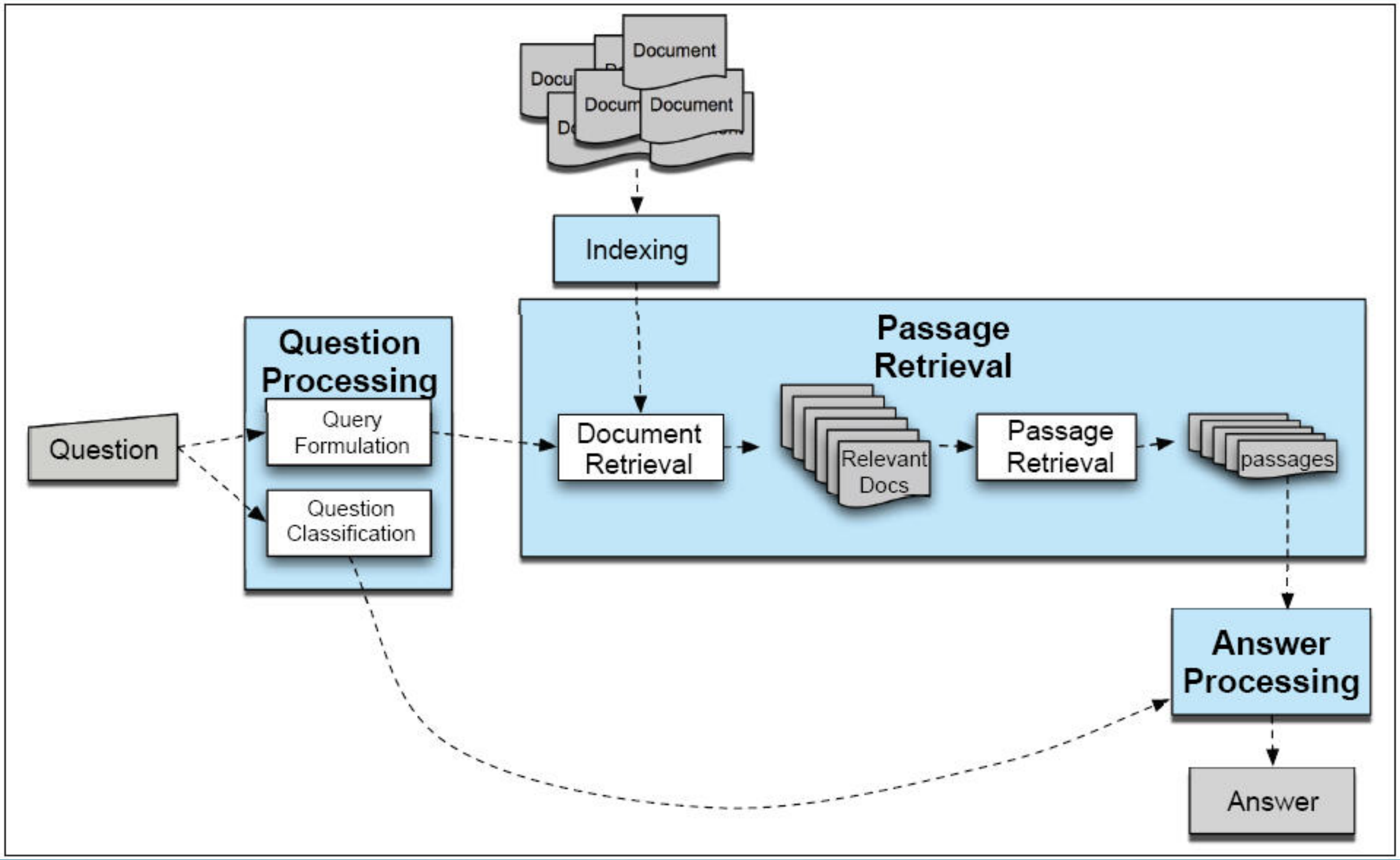
# Shallow & Deep QA Systems

Ling 573
NLP Systems and Applications
April 8, 2014

## Roadmap

- QA systems overview
- QA resources
- Two extremes in QA systems:
  - Redundancy-based QA: Aranea
- Deliverable #2

