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COMS 363

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Homework 3-1

1) (50 points) Derive the I/O costs of different join algorithms of relations R and S given the following variables, which you may or may not use all of them. Suppose that there is 1 page of results for the join. Ignore the CPU time cost. Please write down steps to explain your answer for full credits.

|R|=20: Number of tuples per page in R
|S|=20: Number of tuples per page in S
M=120: Number of pages in R
N=40: Number of pages in S
B=10: Number of available main memory in pages

a) (10 points) What is the minimal I/O cost of block nested loop join?

➔ If R is the outer, then the total cost will be:

$= b_S + (b_R * \text{ceil}(b_S/B-2))$
$= 120 + (120 * \text{ceil}(120 / (10 -2)))$
$= 120 + (120 + \text{ceil}(15))$
$= 120 + 1800$
$= 1920$

If S is the outer, then the total cost will be:

$= 40 + (120 * \text{ceil}(40 / (10 -2)))$
$= 40 + (120 + \text{ceil}(5))$
$= 40 + 600$
$= 640$

b) (10 points) What is the minimal I/O cost of simple nested loop join?

➔ For a simple nested loop join, the total cost will be:

$= b_S + b_S * b_R$
$= 40 + (40 * 120)$

= 40+ 4800

= **4840**

c) (10 points) What is the minimal I/O cost of indexed nested Loops Join? (Suppose the cost of retrieving a matching tuple is 3, for both R and S)

➔ For an indexed nested loop join, the total cost will be:

= 120 + (120 * 40)

= 120 + 4800

= **4920**

d) (10 points) What is the minimal I/O cost of grace hash join?

➔ For a grace hash join, the total cost will be:

= 3(120 + 40)

= 3(160)

= **480**

e) (10 points) What is the minimal I/O cost of Sort-Merge Join? (Suppose the join is on their primary keys which are sorted already)

➔ For a sort-merge join, the total cost will be:

= $2bS (1 + ceil (\log_{b-1} ceil (bS / B))) + 2bR (1 + ceil (\log_{b} ceil (bR / B))) + bS + bR$

= $2*120 (1 + ceil (\log_{51} (51) (200 / 52))) + 2 * 40 (1 + ceil (\log_{51} ceil (1000 / 52))) + 120 + 40$

= $240 (1 + ceil (\log_{51} 4) + 80 (1+ ceil (\log_{51} 20))) + 160$

= 480 + 160 + 160

= 800