INFO 210: Database Management Systems

Homework 2 solutions

- This assignment covers
  - Relational Algebra
  - Oracle basic : To gain some hands-on experience with the Oracle database through the SQL*Plus client tool.
    - You can learn how to connect to Oracle, how to configure your SQL*Plus session, and how to create, populate and query a simple database schema.

Problem 1: Relational algebra

- Consider two relation instances below, with the following schemas:
  - Country (country_name, continent);
  - City (city_name, country_name, is_capital, population).
- In each question (a)-(d) below, **write a relational algebra expression** and **show its result** when the expression is executed with the given instances.

- **(a)** List the names of all European cities with population of more than 600,000.
- **(b)** List the names of all countries for which no cities have been entered into the City table.
- **(c)** List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.
- **(d)** List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

relational algebra

- The usual set operations: union ∪ , intersection ∩, set difference \ , but applied to relations (sets of tuples)
- Operations that remove parts of a relation
  - selection removes rows (tuples) $\sigma_C(R)$
  - projection removes columns (attributes) $\pi_{A_1, A_2, \ldots, A_n}(R)$
- Operations that combine tuples of two relations
  - Cartesian product - pairs tuples in two relations in all possible ways $R \times S$
  - join - selectively pairs tuples from two relations $R \bowtie_C S$
- Combining operations into queries

  e.g. : $\pi_{name}(\sigma_{grade='A'}(Students \bowtie Enrollment))$

R

id	name	age
1	Ann	18
2	Jane	22

S

id	name	age
1	Ann	18
3	Mike	21
4	Dave	27

$R \cup S$

id	name	age
1	Ann	18
2	Jane	22
3	Mike	21
4	Dave	27

$R \cap S$

id	name	age
1	Ann	18

R / S

id	name	age
2	Jane	22

S / R

id	name	age
3	Mike	21
4	Dave	27

R

id	name	age	gender
1	Ann	18	F
2	Jane	22	F
3	Mike	21	M
4	Dave	27	M

$\sigma_{age \geq 21}(R)$

id	name	age	gender
2	Jane	22	F
3	Mike	21	M
4	Dave	27	M

$\pi_{gender}(R)$

gender
F
M

$\sigma_{age \geq 21 \ AND \ gender='M'}(R)$

id	name	age	gender
3	Mike	21	M
4	Dave	27	M

$\pi_{id,\ name}(R)$

id	name
1	Ann
2	Jane
3	Mike
4	Dave

R

id	name	age
1	Ann	18
2	Jane	22

S

id	name	age
3	Mike	21
4	Dave	27

$R \times S$

R.id	R.name	R.age	S.id	S.name	S.age
1	Ann	18	3	Mike	21
1	Ann	18	4	Dave	27
2	Jane	22	3	Mike	21
2	Jane	22	4	Dave	27

$R \bowtie_{R.age < S.age} S$

R.id	R.name	R.age	S.id	S.name	S.age
1	Ann	18	3	Mike	21
1	Ann	18	4	Dave	27
2	Jane	22	3	Mike	21
2	Jane	22	4	Dave	27