# General Architecture



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  - For web search, use result snippets

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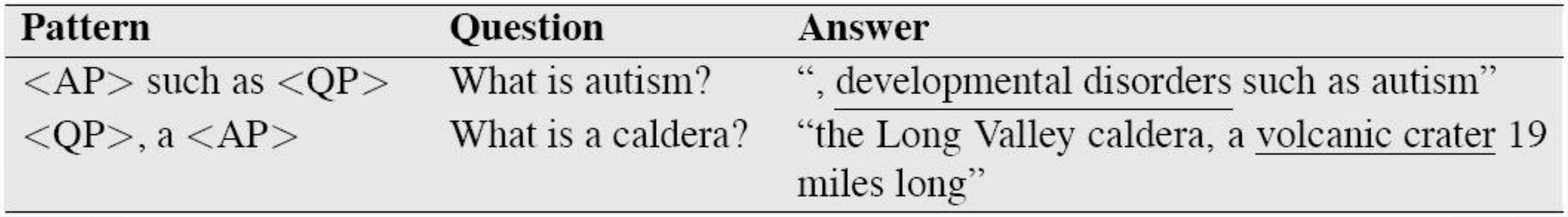
  - Include answer types, regular expressions



| Pattern | Question | Answer |
|---|---|---|
| <AP> such as <QP> | What is autism? | ", developmental disorders such as autism" |
| <QP>, a <AP> | What is a caldera? | "the Long Valley caldera, a volcanic crater 19 miles long" |

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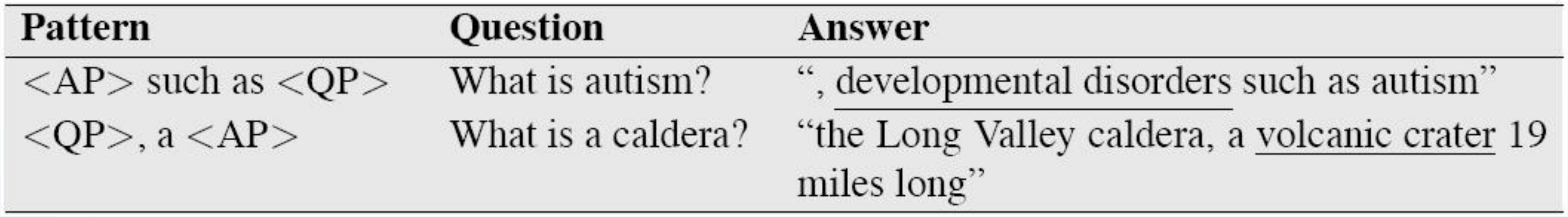

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    - Learn relation b/t answer type and aspect of question
      - E.g. date-of-birth/person name; term/definition
        - Can use bootstrap strategy for contexts
        - <NAME> (<BD>-<DD>) or <NAME> was born on <BD>

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      - Partial data: Web logs – queries and click-throughs

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  - Web itself
  - ....

- Term management:
  - Acronym lists
  - Gazetteers
  - ....

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  - Parsing?
- Answer extraction:
  - NER, IE (patterns)

## Evaluation

- Candidate criteria:
  - Relevance
  - Correctness
  - Conciseness:
    - No extra information
  - Completeness:
    - Penalize partial answers
  - Coherence:
    - Easily readable
  - Justification
- Tension among criteria

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    - Short answer answer keys
      - Litkowski's patterns

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  - Measure: Mean Reciprocal Rank (MRR)
    - For each question,
      - Get reciprocal of rank of first correct answer
        - E.g. correct answer is 4 => ¼
        - None correct => 0
    - Average over all questions

