

Linguistic & social interaction

Methods in AI research

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Practicalities

- **Literature for today:**
 - (optional) *Speech & Language processing*, Section 25.5 (25.5 Natural language generation in the dialog-state model)
 - (optional) *Computational Sociolinguistics: A Survey*, Nguyen et al. 2016
https://www.mitpressjournals.org/doi/full/10.1162/COLI_a_00258#.V-jwiqJ95cR

Language

Making sense of language is more than recognising linguistic content

- Making sense of language involves discovering the goals of different bits of content
- and the way different bits of content connect
- and the broader (social) context in which it was uttered



Speaker



Hearer

Speakers do
not act in
isolation!

What do utterances do?

(Historic view) Language
allows us to *describe* the world

But...

What do utterances do?



I hereby bet you
10 euros it won't
rain tomorrow

What do utterances do?



Order!



Speech Act Theory

- By Austin (*How to Do Things with Words*, 1962) and developed further by Searle.
- So far, focus had been on utterances that describe the state of affairs, but there are utterances for which it doesn't make sense to say whether they are *true or false*
- Austin distinguished between:
 - **Constatives:** true/false statements
 - **Performatives:** action (do)

What do utterances do?

abjure, abolish, accept, acknowledge, acquit, admit, admonish, advise, affirm, agree to, announce, answer, apologize, ascribe, ask, assent, assert, assess, assume, authorize, baptize, beg, bet, bid, call upon, caution, charge, christen, claim, classify, command, commiserate, compliment, concur, congratulate, conjecture, convict, counsel, declare, declare out, delegate, demand, demur, deny, describe, diagnose, disagree, dispute, donate, dub, excuse, exempt, fire, forbid, give notice, grant, guarantee, guess, hire, hypothesize, identify, implore, inform, instruct, license, name, notify, offer, order, pardon, permit, plead, pray, predict, prohibit, promise, proscribe, query, question, rank, recommend, refuse, reject, renounce, report, request, require, rescind, resign, sanction, say, sentence, state, submit, suggest, summon, suppose, swear, tell, testify, thank, urge, volunteer, vouch for, warn, withdraw

from: Keith Allan, "Meaning and Speech Acts"

<http://users.monash.edu.au/~kallan/papers/Speechacts.html>

Types of acts

Austin identifies three types of acts that are performed simultaneously:

- *locutionary act*: basic act of uttering a linguistic expression (*‘what is said’*)
- *illocutionary act*: the kind of action the speaker *intends* to accomplish (*‘what is meant’*), e.g. thanking, ...
 - often this is what referred to when people talk about *speech acts*
- *perlocutionary act*: effects produced on the audience

Relations between Acts

The same *locutionary* act can have different illocutionary forces in different contexts:

- The gun is loaded (threatening, explaining)

The same *illocutionary* act can be realised by different locutionary acts:

- Could you close the door
- Close the door, please

Speech Act taxonomy (Searle)

category	description	example
assertives	committing S to something being the case; causing H to believe something	<i>I make the best cake, She is a great leader</i>
commissives	committing S to do something	<i>I promise that I will.. I will bring the book</i>
directives	getting H to do something	<i>Could you close the door, Turn off the music</i>
expressives	expressing how S feels about a situation	<i>I'm sorry that.. I'm thrilled you will ..</i>
declarations	they immediately change the state of the world	<i>You are fired</i>

How do speech acts come about?

Convention

- speech acts can be linguistically marked
- large variety of how this happens

Out!

Tennis

I now pronounce you
husband and wife!

Priest/registrar

Order!

Speaker of the house

- specific socially recognised situations
- involving agents with specific socially recognised authority

How do speech acts come about?

Convention

- speech acts can be linguistically marked
- large variety of how this happens

The performative formula:

I (hereby) VERB X

I thank you for
helping me

I withdraw from the
competition

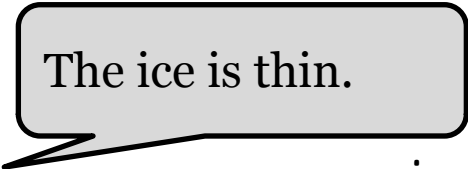
I admit I was wrong

Compare to: I admitted I was wrong

How do speech acts come about?

But

- very often, a speech act is not marked as such
- speech acts can be complex



The ice is thin.

warning



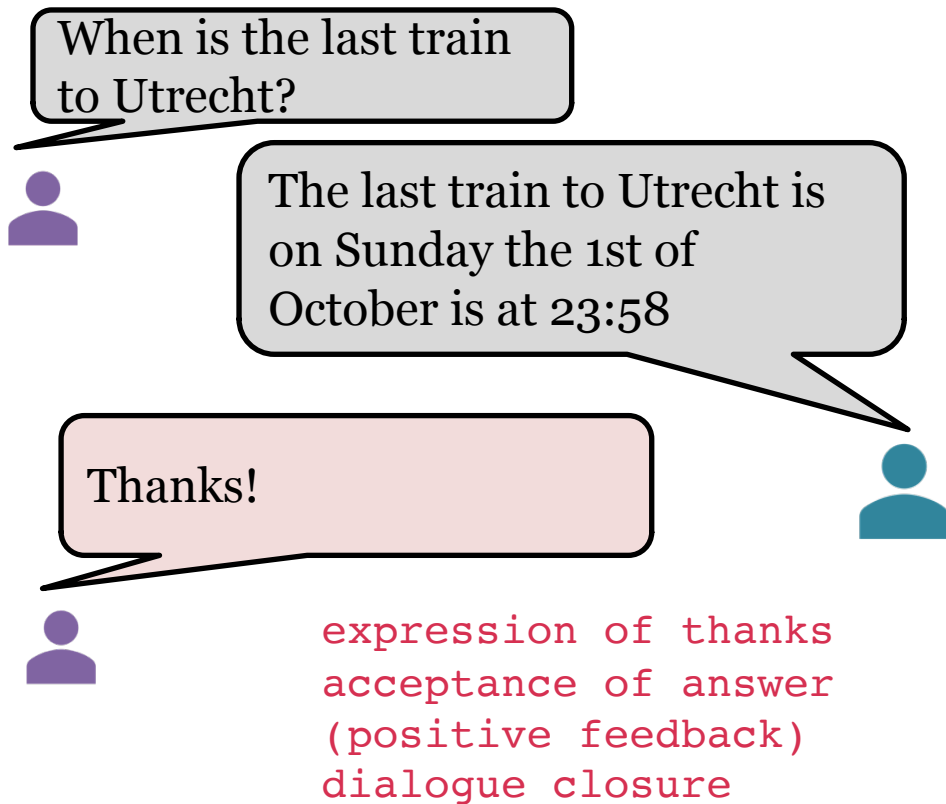
Can you pass the salt?

directive

How do speech acts come about?

