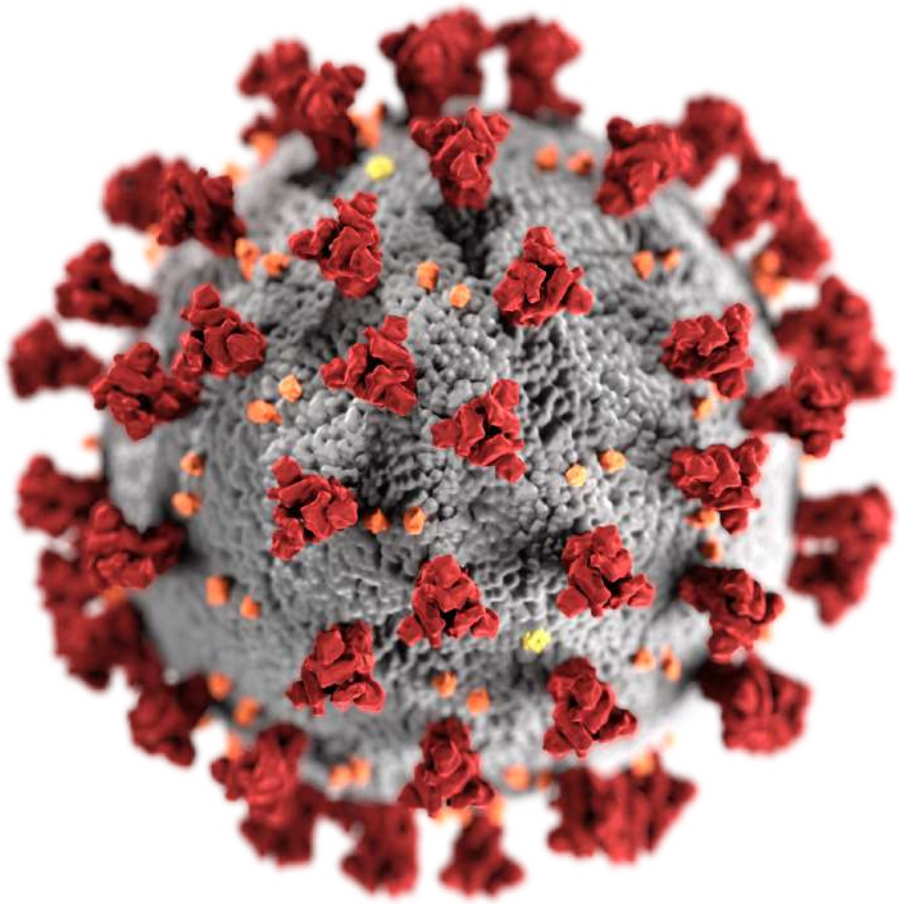
AI Facts and Fantasies: COVID-19

- SPOILER: AI has not cured COVID-19
- What has AI done for COVID-19?



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AI Facts and Fantasies: COVID-19

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A Supercomputer Analyzed Covid-19 — and an Interesting New Theory Has Emerged

A closer look at the Bradykinin hypothesis

Artificial-intelligence tools aim to tame the coronavirus literature

Developers hope that tools for processing natural language will help biomedical researchers and clinicians to find the COVID-19 papers that they need.

Using AI to fast and effectively diagnose COVID-19 in hospitals

The European Commission will invest in the use of Artificial Intelligence to speed up the diagnosis of COVID-19 and improve future treatment of patients. A software developed to assist the work of medical staff by analysing images of pulmonary infections is introduced in 10 hospitals across Europe.

Artificial intelligence model detects asymptomatic Covid-19 infections through cellphone-recorded coughs

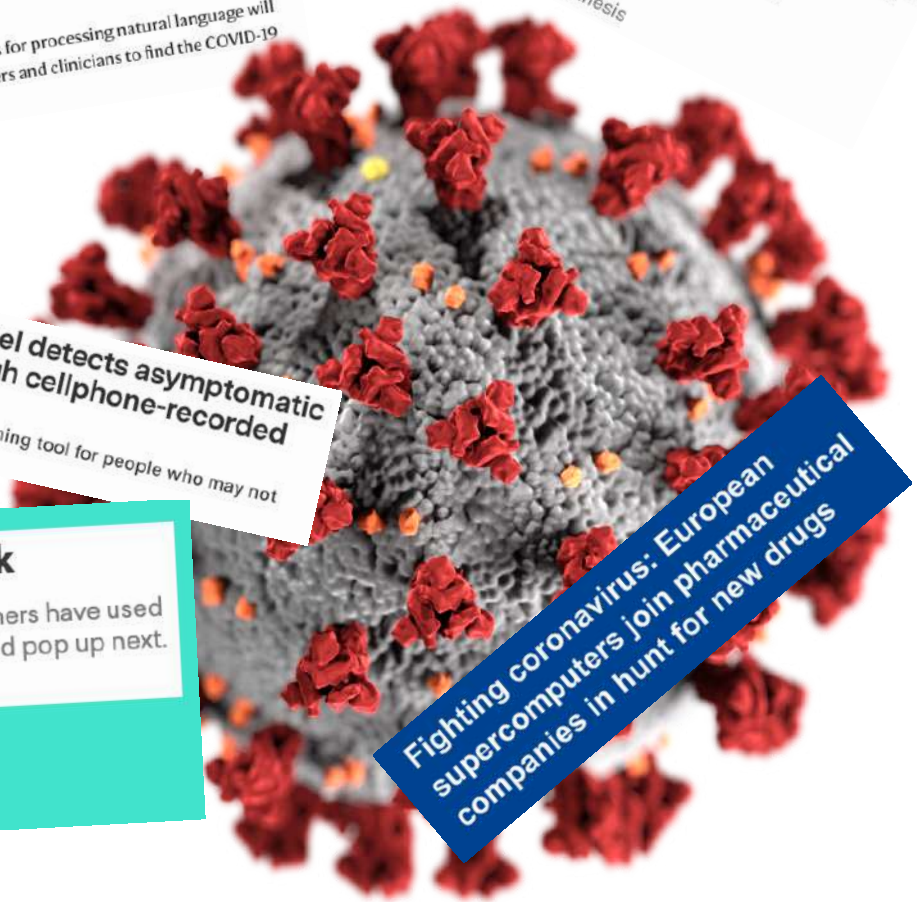
Results might provide a convenient screening tool for people who may not suspect they are infected.

How AI is battling the coronavirus outbreak

AI helped spot an early warning about the outbreak, and researchers have used flight traveler data to figure out where the novel coronavirus could pop up next.

By Rebecca Heilweil | Jan 28, 2020, 1:50pm EST

28 JANUARY, 2020



Fighting coronavirus: European supercomputers join pharmaceutical companies in hunt for new drugs

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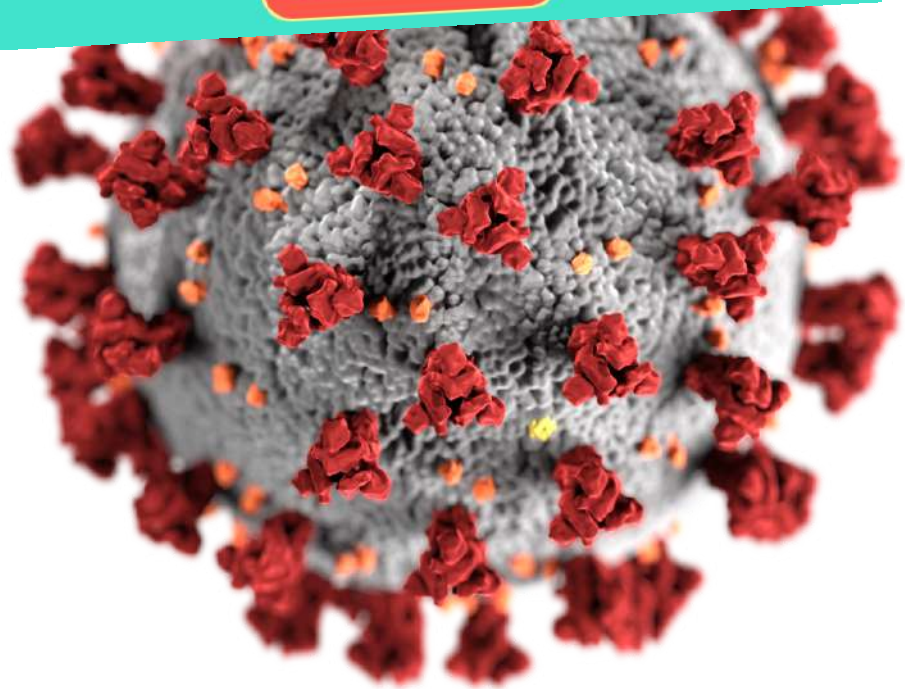

"In other words, our new AI overlords might actually help us survive the next plague."

- Using NLP to track 100,000 articles about 100 diseases in 65 languages
- Travel itineraries and flight paths
- Researching new drugs
- Detecting disease

Vox: https://www.vox.com/recode/2020/1/28/21110902/artificial-intelligence-ai-coronavirus-wuhan

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AI Facts and Fantasies: The Weather

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AI Facts and Fantasies: The Weather

Data to analyze for many locations:

• Temperature • Humidity • Pressure • Windspeed • Wind direction
• Cloud cover • etc

Patterns to discover:

- Does the flap of a butterfly's wings in Brazil set off a tornado in Texas? (Edward Lorenz)
- The relationship between certain parameters in Place A, and subsequent weather in Place B

New Paths:

- If certain parameters are changed in a model for Place A, what are the anticipated outcomes in Place B?

Machine Learning:

- Do future weather events occur as anticipated in the model?

- Analyzes data
- Discovers patterns
- Follows new paths based on those patterns

Machine Learning *if*

- a desired outcome is achieved (eg, win a game)

AI Facts and Fantasies: Online Dating

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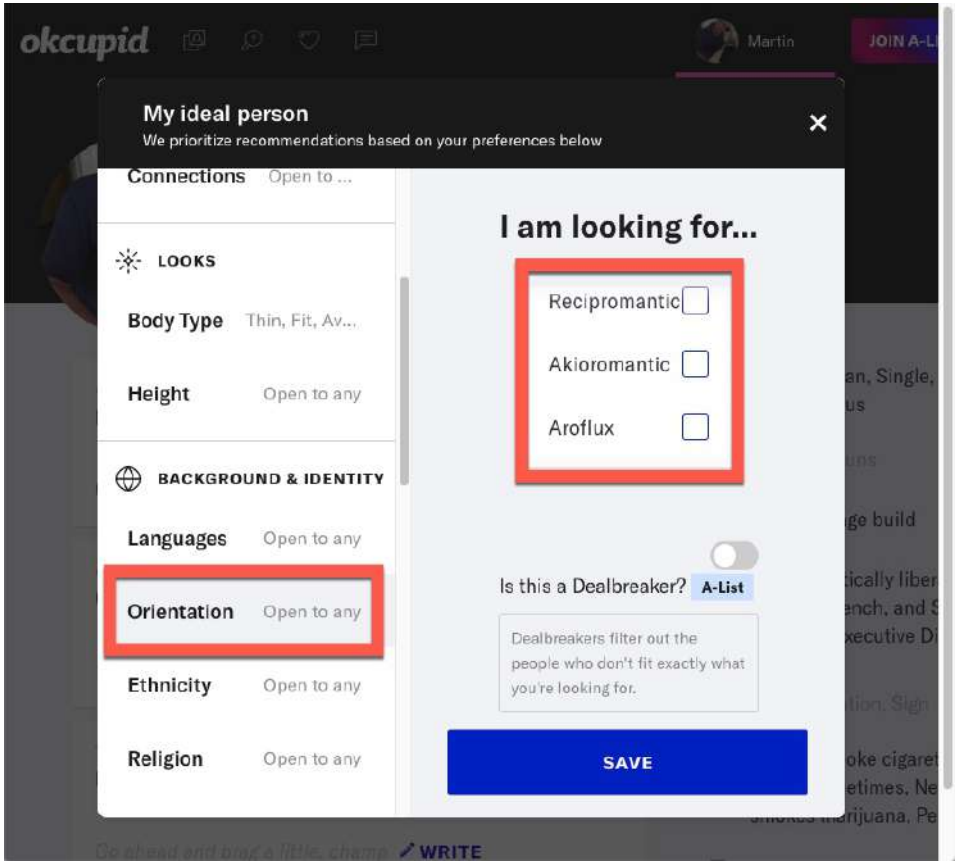
AI Facts and Fantasies: Online Dating

Case Study: OkCupid



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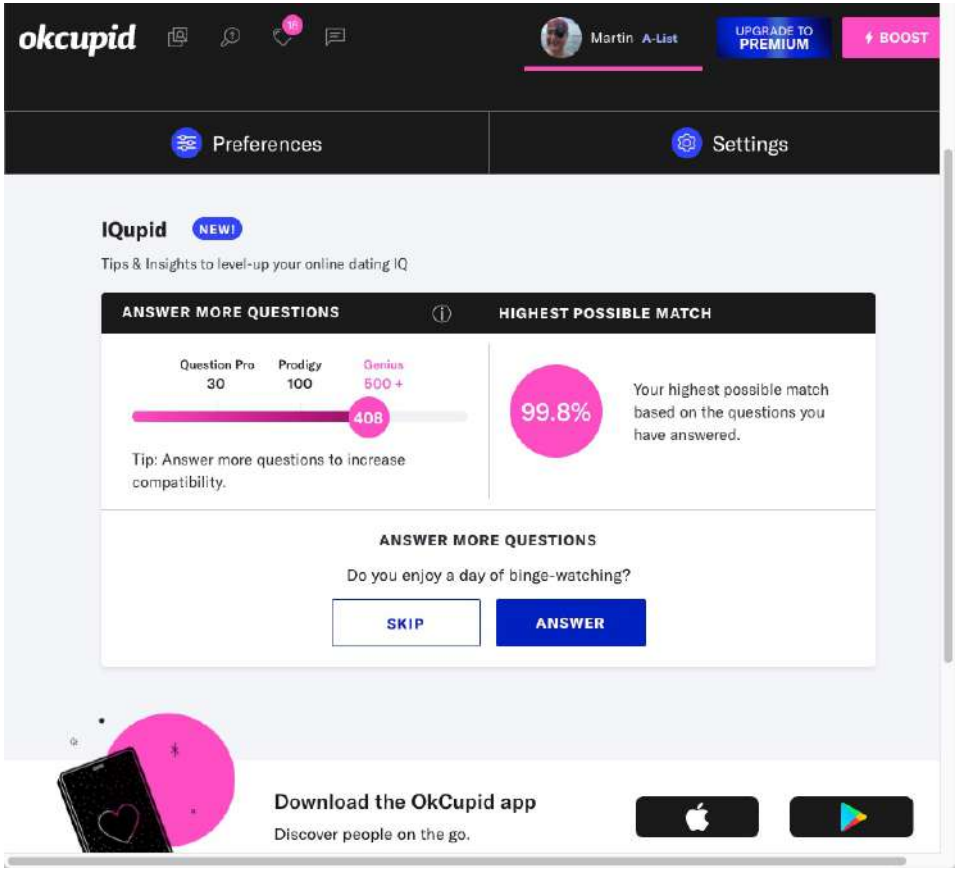

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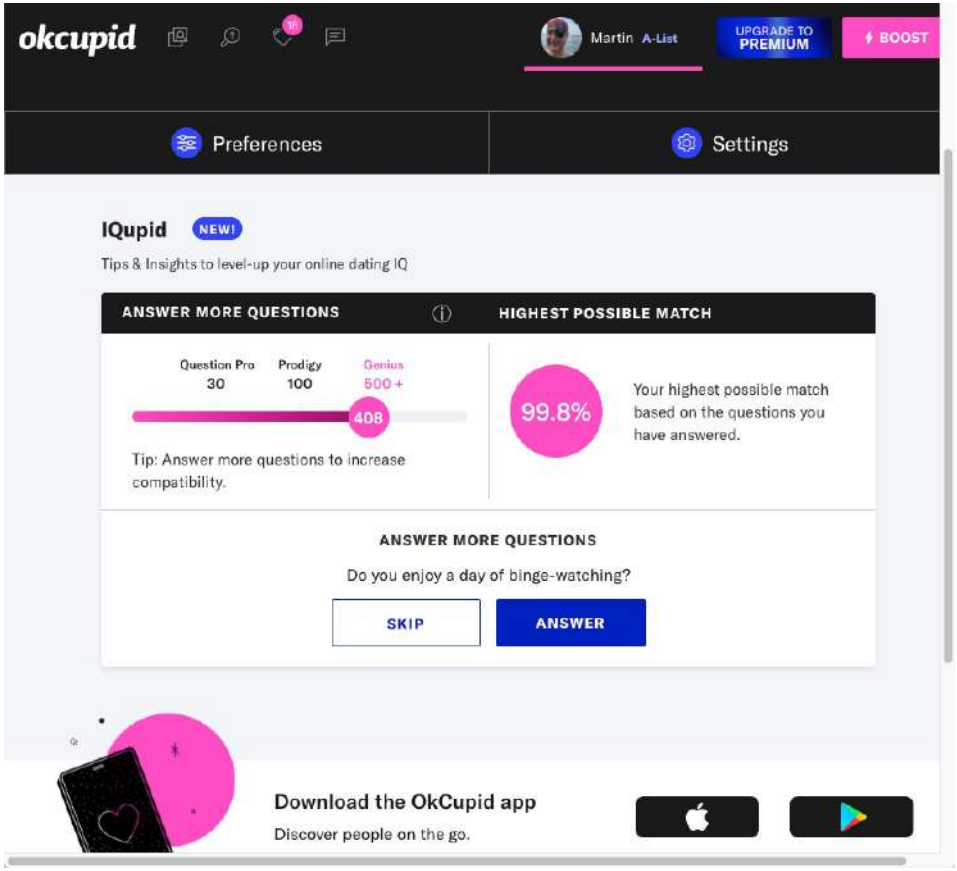

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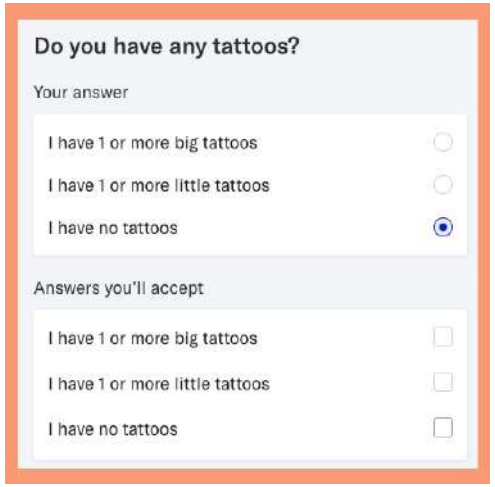

