DATABASE SYSTEM

SAMPLE MDTERM EXAM QUESTIONS (from old exams) 2017

1. Which of the following statements are true

1.1 Each superkey is a superset of some candidate key.

1.2 Each primary key is also a candidate key, but there may be candidate keys that are not primary keys (circle one answer below).

a) only 1.1 is true

b) only 1.2 is true

c) both 1.1 and 1.2 are true

d) neither 1.1 nor 1.2 are true

2. a.) The following questions refer to the instances of relation R(A,B,C,D,E) shown below :

A	B	C	D	E
7	4	1	2	3
1	5	3	1	1
1	6	3	2	4
5	5	1	2	3

Which of the following functional dependencies hold over the instance of relation R given above?

Answers: I) ABC $\rightarrow$ E II) CD $\rightarrow$ EB III) B $\rightarrow$ D

ANSWERS (CIRCLE ONE!) :

a) I & III b) II & III

c) I & II d) I only

e.) OTHER THAN a.), b.), c.), d.)

2. b.) Write a nontrivial functional dependency, implied by the dependency set
$ABC \rightarrow E$ $CD \rightarrow EB$ $B \rightarrow D$

3. Consider Figure 1.1

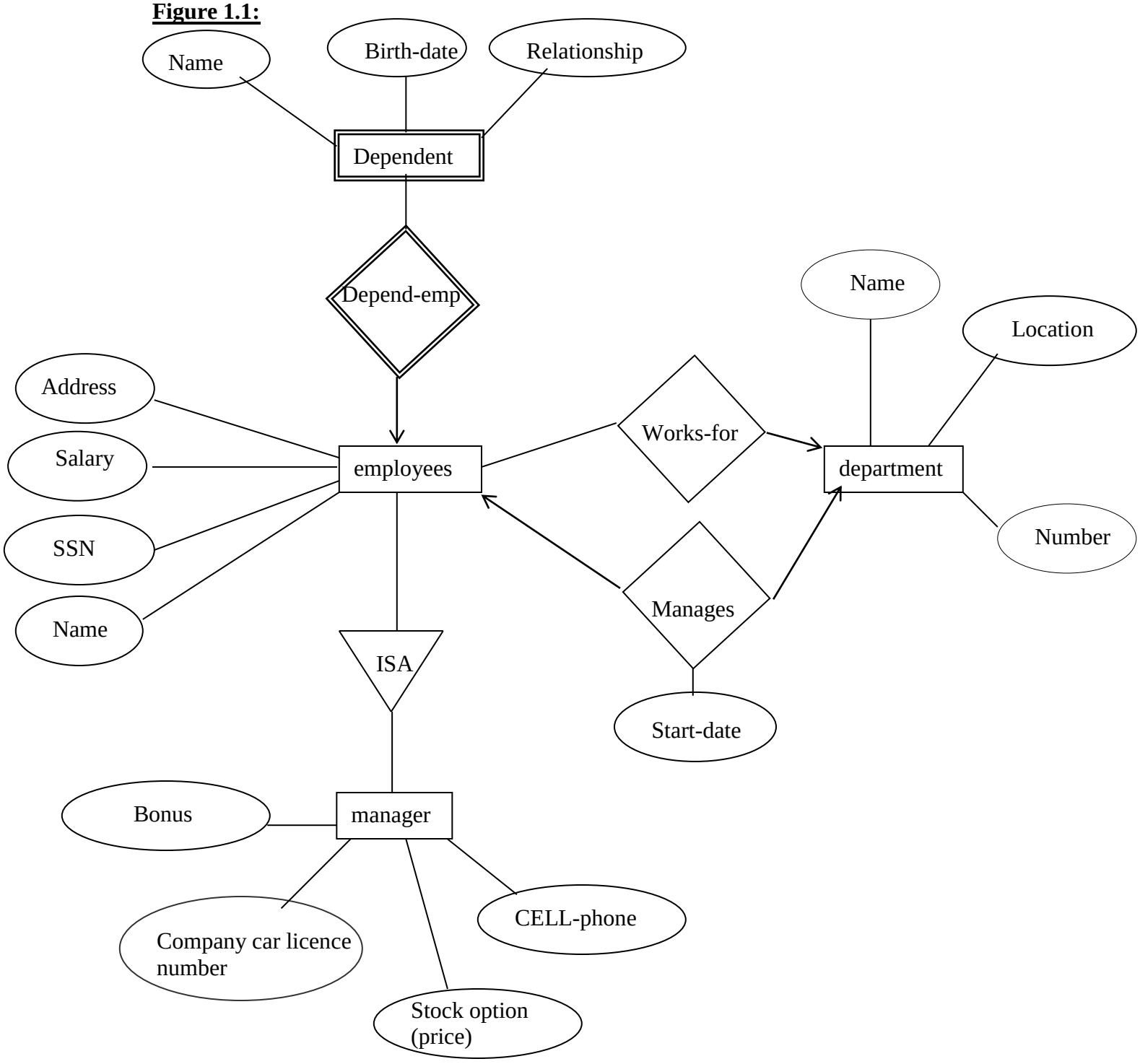
a.) Underline keys

b.) Translate Figure 1.1 into relational model

c.) List all relationship sets, identify their type

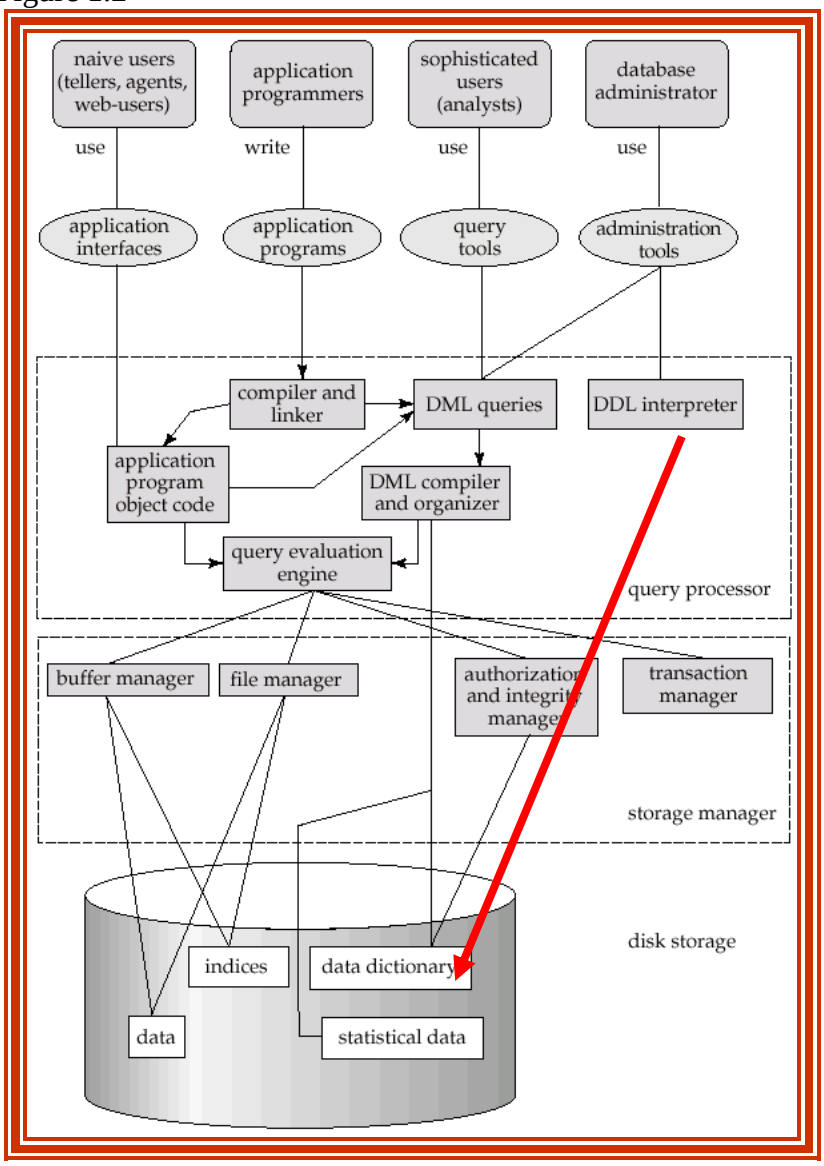
d.) Suppose, that the Works-for relationship is many-to-many. Write a create table statement for the Works-for relationship, also defining the necessary comstraints

