

**CS 631: DATA MANAGEMENT SYSTEMS DESIGN**  
**(Spring semester 2020, Section 102)**

**A**

**Midterm Exam**

**Thursday, March 12, 2020**

- The exam is open book. You may also use the class slides. Nothing else is allowed.
- The total number of points is 100.
- Answer all questions on the exam paper itself and in the space provided after each question.
- Do not write your answers before you have them well thought out. A good idea is to use pencil so that you can make corrections and produce a clear manuscript.
- You may use the last 3 white paper sheets as a draft paper. Please do not use any other paper as scratch paper.
- You are not allowed to share books or notes.
- No electronic device is allowed (cell phone, laptop, tablet etc.)

**Name:**\_\_\_\_\_

**ID Number:**\_\_\_\_\_

**STATEMENT**

On my honor, I pledge that I will not violate the provision of the NJIT Student Honor Code.

**Signature:**\_\_\_\_\_

1	2	3	4	5	Total
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**QUESTION 1****[15 points].**

UPS prides itself on having up-to-date information on the processing and the current location of each shipped item. To do this, UPS relies on a company-wide information system. Shipped items are the heart of the UPS product tracking information system. You have been hired by them as a database designer. The requirements that you collected are as follows:

- Shipped items can be characterized by item number (unique), weight, dimensions, insurance amount, destination, and final delivery date.
- Shipped items are received into the UPS system at a single retail center.
- Retail centers are characterized by their type, uniqueID, and address.
- Shipped items make their way to their destination via one or more standard UPS transportation events (i.e., flights, truck deliveries).
- These transportation events are characterized by a unique scheduleNumber, a type (e.g, flight, truck), and a deliveryRoute.

Draw an ER diagram that captures this information about the UPS system assuming that the entity types are SHIPPED ITEM, RETAIL CENTER, and TRANSPORTATION EVENT. Specify also (a) keys, (b) participation constraints (single/double lines) and cardinality ratios (numbers across the diamond boxes) for every relationship type (c) (min, max) constraints on every participation of an entity type into a relationship type (d) roles (if this is necessary).

State clearly any additional constraints you impose. The additional constraints (if any) should not contradict with the collected specifications.

**QUESTION 2****[15 points]**

In class we have discussed four types of Integrity Constraints: Domain Constraint, Key Constraint, Entity Integrity Constraint and Referential Integrity Constraint.

Suppose that each of the following update operations is applied directly to the COMPANY database, whose schema and instance are shown in Figures 1 and 2 respectively.

Identify all the integrity constraints (if any) that will be violated if we perform the following operations. If a constraint is violated (a) explain briefly (2-3 lines) why this happens, and (b) suggest a reasonable action to be taken for correcting the cause of the violation of the constraint (2 lines).

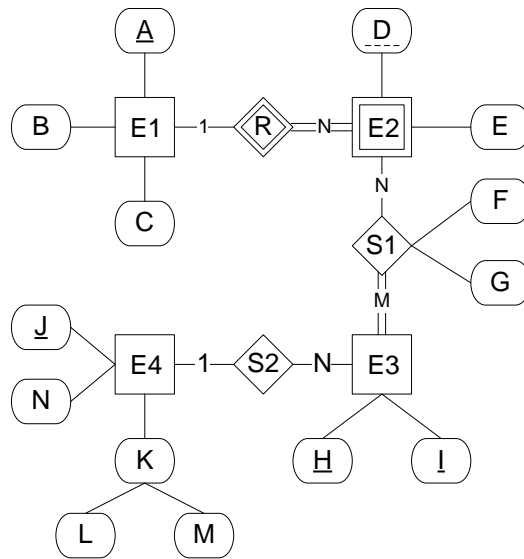
(1) Delete the DEPARTMENT tuple(s) with MGRSSN = '888665555'

(2) Insert <NULL, 40, NULL, 1> into PROJECT.

(3) Insert <'123456789', 2, 32.5> into WORKS\_ON.

