Part 7: Evaluation of IR Systems

Francesco Ricci

Most of these slides comes from the course:
Information Retrieval and Web Search,
Christopher Manning and Prabhakar Raghavan
This lecture

- How do we know if our results are any good?
  - Evaluating a search engine
    - Benchmarks
    - Precision and recall
    - Accuracy
    - Inter judges disagreement
    - Normalized discounted cumulative gain
    - A/B testing
  - Results summaries:
    - Making our good results usable to a user.
Measures for a search engine

- How **fast** does it **index**
  - Number of documents/hour
  - (Average document size)
- How **fast** does it **search**
  - Latency as a function of index size
- **Expressiveness** of query language
  - Ability to express complex information needs
  - Speed on complex queries
- **Uncluttered UI**
- Is it free? 😊
Measures for a search engine

- All of the preceding criteria are *measurable*: we can quantify speed/size
  - we can make expressiveness precise
- But the key measure: **user happiness**
  - What is this?
  - Speed of response/size of index are factors
  - But blindingly fast, useless answers won’t make a user happy
- Need a way of quantifying user happiness.
Measuring user happiness

- Issue: who is the user we are trying to make happy?
  - Depends on the setting

- **Web engine:**
  - User finds what they want and return to the engine
    - Can measure rate of return users
  - User completes their task – search as a means, not end

- **eCommerce site:** user finds what they want and buy
  - Is it the end-user, or the eCommerce site, whose happiness we measure?
  - Measure time to purchase, or fraction of searchers who become buyers?

- **Recommender System:** users finds the recommendations useful OR the system is good at predicting the user rating?
Measuring user happiness

- **Enterprise** (company/govt/academic): Care about “user productivity”
  - How much time do my users save when looking for information?
  - Many other criteria having to do with breadth of access, secure access, etc.
Happiness: elusive to measure

- Most common proxy: *relevance* of search results
- *But how do you measure relevance?*
- We will detail a methodology here, then examine its issues
- Relevance measurement requires 3 elements:
  1. A benchmark document collection
  2. A benchmark suite of queries
  3. A usually binary assessment of either Relevant or Nonrelevant for each query and each document
- Some work on more-than-binary, but not the standard.
From needs to queries

- Information need -> query -> search engine -> results -> browse OR query -> ...

Encoded by the user into a query
Evaluating an IR system

- Note: the information need is translated into a query.
- Relevance is assessed relative to the information need not the query.
- E.g., Information need: I'm looking for information on whether drinking red wine is more effective at reducing your risk of heart attacks than white wine.
- Query: wine red white heart attack effective
- You evaluate whether the doc addresses the information need, not whether it has these words.
Standard relevance benchmarks

- **TREC** - National Institute of Standards and Technology (NIST) has run a large IR test bed for many years
- **Reuters** and other benchmark doc collections used
- “Retrieval tasks” specified
  - sometimes as queries
- Human experts mark, for each query and for each doc, Relevant or Nonrelevant
  - or at least for subset of docs that some system returned for that query.
Relevance and Retrieved documents

Information need

<table>
<thead>
<tr>
<th>Relevant</th>
<th>Not Relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP</td>
<td>FP</td>
</tr>
<tr>
<td>FN</td>
<td>TN</td>
</tr>
</tbody>
</table>

Documents

Query and system
Unranked retrieval evaluation: Precision and Recall

- **Precision**: fraction of retrieved docs that are relevant = $P(\text{relevant}|\text{retrieved})$
- **Recall**: fraction of relevant docs that are retrieved = $P(\text{retrieved}|\text{relevant})$

<table>
<thead>
<tr>
<th></th>
<th>Relevant</th>
<th>Nonrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieved</td>
<td>$tp$</td>
<td>$fp$</td>
</tr>
<tr>
<td>Not Retrieved</td>
<td>$fn$</td>
<td>$tn$</td>
</tr>
</tbody>
</table>

- Precision $P = \frac{tp}{(tp + fp)} = \frac{tp}{\text{retrieved}}$
- Recall $R = \frac{tp}{(tp + fn)} = \frac{tp}{\text{relevant}}$
Accuracy

- Given a query, an engine (**classifier**) classifies each doc as “Relevant” or “Nonrelevant”
  - What is retrieved is classified by the engine as "relevant" and what is not retrieved is classified as "nonrelevant"
- The **accuracy** of the engine: the fraction of these classifications that are correct
  - \( \frac{tp + tn}{tp + fp + fn + tn} \)
- **Accuracy** is a commonly used evaluation measure in **machine learning** classification work
- Why is this not a very useful evaluation measure in IR?
Why not just use accuracy?

