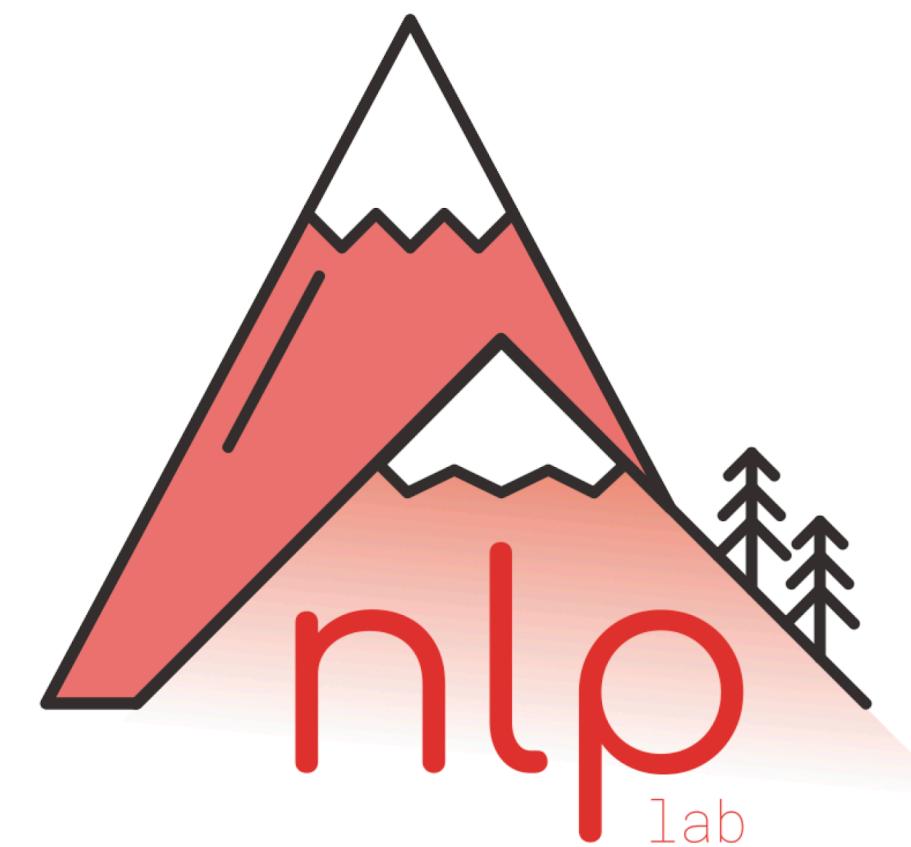


# CS-552: Modern NLP

## Introduction

Antoine Bosselut



# Natural Language Processing

**Enabling  
Human-Machine  
Collaboration**

Search Engines

Dialogue Agents

Text Generation

**Accelerating  
Human-Human  
Communication**

Machine Translation

Text Summarization

Information Extraction

