12. Searching & Midterm review

LING-351 Language Technology and LLMs

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Searching

Finding a friend

Information need: What happened to my friend *Katie Smith* from elementary school? How to find out?

- Google search? (What queries to use?)

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- (Probably not super helpful to ask ChatGPT…)

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Finding a friend

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- Google search? (What queries to use?)
- LinkedIn, Facebook, Instagram?
- (Probably not super helpful to ask ChatGPT…)
- Ask a mutual friend?

This is one example of information retrieval/search.

Intents and information needs

We need to understand that users interacting with technology have various intents.

- Set an alarm for tomorrow at 6.

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Intents and information needs

We need to understand that users interacting with technology have various intents.

- Set an alarm for tomorrow at 6.
- Book a flight to Guatemala.
- Intent recognition: identify user's intent from what they say
  - closely related to text classification problem

Intents and information needs

Information needs are the user's underlying intentions to find out or learn something. For example, if someone asks:

- What is the capital of Guatemala?
- What's the weather there?
- When did Mandarin and Cantonese diverge?
- What happened to my friend Katie Smith?

all of these are information needs, because the user's goal is to know something

Intents and information needs

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When these needs are turned into search queries, they often appear in a shorter or less natural form. For instance, those same needs might become queries like… (your thoughts?)

- The information need is the question in the user’s mind
- The query is the way they actually type it into a search engine

Evaluating search results

How to quantify success? Some common metrics.

- Precision
- Recall

Evaluating search results

Precision: Percentage of the documents returned that are relevant.

- Search engine gives you 400 documents, 200 of them are actually relevant: precision is 200/400 = 50%.

Evaluating search results

Precision: Percentage of the documents returned that are relevant.

- Search engine gives you 400 documents, 200 of them are actually relevant: precision is 200/400 = 50%.
- Aka positive predictive value (medicine!): what percent of positives are true positives?

Evaluating search results

Recall: Percentage of relevant documents that are returned.

- There are 1000 relevant documents out there; search engine gives 200 of them: precision is 200/1000 = 20%.

Evaluating search results: Summary

$$\textbf{Precision} = \frac{\text{Number of relevant documents retrieved}}{\text{Total number of documents retrieved}}$$

$$\textbf{Recall} = \frac{\text{Number of relevant documents retrieved}}{\text{Total number of relevant documents in the collection}}$$

Evaluating search results: Summary

$$\textbf{Precision} = \frac{\text{Number of relevant documents retrieved}}{\text{Total number of documents retrieved}}$$

$$\textbf{Recall} = \frac{\text{Number of relevant documents retrieved}}{\text{Total number of relevant documents in the collection}}$$

Precision $\Rightarrow$ *How accurate the results are*

Recall $\Rightarrow$ *How complete the results are*

Evaluating search results: Trade-offs and measures

- What would happen if a search engine aimed for **100% precision** but didn't care about recall? $\rightarrow$ *It would return very few (or even one) perfectly relevant documents.*

Evaluating search results: Trade-offs and measures

- What would happen if a search engine aimed for **100% precision** but didn't care about recall? $\rightarrow$ *It would return very few (or even one) perfectly relevant documents.*
- What would happen if a search engine aimed for **100% recall** but didn't care about precision? $\rightarrow$ *It would return everything, including all irrelevant documents.*

Evaluating search results: Trade-offs and measures

F-measure: balances precision and recall (because both matter)

$$F_1 = \frac{2 \times P \times R}{P + R}$$

Evaluating search results: Trade-offs and measures

- In reality, search results are also **ranked** — people care most about the precision of the top-ranked results.

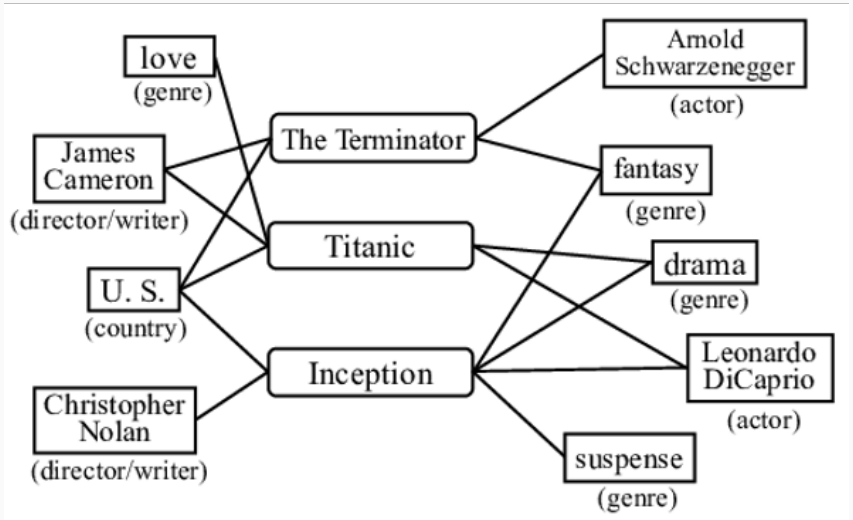
Evaluating search results: Trade-offs and measures

- In reality, search results are also **ranked** — people care most about the precision of the top-ranked results.
- **Precision@k**: looks at the top k results and asks, *what percent of these are relevant?*

