Computational Linguistics

Lecture 1: Introduction

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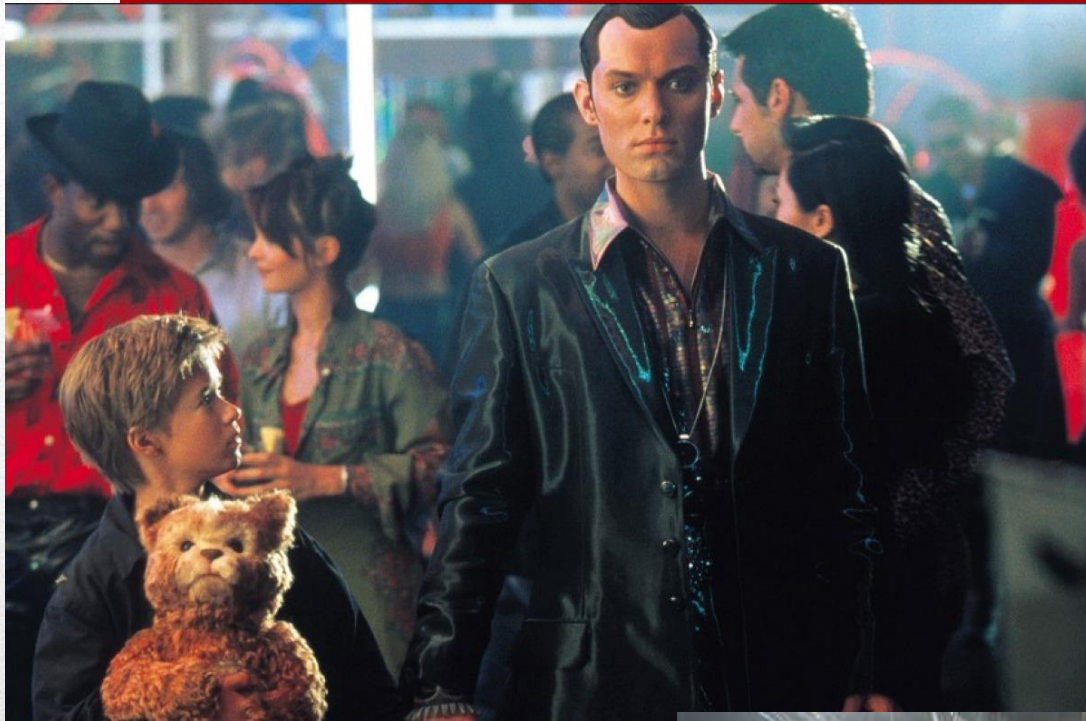
Year Work Grading

