Database Systems Exercise sheet 1

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# Exercise 1: EER-diagrams

# Exercise 2: Semantics of EER diagram

At the first relationship between Server and Racks, when we see N:1 notation, that means that we can have multiple servers in one Rack. But we don’t have a knowledge of the constraints on how many Servers can be stored in one rack. When we see the min, max notation we can state that 1 specific rack can be seen maximum 12 times (1 time for each server).

With min, max notation we can put the constraints on real world object and the capacity for them.

On the further example on Rack we have (1, 2) notation. We don’t have a knowledge if that is for the building or the Emergency generator. Where we can have maximum two racks?

# Exercise 3: Construct a relational schema

Employee: (**SVNR**, Name, Address)

Dung: (**Type**, Stock)

Checkup: (**Date**,

***emp\_nr:*** *Employee.SVNR*,

***gh\_id:*** *Greenhouse.GId*,

***gh\_address:*** *Greenhouse.estate\_address*)

Greenhouse: (**GId**,

***estate\_address****: Estate.Address*,

Size)

Estate: (**Address**,

*Adjected: Estate.address*,

Size)

Heating\_System: (**HId**,

***estate\_address****: Estate.Address*)

Heats: (***gh\_Nr:*** *Greenhouse.GId*,

***heating\_system****: Heating\_System.HId*,

***heating\_sys\_address****: estate\_address*)

Heat Pump: (**Heating\_System.HId**)

Gas Heating: (**Heating\_System.HId**)

Plants: (***Name, Count,***

***gh\_id:*** *Greenhouse.GId*,

***gh\_address:*** *estate\_address*)

Succlents: (**pl**: ***Name, cnt: Count, gh\_id: Greenhouse.GId, gh\_address: estate\_address***)

Orchids: (**pl*: Name, cnt: Count, gh\_id: Greenhouse.GId, gh\_address: estate\_address,*** Color)

Palmtrees: (pl: ***Name, cnt: Count, gh\_id: Greenhouse.GId, gh\_address: estate\_address,*** Frost-resistant)

Dungs: (***emp\_nr****: Employee.SVNR*,

***dg\_type:*** *Dung.Type*,

***plant\_name:*** *Plants.Name*,

***plant\_count:*** *Plants.Count*,

***gh\_id:*** *Greenhouse.GId*,

***gh\_address:*** *estate\_address*)

# Exercise 4: Relational Algebra

A)

1.

|  |  |
| --- | --- |
|  | |
| **name** | **cname** |
| Renault | Renault 10 |
| Fiat | Fiat Nuova 500 |
| Fiat | Fiat 1500 Spider |

2.

|  |  |  |  |
| --- | --- | --- | --- |
|  | | | |
| **sname** | **horsepower** | **date** | **insurance** |
| Renault 10 | 46 | 2002-09-09 | full |
| Fiat Nuova 500 | 13.5 | 2010-06-08 | full |
| Ford Model A | 40 | 2014-10-08 | full |

3.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | | | |
| **name** | **cname** | **sname** | **horsepower** | **date** | **insurance** |
| Renault | Renault 10 | Renault 10 | 46 | 2002-09-09 | full |
| Fiat | Fiat Nuova 500 | Fiat Nuova 500 | 13.5 | 2010-06-08 | full |

B)

|  |  |
| --- | --- |
| **m.country** | **c.horsepower** |
| Germany | 277 |

# Exercise 5: Equivalences

1. Both of the expressions are **valid and equivalent.**

We can represent the q1 as follows:

σB>3(πB(S)) ∩ σB>3(πB(T)) -> σB>3(πB(S) ∩ πB(T)) And based on the rule that (R – (R –T)) = S ∩ T we have:

σB>3(πB(S) − (πB(S) − πB(T)))

1. q4 is not valid expression

q3 is valid but on q4 we need to make a union on the left relation with attributes R(F,C,E) but the other relation has attributes (F,C,A,B,D) which are not the same.

The new attributes are coming from the join S (T  pF <-A(R)).