Structured data

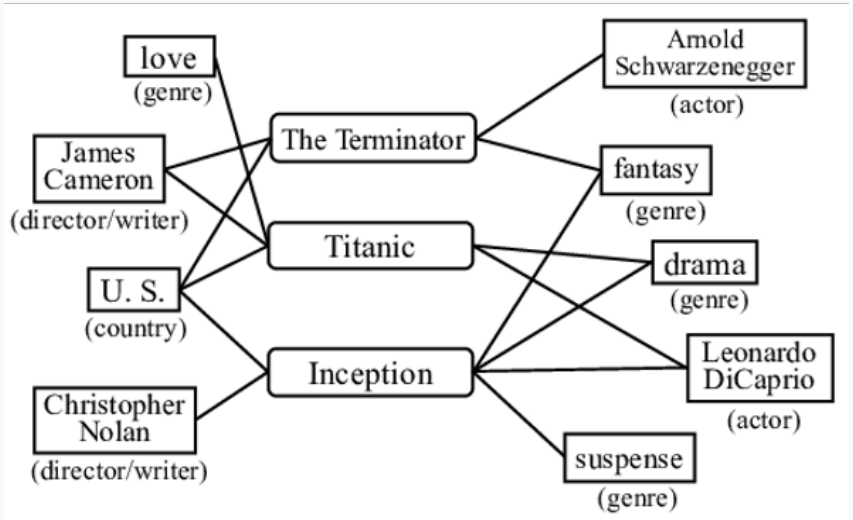
Structured data

- **IMDB**: links each film with year, director, producer, actor, etc.



Structured data

- **IMDB**: links each film with year, director, producer, actor, etc.
- Can visualize in a (limited-domain) knowledge graph (i.e., “ontology”)



Knowledge graphs

- *Google Scholar*: links each paper with year, author, who it cites, who cites it. (`https://scholar.google.com/`)

Knowledge graphs

- *WordNet*: hand-built lexicon representing, e.g., that dogs are animals, animals are living things (hypernym/hyponym relations)

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Knowledge graphs

- *WordNet*: hand-built lexicon representing, e.g., that dogs are animals, animals are living things (hypernym/hyponym relations)
- *FrameNet*: a lexical database of English that is both human- and machine-readable (`https://framenet.icsi.berkeley.edu/`)
- *ConceptNet*: a freely-available semantic network, designed to help computers understand the meanings of words that people use (`https://conceptnet.io/`)

Knowledge graphs

- Google's knowledge graph (`https://www.youtube.com/watch?v=mmQl6VGvX-c`)

Knowledge graphs

- Google's knowledge graph (https://www.youtube.com/watch?v=mmQl6VGvX-c)
- Knowledge graph and searching (https://www.youtube.com/watch?v=Q5izD6Xlb8o)

Midterm

Logistics

- Start Date: October 9, 2025 — 9:00 AM
- End Date: October 9, 2025 — 5:00 PM
- Time Limit: 60 minutes
- Mode: Asynchronous (open within the given window)
- Attempt: 1
- Format: Open-book, but not Open-AI (PLEASE take this as an opportunity to review and apply what you've learned)

Logistics

- Total 19 questions

Logistics

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- Each class slide is related to 2-3 questions

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- Multiple choice (10 questions)

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- Short written response (8 questions)

Logistics

- Total 19 questions
- Each class slide is related to 2-3 questions
- Multiple choice (10 questions)
- Short written response (8 questions)
- Longer written response (1 question)

Slide guides

- Introduction & Encoding

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  - What is language

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  - What is language
  - Different type of languages (alphabetic, syllabic, logographic)

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  - language vs. writing (symbols)

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- Spelling checkers

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  - What is language
  - Different type of languages (alphabetic, syllabic, logographic)
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  - Simple checkers

Slide guides

- Introduction & Encoding
  - What is language
  - Different type of languages (alphabetic, syllabic, logographic)
  - language vs. writing (symbols)
- Spelling checkers
  - Simple checkers
  - More complex checkers

Slide guides

- Grammar checkers

Slide guides

- Grammar checkers
  - Syntax

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  - Syntax
  - POS

Slide guides

- Grammar checkers
  - Syntax
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  - Dependency relations

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  - transfer

Slide guides

- Grammar checkers
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  - Dependency relations
- CALL
  - Language learning
  - L1 vs. L2
  - transfer
  - social factors

Slide guides

- Text as data

Slide guides

- Text as data
    - knowledge-driven

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  - knowledge-driven
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  - (skip different previous studies)

Slide guides

- Text as data
  - knowledge-driven
  - data-driven
  - (skip different previous studies)
- Corpus, word distributions

Slide guides

- Text as data
  - knowledge-driven
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  - (skip English corpora)

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  - Word distributions - Zipf, Heap

Slide guides

- Text as data
  - knowledge-driven
  - data-driven
  - (skip different previous studies)
- Corpus, word distributions
  - (skip English corpora)
  - Word distributions - Zipf, Heap
  - Word vectors

Slide guides

- Text classification

Slide guides

- Text classification
  - Different text classification tasks (e.g., spam filtering)

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- Text classification
  - Different text classification tasks (e.g., spam filtering)
  - How do we make text classifier?

Slide guides

- Text classification
  - Different text classification tasks (e.g., spam filtering)
  - How do we make text classifier?
  - (skip the details of the perceptron)

Group

Group assigned

- Groups have been assigned and added to myCourses.
- Each group consists of 2–3 members.
- There will be two presentations per group:
  - One member presents in the first round.
  - Another member presents in the second round.
- We will discuss presentation preparation in more detail on **October 16**, after the fall break.
- For now, please stay in touch with your group members and start discussing your ideas.