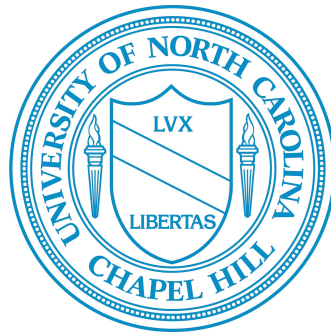


# COMP 790.139 (Fall 2016)

## Natural Language Processing

(with some vision, robotics, and deep learning)



Mohit Bansal

# Class Info/Logistics

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- ▶ COMP 790.139 'Natural Language Processing'
- ▶ **\*\*3 UNITS\*\***
- ▶ Instructor: Mohit Bansal (SN258, <http://www.cs.unc.edu/~mbansal/>)
- ▶ Time: Wed 10.10am-12.40pm
- ▶ Room: FB008
- ▶ Office Hours: Wed 12.40-1.40pm (by appointment), SN258
- ▶ Course Webpage: <http://www.cs.unc.edu/~mbansal/teaching/nlp-seminar-fall16.html>
- ▶ **\*\*Course Email\*\***: [nlpcomp790unc@gmail.com](mailto:nlpcomp790unc@gmail.com)

# About Me

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- ▶ Asst. Professor, CS, UNC (joined Fall 2016)
- ▶ Research Asst. Professor, TTI-Chicago, 2013-2016
- ▶ PhD, UC Berkeley, 2008-2013
  
- ▶ Research Interests:
  - ▶ Past: Syntactic parsing, coreference resolution, taxonomy induction, world knowledge and commonsense induction
  - ▶ Current: Multimodal and embodied semantics (i.e., language with vision and speech, for robotics); human-like language generation and Q&A/dialogue; interpretable and structured deep learning
  
- ▶ Office SN258
  
- ▶ Webpage: <http://www.cs.unc.edu/~mbansal/>, Email: [mbansal@cs.unc.edu](mailto:mbansal@cs.unc.edu)

# Your Introductions

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- ▶ Please say your:
  - ▶ Name
  - ▶ Department/degree/major
  - ▶ Research interests (ML/AI/NLP/CV experience? Coding?)
  - ▶ Fun fact 😊

(send me a few lines of intro at [nlpcomp790unc@gmail.com](mailto:nlpcomp790unc@gmail.com))



# About the Course (and its Goals)

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- ▶ Research-oriented seminar course! We will read lots of interesting papers, brainstorm, and do fun novel projects!
- ▶ We'll start with some basics of NLP
- ▶ Then cover some specific, latest research topics via several paper readings
- ▶ E.g., we will discuss connections of NLP with vision and robotics, and several deep learning for NLP models
- ▶ Brainstorm regularly and code + write up fun/novel projects!
- ▶ Some lecture(s) on academic/research quality paper writing
- ▶ No NLP background needed but some ML and coding experience highly recommended!

# Expectations/Grading

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- ▶ Paper presentation (20%)
- ▶ Paper written summaries (15%)
- ▶ Class participation, discussion and brainstorming (25%)
- ▶ Project reports and presentations (40%)

# Paper Presentation

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- ▶ Lead discussion for 1-2 papers on a topic some week (may be done in pairs/groups depending on class size)
- ▶ Read related papers and present background to audience
- ▶ Present task and model details of given paper
- ▶ Present demo's of related code, etc.
- ▶ Ask interesting questions to initiate brainstorming
- ▶ Mention some next steps, future work, extension ideas!

# Paper Written Summaries

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- ▶ 0.5-1 page (per paper) write-up for every week's paper(s)
- ▶ Describe the task
- ▶ Summarize the method
- ▶ Explain the novelty
- ▶ Discuss the next steps or potential improvements

# Class Participation and Brainstorming

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- ▶ Audience students expected to take part in lively discussion every paper reading!
- ▶ After every topic gets completed (i.e., several papers in 2-3 weeks), we will have a brainstorming and 'idea-generation' session!
- ▶ Exact details to be announced soon but students expected to submit and discuss novel idea(s) on the whole general topic, e.g., new related task or dataset, new approach to existing task, combinations of tasks/approaches, etc.
- ▶ Don't hesitate to propose fancy ideas 😊, but try to keep them grounded/feasible and think of how to approach them realistically (in terms of datasets, models, speed, memory, etc.)

