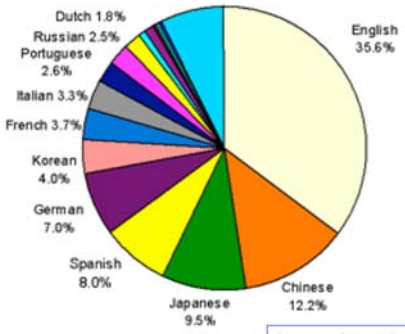
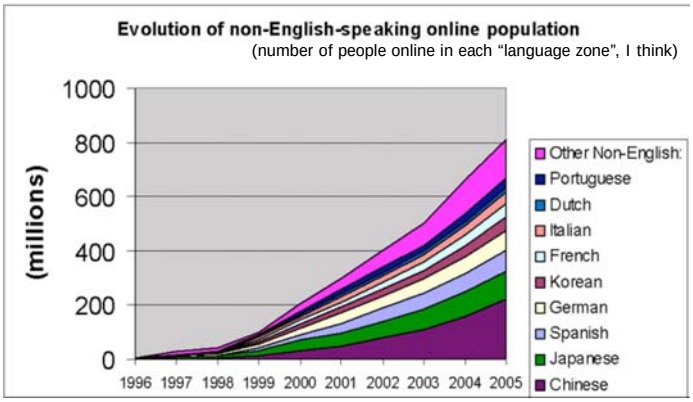
Learning to Translate



Source: Global Reach (www.glreach.com)



Source: Global Reach (www.glreach.com), 11/2003

Machine Translation in the 1950's

- "We'll have this up and running in a few years, it'll be great, give us lots of $$$"
- Oops! Foundered on word-sense disambiguation.
- Nearly sank funding for all of AI.

Currently available technology

(L&H translator, via Japanese)

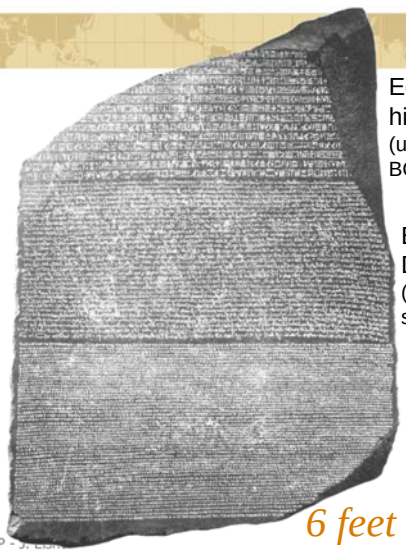
At the beginning a god created Hajime for the sky and the earth. The earth is frozen as missing, formlessly, darkness was frozen as ceasing, and superficially, deeply, then a divine mind moved on a surface of water.

(Babelfish translator, via Japanese)

God drew up the heaven and the earth with beginning. The earth the formless and was invalid, as for the darkness there was a surface being deep, mind of God was moving to the surface of the water.

The Rosetta Stone (196 BC)

found 1799; hieroglyphs decoded in 1822 by Champollion



Egyptian: hieroglyphs (used from 3300 BC – 400 AD)

Egyptian: Demotic (a late cursive script)

Greek (the language of Ptolemy V, ruler of Egypt)

6 feet tall

The online Bible as Rosetta Stone

English: In the beginning God created the heavens and the earth.
Spanish: En el principio crió Dios los cielos y la tierra.
French: Au commencement Dieu créa les cieux et la terre.
Haitian: Nan konmansman, Bondye kreye syèl laak latèa.
Danish: Begyndelsen skabte Gud Himmelen og Jorden.
Swedish: I begynnelsen skapade Gud himmel och jord.
Finnish: Alussa loi Jumala taivaan ja maan.
Greek: *Εν αρχη εποιησεν ο Θεοζ τον ουρανον και την γην.*
Latin: in principio creavit Deus caelum et terram
Vietnamese: Ban dâu Đúc Chúa Trời dung nên trời dât.

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Where's "heaven" in Vietnamese?

English: In the beginning God created the **heavens** and the earth.
Vietnamese: Ban dâu Đúc Chúa Trời dung nên trời dât.

English: God called the expanse **heaven**.
Vietnamese: Đúc Chúa Trời dat tên khoang không la trời.

English: … you are this day like the stars of **heaven** in number.
Vietnamese: … các nguoi dông nhu sao trên trời.

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"Created" in Vietnamese?

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English: God **created** the great sea monsters …
Vietnamese: Đúc Chúa Trời dung nên các loài cá lón …

English: God **created** man in His own image …
Vietnamese: Đúc Chúa Trời dung nên loài nguòi nhu hình Ngài …

"Created" in Vietnamese? Uh-oh

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"God" has a stronger claim …

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… "created" makes do with rest

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What's "bathroom" in Vietnamese?