Figure 1.1:



e.) Consider Figure 1.2. Try to explain, what happens in the DBMS if you create a table! Identify which parts of the architecture is "activated" by your work!

Figure 1.2



f.)

In Figure 1.2 there is a Data Dictonary part. Can you mention an object from your practice stored in the Data Dictionary?

6. The following instances of R and S are given:

R

A	B	C
1	1	3
1	2	1
2	3	2
3	1	2
3	2	3

S

B	C	D	E
1	3	1	2
2	1	2	3
2	3	3	1
3	2	1	1

Give the results of the following relational algebraic expressions! (2+2+3 pont)

a.) $\pi_{A,E}(\sigma_{C>D}(R \triangleright\triangleleft S))$

b.) $\pi_{A,F}(\sigma_{A>=F \text{ AND } G>F}(\rho_{P(A,F,G)}(\pi_{A,D,E}(R \triangleright\triangleleft S))))$

c.) Rewrite a.) into SQL

8. Suppose that each of the following update operation is applied directly to the database shown in Figure 5.6. If the update is a valid one, just write “Valid”, otherwise, indicates it is “Invalid” and explicitly indicate why it is invalid. (RESTRICT is the default option for delete) (20 pts)

(a) Insert < 'Robert', 'F', 'Scott', '666884444', '21-JUN-42', '2365 Newcastle Rd, Bellaire, TX', M, 58000, '888665555', 1 > into EMPLOYEE.

PK is existed

(b) Insert < 'ProductA', 4, 'Bellaire', 1 > into PROJECT.

Valid

(c) Insert < 'Production', null, '943775543', '01-OCT-88' > into DEPARTMENT.

PK is NULL

(d) Insert < '888665555', 20, '40.0' > into WORKS_ON.

PK is existed

(e) Insert < '453453453', 'John', M, 'null', 'SPOUSE' > into DEPENDENT.

Valid

(f) Delete the WORKS_ON tuples with Hours= 'null'.

Hours is not PK

(g) Delete the EMPLOYEE tuple with SSN= '888665555'.

It’s referenced

(h) Delete the PROJECT tuple with Pnumber= '20'.

It’s referenced

(i) Modify the Dnumber, Mgr_ssn and Mgr_start_date of the DEPARTMENT tuple with DNUMBER=5 to ‘6’, '123456789' and '01-OCT-88', respectively.

Dnumber is referenced

(j) Modify the SUPERSSN attribute of the EMPLOYEE tuple with SSN= '999887777' to '999887777'.

Valid

a.) What types of relationship sets do you know?

b.) Identify relationship sets in Figure 5.6 below: give an example – if any- for each you mentioned in a.)

c.) Give an example for foreign key constraint in Figure 5.6:

d.) Write a SQl table definition for Employee. Salary must be filled and must not be less than 30 000 (annual, in dollars). Provide all other constraints you know.