$$MRR = \frac{\sum_{i=1}^{N} \frac{1}{rank_i}}{N}$$

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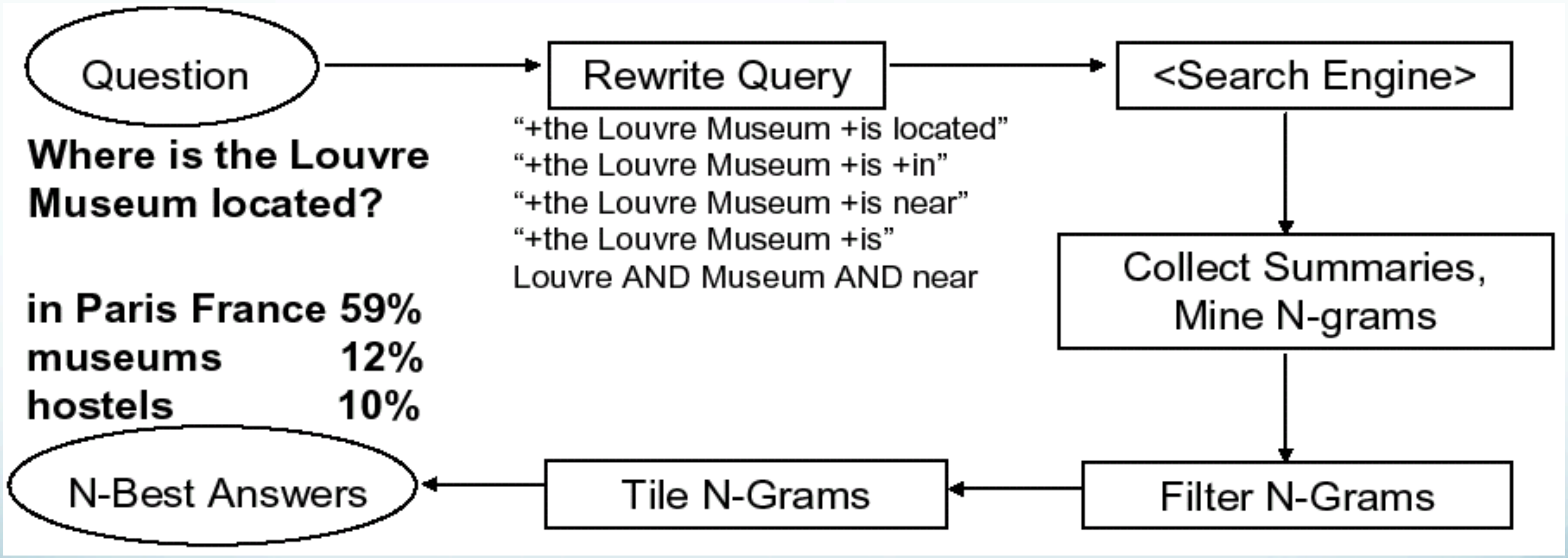
- Answer types
  - Predominantly extractive, short answer in context
- Evaluation:
  - Official: human; proxy: patterns
- Presentation: One interactive track

# Redundancy-based QA

- AskMSR (2001,2002); Aranea (Lin, 2007)


Question
Rewrite Query
<Search Engine>
"+the Louvre Museum +is located"
"+the Louvre Museum +is +in"
"+the Louvre Museum +is near"
"+the Louvre Museum +is"
Louvre AND Museum AND near
Where is the Louvre Museum located?
Collect Summaries, Mine N-grams
in Paris France 59%
museums 12%
hostels 10%
N-Best Answers
Tile N-Grams
Filter N-Grams

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  - In ‘easy’ passages, simple string match effective

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- Concordia (2007): Strict: 25%; Rank 5
- Many systems incorporate some redundancy
  - Answer validation
  - Answer reranking
    - LCC: huge knowledge-based system, redundancy improved

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- Create type-specific answer type (Person, Date, Loc)