# Project

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- ▶ This is a 'Reading, Coding, and Writing' class!
- ▶ Students will pick (early) their favorite topic among latest cutting-edge research topics covered in class
- ▶ And will try a novel idea (implementing+extending or original) -- I am happy to discuss details!
- ▶ Midterm and final report + presentation (and possibly some updates)
- ▶ Might be in pairs/groups depending on final class size
- ▶ Use ACL conference style files and aim for conference-quality papers
- ▶ Will have some lecture(s) on research-quality paper writing

# Reference Books

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- ▶ **SLP2**: D. Jurafsky & James H. Martin. “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”. Prentice Hall, Second Edition, 2009.
- ▶ **SLP3**: Some draft chapters of the third edition are available online at <https://web.stanford.edu/~jurafsky/slp3/>
- ▶ **FSNLP**: Chris Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press. Cambridge, MA: May 1999. <http://nlp.stanford.edu/fsnlp/>
- ▶ **ML Background**: Andrew Ng’s Coursera Machine Learning course <https://www.coursera.org/learn/machine-learning>

# Course Syllabus/Topics (tentative)

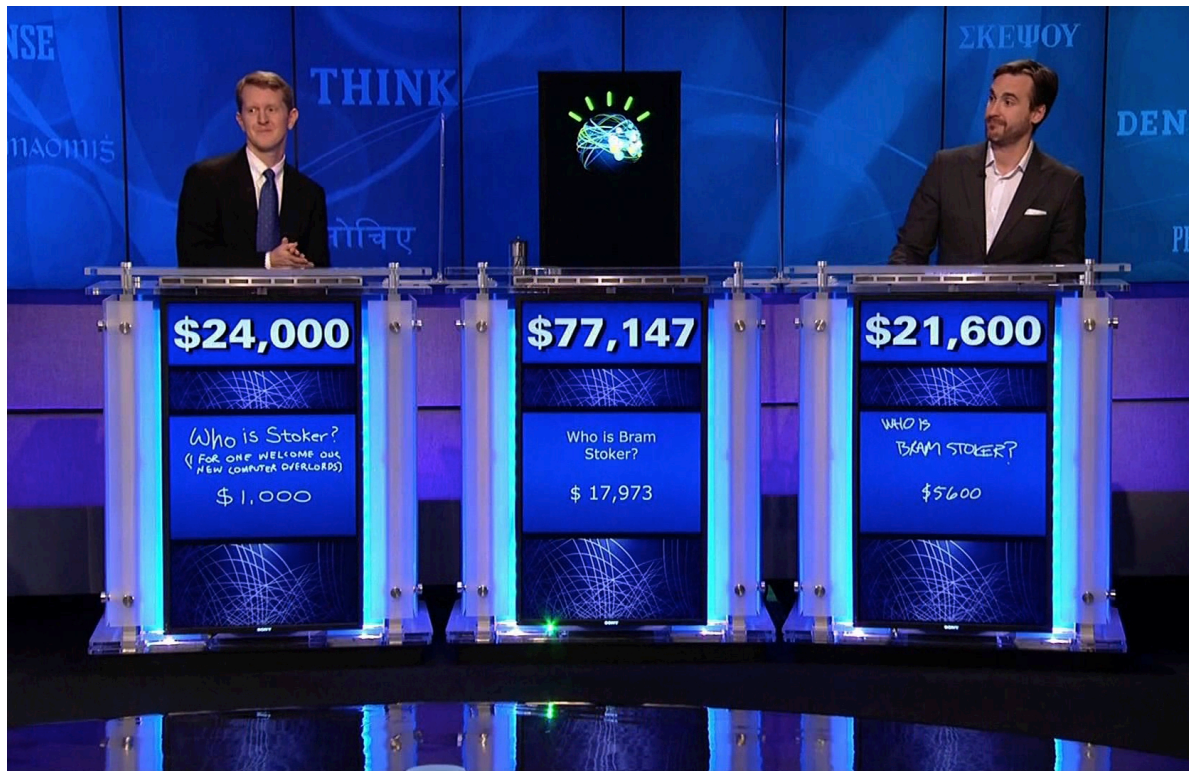
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- ▶ NLP Basics, Foundations, and Core Tasks (in brief):
  - ▶ Language Modeling
  - ▶ Part-of-speech tagging
  - ▶ Syntactic parsing: Constituent, Dependency, CCG, others
  - ▶ Coreference Resolution
  - ▶ Distributional Semantics: PMI, NNs, CCA
  - ▶ Compositional Semantics: Logical-form, Semantic Parsing, Vector-form
  - ▶ Question Answering: Factoid-based, Passage-based
  - ▶ Sentiment Analysis
  - ▶ Generation: Summarization, Dialogue Models
  - ▶ Machine Translation
- ▶ Human-like Language Understanding and Generation:
  - ▶ Ambiguities: Attachment ambiguities, Coreference ambiguities
  - ▶ Non-literal: Metaphors/Idioms, Politeness, Sarcasm, Humor
  - ▶ Generating Non-literal/Ambiguous Language, Coherent and Intelligent Dialogue
- ▶ Language and Vision: Image-Text Alignment, Language Disambiguation via Images, Image/Video Captioning, Image/Video Question Answering, Text to Image Generation, Visual Story Entailment
- ▶ Language for Robotics: Instructions for Navigation, Articulation, Manipulation, Skill learning
- ▶ Several interesting machine/deep learning models along the way, e.g., deep+structured models, interpretable models, adversarial models, reward-based models (reinforcement learning)



# What is NLP?

- ▶ Question answering



# What is NLP?

## ► Question answering

The image shows a Google search interface. The search bar contains the text "What was the U.S. population when Bernie Sanders was born?". Below the search bar, the "All" tab is selected. The search results show "About 1,620,000 results (0.67 seconds)". A knowledge panel is displayed for "United States of America / Population (1941)". The panel shows the answer "133.4 million" for the year "1941". To the right of the text is an image of the United States flag. To the right of the flag is a vertical blue bar with the text "North Pacific Ocean". At the bottom right of the knowledge panel is a "Feedback" link.