**Mining  
Human Insights**

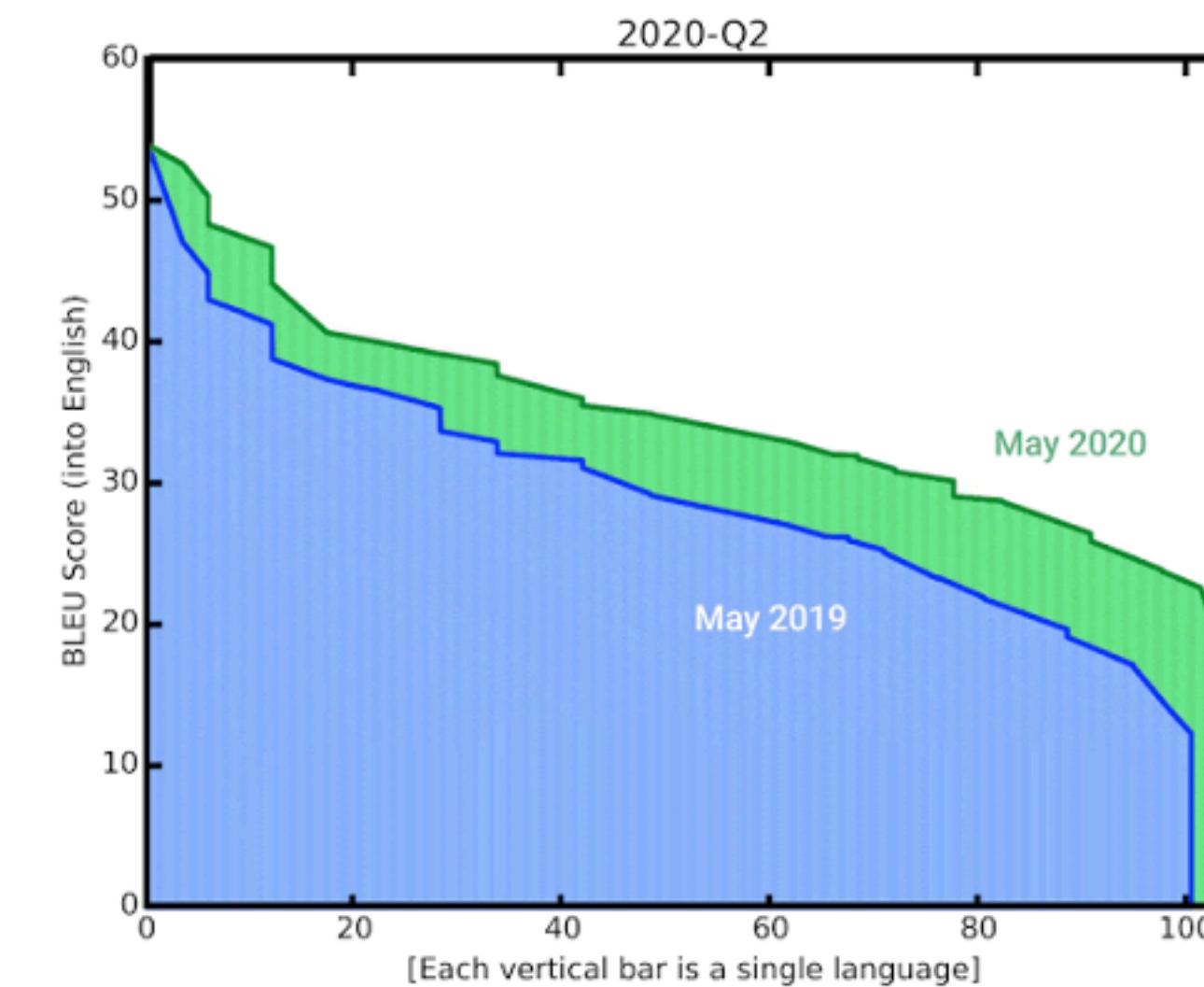
Sentiment Analysis

Motivation Analysis

Emotion Detection



# Machine Translation



DETECT LANGUAGE FRENCH ENGLIS ▾ ↕ ENGLISH FRENCH SPANISH ▾

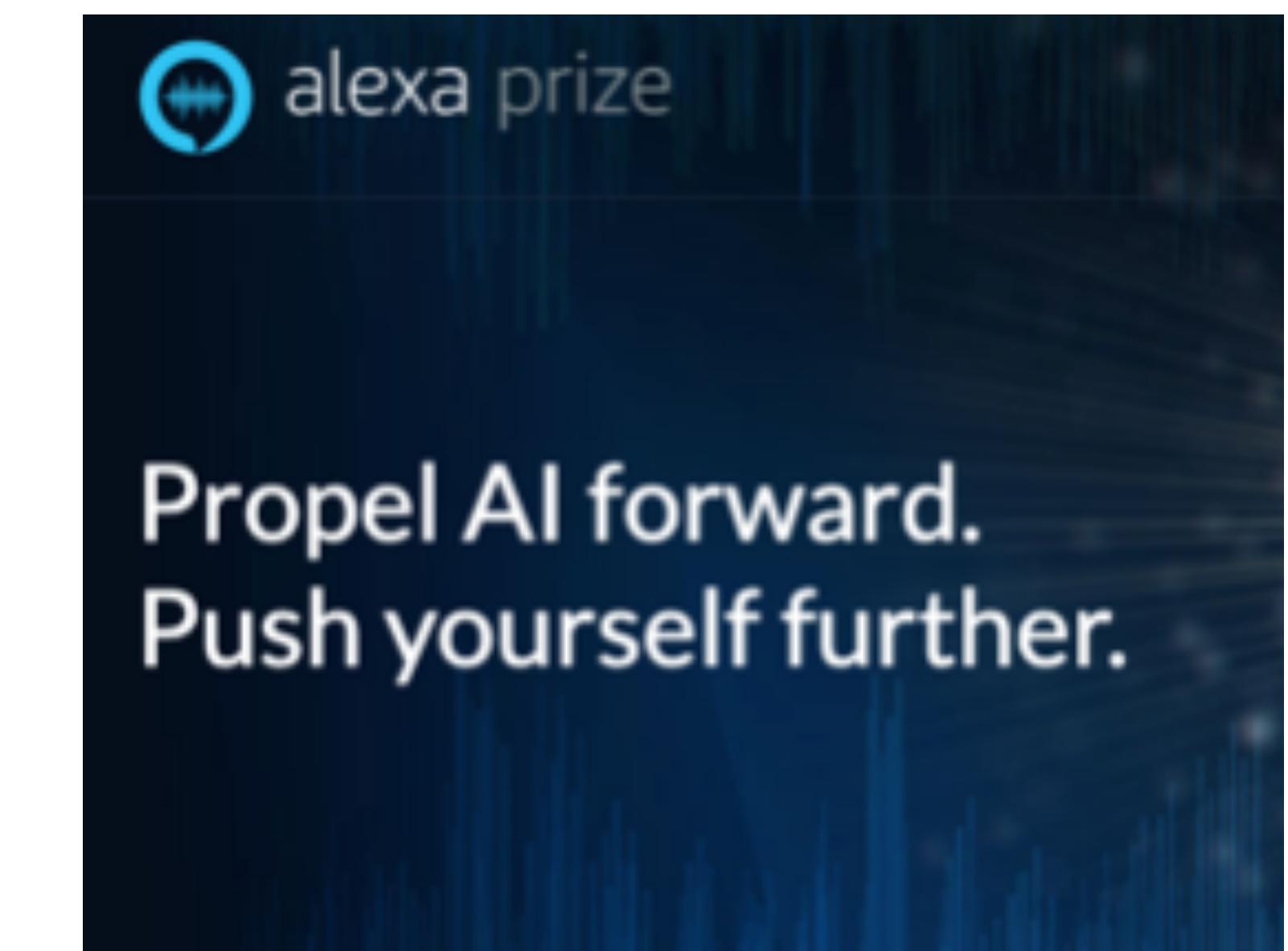
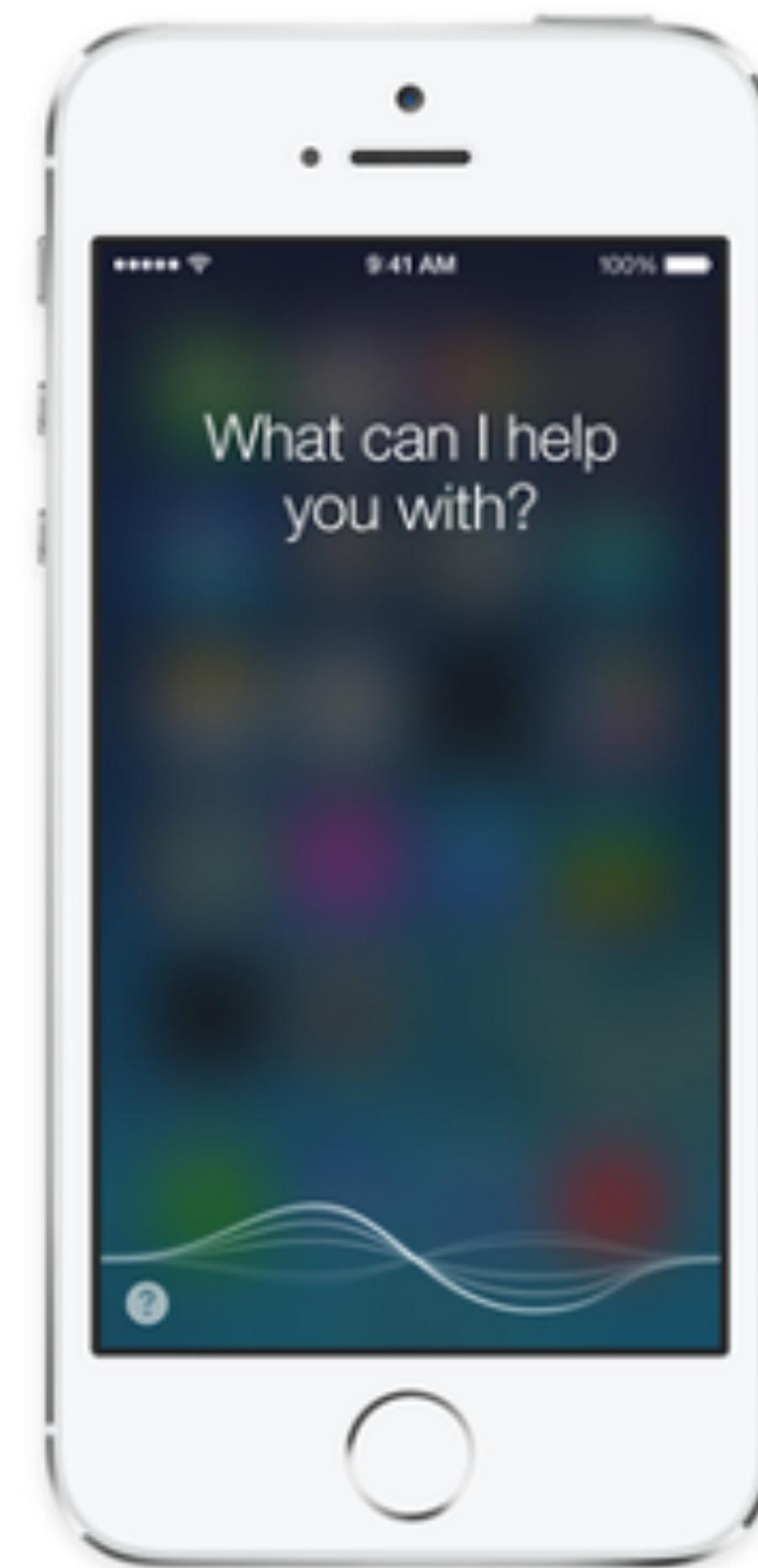
J'ai mangé avec mon avocat × I ate with my lawyer today ☆