- How to build a 99.9999% accurate search engine on a low budget?

People doing information retrieval want to find something and have a certain tolerance for junk.
Precision, Recall and Accuracy

Very low precision, very low recall, high accuracy

\[ p = 0 \]
\[ r = 0 \]

\[ a = \frac{tp + tn}{tp + fp + fn + tn} \]
\[ = \frac{0 + (27 \times 17 - 2)}{0 + 1 + 1 + (27 \times 17 - 2)} = 0.996 \]
Precision/Recall

- What is the recall of a query if you retrieve all the documents?
- You can get high recall (but low precision) by retrieving all docs for all queries!
- Recall is a non-decreasing function of the number of docs retrieved
  - Why?
- In a good system, precision decreases as either the number of docs retrieved or recall increases
  - This is not a theorem (why?), but a result with strong empirical confirmation.
Precision-Recall

What is 1000?

P=0/1, R=0/1000

P=1/2, R=1/1000

P=2/3, R=2/1000

P=2/4, R=2/1000

P=3/5, R=3/1000

Aaron Copland - Wikipedia, the free encyclopedia
Before emigrating from Scotland to the United States, Copland's father, ..., Travels to Italy, Austria, and Germany rounded out Copland's musical education. ...
Biology - Composer - Film composer - Critic, writer, and teacher
en.wikipedia.org/wiki/Aaron_Copland - Cached - Similar

Copland - Wikipedia, the free encyclopedia
From Wikipedia, the free encyclopedia. Jump to: navigation, search. Copland can mean: [exclamatory]
Surname. Aaron Copland (1900–1990), American composer ...
en.wikipedia.org/wiki/Copland - Cached - Similar

Books by Aaron Copland
What to Listen for in Music - 2002 - 308 pages
Music and Imagination - 1980 - 134 pages
Aaron Copland: A Reader Selected Writings 1923 ... - 2004 - 416 pages
books.google.it - More book results »

C O P L A N D
Maker and one line of products: stereo and multi-channel valve amplifier, stereo and multi-channel power amplifier and cd player.
w w w . c o p l a n d . c o / - C a c h e d - S i m i l a r

Aaron Copland I American Composer
4 Jan 2013 ... Lucidcafe's profile noting life, works, and style with photograph and links.
w w w . l u c i d c a f e . c o m / l i b r a r y / s u n / o v e r / c o p l a n d . h t m l - C a c h e d - S i m i l a r

Classical Net - Basic Repertoire List - Copland
As much as anyone, Aaron Copland established American concert music through his
Difficulties in using precision/recall

- Should average over large document collection/query ensembles
- Need human relevance assessments
  - People aren’t reliable assessors
- Assessments have to be binary
  - Nuanced assessments?
- Heavily skewed by collection/authorship
  - Results may not translate from one domain to another.
A combined measure: $F$

- Combined measure that assesses precision/recall tradeoff is **$F$ measure** (weighted harmonic mean):

  $$F = \frac{1}{\frac{1}{P} \alpha + (1 - \alpha) \frac{1}{R}} = \frac{(\beta^2 + 1)PR}{\beta^2 P + R}$$

  $$\beta^2 = \frac{1 - \alpha}{\alpha}$$

- People usually use balanced $F_1$ measure
  - i.e., with $\beta = 1$ or $\alpha = \frac{1}{2}$

- Harmonic mean is a **conservative** average
  - See CJ van Rijsbergen, *Information Retrieval*
F₁ and other averages

