National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	**Information Retrieval**	**Course Code:**	**CS317**
Degree Program:	**BSCS**	**Semester:**	**Fall 2019**
Exam Duration:	**180 Minutes**	**Total Marks:**	**58**
Paper Date:	**26th Dec 2019**	**Weight**	**45**
Section:	**ALL**	**Page(s):**	**10**
Exam Type:	**Final Exam**		

Student : Name:_____ **Roll No.**_____ **Section:**_____

Instruction/Notes: ***Attempt the examination on this question paper.****. You can use extra sheets for rough work but do not attach extra sheets with this paper. Do not fill the table titled Question/marks*

Questions	1-2	3-5	6-7	8	9	10-11	12	Total
Total Marks	12	11	9	8	6	8	4	**58**
Obtained Marks								

Q1) True/False [7 Marks]

a) If I search for term *X*, and term *X* has many synonyms, precision is more likely to be a problem than recall.

b) Smoothing is necessary because otherwise the model would assign a zero probability to queries that contain terms not present in the original document (from which the model was built)

c) Stemming should be invoked at indexing time but not while doing a query

d) Words with high Document Frequency (DF) are more discriminative than those with low DF

e) Stemming increases the size of the lexicon (vocabulary)

f) Smoothing of a language model is not needed if all the query terms occur in a document.

g) Suppose a user enters a single word query to two different search engines. One search engine uses normalized TF as score of documents and other search engine uses (normalized TF)*IDF as score of documents. The two search engines produce different rankings of documents.

Q2) a) Which of the following is most likely effective for increasing the PageRank score of a page: [5 Mark]

i. adding an inlink
ii. adding an outlink
iii. deleting an inlink
iv. deleting an outlink

b) Which is most likely going to decrease the PageRank score of the page?

i. adding an inlink
ii. adding an outlink
iii. deleting an inlink
iv. deleting an outlink

c) What is the most probable type of query for the web query "Microsoft"?

i. Informational query
ii. Shopping query
iii. Downloads and documentation query
iv. Navigational query

d) Suppose a search returns documents D1, D2, D3, and D4 in this order. The correct results in the system would have been D2, D1, D4, D6, and D5 in this order. What is average precision in this case?

i. 0.68 ii. 0.85 iii. 0.55

Q3) Apply the SPIMI algorithm to the following collection: [3 Marks]
d1: bsbi use term id
d2: sort term id doc id
d3: spimi use term
d4: no term id sort
Assume that main memory can only hold two documents at a time, i.e., the SPIMI algorithm will write to disk each time after two documents, a block, have been processed. Write out the content of each block just before merging and the result after merging in the following format:

Block 1:
bsbi →1
...
term → 1, 2

Before Merging

After Merging

Q4) Consider the following positional index, where docids and positions are **delta encoded**. Format is as follow:

Docid1: position1, postion2,… ..;

Docid2: …

<information: **11:** 7, 18, 33, 12, 46, 31; **2:** 3, 149; **54:** 17, 11, 291, 30, 44; **77:** 54, 12, 3, 22; **19:** 4, 12, 333;>	<retrieval: **11:** 6, 20, 33, 72, 86, 231; **3:** 34, 19; **53:** 107, 191, 22, 40, 434; **5:** 363, 138;>

What are all the document Ids and all the absolute positions at which the query phrase "information retrieval" occurs? [3 Marks]

Q5) a) Indexing New York Times newswire from 1991–1995 reveals that it contains about 400 million word tokens, and a lexicon (vocabulary) of size about 1 million (given certain fixed decisions on term normalization, lowercasing, treatment of numbers etc.). What would be a good prediction of how many word tokens and what lexicon size one would get in indexing New York Times newswire from 1991–2000? [3 Marks]

c) Why do we need to normalize term frequency in TF.IDF weighting scheme? [2 Marks]

Q6) Suppose we have a collection that consists of the 4 documents given in the table below. [6 Marks]

Document Id	**Document Text**
Doc1	click go the shears boys click click click
Doc2	click click
Doc3	metal here
Doc4	metal shears click here

Perform retrieval using two models. Fill in these scores in the below table:

a) Tf.IDF

Query	**Doc1**	**Doc2**
click		
shears		
click shears		

b) Language model using Jelinek Mercer smoothing ($\lambda = 0.7$)

Query	**Doc1**	**Doc2**
click		
shears		
click shears		

Q7) Suppose that a user's initial query is **cheap CDs cheap DVDs extremely cheap CDs**. The user examines two documents, d1 and d2. She judges d1, with the content **CDs cheap software cheap CDs** relevant and d2 with content **cheap thrills DVDs** nonrelevant. Assume that we are using direct term frequency (with no normalization and no IDF) as vector weights. Using Rocchio relevance feedback what would the revised query vector be after relevance feedback? Assume alpha= 1, beta= 0.75, gamma= 0.25. [3 Marks]

Q8) a) Is it possible that one system outperforms the other in terms of MAP by loses to the other in terms of precision at 10 documents? If your answer is yes then justify with an example. [2 Marks]