aujourd'hui

38 / 5000

Microphone icon, speaker icon, text input field, sound icon, like icon, share icon

# Conversational Systems



# Question Answering

what is the tallest mountain in europe ?

All Images Maps News Videos More Tools

About 12'400'000 results (1.10 seconds)

Europe / Mountains / Maximal / Elevation

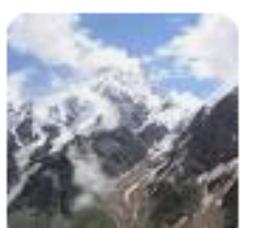
## Mount Elbrus

5,642 m

### Mountains



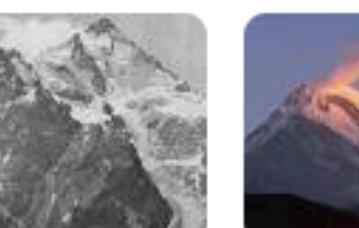
Mount  
Elbrus  
5,642 m



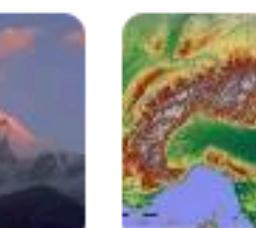
Dykh-Tau  
5,205 m



Shkhara  
5,193 m



Koshtan-Tau  
5,151 m



Mount  
Kazbek  
5,033 m



Alps



Mont Blanc  
4,810 m

who is the president of switzerland ?

All Images News Maps Videos More Tools

About 415'000'000 results (0.82 seconds)

## Guy Parmelin

The President of the Swiss Confederation in 2021 is **Guy Parmelin** from the canton of Vaud. He was elected on 9 December 2020. The President's department in 2021 is the Federal Department of Economic Affairs, Education and Research EAER.

<https://www.admin.ch> › gov › start › federal-presidency

### Presidential year 2021

[About featured snippets](#) • [Feedback](#)

# Text Generation

AN

Can you give me a two-day itinerary for a weekend trip to Paris ? Please don't include more than three activities per day.



Day 1:

1. Visit the Eiffel Tower - Start your day with the iconic symbol of Paris, the Eiffel Tower. Take a stroll around the Champ de Mars and enjoy the views from the tower.
2. Explore the Louvre Museum - After lunch, head to the Louvre Museum and admire the world-famous artwork such as the Mona Lisa and the Venus de Milo.
3. Stroll along the Seine River - In the evening, take a romantic stroll along the Seine River and enjoy the Parisian atmosphere.

Day 2:

1. Visit Notre-Dame Cathedral - Start your day by visiting one of the most famous Gothic cathedrals in the world, Notre-Dame Cathedral.
2. Explore the Marais neighborhood - After lunch, explore the Marais neighborhood, known for its historical architecture, trendy boutiques, and restaurants.
3. Enjoy a Cabaret Show - In the evening, enjoy a cabaret show at the famous Parisian venue, the Moulin Rouge, and end your trip with a memorable experience.

