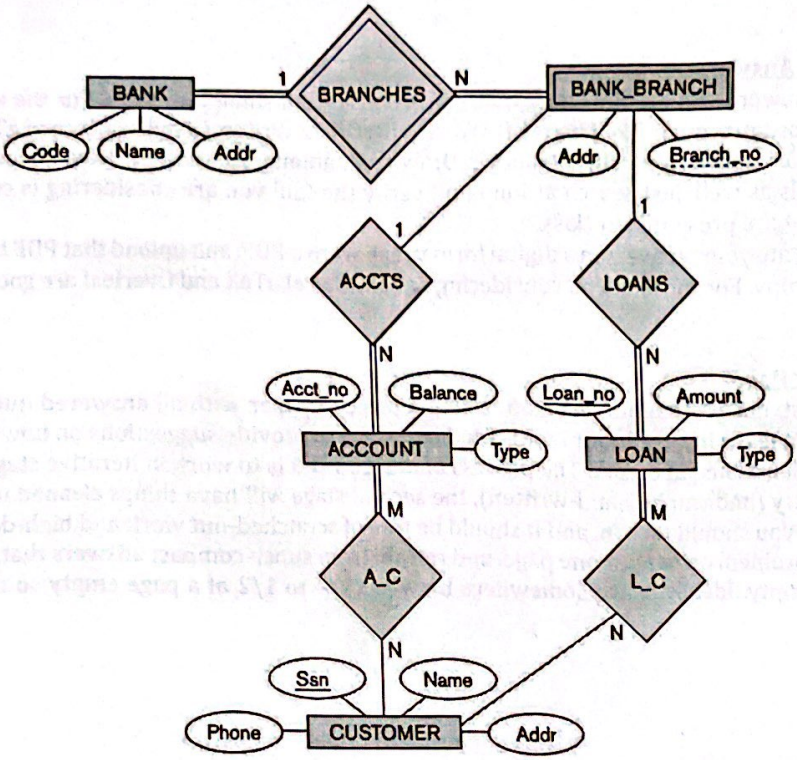
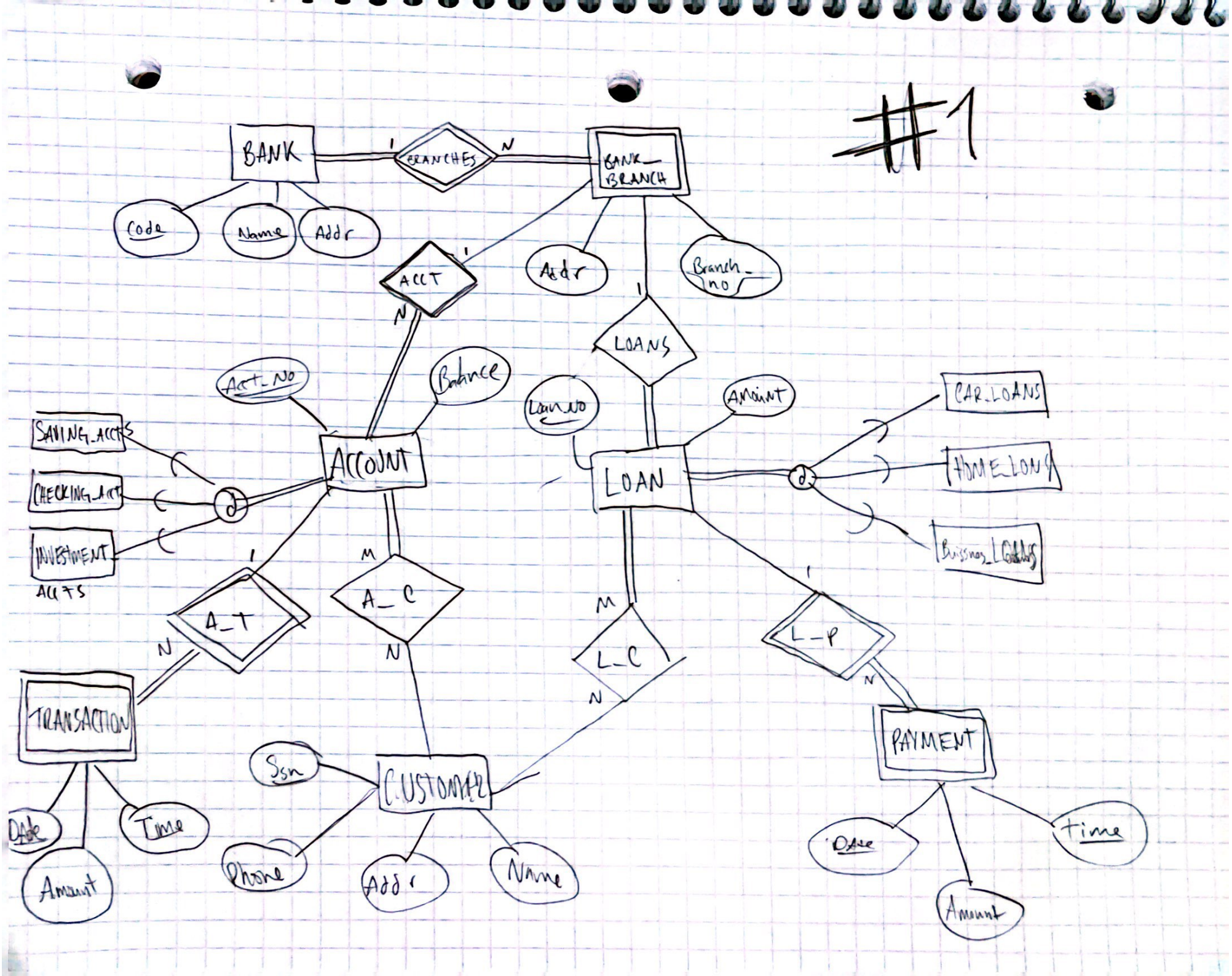
Problem 1 [15 points]

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.



On Separate Sheet



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.
There are no constraint violations, and the relation state will be updated in a new tuple.

b) Insert <'ProductA', 4, 'Bellaire', 2> into PROJECT.
There is a Referential integrity Violation: There is no tuple in department w/ Dnumber = 2. The Remedy is Reject operation.

c) Insert <'Production', 4, '943775543', '2007-10-01'> into DEPARTMENT.
Key Constraint Violation: no tuple in Department w/ Dnumber = 4. The Remedy is to auto increment Dnumber until it finds an unused variable

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'.

On Separate Sheet

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'.

d) Referential Integrity Violation:
- There is no tuple in Employee with that particular social security number.
- Remedy is to reject the operation.

Entity Integrity Violation:
- a null value cannot be matched up with PNO because it is part of a key
- the Remedy is to Reject the operation

e) There is no constraint Violations.

f) There is no constraint violations.

g) Referential Integrity Violations:
- there are an Employee in 2 seperate sections.
- Remedy is to reject the operation

h) Referential Integrity Violation:
- there exists tuples in WORKS_ON
- Reject the wholeoperation.

i) No constraint Violation

j) no Constraint Violations

k) no Constrain Violations.

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
ORDER.Cust #	CUSTOMER.Cust #
ORDER_ITEM.Order #	ORDER.Order #
ORDER_ITEM.Item#	ITEM.Item #
SHIPMENT.Order #	ORDER.Order#
SHIPMENT.Warehouse#	WAREHOUSE.Warehouse#

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, ...).