Google

What was the U.S. population when Bernie Sanders was born?

All News Images Videos Shopping More Search tools

About 1,620,000 results (0.67 seconds)

United States of America / Population (1941)

133.4 million

1941

Feedback

North Pacific Ocean

# What is NLP?


## ► Question answering



[All](#) [Maps](#) [Images](#) [News](#) [Shopping](#) [More ▼](#) [Search tools](#)

About 2,710,000 results (0.81 seconds)

This major inland sea is bordered by six countries — **Romania** and **Bulgaria** to the west; **Ukraine**, **Russia**, and **Georgia** to the north and east; and **Turkey** to the south. Additionally, it is impacted by another 10 nations through the five major rivers that empty into the Black Sea, the largest of which is the Danube River.

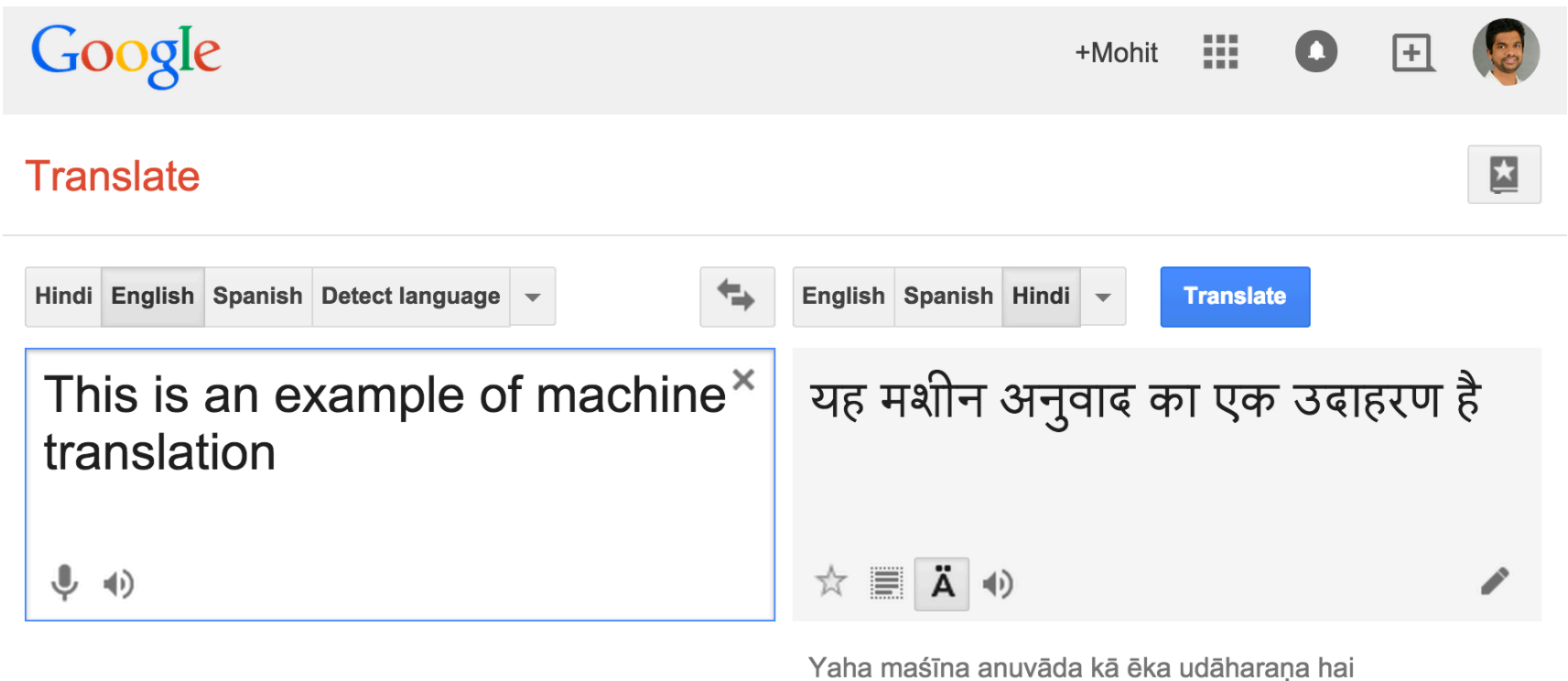


[Black Sea Geography - College of Earth, Ocean, and Environment](https://www.ceoe.udel.edu/blacksea/geography/index.html)  
<https://www.ceoe.udel.edu/blacksea/geography/index.html> University of Delaware ▼