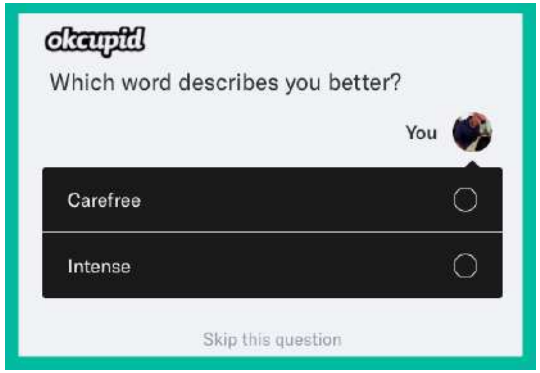

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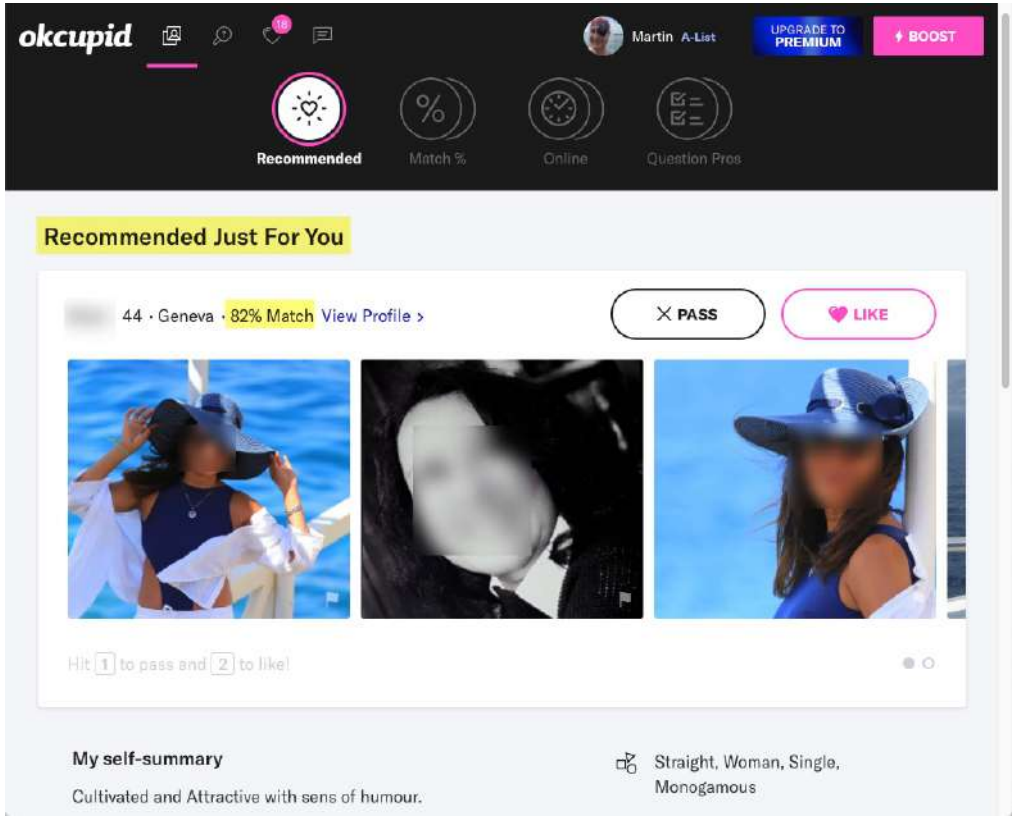

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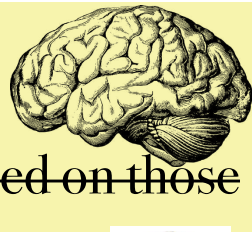

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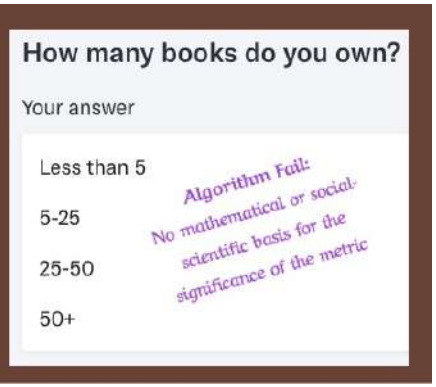
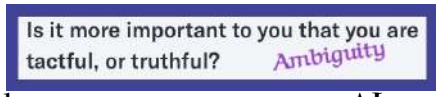
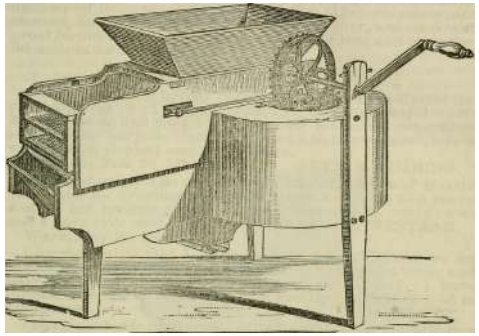
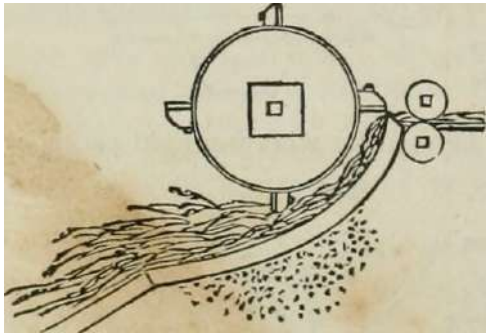


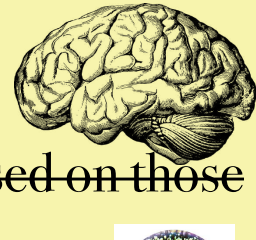
- Arbitrary metrics – questions have equal weight, but unequal (and unmeasurable) significance. (Eg, "Is pizza a top 5 food?" = "Would you date a single parent?")
- Ambiguity



- Machine is discovering equal answers, not patterns – AI would analyze the similarities among people one "likes" to find unseen preferences
- All data, no chemistry – and no way to predict or evaluate chemistry
- No outcome for a machine learning opportunity is either proposed or evaluated: • mutual "likes? • a chat? • a date? • a relationship? • marriage? • kids?







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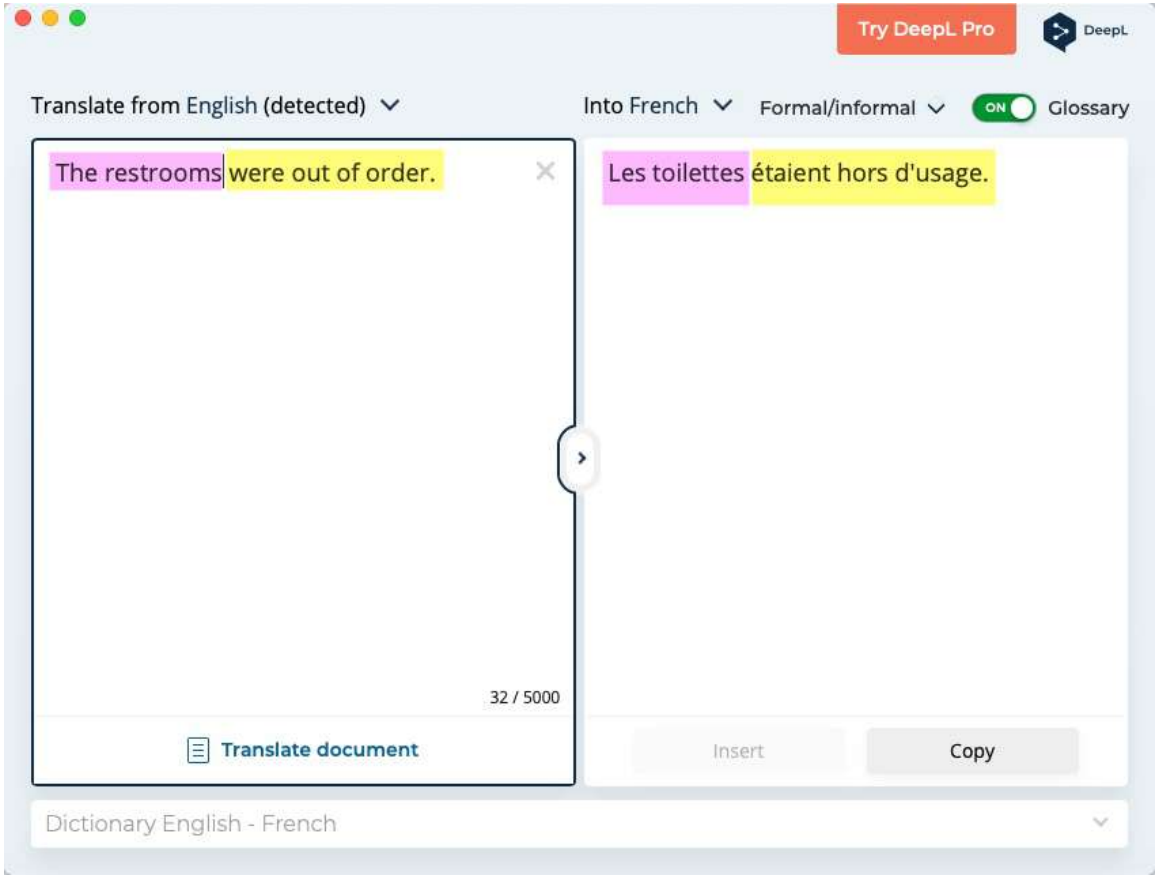
AI Facts and Fantasies: Language

Case Study: DeepL



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-- or --

- a human confirms the outcome (eg, that photo is indeed a cat)

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AI Facts and Fantasies: Language

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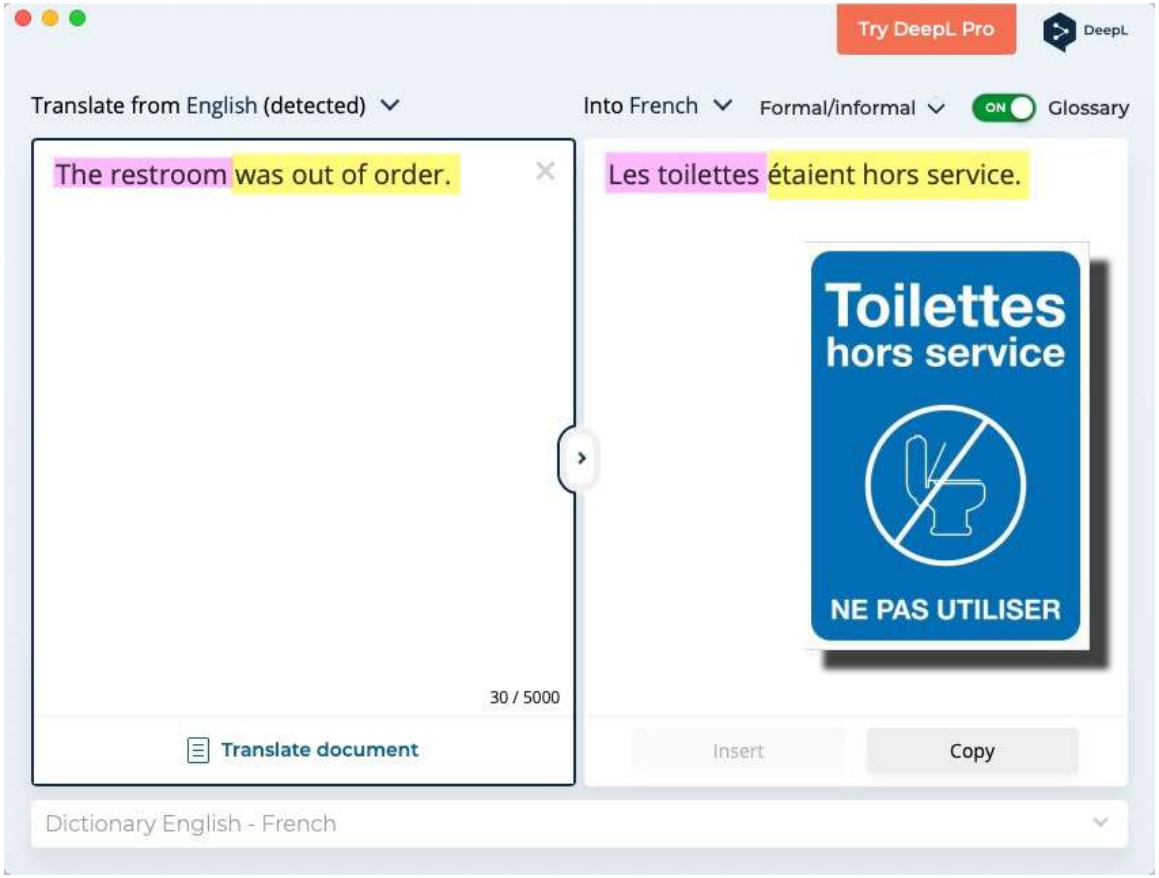

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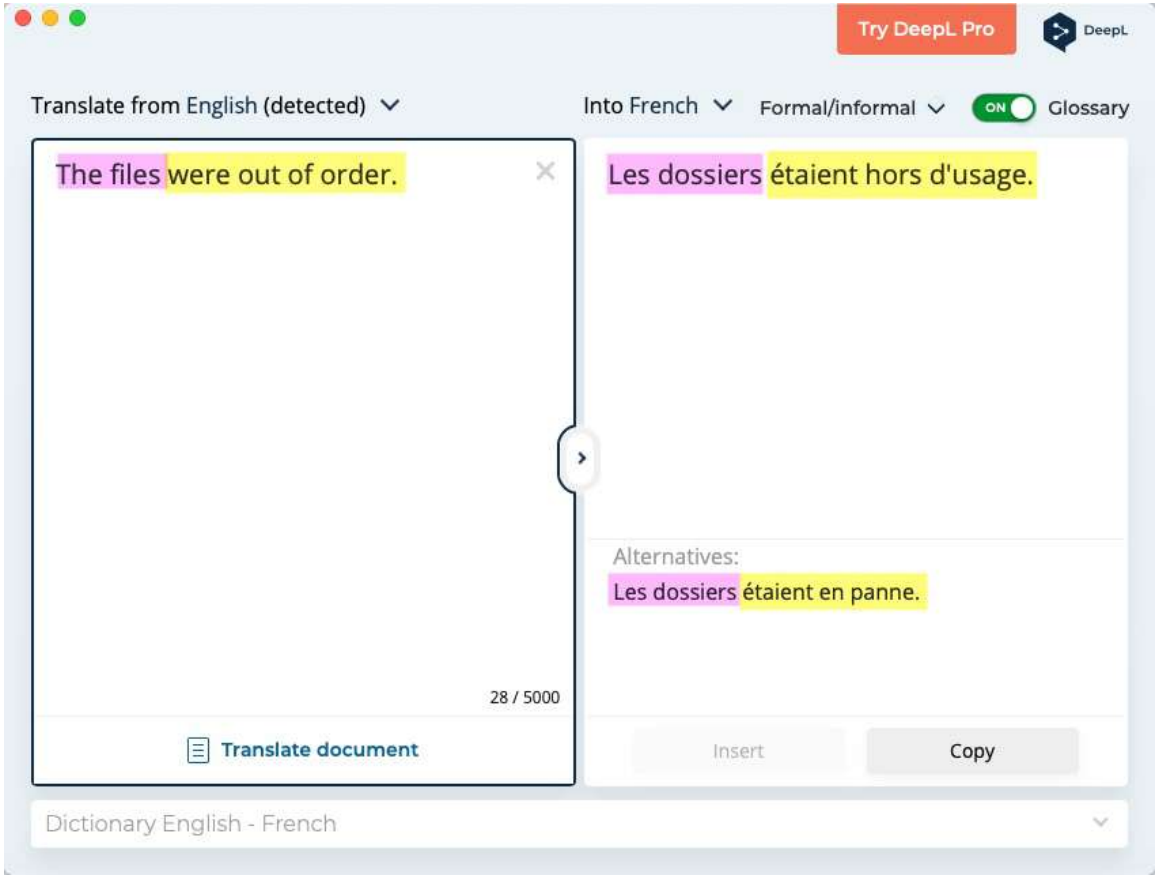

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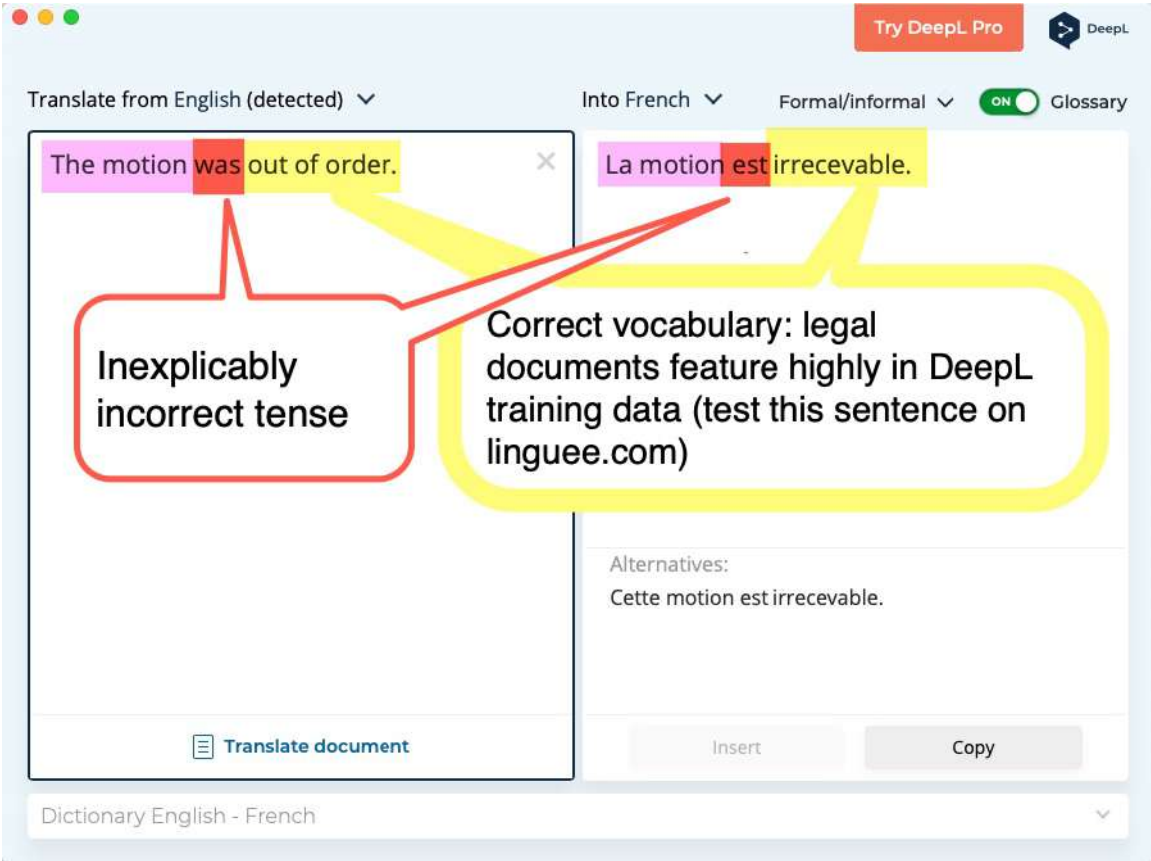

