

Data Science And Database Technology

Homework 3

The following relations are given (primary keys are underlined):

```
CLEANING-COMPANY(CId, Name, Address, City, Region)
OFFERED-SERVICES(CId, SIId)
SERVICES(SIId, ServiceName, Category)
BUILDING(BId, BuildingName, BuildingType, Address, City, Region)
CLEANING-SERVICES(CId, BId, Date, SIId, Cost, NumberOfHours)
```

Assume the following cardinalities:

- $\text{card}(\text{CLEANING-COMPANY}) = 10^4$ tuples,
distinct values of Region = 20
- $\text{card}(\text{OFFERED-SERVICES}) = 2 \cdot 10^5$ tuples
- $\text{card}(\text{SERVICES}) = 100$ tuples,
distinct values of Category = 10
- $\text{card}(\text{BUILDING}) = 5 \cdot 10^7$ tuples,
distinct values of City = 1000
distinct values of BuildingType = 10
- $\text{card}(\text{CLEANING-SERVICES}) = 10^9$ tuples,
MIN(Date) = 1/1/2013, MAX(Date) = 31/12/2022

Furthermore, assume the following reduction factor for the group by condition:

- having $\text{COUNT}(\ast) > 1 \simeq \frac{1}{2}$.
- having $\text{SUM}(\text{Cost}) \geq 1000 \simeq \frac{1}{10}$.

Consider the following SQL query:

```
select BId, SUM(Cost) as TotCost, SUM(NumHors) as TotHours
from CLEANING-SERVICES CS, BUILDING B
where CS.Date >= 1/1/2022 and CS.Date <= 31/12/2022
and B.BuildingType <> 'Office'
and B.City = 'Turin'
and CS.BId = B.BId
and CS.SId IN ( select OS.SId
                from CLEANING-COMPANY CC, SERVICES S, OFFERED-SERVICE OS
                where OS.SId = S.SId and OS.CId = CC.CId
                  and (Region = 'Piedmont' or Region = 'Liguria')
                  and Category = 'IndoorCleaning'
                group by OS.SId
                having COUNT(\ast) > 1)
group by CS.BId
having SUM(Cost) >= 1000
```

Homework tasks

For the SQL query:

1. Report the corresponding algebraic expression and specify the cardinality of each node (representing an intermediate result or a leaf). If necessary, assume a data distribution. Also analyze the GROUP BY anticipation.
2. Select one or more secondary physical structures to increase query performance. Justify your choice and report the corresponding execution plan (join orders, access methods, etc.).