

ITCS 3160-081 Database Design & Implementation

Summer 2021 Final Exam

REMEMBER:

- **Resources permitted:** the textbook, your notes, the resources I posted on Canvas, asking me (Dr. Berardinelli) a question via Campuswire
- **Resources NOT permitted:** other online tools like Google, Stack Overflow, sites that will answer the questions for you; other humans including classmates and non-classmates

Problem 1: A data science team wants to analyze the performance of professional baseball teams against the economic indicators for the region where the team plays their home games. The researchers will be using *MSA*, or metropolitan statistical area, to identify each team's region. They will use statistics about the top 20 industries in that MSA, as well as GDP per capita, in their first round of analysis, when they will only be looking at end-of-season results for each baseball team.

Use the ERD on page 5 of this document, with the context given above, to answer the questions below.

- (A) Write a SQL query to show the full team name and the number of wins in the 2020 season for each team.
- (B) Write a SQL query to add the GDP per capita for Charlotte in 2017, which was 58,064. Charlotte's MSA ID is 16740.
- (C) Write a SQL query to show the description of *every* MSA in the database, along with the league, division, and full team name of any teams within the MSA.
- (D) Write a SQL query to create the **TEAM** table. Each team will have a three letter code that identifies them (examples: PIT, NYY), will be in one of two leagues (NL or AL are the only possible values), and will be in one of three divisions (East, West, and Central are the only possible values).
- (E) Write a SQL query to show the average GDP per capita in Charlotte for the years 2010-2020.
- (F) Write a SQL query to show the year, value, and industry for all industry earnings entries from Charlotte in 2019.

Problem 2: You have been hired by a new startup as their database designer and administrator. The startup is a new airline hoping to disrupt the current state of the air travel industry. They will need to be able to keep track of customer contact and billing information and the schedule of flights offered. The company needs to know information about each plane in their fleet, including manufacturer and technical specifications, as well as which flight paths the plane is scheduled to fly, including flight crew information, origin, destination, schedule, and customers who have purchased tickets for the flight. The company also intends to use advanced analytics, supported by the data stored in this database, to optimize their offering of flights. They are looking to grow strategically, in terms of number of flights, times of flights, different origins and destinations, sizes of aircrafts, etc.

(A) Draw the entity-relationship diagram for this database application using the Crow's Foot model. To save time and space, do *not* include attributes in your diagram – only entities and relationships.

(B) List five use cases for this database application.

You must clearly identify the following components of each use case: (1) the user and (2) the “goal,” which is a one-sentence descriptive title for precisely what must be accomplished in this use case.

Example: “A student views their schedule for a specific semester.” might be a use case for Self-Service Banner. The user is underlined and the entire sentence is the goal.

Problem 3: Below is a relation for a database system that tracks tutors and tutoring sessions.

SESSION(TutorID, StudentID, TutorName, StudentName, SessionDate,
CourseID, SessionNotes, SessionStartTime, SessionLength,
SessionLocation)

Assumptions:

- Tutoring sessions are always done one-on-one.
- Students can only seek tutoring for courses in which they are currently enrolled.
- The same student and tutor might meet multiple times to cover material from the same course.

(A) What is the primary key of this relation?

(B) List all one- and two-attribute candidate keys for this relation.

(C) List all functional dependencies for this relation.

(D) Is this relation in Boyce-Codd Normal Form (BCNF)? If not, rewrite it so that it is in BCNF.