**QUESTION 3****[15 points].**

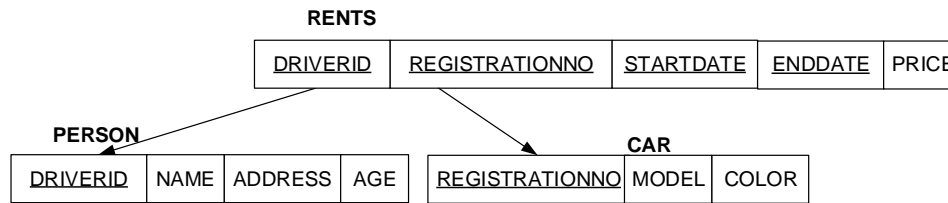
Map the following ER schema into a relational schema.



Specify: (a) relation schemas, (b) primary keys, (c) foreign keys.

**QUESTION 4****[40 points]**

Consider the following database schema:



The meaning of these relations is straightforward. Primary key attributes are underlined. Thus DRIVERID is the primary key for PERSON, REGISTRATIONNO is the primary key for CAR, and attributes DRIVERID, REGISTRATIONNO, STARTDATE and ENDDATE of RENTS together form the primary key of RENTS. Arrows indicate foreign keys. We assume that NULL values are not allowed.

Write the following queries in Relational Algebra.

1. Find the names of the Persons who have rented a car with Model = 'Nissan Altima'.
2. Find the DRIVERIDs of persons who have rented a red car but not a blue car.

- Find the names of persons who have rented a red car and a black car.
- Find all the REGISTRATIONNOs of cars which are either green in color or rented by a person whose address is 'Newark'.

5. Find the REGISTRATIONNOs of the cars which have been rented by all persons who are younger than 25 years.

6. Find the names of persons who have rented less than 5 cars.



**QUESTION 5****[15 points]**

Write appropriate Data Definition Language SQL statements to declare the following database schema.

ASSIGNMENT

<u>INSTRUCTOR_ID</u>	<u>COURSEID</u>	<u>SEMESTER</u>	ROOM
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COURSES

<u>COURSEID</u>	CNAME	PREREQ_CID	INTRODUCED_SINCE	CREDIT
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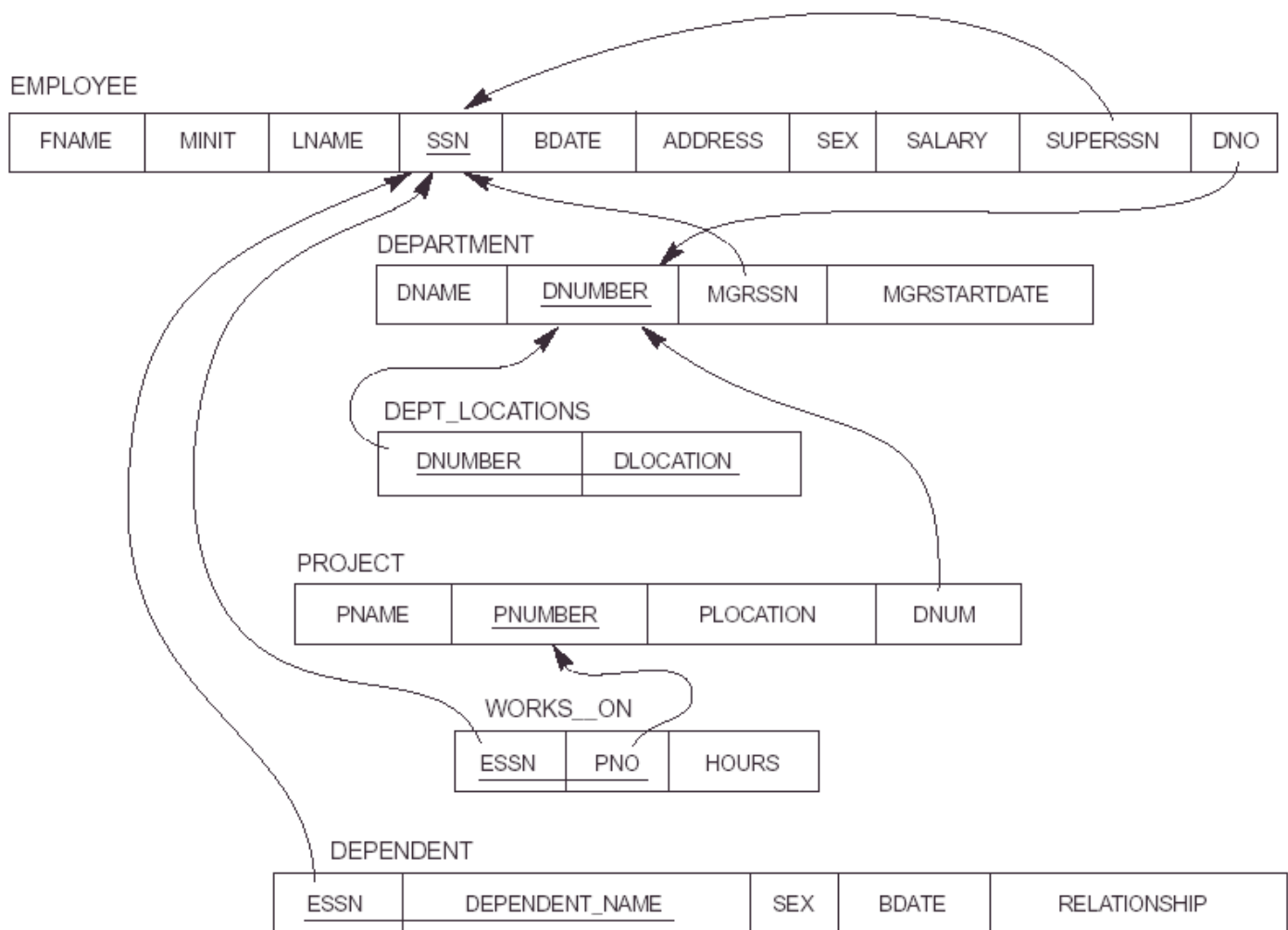
Specify: (a) Tables, attributes, domains, data types, NOT NULL constraints, DEFAULT values (if necessary).