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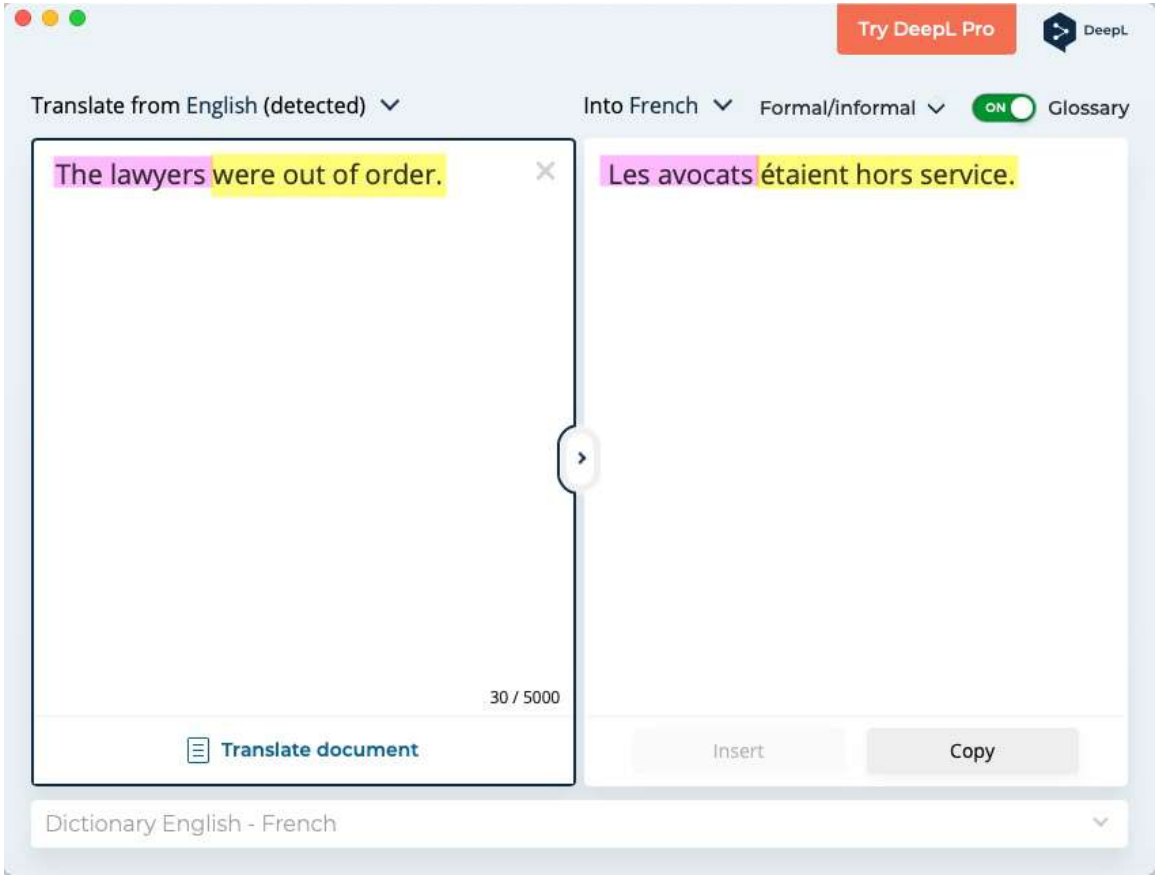

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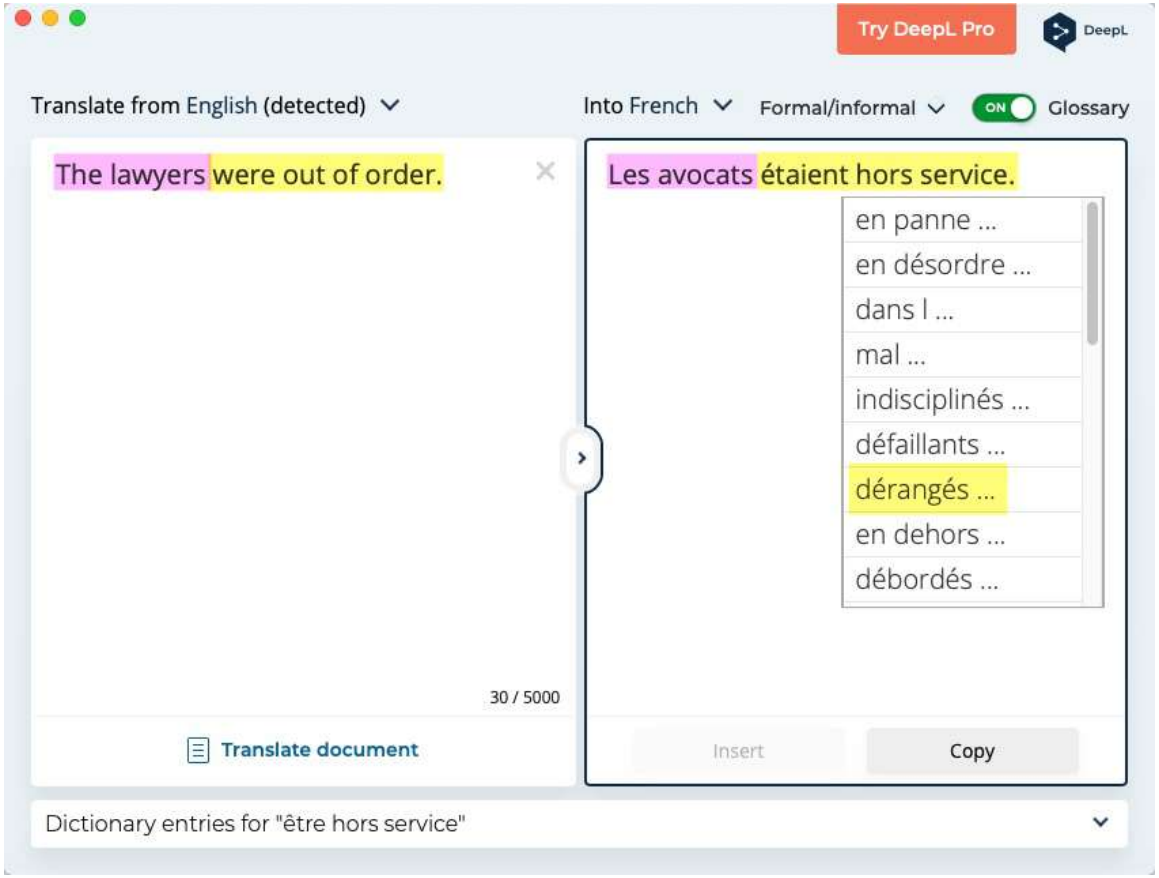

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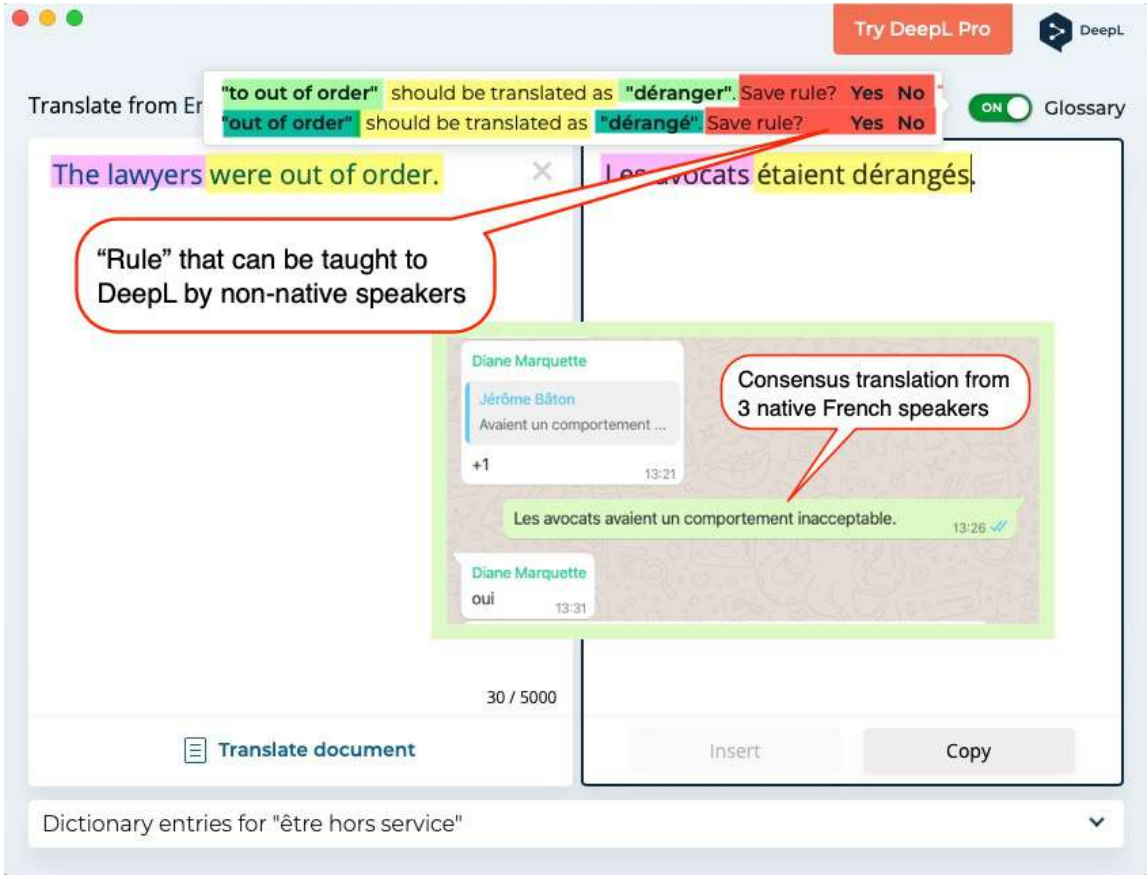

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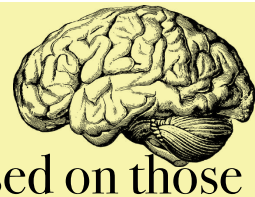

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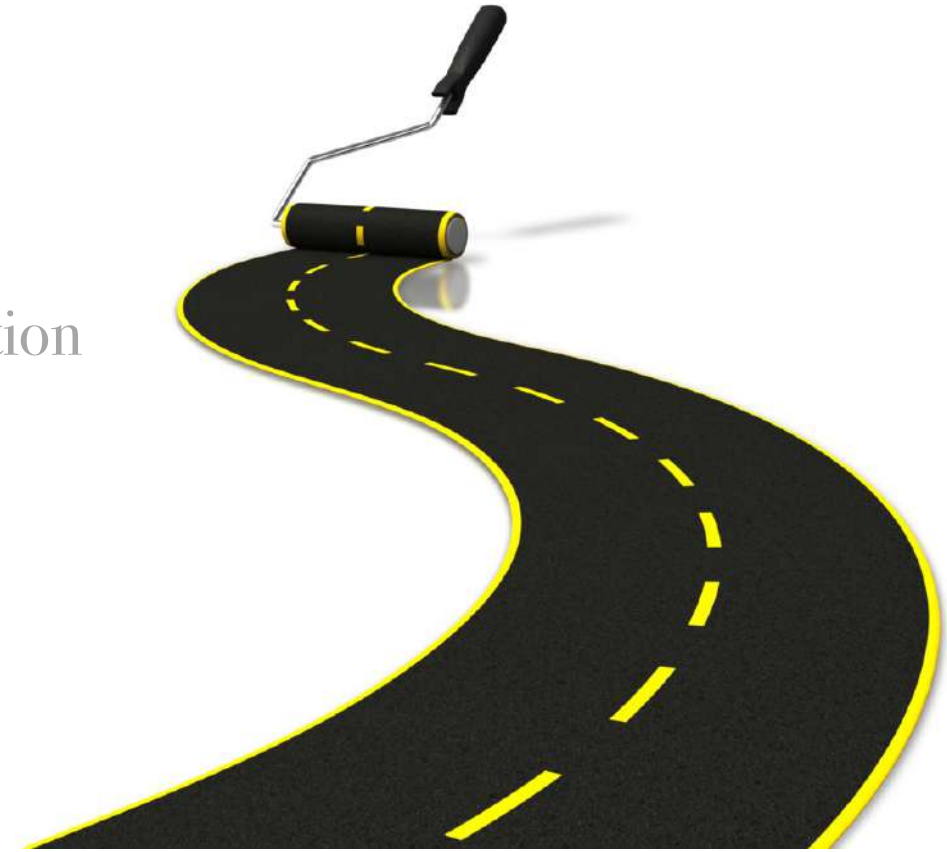

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Chapter 2: Myths about AI and MT

1. We have the data
2. We have the methods
3. Other biases and blind spots

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Myths about AI and MT

1. We have the data
2. We have the methods
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Myths about AI and MT: We have the data

Data

Words that have been **digitized** in a way that can be used within computer processes

- English
- Other high-investment languages
- Other high-population languages
- The other 98% of languages

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Myths about AI and MT: We have the data

Words that have been **digitized** in a way that can be used within computer processes

- 70 years of R & D
- All English words have some digital existence
- Many data sets include party terms (aka "multiword expressions")
- Natural Language Processing (NLP) can perform many analytical marvels (deduce parts of speech, verb conjugations, compose syntactically correct sentences…)
- Meaning and Shape are poorly associated (stay tuned!)

- We cannot interpret the data across systems (interoperability)
- We do not have reliable translations of English terms to most other languages (polysemy, party terms)

- Translation to and from English is only a small part of global translation needs

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Myths about AI and MT: We have the data

Words that have been **digitized** in a way that can be used within computer processes

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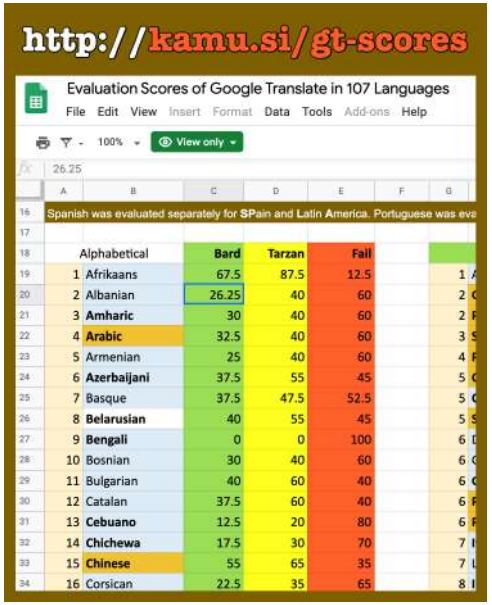
- Major European languages (especially French, Italian, German, Spanish, Portuguese, Russian)
- Arabic, Chinese, Korean, and Japanese
- Tax money at work, e.g. Catalan, Estonian
- A few dozen somewhere on this part of the gradient

- Many words have some monolingual digital existence
- Some data sets with some party terms
- NLP inferior to English (claim based on analysis of which languages get research attention in computational linguistics)
- Parallel corpora with English
- Little data between non-English pairs

- We cannot interpret the data across systems (interoperability)
- MT is computed through spelling or word embeddings, disassociated from meaning



	Alphabetical	Bard	Tarzan	Fail
1	Afrikaans	67.5	87.5	12.5
2	Albanian	26.25	40	60
3	Amharic	30	40	60
4	Arabic	32.5	40	60
5	Armenian	25	40	60
6	Azerbaijani	37.5	55	45
7	Basque	37.5	47.5	52.5
8	Belarusian	40	55	45
9	Bengali	0	0	100
10	Bosnian	30	40	60
11	Bulgarian	40	60	40
12	Catalan	37.5	60	40
13	Cebuano	12.5	20	80
14	Chichewa	17.5	30	70
15	Chinese	55	65	35
16	Corsican	22.5	35	65

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Myths about AI and MT: We have the data

Words that have been **digitized** in a way that can be used within computer processes

- 9-figure languages, e.g. Hindi, Bengali, Indonesian, Swahili
- Fast growing languages throughout Africa and Asia
- 300+ embattled languages with more than 1,000,000 speakers

- Some words with some monolingual digital existence (e.g. brick-of-text dictionaries with some thousands of terms)
- Some basic bilingual dictionaries (lemmatic forms only), usually to English or French
- No NLP for most
- Some monolingual corpora higher on the gradient
- Zero interoperability
- MT to English exists for a few dozen, but is unusable

- English
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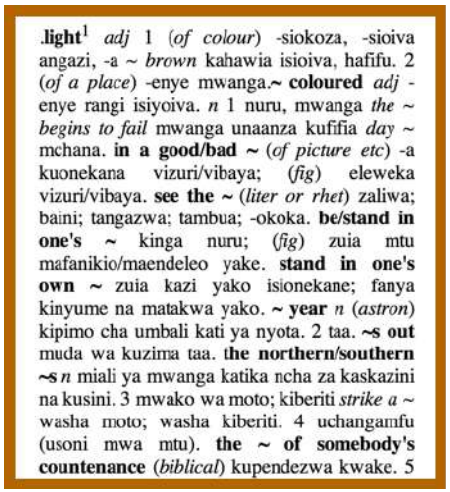
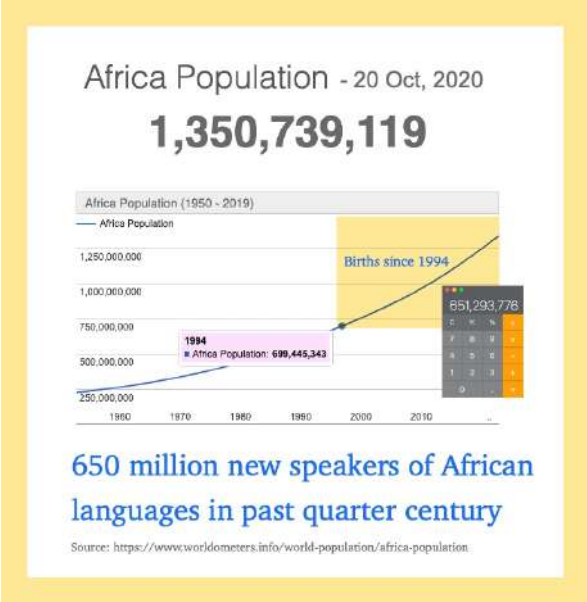
- The other 98% of languages


light[1] *adj* 1 (*of colour*) -siokoza, -sioiva angazi, -a ~ *brown* kahawia isioiva, hafifu. 2 (*of a place*) -enye mwanga.~ **coloured** *adj* -enye rangi isiyoiva. *n* 1 nuru, mwanga *the ~ begins to fail* mwanga unaanza kufifia *day ~* mchana. **in a good/bad ~** (*of picture etc*) -a kuonekana vizuri/vibaya; (*fig*) eleweka vizuri/vibaya. **see the ~** (*liter or rhet*) zaliwa; baini; tangazwa; tambua; -okoka. **be/stand in one's ~** kinga nuru; (*fig*) zuia mtu mafanikio/maendeleo yake. **stand in one's own ~** zuia kazi yako isionekane; fanya kinyume na matakwa yako. **~ year** *n* (*astron*) kipimo cha umbali kati ya nyota. 2 taa. **~s out** muda wa kuzima taa. **the northern/southern ~s** *n* miali ya mwanga katika ncha za kaskazini na kusini. 3 mwako wa moto; kiberiti *strike a ~* washa moto; washa kiberiti. 4 uchangamfu (usoni mwa mtu). **the ~ of somebody's countenance** (*biblical*) kupendezwa kwake. 5



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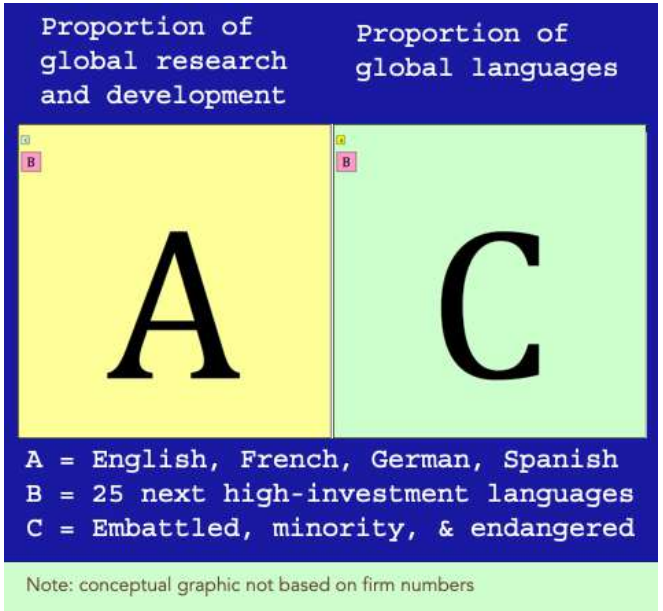
Myths about AI and MT: We have the data

Words that have been **digitized** in a way that can be used within computer processes