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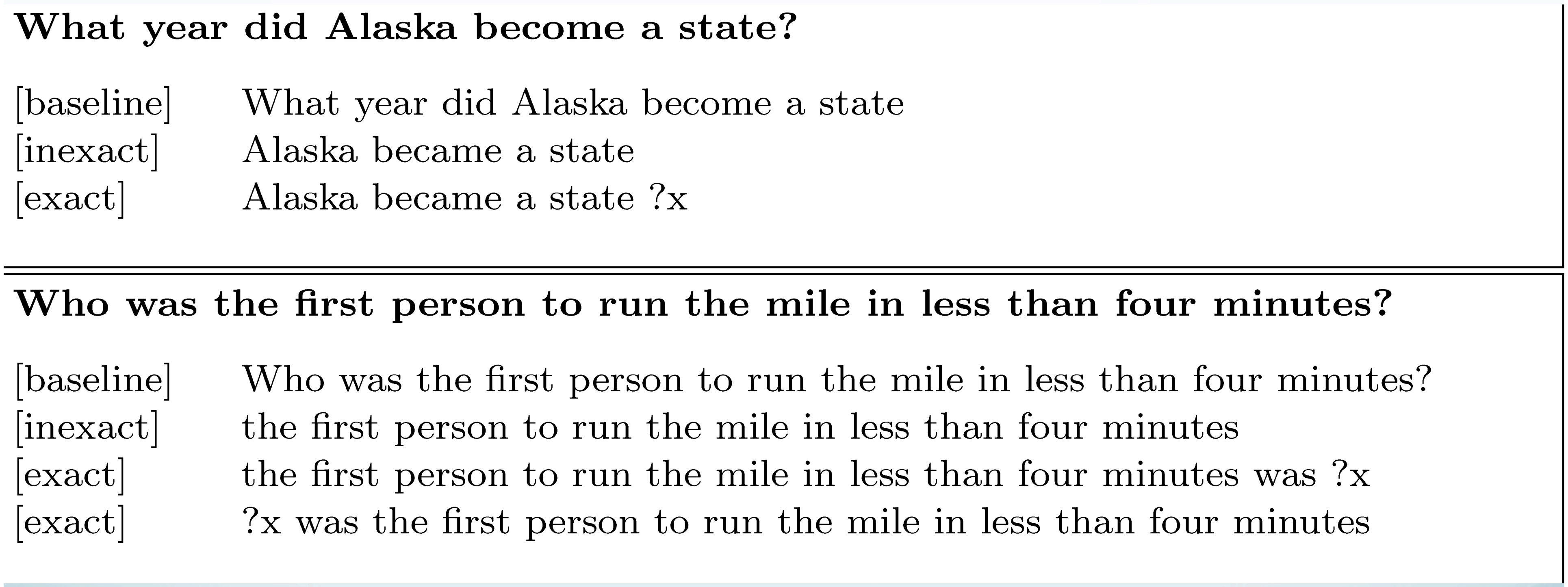
      - Where is A? -> A is located in ?x  (specific)
  - Inexact reformulation: bag-of-words

## Query Reformulation

- Examples



**What year did Alaska become a state?**

| | |
|---|---|
| [baseline] | What year did Alaska become a state |
| [inexact] | Alaska became a state |
| [exact] | Alaska became a state ?x |

**Who was the first person to run the mile in less than four minutes?**

| | |
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| [baseline] | Who was the first person to run the mile in less than four minutes? |
| [inexact] | the first person to run the mile in less than four minutes |
| [exact] | the first person to run the mile in less than four minutes was ?x |
| [exact] | ?x was the first person to run the mile in less than four minutes |

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  - Filtering
  - Combining
  - Scoring
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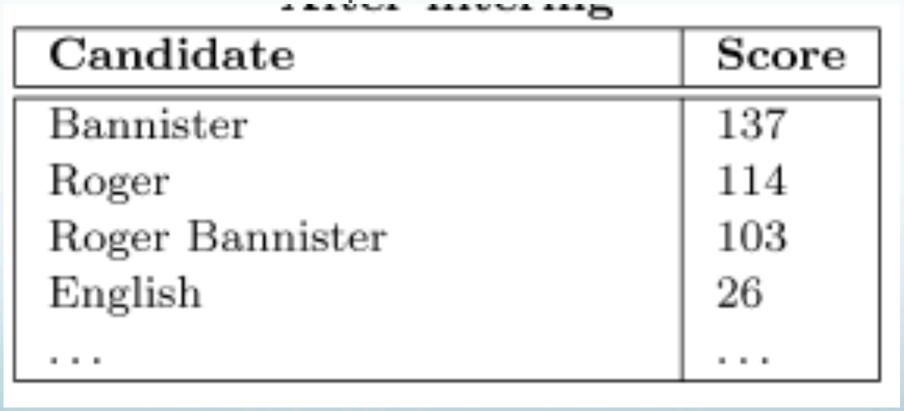
- Example after filtering:
  - Who was the first person to run a sub-four-minute mile?