Figure 5.6
One possible database state for the COMPANY relational database schema.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours

PROJECT

Pname	Pnumber	Plocation	Dnum

Give an SQL query for finding

e. the names those employees, who does **not** have a dependent.

f. the employees' names, salaries together with the name of department they work for. We prefer to have the names in decreasing order with respect to the salary. (3 points)

g. the department (by its number) in which the maximum salary is greater than the one in department 5. (3 points)

h. the managers with their names and their employees

j. names of those employees who are working on all projects

k. employee names and address working on the same project

Write a Relational algebra query

l. find the employee(s) with maximum salary

m.) finding the employees' names, salaries together with the name of department they work for.

n.) find those employees' Esssn , who works in all project.

o.) find employees'name working on all project

9. a. What are Armstrong axioms? State them (2 points), prove the correctness of any of them

9.b Prove or disprove the following derivation rule:

IF $\alpha \rightarrow \beta$ and $\gamma \rightarrow \delta$ (BOTH) hold on a relation instance r, then $\alpha\gamma \rightarrow \beta\delta$ also hold on that instance.

9.c.
Give the definition of functional dependency. (2 points)

10. Consider the following schema for an airlane database (primary key attributes are underlined)

FLIGHTS(flight_number, source_city, destination_city)

DEPARTURES(flight_number, date, plane_type)

PASSANGERS(passanger_id, passenger_name, passenger_address)

BOOKINGS(passanger_id, flight_number, date, seat_number)

Express the following ones of relational algebra (RA) and SQL, as indicated. You may abbreviate the attributes, but your notation must be clear.

Find the cities that have direct (non-stop) fligts to both Honolulu and Bagdad.

RA

SQL: DO NOT USE INTERSECT please.

RA:

Find passenger_name of all passengers, who have a seat booked on at least one plane of **every** type.

RA:

Find the flight_number, date of all flights for which there is no reversations.

RA and SQL:

FInd those passengers who booked exactly 2 flights

SQL: Print an ordered list in the screen of all source cities and the number of distinct destination cities that they have direct (non-stop) flights to. We want this list in reversed alphabetical order. The list should contain only those source cities that have flights to 25 or more distinct destinations. The output shuld look like this:

source_city number_of_destination

Winnipeg 100

New York 1245

…..

Budapest 200

11. What is a NULL value? How can we compare 2 piece of data if one of them is NULL?

IN other words: What is 3 –valued logic, how it works, why it is needed?

12. Consider a relation *R(A,B,C,D,E)* with the following functional dependencies:

$ABC \rightarrow DE$ and
$D \rightarrow AB$.

The number of superkeys of *R* is:

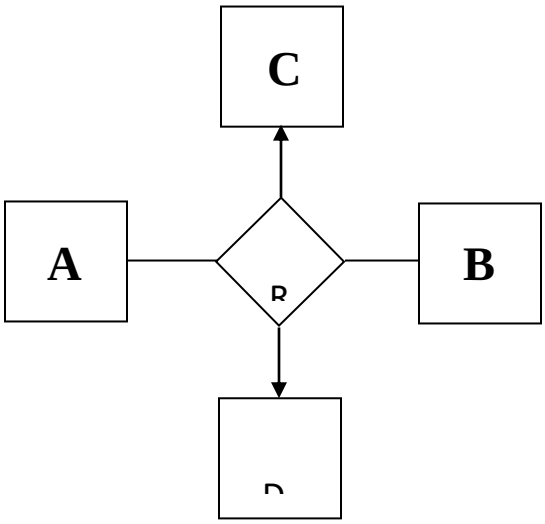
(a) 2

(b) 7

(c) 10 *****

(d) 12

13. Consider the following E/R diagram:



Below are three possible relationship sets for this E/R diagram:

	A	*B*	*C*	*D*
I.	a_1	b_1	c_1	d_1
	a_1	b_1	c_1	d_2

	A	B	C	D
II.	a_1	b_1	c_1	d_1
	a_1	b_1	c_2	d_2

	A	B	C	D
III.	a_1	b_1	c_1	d_1
	a_1	b_2	c_1	d_1

You may assume that different symbols stand for different values, e.g., d_1 is definitely not equal to d_2. Which of the above could ***not*** be the relationship set for the E/R diagram?