- Almost 7,000 languages
  (exact number discussed at http://kamu.si/7000-languages)

- Negligible digital existence of any sort of data for most languages
- No data = not possible in universe of "Universal Translation"
- Included in the universe of "Universal Translation" hype
- Important to document, preserve, and offer certain technological services – e.g., high quality dictionaries, language models
- Lesser call for text-to-text MT – low (if any) literacy, few (if any) texts
- Speech-to-speech translation could be valuable, is technologically possible (needs 7000 graduate students to collect and make sense of data)

- English
- Other high-investment languages
- Other high-population languages
- The other 98% of languages



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Myths about AI and MT

1. We have the data
2. We have the methods
3. Other biases and blind spots

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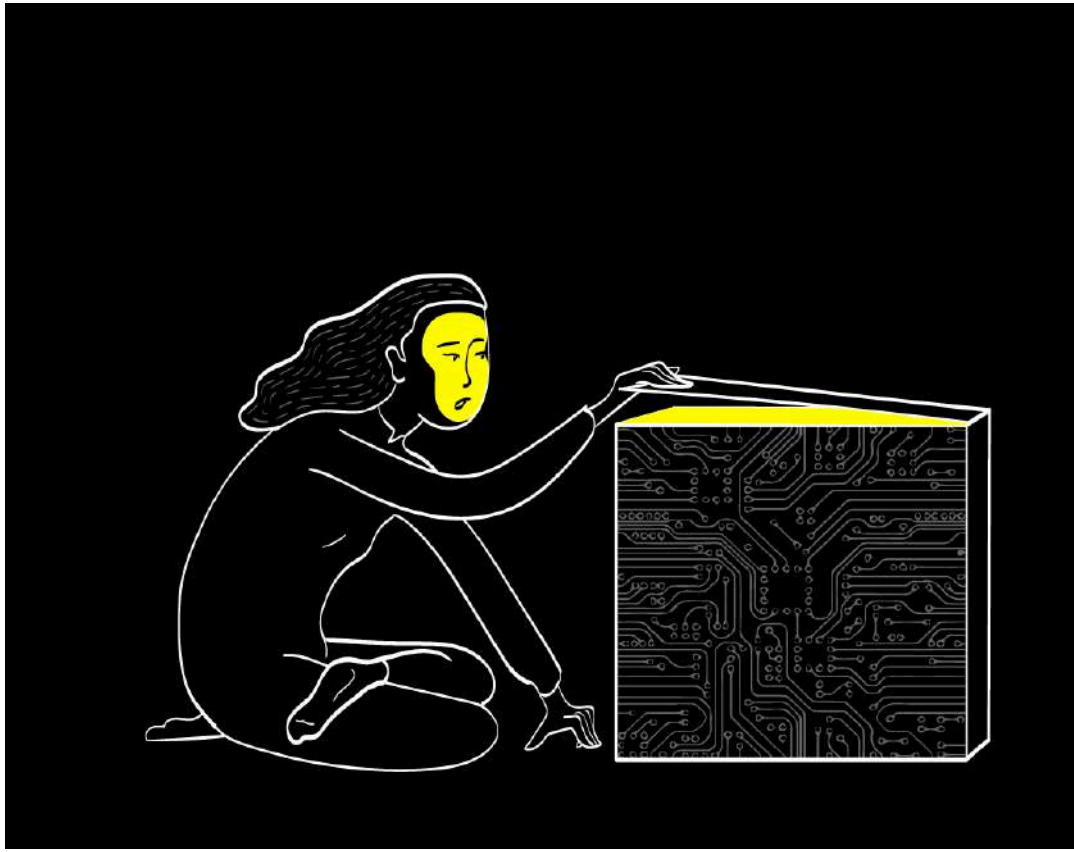
Myths about AI and MT: We have the methods

- Statistics (SMT)
- Corpora
- Neural Networks (NMT)
- Zero Shot
- Learning



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Myths about AI and MT: We have the methods

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- SMT is still a part of MT services (e.g., NMT can make no intelligent guesses about polysemy without context)
- Needs parallel data
- How SMT guesses (cartoon version)
  - "spring" = "primavera" in 40% of parallel sentences
  - other 60% "spring" = 10% bounciness, 10% a metal coil, 10% water flowing from the ground, 10% elastic force, 10% stretchiness, 10% a jump
  - Chance that SMT picks "springtime" sense = near 100%

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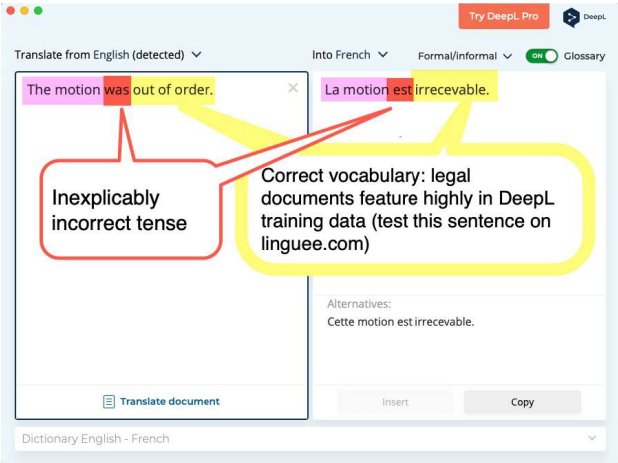
Myths about AI and MT: We have the methods

- Monolingual corpora can yield words, inflections, and expressions in one language
- Parallel corpora (translation gold) = extremely few pairs
- Limited topics – formal documents in the public domain
- Daily speech generally out of scope (including second-person constructions necessary for correspondence and text conversations)



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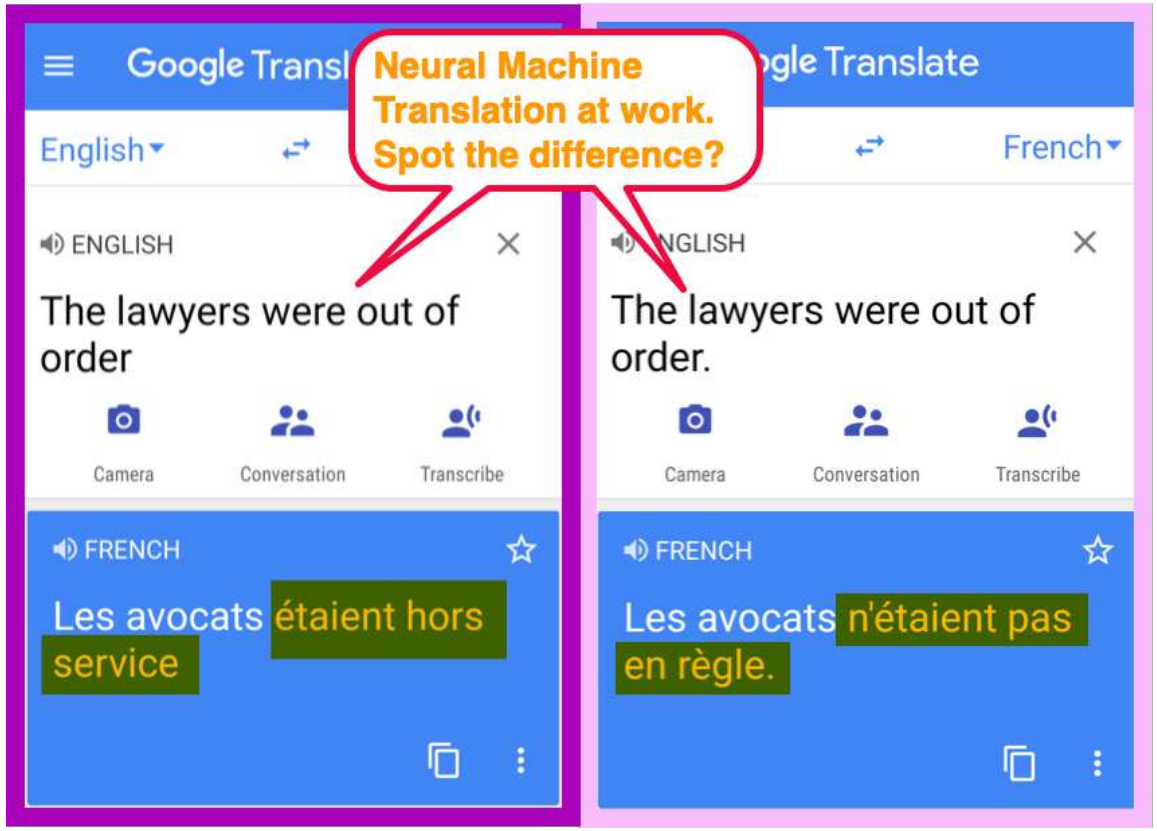
Myths about AI and MT: We have the methods



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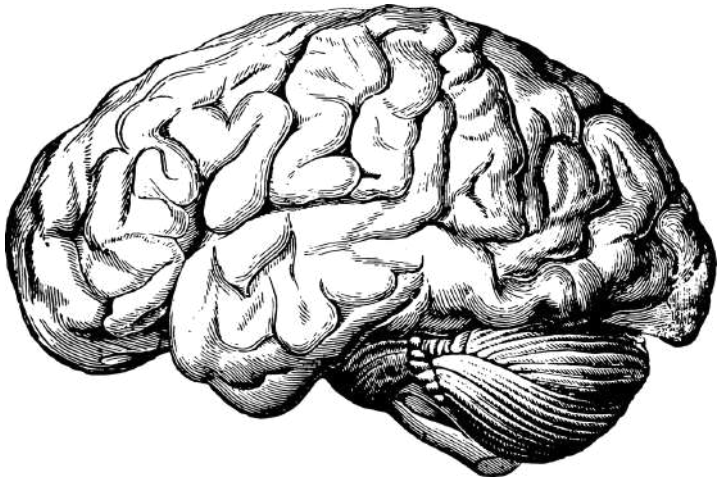

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Myths about AI and MT: We have the methods

- There is no brain. There are no neurons. "Neural network" is a marketing metaphor.
- NMT runs a lot of tests, can find hidden patterns
- With lots of parallel data, NMT performs nicely in certain circumstances:
  1. The language is at the upper tier of testing on teachyoubackwards.com
  2. The conversion is to or from English
  3. The text is well structured and written using formal language and short sentences
  4. The text relates to formal topics
  5. The translation is for casual purposes where misunderstanding cannot result in unpleasant consequences
- Even with lots of parallel data, lots of misses (e.g., our "out of order" examples, with context words, missed 4 out of 5 times)
- MUSA: The Make Up Stuff Algorithm
- Much more: http://kamu.si/myth2
- Most language pairs do not have parallel data, so…

- Statistics (SMT)
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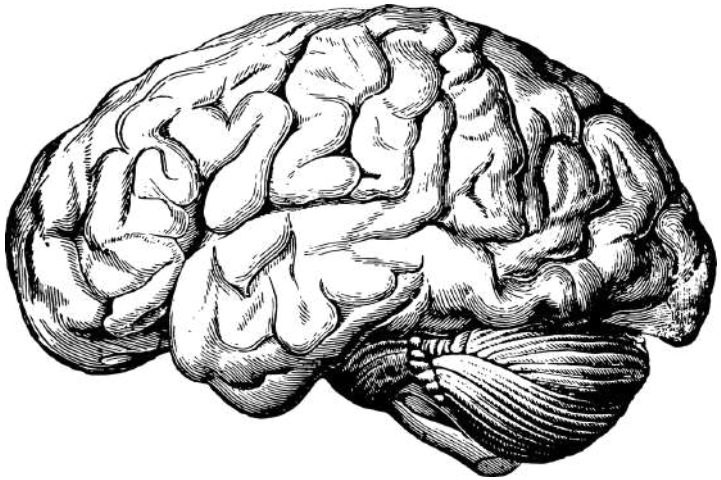

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Myths about AI and MT: We have the methods

- MUSA: The Make Up Stuff Algorithm

(Facebook MT)

Real Somali ⇛

Fake English ⇛

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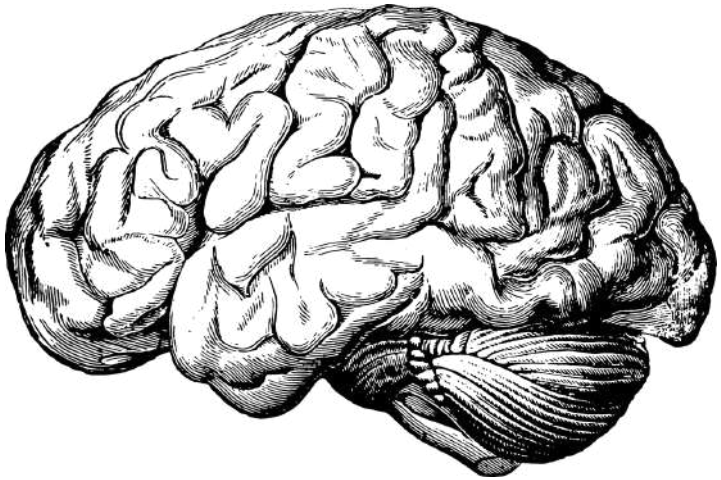

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Myths about AI and MT: We have the methods

- The idea:
  1. Align data from Language A with English.
  2. Align data from Language B with English.
  3. Shake.
  4. Remove English.
  5. A to B Translation!


Google's AI can translate language pairs it has never seen

If it can convert English to Korean and Japanese, it can automatically do Korean to Japanese

- Results (technically): phenomenally bad
- Results (media): phenomenally good
- Results (public perception): phenomenally good

- Much more: http://kamu.si/myth3

- Statistics (SMT)
- Corpora
- Neural Networks (NMT)
- Zero Shot
- Learning

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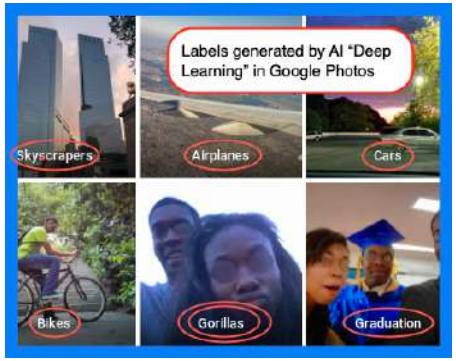
Myths about AI and MT: We have the methods

- Machine Learning
  - Needs a "gold standard" to compare results against a "ground truth"

  - else -
  - Needs human validation of results

  - else - Garbage In, Garbage Out
  - Only finds patterns within existing data
  - Risks locking info that is *sometimes* right as *always* right

- Learning from Users
  - 4 year "suggest an edit" experiment on Google Translate finds maximum 40% uptake
  - Crowdsourcing must be carefully fortified against bogus results – not the case for Google "Translate Community" DeepL "Rules"
  - Companies pay employees to teach AI for self-driving cars (so nobody dies), but not for most languages. That's a business choice, not science.
  - More: http://kamu.si/myth5



- Statistics (SMT)
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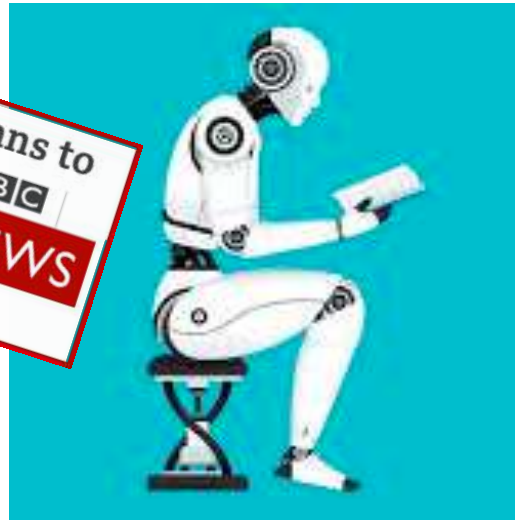
Why Big Tech pays poor Kenyans to teach self-driving cars

When Artificial Intelligence works as intended, Silicon Valley types often say it's "like magic".

But it isn't magic. It's Brenda, a 26-year-old single mother who lives Kibera, Africa's largest slum, and perhaps the toughest neighbourhood on earth, where hundreds of thousands of people live in a space not too much bigger than London's Hyde Park.

BBC NEWS



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Myths about AI and MT

1. We have the data
2. We have the methods
3. Other biases and blind spots

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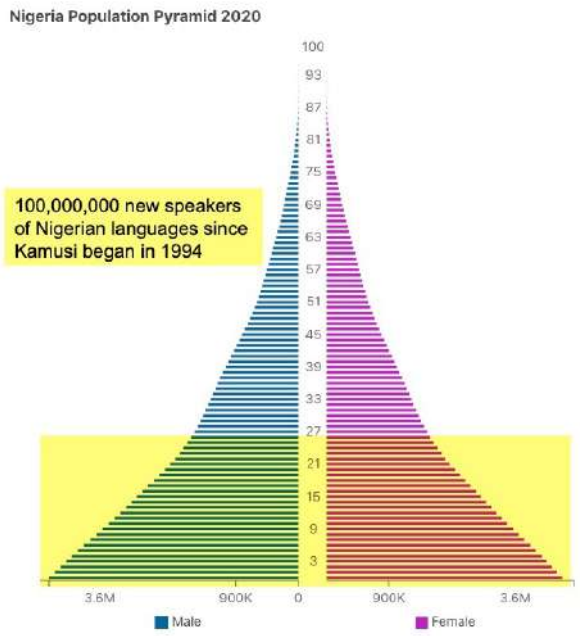
Myths about AI and MT: Biases and blind spots

- Follow the money
  - Corporate investment
  - Government support
  - Foundation grants
- Follow the research

- English ≠ Translation. Less important than people immersed in it think it is
- Elite language bias shared by leaders in Africa, India, etc
- Large tech-excluded languages are "Embattled" but not "Endangered" – growing, not going, with unserved language needs and untapped market potential

- Yes, language technology is inequitable. Yes, it matters.

- White languages matter (+CKJ)
- Technology works
- Computer knows best



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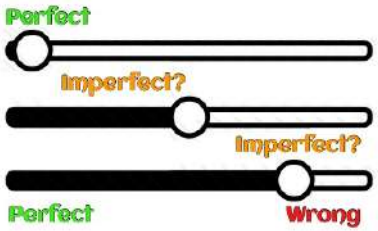
Myths about AI and MT: Biases and blind spots

- We tend to trust technology to do what it claims
  - Maybe your GPS takes you down a cow path today, but you'll certainly follow it again tomorrow
  - Search for "gorilla", you'll get mostly gorillas
  - Would Google put Samoan in their service if it didn't work? How's your Samoan?
- It isn't perfect, but…



- Willing suspension of disbelief
- Rooting for "Team Translate" – we like tech victories, forgive (and forget) the defeats

- White languages matter (+CKJ)
- Technology works
- Computer knows best

"wild turkey" results in Google Images (top)
"turkish wilderness" result in Flickr (bottom)

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Myths about AI and MT: Biases and blind spots

- Don't mind the gaps – we fill in holes with our own understanding (fix tenses, odd words…)
- Confirmation bias – we can see that some of the translation is correct, so the rest must be okay
- Magic wand – results change as we type, so serious optimal calculations must be occurring. See "magic" in action: http://kamu.si/myth4
- Gaslighting – it looks suspicious, but who am I to challenge the engineers and linguists who are telling me it's right?

