Languages of the World
(or why is MT so hard!)

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Why is MT hard?

Inspired by Josef van Genabith slides

Outline

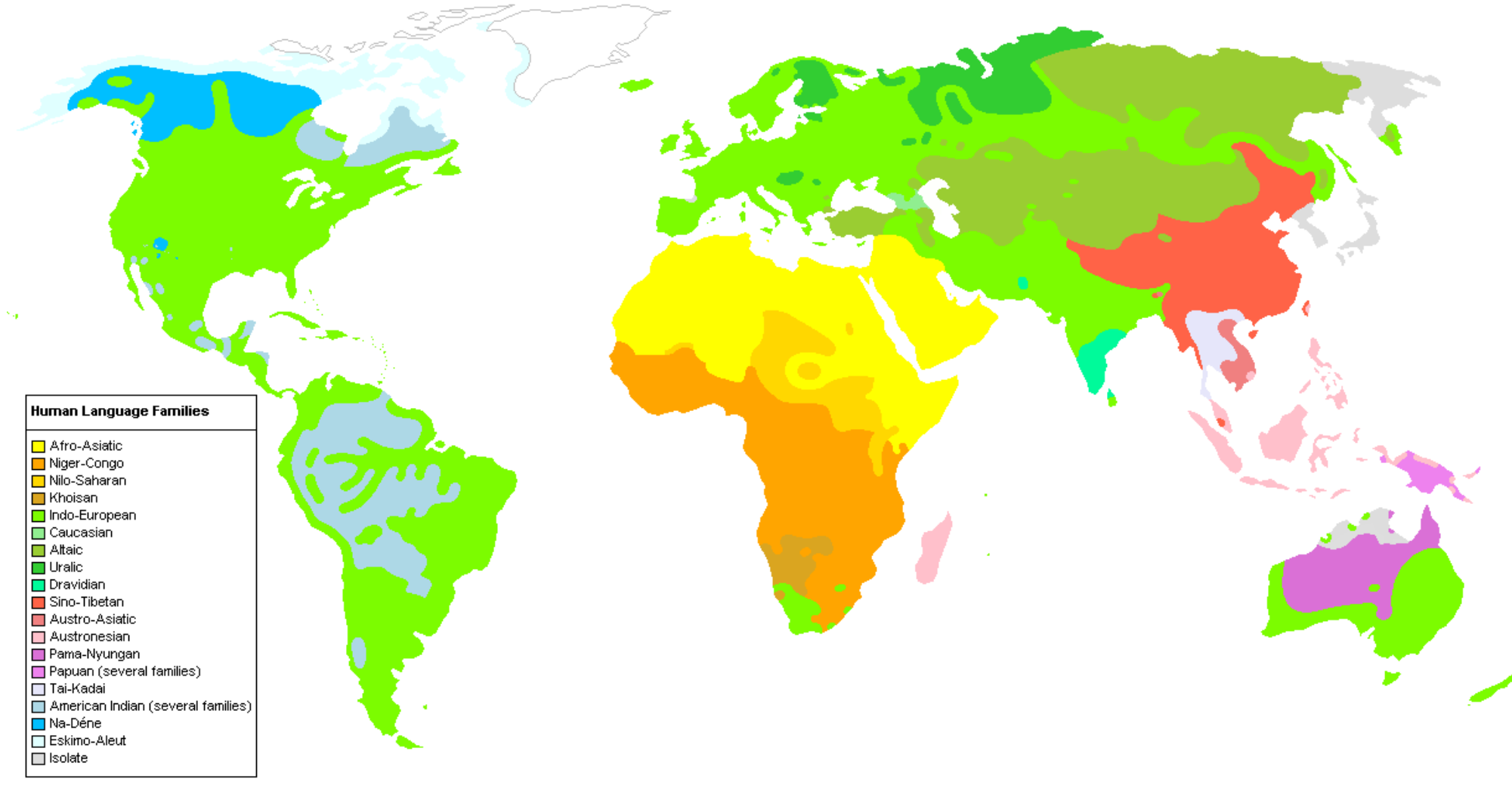
Languages of the World

Some Numbers

- There are more than **7000 languages**
  (even if the definition of language is not straightforward!)
- **141 language families**
  (6 of them account for 2/3 of all languages and 5/6 of the world's population)

Languages of the World

Language Families



Languages of the World

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Explore:

Ethnologue	`https://www.ethnologue.com/`
Glottolog	`http://glottolog.org/`
Linguistic Maps	`http://linguisticmaps.tumblr.com/`

Languages of the World

Distribution by number of first-language speakers

Population range	Living languages			Number of speakers	
	Count	*Percent*	*Cumulative*	*Total*	*Percent*
100,000,000 to 999,999,999	8	0.1	0.1%	2,736,892,880	40.38033
10,000,000 to 99,999,999	85	1.2	1.3%	2,699,413,660	39.82735
1,000,000 to 9,999,999	308	4.3	5.7%	962,414,866	14.19954
100,000 to 999,999	969	13.7	19.3%	309,471,921	4.56597
10,000 to 99,999	1,803	25.4	44.7%	61,598,950	0.90884
1,000 to 9,999	1,969	27.7	72.5%	7,516,041	0.11089
100 to 999	1,047	14.8	87.2%	466,977	0.00689
10 to 99	316	4.5	91.7%	12,150	0.00018
1 to 9	151	2.1	93.8%	608	0.00001
0	248	3.5	97.3%	0	0.00000
Unknown	193	2.7	100.0%		
Totals	7,097	100.0		6,777,788,053	100.00000

http://www.ethnologue.com/ethno_docs/distribution.asp?by=size#3

Languages of the World

Ranking by number of speakers

Rank	Language	Primary Country	Total Countries	Speakers (millions)
1	*Chinese [zho]*	*China*	*38*	*1,299*
2	Spanish [spa]	Spain	31	442
3	English [eng]	United Kingdom	118	378
4	*Arabic [ara]*	*Saudi Arabia*	*58*	*315*
5	Hindi [hin]	India	4	260
6	Bengali [ben]	Bangladesh	4	243
7	Portuguese [por]	Portugal	15	223
8	Russian [rus]	Russian Federation	18	154
9	Japanese [jpn]	Japan	2	128
10	*Lahnda [lah]*	*Pakistan*	*6*	*119*
11	Javanese [jav]	Indonesia	3	84.4
12	Turkish [tur]	Turkey	8	78.5
13	Korean [kor]	South Korea	6	77.2
14	French [fra]	France	53	76.8
15	German, Standard [deu]	Germany	28	76.0
16	Telugu [tel]	India	2	74.8
17	Marathi [mar]	India	1	71.8
18	Urdu [urd]	Pakistan	7	69.2
19	Vietnamese [vie]	Viet Nam	3	68.0
20	Tamil [tam]	India	7	66.7
21	Italian [ita]	Italy	14	64.8

Characteristics of Human Languages

Description

Human languages are a tool to communicate thoughts and they are

elegant, **efficient**, **flexible**, **complex**

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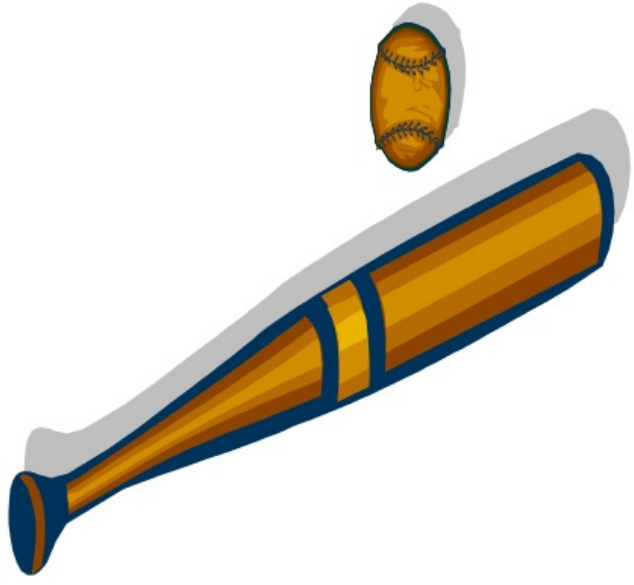
Cool for a human, but for a machine...