*About this result • Feedback*

# What is NLP?

## ► Machine Translation



The screenshot displays the Google Translate web interface. At the top, the Google logo is on the left, and user account information (+Mohit, grid icon, notification bell, add link icon, and profile picture) is on the right. Below the header, the word "Translate" is written in red on the left, and a star icon is on the right. The main interface features two language selection bars. The left bar has buttons for "Hindi", "English" (selected), "Spanish", and "Detect language" with a dropdown arrow. The right bar has buttons for "English", "Spanish", "Hindi" (selected), and a dropdown arrow, followed by a blue "Translate" button. Below these bars, the input text "This is an example of machine translation" is shown in a box with a close icon (x) at the top right and audio icons (microphone and speaker) at the bottom left. The output text "यह मशीन अनुवाद का एक उदाहरण है" is displayed in a larger font on the right, with a star icon, a list icon, a text icon (A), and a speaker icon at the bottom left, and a pencil icon at the bottom right. At the very bottom, the transliterated text "Yaha maśīna anuvāda kā ēka udāharaṇa hai" is shown.

Google

+Mohit

Translate

Hindi English Spanish Detect language ▼

↔ English Spanish Hindi ▼ Translate

This is an example of machine translation<sup>x</sup>

यह मशीन अनुवाद का एक उदाहरण है

Yaha maśīna anuvāda kā ēka udāharaṇa hai

# What is NLP?

## ► Sentiment Analysis

### Sentiment Analysis with Python NLTK Text Classification

This is a demonstration of **sentiment analysis** using a **NLTK 2.0.4** powered **text classification** process. It can tell you whether it thinks the text you enter below expresses **positive sentiment**, **negative sentiment**, or if it's **neutral**. Using **hierarchical classification**, *neutrality* is determined first, and *sentiment polarity* is determined second, but only if the text is not neutral.



#### Analyze Sentiment

##### Language

english ▾

##### Enter text

It always amazes me how Universal never cares to create anything remotely clever when it comes to their animations, and so once again they come up with a harmless little story that wants to be cute and funny (which it is sometimes) but is only bound to be quickly forgotten.

Enter up to 50000 characters

Analyze

#### Sentiment Analysis Results

The text is **neg**.

The final sentiment is determined by looking at the classification probabilities below.

##### Subjectivity

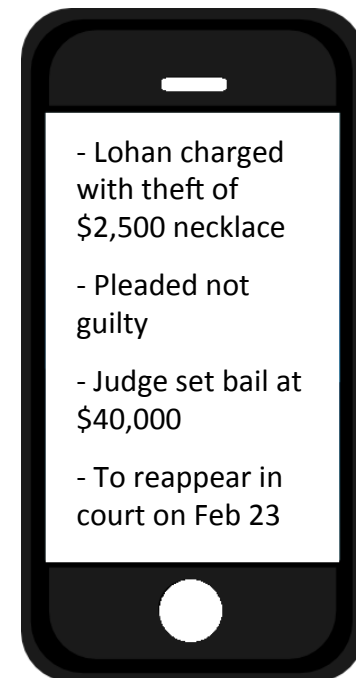
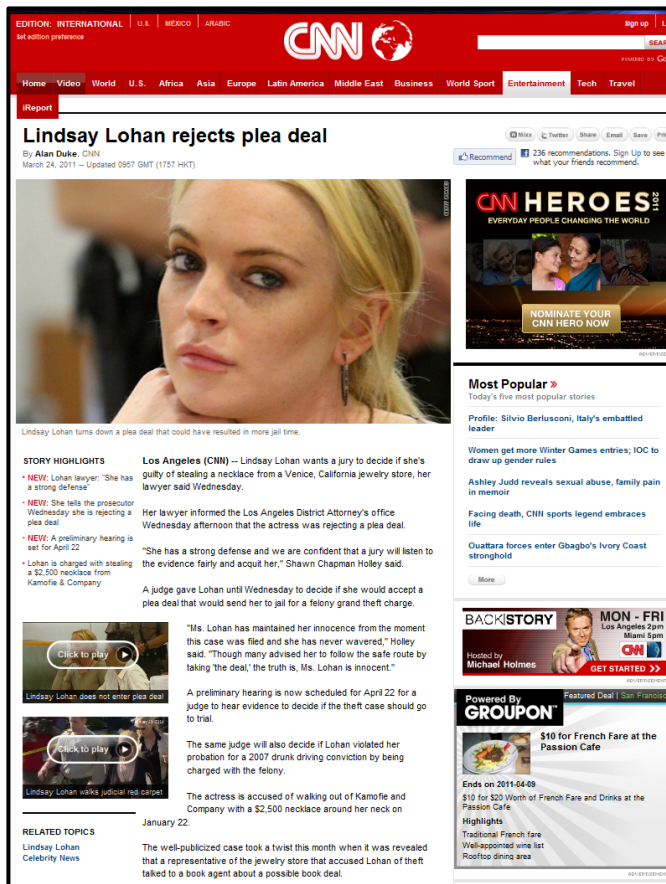
- neutral: 0.3
- **polar: 0.7**