**Why is natural language processing difficult?**

# Ambiguity

Kids make nutritious snacks

Stolen painting found by tree

Miners refuse to work after death

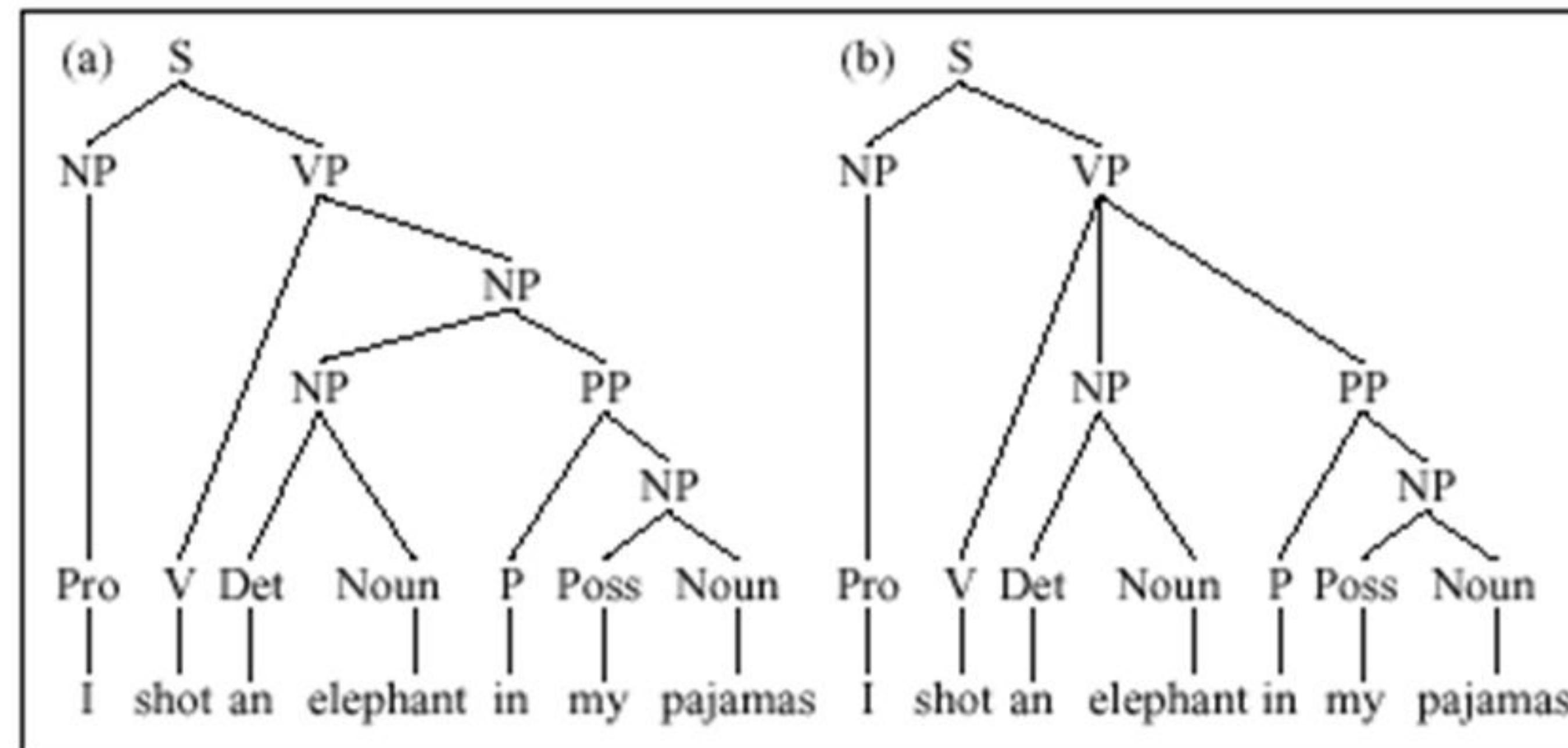
Squad helps dog bite victim

Killer sentenced to die for second time in 10 years

Lack of brains hinders research

# Ambiguity: Syntax

I shot an elephant in my pajamas



# Ambiguity: Semantics

The city council refused the demonstrators a permit because they advocated violence

The city council refused the demonstrators a permit because they feared violence

The city council refused the demonstrators a permit because they \_\_\_\_\_ violence

# Ambiguity?

- Often, there aren't only a few possibilities that can be resolved pragmatically

*il fait vraiment beau*



It is really nice out

It's really nice

The weather is beautiful

It is really beautiful outside

~~He makes truly beautiful~~

~~It fact actually handsome~~

- There could be combinatorially many possibilities
- Many won't even register as ambiguities, but systems must resolve them

AN

In the sentence, "The city council refused the demonstrators a permit because they advocated violence" who does "they" refer to ?



In this sentence, the pronoun "they" refers to the demonstrators. The sentence states that