➢Mid-Term: 5

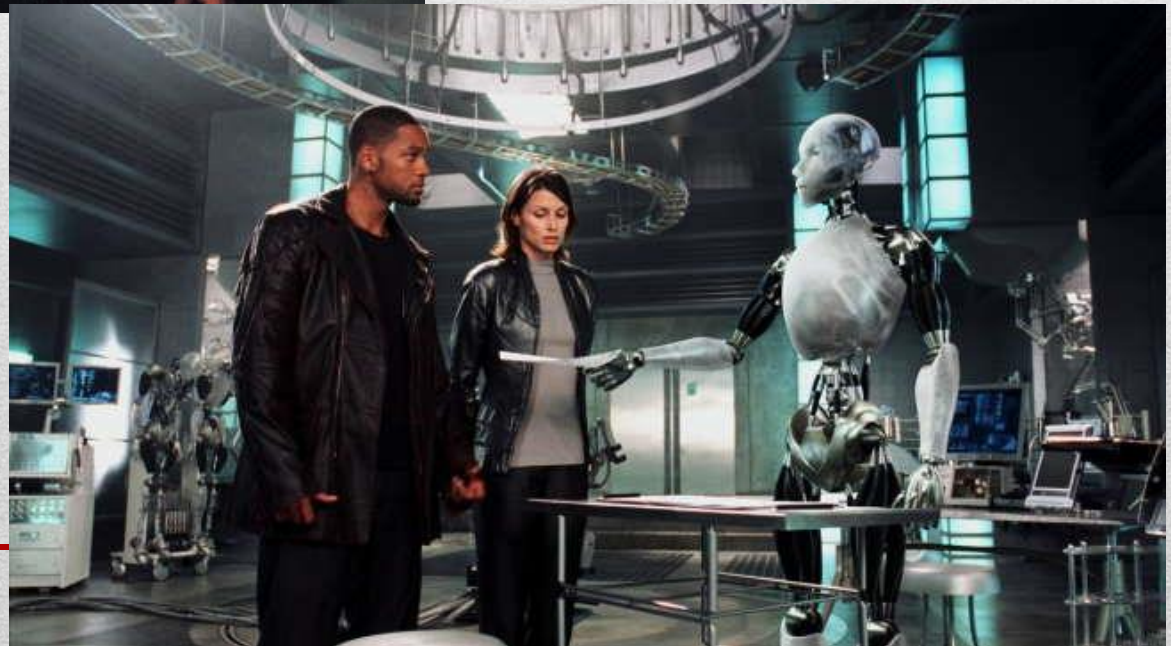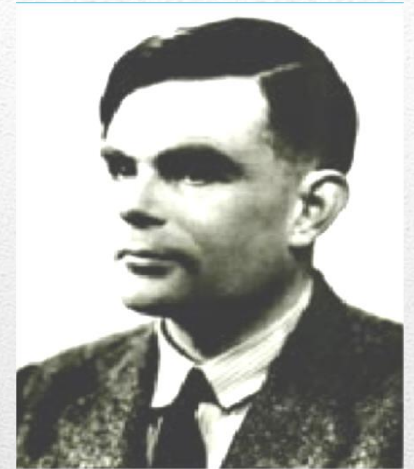➢Lecture Work: 5

➢Final Exam: 40

➢Total: 50

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AI 2001

I Robot 2004

Turing Test (Alan Turing 1950)

➢Alan M.Turing (1912-1954)

Computing machinery and intelligence. Mind, Vol. LIX. 433-460, 1950

The paper discussed conditions for considering a machine to be intelligent
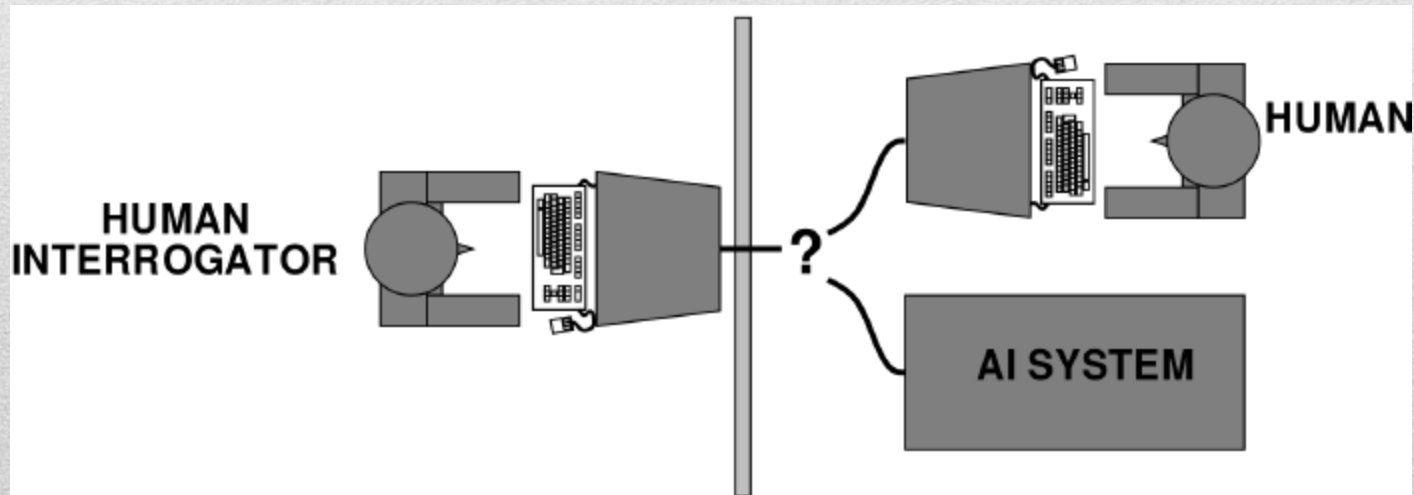
Can machines think?" ←→ "Can machines behave intelligently?"