##### Polarity

- pos: 0.2
- **neg: 0.8**

# What is NLP?

## ► Natural Language Generation: Summarization

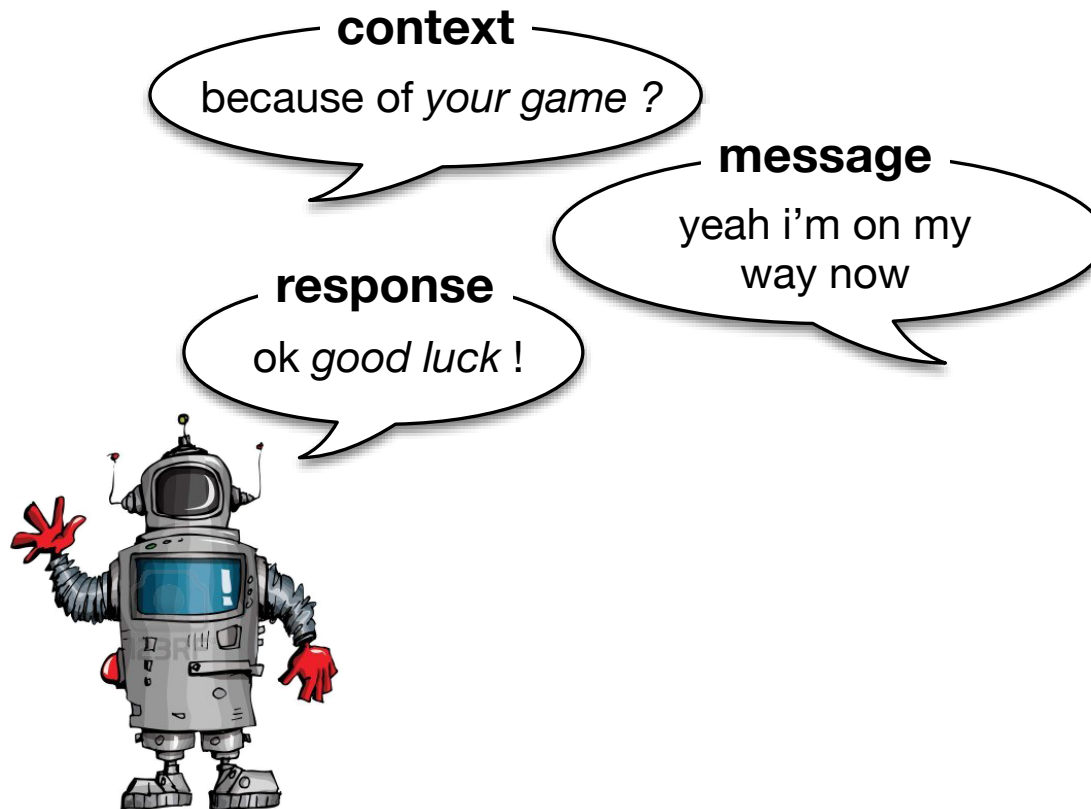


- Lohan charged with theft of \$2,500 necklace
- Pleaded not guilty
- Judge set bail at \$40,000
- To reappear in court on Feb 23

# What is NLP?

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- ▶ Natural Language Generation: Conversation/Dialogue





# What is NLP?

## ► Natural Language Generation: Image Captioning

← → ↻ ⓘ [www.cs.toronto.edu/~nitish/nips2014demo/results/8832804.html](http://www.cs.toronto.edu/~nitish/nips2014demo/results/8832804.html)

### Results

#### Tags

- authors
- scones
- luncheon
- breakfast
- seder

#### Nearest Caption in the Training Dataset

a man cuts a cake while children sit around at the table , looking on .

#### Generated Captions

- two people at a table with a cake .
- the two people are having a meal that is in a party .
- a man and two children in a blue table with a cake .
- a man sitting at a table with a bunch of cake on it .
- a man and woman sitting at a table with cake at a party .

[back](#)





# What is NLP?

## ► Natural Language Generation: Visual Question Answering



What color are her eyes?  
What is the mustache made of?



How many slices of pizza are there?  
Is this a vegetarian pizza?



Is this person expecting company?  
What is just under the tree?

