Information Retrieval (CS60092)
Computer Science and Engineering, Indian Institute of Technology Kharagpur

Session: Autumn 2012 – 2013
Class Test 1

Time: 1 hour
Full Marks: 20

Attempt all questions.
Use of calculator is allowed.
State any assumptions made clearly.

Q. 1> For the document collection:

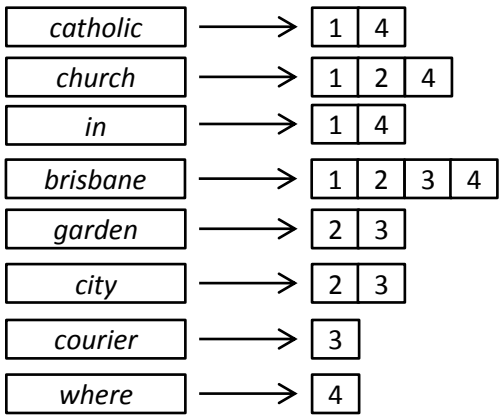
D_1*: catholic church in brisbane*
D_2*: garden city church brisbane*
D_3*: brisbane courier garden city*
D_4*: where in brisbane catholic church*

a. Draw the term-document incidence matrix.
b. Draw the inverted index that would be built. **(1 + 1 = 2)**

A. 1> a.

	D_1	D_2	D_3	D_4
catholic	1	0	0	1
church	1	1	0	1
in	1	0	0	1
brisbane	1	1	1	1
garden	0	1	1	0
city	0	1	1	0
courier	0	0	1	0
where	0	0	0	1

A. 1> b.



Q. 2> What would be the best query processing order for the Boolean queries below, given the following term postings size:

poison	4133
blue	97002
dart	1079
life	27145
frog	466
cycle	3162

a. (poison OR blue) AND (dart OR frog) AND (life OR cycle)
b. (cycle OR blue) AND (poison OR frog) AND (dart OR life) **(1 + 1 = 2)**

A. 2> a.

(poison OR blue)	-> 4133 + 97002	= 101135
(dart OR frog)	-> 1079 + 466	= 1545
(life OR cycle)	-> 27145 + 3162	= 30307

So the best order is
((dart OR frog) AND (life OR cycle)) AND (poison OR blue)
Any commutative other order is fine, like *(a and b) and c* is same as *c and (b and a).*

A. 2> b.

(cycle OR blue)	-> 3162 + 97002	= 100164
(poison OR frog)	-> 4133 + 466	= 4599
(dart OR life)	-> 1079 + 27145	= 28224

So the best order is
((poison OR frog) AND (dart OR life)) AND (cycle OR blue)

Q. 3> What would be the permuterm vocabulary for "cat"? **(1)**

A. 3> cat$, at$c, t$ca, $cat

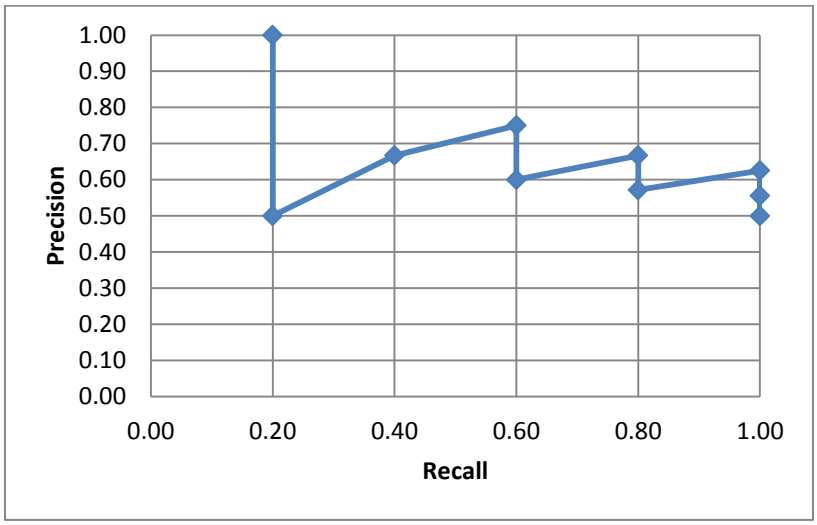
Q. 4> What is the likely effect of (a) Stemming and (b) Lemmatization on
(i) Vocabulary size: Increase, Decrease, Unpredictable?
(ii) Precision: Increase, Decrease, Unpredictable?
(iii) Recall: Increase, Decrease, Unpredictable? **(3)**

A. 4> (a) Stemming
(i) Vocabulary: Decrease (*bring, bringing, brings* all become *bring*) (If someone specifically states we add stemmed terms to existing list, then Increase is fine, because sometimes stem is a new term, like *duplic*)
(ii) Precision: Unpredictable
(iii) Recall: Increase

A. 4> (b) Lemmatization:
(i) Vocabulary: Decrease (Same logic, actually the decrease is more here as even *brought* becomes *bring;* doesn't matter wrt marks)
(ii) Precision: Unpredictable
(iii) Recall: Increase