But

- very often, a speech act is not marked as such
- speech acts can be **complex**



Dialog acts

- Speech act theory focusses on the intentions of the speaker. But a dialogue is not simply a sequence of actions each performed by individual speakers.
- Dialogue requires **coordination** amongst participants.
 - Many actions in dialogue serve to manage the interaction itself (e.g. grounding). These are overlooked by speech act theory
- Dialog acts extends the notion of speech acts for conversational phenomena.

Conversational structure

- **Adjacency pairs:** Pairing of two dialog acts
 - *Questions and answers, greeting and greeting, proposal and acceptance (or rejection)*

Use: I want to fly from UNKNOWN to London

System: Let's see, where do you want
to fly from?

User: Barcelona

System: Ok, here are some flights from
Barcelona to London

Side sequence
(here: clarification
question)

Identifying dialog acts

Words:

- *Please*..., *would you*... (request)

Conversational structure:

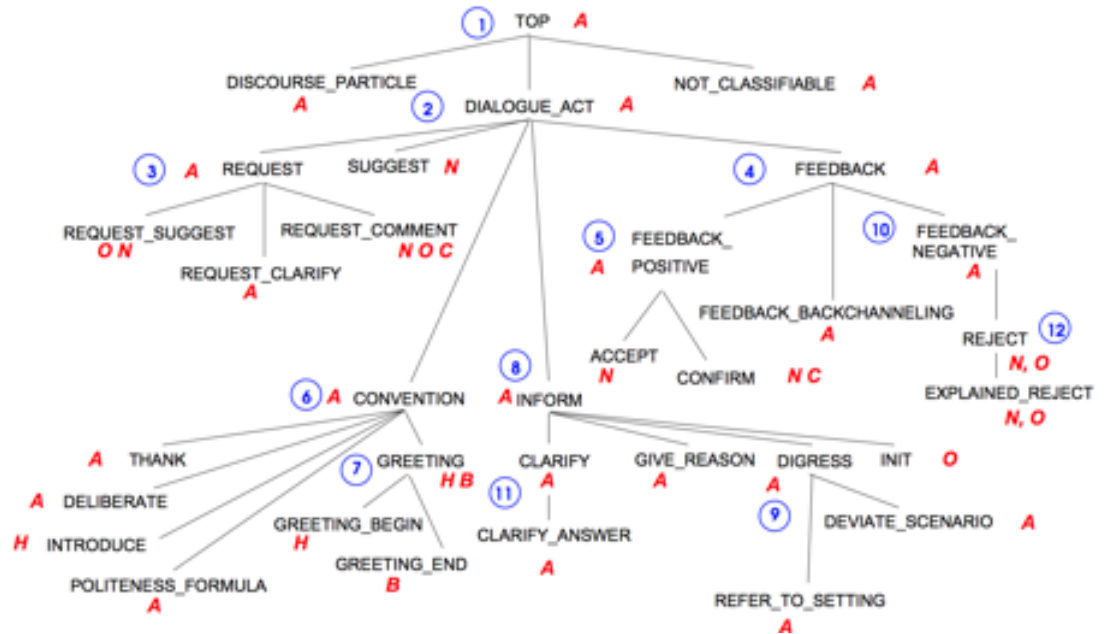
- *yeah* after a proposal vs. *yeah* following an inform

Prosody:

- Final rising pitch (question)

VerbMobil-2

Acts specific to
meeting scheduling
domain



Dialogue Acts in VERBMOBIL-2,
Alexandersson et al., 1997

Switchboard Dialog Acts



Hi, Wanet <last name>

Conventional-opening



How are you?

Conventional-opening



I'm doing fine

Conventional-opening



Where you from?

Wh-Question



I'm from New England

Statement-non-opinion

<http://compprag.christopherpotts.net/swda.html>

Applications

- Dialog systems!
- **E-mail assistant (Cohen et al. 2004)**
- Conversation analysis (Twitter, e-mails, dating)

Bill, Do you have any sample scheduling-related email we could use as data? -Steve	Assistant announces: "new email request , priority unknown."
Sure, I'll put some together shortly. -Bill	Assistant: "should I add this new commitment to your to- do list?"
Fred, can you collect the msgs from the CSPACE corpora tagged w/ the "meeting" noun, ASAP? -Bill	Assistant: notices outgoing request , may take action if no answer is received promptly.
Yes, I can get to that in the next few days. Is next Monday ok? -Fred	Assistant: notices incoming commitment . "Should I send Fred a reminder on Monday?"

