

# 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**


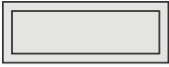
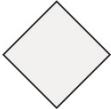
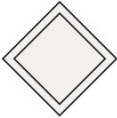


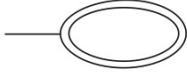
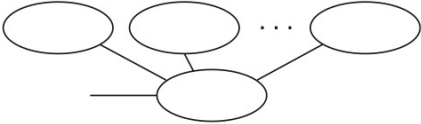

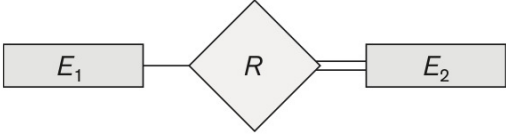
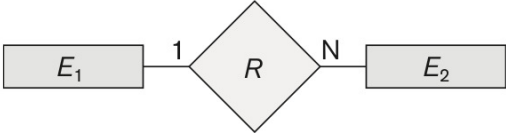
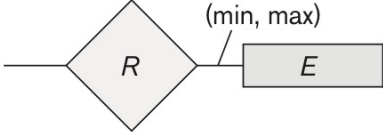
In the past, many students turned in a single piece of paper with all answered questions smooshed onto it. This did not leave my grader or I with adequate room to provide suggestions on how a design could be improved nor explanations on errors. The process of design work is to work in iterative stages: 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/>

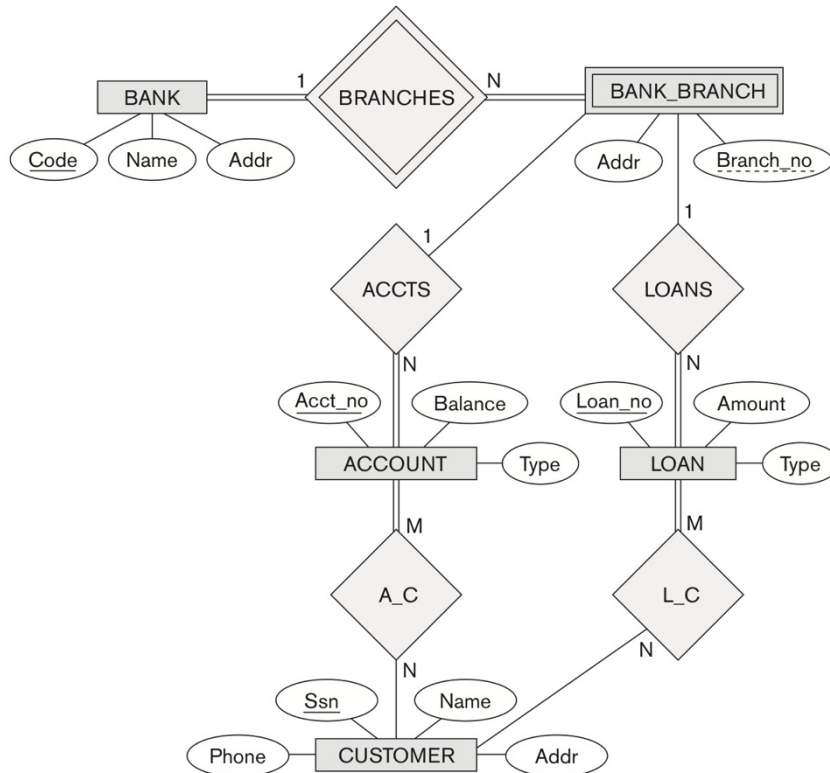
**Problem 1 [22 pts]**

Complete the following notation table for ER diagrams.

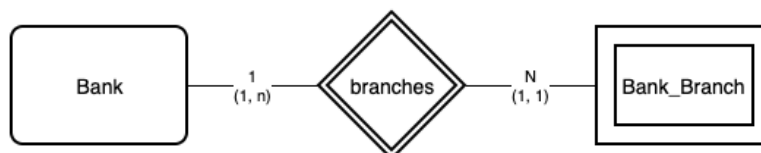
Symbol	Meaning
	<i>entity</i>
	<i>weak entity</i>
	<i>Relationship</i>
	<i>e.g. identifying relationship</i>
	<i>attribute</i>
	<i>Key attribute</i>
	<i>multivalued attribute</i>
	<i>Composite attribute</i>
	<i>Derived attribute</i>
	<i>Total Participation of E2 in R</i>
	<i>Cardinality of 1:N for E1:E2 in R</i>
	<i>Structural constraint on participation of E in R.</i>

## Problem 2 [20 pts]

Consider the ER diagram shown below for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans.



- List the strong entity types in the ER diagram. [5] **BANK, ACCOUNT, CUSTOMER, LOAN**
- Is there a weak entity type? [10]
  - If so, give its name, partial key, and identifying relationship. **BANK-BRANCH, BranchNo., BRANCHES**
  - If so, specify the context (meaning) that the partial key and the identifying relationship of the weak entity type convey in this diagram.
- List the names of all relationship types, and specify the (min, max) constraint on each participation of an entity type in a relationship type. Justify your choices. [5]
  - Example)** A bank should have at least one branch and up to  $n$  branches (thus  $(1, n)$ ) and a bank branch can only belong to a single particular bank since no two banks should own a single branch together (thus  $(1, 1)$ ).



Digitally produced via draw.io using the "Entity-Relation" Module.