➢Led to Artificial Intelligence (AI)

• Expert systems

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Acting Humanly: The Turing Test

➢ The Turing test (The Imitation Game): Operational definition of intelligence.

The Turing Test

➢Turing predicted that roughly by the end of the twentieth century a machine with 10 gigabytes of memory would have around a 30% chance of fooling a human interrogator after 5 minutes of questioning

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What is Computational Linguistics?

➢Study of computer processing of natural languages

The field goes by various names…

➢ **Computational linguistics (CL)**
  - The science of doing what linguists do with language, but using computers.

➢ **Natural language processing (NLP)**
  - The engineering discipline of doing what people do with language, but using computers.

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Science vs. Engineering

➢What is the goal ?

- Understanding the phenomenon of human language.

- Building better applications.

NLP Problems

1. English sentences are incomplete descriptions of the information that they are intended to convey.

➢ The speaker can be as vague or as precise as they wish. They can leave out things they believe the hearer already knows.

e.x. " The boys are late" !

NLP Problems

2. The same expression can have different meaning in different contexts

e.x. " We need to put an eye on him"

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NLP Problems

2. There are a lot of ways to say the same thing

e.x.

" Ahmed was born on October 11th"

"Ahmed's birthday is October 11th"

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Knowledge of the language..

➢ To write programs that understand language, we have to define precisely:

- What the underlying task is and..

- What the target representation should look like. **13**

Knowledge of the language..

➢ **Phonetics and Phonology** – The study of linguistic sounds. [in case of spoken language]

➢ **Morphology** – The study of the meaningful components of words.

➢ **Syntax** – The study of the structural relationships between words.

➢ **Semantics** – The study of meaning.

➢ **Discourse** – The study of linguistic units larger than a single utterance

➢ **Pragmatics** – The study of how language is used to accomplish goals.

[All others are needed for written language]

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Morphological Analysis

Individual words are analyzed into their components and non-word tokens (punctuation) are separated from the words.

➤ Morpheme: smallest linguistic unit that has meaning
➤ Morphemes are combined into words
- duck + s = [$_N$duck] + [$_{plural}$s]
- duck + s = [$_V$duck] + [$_{3rd\ person\ singular}$s]
- happiness = [$_{Adj}$happy] + [ness]

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Syntactic Analysis

The study of the structural relationships between words

- ➢I Saw the man
- ➢Man the saw I

Semantic Analysis

Different words/structure, same meaning

➢ She needed to make a quick decision in that situation.

➢ The scenario required her to make a split-second judgment.

➢ I saw the man.

➢ The man was seen by me.

Semantic Analysis

Different words/structure, same meaning

➢ I walked by the bank
- … to deposit my check.
- … to take a look at the river.

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Discourse Analysis

The meaning of an individual sentence may depend on the sentences that precede or follow it

➢ Pronoun reference:

"The dog wanted the bone, but Sam threw <u>it</u> away."

➢ Inference and other relations between sentences:

"The bomb exploded in front of the hotel. The fountain was destroyed, but the lobby was largely intact."

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Pragmatic Analysis

The structure representing what was said is reinterpreted to determine what was actually meant.

- ➤ I'm afraid, I can't be able to help you
- ➤ I won't help you

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Why is CL/NLP hard?

Ambiguity

Ambiguity

➢ I made her duck

have different interpretations….

1. I cooked a duck for her
2. I cooked the duck belonging to her
3. I caused her to lower her head or body
4. I waved my magic wand and turned her into duck !

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Ambiguity Analysis

➢ The words *duck* and *her* are morphologically or syntactically ambiguous.

➢ *Duck* can be a verb or a noun, while *her* can be a dative pronoun or a possessive pronoun.

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Ambiguity Analysis

➢ The word *make* is <u>semantically</u> ambiguous; it can mean *create* or *cook*.

➢ The verb *make* is <u>syntactically</u> ambiguous. It can be transitive, i.e. taking a single direct object (e.x. 2), or it can be ditransitive, i.e. taking two objects (e.x. 4)

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Ambiguity Analysis

➢ *make* can take a direct object and a verb (e.x 3), meaning that the object (*her*) got caused to perform the verbal action (*duck*)