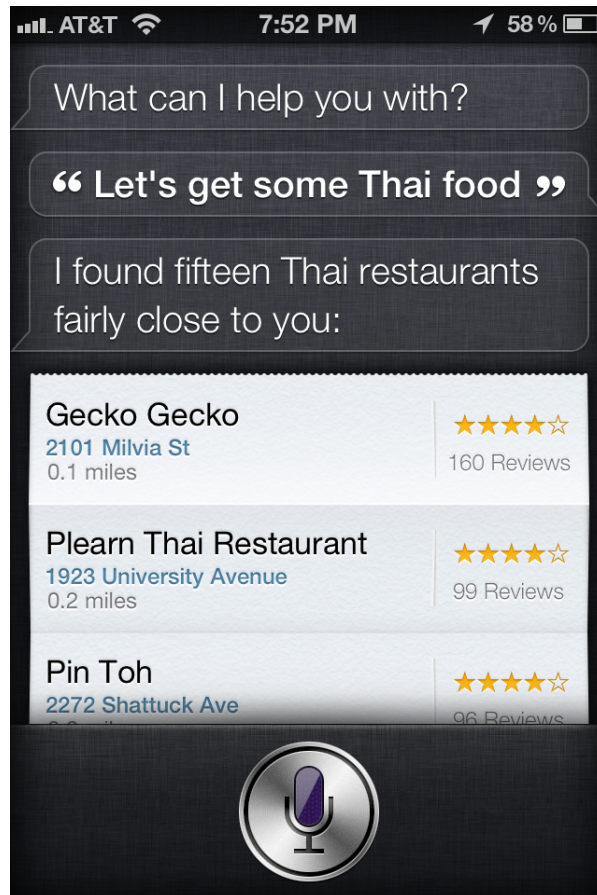


Does it appear to be rainy?  
Does this person have 20/20 vision?

# What is NLP?

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## ► Automatic Speech Recognition



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10-min break?

# Some Exciting NLP Challenges

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- 1) Human-like Language Understanding: metaphors/idioms, humor, sarcasm, politeness/rudeness
- 2) Language Generation and Dialogue: document summarization, database to language summary, coherent and intelligent conversation models
- 3) Grounded Language with Vision and Speech: image-text alignment, language disambiguation via images, image/video captioning, image/video question answering, text to image generation, visual story entailment
- 4) Embodied Language for Robotic Tasks: instructions for navigation, articulation, manipulation, skill learning
- 5) Machine Learning Models: deep+structured models, interpretable models, adversarial models, reward-based models (reinforcement learning)

# Human-like Ambiguous Language

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## ► Non-literal: Idioms, Metaphors



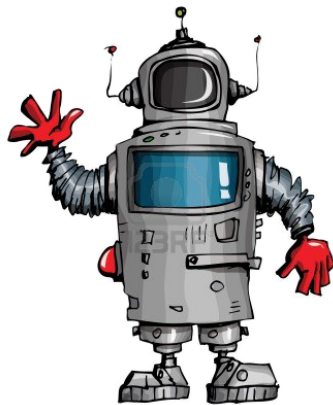
You: *I am under the weather today.*

Siri: *Here is the weather today... 50 F*

# Human-like Ambiguous Language

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- ▶ Non-literal: Idioms, Metaphors



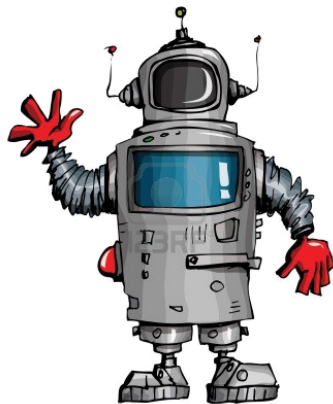
*Break a leg!*



# Human-like Ambiguous Language

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- ▶ Humor, Sarcasm, Politeness/Rudeness



*I bet I can stop  
gambling!*

*Yeah, right!*

*Please do not ...*



# Human-like Ambiguous Language

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- ▶ Prepositional Attachment, Coreference Ambiguities





# Human-like Ambiguous Language

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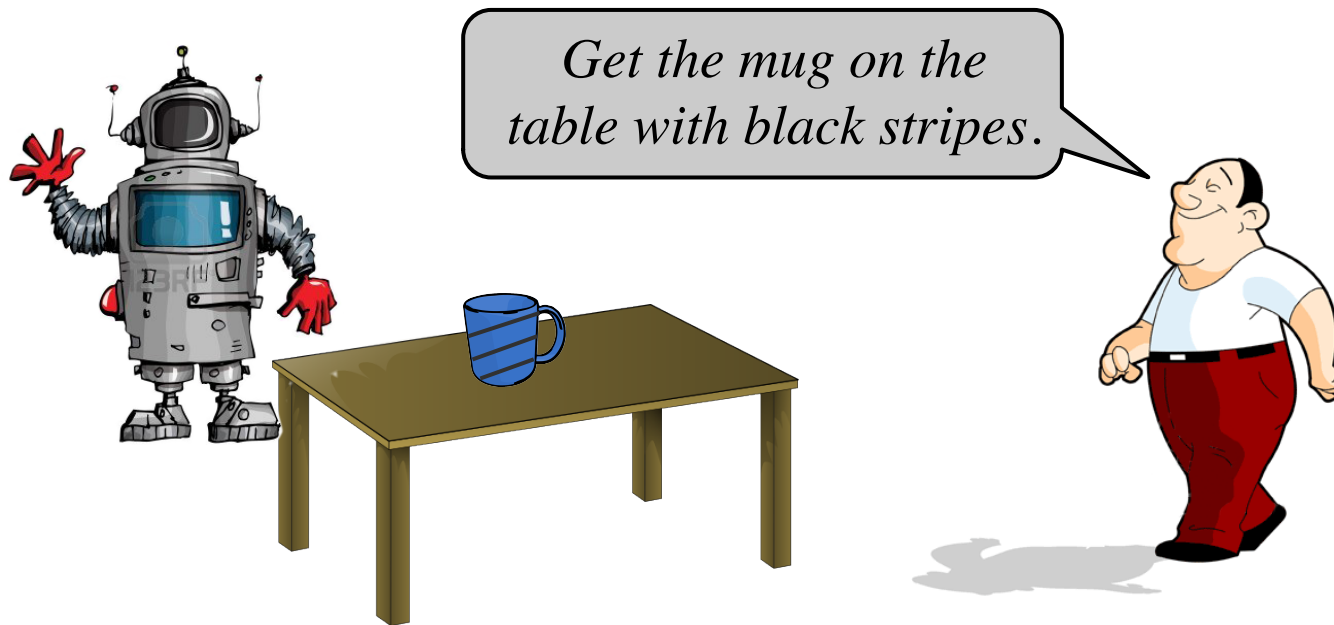
- ▶ Prepositional Attachment, Coreference Ambiguities