Geometric mean of a and b is \((a*b)^{1/2}\)
Evaluating ranked results

- The system can return any number of results – by varying its behavior or
- By taking various numbers of the top returned documents (levels of recall), the evaluator can produce a precision-recall curve.
Precision-Recall

<table>
<thead>
<tr>
<th>P</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/1</td>
<td>0/1000</td>
</tr>
<tr>
<td>1/2</td>
<td>1/1000</td>
</tr>
<tr>
<td>2/3</td>
<td>2/1000</td>
</tr>
<tr>
<td>2/4</td>
<td>2/1000</td>
</tr>
<tr>
<td>3/5</td>
<td>3/1000</td>
</tr>
</tbody>
</table>

**Cop Land** (1997)
Do you know that he was paid only $60,000 for his acting in *Cop Land,* ... To me *Cop Land* is the kind of movie Stallone should have made after *First Blood.* ...
www.imdb.com/title/tt0118867/ - 13 hours ago - Cached - Similar

**Aaron Copland** - Wikipedia, the free encyclopedia
Before emigrating from Scotland to the United States, *Copland's* father, .... Travels to Italy, Austria, and Germany rounded out *Copland's* musical education. ...
Biography - Composer - Film composer - Critic, writer, and teacher
en.wikipedia.org/wiki/Aaron_Copland - Cached - Similar

**Copland** - Wikipedia, the free encyclopedia
From Wikipedia, the free encyclopedia. Jump to navigation, search. *Copland* can mean: [en]Surname. Aaron *Copland* (1900–1990), American composer ...
en.wikipedia.org/wiki/Copland - Cached - Similar

**Books by Aaron Copland**
What to Listen for in Music - 2002 - 308 pages
Music and Imagination - 1980 - 134 pages
Aaron Copland: A Reader Selected Writings 1923 ... - 2004 - 416 pages
books.google.it - More book results »

**Copland**
Maker and one line of products: stereo and multi-channel valve amplifier, stereo and multi-channel power amplifier and CD player.
www.copland.dk - Cached - Similar

**Aaron Copland | American Composer**
4 Jan 2013 ... Lucidcafe's profile noting life, works, and style with photograph and links.
www.lucidcafe.com/library/SSNov/copland.html - Cached - Similar

**Classical Net - Basic Repertoire List - Copland**
As much as anyone, Aaron *Copland* established American concert music through his
The precision-recall curve is the thicker one.

What is happening here where precision decreases without an increase of the recall?
Averaging over queries

- A precision-recall graph for one query isn’t a very sensible thing to look at.
- You need to **average** performance over a whole bunch of queries.
- But there’s a technical issue:
  - Precision-recall calculations place some points on the graph.
  - How do you determine a value (interpolate) between the points?
Interpolated precision

- Idea: if locally precision increases with increasing recall, then you should get to count that...
- So you take the max of the precisions for all the greater values of recall

\[ p_{interp}(r) = \max_{r' \geq r} p(r') \]  

Definition of interpolated precision
Evaluation: 11-point interpolated prec.

- **11-point interpolated average precision**
  - The standard measure in the early TREC competitions
  - Take the *interpolated* precision at 11 levels of recall varying from 0 to 1 by tenths
  - The value for 0 is always interpolated!
  - Then *average* them
  - Evaluates performance at all recall levels.
Typical (good) 11 point precisions

- SabIR/Cornell 8A1 11pt precision from TREC 8 (1999)

![Graph showing precision vs recall]

**Average** – on a set of queries - of the precisions obtained for recall $\geq 0$
Precision recall for recommenders

- Retrieve all the items whose predicted rating is \( \geq x \) (\( x = 5, 4.5, 4, 3.5, \ldots, 0 \))
- Compute precision and recall
- An item is Relevant if its true rating is \( > 3 \)
- You get 11 points to plot
- Why precision is not going to 0? Exercise.
- What the 0.7 value represents? I.e. the precision at recall = 1.
Evaluation: Precision at k