R

sid	name	gpa
1111	Joe	3.2
2222	Ann	4.0
3333	Mike	3.5

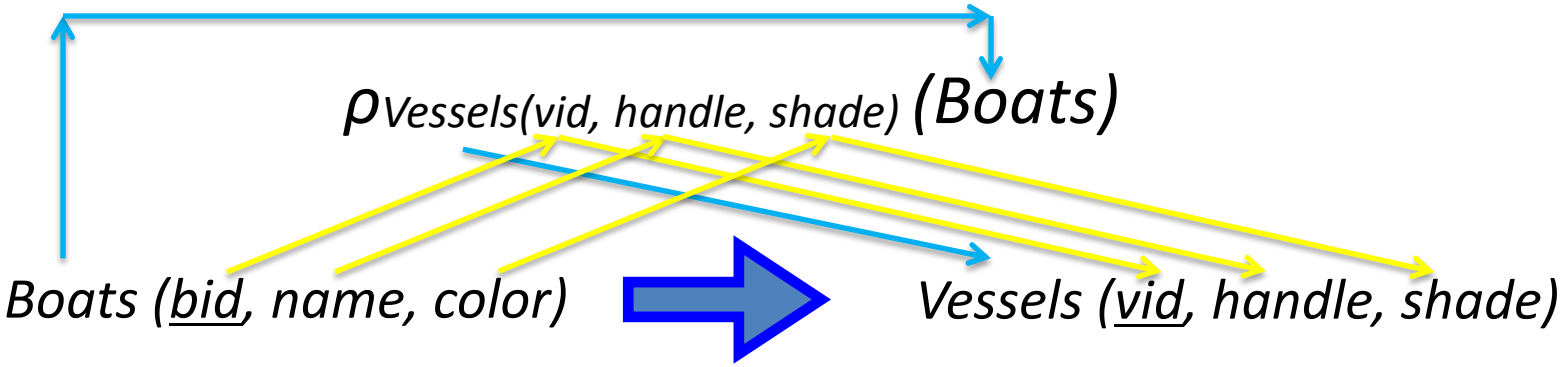
S

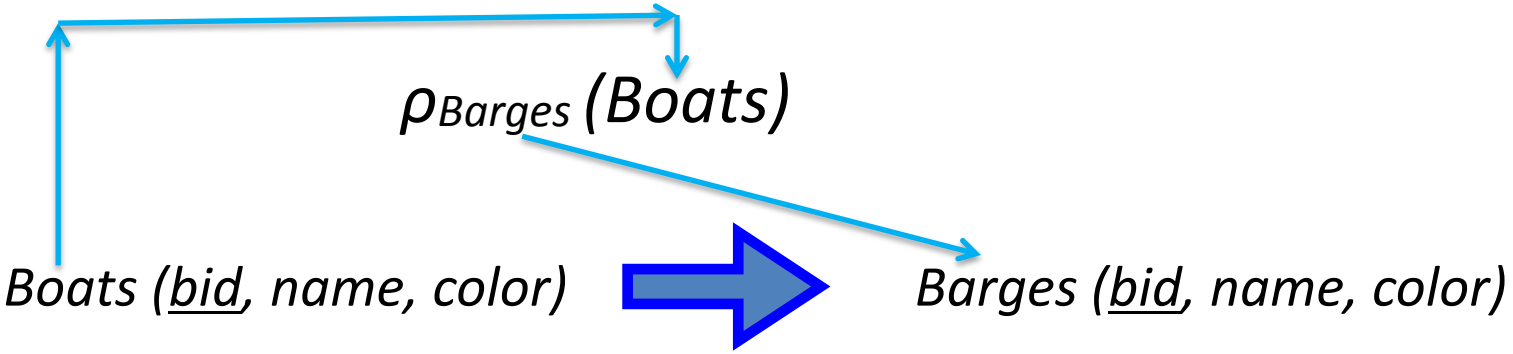
sid	did	cid	term	grade
1111	1	210	Fall 2012	A
2222	1	220	Winter 2013	

$R \bowtie S$

R.sid	R.name	R.gpa	S.sid	S.did	S.cid	S.term	S.grade
1111	Joe	3.2	1111	1	210	Fall 2012	A
2222	Ann	4.0	2222	1	220	Winter 2013	

renaming operator ρ.





Problem 1: Relational algebra

- Consider two relation instances below, with the following schemas:
  - Country (country_name, continent);
  - City (city_name, country_name, is_capital, population).
- In each question (a)-(d) below, **write a relational algebra expression** and **show its result** when the expression is executed with the given instances.

- **(a)** List the names of all European cities with population of more than 600,000.
- **(b)** List the names of all countries for which no cities have been entered into the City table.
- **(c)** List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.
- **(d)** List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

Problem 1: Relational algebra

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  - Country (country_name, continent);
  - City (city_name, country_name, is_capital, population).
- In each question (a)-(d) below, **write a relational algebra expression** and **show its result** when the expression is executed with the given instances.

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

a) List the names of all European cities with population of more than 600,000.

$$(\sigma_{continent='Europe'} (Country))$$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

a) List the names of all European cities with population of more than 600,000.

$(\sigma_{continent='Europe'} (Country))$ $(\sigma_{population>600,000} (City))$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
Germany	Europe
Germany	Europe
France	Europe
France	Europe

City

city_name	country_name	is_capital	population
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000

a) List the names of all European cities with population of more than 600,000.

$$(\sigma_{continent='Europe'} (Country)) \bowtie (\sigma_{population>600,000} (City))$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

Country.country_name	continent
Germany	Europe
Germany	Europe
France	Europe
France	Europe

City

city_name	City.country_name	is_capital	population
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000

a) List the names of all European cities with population of more than 600,000.

$$\pi_{city\_name}\left(\left(\sigma_{continent='Europe'}(Country)\right) \bowtie \left(\sigma_{population>600,000}(City)\right)\right)$$

$$\pi_{city\_name}\left(\sigma_{continent='Europe'}(Country) \bowtie \sigma_{population>600,000}(City)\right)$$

city_name
Berlin
Hamburg
Paris
Lyon

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

a) List the names of all European cities with population of more than 600,000.