(a) **I** only *****

(b) **I** and **II** only

(c) **II** only

(d) **I**, **II** and **III**.

14. One of the following four expressions of relational algebra is not equivalent to the other three. They are all based on the relations *R(A,B)* and *S(B,C).* Indicate which is not equivalent to the others.

(a) $\pi_{AB}\,(R \bowtie S)$

(b) $R \bowtie \pi_B(S)$

(c) $R \cap (\pi_A(R) \times \pi_B(S))$

(d) $\pi_{A,R.B}(R \times S)$ *******

15. Of the following three equivalence's between expressions of relational algebra, each involving relations *R(A,B)* and *S(C,D)* (note the schema of *S* is different from that of the question above), which is true?

(a) $\pi_{A,B}(R \times S) = R$

(b) $R - \rho_{T(A,B)}(S) = \rho_{T(A,B)}(S - \rho_{U(C,D)}(R))$

(c) $\pi_{A,B,D}(R \underset{B=C}{\bowtie} S) = R \bowtie \rho_{T(B,D)}(S)$ ********

(d) none of the above (i.e., they are all false)

The following 4 questions are based on a relation

Emps(empID, ssNo, name, mgrID)

giving for a set of employees their employee ID (assumed unique), their social-security number (also unique), the name of the employee (not necessarily unique, and the employee ID of the manager of the employee. Assume that the president is his/her own manager, so every employee has a unique manager. You may assume there are no duplicate tuples in this relation.

16: Here are two possible ways to declare the relation `Emps`.

I.
```
CREATE TABLE Emps (
   empID INT,
   ssNo INT,
   name CHAR(50),
   mgrID INT,
   UNIQUE (empID),
   PRIMARY KEY (ssNo),
   FOREIGN KEY mgrID REFERENECES Emps (empID)
);
```

II.
```
CREATE TABLE Emps (
   empID INT PRIMARY KEY,
   ssNo INT UNIQUE,
   name CHAR(50),
   mgrID INT REFERENECES Emps (empID)
);
```

Which, if any, of the two declarations above will correctly (in SQL2) declare the relation `Emps`?

(a) Both **I** and **II**

(b) **I** only

(c) **II** only **********

(d) Neither **I** nor **II**

17: Suppose we wish to find the ID's of the employees that are managed by people who are managed by the employee with ID 123. Here are two possible queries:

I.
```
SELECT ee.empID
FROM Emps ee, Emps ff
WHERE ee.mgrID = ff.empID AND ff.mgrID = 123;
```

II.
```
SELECT empID
FROM Emps
WHERE mgrID IN
   (SELECT empID FROM Emps WHERE mgrID = 123);
```

Which, if any, of the two queries above will correctly (in SQL2) get the desired set of employee ID's?

(a) Both **I** and **II** **********

(b) **I** only

(c) **II** only

(d) Neither **I** nor **II**

18. Suppose we wish to find the ID's of the employees who do *not* manage any employee named "Sally." Here are two possible queries:

I.
```
SELECT mgrID
FROM Emps
WHERE NOT EXISTS(SELECT * FROM Emps WHERE NAME =
'Sally');
```

II.
```
SELECT mgrID
FROM Emps
WHERE NOT (empID = ANY(SELECT EmpID FROM Emps WHERE
name = 'Sally'));
```

Which, if any, of the two queries above will correctly (in SQL2) get the desired set of employee ID's?

(a) Both **I** and **II**

(b) **I** only

(c) **II** only

(d) Neither **I** nor **II** **********

19.

Consider the following SQL query on the relation R(A,B) that has no NULL's.

```
Select rr.A, rr.B,ss.A, ss.B
From R as rr, R as ss
Where rr.A = ss.A and rr.B = ss.B
```

Suppose that *R* has n tuples (not necessarily all distinct). Which of the above conditions is the most restrictive correct limitation on m, the number of tuples (again not necessarily all distinct) in the result?