- White languages matter (+CKJ)
- Technology works
- Computer knows best

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Artificial Intelligence (AI) & Machine Translation (MT) on the Road toward Universal Translation

1. AI facts and fantasies
2. Myths about AI and MT
3. Realistic fantasies about computation and translation

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Chapter 3:
Realistic Fantasies about Computation and Translation

- Smurfs and Ducks
- Kam4D
- SlowBrew

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Realistic Fantasies about Computation and Translation

- Smurfs and Ducks
- Kam4D
- SlowBrew

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Realistic Fantasies about Computation and Translation

SMURF =
Spelling/ Meaning
Unit Reference

- Smurfs and Ducks
- Kam4D – kamu.si/kam4d
- SlowBrew

DUCKS = Data
Unified Concept
Knowledge Set

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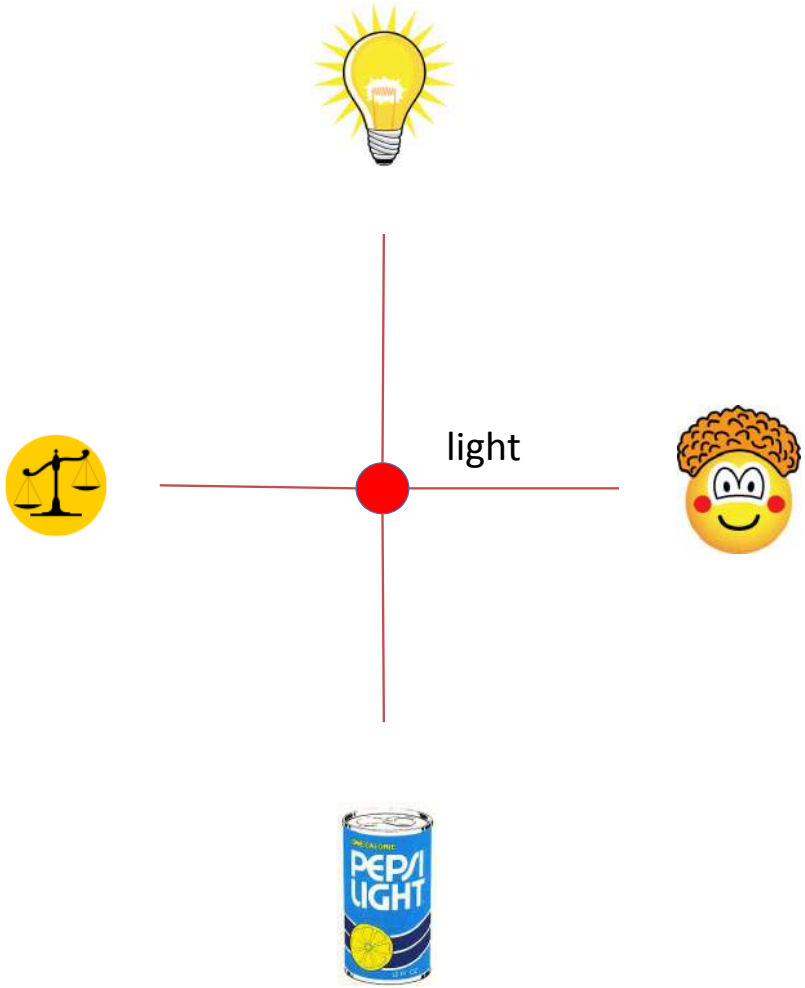
light



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why multilingual dictionaries were impossible

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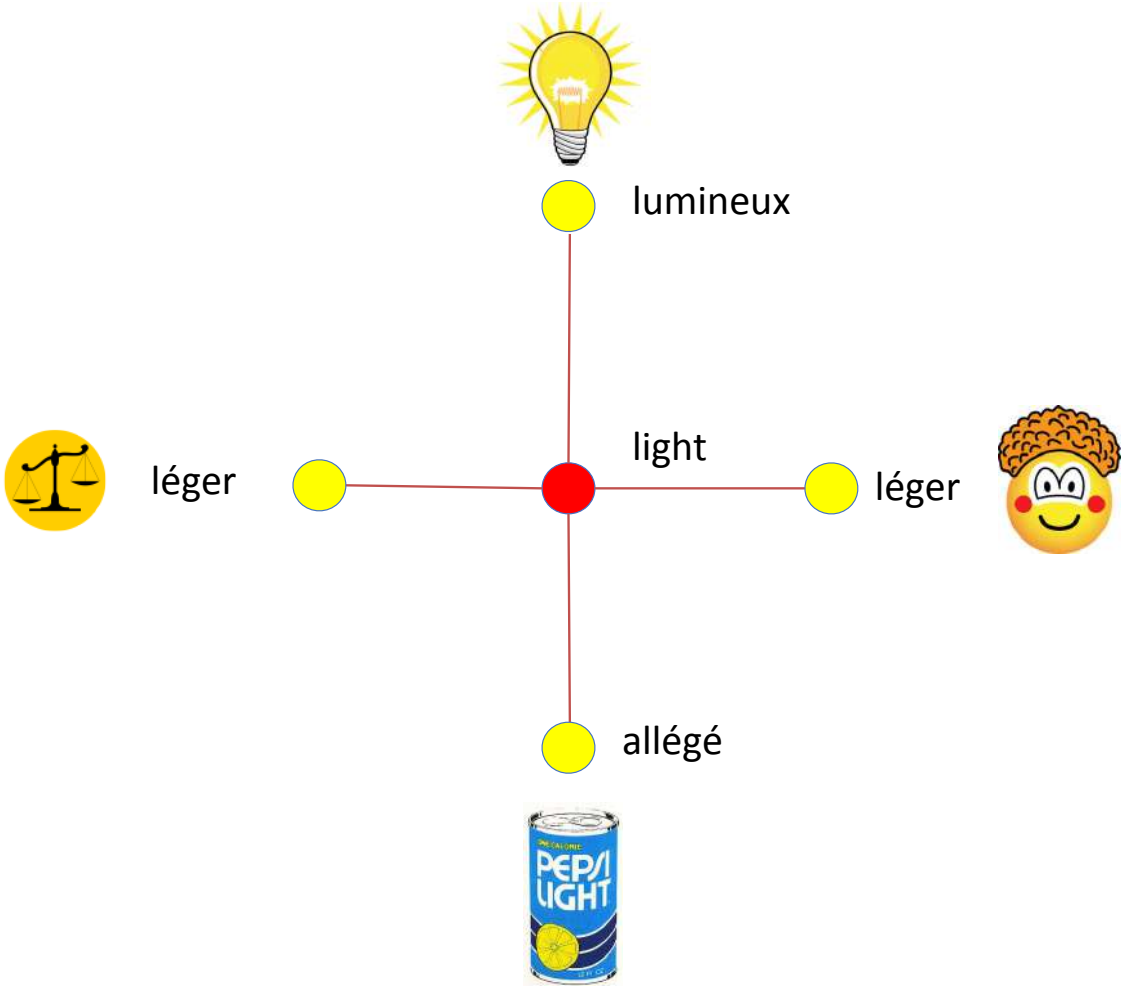

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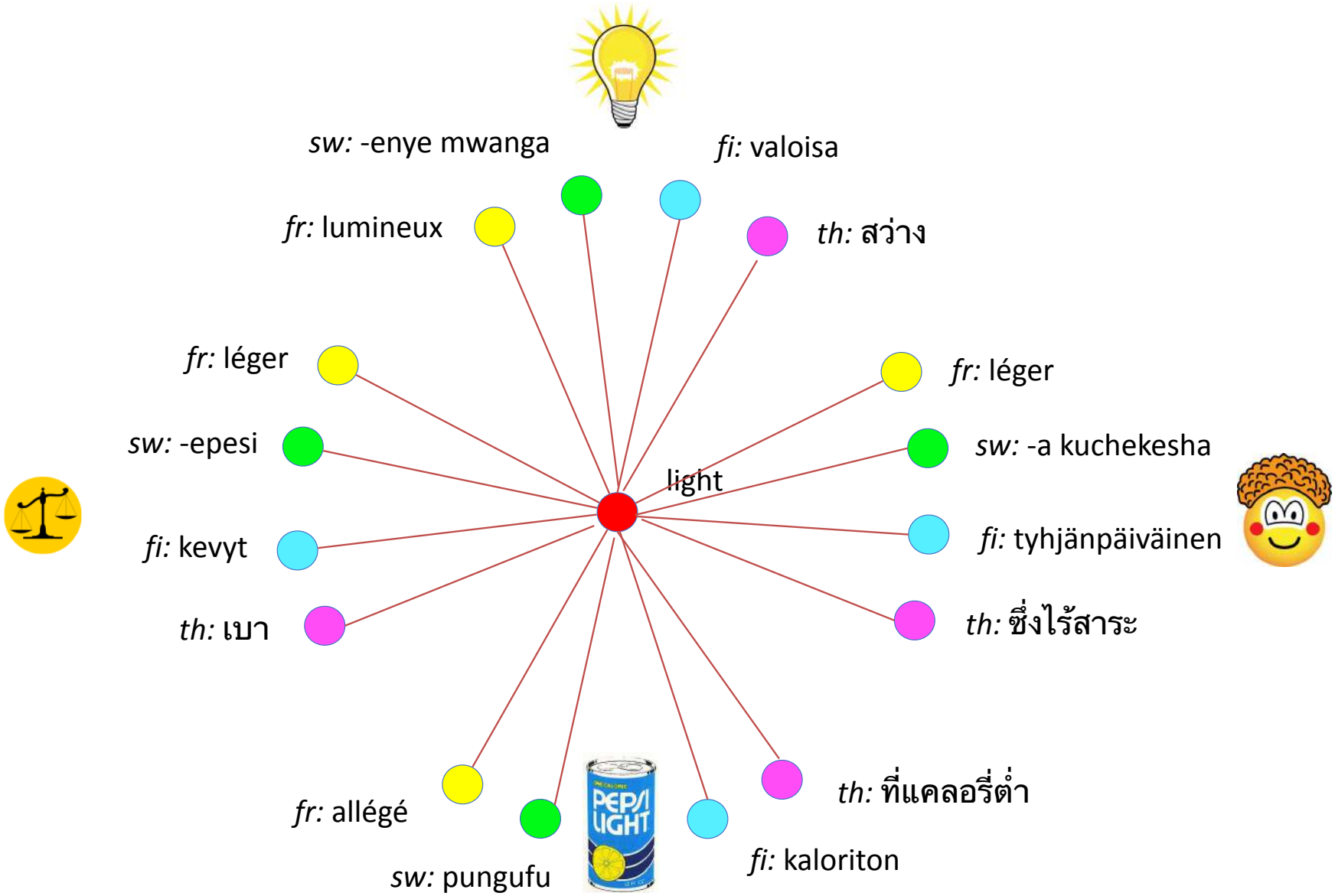

why multilingual dictionaries were impossible

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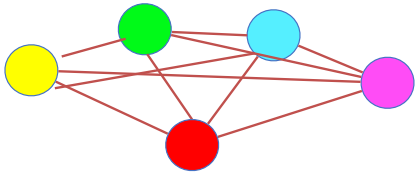
sw: -enye mwanga

fi: valoisa

fr: lumineux

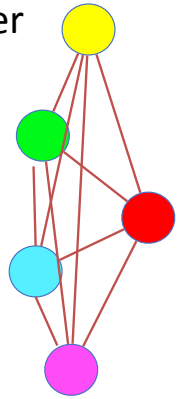


th: สว่าง

en: light

fr: léger

sw: -epesi

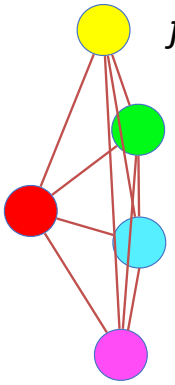


en: light

fi: kevyt

th: เบา

fr: léger



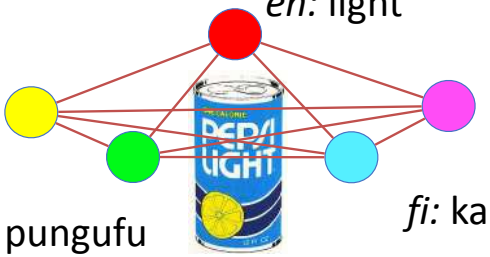
sw: -a kuchekesha

en: light

fi: tyhjänpäiväinen

th: ซึ่งไร้สาระ

en: light



th: ที่แคลอรี่ต่ำ

fr: allégé

sw: pungufu

fi: kaloriton

why multilingual dictionaries were impossible

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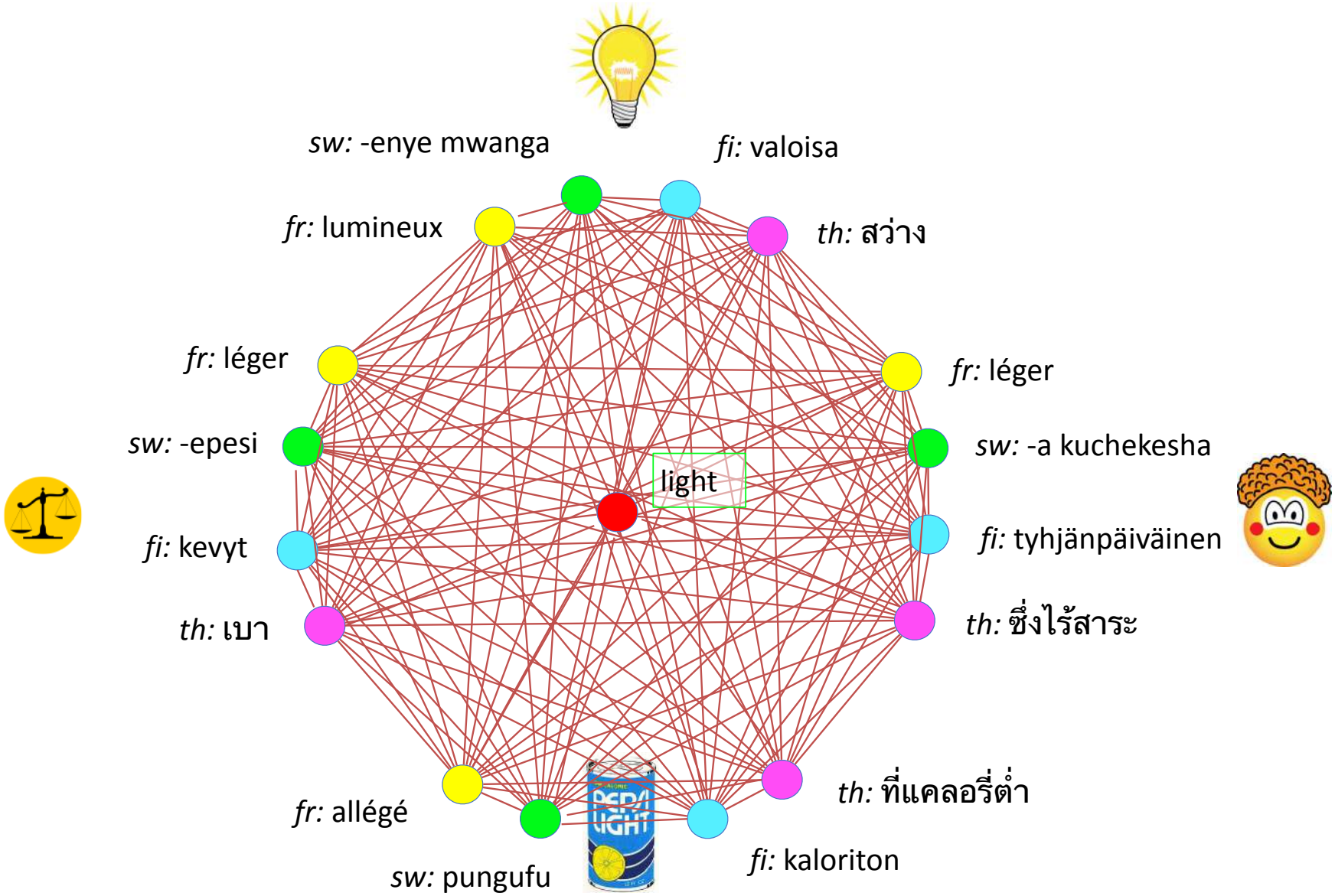

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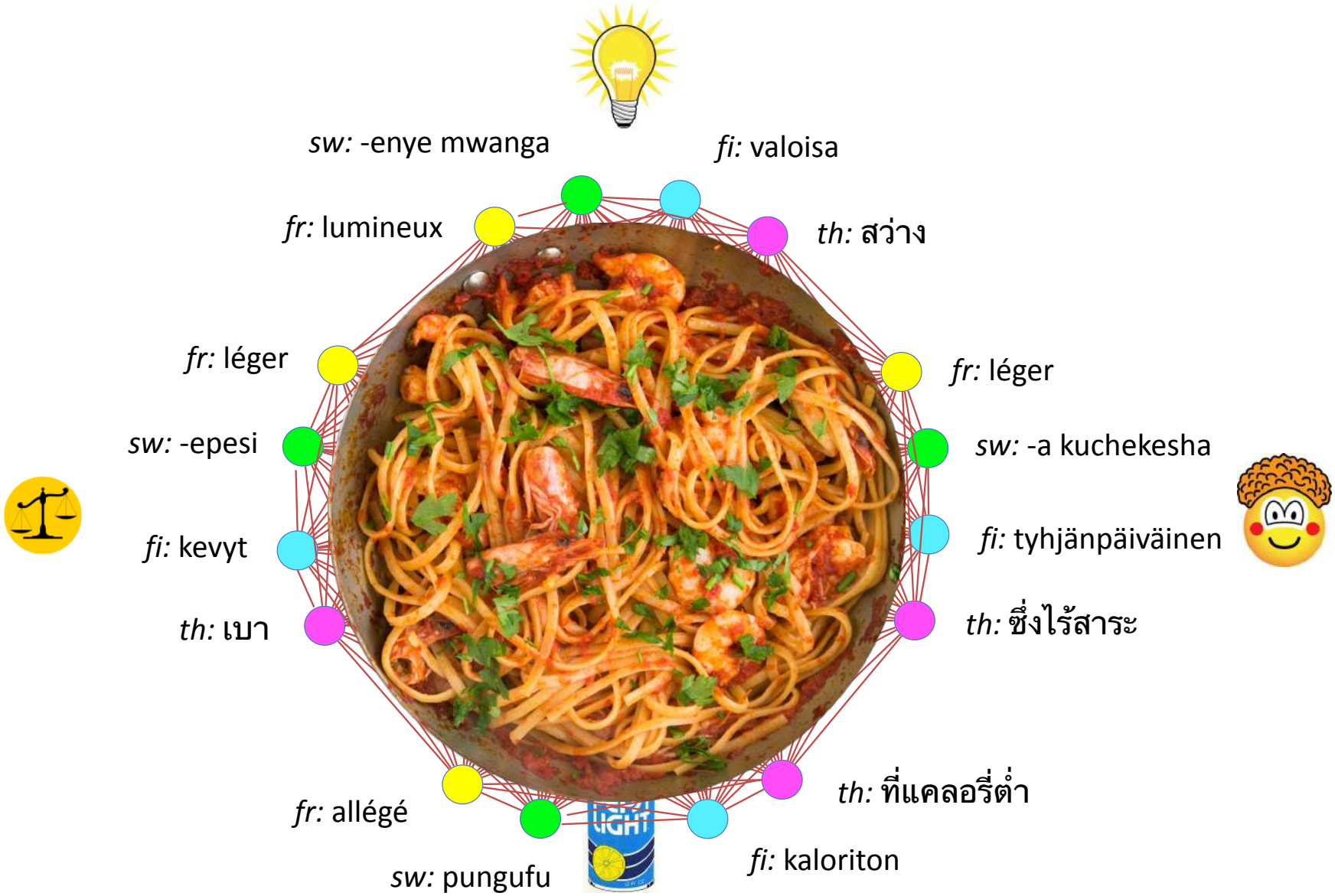

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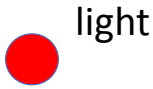