While on q3 we still perform a join on S and T but then we make semi-join on R and we keep the attributes F, C, E

1. Both of the expressions are valid but not equivalent

The first expression is joining R(B,C,E) with outer joined S and T(B,C,D,E,F)

While the second expression is joining relations T and S based on two same attributes (B and E). So the selected tuples will be less.

We shouldn’t have the selection on T. It should be:

σB=3(S) πBCE(T  ρB←A(σA=3(R)))

# Exercise 6: Answer Sizes

A) **Minimum 2**

|  |  |  |
| --- | --- | --- |
| R | | |
| **A** | B | C |
| 1 | 1 | 1 |
| 2 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| S | | | |
| A | B | **C** | **E** |
| 2 | 2 | 1 | 1 |
| 2 | 2 | 2 | 2 |
| 2 | 2 | 3 | 3 |
| 2 | 2 | 4 | 4 |
| 2 | 2 | 5 | 6 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| R and S full outer join | | | | |
| A | B | D | C | E |
| 1 | 1 | 1 | null | null |
| 2 | 1 | 1 | null | null |
| 2 | 2 | null | 1 | 1 |
| 2 | 2 | null | 2 | 2 |
| 2 | 2 | null | 3 | 3 |
| 2 | 2 | null | 4 | 4 |
| 2 | 2 | null | 5 | 6 |

And joining the table with R again on natural join we have 2 values in A and B matching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A | B | D | C | E |
| 1 | 1 | 1 | null | null |
| 2 | 1 | 1 | null | null |

**Maximum 6**

|  |  |  |
| --- | --- | --- |
| R | | |
| A | B | C |
| 1 | 1 | 1 |
| 2 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| S | | | |
| A | B | C | E |
| 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 2 |
| 1 | 1 | 1 | 3 |
| 1 | 1 | 1 | 4 |
| 1 | 1 | 1 | 5 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| R and S full outer join | | | | |
| A | B | D | C | E |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 2 |
| 1 | 1 | 1 | 1 | 3 |
| 1 | 1 | 1 | 1 | 4 |
| 1 | 1 | 1 | 1 | 5 |
| 2 | 1 | 1 | null | null |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| natural join | | | | |
| A | B | D | C | E |
| 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 2 |
| 1 | 1 | 1 | 1 | 3 |
| 1 | 1 | 1 | 1 | 4 |
| 1 | 1 | 1 | 1 | 5 |
| 2 | 1 | 1 | null | null |

**B) Maximum 6**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| R | | | | |
| A | B | | C | |
| 1 | 1 | | 5 | |
| 2 | 1 | | 5 | |
| S | | | | | | |
| A | | B | | C | | E |
| 1 | | 1 | | 1 | | 1 |
| 1 | | 1 | | 1 | | 2 |
| 1 | | 1 | | 1 | | 3 |
| 1 | | 1 | | 1 | | 4 |

|  |  |  |  |
| --- | --- | --- | --- |
| T | | | |
| A | C | D | E |
| 1 | 1 | 5 | 10 |
| 1 | 1 | 6 | 11 |
| 1 | 1 | 7 | 12 |
| 1 | 1 | 8 | 13 |
| 1 | 1 | 9 | 14 |

|  |  |
| --- | --- |
| ПCE S | |
| C | E |
| 1 | 1 |
| 1 | 2 |
| 1 | 3 |
| 1 | 4 |

|  |  |
| --- | --- |
| ПCE T | |
| C | E |
| 1 | 10 |
| 1 | 11 |
| 1 | 12 |
| 1 | 13 |
| 1 | 14 |
| S - T | |
| C | E |
| 1 | 1 |
| 1 | 2 |
| 1 | 3 |
| 1 | 4 |

**After that S-T = S and with the intersection with S we will have the same 4 values.**

|  |  |
| --- | --- |
| ПАЕR | |
| A | E |
| 1 | 5 |
| 2 | 6 |

|  |  |
| --- | --- |
| A | E |
| 1 | 5 |
| 2 | 6 |
| null | 1 |
| null | 2 |
| null | 3 |
| null | 4 |