(Cohen et al. 2004)

Applications

- Dialog systems!
- E-mail assistant (Cohen et al. 2004)
- **Conversation analysis (Twitter, e-mails)**

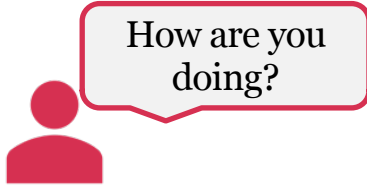
Prabhakaran & Rambow 2017

analyzed over 90k e-mails from the Enron corpus to study power structures, by making use of dialog acts:

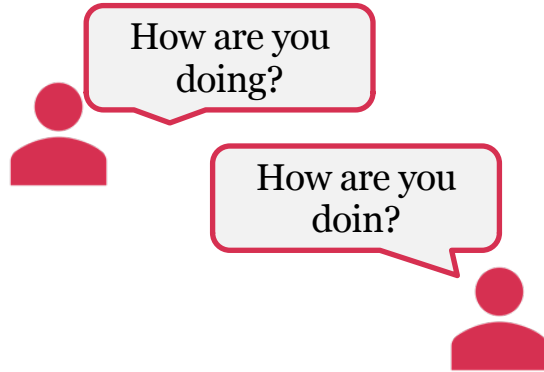
- Request Action
- Request information
- Inform
- Conventional (e.g. greetings)

Language and social interaction

Social meaning



Social meaning



Social meaning



Social media

The phrase “never won an Oscar” can no longer apply to Leonardo DiCaprio. The actor, who was famously snubbed by the Academy five times, was awarded best actor for his performance in “The Revenant.” DiCaprio was heavily favored to win, with many a fan and critic declaring he “deserves” it now more than ever.

(The Washington Post, Feb. 29, 2016)



LLCOOLJ. @llcoolj · Feb 29

I'm truly happy for this guy...
leonardodicaprio congrats man.. great
message.. #oscars...
[instagram.com/p/BCXBg4XI6lp/](https://www.instagram.com/p/BCXBg4XI6lp/)



184



715



Oprah Winfrey @Oprah · Feb 29

It Happppppppened!! bravo Leo! standing O in
my p.j's. #Oscars 🏆



3.9K



9.7K



**Language variation
carries social
meaning.**

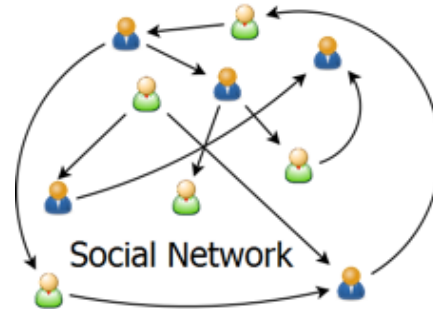
Normalization throws
away meaningful
signals (**Eisenstein**
2013)



Sociolinguistics

Sociolinguistics is the descriptive study of the effect of any and all aspects of society, including cultural norms, expectations, and context, on the way language is used, and the effects of language use on society.

(Wikipedia)



Computational Sociolinguistics

Computational methods to study how **language and society** relate

- Combining ideas and methods from both sociolinguistics and computer science
- See Nguyen et al., Computational Linguistics, 2016

Motivation

- Better NLP tools
- Testing and refining theories using large-scale naturalistic text data
- New analysis tools for sociolinguists and social scientists
- More fine-grained analyses of online behavior (e.g., user profiling, participation in campaigns)

Gezellig bij Emily en Charlotte.
Translation: Having fun with Emily
and Charlotte.

Hiiiiii schatjesss!
Translation: Hiiiiii cutiesss!

♥ @USER

Goodmorning

Saaie middag.
Translation: Boring afternoon

How old?

Gezellig bij Emily en Charlotte.
Translation: Having fun with Emily
and Charlotte.

Hiiiiii schatjesss!
Translation: Hiiiiii cutiesss!

♥ @USER

Goodmorning

Saaie middag.
Translation: Boring afternoon

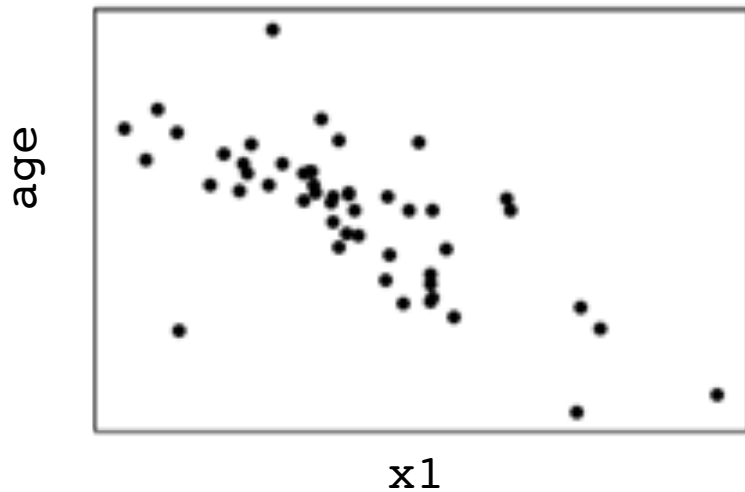
15 year old

*We asked 220 people:
average guess 16.7 years*

How old?

RECAP!

Regression



How do we get the training data?

features

target

$$\{ \langle \mathbf{x}^{(1)}, \mathbf{y}^{(1)} \rangle, \dots, \langle \mathbf{x}^{(N)}, \mathbf{y}^{(N)} \rangle \}$$

Goal: Predict the target using the features

Regression task:

Output is a continuous value ($\mathbf{y} \in \mathbb{R}$)

Notation:

Each instance $\mathbf{x}^{(i)}$ has d features:

$$[x_1, \dots, x_d]$$

$x_j^{(i)}$: the j^{th} feature of instance i

Data collection: self-reported



user-provided information

disadvantages:
biases? availability?

advantage:
high accuracy



Data collection: annotation

disadvantages:

time-consuming
annotator biases

advantage:

random set



text

name

picture

linked profiles (e.g., LinkedIn)

Data collection: derived

Location:

Tweets with GPS
coordinates

```
u'geo': {  
  u'type': u'Point',  
  u'coordinates':  
  
    [51.452131,  
      6.05643]  
}
```

Gender:

Names

biases?