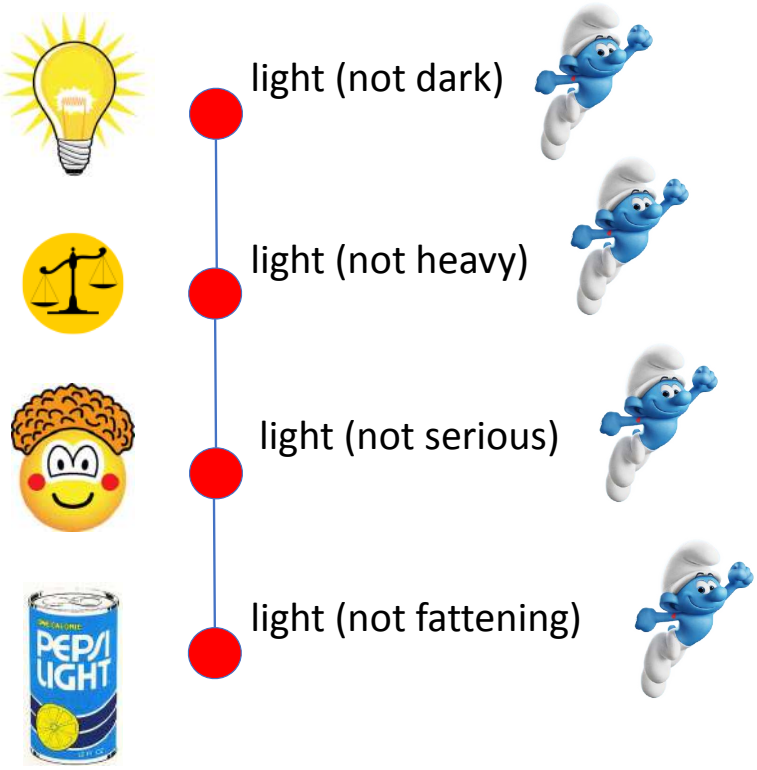

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how Kamusi makes a multilingual dictionary possible

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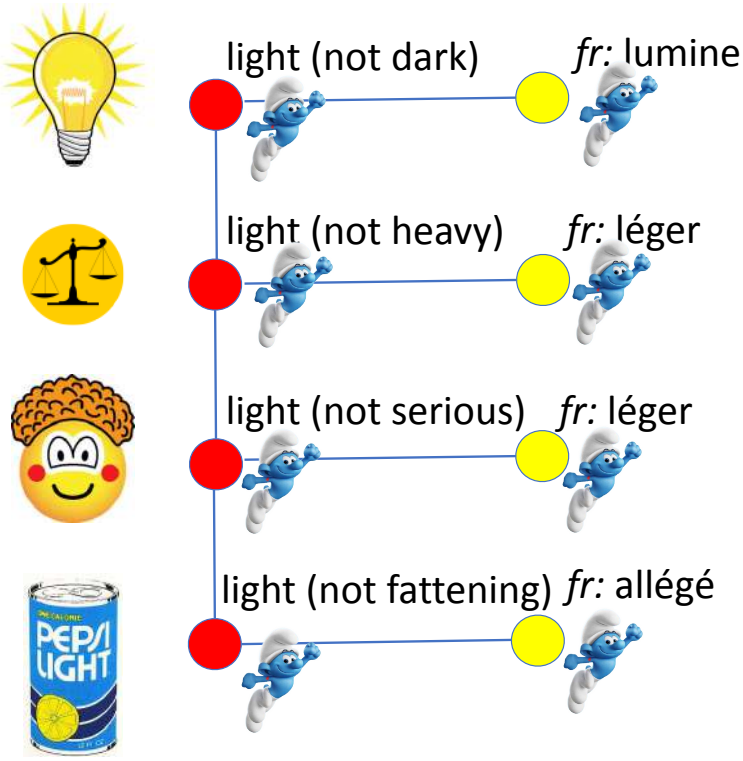

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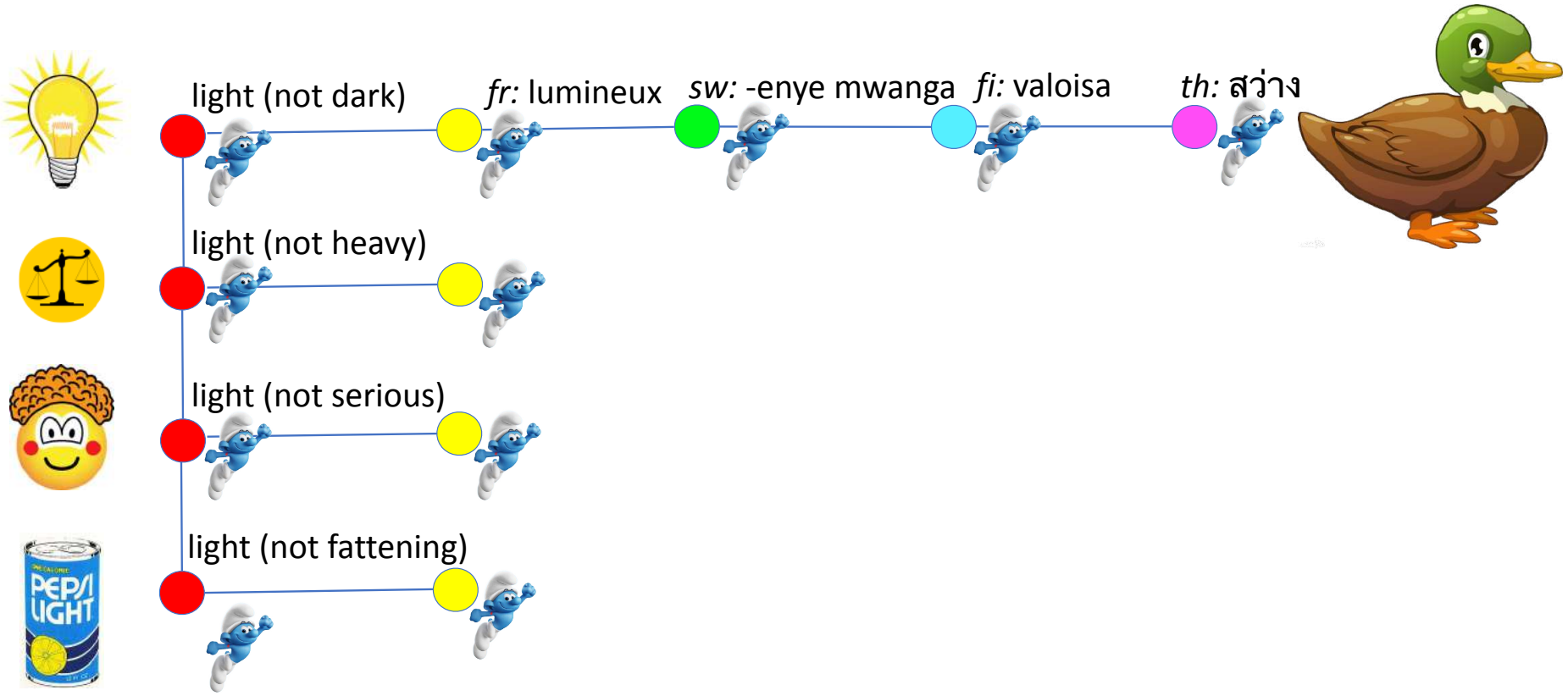

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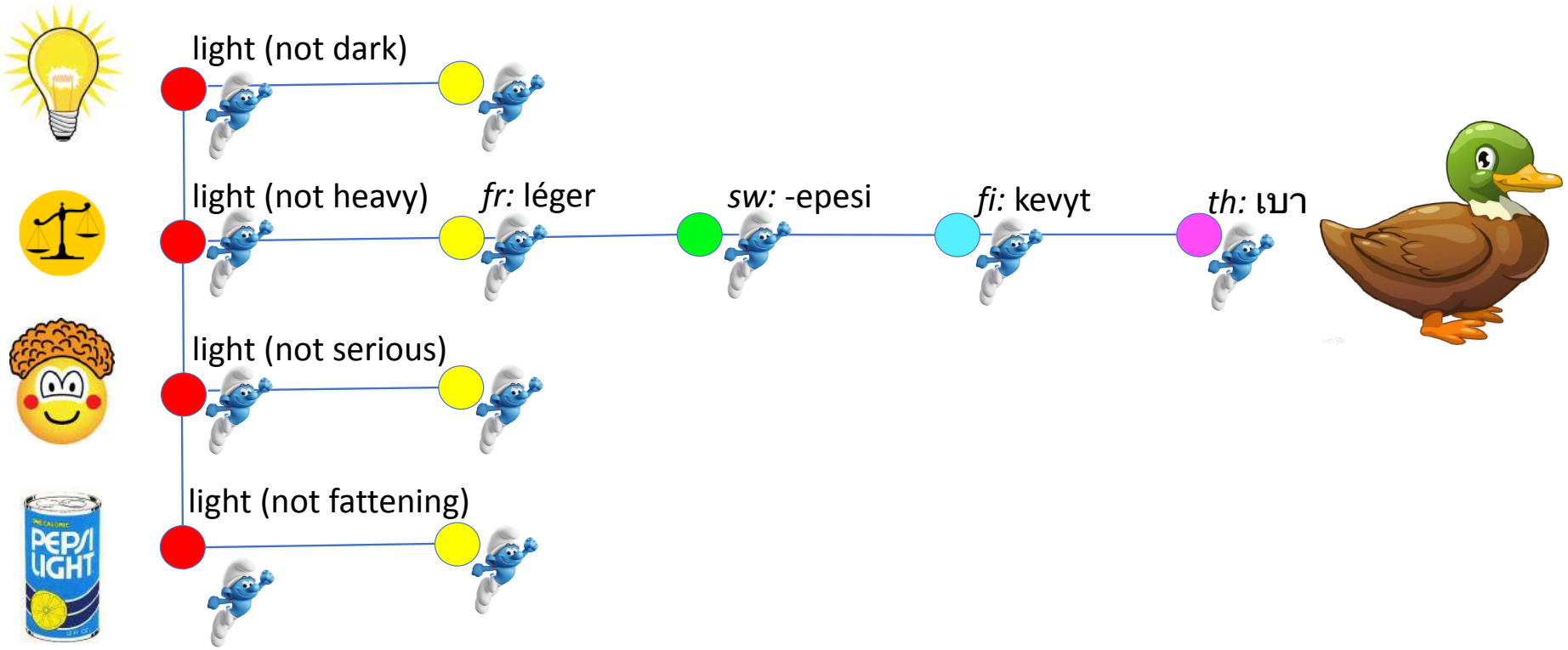

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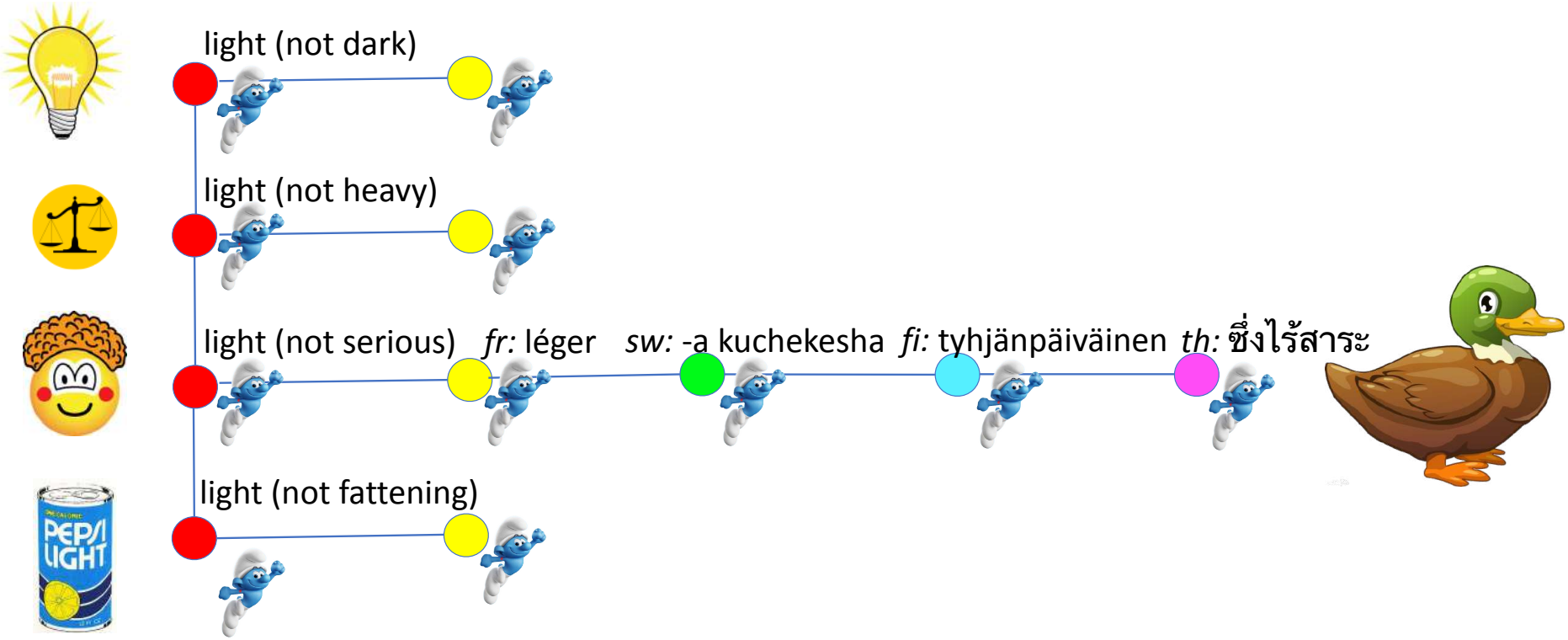

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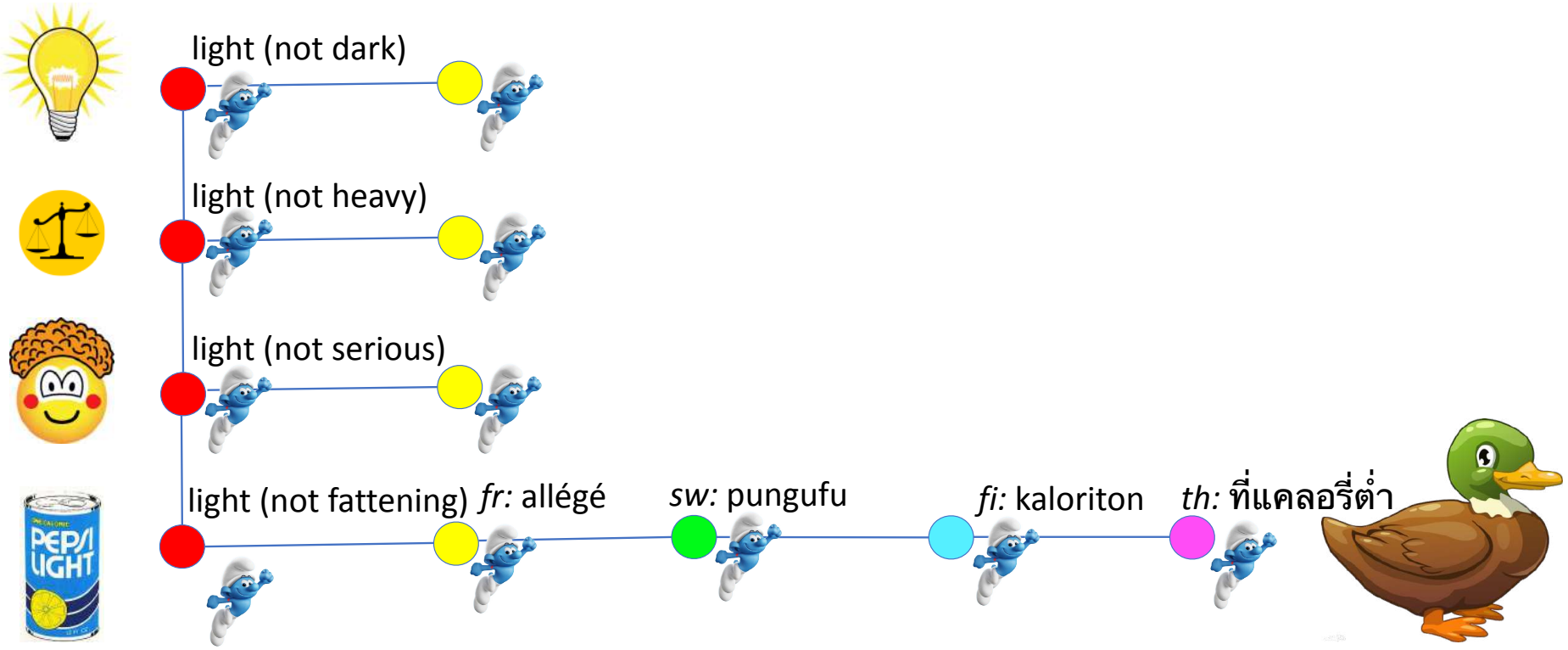

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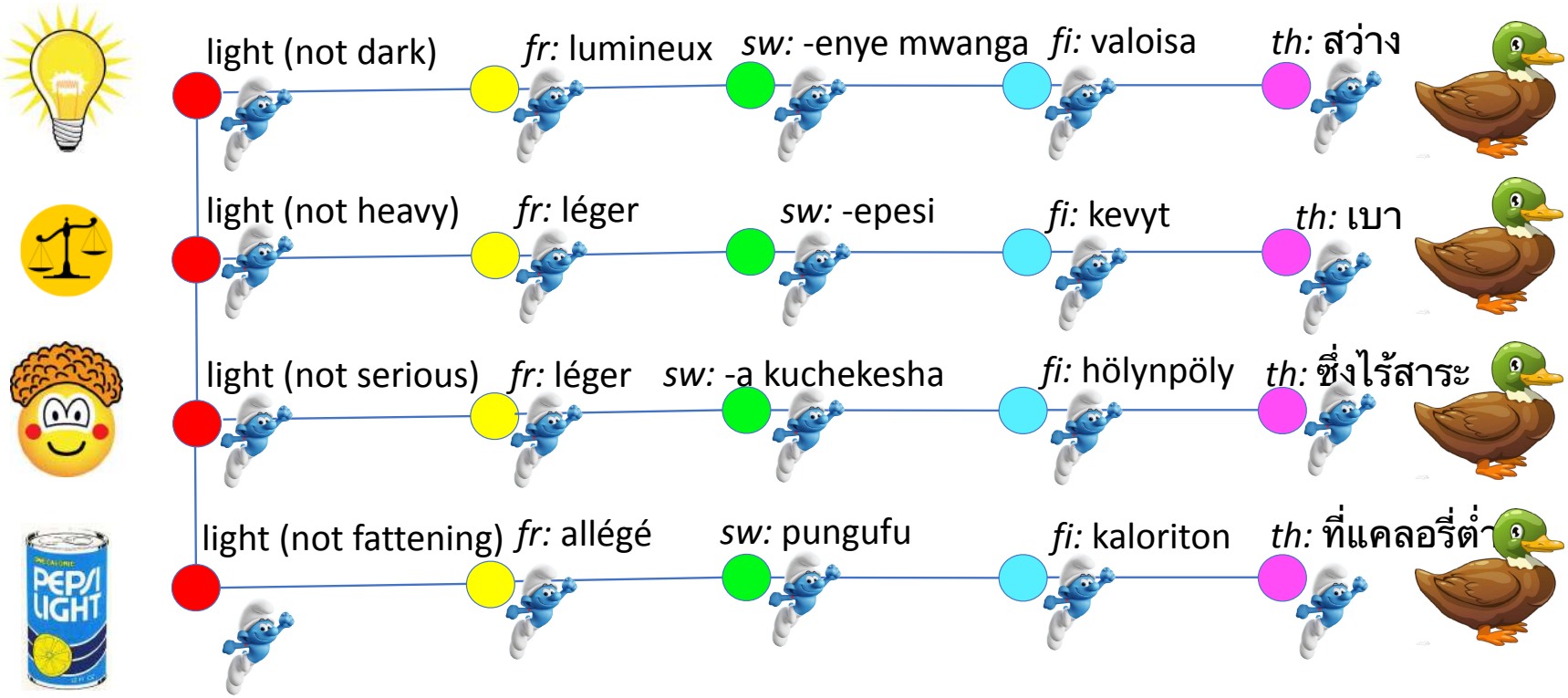

