

# CS 2300 – Homework 2

Submit a digital copy (of PDF) to Canvas

Total possible points: 100 points

## Homework Guidelines

### **No Handwritten Answers**

This homework will require some written responses and some diagrams. For the written responses, use a standard word processor like Microsoft Word, LibreOffice Writer, Google Docs, or LaTeX. Drawings can be made using Microsoft PowerPoint or Google Drawings<sup>1</sup>, among others (e.g. draw.io, lucidchart). You can explore other tools as well, just search around and verify the tool you are considering is compliant with the design aspects that are presented in class.

Please create your answers in a digital format, export to a PDF, and upload that PDF to Canvas. No need to turn a printed copy. For those of you considering LaTeX, ShareLaTeX and Overleaf are good online editors.

### **One Problem per Page**

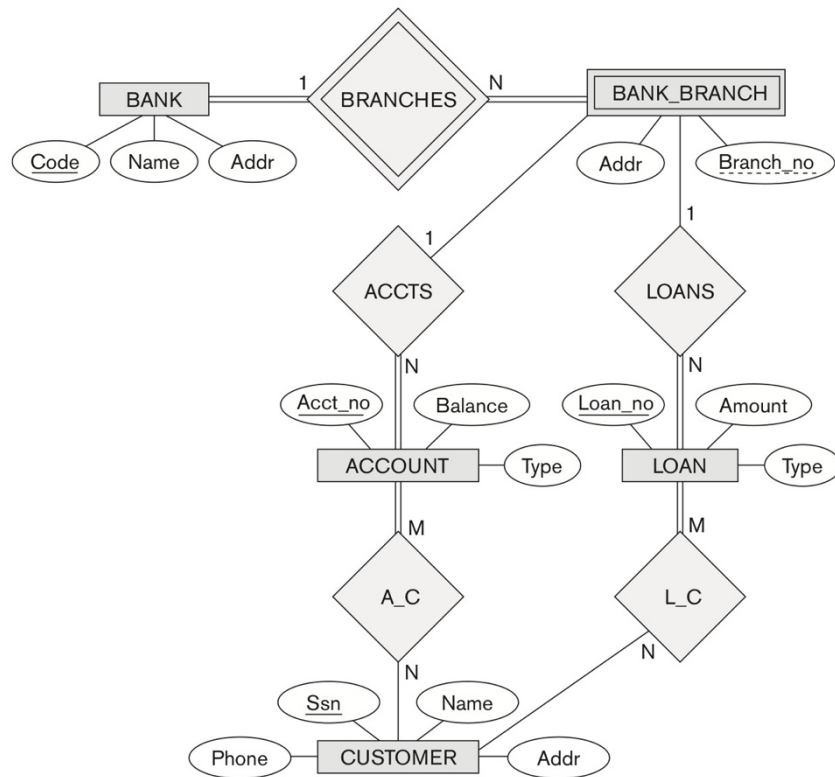
In the past, many students turned in a single piece of paper with all answered questions smooshed onto it. This did not leave my grader or I with adequate room to provide suggestions on how a design could be improved nor explanations on errors. The process of design work is to work in iterative stages: the first stage will be rather messy (and can be hand-written), the second stage will have things cleaned up, and so on. The final stage is what you should turn in, and it should be free of scratched-out work and high-density drawings. Only answer one problem on *at least* one page, and refrain from super-compact answers that leaves more than 1/2 of the page empty. Ideally, leave somewhere between 1/4 to 1/2 of a page empty so that we can make annotations.

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<sup>1</sup> <https://docs.google.com/drawings/>

**Problem 1 [15 points]**

Consider the BANK ER diagram below, and suppose that it is necessary to keep track of different types of ACCOUNTS (SAVINGS\_ACCTS, CHECKING\_ACCTS, INVESTMENT\_ACCTS) and LOANS (CAR\_LOANS, HOME\_LOANS, BUSINESS\_LOANS). Suppose that it is also desirable to keep track of each account's TRANSACTIONS and each loan's PAYMENTS; both of these include the amount, date, and time. Enhance the existing ER diagram, using the concepts of specialization and generalization.



**Problem 2 [55 pts; 5 pts each]**

The following update operations are applied to the database state from Figure 1 (on the next page), which has the relational schema shown in Figure 2. If there are any integrity violations, discuss which violations occur and why they occur, as well as remedial strategies that enforce these constraints. If an operation is executed successfully, assume the state of the relation is updated to reflect this.