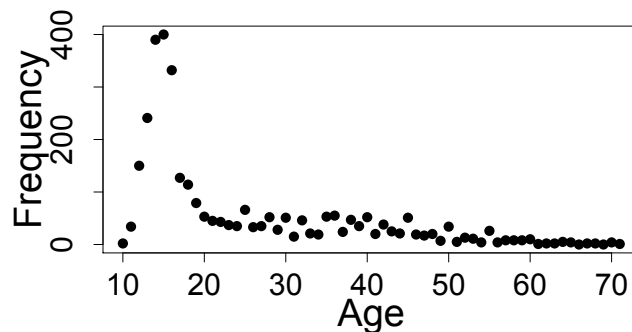
Popular Names in 1980 (SSA)

Rank	Male name	Female name
1	Michael	Jennifer
2	Christopher	Amanda
3	Jason	Jessica

<https://www.ssa.gov/oact/babynames/>

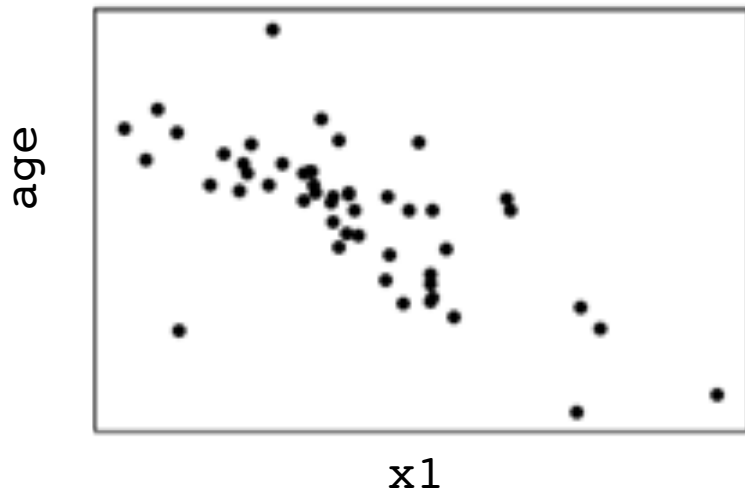
Nguyen et al (2013): data collection

- Goal: Sample a ‘representative’ set of Dutch Twitter users
- How: Sample based on ‘*het*’ (definite article, pronoun)
- Two annotators annotated demographic information age, based on social media profiles (Twitter, Facebook, LinkedIn), tweets etc



RECAP!

Regression



features

target

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Age prediction: features

Younger

- first (*I*) and second (*you*) singular pronouns
- alphabetical lengthening
- capitalization of words
- slang words
- Internet acronyms

Older

- first (*we*) plural pronouns
- prepositions
- determiners
- articles
- longer words
- longer sentences
- links
- hash tags

Features: just unigrams
(we also tried more
advanced ones, did not
help performance much)

*See
Nguyen et
al. (2016)
for a more
detailed
overview*

adolescents use the **most non-standard** forms



RECAP !

Linear regression

For each feature x_j we learn a weight w_j , so $w \in \mathbb{R}^d$ and $b \in \mathbb{R}$. Given an instance, map it to a real number:

$$\begin{aligned} y &= b + w_1 x_1 + \dots + w_d x_d \\ &= b + \sum w_i x_i = b + w \cdot x \end{aligned}$$

Diagram illustrating the linear model equation: $y = b + w_1 x_1 + \dots + w_d x_d$. The term b is labeled "bias" with a green arrow. The terms $w_1 x_1$ and $w_d x_d$ are labeled "weights" with blue arrows.

This is a **linear model**.

features target
 $\{ \langle x^{(1)}, y^{(1)} \rangle, \dots, \langle x^{(N)}, y^{(N)} \rangle \}$

Goal: Predict the target using the features

Regression task:

Output is a continuous value ($y \in \mathbb{R}$)

Notation:

Each instance $x^{(i)}$ has d features:

$[x_1, \dots, x_d]$

$x_j^{(i)}$: the j^{th} feature of instance i

Prediction experiments

We used linear regression
with **L2 regularization**

How well does the model
perform?

- $r = 0.8845$
- Mean absolute error:
3.8812

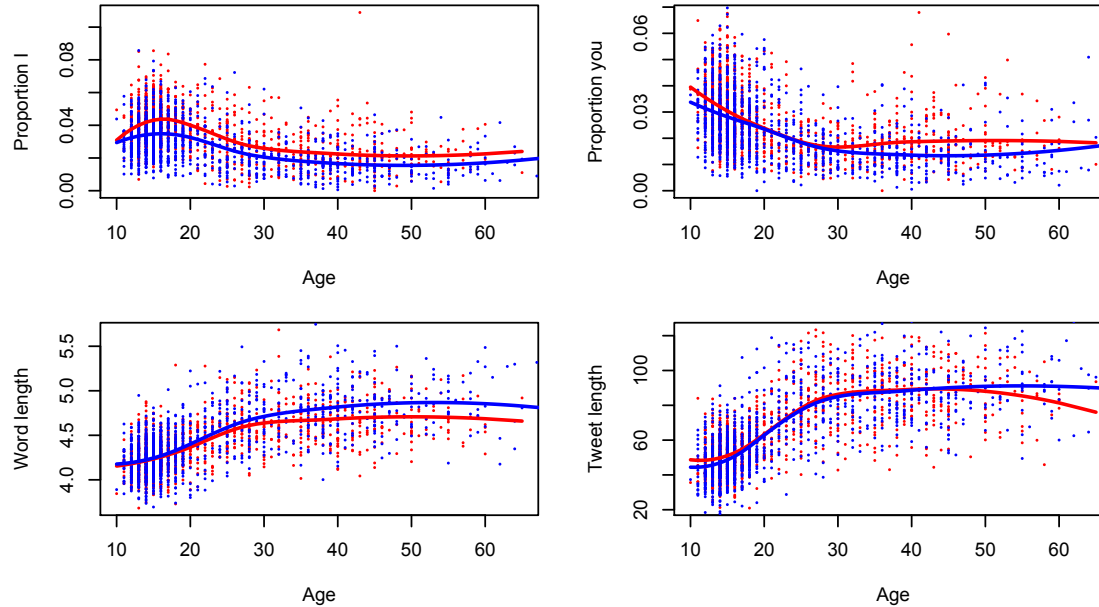
Dutch	English
school	school
ik	I
:)	:)
werkgroep	work group
stages	internships
oke	okay
xd	xd
ben	am
haha	haha
als	if