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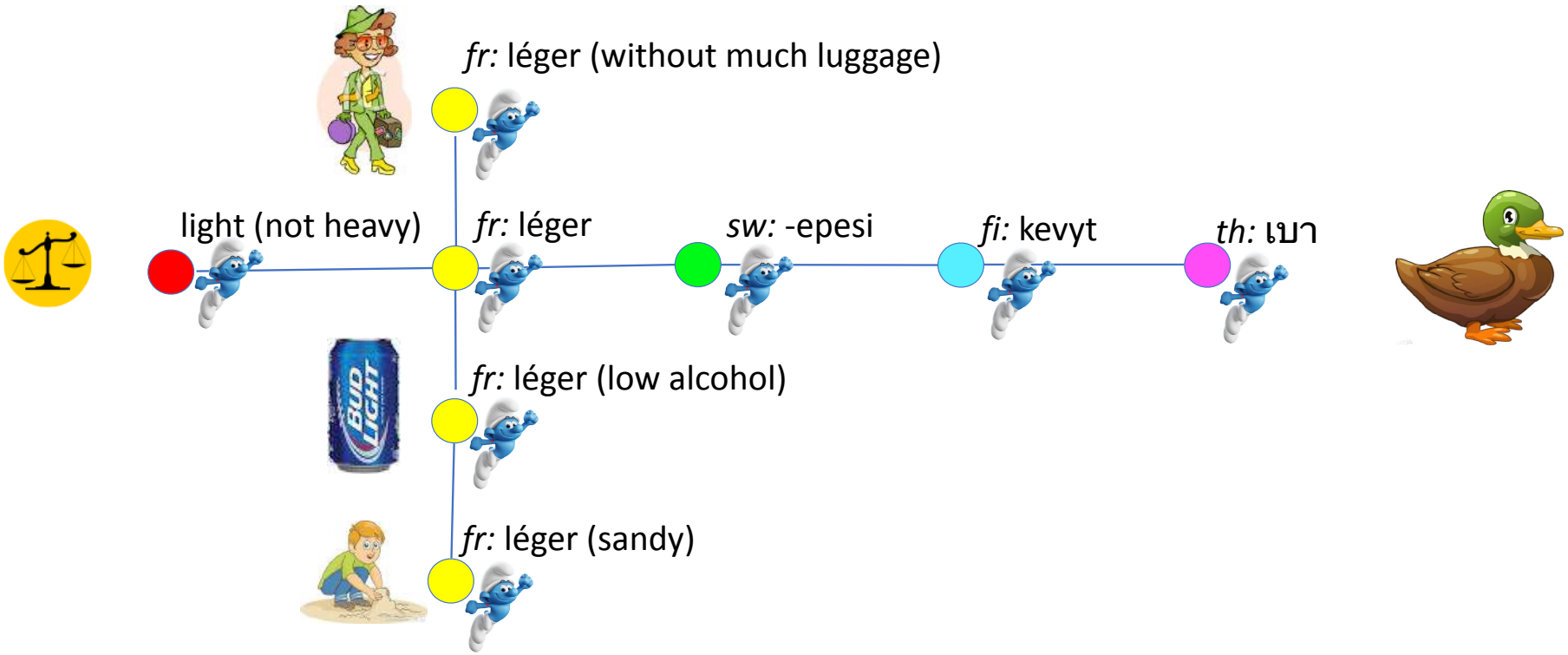

how Kamusi makes a multilingual dictionary possible

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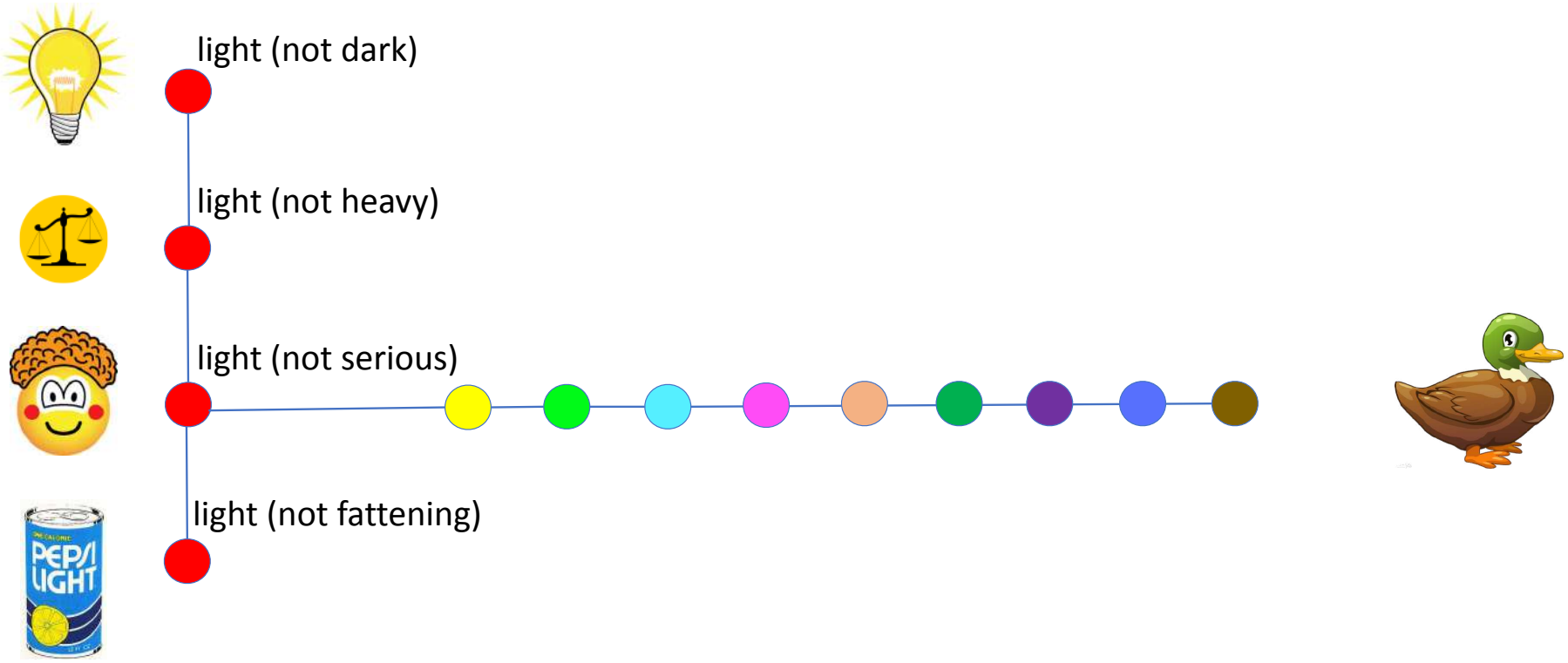

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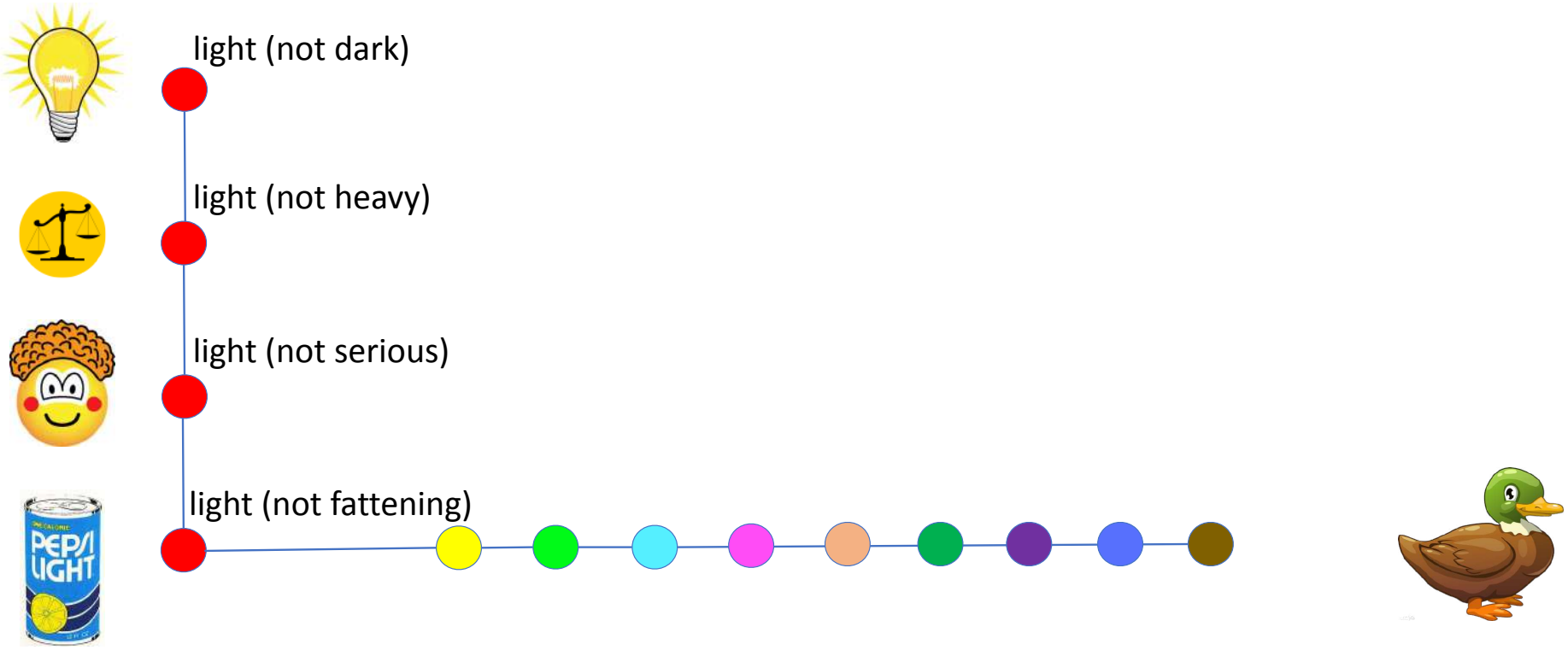

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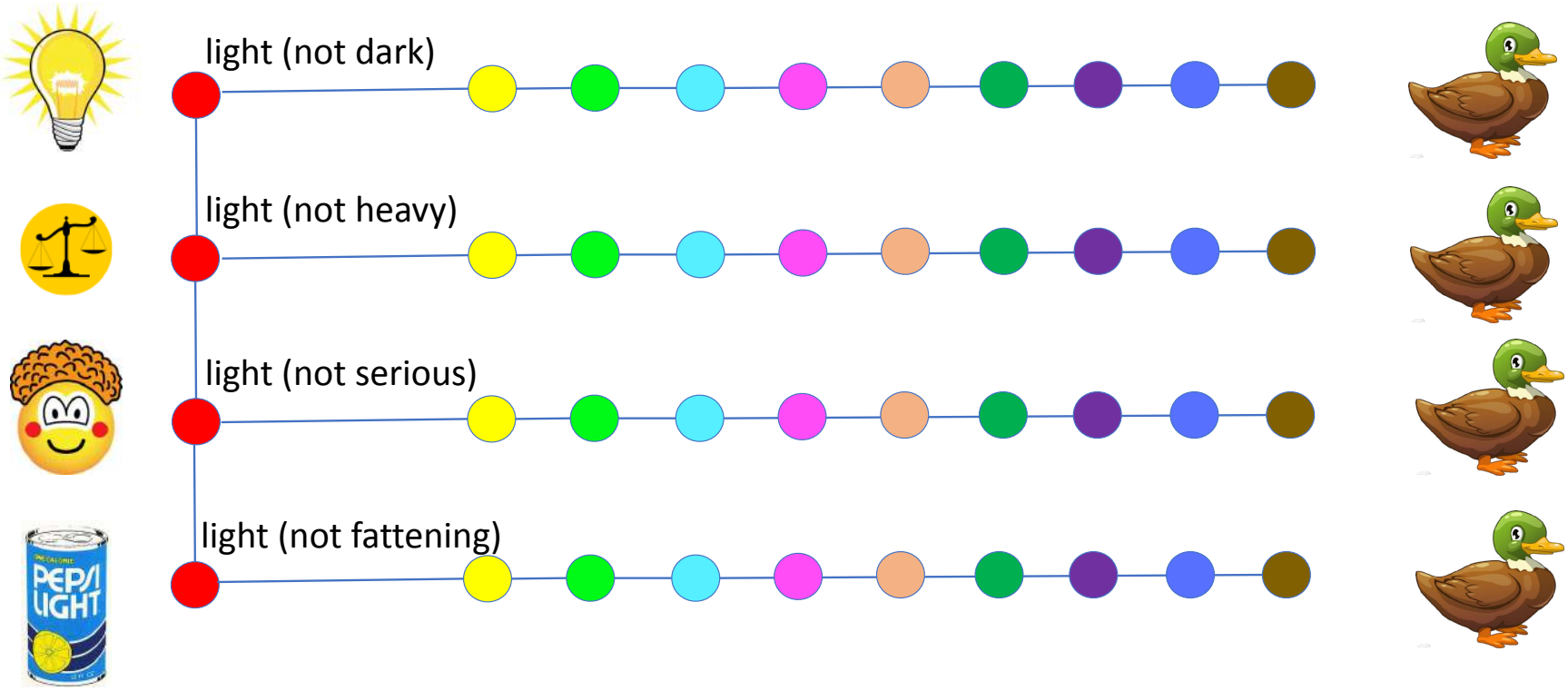

light (not dark)
light (not heavy)
light (not serious)
light (not fattening)
PEPSI
LIGHT

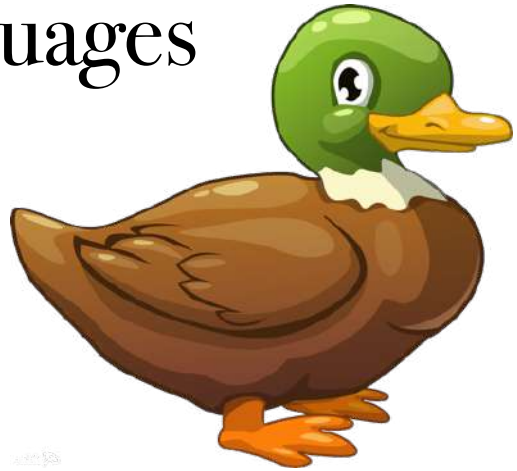
Realistic Fantasies about Computation and Translation

November 2020 census:

- 2,099,419 Smurfs
- 122 Languages

- Smurfs and Ducks
- Kam4D – kamu.si/kam4d
- SlowBrew

- ~138,000 Ducks
- 44 Languages



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Realistic Fantasies about Computation and Translation

- Smurfs and Ducks
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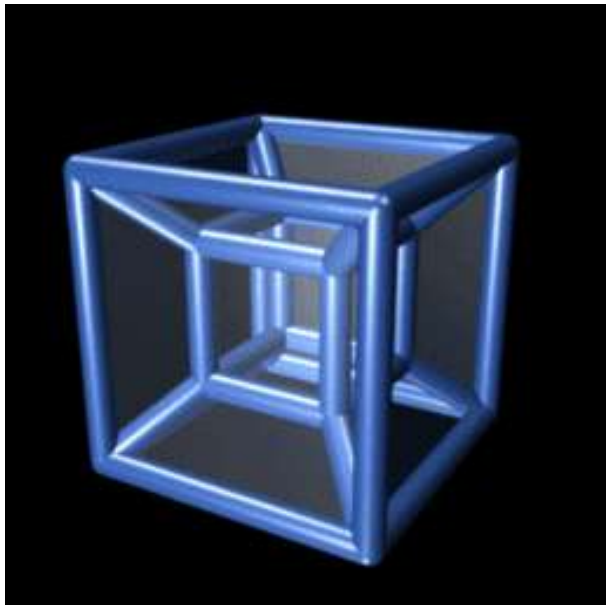
Realistic Fantasies about Computation and Translation

- 4D = Four Dimensional
  - Time is the fourth dimension - capacity to treat language change and historical languages
- Graph database structure for a complete matrix of human expression across time and space
  - the structure is realistic; the final goal is an impossible aspiration
- Molecular lexicography design

- Smurfs and Ducks
- Kam4D – kamu.si/kam4d
- SlowBrew



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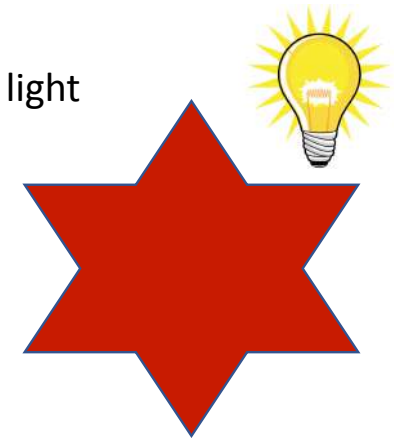
- Smurfs and Ducks
- Kam4D – kamu.si/kam4d
- SlowBrew

light

kamusi.org



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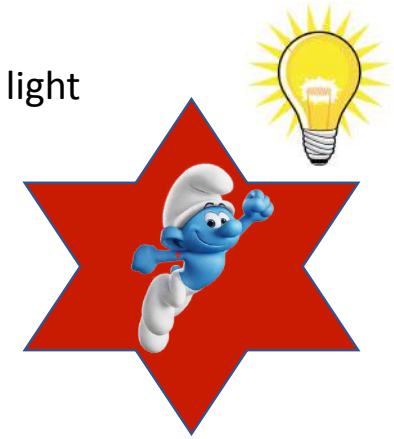

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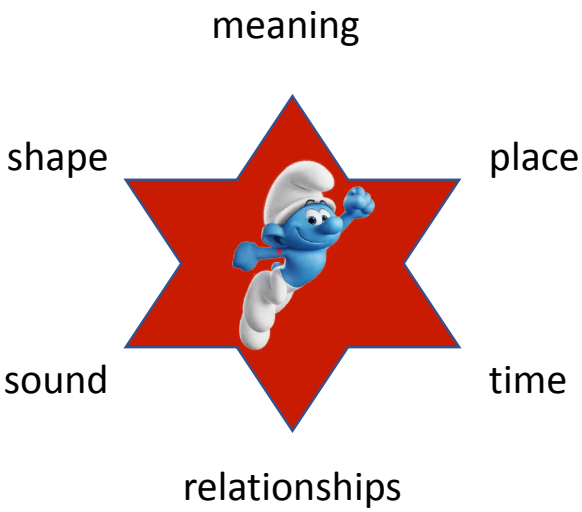