- Graphs are good, but people want summary measures!
- Precision at fixed retrieval level
  - **Precision-at-\(k\):** Precision of top \(k\) results
  - Perhaps appropriate for most of web search: all people want are good matches on the first one or two results pages
  - But: averages badly and has an arbitrary parameter of \(k\).
Mean average precision (MAP)

Average of the precision values obtained for increasing values of $K$, for the top $K$ documents, each time a new relevant doc is retrieved

Avoids interpolation, use of fixed recall levels

MAP for a query collection is arithmetic average

- Macro-averaging: each query counts equally

**Definition:** if the set of relevant documents for an information need $q_j$ is \( \{d_1, \ldots, d_{m_j}\} \) and $R_{jk}$ is the set of documents retrieved until you get $d_k$, then:

\[
\text{MAP}(Q) = \frac{1}{|Q|} \sum_{j=1}^{Q} \frac{1}{m_j} \sum_{k=1}^{m_j} \text{Precision}(R_{jk})
\]
Example

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>2/3</td>
<td>2/2</td>
<td></td>
</tr>
<tr>
<td>3/7</td>
<td>3/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\frac{(1+2/3+3/7)}{3} = 0.69
\]

\[
\frac{(1+1+3/6+4/7)}{4} = 0.76
\]

Average precision = \[
\frac{(0.69 + 0.76)}{2} = 0.72
\]

Nonrelevant

Relevant
R-precision

- If I known the set of relevant documents $\text{Rel}$, then calculate the precision of top $|\text{Rel}|$ docs returned
- Perfect system could score 1.0.
- If there are $|\text{Rel}|$ relevant documents for a query, we examine the top $|\text{Rel}|$ results of a system, and find that $r$ are relevant then
  - $P = \frac{r}{|\text{Rel}|}$
  - $R = \frac{r}{|\text{Rel}|}$
- R-precision turns out to be identical to the break-even point, i.e., where precision is equal to recall.
Performance Variance

- For a test collection, it is usual that a system does very **bad** on some information needs (e.g., MAP = 0.1) and **excellently** on others (e.g., MAP = 0.7)

- Indeed, it is usually the case that the variance in performance of the same system across queries is much greater than the variance of different systems on the same query

- That is, there are easy information needs and hard ones!
CREATING TEST COLLECTIONS FOR IR EVALUATION
## Test Collections

### TABLE 4.3 Common Test Corpora

<table>
<thead>
<tr>
<th>Collection</th>
<th>NDocs</th>
<th>NQrys</th>
<th>Size (MB)</th>
<th>Term/Doc</th>
<th>Q-D RelAss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADI</td>
<td>82</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIT</td>
<td>2109</td>
<td>14</td>
<td>2</td>
<td>400</td>
<td>&gt;10,000</td>
</tr>
<tr>
<td>CACM</td>
<td>3204</td>
<td>64</td>
<td>2</td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>CISI</td>
<td>1460</td>
<td>112</td>
<td>2</td>
<td>46.5</td>
<td></td>
</tr>
<tr>
<td>Cranfield</td>
<td>1400</td>
<td>225</td>
<td>2</td>
<td>53.1</td>
<td></td>
</tr>
<tr>
<td>LISA</td>
<td>5872</td>
<td>35</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medline</td>
<td>1033</td>
<td>30</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPL</td>
<td>11,429</td>
<td>93</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSHMED</td>
<td>34,8566</td>
<td>106</td>
<td>400</td>
<td>250</td>
<td>16,140</td>
</tr>
<tr>
<td>Reuters</td>
<td>21,578</td>
<td>672</td>
<td>28</td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>TREC</td>
<td>740,000</td>
<td>200</td>
<td>2000</td>
<td>89-3543</td>
<td>» 100,000</td>
</tr>
</tbody>
</table>
From document collections to test collections

- Still need
  1. Test queries
  2. Relevance assessments

- Test queries
  - Must be appropriate for docs available
  - Best designed by domain experts
  - Random query terms generally not a good idea

- Relevance assessments
  - Human judges, time-consuming
  - Are human panels perfect?
TREC (Text REtrieval Conference)