$\pi_{city\_name}\ (\ \sigma_{continent='Europe'\ AND\ population>600,000}\ (Country \bowtie City)\ )$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
US	North America
US	North America
Canada	North America
Canada	North America
Germany	Europe
Germany	Europe
Germany	Europe
France	Europe
France	Europe
Mali	Africa
Mali	Africa
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
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Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
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Timbuktu	Mali	no	50,000
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$\pi_{city\_name}\ (\ \sigma_{continent='Europe'\ AND\ population>600,000}\ (Country \bowtie City)\ )$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

Country.country_name	continent
US	North America
US	North America
US	North America
Canada	North America
Canada	North America
Germany	Europe
Germany	Europe
Germany	Europe
France	Europe
France	Europe
Mali	Africa
Mali	Africa
Mali	Africa

City

city_name	City.country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
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Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
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$\pi_{city\_name}\ (\ \sigma_{continent='Europe'\ AND\ population>600,000}\ (Country \bowtie City)\ )$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

Country.country_name	continent
US	North America
US	North America
US	North America
Canada	North America
Canada	North America
Germany	Europe
Germany	Europe
Germany	Europe
France	Europe
France	Europe
Mali	Africa
Mali	Africa
Mali	Africa

City

city_name	City.country_name	is_capital	population
New York, NY	US	no	8,000,000
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Toronto	Canada	no	2,500,000
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Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

a) List the names of all European cities with population of more than 600,000.

$\pi_{city\_name}\ (\ \sigma_{continent='Europe'\ AND\ population>600,000}\ (Country \bowtie City)\ )$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

Country.country_name	continent
Germany	Europe
Germany	Europe
France	Europe
France	Europe

City

city_name	City.country_name	is_capital	population
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000

a) List the names of all European cities with population of more than 600,000.

π_{city_name} ($\sigma_{continent='Europe' \text{ AND } population>600,000}$ (*Country* ⋈ *City*))

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

b) List the names of all countries for which no cities have been entered into the City table.

$\pi_{country\_name}$ (*Country*)

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name
US
Canada
England
Germany
France
Mali

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
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$\pi_{country\_name}$ (*Country*)

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name
US
Canada
England
Germany
France
Mali

City

country_name
US
US
US
Canada
Canada
Germany
Germany
Germany
France
France
Mali
Mali
Mali

b) List the names of all countries for which no cities have been entered into the City table.

$\pi_{country\_name}(Country) \setminus \pi_{country\_name}(City)$

country_name
England

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
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Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$\sigma_{continent='Europe'}(Country)$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$\sigma_{continent='Europe'}(Country)$

$\sigma_{is\_capital='yes' \text{ AND } population > 1{,}000{,}000}(City)$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
England	Europe
Germany	Europe
France	Europe

City

city_name	country_name	is_capital	population
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

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$\sigma_{is\_capital='yes' \text{ AND } population > 1{,}000{,}000}(City)$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
England	Europe
Germany	Europe
France	Europe

Country

Country.country_name	Country.continent
Germany	Europe
France	Europe
Mali	Africa

City

city_name	City.country_name	is_capital	population
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$\sigma_{continent='Europe'}(\ Country)$

$(\sigma_{is\_capital='yes'\ AND\ population\ >\ 1{,}000{,}000}\ (City)) \bowtie$ Country

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
England	Europe
Germany	Europe
France	Europe

Country

Country.country_name	Country.continent
Germany	Europe
France	Europe
Mali	Africa

country_name	continent
England	Europe
Germany	Europe
France	Europe
Germany	Europe
France	Europe
Mali	Africa

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$$\sigma_{continent='Europe'}(Country) \cup$$

$$\pi_{country.country\_name,\ country.continent}($$

$$(\sigma_{is\_capital='yes'\ AND\ population\ >\ 1{,}000{,}000}(City)) \bowtie Country\ )$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
England	Europe
Germany	Europe
France	Europe

Country

Country.country_name	Country.continent
Germany	Europe
France	Europe
Mali	Africa

country_name	continent
England	Europe
Germany	Europe
France	Europe
Mali	Africa

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$$\sigma_{continent='Europe'}(Country) \cup$$

$$\pi_{country.country\_name,\ country.continent}($$

$$(\sigma_{is\_capital='yes'\ AND\ population\ >\ 1{,}000{,}000}(City)) \bowtie Country\ )$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
England	Europe
Germany	Europe
France	Europe