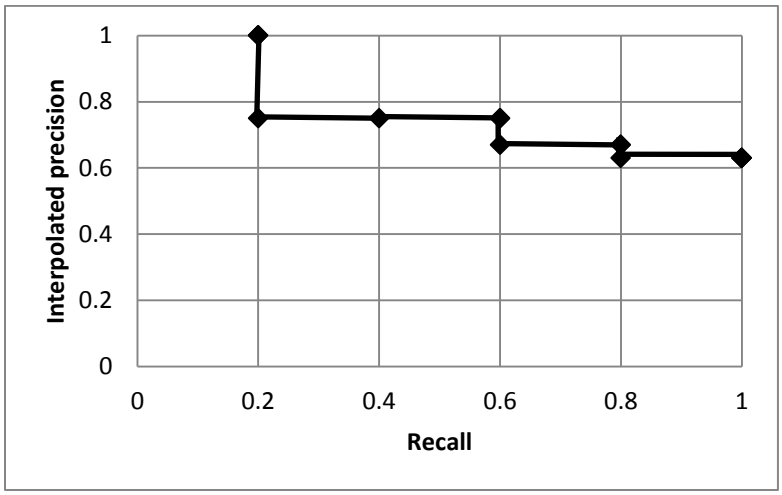
Q. 5> Let the relevance of top ten documents (leftmost = Rank 1) retrieved for a query be:
R, NR, R, R, NR, R, NR, R, NR, NR
where R = relevant and NR = non-relevant.
For this list, plot the (i) Precision-Recall curve and (ii) Interpolated Precision-Recall curve. **(3 + 3 = 6)**

A. 5> (i)



Doc	Recall	Precision
R	0.20	1.00
NR	0.20	0.50
R	0.40	0.67
R	0.60	0.75
NR	0.60	0.60
R	0.80	0.67
NR	0.80	0.57
R	1.00	0.63
NR	1.00	0.56
NR	1.00	0.50

A. 5> (ii)



Doc	Recall	Interpolated Precision
R	0.20	1.00
NR	0.20	1.00
R	0.40	0.75
R	0.60	0.75
NR	0.60	0.75
R	0.80	0.67
NR	0.80	0.67
R	1.00	0.63
NR	1.00	0.63
NR	1.00	0.63

Q. 4> Let the top ten documents (leftmost = Rank 1) returned by an IR system for three queries be graded for relevance as (6-point relevance scale, 0-5):

q_1: 5, 5, 3, 3, 5, 4, 2, 1, 0, 0
q_2: 4, 3, 0, 2, 2, 1, 5, 5, 5, 5
q_3: 4, 4, 5, 5, 5, 2, 1, 1, 1, 1

nDCG@10 = DCG@10/IDCG@10. DCG@*p* of a graded ranked list of *p* documents is given by

$$DCG@p = rel_1 + \sum_{i=2}^{p} \frac{rel_i}{\log_2(i+1)}$$

where *p* = 10 in this case, rel_i is the relevance rating of document at Rank *i*.
Assume IDCG@*p* = DCG@*p* for a list of *p* documents where each document has the maximum rating (5 in this case).
nDCG = Normalized Discounted Cumulated Gain
DCG = Discounted Cumulated Gain
IDCG = Ideal Discounted Cumulated Gain

Find the average nDCG@10 of the system for this result set. Show each step of the computation. **(6)**

A. 4>

$$DCG\ for\ q_1 = 5 + \frac{5}{\log_2(2+1)} + \frac{3}{\log_2(3+1)} + \frac{3}{\log_2(4+1)} + \frac{5}{\log_2(5+1)} + \frac{4}{\log_2(6+1)} + \frac{2}{\log_2(7+1)} + \frac{1}{\log_2(8+1)} + \frac{1}{\log_2(9+1)} + \frac{0}{\log_2(10+1)} = 15.288$$

$$DCG\ for\ q_2 = 4 + \frac{3}{\log_2(2+1)} + \frac{0}{\log_2(3+1)} + \frac{2}{\log_2(4+1)} + \frac{2}{\log_2(5+1)} + \frac{1}{\log_2(6+1)} + \frac{5}{\log_2(7+1)} + \frac{5}{\log_2(8+1)} + \frac{5}{\log_2(9+1)} + \frac{5}{\log_2(10+1)} = 14.079$$

$$DCG\ for\ q_3 = 4 + \frac{4}{\log_2(2+1)} + \frac{5}{\log_2(3+1)} + \frac{5}{\log_2(4+1)} + \frac{5}{\log_2(5+1)} + \frac{2}{\log_2(6+1)} + \frac{1}{\log_2(7+1)} + \frac{1}{\log_2(8+1)} + \frac{1}{\log_2(9+1)} + \frac{1}{\log_2(10+1)} = 15.063$$

IDCG for all = 22.718

Thus, nDCG for q_1 = 15.288/22.718 = 0.673
nDCG for q_2 = 14.079/22.718 = 0.620
nDCG for q_3 = 15.063/22.718 = 0.663

Thus, average nDCG of system = (0.673 + 0.620 + 0.663)/3 = 0.652 **Ans.**