- TREC Ad Hoc task from first 8 TREC is standard IR task
  - 50 detailed information needs a year
  - Human evaluation of pooled results returned
  - More recently other related things: Web track, HARD
- A TREC query (TREC 5)
  - a topic id or number;
  - a short title, which could be viewed as the type of query that might be submitted to a search engine;
  - a description of the information need written in no more than one sentence; and
  - a narrative that provided a more complete description of what documents the searcher would consider as relevant.

http://trec.nist.gov/
Example TREC ad hoc topic

<top>
<num> Number: 200
<title> Topic: Impact of foreign textile imports on U.S. textile industry
<desc> Description: Document must report on how the importation of foreign textiles or textile products has influenced or impacted on the U.S. textile industry.
<narr> Narrative: The impact can be positive or negative or qualitative. It may include the expansion or shrinkage of markets or manufacturing volume or an influence on the methods or strategies of the U.S. textile industry. "Textile industry" includes the production or purchase of raw materials; basic processing techniques such as dyeing, spinning, knitting, or weaving; the manufacture and marketing of finished goods; and also research in the textile field.
</top>
Standard relevance benchmarks: Others

- **GOV2**
  - Another TREC/NIST collection
  - 25 million web pages
  - Largest collection that is easily available
  - But still 3 orders of magnitude smaller than what Google/Yahoo/MSN index

- **NTCIR**
  - East Asian language and cross-language information retrieval

- **Cross Language Evaluation Forum (CLEF)**
  - This evaluation series has concentrated on European languages and cross-language information retrieval.

- Many others
Unit of Evaluation

- We can compute precision, recall, and F curve for different **units**
- Possible units (i.e., *what content is retrieved*):
  - Documents (most common)
  - Facts (used in some TREC evaluations)
  - Entities (e.g., car companies)
- May produce different results. Why?
Kappa measure for inter-judge (dis)agreement

- Kappa measure
  - Agreement measure among judges
  - Designed for categorical judgments
  - Corrects for chance agreement
- Kappa = \[ \frac{P(A) - P(E)}{1 - P(E)} \]
- \( P(A) \) – proportion of time judges agree
- \( P(E) \) – what agreement would be by chance – but using the probability to output relevant/nonrelevant as observed in the panel of the judges
- Kappa = 0 for chance agreement, 1 for total agreement.
# Kappa Measure: Example

<table>
<thead>
<tr>
<th>Number of docs</th>
<th>Judge 1</th>
<th>Judge 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>Relevant</td>
<td>Relevant</td>
</tr>
<tr>
<td>70</td>
<td>Nonrelevant</td>
<td>Nonrelevant</td>
</tr>
<tr>
<td>20</td>
<td>Relevant</td>
<td>Nonrelevant</td>
</tr>
<tr>
<td>10</td>
<td>Nonrelevant</td>
<td>Relevant</td>
</tr>
</tbody>
</table>
Kappa Example

- $P(A) = \frac{370}{400} = 0.925$
- Agreement by chance: $P(E)$
  - $P(\text{nonrelevant}) = \frac{10+20+70+70}{800} = 0.2125$
  - $P(\text{relevant}) = \frac{10+20+300+300}{800} = 0.7878$
  - $P(E) = 0.2125^2 + 0.7878^2 = 0.665$
- Kappa = $\frac{(0.925 - 0.665)}{1-0.665} = 0.776$

- Kappa > 0.8 = good agreement
- $0.67 < \text{Kappa} < 0.8 \rightarrow \text{“tentative conclusions” [Carletta ’96]}
- Depends on purpose of study
- For >2 judges: average pairwise kappas
## Interjudge Agreement: TREC 3

<table>
<thead>
<tr>
<th>Information need</th>
<th>Number of docs judged</th>
<th>Disagreements</th>
<th>NR</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>211</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>62</td>
<td>400</td>
<td>157</td>
<td>149</td>
<td>8</td>
</tr>
<tr>
<td>67</td>
<td>400</td>
<td>68</td>
<td>37</td>
<td>31</td>
</tr>
<tr>
<td>95</td>
<td>400</td>
<td>110</td>
<td>108</td>
<td>2</td>
</tr>
<tr>
<td>127</td>
<td>400</td>
<td>106</td>
<td>12</td>
<td>94</td>
</tr>
</tbody>
</table>
Impact of Inter-judge Agreement