Country

Country.country_name	Country.continent
Germany	Europe
France	Europe
Mali	Africa

country_name	continent
England	Europe
Germany	Europe
France	Europe
Mali	Africa

c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

$$\sigma_{continent='Europe'}(Country) \cup$$

$$\pi_{country.country\_name,\ country.continent}($$

$$(\sigma_{is\_capital='yes'\ AND\ population\ >\ 1{,}000{,}000}(City)) \bowtie Country\ )$$

Country_name	Continent
England	Europe
Germany	Europe
France	Europe
Mali	Africa

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
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France	Europe
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City

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Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

A self-join

A self-join is a join that joins together tuples from two copies of the same table

List all possible heterosexual couples (girl name, boy name), where the boy is older than the girl.

People

id	name	age	gender
1	Ann	18	F
2	Jane	22	F
3	Mike	21	M
4	Dave	27	M

$$\pi_{Girls.name,\ Boys.name}\ (\ \rho_{Girls}\ (\ \sigma_{gender=F}\ (People))\ \bowtie_{Girls.age<Boys.age}\ \rho_{Boys}\ (\ \sigma_{gender=M}\ (People))\ )$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\sigma_{is\_capital='yes'}(City)$$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
Washington, DC	US	yes	600,000
Ottawa	Canada	yes	800,000
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\sigma_{is\_capital='yes'}(City)$$

$$\sigma_{is\_capital='no'}(City)$$

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Washington, DC	US	yes	600,000
Philadelphia, PA	US	no	1,500,000
Ottawa	Canada	yes	800,000
Toronto	Canada	no	2,500,000
Berlin	Germany	yes	3,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Paris	France	yes	2,000,000
Lyon	France	no	700,000
Bamako	Mali	yes	2,000,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

City

city_name	country_name	is_capital	population
Washington, DC	US	yes	600,000
Ottawa	Canada	yes	800,000
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000

City

city_name	country_name	is_capital	population
New York, NY	US	no	8,000,000
Philadelphia, PA	US	no	1,500,000
Toronto	Canada	no	2,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Lyon	France	no	700,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\sigma_{is\_capital='yes'}(City)$$

$$\sigma_{is\_capital='no'}(City)$$

Problem 1: Relational algebra

- Country (country_name, continent);
- City (city_name, country_name, is_capital, population).

Country

country_name	continent
US	North America
Canada	North America
England	Europe
Germany	Europe
France	Europe
Mali	Africa

Cap

Cap.city_name	Cap.country_name	Cap.is_capital	Cap.population
Washington, DC	US	yes	600,000
Ottawa	Canada	yes	800,000
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000

Non_Cap

Non_Cap.city_name	Non_Cap.country_name	Non_Cap.is_capital	Non_Cap.population
New York, NY	US	no	8,000,000
Philadelphia, PA	US	no	1,500,000
Toronto	Canada	no	2,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Lyon	France	no	700,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\rho_{Cap}\,(\sigma_{is\_capital='yes'}\,(City))$$

$$\rho_{Non\_Cap}\,(\sigma_{is\_capital='no'}\,(City))$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Cap

Cap.city_name	Cap.country_name	Cap.is_capital	Cap.population
Washington, DC	US	yes	600,000
Washington, DC	US	yes	600,000
Ottawa	Canada	yes	800,000
Berlin	Germany	yes	3,500,000
Berlin	Germany	yes	3,500,000
Paris	France	yes	2,000,000
Bamako	Mali	yes	2,000,000
Bamako	Mali	yes	2,000,000

Non_Cap

Non_Cap.city_name	Non_Cap.country_name	Non_Cap.is_capital	Non_Cap.population
New York, NY	US	no	8,000,000
Philadelphia, PA	US	no	1,500,000
Toronto	Canada	no	2,500,000
Hamburg	Germany	no	2,000,000
Bonn	Germany	no	300,000
Lyon	France	no	700,000
Timbuktu	Mali	no	50,000
Mopti	Mali	no	100,000

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\rho_{Cap}(\sigma_{is\_capital='yes'}(City)) \bowtie_{Cap.country\_name=Non\_Cap.country\_name} \rho_{Non\_Cap}(\sigma_{is\_capital='no'}(City))$$

Problem 1: Relational algebra

- Country (<u>country_name</u>, continent);
- City (<u>city_name</u>, <u>country_name</u>, is_capital, population).