Younger users

Dutch	English
verdomd	damn
dochter	daughter
wens	wish
zoon	son
mooie	beautiful
geniet	enjoy
dank	thanks
goedemorgen	good morning
evalueren	evaluate
sterkte	take care

Older users

Language & Age



D. Nguyen, R. Gravel, D. Trieschnigg and
T. Meder: "How Old Do You Think I Am?": A
Study of Language and Age in Twitter.
ICWSM 2013

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Sentiment analysis

★★★★★ Best protective screen around

In 20 odd years of having a mobile I must dropped a mobile maybe 2/3 times but luckily the screen never cracked.this year alone I dropped my mobile 6 times in 2 days and the only thing that stopped the screen from cracking was this protecting tempered screen which cracked.
I can't recommed this product enough

★☆☆☆☆ Waste of money

How can this product be 'amazons choice'? I found it to be a waste of money. Says it fits iPhone 7 but doesn't even cover the width of the active part of the screen. The packaging (which says iPhone 7/8 on a sticker on one side and iPhone 5 on the other) had previously been opened and both protectors had feint scratches the whole way from top to bottom. Alignment stickers not sticky enough so came off when trying to fit the protector so ended up crooked. Not happy with this purchase at all.

Sentiment analysis

Every single shot is masterfully created and there are some genuinely scary scenes which will make you sit on the edge of your seat. (IMDB review)



What it's like to drive?

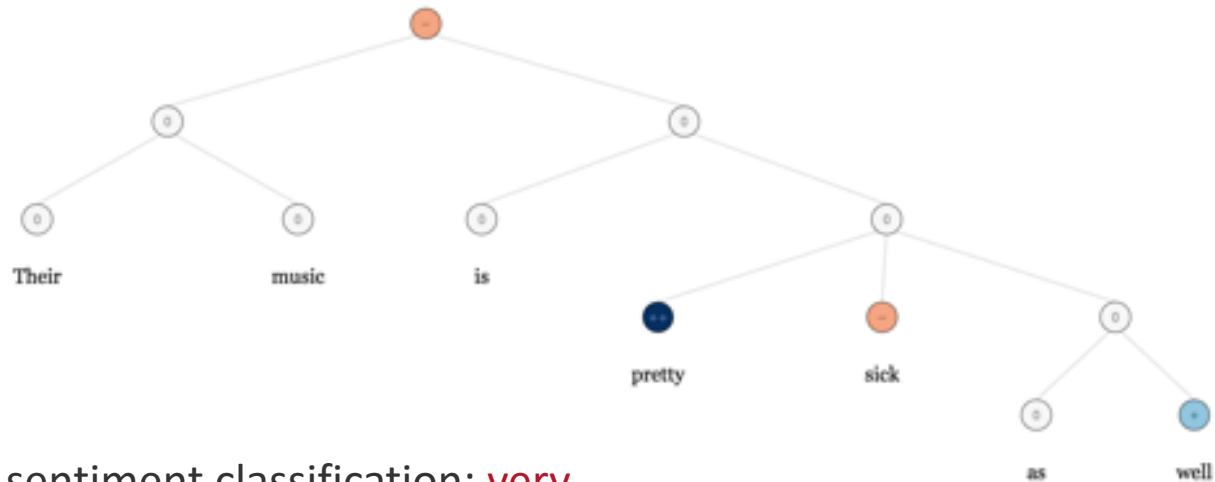
A bit scary at times but handles better in the dry



Whether 'scary' is positive or negative depends on the domain!

Sentiment analysis

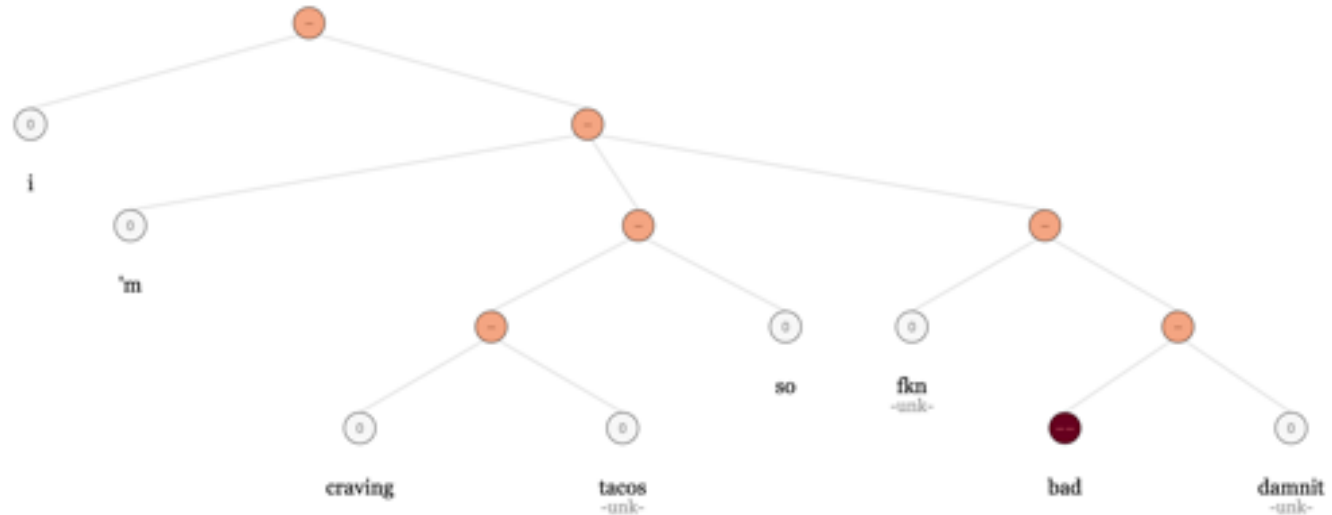
Their music is pretty sick as well



There are 5 classes of sentiment classification: **very negative**, **negative**, neutral, **positive**, and **very positive**.