- a) Insert <'Robert', 'F', 'Scott', '943775543', '1972-06-21', '2365 Newcastle Rd, Bellaire, TX', M, 58000, '888665555', 1> into EMPLOYEE.
- b) Insert <'ProductA', 4, 'Bellaire', 2> into PROJECT.
- c) Insert <'Production', 4, '943775543', '2007-10-01'> into DEPARTMENT.
- d) Insert <'677678989', NULL, '40.0'> into WORKS\_ON.
- e) Insert <'453453453', 'John', 'M', '1990-12-12', 'spouse'> into DEPENDENT.
- f) Delete the WORKS\_ON tuples with Essn = '333445555'.
- g) Delete the EMPLOYEE tuple with Ssn = '987654321'.
- h) Delete the PROJECT tuple with Pname = 'ProductX'.
- i) Modify the Mgr\_ssn and Mgr\_start\_date of the DEPARTMENT tuple with Dnumber = 5 to '123456789' and '2007-10-01', respectively.
- j) Modify the Super\_ssn attribute of the EMPLOYEE tuple with Ssn = '999887777' to '943775543'.
- k) Modify the Hours attribute of the WORKS\_ON tuple with Essn = '999887777' and Pno = 10 to '5.0'.

**EMPLOYEE**

Fname	Minit	Lname	<u>Ssn</u>	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	<u>Dnumber</u>	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**

<u>Dnumber</u>	<u>Dlocation</u>
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

**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 1. A database state for the COMPANY relational database schema.**

**EMPLOYEE**

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
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**DEPARTMENT**

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
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**DEPT\_LOCATIONS**

<u>Dnumber</u>	<u>Dlocation</u>
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**PROJECT**

Pname	<u>Pnumber</u>	Plocation	Dnum
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**WORKS\_ON**

<u>Essn</u>	<u>Pno</u>	Hours
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**DEPENDENT**

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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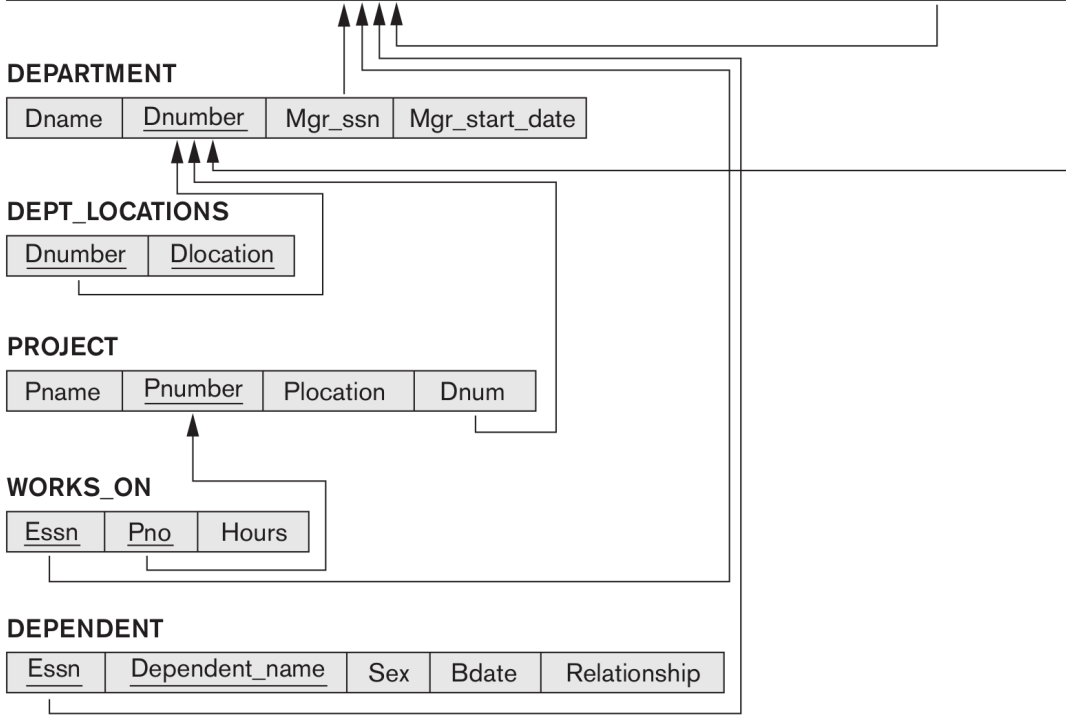


Figure 2

**Problem 3 [10 pts]**

An order-processing database for a company may have the following six relations:

**CUSTOMER** (Cust#, Cname, City)  
**ORDER** (Order#, Odate, Cust#, Ord\_Amt)  
**ORDER\_ITEM** (Order#, Item#, Qty)  
**ITEM** (Item#, Unit\_price)  
**SHIPMENT** (Order#, Warehouse#, Ship\_date)  
**WAREHOUSE** (Warehouse#, City)

where Ord\_Amt is the total spent on an order (in dollars); Odate refers to when an order was placed; Ship\_date refers when an order was shipped from a warehouse.

Assumption: *an order can be shipped from multiple warehouses*

Based on intuition, which of these attributes are foreign keys for this schema, and to which relation (and primary / candidate key) would each reference? Explicitly state any assumptions you make.

Foreign Key	Referenced Primary Key

**Problem 4 [20 pts]**

Convert the following ER diagram into relational schemas, see Figure 2 within this document.

Make sure to denote foreign keys by drawing the arrows and include the data types for each attribute, e.g. R(id:int, name:str, ...).