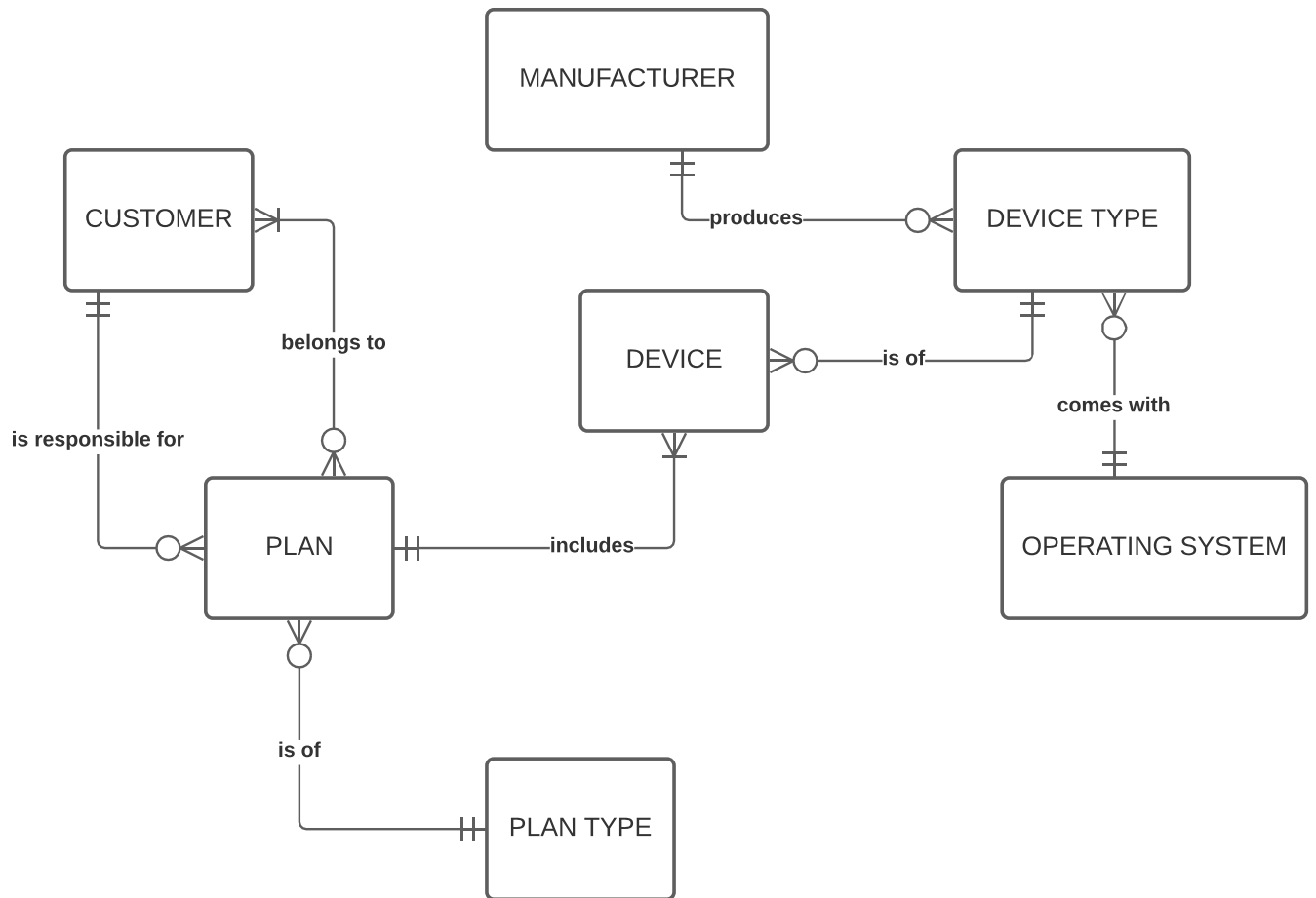
Problem 4:

- (A) What does DBMS stand for? Briefly explain what a DBMS is for and give one example.
- (B) What does ACID stand for? Briefly explain what ACID means in the context of databases.
- (C) What does SDLC stand for?

Problem 5: Use the ERD provided on page 4 of this document to answer the questions below.

The ERD is for a database that stores information about customers of a cell phone company, including the plans they pay for, the services on those plans, and the devices they use to access those services.

- (A) List all relationships in the diagram provided. For each relationship, be sure to include the names of the entities involved, the name of the relationship, and the cardinality of each relationship.
- (B) List all of the linking tables (aka association tables or intersection tables) that need to be added in order to transform this diagram into a physical relational data model.
- (C) List all foreign keys that need to be added in order to transform this diagram into a physical relational data model. For each foreign key, be sure to include the table that the key needs to be added to, and the table that the key is referencing.



Baseball-Economics ERD