## How did we get so good at natural language processing over the last few years?

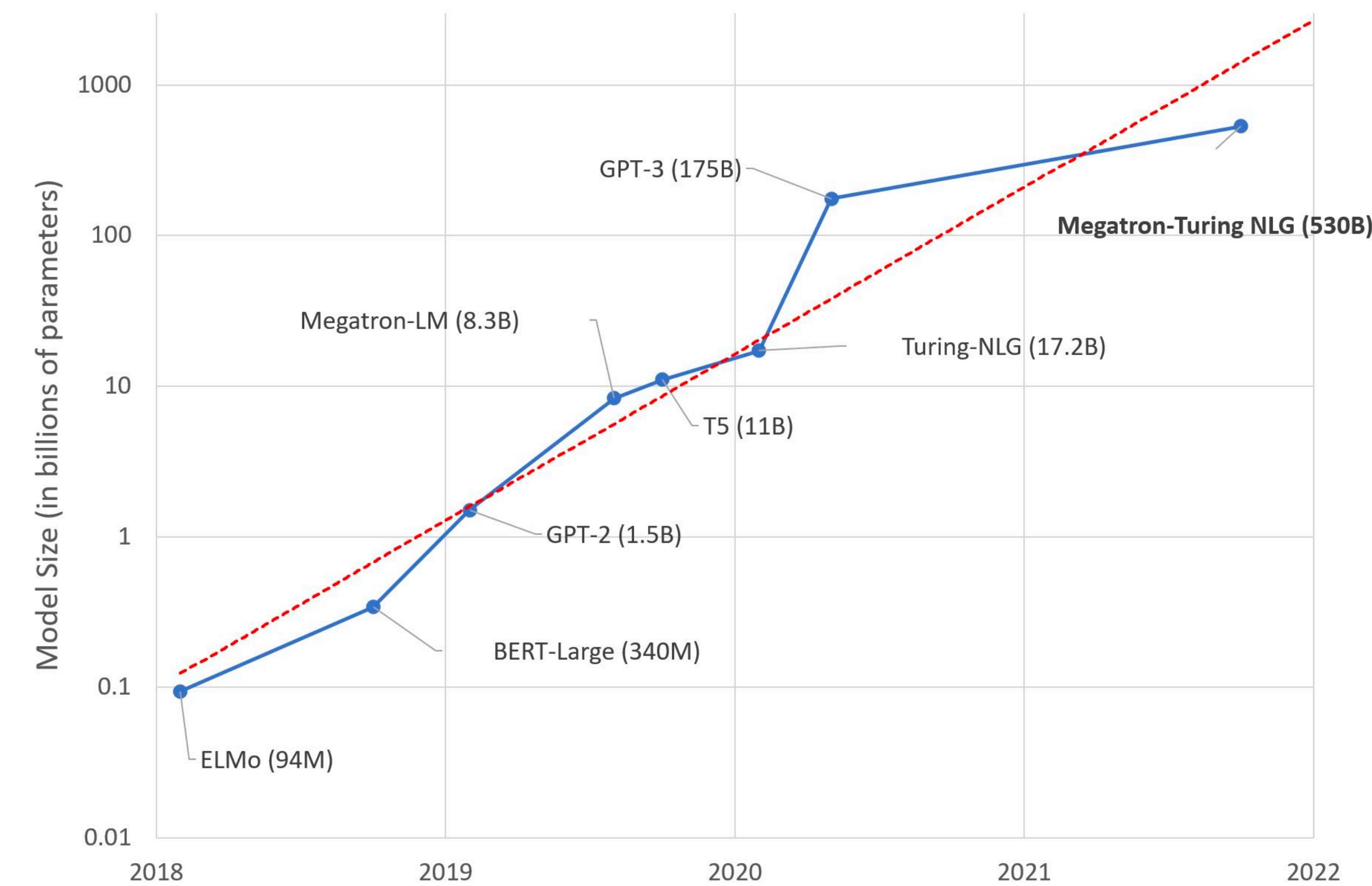


In this sentence, the pronoun "they" refers to the city council. The sentence states that the city council refused the demonstrators a permit because they (the city council) feared violence.



# Language models got a lot bigger!

- Advances in hardware and algorithms allow researchers to train larger language models
- **Growth:** ~5000x increases in model size from 2018 to 2022
- **Comparison:** human cerebral cortex contains ~1000x more neurons than that of mice



AN

In the sentence, "The city council refused the demonstrators a permit because they advocated violence" who does "they" refer to ? 



In this sentence, the pronoun "they" refers to the demonstrators. The sentence states that the city council refused the demonstrators a permit because they (the demonstrators) advocated violence.  

## Neural modeling at scale makes things better!

## Still a lot of work to be done!



I apologize for the confusion in my previous response. In the sentence, "The city council refused the demonstrators a permit because they feared violence," the pronoun "they" actually refers to the demonstrators.  

The sentence means that the city council denied the permit requested by the demonstrators, and the reason for that denial was that the city council was afraid of violence that might occur if the permit was granted to the demonstrators. So, in this sentence, "they" refers to the demonstrators.

# Today's Outline

- **Section 1:** Course Introduction
- **Section 2:** An simple introduction to Neural NLP

**What will we cover in this class?**

# Course Goals

- Define basic problems and tasks in natural language processing (e.g., text classification; generation)
- Implement common modern approaches for tackling NLP problems and tasks (e.g., embeddings, neural models, transformers)
- Understand failure modes of these models and learning algorithms (e.g., robustness, ethics, evaluation)
- Deploy your understanding of these concepts in applied scenarios (assignments, projects)



# Building Blocks: Models

<b>Week</b>	<b>Date</b>	<b>Topic</b>
Week 1	2/19/2025	Introduction + Building a simple neural classifier
	2/20/2025	Neural word embeddings
Week 2	2/26/2025	Classical and Fixed-context Language Models
	2/27/2025	Recurrent Neural Networks + Gated RNN Variants
Week 3	3/5/2025	Attention + Transformers
	3/6/2025	Transformers continued
Week 4	3/12/2024	Pretraining: ELMo, BERT
	3/13/2024	Transfer Learning: Introduction

# Building Blocks: Learning

Week 5	3/19/2025	Transfer Learning: Dataset Biases
	3/20/2025	Text Generation
Week 6	3/26/2025	Text Generation
	3/27/2025	Text Generation
Week 7	4/2/2025	In-context Learning + RLHF or Midterm
	4/3/2025	<b>Project Description or None</b>
Week 8	4/9/2025	Midterm or In-context Learning + RLHF
	4/10/2025	<b>None or Project Description</b>

