

**Q1** (1 point)

**a)** (1/4 point)

\* if any of the following points are mentioned, they will get all the credit points\*

- Difference 1:
  - Traditional vector space models: computing similarity based on the query vector and the document vector
  - Statistical language models: finding the likelihood a document language model generates a given query
- Difference 2:
  - Traditional vector space model: contains information about word frequency, no information on the sequence of the words
  - Statistical language models: consider the correlation between the words

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**b)** (1/4 point)

- Information need: the information the user wants to look for
- Query: the search term the user comes up with for their information need
- Example:
  - User is looking for a way to install Microsoft Office on their system
  - Information need: steps to purchase and install Microsoft Office
  - Query: "Microsoft Office Subscription" or "How to purchase Microsoft Office"

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**c)** (1/4 point)

- Similar to relevance feedback
- Instead of asking the user, assumes the top k results are already relevant, performance relevance feedback based on that
- Query expansion:
  - a method for incorporating relevance feedback
  - Can involve adding new terms, adjusting the weights of existing terms

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**d)** (1/4 point)

- Users focused on the top few positions of the search results, not examining the rest

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**Q2** (1 point)

**a)** (1/4 point)

$$precision = 5/10 = 0.5$$

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**b)** (1/4 point)

$$recall = 5/30 = 0.17$$

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**c)** (1/4 point)

$$F - measure = 2 * 0.5 * 0.17 / (0.5 + 0.17) = 0.25$$

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**d)** (1/4 point)

$$precision = 30/100 = 0.3 \text{ (1/16 point)}$$

$$recall = 30/30 = 1 \text{ (1/16 point)}$$

- Precision: (1/16 point)
    - drops from 0.5 to 0.3
    - Because the proportion of the relevant documents to all documents is lower than the proportion of relevant documents retrieved in the first scheme to all retrieved documents.
  - Recall: (1/16 point)
    - Increases from 0.17 to 1
    - Recall can only increase.
    - Because it is the number of relevant documents that are retrieved compared to all relevant documents which can only increase by returning more documents.
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**Q3** (3 points)

**a)** (1 point)

For system 1, the real value is: 3, 2, 2, 0, 1, 3, 0, 0, 0, 0

$$DCG = \frac{2^3-1}{\log_2 2} + \frac{2^2-1}{\log_2 3} + \frac{2^2-1}{\log_2 4} + \frac{2^0-1}{\log_2 5} + \frac{2^1-1}{\log_2 6} + \frac{2^3-1}{\log_2 7} + \frac{2^0-1}{\log_2 8} + \frac{2^0-1}{\log_2 9} + \frac{2^0-1}{\log_2 10} + \frac{2^0-1}{\log_2 11} = 13.273$$

For system 2, the real value is: 3, 3, 2, 2, 0, 0, 0, 1, 0, 0

$$DCG = \frac{2^3-1}{\log_2 2} + \frac{2^3-1}{\log_2 3} + \frac{2^2-1}{\log_2 4} + \frac{2^2-1}{\log_2 5} + \frac{2^0-1}{\log_2 6} + \frac{2^0-1}{\log_2 7} + \frac{2^0-1}{\log_2 8} + \frac{2^1-1}{\log_2 9} + \frac{2^0-1}{\log_2 10} + \frac{2^0-1}{\log_2 11} = 14.524$$

As a result, system 2 has a higher NDCG score.

- Ideal ranking the same for both systems.
  - So NDCGs could be compared using the values at hand.
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**b)** (1 point)

**b1)** (1/3 point)

- Both the same: 3/3
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**b2)** (1/3 point)

- Both the same: 4/5
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**b3)** (1/3 point)

MAP for system 1:

$$(1/1 + 2/2 + 3/3 + 4/5 + 5/6)/5 = 0.9266$$

MAP for system 2:

$$(1/1 + 2/2 + 3/3 + 4/4 + 5/8)/5 = 0.925$$

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**c)** (1 point)

- System 2 (0.5 point)  
\*any of the following, 0.5 point\*
  - Because provides a higher NDCG, provides best results for the first 4
  - Which helps users have very relevant information in the first few results.
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