Characteristics of Human Languages

One word/sentence may mean many things

Homonymy and Polysemy

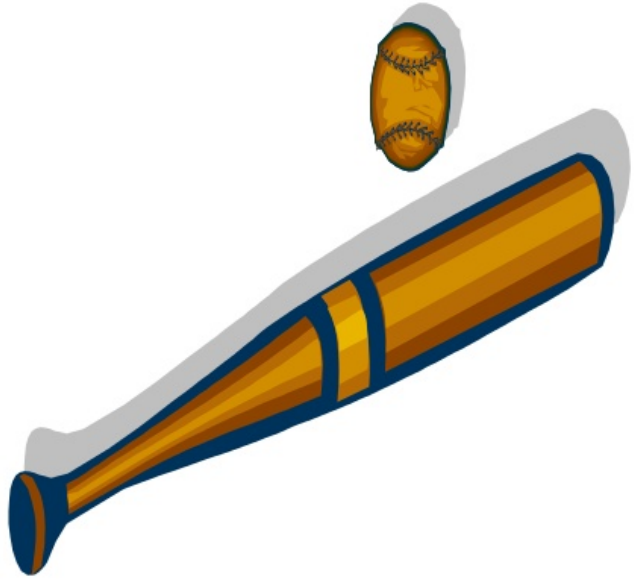


Characteristics of Human Languages

One word/sentence may mean many things

Homonymy and Polysemy

bat



Characteristics of Human Languages

Meaning depends on context

Bats!

Characteristics of Human Languages

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Bats! *(I'm inside a cave)*

Characteristics of Human Languages

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This **bat** is brown

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Meaning depends on context

Bats! *(I'm inside a cave)*

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Streaks and slumps are as common to baseball as **bats**

He **bats** the flies away

We **bat** around a wide variety of issues

When he told me what he'd done, I didn't **bat** an eye

Characteristics of Human Languages

Many ways of saying the same thing

Synonymy

gift **present**

Characteristics of Human Languages

Literal and figurative language (metaphors)

This coffee shop **is an ice box**

vs.

It is very cold in this coffee shop

Characteristics of Human Languages

Language is culture

The early bird catches the worm

vs.

Morgenstund hat Gold im Mund

vs.

Qui matina fa farina

vs.

A quien madruga, Dios le ayuda

Characteristics of Human Languages

Language is culture

Jurafsky & Martin, 2007 (Ch.25)