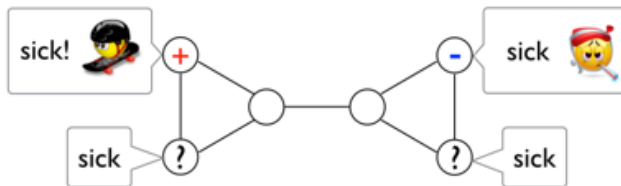
Sentiment analysis

i'm craving
tacos so fkn
bad damnit



There are 5 classes of sentiment classification: **very negative**, **negative**, neutral, **positive**, and **very positive**.

Sentiment analysis



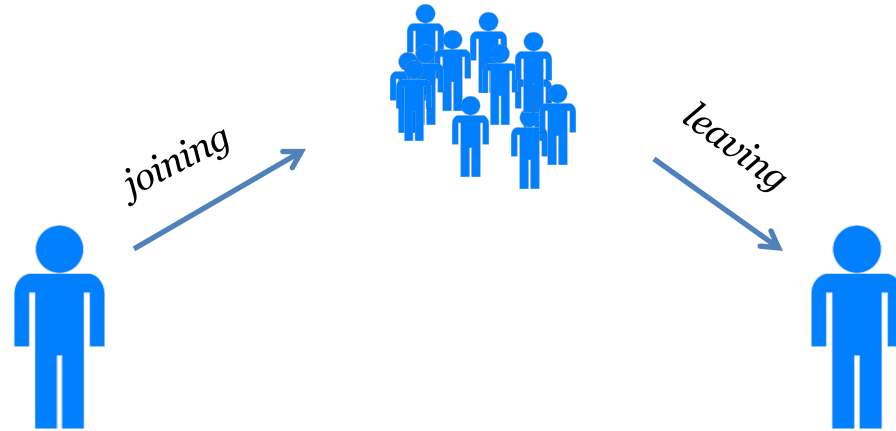
Linguistic homophily:
socially connected
individuals tend
to use language in a
similar way.

Yang and Eisenstein (TACL 2017) exploit social network structures to improve sentiment analysis.

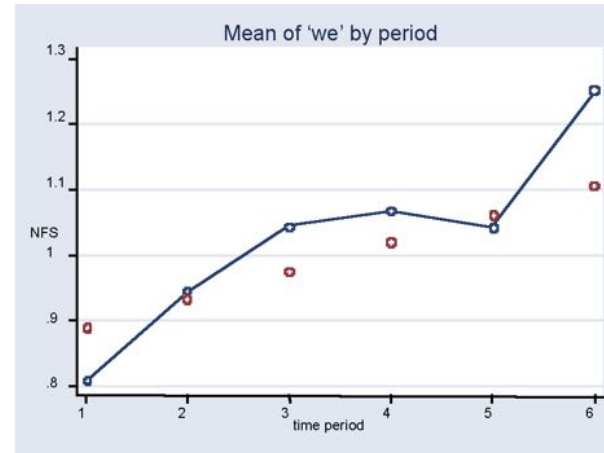
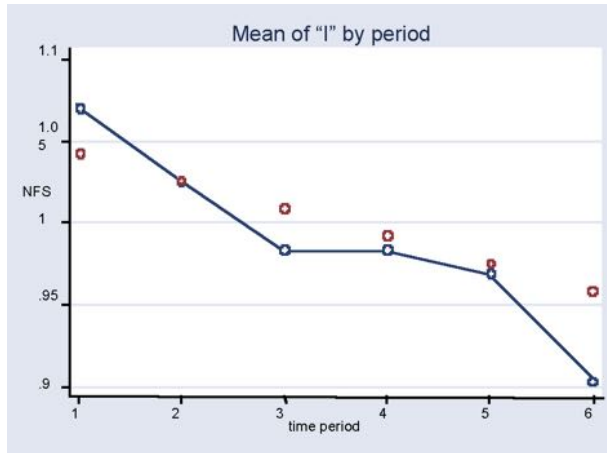
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Linguistic change & online communities



Adoption of of community norms

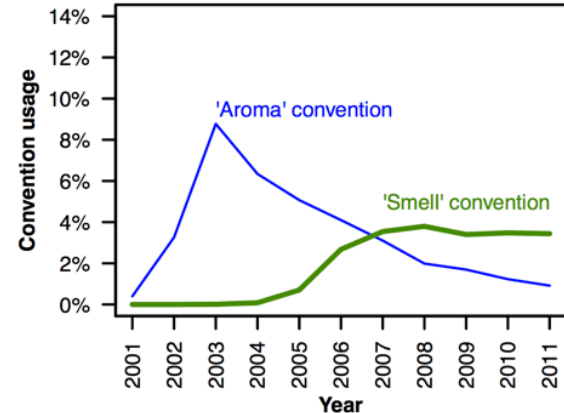


The Language of Online Intercultural Community Formation,
Cassell and Tversky, Journal of Computer-Mediated Communication
Volume 10, Issue 2, 2006

Online beer communities

- 10 years of data (2001 – 2011)
- 1,586,614 posts. 33,387 users

Beeradvocate®



Linguistic change in Beeradvocate: Comparing language models

Community language model (q)

$P(\text{"I am"}) = 0.09$

$P(\text{"You are"}) = 0.05$

...

User language model (p)

$P(\text{"I am"}) = 0.15$

$P(\text{"You are"}) = 0.02$

...

How to compare two probability distributions?