# Modern NLP

Week 9 4/16/2025 Scaling Laws + Model Compression

4/17/2025 **No Class - Work on your project**

Week 10 4/23/2025 **No Class - Easter Break**

4/24/2025 **No Class - Easter Break**

Week 10 4/30/2025 Ethics in NLP

5/1/2025 **No Class - Work on your project**

Week 11 5/7/2025 Tokenization + Multilingual LMs

5/8/2025 **No Class - Work on your project**

# Modern NLP

Week 12 5/14/2025      Interpretability of Language Models

5/15/2025      **No Class - Work on your project**

Week 13 5/21/2025      Retrieval-Augmented LMs & Agents

5/22/2025      **No Class - Work on your project**

Week 14 5/28/2025      Language & Vision + Wrap-up

5/29/2025      **No Class - Holiday**

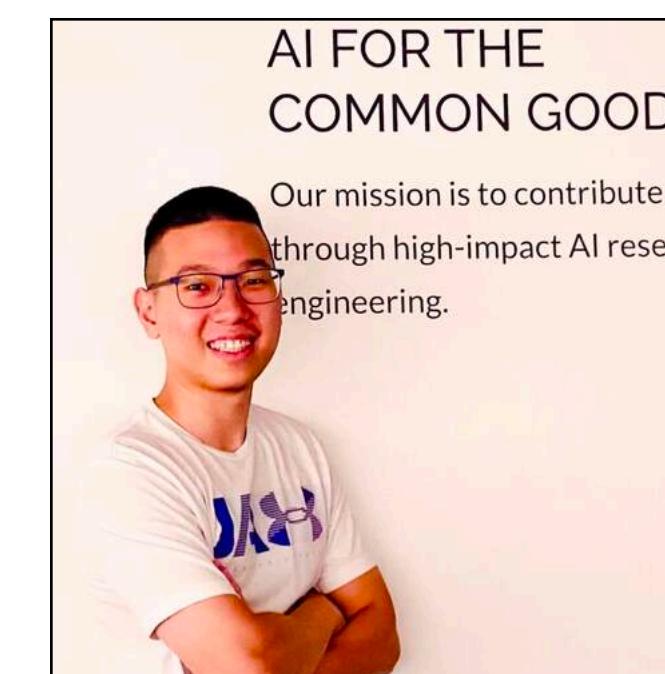
# Course Team



**Angelika Roman**  
TA



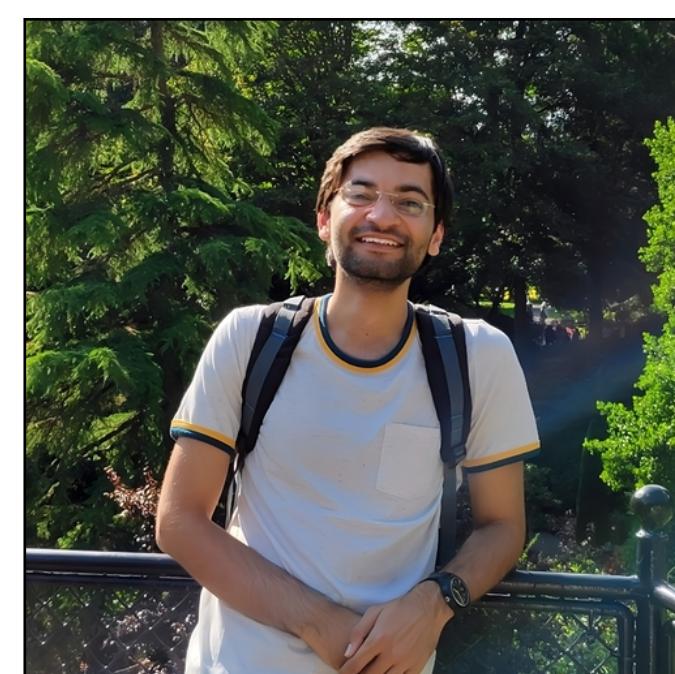
**Beatriz Borges**  
TA



**Zeming (Eric) Chen**  
TA



**Mete Ismayil**  
TA



**Madhur Panwar**  
TA



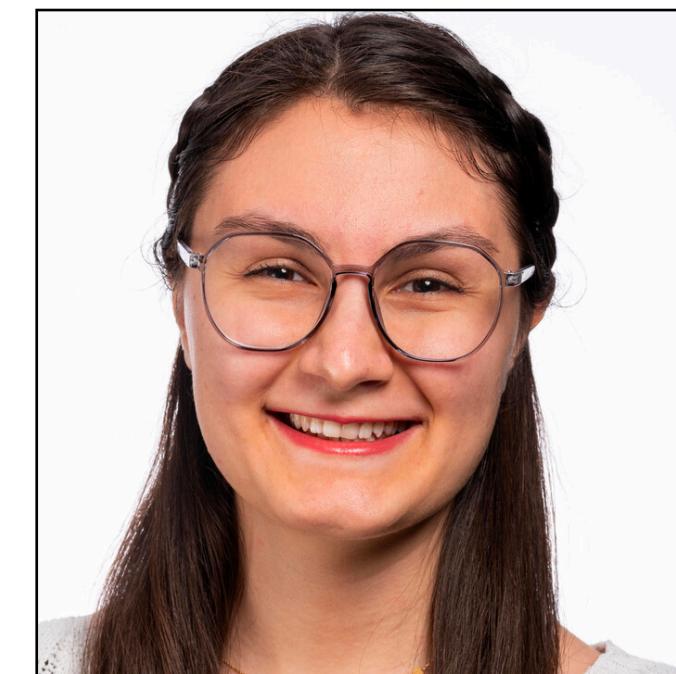
**Auguste Poiroux**  
TA



**Badr AlKhamissi**  
TA



**Simin (Olivia) Fan**  
TA



**Sepideh Mamooler**  
TA



**Ayush Tarun**  
TA

# Course Team



**Agatha Duzan**  
AE



**Jérémie Barghorn**  
AE



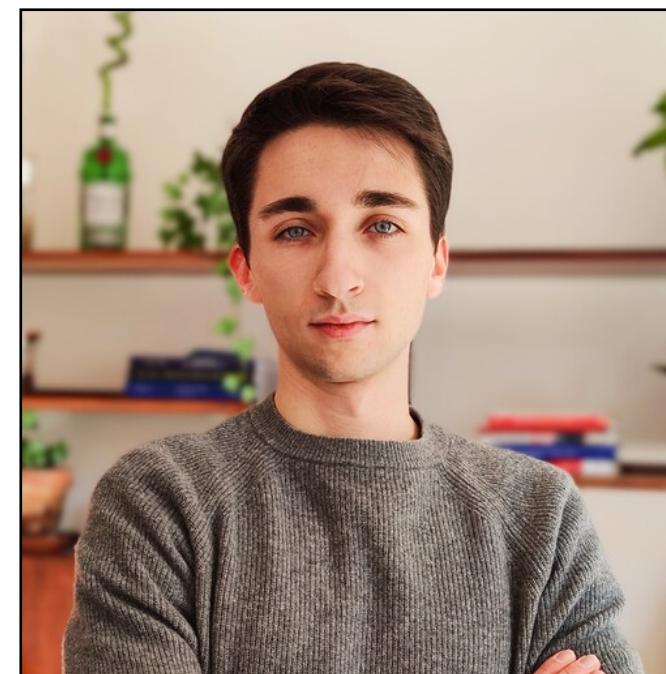
**Yannis Laaroussi**  
AE



**Jan Kokla**  
AE



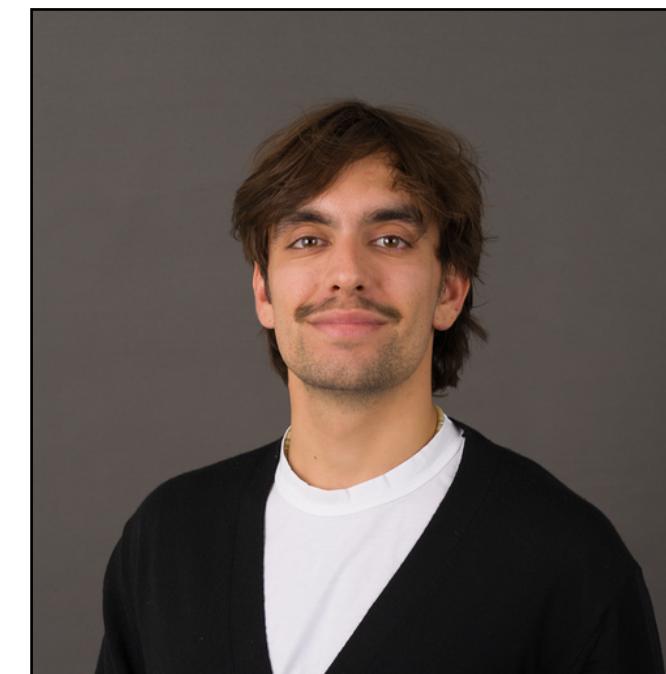
**Antonio Mari**  
AE



**Matteo Santelmo**  
AE



**Matin Ansaripour**  
AE



**Théo Schifferli**  
AE

# Prerequisites

- This course assumes some prior exposure to the following topics:
  - Comfort with Python Programming (PyTorch, HuggingFace)
  - Comfort with mathematical concepts: linear algebra, probability and statistics
  - Machine Learning (CS-233; CS-433 or some equivalent)
- If you're missing background in these topics, brush up on them, though I'll try keep the course as self-contained!