- Bible only gives you "begat," not "bathroom" – but web is much bigger
- Find bilingual web pages automatically
  - "Click for English / Français"
  - Government, tourist, commercial, tech ...
- Run this strategy on them automatically
- Get a dictionary
- Uses: multilingual search, translation aid ...

Competitive Linking Algorithm

… nod your head … wag your tail … head of the class … swollen head …
… hochez la tête … hochez la queue … en tête de la classe … bouffant d'orgeuil …

Head ≠ hochez … but often paired
head = tête … though not always
nod = hochez … though not always

1. Link words that look alike or often go together.
2. Make a tentative French-English dictionary of linked words.

(or if such a dictionary exists already, maybe you can convince the publisher to give you the typesetting files – will work better)

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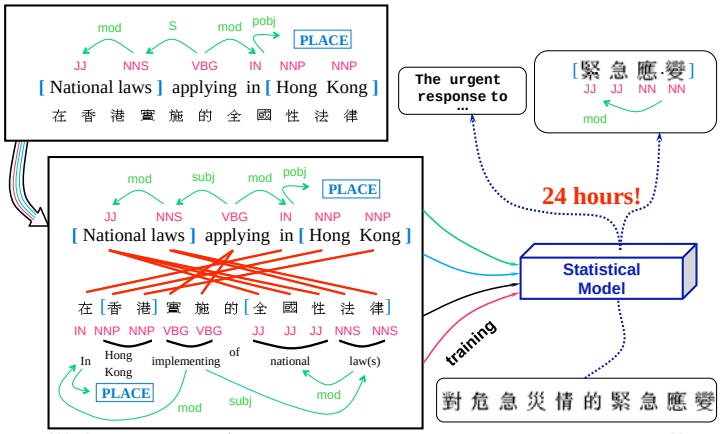
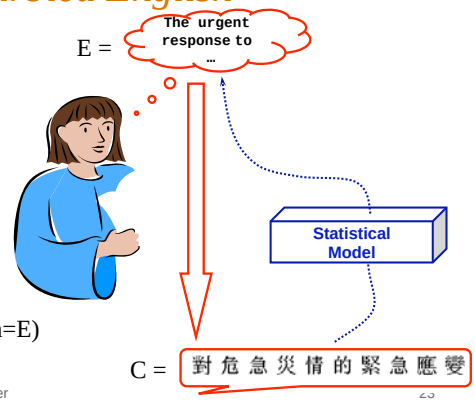
1. Link words that look alike or often go together.
2. Make a tentative French-English dictionary of linked words.
3. Use the dictionary to greedily guess each word's best link.
4. Use the links to get a better dictionary.
5. Repeat!

Translingual Knowledge Projection and Statistical Machine Translation



Noisy Channel Model: Chinese as Garbled English

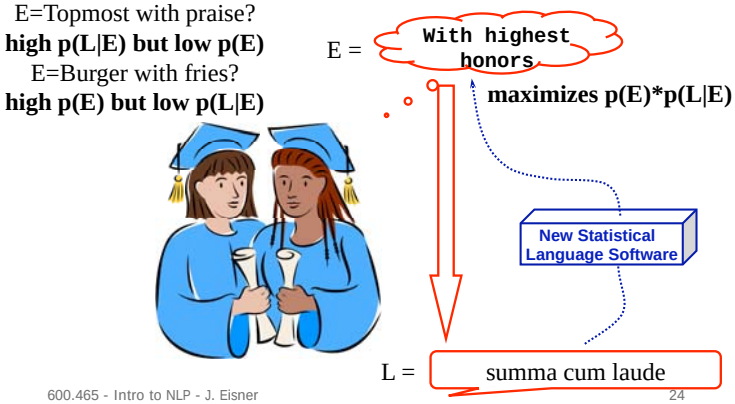


Given input C, software chooses E that maximizes

p(English=E)
x
p(Chinese=C | English=E)

Latin as Garbled English

E=Topmost with praise?
high p(L|E) but low p(E)
E=Burger with fries?
high p(E) but low p(L|E)



What are the models?

- Source model p(E) could be trigram model
  - Guarantees semi-fluent English
- Channel model p(C|E) or p(L|E) could be finite-state transducer
  - Stochastically translates each word + allows a little random rearrangement – with high prob, words stay more or less put
  - Maximizing p(C|E) would give really lousy Chinese translation of English
    - Random word translation is stupid – need word sense from context
    - Random word rearrangement is stupid – phrases rearrange!
    - This channel has no idea what fluent Chinese looks like
  - But maximizing p(E)*p(C|E) gives a better English translation of Chinese because p(E) knows what English should look like.
- Currently trying to make these models less stupid.