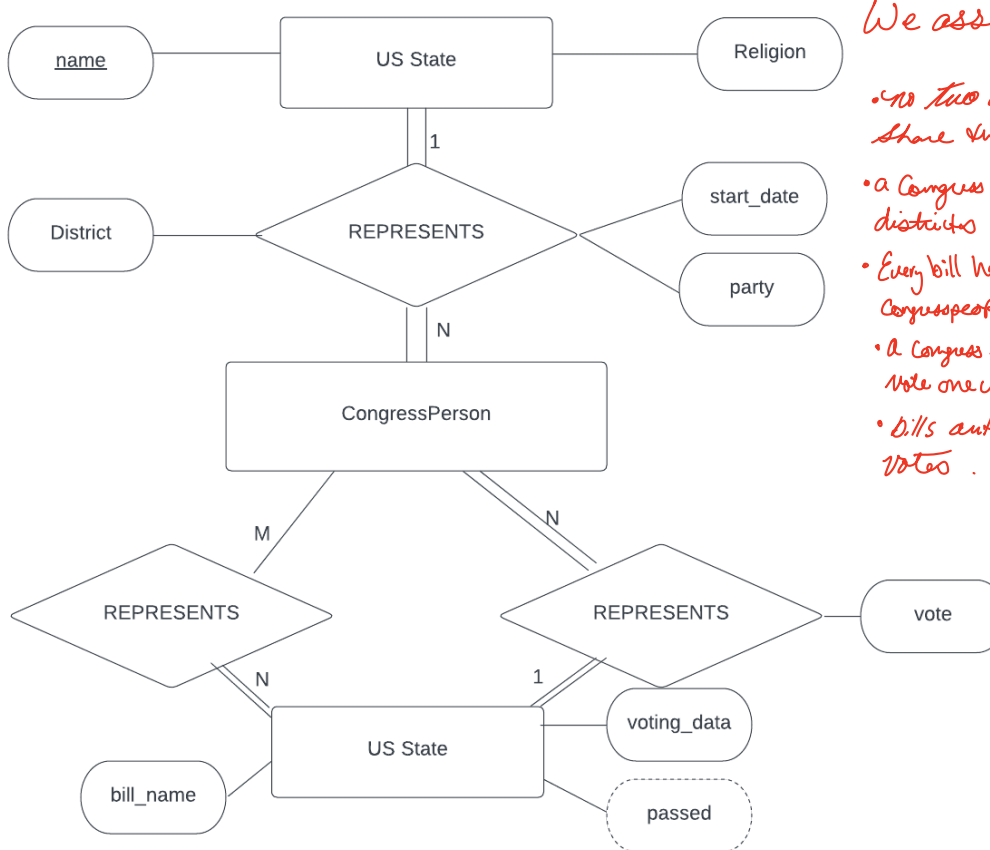
- a loan can be signed by 1 person or signed for up to  $n$  people
- a customer can have any specific number of loans
- a loan only has one branch attached to it but a branch can have many loans
- an account can belong between 1 &  $n$  people and any person can have 1 to  $n$  accounts.

BranchNo. may occur @ different banks. So you need bank code & branchno. in order to identify a bank branch.

### Problem 3 [ 28 pts]

Design an ER diagram for keeping track of information about votes taken in the U.S. House of Representatives during the current two-year congressional session. The database needs to keep track of each U.S. STATE's name (e.g., *Texas*, *New York*, *California*) and include the region of the state (whose domain is {*Northeast*, *Midwest*, *Southeast*, *Southwest*, *West*}). Each CONGRESS\_PERSON in the House of Representatives is described by his or her name, plus the district represented, the start\_date when the congressperson was first elected, and the political party to which he or she belongs (domain of {*Republican*, *Democrat*, *Independent*, *Other*}). The database keeps track of each BILL (i.e. proposed law), including the bill\_name, the voting\_date on the bill, whether the bill passed (domain of {*Yes*, *No*}), and the sponsor (the congressperson(s) who sponsored - that is, proposed - the bill). The database also keeps track of how each congressperson voted on each bill (domain of {*Yes*, *No*, *Abstain*, *Absent*}).

Draw an ER schema diagram for this application. Clearly state any assumptions you make.



*We assume . . . .*

- no two congress people share the same name*
- a Congress person can switch districts*
- Every bill has to be sponsored but Congresspeople do not have to sponsor*
- A Congress person is only allowed to vote one way on a bill*
- Bills outcomes come from the votes .*

#### **Problem 4 [30 pts]**

Design ER model specifying key attributes, entity types, relationship types (1:1, 1:N, M:N), and structural constraints (partial or total participations). Make your assumptions and state them (if any). Choose appropriate attributes if not given as part of the requirement analysis.

Consider the following requirements for a University Accommodation Office:

1. Each hall of residence has a name, number, address, telephone number and a hall manager who supervises the operation of the hall. The halls provide only single rooms which have a room number, place number and weekly rent rate. The total number of rooms provided by each residence hall should be able to be computed on the fly.
2. The place number uniquely identifies each room in all of the halls and is used when renting a room to a student.
3. Students may rent rooms throughout the academic year for various periods of time. The data regarding rooms currently rented include the lease number, date that the students started rent period and date that the student wishes to terminate the rent period.
4. Information regarding an undergraduate student includes student ID, name (first, middle, last), home address (street, city, state, zipcode), date of birth, category of student (e.g. freshman, sophomore).
5. The total number of students living in each hall should be able to be computed.
6. Information about a student's emergency contact is stored, including name, relationship, address, and contact number.