# Visually Grounded Language

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- ▶ Text-Image Alignment: Most of our daily communication language points to several objects in the visual world



# Visually Grounded Language

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- ▶ Visual Question Answering: Humans asking machines about pictures/videos, e.g., for visually impaired, in remote/dangerous scenarios, in household service settings



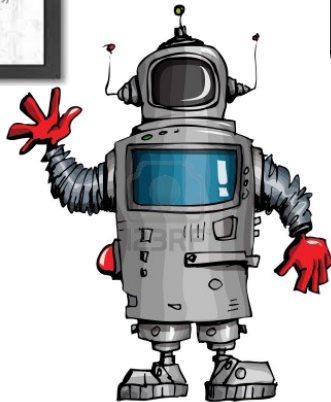
*Is there milk in the refrigerator?*



# Embodied Language (Robot Instructions)

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- ▶ Task-based instructions, e.g., navigation, grasping, manipulation, skill learning



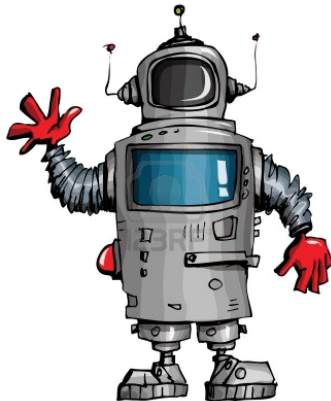
*Turn right at the  
butterfly painting, then  
go to the end of the hall*



# Embodied Language (Robot Instructions)

---

- ▶ Task-based instructions, e.g., navigation, grasping, manipulation, skill learning



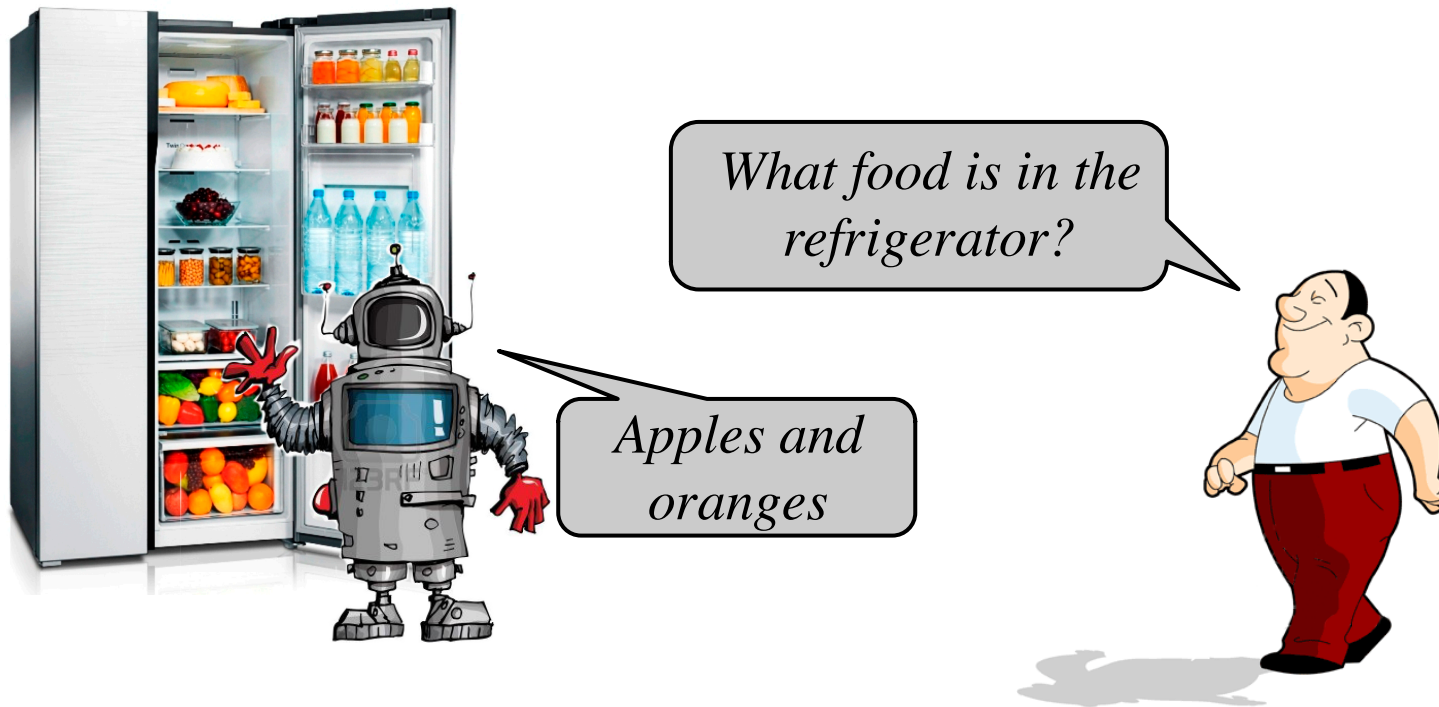
*Cut some onions, and  
add to broth, stir it*