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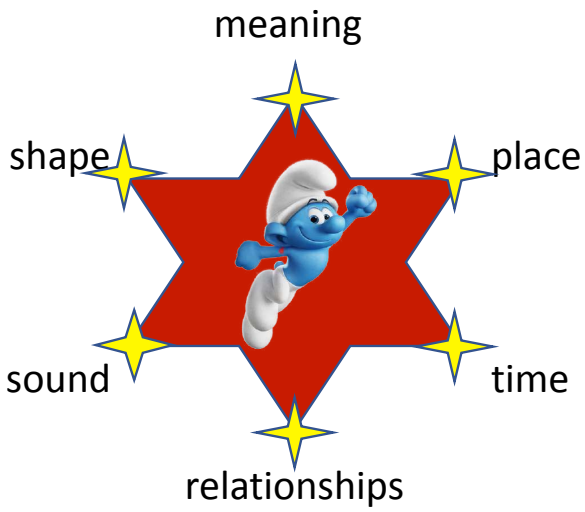

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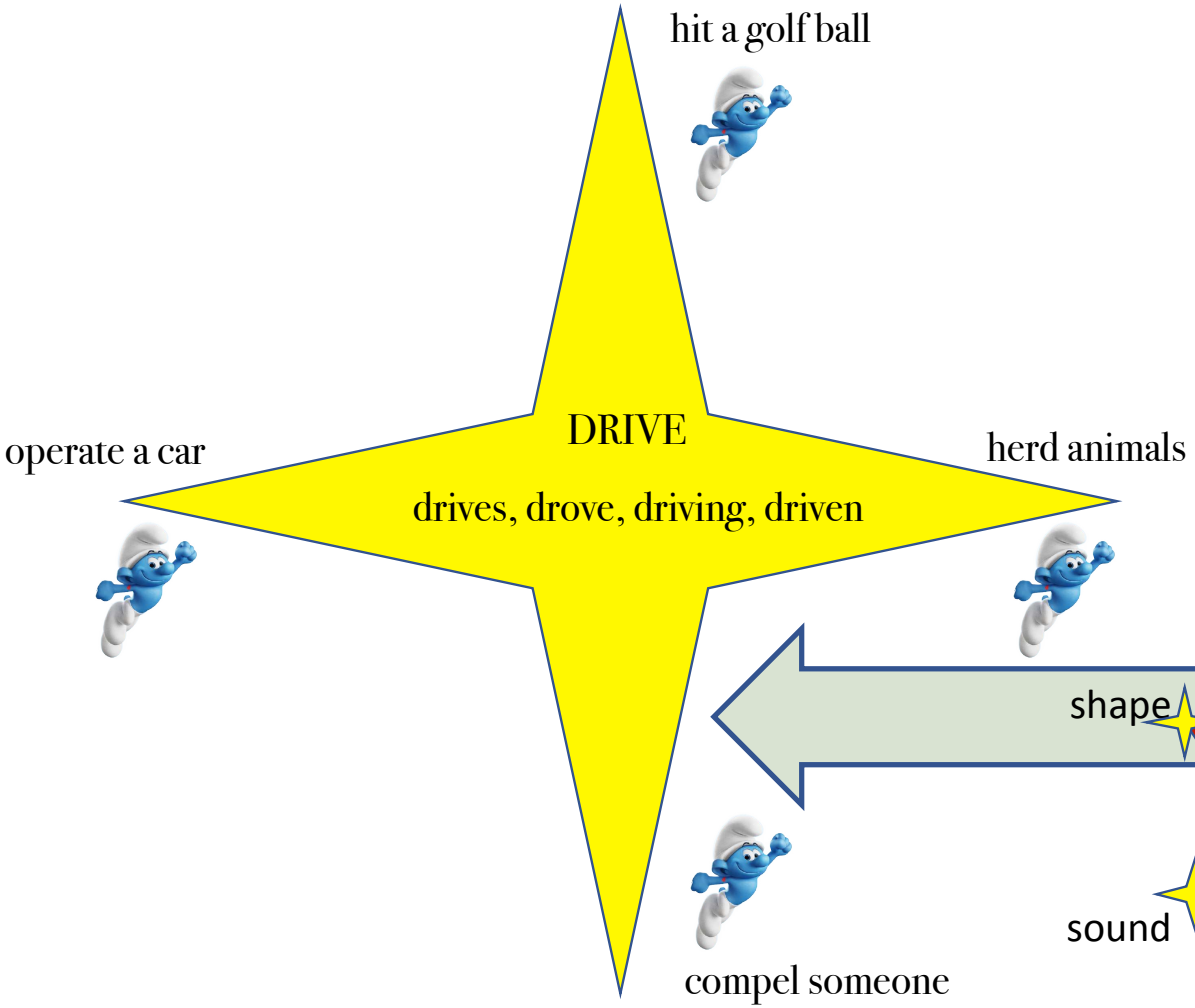

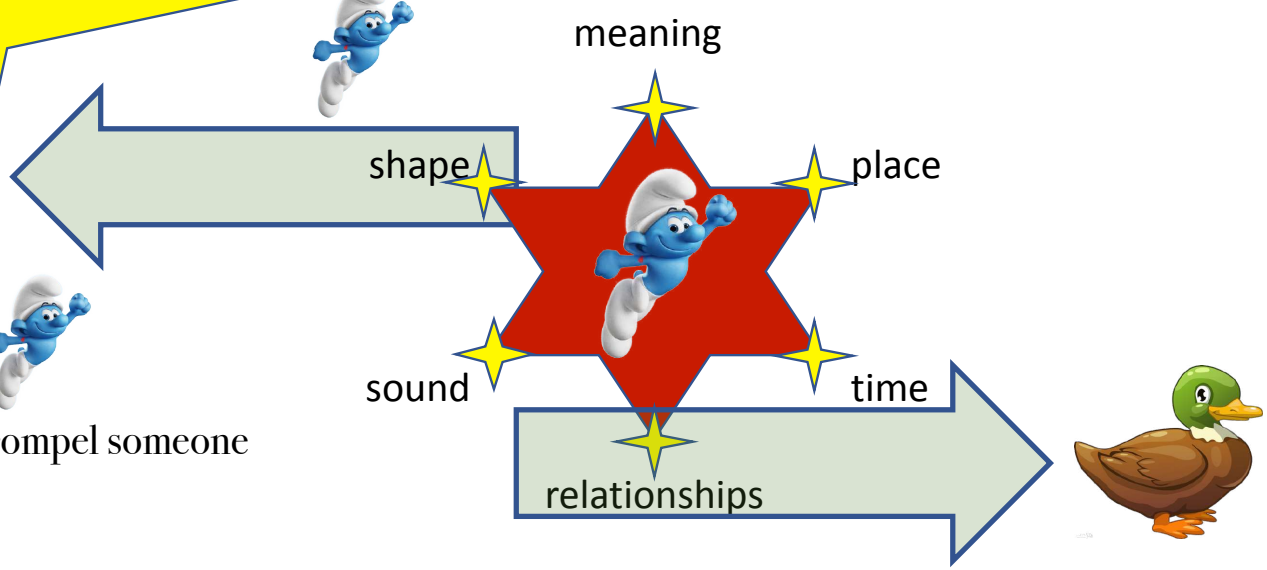

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Realistic Fantasies about Computation and Translation

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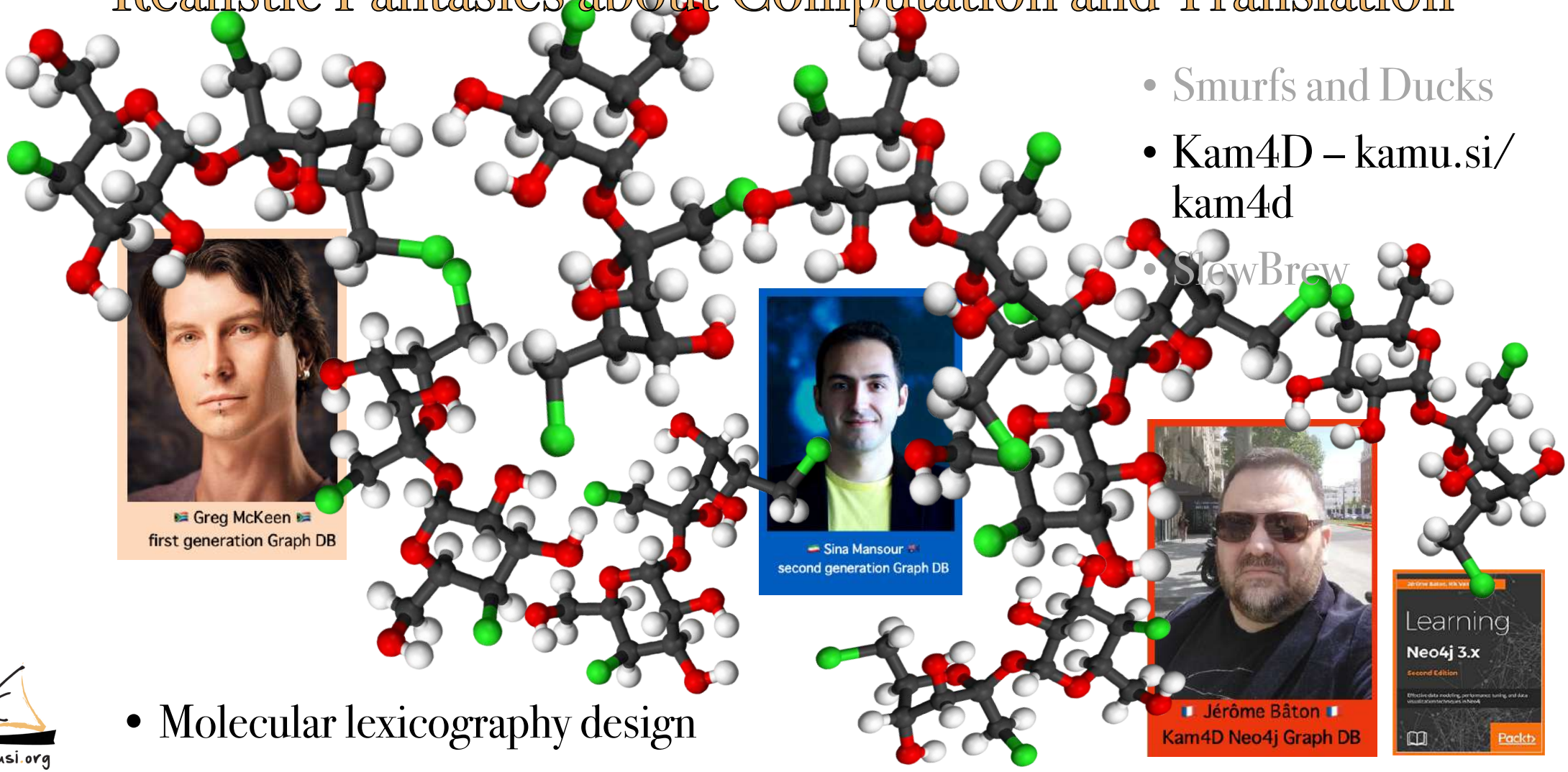

- Molecular lexicography design

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Realistic Fantasies about Computation and Translation

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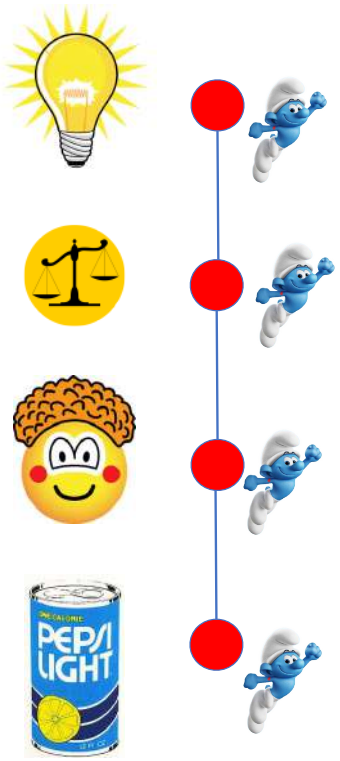
Realistic Fantasies about Computation and Translation

- User selects their meaning on the source side (predisambiguation)
  - Users can suggest missing senses



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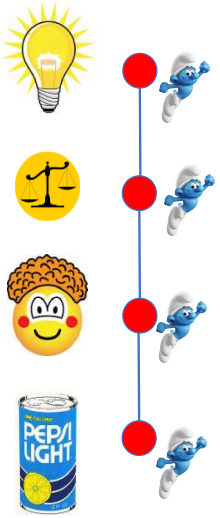

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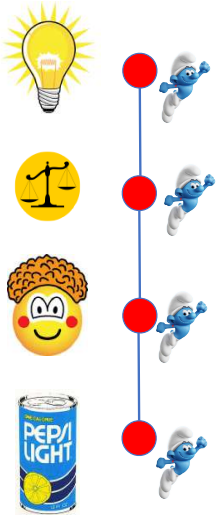
Realistic Fantasies about Computation and Translation



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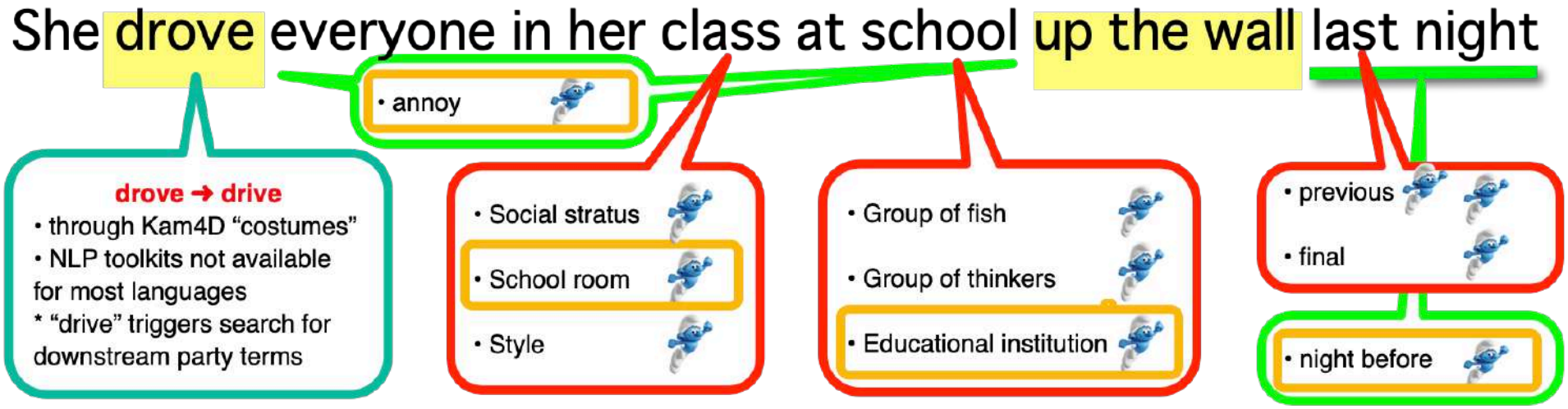

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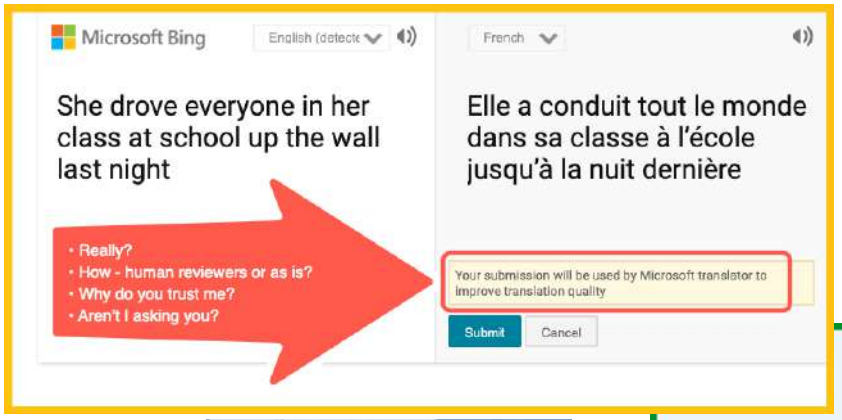

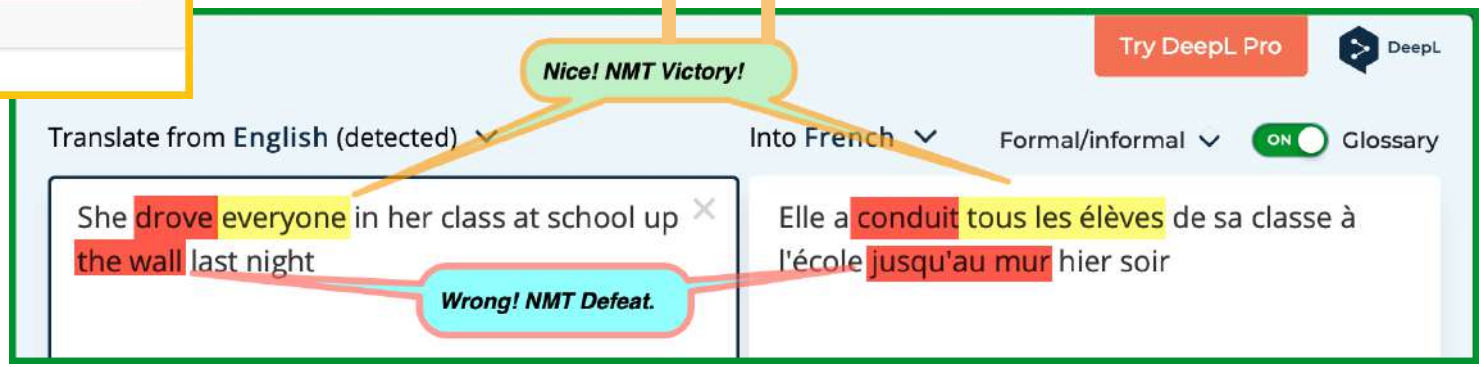

She drove everyone in her class at school up the wall last night

- annoy

drove → drive
- through Kam4D "costumes"
- NLP toolkits not available for most languages

* "drive" triggers search for downstream party terms

- Social stratus
- School room
- Style

- Group of fish
- Group of thinkers
- Educational institution

- previous
- final
- night before

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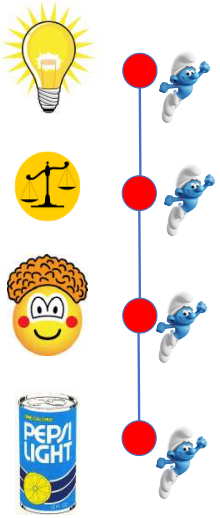
Realistic Fantasies about Computation and Translation



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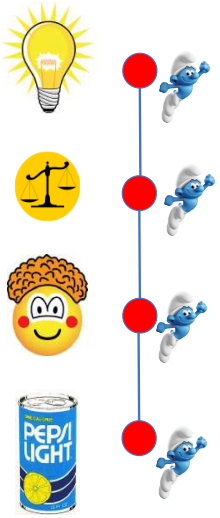

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- Machine learns from context-specific user selections
  - Crowdsourced dataset of spelling/meaning annotations
  - AI builds from human intelligence on the source-side

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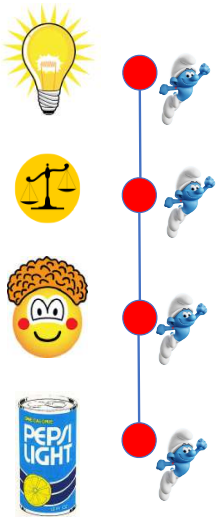
Realistic Fantasies about Computation and Translation



Unanswered Questions:

- Will users take the time to predisambiguate?
  - People take time to choose images
  - People take time to spellchick
- Syntax on the target side?
  - Outside Kamusi wheelhouse – partners needed
- How to pay for it?

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How AI Cured Coronavirus and Delivered Universal Translation, and Other MT Myths and Magic

martin@kamusi.org

recommended reading:
- ➢ teachyoubackwards.com
- ➢ kamu.si/kam4d

Martin Benjamin

18 November 2020 Translating and the Computer
ASLING TC42 online
Keynote Address