Timothee Guerin
260447866

Comp 421 – Assignment 3

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

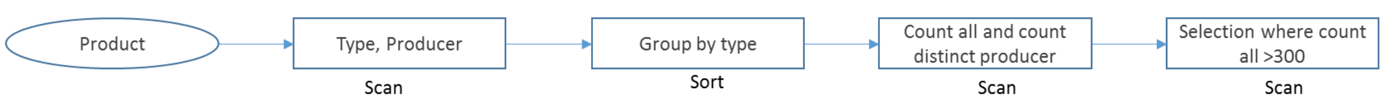
1) We have $200 * 50 = 10000$ possible different values. Then as its uniformly distributed we have 10000 data entries
   The number of rids per data entry is $\left(\frac{number\ of\ tuples}{diff\ values}\right) = \frac{20000}{10000} = 2$
   The average length of a data entry is $size\ of\ key + nb\ of\ rids * size(rids) = 30 * 2 + 2 * 10 = 80$

2) The size of an 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.

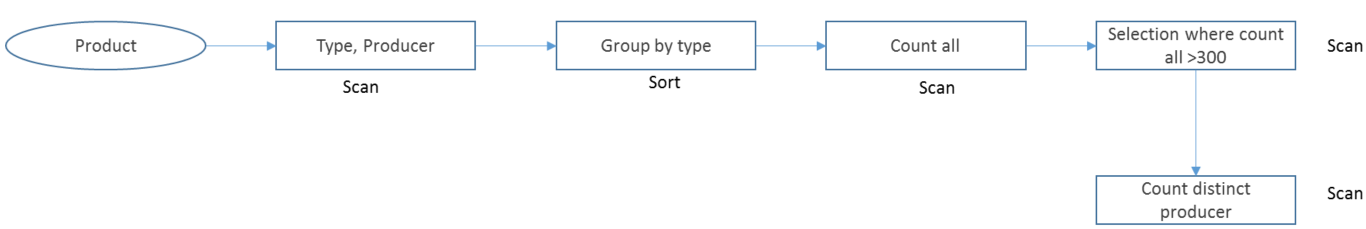
Question 2

Question 2.1

The first execution plan is the following



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



Timothee Guerin
260447866

The cost is the same here in number of pages. However as we filter with the count > 300 the number of types for which we need to count the distinct producer is considerably reduced and as DISTINCT is a costly operation it will result into an improvement.

Question 2.2

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

a)

- i) As the pid is not sorted we need to go through all possible values. And when we have a corresponding row we can just check the inStock is inferior to Y and return this row or not. Then the cost is 40 000. As we don't know if the table is sorted using X=200 and Y =10 will be the same cost
- ii) As we have 20 000 products and 4 million store prices we can suppose we will have in average a match of 200 tuples which means that we will in the worst case get 200 pages. Then the $cost = \#of\ leaf\ pages + \#of\ data\ pages = 1 + 200 = 201$. This will be the same for X=200 and Y=10
- iii) As inStock is uniformly distributed between 1 and 500 we have on average a result of $\frac{4M*Y}{500} = 8000Y$ tuples matching. But as we are using an unclustered index the results are spread across all pages. (Ignoring if Y < 5) the cost will be 40 000 pages + Y leafs page. In the case were Y =10 we have a cost of 40010.
- iv) With both index we will get Y index pages and $\frac{200*Y}{500} = 0.4Y$ data pages to check. Then the cost is $Y + 0.4Y$ So in the case X=200 and Y=10 we will have $cost = 10 + 0.4 * 10 = 14$

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) $cost = 3 * 40\ 000 + 3 * 600 = 121\ 800$

Timothee Guerin
260447866

Question 4

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

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

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

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

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

We are going to only select required column before joining.

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

Finally we are going to switch the cross product with a join by switching the order of joins

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

This is the graph we get at the final state. In green are the estimated tuples flow.