- Judge variability: impact on absolute performance measure can be significant (e.g., 0.32 using a judge vs 0.39 using the other judge)
- Little impact on ranking of different systems or relative performance
- Suppose we want to know if algorithm A is better than algorithm B
- A standard information retrieval experiment will give us a reliable answer to this question.
Critique of pure relevance

- Relevance vs Marginal Relevance
  - A document can be **redundant** even if it is highly relevant
  - Duplicates
  - The same information from different sources
  - **Marginal relevance is a better measure of utility for the user**

- Using facts/entities as evaluation units more directly measures true relevance

- But harder to create evaluation set.
Can we avoid human judgment?

- No
- Makes experimental work hard
  - Especially on a large scale
- In some very specific settings, can use proxies
- E.g.: for testing an approximate vector space retrieval:
  - compare the cosine distance closeness of the true closest docs to those found by the approximate retrieval algorithm
- But once we have test collections, we can reuse them (so long as we don’t overtrain too badly).
Evaluation at large search engines

- Search engines have test collections of queries and hand-ranked results
- Recall is difficult to measure on the web (why?)
- Search engines often use top k precision, e.g., k=10
- ... or measures that reward you more for getting rank 1 right than for getting rank 10 right: NDCG (Normalized Cumulative Discounted Gain)
- Search engines also use non-relevance-based measures:
  - **Clickthrough on first result:** Not very reliable if you look at a single clickthrough ... but pretty reliable in the aggregate
  - Studies of **user behavior in the lab**
  - **A/B testing.**
Normalised Discounted Cumulative Gain

- Like precision at $k$, it is evaluated over some number $k$ of top search results.
- For a set of queries $Q$, let $R(j, m)$ be the relevance score that human assessors gave to document at rank index $m$ for query $j$.

\[
\text{NDCG}(Q, k) = \frac{1}{|Q|} \sum_{j=1}^{|Q|} Z_{kj} \sum_{m=1}^{k} \frac{2^{R(j,m)} - 1}{\log_2(1 + m)}
\]

- Where $Z_{kj}$ is a normalization factor calculated to make it so that a perfect ranking’s NDCG at $k$ for query $j$ is 1.
- For queries for which $k’ < k$ documents are retrieved, the last summation is done up to $k’$.  

A/B testing

- **Purpose:** Test a single innovation
- **Prerequisite:** You have a large search engine up and running.
- Have **most users use old system**
- **Divert a small proportion of traffic** (e.g., 1%) to the new system that includes the innovation
- Evaluate with an “automatic” measure like clickthrough on first result
- Now we can directly see if the innovation does improve user happiness
- Probably the evaluation methodology that large search engines trust most (true also for RecSys).
Result Summaries

- Having ranked the documents matching a query, we wish to present a results list.
- Most commonly, a list of the document titles plus a short summary, aka “10 blue links”
Summaries

- The title is often automatically extracted from document metadata. What about the summaries?
  - This description is crucial
  - User can identify good/relevant hits based on description
- Two basic kinds:
  - Static
  - Dynamic
- A **static summary** of a document is always the same, regardless of the query that hit the doc
- A **dynamic summary** is a *query-dependent* attempt to explain why the document was retrieved for the query at hand.
Example in Recommender Systems

- **Rosengarten, Rotwand and ...**
  - Climbing
  - 🌟🌟🌟🌟🌟
  - During spring, you may enjoy this place very much.

- **Via Ferrata Roda Di Vael**
  - Climbing
  - 🌟🌟🌟🌟🌟
  - 51.37 km
  - This place is worth visiting as you are not first in the area and probably know more famous places.