**c) Minimum 0**

|  |  |  |
| --- | --- | --- |
| R | | |
| A | B | C |
| 5 | 1 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| S | | | |
| A | B | C | E |
| 1 | 1 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| T | | | |
| A | C | D | E |
| 1 | 1 | 5 | 1 |
| 2 | 1 | 6 | 1 |
| 3 | 1 | 7 | 1 |
| 4 | 1 | 8 | 1 |

|  |  |  |
| --- | --- | --- |
| ПADET | | |
| A | D | E |
| 1 | 1 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| T X S | | | |  |
| A | D | E | C | B |
| 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 |

|  |  |
| --- | --- |
| ПBCS | |
| B | C |
| 1 | 1 |

|  |  |  |
| --- | --- | --- |
| R (A=1) | | |
| A | B | C |

We have empty table because of missing value for the condition.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Right Join with T X S | | | | |
| A | D | E | C | B |

**Maximum 4**

|  |  |  |
| --- | --- | --- |
| R | | |
| A | B | C |
| 1 | 1 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| S | | | |
| A | B | C | E |
| 1 | 1 | 1 | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| T | | | |
| A | C | D | E |
| 1 | 1 | 5 | 1 |
| 1 | 1 | 6 | 1 |
| 1 | 1 | 7 | 1 |
| 1 | 1 | 8 | 1 |

|  |  |  |
| --- | --- | --- |
| ПADET | | |
| A | D | E |
| 1 | 5 | 1 |
| 1 | 6 | 1 |
| 1 | 7 | 1 |
| 1 | 8 | 1 |

|  |  |
| --- | --- |
| ПBCS | |
| B | C |
| 1 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| T X S | | | |  |
| A | D | E | C | B |
| 1 | 5 | 1 | 1 | 1 |
| 1 | 6 | 1 | 1 | 1 |
| 1 | 7 | 1 | 1 | 1 |
| 1 | 8 | 1 | 1 | 1 |

|  |  |  |
| --- | --- | --- |
| R (A=1) | | |
| A | B | C |
| 1 | 1 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Right Join T X S | | | |  |
| A | D | E | C | B |
| 1 | 5 | 1 | 1 | 1 |
| 1 | 6 | 1 | 1 | 1 |
| 1 | 7 | 1 | 1 | 1 |
| 1 | 8 | 1 | 1 | 1 |

# Exercise 7: Query Languages

A)

Tuple relational calculus:

{|s| s ∈ S ^ ∃r ∈ R(r.B != 1 ^ r.A=s.A)}

Domain relational Calculus

{[a,b,c,d] | ∃ a,b([a,b,c,d] ∈ S ^ ∃a[a,b] ∈ R ^ b!= 1)}

B)

Relational algebra

πAB(SPC<-A,D<-B(R))

Tuple Relational Calculus

{|s.A, s.B| s ∈ S ^ ∃r ∈ R(r.A=s.C ^ r.B = s.D)}

C)

Domain Calculus

{[a,d] | ∃b,d([a,b,c,d] ∈S ^ [a,b,e,f] ∈ T) }

Relational algebra

ΠA,D(ST.A > S.B T)

# Exercise 8: Query

a)

Relational algebra:

ПRSSI, Brightness(ZigbeeDevice  (LightDevice  σname=” Deckenleuchten Badezimmer ”ZigbeeGroup))

TupleRelational Calculus:

{[zb.RSSI, ld.Brightness] | zb ∈ ZigbeeDevice ^ ∃ld ∈ LightDevice(ld.DId = zg.DId ^ ∃zg ∈ Zigbeegroup(zg.name = “Deckenleuchten Badezimmer”))}

b)

TupleRelational Calculus:

{[d.name] | d∈ ^ ∀l ∈ Link(d.DId = l.Dev2)}

Relational Algebra

ПName(Device  Device.DId = link.Dev2 link)

Domain Relational Calculus

{[ name] | d∈ ^ ∀l ∈ Link(d.DId = l.Dev2)}