

# COSC265 Tutorial 4

1. What are the results of the following relational algebra queries given that the extension of the PRODUCT table is:

Number	Type	Quantity
1	A	2
2	B	3
3	A	4
4	D	2
5	B	4
6	A	1
7	C	5

- $\mathcal{F} \text{ SUM Quantity}(\text{PRODUCT})$
- $\text{Number } \mathcal{F} \text{ SUM Quantity}(\text{PRODUCT})$
- $\text{Type } \mathcal{F} \text{ SUM Quantity}(\text{PRODUCT})$
- $\mathcal{F} \text{ MAXIMUM Quantity}(\text{PRODUCT})$
- $\mathcal{F} \text{ MINIMUM Quantity}(\text{PRODUCT})$
- $\mathcal{F} \text{ AVERAGE Quantity}(\text{PRODUCT})$
- $\mathcal{F} \text{ COUNT Number}(\text{PRODUCT})$
- $\mathcal{F} \text{ SUM Quantity}(\sigma_{\text{Type}='A'}(\text{PRODUCT}))$

2. Given two relations, R and S, determine:

R

A	B	C
a1	b1	c1
a1	b2	c3
a2	b1	c2
a1	b1	c2
a1	b1	c3
a2	b2	c3
a2	b1	c3

S

D	E
a1	b1
a1	b2
a2	b1

- (a)  $R \times S$   
(b)  $R - S$   
(c)  $R \div S$

3. The following tables form a database:

HOTEL(Hotel\_No, Name, Address)

ROOM(Room\_No, Hotel\_No, Type, Price)

BOOKING(Hotel\_No, Guest\_No, Date\_From, Date\_To, Room\_No)

GUEST(Guest\_No, Name, Address)

Generate the relational algebra operations for the following queries:

- (a) List all hotels.
  - (b) List all single rooms with a price below \$40 per night.
  - (c) List all guests currently staying at the Park Hotel.
  - (d) List the details of all rooms at the Park Hotel, including the name(s) of the guest(s) staying in the room, if the room is occupied.
4. The STUDENT file has  $r = 20,000$  fixed-length records. Each record has the following fields: Name (30B), SSN (9B), Address (40B), Phone (9B), Birthdate (8B), Gender (1B), MajorDept (4B), MinorDept (4B), Course (4B, integer) and Degree (3B). An additional byte is used as a deletion marker. The file is stored on the disks with block size  $B=512B$ .
- (a) Calculate the record size  $R$ .
  - (b) Calculate the blocking factor  $bfr$ , and the number of file blocks  $b$  assuming an unspanned organization.
  - (c) How many blocks need to be accessed on average to find a record by doing a linear search on the file?
  - (d) Assume the file is ordered by SSN. How many blocks need to be transferred from the disk to search for a record given its SSN value?

5. Consider a disk with block size  $B = 512B$ . A block pointer is  $P = 6B$  long, and a record pointer is  $P_r = 7B$  long. A file has  $r = 30,000$  records of fixed length. Each record has the following fields: Name (30B), SSN (9B), Dept (9B), Address (40B), Phone (9B), Birthdate (8B), SEX (1B), Jobcode (4B), Salary (4B, real number). An additional byte is used as a deletion marker.

- (a) Calculate the record size  $R$ .
- (b) Calculate the blocking factor and the number of file blocks  $b$  assuming an unspanned organization.
- (c) Suppose the file is ordered by the key field SSN and we want to construct a primary index on SSN. Calculate the index blocking factor  $bfr_i$  (which is also the index fan-out,  $fo$ ). Find the number of first-level index entries and the number of first-level index blocks. How many levels are needed if we want a multi-level index? What is the total number of blocks required for a multi-level index? How many block accesses are needed to search for a record given its SSN value, using the multilevel index?
- (d) Suppose the file is not ordered, and we want to construct a secondary index on SSN. How many block accesses are needed using multilevel indexing to retrieve a specific record?
- (e) Suppose that the file is not ordered by the key field SSN and we want to construct a  $B^+$ -tree index on SSN. Calculate the orders  $p$  and  $p_{leaf}$  of the  $B^+$ -tree.

6. Consider the following two queries based on the COMPANY database:

```
SELECT E.FNAME, E.LNAME, S.FNAME, S.LNAME  
FROM EMPLOYEE E, EMPLOYEE S  
WHERE E.SUPERSSN = S.SSN;
```

```
SELECT FNAME, LNAME, SALARY  
FROM EMPLOYEE, WORKS_ON, PROJECT  
WHERE SSN=ESSN AND PNO=PNUMBER and PNAME='ProductX';
```

Draw the initial (canonical) query tree and also one other query tree for each SELECT statement.