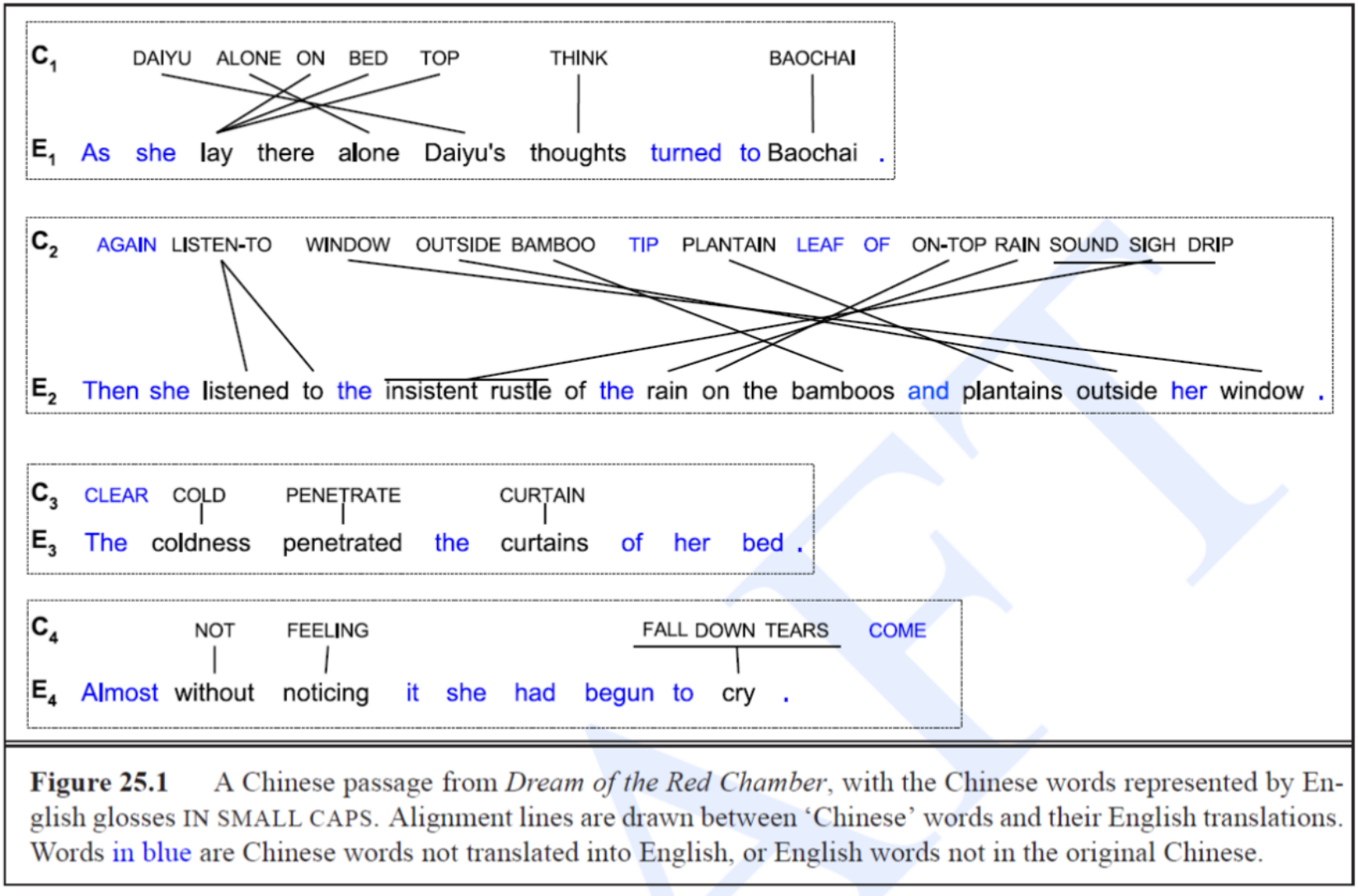

Figure 25.1 A Chinese passage from *Dream of the Red Chamber*, with the Chinese words represented by English glosses IN SMALL CAPS. Alignment lines are drawn between 'Chinese' words and their English translations. Words in blue are Chinese words not translated into English, or English words not in the original Chinese.

Universal Aspects

Cultures & Language

Different cultures share basic **concepts** and **actions** and communicate them with words

- Vocabulary: We all have a mother, a father, and see trees, water...
- Grammar: nouns and verbs

Non-Universal Aspects

Cultures & Language

But different cultures communicate them with words in different ways and cover different necessities

46 words for *snow* in Icelandic

https://reportsfromtherock.wordpress.com/page/2/

Non-Universal Aspects

Differences among languages

Besides different necessities for concepts and lexicon, languages differ in **morphology**

Aliikkusersuillammassuaanerartassagaluarpaalli

Non-Universal Aspects

Differences among languages

Besides different necessities for concepts and lexicon, languages differ in **morphology**

Western Greenlandic:
Aliikkusersuillammassuaanerartassagaluarpaalli

English:
However, they will say that he is a great entertainer but

Non-Universal Aspects

Differences among languages

Besides different necessities for concepts and lexicon, languages differ in **morphology**

Aliikkusersuillammassuaanerartassagaluarpaalli

`aliikku-sersu-i-llammas-sua-a-nerar-ta-ssa-galuar-paal-li`

`entertainment-provide-SEMITRANS-one.good.at-COP-say.that-REP-FUT-sure.but-3.PL.SUBJ/3SG.OBJ-but`

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Non-Universal Aspects

Morphology

Analytic/Isolating Languages

- low morpheme-per-word ratio and low inflection

Synthetic Languages

- high morpheme-per-word ratio

Polysynthetic	one word, many morphemes
Fusional	each morpheme denotes several features
Agglutinative	one morpheme per feature

