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Question 1

- 20000 tuples
- 600 data pages
- Prefix: 20 bytes
- Full: 30 bytes
- 200 different types
- 50 producers
- Rid has 10 bytes
- Pointer has 6 bytes
- Leaf pages are filled about 70%
- Index page has 4000 Bytes

1) We have $200 * 50 = 10000$ possible different values. Then as its uniformly distributed we have 10000 data entries

   The number of rids per data entry is $\left(\frac{number\ of\ tuples}{diff\ values}\right) = \frac{20000}{10000} = 2$

   The average length of a data entry is $size\ of\ key + nb)(rids * size(rids) = 30 * 2 + 2 * 10 = 80$

2) The size of a index entry is $20 + 20 + 6 = 46$. Then the average number of index entry per intermediate page is $\frac{4000}{46} = 86$ and the average number of data entry per page is $\frac{0.7*4000}{80} = 35$. If we have a tree of height 2 then we can cover at most $86 * 86 = 7396$ different cases then we need a tree of height 3 as $86 * 86 * 86 = 636056 \gg 10000$.

   Number of leaf pages is $\frac{10000}{35} = 285$ and as $\frac{285}{86} > 3$ there is 4 intermediate pages.

Question 2

Question 2.1

The first execution plan is the following

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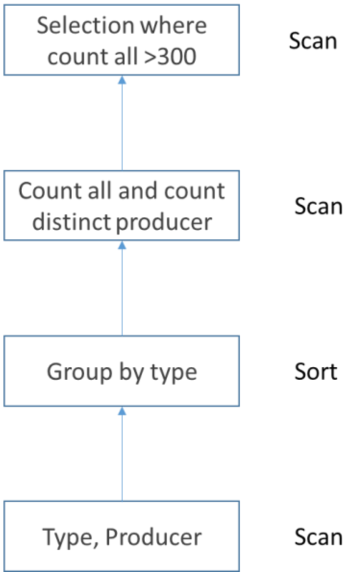
Selection where count all >300
Scan
Count all and count distinct producer
Scan
Group by type
Sort
Type, Producer
Scan

We have 600 pages and as we are searching on arbitrary attribute we have a cost of 600

Question 2.2

We have 40 000 data pages and 4M entries so there is 100 entries in each pages.

a)

i) In the general case we will on average cycle trough half of the pages to get the good pid. And when we have to corresponding row we can just check the inStock is inferior to Y and return this row or not. So there is on average a cost of 20 000. As we don't know if the table is sorted using X=200 and Y =10 will be the same average cost

ii) We going to get a one row matching so one data page and one index page then we have a cost of 2. Using X=200 and Y=10 will result in the same cost.

iii) As inStock is uniformly distributed between 1 and 500 we have on average a result of $\frac{4M*Y}{500} = 8000Y$ tuples matching. As we are using a unclustered index the results are spread across all pages. So the cost will be 40 000 pages + Y leafs page. In the case were Y =10 we have a cost of 40010.

iv) TODO

b) Changing to a clustered index on pid will not change the cost(Still going to be 2). However changing to a clustered index on inStock will considerably improve the cost. The matching tuples will be clustered into a few adjacent data page so we will access only those few data page.

Question 3

We have

- 20 000 products on 600 pages
- 4 000 000 store prices on 40 000 pages

- 1000 Stores on 80 pages

1. We will get an output of 4 000 000 tuples as the outer join will get all possible storePrices and as all product are sold somewhere.
2.
   a) $cost = nb\ of\ product\ pages + (nb\ of\ products * \ cost\ of\ getting\ store\ prices)$
   $cost = 600 + 20000 * 2 = 40\ 600$

   b) $cost = nb\ of\ storeprices\ pages + (nb\ of\ storeprices\ * \ cost\ of\ getting\ product)$
   $cost = 40\ 000 + 4M * 2 = 8\ 040\ 000$

   c) $cost = \ nb\ of\ product\ pages + \frac{nb\ of\ product\ pages\ *nb\ of\ storePrices\ pages}{B-2}$
   $cost = \ 600 + \frac{600*40\ 000}{98} = 245498$
   d) $cost = \ nb\ of\ storePrices\ pages + \frac{nb\ of\ storePrices\ pages\ *nb\ of\ product\ pages}{B-2}$
   $cost = \ 40\ 000 + \frac{40\ 000*600}{98} = 284898$
   e) $cost = 3 * 40\ 000 + 3 * 600 = 121\ 800$

Question 4

$$\pi_{pid;pname;storeID}\left(\sigma_{adresscontainsMontreal \wedge sellingprices*inStock<100} \quad (Products \times Stores) \bowtie StorePrices\right)$$

First we are going to select only store where the address contains Montréal before the join.

$$\pi_{pid;pname;storeID}\left(\sigma_{sellingprices*inStock<100} \quad \left(\left(Products \times \sigma_{adresscontainsMontreal}\ (Stores)\right) \bowtie StorePrices\right)\right)$$

Now we are going to select only the store prices where the sellings prices * inStock < 10 before join.

$$\pi_{pid;pname;storeID}\left(\left(Products \times \sigma_{adresscontainsMontreal}\ (Stores)\right) \bowtie \sigma_{sellingprices*inStock<100}(StorePrices)\right)$$

Finally we are going to only select required column before joining.

$$\left(\left(\pi_{pid,pname}Products \times \pi_{storeId}\left(\sigma_{adresscontainsMontreal}\ (Stores)\right)\right) \bowtie \pi_{pid,storeId}\left(\sigma_{sellingprices*inStock<100}(StorePrices)\right)\right)$$

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