(b) Primary keys

(c) Foreign keys

(d) Reasonable on-delete and on-update referential triggered actions for the foreign keys.





**Figure 1: The COMPANY relational database schema.**

EMPLOYEE	FNAME	MINIT	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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

					DEPT_LOCATIONS	<u>DNUMBER</u>	DLOCATION
						1	Houston
						4	Stafford
						5	Bellaire
						5	Sugarland
						5	Houston
DEPARTMENT	DNAME	<u>DNUMBER</u>	MGRSSN	MGRSTARTDATE			
	Research	5	333445555	1988-05-22			
	Administration	4	987654321	1995-01-01			
	Headquarters	1	888665555	1981-06-19			

WORKS_ON	<u>ESSN</u>	<u>PNO</u>	HOURS
	123456789	1	32.5
	123456789	2	7.5
	666884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0
	999887777	30	30.0
	999887777	10	10.0
	987987987	10	35.0
	987987987	30	5.0
	987654321	30	20.0
	987654321	20	15.0
	888665555	20	null

PROJECT	PNAME	<u>PNUMBER</u>	PLOCATION	DNUM
	ProductX	1	Bellaire	5
	ProductY	2	Sugarland	5
	ProductZ	3	Houston	5
	Computerization	10	Stafford	4
	Reorganization	20	Houston	1
	Newbenefits	30	Stafford	4

DEPENDENT	<u>ESSN</u>	<u>DEPENDENT_NAME</u>	SEX	BDATE	RELATIONSHIP
	333445555	Alice	F	1986-04-05	DAUGHTER
	333445555	Theodore	M	1983-10-25	SON
	333445555	Joy	F	1958-05-03	SPOUSE
	987654321	Abner	M	1942-02-28	SPOUSE
	123456789	Michael	M	1988-01-04	SON
	123456789	Alice	F	1988-12-30	DAUGHTER
	123456789	Elizabeth	F	1967-05-05	SPOUSE

**Figure 2: An instance corresponding to the COMPANY schema.**