(a) $n \leq m \leq n*n$ ********

(b) $n \leq m \leq 2n$

(c) $0 \leq m \leq n$

(d) $m = n$

20.

Suppose now that R(A,B) and S(A,B) are two relations with r and s tuples, respectively (again, not necessarily distinct). If m is the number of (not necessarily distinct) tuples in the result of the SQL query:

```
R intersect S;
```

Then which of the following is the most restrictive, correct condition on the value of m?

(a) $m = \min(r,s)$
(b) $0 \leq m \leq r + s$
(c) $\min(r,s) \leq m \leq \max(r,s)$
(d) $0 \leq m \leq \min(r,s)$ **********

21. What are data abstraction levels? In which level you are working when you are using the NEPTUN system? What is data independence?

22. /Fill the second column of the table below using the identifiers in the second table second column (ID). (0-2 matching is 0 point, 3 –4 matching is 1 point, 5-6 matching is 3 points, 7-8 matching is 4,
9 matching is 9 points) Each false answer is –0.5 point!

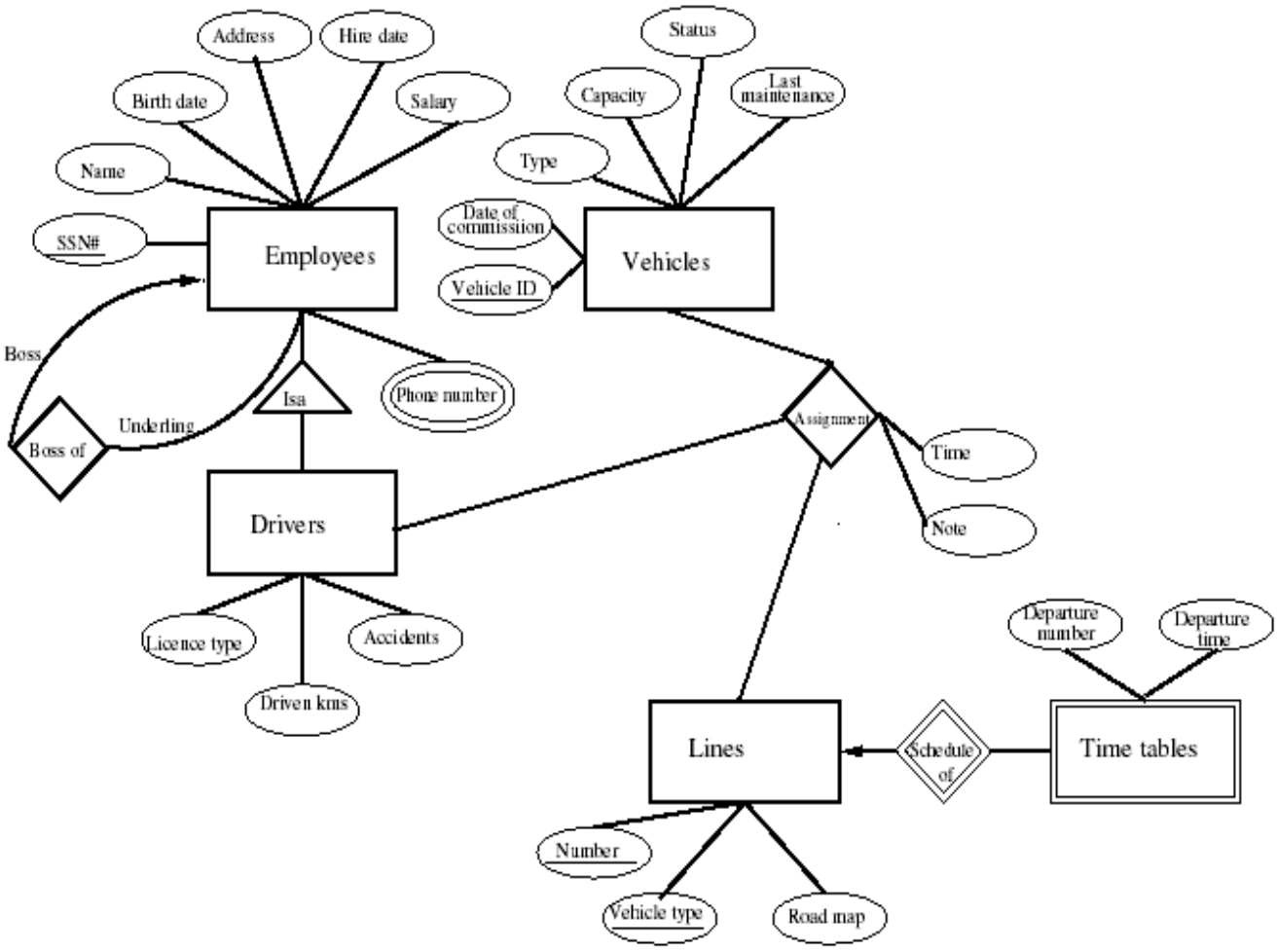
	Best fitting sentence identifiers
Metadata	
Primary key	
Null value	
Superkey	
Soundness	
Candidate key	
Completeness	
Database instance	
Logical level	