# Platforms

- Course Webpage: <https://nlp.epfl.ch/cs-552-modern-nlp/>
  - Contains all detailed information about the course (slides, exercise sessions, reading lists, etc.)
- Moodle: <https://moodle.epfl.ch/course/view.php?id=17143>
  - Used to point you to links to other course resources (Webpage, Ed, etc.)
- Ed: <https://edstem.org/eu/courses/2071/discussion/>
  - Will be used for class-related questions, discussion, and communication with course staff
  - Queries of a more personal or private nature can be sent to:  
`nlp-cs552-spring2025-ta-team@groupes.epfl.ch`

# Platforms

- **Course Github:** links will be at <https://nlp.epfl.ch/cs-552-modern-nlp/>
  - Contains all detailed information about submitting project milestones & finding exercises

# Lectures

- **Outline Slide:** What will be covered in the class today
- **Motivating Questions:** How should we think about the problems we're trying to solve ?
  - If no one answers, I wait until someone humours me.
- **Content & Material**
- **Comprehension Questions:** Quick tests
  - If no one answers, I go back and re-teach the section :)
- **Participate!**

# Lectures

- Two sessions / week
- **Wednesdays:** 11:15 AM - 1:00 PM in **STCC - Cloud C**
- **Thursdays:** 1:15 - 2:00 PM in **CE16**
- Lecture and topic schedule found on website
- Lecture slides should be posted before each lecture

# WELCOME TO THE SWISSTECH CONVENTION CENTER

THIS COURSE IS BEING HELD IN A PRIVATE BUILDING. ONLY USE THE ENTRANCE AND FACILITIES  
CLEARLY INDICATED «COURS EPFL»

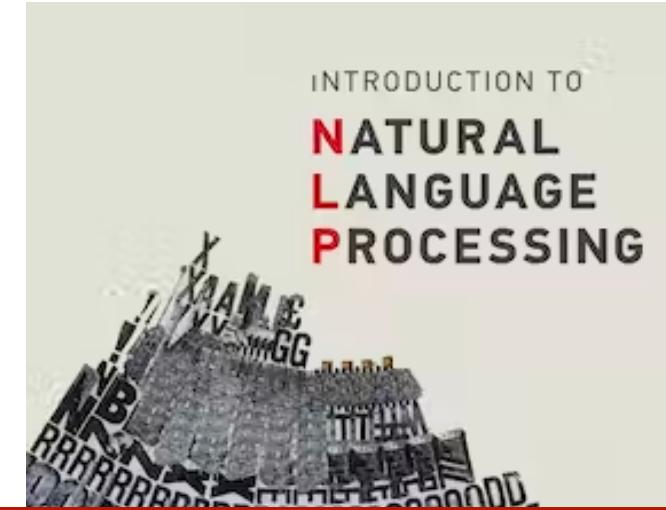
PLEASE DO NOT EAT OR DRINK IN THE AUDITORIUM – DON'T LEAVE YOUR WASTE  
DON'T FORGET TO TAKE ALL YOUR BELONGINGS

SHOULD YOU FORGET SOMETHING, NOTE THAT THE «LOST & FOUND» IS LOCATED AT THE  
ENTRANCE OF THE AUDITORIUM

THANK YOU FOR YOUR COOPERATION !