- **Castel Flavon - Haselburg**
  - Castle
  - 🌟🌟🌟🌟
  - 48.64 km
  - This place is worth visiting as you are not first in the area and probably know more famous places.
## Example II

These recommendations are based on items you own and more.

| View: | All | New Releases | Coming Soon | More results |

<table>
<thead>
<tr>
<th><strong>1.</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canon EF 85mm f/1.8 USM Medium Telephoto Lens for Canon SLR Cameras</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>by Canon (November 14, 2002)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Customer Review: ⭐⭐⭐⭐⭐ (498)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>List Price:</strong> $419.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Price:</strong> <a href="#">Click to see price</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44 used &amp; new from $329.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️ I own it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✗ Not interested</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✮✮✮✮✮ Rate this item</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended because you added <strong>Canon EF 50mm f/1.4 USM Standard &amp; Medium Telephoto Lens</strong>... to your Shopping Cart and more (Fix this)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>2.</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canon EOS 5D Mark III 22.3 MP Full Frame CMOS with 1080p Full-HD Video Mode Digital SLR Camera (Body)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>by Canon (March 20, 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Customer Review: ⭐⭐⭐⭐⭐ (401)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>List Price:</strong> $3,399.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Price:</strong> <a href="#">Click to see price</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53 used &amp; new from $2,600.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️ I own it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✗ Not interested</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✮✮✮✮✮ Rate this item</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended because you added <strong>Canon EF 50mm f/1.4 USM Standard &amp; Medium Telephoto Lens</strong>... to your Shopping Cart and more (Fix this)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>3.</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canon EOS 5D Mark II 21.1MP Full Frame CMOS Digital SLR Camera (Body Only)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>by Canon (September 17, 2008)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Customer Review: ⭐⭐⭐⭐⭐ (395)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Price:</strong> $2,749.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57 used &amp; new from $989.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️ I own it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✗ Not interested</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✮✮✮✮✮ Rate this item</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended because you added <strong>Canon EF 50mm f/1.4 USM Standard &amp; Medium Telephoto Lens</strong>... to your Shopping Cart and more (Fix this)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Static summaries

- In typical systems, the static summary is a subset of the document
  - Simplest heuristic: the first 50 (or so – this can be varied) words of the document
    - Summary cached at indexing time
  - More sophisticated: extract from each document a set of “key” sentences
    - Simple NLP heuristics to score each sentence
    - Summary is made up of top-scoring sentences
  - Most sophisticated: NLP used to synthesize a summary
    - Seldom used in IR; cf. text summarization work.
Dynamic summaries

- Present one or more “windows” within the document that contain several of the query terms
  - “KWIC” snippets: Keyword in Context presentation
Techniques for dynamic summaries

- **Find small windows in doc that contain query terms**
  - Requires fast window lookup in a document cache

- **Score each window wrt query**
  - Use various features such as window width, position in document, etc.
  - Combine features through a scoring function – methodology to be covered later in this course

- Challenges in evaluation: judging summaries
  - Easier to do pairwise comparisons rather than binary relevance assessments.
Quicklinks

- For a navigational query such as *united airlines* user’s need likely satisfied on www.united.com
- Quicklinks provide navigational cues on that home page
United Airlines - Airline Tickets, Airline Reservations ... (Nasdaq: UAUA)
Official site for United Airlines, commercial air carrier transporting people, property, and mail across the U.S. and worldwide.

www.united.com - 65k - Cached

Planning & Booking    Shop for Flights
Itineraries & Check-in Special Deals
Mileage Plus          Flight Status
Services & Information Customer Service

more results from united.com »

Best match
United Airlines - Airline Tickets, Airline Reservations, Flight ...
www.united.com - Official site
Airline tickets, airline reservations, flight airfare from United Airlines. Online reservations, airline ticket purchase, electronic tickets, flight search, fares and availability ...

Flights    Redeem miles
Check In Online    Children, pets, & assistance
My Itineraries    Change your travel plans
Baggage    Special deals

Customer service 800-864-8331
Alternative results presentations?

- An active area of HCI research
- An alternative: http://www.searchme.com copies the idea of Apple’s Cover Flow for search results (searchme recently went out of business)
Resources for this lecture

- IIR 8