Sentence	*ID*
The person responsible for passwords and accounts..	1
0 value of a numeric type.	2
For example table about a table .	3
Data of a part (eg. tables, etc.) of a database.	4
If all the instances satisfy a given dependency set F, and also a given functional dependency $\alpha \rightarrow \beta$, then there is a derivation from F of $\alpha \rightarrow \beta$ using only the Armstrong axioms.	5
Also E/R can be counted as that is in it.	6
All the attributes are functionally determine by it.	7
It is the minimal set of attributes which is able to determine functionally all the attributes.	8
Already populated (filled) tables.	9
Physical level.	10
The value is not filled.	11
One chosen candidate key.	12
Any set of attributes containing a candidate key.	13
Using only Armstrong axioms and a given dependency set F, if a relation satisfies F, then it does satisfy any derived functional dependency.	14
Metatable, table about tables.	15
A list of relation schemas.	16
The best, appropriate candidate key.	17
Value unknown.	18

23. Define natural join/max-min/division operator, express division by BASIC relational algebraic operators and explain the truth of this expression.

24.

1.1 Transfrom the following entity relational model into relational model. Mark clearly the primary keys by underlining the appropriate attribute(s). (7 marks)



25. Which one of the following types of relationships can be observed in E/R figure in Give examples from the figure. (3 marks)

1-1:

1-to –many:

many-to-many.

36. Consider the following schema:

Teacher(t_id, t_name, age)
Courses(c_id, c_name)
Teach(t_id, c_id)
Student(s_id, s_name)
Fullfilled(s_id, c_id, grade)

Describe the following queries in the specified form:

a.) Find the names of teachers and names of courses they teach!

Rel. alg.

SQL

b.) Compute the average grade of fulfilled courses!

SQL

c.) Find the names of students who fulfilled all courses of ‘Prof. Boyce’!
Rel. alg.

d.) Find the names of students who has better average than the overall average of all the students!
SQl

27.

Consider the relation scheme R (A, B, C, D, E, G) and a set of functional dependencies F that relation on scheme R must satisfy:

F:={C→AB, CD→E, G→E, D→E, B→D}

Give at least 4 nontrivial members of F+, using the following rules (EXPLAIN!)

Decomposition:

Augmentation:

Transtivity:

Pseudotransitivity:

28. Define the following:
- candidate key
- superkey
-primary key

29. Define the following using functional dependencies:
- candidate key
- superkey
-primary key
- legal relation
-illegal relation
-partial dependency
- trivial dependency