# Textbooks (optional!)

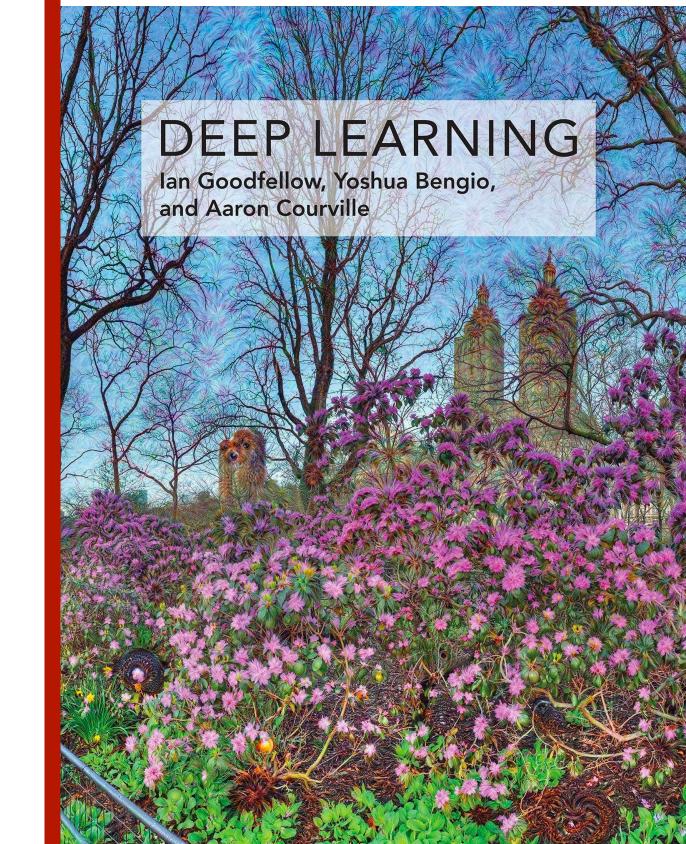
- Jacob Eisenstein. *Natural Language Processing*.



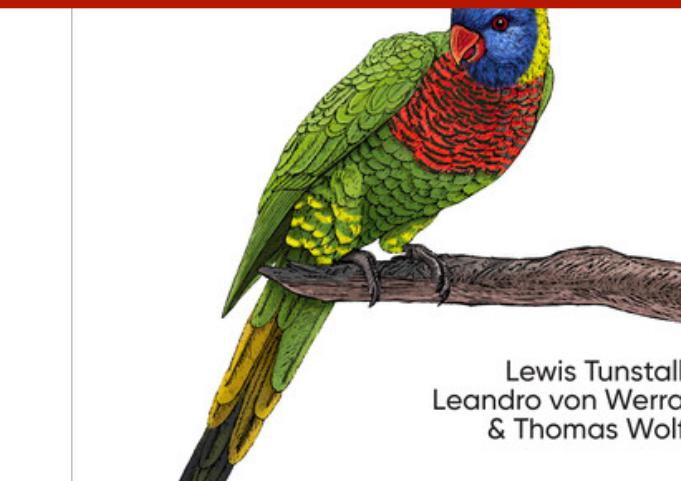
- Yoav Goldberg. *Models for Language Processing*.
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep Learning*.

**Caution: The NLP field moves very fast!**

Books may be a bit out of date!



- Lewis Tunstall, Leandro von Werra, and Thomas Wolf. *Natural Language Processing with Transformers*.



# Exercise Sessions

- **Thursdays:** 2:15 - 4:00 pm in **CE11**
- **First half of semester:**
  - **First part:** Review of previous week's exercises
  - **Second part:** New week's exercises
- **Second half of semester:**
  - Optional meetings with Project Supervisors if you have questions about the project
- 1-2 TAs + 2 AEs will be present (could be increased depending on engagement)
- Schedule on website

**How will you be graded in this course?**

# Midterm (30%)

- **2 hours long**
- Will be held week of **April 2nd or April 9th**
  - depending on room availability
  - no lecture week of midterm

# Final Project (70%)

- Topic: **Create your own Educational Assistant !**
- Complete in teams of 4
- Deliverables (due dates on website):
  - Proposal (1%) - Week 9
  - 2 Milestones (19%) - Week 10, 12
  - Final report, code, and data (50%) - Week 14
- **More details in following weeks!**

# Late Deliverable Policy

- All assignments and milestones are due at **11:59 PM** on their due date
- You get 3 individual late days (and 2 group late days) throughout the semester to turn in your assignments and project milestones late.
  - Late day is used as soon as the clock strikes 12:00 AM
  - After last individual deadline (Project M1), remaining individual late days will be pooled for the whole group to get more group late days
- **Final project must be handed in on June 8th. No exceptions.**

# Course Integrity Policy

- For the assignments, you **should not use outside codebases** unless explicitly allowed by the course staff in the assignment description. **You can use ChatGPT or other AI-based tools for any assignment or part of your project. Any use of ChatGPT and other AI-based tools must be cited and mentioned. Uncited use of these tools will be penalised.**
- For the project, you may build your work upon existing open-source codebases, but are **required to write new code** to perform your experiments. In the project, clearly specify your team's contributions and how they differ from the pre-existing codebase in your milestone reports and final report.
- You are free to discuss ideas and implementation details with other project teams. However, you **should not look at another team's code**, or incorporate their code into your project (unless explicitly allowed by the course staff).

- **Natural Language Processing** Lab
  - Master's Theses, Semester Projects available every term
- Other **NLP** courses
  - **Fall 2025:** Introduction to Natural Language Processing (6 credits)
    - ▶ Lectures, Quizzes, Final Exam
  - **Fall 2025:** Topics in Natural Language Processing (2 credits)
    - ▶ Paper reading, paper reviewing, discussion

**Let's have a great semester!**