→ Cross entropy

$$H(p, q) = - \sum p(x) \log(q(x))$$

Aside: cross-entropy

x	p(x)	q(x)	s(x)
A	0.1	0.2	0.6
B	0.8	0.6	0.1
C	0.1	0.2	0.3

$$H(p, q) = -0.1 * \ln(0.2) - 0.8 * \ln(0.6) - 0.1 * \ln(0.2) = 0.731$$

$$H(s, q) = 1.50$$


$$H(p, q) = - \sum p(x) \log(q(x))$$

Aside: cross-entropy

Cross entropy loss! (recall: logistic regression and neural networks)

x	p(x)	q(x)
A	0	0.1
B	1	0.8
C	0	0.1

$$H(p, q) = -1 * \ln(0.8) = 0.223$$


true label *classifier output*

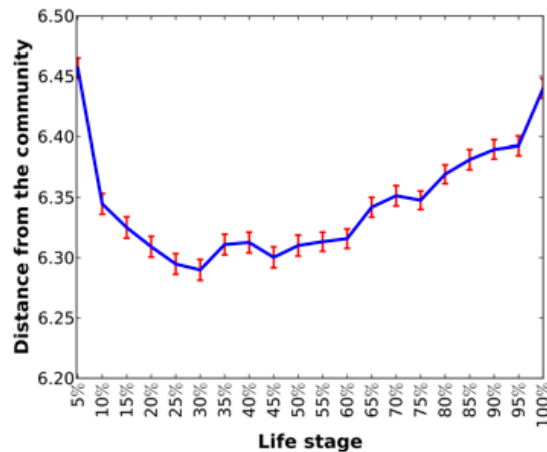
$$H(p, q) = - \sum p(x) \log(q(x))$$

Linguistic change in Beeradvocate: Comparing language models

Compare the language models of a user at different 'life stages' to the community language model at that time

Users stop adapting to language in the community.

Turns out to be useful signal for predicting whether a user will leave the community.



(a) BeerAdvocate

Life stage: %posts written out of total number

*No Country for Old Members:
User Lifecycle and Linguistic
Change in Online Communities ,
Danescu-Niculescu-Mizil et al,
WWW 2013*

Text Generation

Natural Language Generation

Computer algorithms/systems that produce useful texts in human language

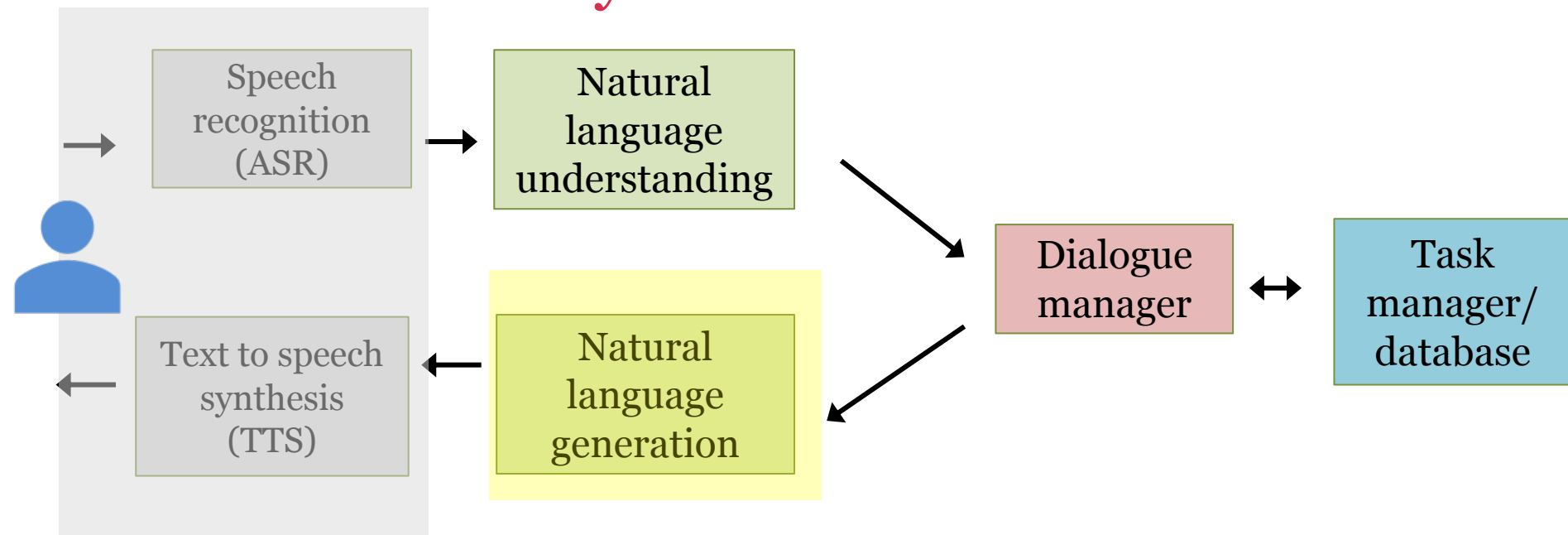
- Input: data (sensor data, logic formulas, database tables,...)
- Output: answers to queries; help messages, documents, reports, explanations, etc.

Goals can differ:

- Building models of human language use
- Building practically useful systems

RECAP!

Typical Frame-based Dialogue System Architecture



Two components

- Content planning (*what to say*)
 - In dialog systems: Dialog policy
- Sentence realization (*how to say it*)

Two components

- Content planning (*what to say*)
 - In dialog systems: Dialog policy
- **Sentence realization** (*how to say it*)

Given a dialog act to generate and some additional information (slots and values), how to generate the text?

NLG using sentence templates

Create a set of templates with gaps.

There is a restaurant in the X
area of town called Y in the Z
price range

- Fill X with a name of an area
- Fill Y with a restaurant name
- Fill Z with low / medium / high

Use syntactic rules

More variation

There is_{sg}/are_{plur} a restaurant_{sg}
/ restaurants_{plur} in the X area

Number Agreement rule:

- 1st gap = sg iff 2nd gap = sg
- 1st gap = plur iff 2nd gap = plur

Referring expressions

Adding conditions on template filling

There is a restaurant in X

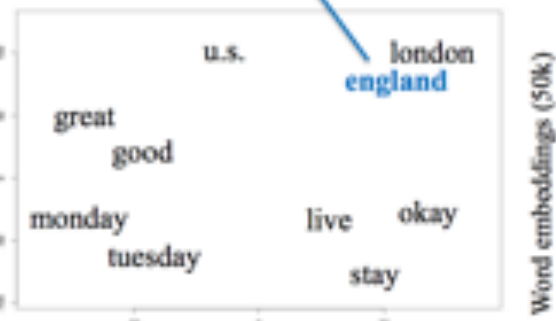
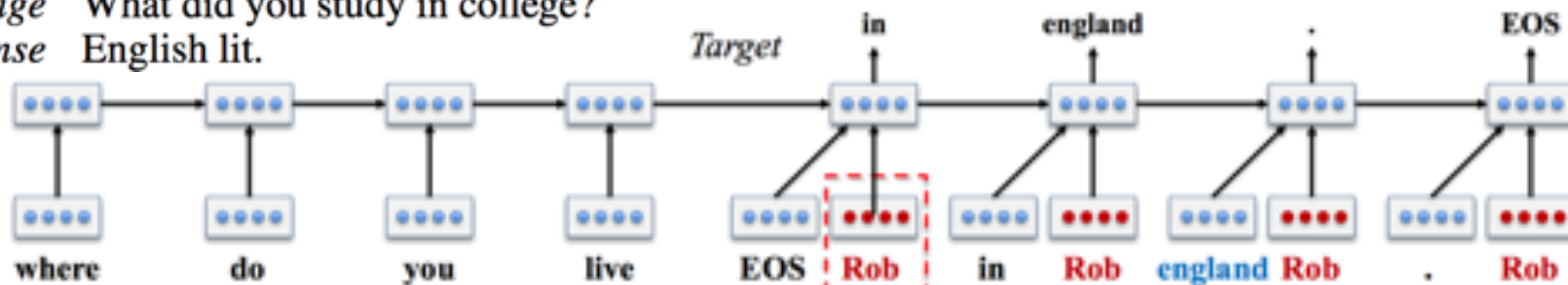
Fill X with ‘in the same area’ iff the area where the restaurant is located is the only area mentioned in the previous utterance.

Consistent persona

message How old are you?
response 16 and you?
message What's your age?
response 18.

message What is your major?
response I'm majoring in psychology
message What did you study in college?
response English lit.

A Persona-Based Neural
Conversation Model,
Li et al. 2016



Which words to use?

- Depends on the social context and speaker characteristics!

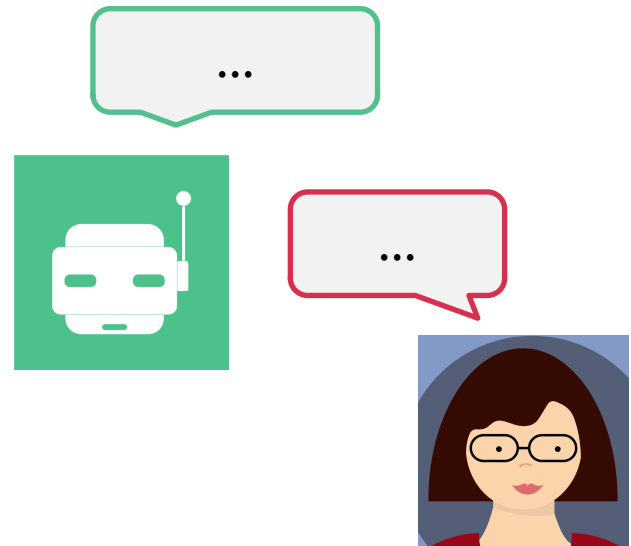
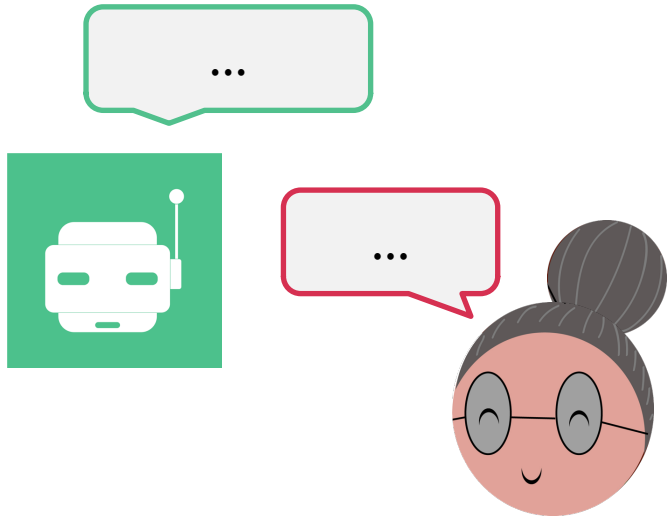
Where is the **elevator**?

The **lift** is located near the reception.

Where is the **elevator**?

The **elevator** is located near the reception.

Style



Summary

- Making sense of language is more than recognising linguistic content
 - Can we integrate ideas about linguistic and social aspects of conversations to make better dialog systems?

What do you need to know

- What speech acts are
 - Why recognizing speech acts and dialog acts can be challenging when just looking at the textual content
- What dialog acts are
- That there is a rich connection between language and society (and why text normalisation for some tasks isn't a good idea)
- Cross entropy
- Template-based text generation

Thanks

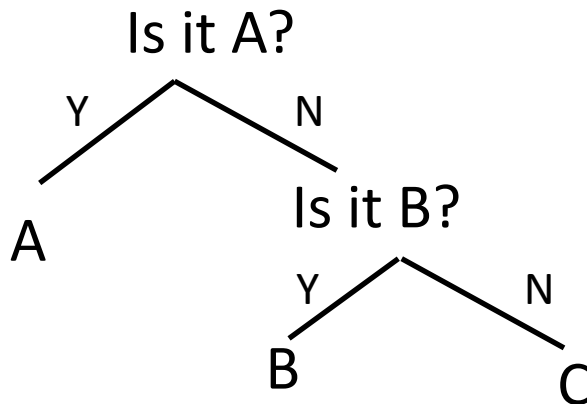
Part of the slides based on slides from Rick Nouwen (speech acts), Kees van Deemter (text generation), Raquel Fernández (speech acts)

Entropy

A: 0.50%

B: 0.25%

C: 0.25%



Average number of questions:

$$0.50 * 1 + 0.25 * 2 + 0.25 * 2 = 1.5$$

Entropy:

$$-0.5 * \log_2(0.5) - 0.25 * \log_2(0.25) - 0.25 * \log_2(0.25) = 1.5$$