Cap

Cap.city_name
Washington, DC
Washington, DC
Ottawa
Berlin
Berlin
Paris
Bamako
Bamako

Non_Cap

Non_Cap.city_name
New York, NY
Philadelphia, PA
Toronto
Hamburg
Bonn
Lyon
Timbuktu
Mopti

d) List all pairs of cities such that one of them is a capital of some country, and the other is a non-capital city in that same country. For each city in the pair, list its name.

$$\pi_{Cap.city\_name,\ Non\_Cap.city\_name}\ (\ \rho_{Cap}\ (\sigma_{is\_capital='yes'}\ (City))\ \bowtie_{Cap.country\_name=Non\_Cap.country\_name}\ \rho_{Non\_Cap}\ (\sigma_{is\_capital='no'}\ (City)))$$

Cap. city_name	Non_cap.city_name
Washington, DC	New York, NY
Washington, DC	Philadelphia, PA
Ottawa	Toronto
Berlin	Hamburg
Berlin	Bonn
Paris	Lyon
Bamako	Timbuktu
Bamako	Mopti

Problem 2: Executing simple SQL commands

- SQL> @CreateDB

- take another look at CreateDB.sql and use the commands in this file as an example.

- a) Write and execute SQL statements that *add* another INFO course, and enroll 2 students in this course. Copy and paste the statements and their output into your submission file.

- b) Write and execute SQL statements that *list the contents* of the database tables that were modified as a result of your statements in (a) above. Copy and paste the statements and their output into your submission file.

Problem 2: Executing simple SQL commands

- 1. upload the attached CreateDB.sql file
  - Bblearn Announcement Section instruction
- 2. connect to your online Oracle account
  - First login to Linux, then login to Oracle
    - How to connect to Linux/Oracle from Windows
    - ----------(download and install **SSH** client software)
    - How to connect to Linux/Oracle from Mac OS X
    - ----------(no need extra software, just use **terminal**)
- 3. SQL> @CreateDB
- 4. Display configuration:
  - set linesize [N]
  - set pagesize [N]
  - column [col_NAME] format a[N]

  for example:
    - set linesize 999
    - set pagesize 999
    - column Term format a15

SQL> column name format a20
SQL> select * from courses;

Problem 2: Executing simple SQL commands

- SQL> @CreateDB
- take another look at CreateDB.sql and use the commands in this file as an example.
- a) Write and execute SQL statements that *add* another INFO course, and enroll 2 students in this course. Copy and paste the statements and their output into your submission file.

```
SQL> insert into Courses(cid, did, name, credits) values (220, 200, 'Database Systems);

SQL> insert into Enrollment(did, cid, sid, term) values (200, 220, 2, 'Winter 2013');

SQL> insert into Enrollment(did, cid, sid, term, grade) values (200, 220, 1, 'Fall 2012', 3);
```

Problem 2: Executing simple SQL commands

- SQL> @CreateDB
- take another look at CreateDB.sql and use the commands in this file as an example.
- a) Write and execute SQL statements that *add* another INFO course, and enroll 2 students in this course. Copy and paste the statements and their output into your submission file.

Be careful about the integrity constraints (e.g. Foreign Key constraint)

```
SQL> insert into Courses(cid, did, name, credits) values (220, 200, 'Database Systems);

SQL> insert into Enrollment(did, cid, sid, term) values (200, 220, 2, 'Winter 2013');

SQL> insert into Enrollment(did, cid, sid, term, grade) values (200, 220, 1, 'Fall 2012', 3);
```

Problem 2: Executing simple SQL commands

- SQL> @CreateDB

- take another look at CreateDB.sql and use the commands in this file as an example.

- b) Write and execute SQL statements that *list the contents* of the database tables that were modified as a result of your statements in (a) above. Copy and paste the statements and their output into your submission file.

```
SQL> select * from Courses;

       CID    DID NAME                      CREDITS
---------- ---------- -------------------- ----------
       101    100 Calculus 1                    3
       101    200 Introduction to IT            3
       210    200 Database Systems              3
       220    200 Database Systems 2            3

SQL> select * from Enrollment;

       DID     CID      SID TERM                    GRADE
---------- ---------- ---------- --------------- ----------
       100    101          1 Fall 2012
       100    101          2 Fall 2012
       200    210          1 Spring 2012              2
       200    210          2 Spring 2012              3
       200    210          3 Spring 2012              4
       200    210          4 Spring 2012
       200    220          1 Fall 2012                3
       200    220          2 Winter 2013

8 rows selected.
```