| Candidate | Score |
|---|---|
| Bannister | 137 |
| Roger | 114 |
| Roger Bannister | 103 |
| English | 26 |
| ... | ... |

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  - Type-neutral & Type-specific: drops 5%

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  - Bad units: Roger Bannister was – blocked by filters
    - Also, increments score so long bad spans lower
- Improves significantly

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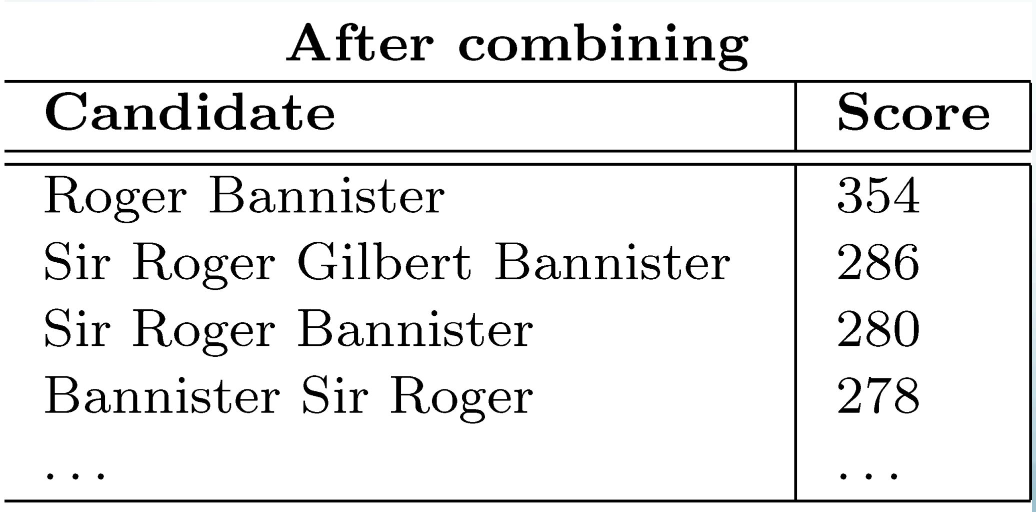

**After combining**

| **Candidate** | **Score** |
|---|---|
| Roger Bannister | 354 |
| Sir Roger Gilbert Bannister | 286 |
| Sir Roger Bannister | 280 |
| Bannister Sir Roger | 278 |
| ... | ... |