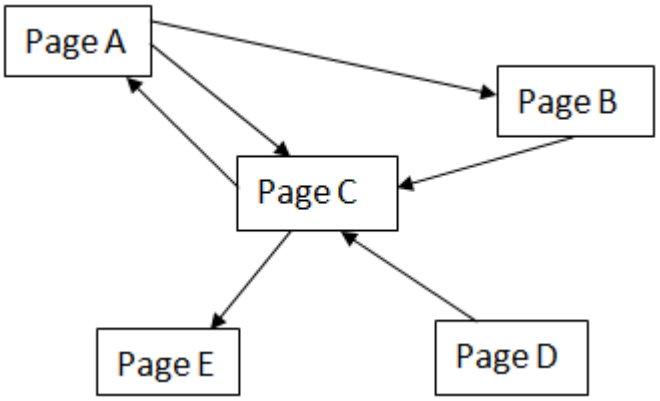
b) Give two advantages of average precision as compared to P@5. Justify with examples. [4 Marks]
Advantage 1 with example:

Advantage 2 with example:

c) In what situation a system's Mean Average Precision performance will be equal to its Mean Reciprocal Rank performance? [1 Mark]

d) What is the advantage of using NDCG as compared to Average Precision?.[1 Mark]

Q9) a) Compute Page rank score of following pages. Assume teleportation probability is 0.2. Show results for 2 iterations. [4 Marks]



Fill in the table below with page rank scores.

	Page Rank (A)	Page Rank (B)	Page Rank (C)	Page Rank (D)	Page Rank (E)
Initialization					
After First Iteration					
After Second Iteration					

b) In the standard PageRank algorithm, every page starts with the same "inherent" values, and then acquires more value through its inlinks. A. It has been suggested that a link from page P to page Q should be considered as more "significant" if P and Q are from different domains than if they are from the same domain. Give an argument in favor of this. [2 Marks]

Q10) Suppose we use the number of times a term occurs in all the documents to form a vector to represent each term. For example, if a term T occurred once in document 1, 10 times in document 3, 5 times in document 4, …, we would have a vector like V(T)=(1, 0, 10, 4,…). Suppose we use dot-product or cosine measure to compute the similarity between two vectors representing two terms. [3 Marks]

a) What kind of term pairs would have the highest similarity?

b) Suppose we do clustering of terms based on such a similarity function on a collection of product reviews from Amazon. Can we expect to obtain some meaningful clusters of terms? For example, could we expect feature terms describing a particular kind of product (e.g., cell phones) be grouped together? Why?

c) What will be effect (on type of clusters formed) of adding IDF weighting to the weight of each element in a vector?

Q11) a) Word2Vec represents a family of embedding algorithms that are commonly used in a variety of contexts. Suppose in a recommender system for online shopping, we have information about co-purchase records for items $x_1, x_1, \ldots, x_n$ (for example, item x_i is commonly bought together with item x_j). Explain how you would use ideas similar to Word2Vec to recommend similar items to users who have shown interest in any one of the items. [2 Marks]

b) What should be training data for WordToVec if you want to use it for following tasks: [3 Marks]

Task	**Trained on pairs of**
Document Ranking	
Query Auto Completion	
Next Query Suggestion	

Q12) Given the following distance matrix between 6 data points, which of the following clustering representations and dendrogram depicts the use of **Single link** similarity function in hierarchical clustering: [4 Marks]

	P1	**P2**	**P3**	**P4**	**P5**	**P6**
P1	0					
P2	0.235	0				
P3	0.22	0.148	0			
P4	0.36	0.204	0.153	0		
P5	0.34	0.138	0.284	0.293	0	
P6	0.234	0.254	0.11	0.22	0.39	0

Table 1: Distances for six points

A.

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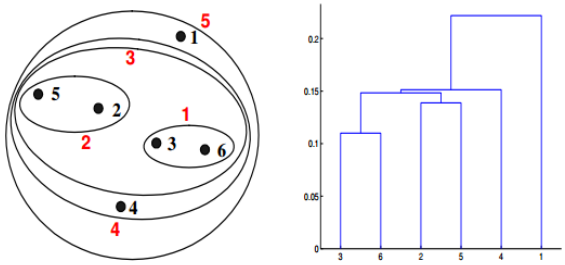
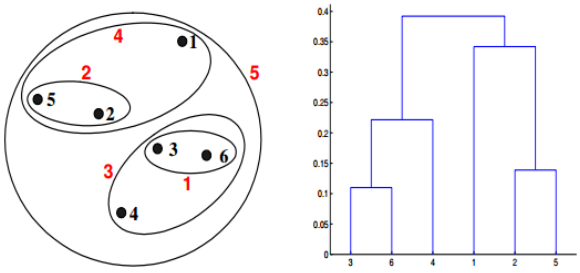
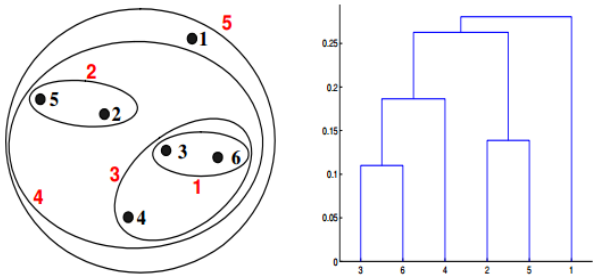


B.



C.



D.