Non-Universal Aspects

Morphology Examples

Analytic Mandarin

我 给 你 一本 书

I give you one book

Non-Universal Aspects

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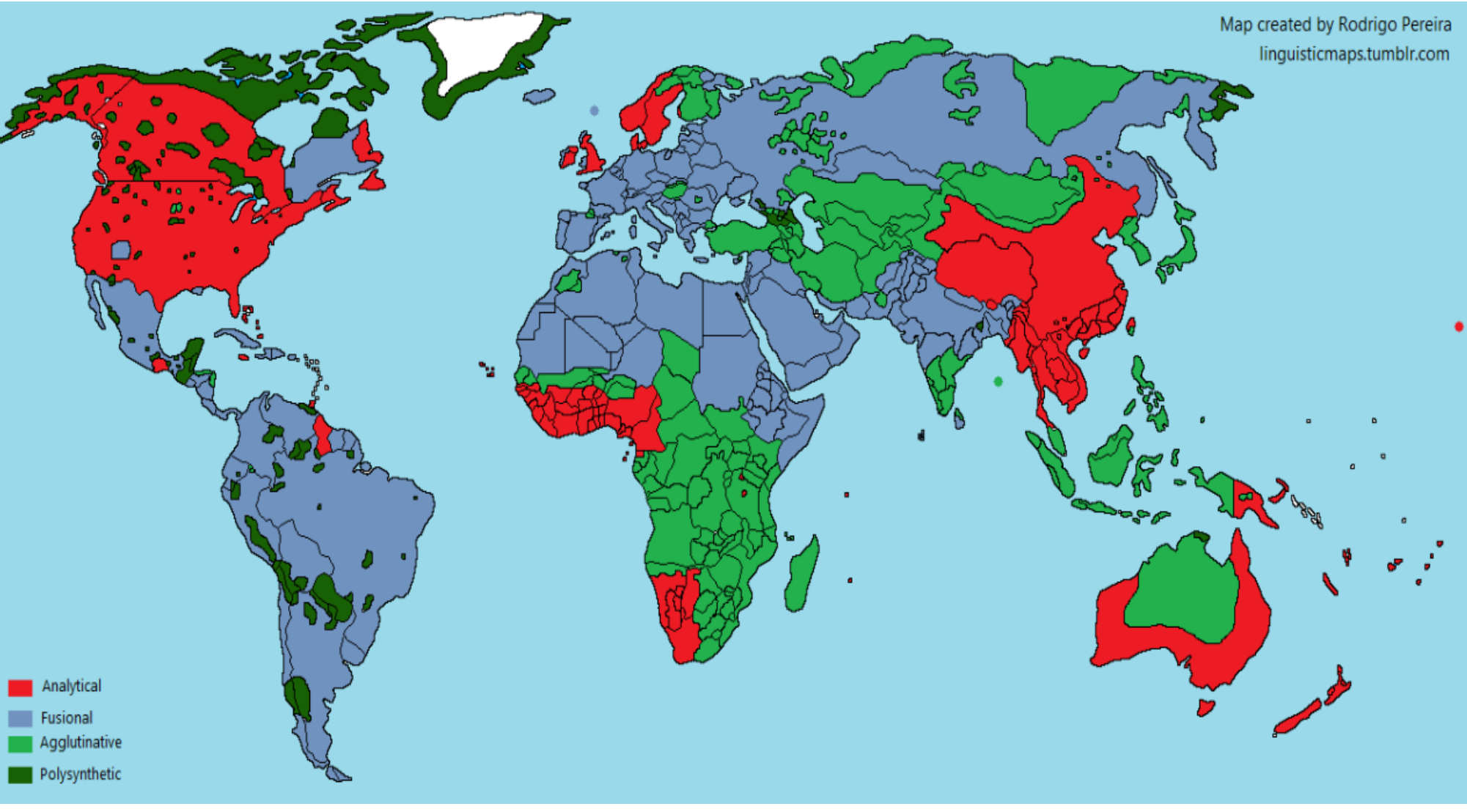
Agglutinative Turkish

evlerinizden

ev-ler-iniz-den: house, PL., your, from

Non-Universal Aspects

Distribution of Languages by Morphology Type



Non-Universal Aspects

Syntax

Declarative sentences with a **S**ubject, a **V**erb and an **O**bject can follow different orders

SOV: Japanese, Hindi...

`Inu ga` (subject) `neko` (object) `o oikaketa` (verb)

SVO: English, French, Mandarin...

`The dog` (subject) `chased` (verb) `the cat` (object)

VSO: Irish, Arabic...

`yutarid` (verb) `alkalb` (subject) `alqut` (object)