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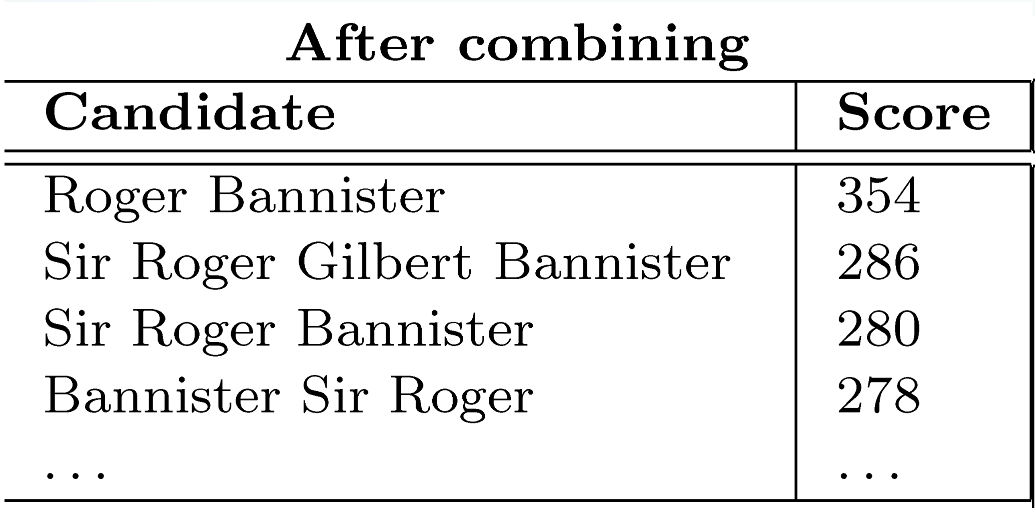
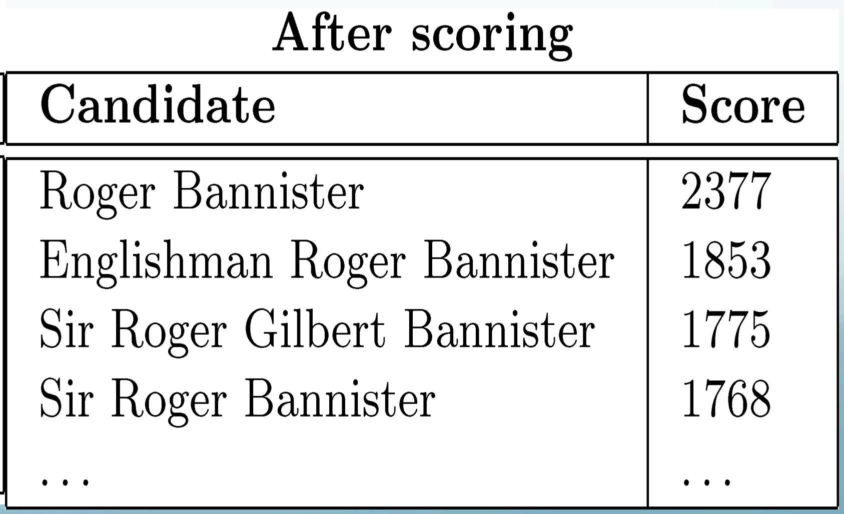
- Solution: IDF-based scoring

  $S_c = S_c$ * average_unigram_idf



**After combining**

| **Candidate** | **Score** |
|---|---|
| Roger Bannister | 354 |
| Sir Roger Gilbert Bannister | 286 |
| Sir Roger Bannister | 280 |
| Bannister Sir Roger | 278 |
| ... | ... |



**After scoring**

| **Candidate** | **Score** |
|---|---|
| Roger Bannister | 2377 |
| Englishman Roger Bannister | 1853 |
| Sir Roger Gilbert Bannister | 1775 |
| Sir Roger Bannister | 1768 |
| ... | ... |

## N-gram Reranking

- Promote best answer candidates:

# N-gram Reranking

- Promote best answer candidates:
  - Filter any answers not in at least two snippets

# N-gram Reranking

- Promote best answer candidates:
  - Filter any answers not in at least two snippets
  - Use answer type specific forms to raise matches
    - E.g. ‘where’ -> boosts ‘city, state’
- Small improvement depending on answer type

## Summary

- Redundancy-based approaches
  - Leverage scale of web search
  - Take advantage of presence of 'easy' answers on web
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  - Provide significant improvements in other systems
    - Esp. for answer filtering

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- Redundancy-based approaches
  - Leverage scale of web search
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  - Exploit statistical association of question/answer text
- Increasingly adopted:
  - Good performers independently for QA
  - Provide significant improvements in other systems
    - Esp. for answer filtering
- Does require some form of ‘answer projection’
  - Map web information to TREC document

## Deliverable #2

- Baseline end-to-end Q/A system:
  - Redundancy-based with answer projection

  also viewed as
  - Retrieval with web-based boosting

- Implementation: Main components
  - (Suggested) Basic redundancy approach
  - Basic retrieval approach (IR next lecture)

## Data

- Questions:
  - XML formatted questions and question series
- Answers:
  - Answer ‘patterns’ with evidence documents
- Training/Devtext/Evaltest:
  - Training: Thru 2005
  - Devtest: 2006
  - Held-out: …
- Will be in /dropbox directory on patas
- Documents:
  - AQUAINT news corpus data with minimal markup