# Grounded Language Generation/Dialogue

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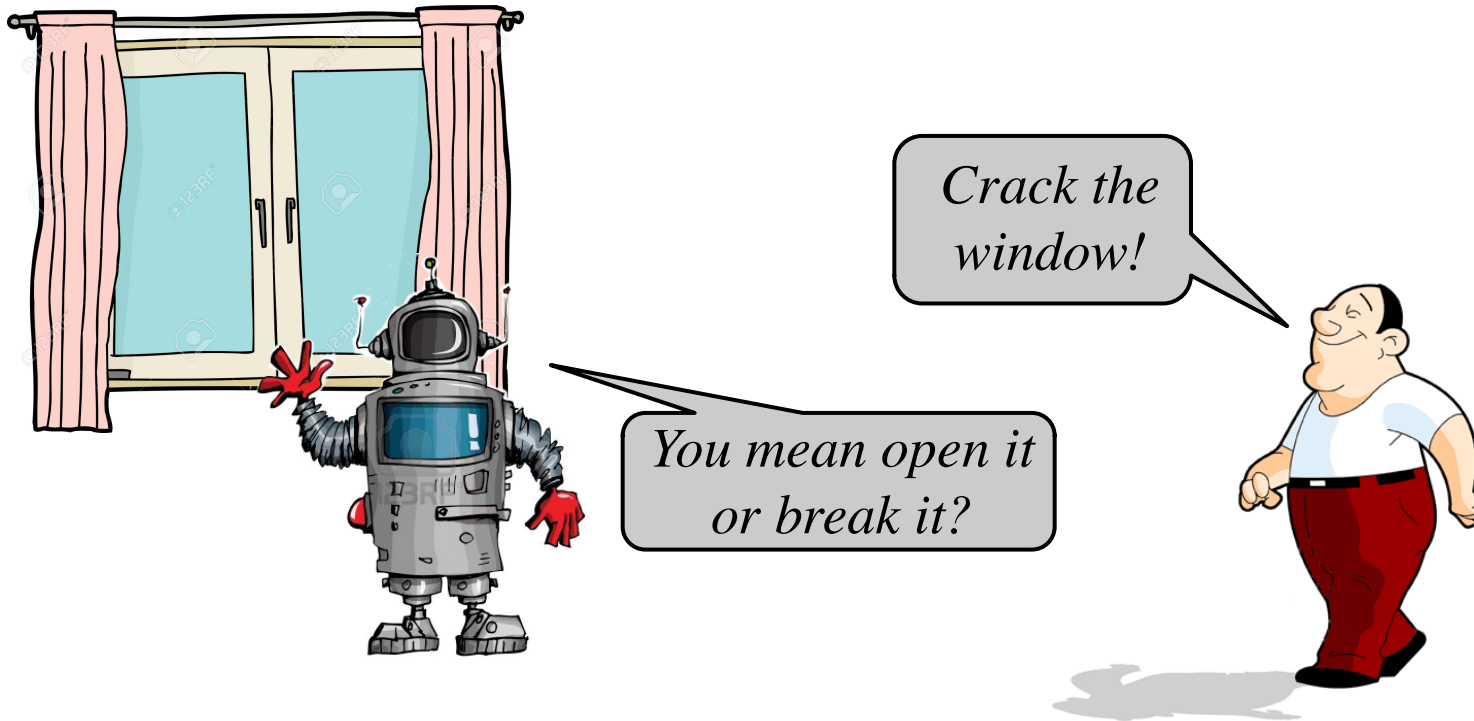
- ▶ Both for answering human questions, and to ask questions back, and for casual chit-chat



# Grounded Language Generation/Dialogue

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- ▶ Both for answering human questions, and to ask questions back, and for casual chit-chat



# Next Week

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- ▶ We will start with some basic of NLP, e.g., tagging, parsing, coreference, etc.
- ▶ Website will be updated with initial paper list very soon
- ▶ Once paper list is up, start volunteering for paper presentation!
- ▶ We might do pairs/groups of students depending on class size
- ▶ Project details and dates will be announced soon