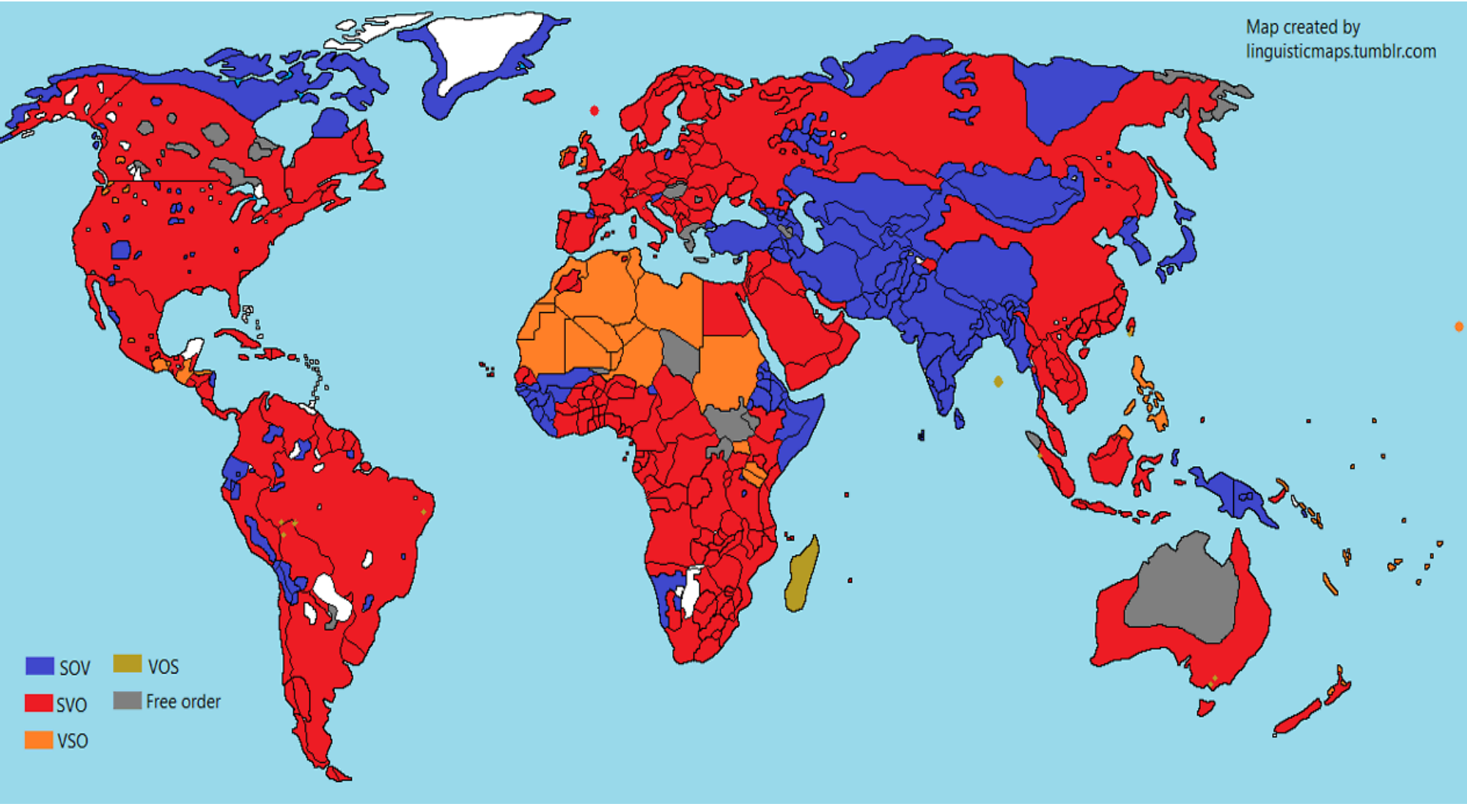
Non-Universal Aspects

Syntax – Observations

- Synthetic languages have more freedom in order than isolating languages
- SVO tend to have prepositions
- SOV tend to have postpositions

Non-Universal Aspects

Distribution of Languages by Syntax Type



Non-Universal Aspects

Other differences among languages

- Omision of elements (e.g. pronouns)
- Short range order

  Adj Noun Blue house
  Noun Adj Casa blava

- Structure, e.g. dates

  DD/MM/YY British English
  MM/DD/YY American English
  YY/MM/DD Japanese

Summary

Keep in mind

Remember all these aspects of languages when we design machine translation systems

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Remember all these aspects of languages when we design machine translation systems

Related **keywords** for Wednesday and later

`reordering model`

`interlingua`

`rule based`

`WSD`

`factored model`

`translation model`

`hierarchical`

`vocabulary`

Summary

Summary

By the way, I do:

How is German?

And your language?

Summary

References

- *Speech and Language Processing: An introduction to natural language processing, computational linguistics, and speech recognition.* Daniel Jurafsky & James H. Martin. 2007. Chapter 25.
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- *Languages of the world*. Slides of the course. Gerhard Jäger