COMP 790.139 (Fall 2016)  
Natural Language Processing  
(with some vision, robotics, and deep learning)

Mohit Bansal
Class Info/Logistics

- COMP 790.139 ‘Natural Language Processing’
- **3 UNITS**
- Time: Wed 10.10am-12.40pm
- Room: FB008
- Office Hours: Wed 12.40-1.40pm (by appointment), SN258
- **Course Email**: nlpcomp790unc@gmail.com
About Me

- 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/](http://www.cs.unc.edu/~mbansal/), Email: mbansal@cs.unc.edu
Your Introductions

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)
About the Course (and its Goals)

- 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

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

- 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

- 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

- 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.)
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


► **SLP3**: Some draft chapters of the third edition are available online at [https://web.stanford.edu/~jurafsky/slp3/](https://web.stanford.edu/~jurafsky/slp3/)


► **ML Background**: Andrew Ng’s Coursera Machine Learning course [https://www.coursera.org/learn/machine-learning](https://www.coursera.org/learn/machine-learning)
Course Syllabus/Topics (tentative)

- 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 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

Google search result:

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

About 1,620,000 results (0.67 seconds)

United States of America / Population (1941)

133.4 million

1941
What is NLP?

- Question answering

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

University of Delaware
What is NLP?

- Machine Translation

Google Translate

This is an example of machine translation

Translate

यह मशीन अनुवाद का एक उदाहरण है

Yaha mašīna 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

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
- Plead not guilty
- Judge set bail at $40,000
- To reappear in court on Feb 23
What is NLP?

- Natural Language Generation: Conversation/Dialogue

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context
because of *your game* ?

message
yeah i’m on my way now

response
ok good luck !
What is NLP?

Natural Language Generation: Image Captioning

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.
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?

- Automatic Speech Recognition

![Text regarding speech recognition and restaurant options](image-url)
10-min break?
Some Exciting NLP Challenges

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

- Non-literal: Idioms, Metaphors

You:  
Siri:  

You:  \textit{I am under the weather today.}
Siri:  \textit{Here is the weather today…50 F}
Human-like Ambiguous Language

- Non-literal: Idioms, Metaphors

*Break a leg!*
Human-like Ambiguous Language

- Humor, Sarcasm, Politeness/Rudeness

Robot saying: I bet I can stop gambling!

Man saying: Yeah, right!

Robot saying: Please do not …
Clean the dishes in the sink.
Human-like Ambiguous Language

- Prepositional Attachment, Coreference Ambiguities
Visually Grounded Language

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

Get the mug on the table with black stripes.
Visually Grounded Language

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)

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

What food is in the refrigerator?

Apples and oranges
Grounded Language Generation/Dialogue

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

You mean open it or break it?

Crack the window!
Next Week

- 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.