

Homework 01: Data Modeling

CS 355 Database Systems
Habib University
Fall 2025

1 Instructions

- The deadline for submitting this Homework is 1st October 2025, 11:59 PM.
- You may submit it by 2nd October 2025, 11:59 PM with a 20% penalty.
- This homework must be submitted online via CANVAS.
- You are required to submit a **single pdf** which contains the solutions of all 3 questions.
- This homework will be done in pairs. Please ensure that both the members have joined the same team on Canvas. **If your team does not correspond with your group name on Canvas, then your submission will not be graded.**
- The pdf file should be named HW_01_team_XX.pdf where XX will be replaced with your respective team number on Canvas.
- *Files that don't follow the appropriate naming convention will not be graded.*

1.1 Marking scheme

This Homework will be marked out of 100.

- 30 Marks are for Normalization
- 40 Marks are for Orchard ERD
- 30 Marks are for Khaadi ERD

1.2 Submission Guidelines

- Models can be developed in DB Designer or any Database Diagram tool that can generate a schema.
- **No handwritten submissions will be accepted**
- If you make any assumptions regarding the scenario, clearly state them in your pdf document. **Your assumptions should not contradict the actual scenario.**

1.3 Late submission policy

Refer to the course syllabus for the late submission policy.

1.4 Use of AI

Taking help from any AI-based tools such as ChatGPT is strictly prohibited and will be considered plagiarism.

1.5 Viva

Course staff may call any student for Viva to provide explanation for their submission.

2 Objective

The purpose of this homework is to enable students to analyze real-world business specifications and construct their data model. This skill helps them build the data management system of any business entity.

3 Questions

Question 01 - Normalization

Imagine you are employed as a Data Analyst at Habib University responsible for managing students' extracurricular activities information. A student can be a part of multiple extracurricular activities. Each of these activities are scheduled at different timings. During each time slot, there is always an Activity Lead who overlooks all the participating students in that group. A student can attend any of the time slots, as per their availability, so no specific slot will always have the same set of students. The university administration is using a table to store this information. Some of the rows from that table are given in Figure 1 for reference.

- Please analyze the provided extracurricular activities data table, and derive a relation schema for it in 1NF, by specifying the primary keys. Give reasons for choosing the primary keys.
- Identify full, partial, and transitive functional dependencies that exist among its attributes. If there are no dependencies, please state that explicitly.
- Normalize the schema up to the Third Normal Form (3NF) by creating new tables. Provide schemas for 2NF, and 3NF.

StudentID [PK]	StudentName	DOB	Year	Activity	Activity Type	Activity Timings	ActivityLead	ActivityJoiningDate	ActivityLevel	GuardianID	GuardianName	GuardianContact
101	Ammara Javed	13-02-2005	1st	Basketball	Sports	Morning	Mr. X	31-08-2024	Intermediate	1	Javed Jaffrey	555-1234
102	Bilal Syed	22-08-2004	2nd	Drama Club	Performance	Afternoon	Mr. Y	15-09-2024	Beginner			
103	Coding Club	Hobby	Morning	Mr. A						2	Mariam Syed	555-5678
104	Chess Club	Educational	Afternoon	Mr. B								
105	Debate	Performance	Evening	Mr. C								
106	Football	Sports	Morning	Ms. D								
107	Robotics	Educational	Afternoon	Ms. E								
108	Robotics	Performance	Evening	Mr. F								
109	Robotics	Debate	Morning	Mr. G								
110	Robotics	Cooking Club	Afternoon	Mr. H								
111	Robotics	Debate	Evening	Mr. I								
112	Robotics	Drama Club	Morning	Ms. J								
113	Robotics	Cooking Club	Afternoon	Mr. K								
114	Robotics	Debate	Evening	Mr. L								
115	Robotics	Drama Club	Morning	Ms. M								
116	Robotics	Cooking Club	Afternoon	Mr. N								
117	Robotics	Debate	Evening	Mr. O								
118	Robotics	Drama Club	Morning	Ms. P								
119	Robotics	Cooking Club	Afternoon	Mr. Q								
120	Robotics	Debate	Evening	Mr. R								
121	Robotics	Drama Club	Morning	Ms. S								
122	Robotics	Cooking Club	Afternoon	Mr. T								
123	Robotics	Debate	Evening	Mr. U								
124	Robotics	Drama Club	Morning	Ms. V								
125	Robotics	Cooking Club	Afternoon	Mr. W								
126	Robotics	Debate	Evening	Mr. X								
127	Robotics	Drama Club	Morning	Ms. Y								
128	Robotics	Cooking Club	Afternoon	Mr. Z								
129	Robotics	Debate	Evening	Mr. A								
130	Robotics	Drama Club	Morning	Ms. B								
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143	Robotics	Cooking Club	Afternoon	Mr. O								
144	Robotics	Debate	Evening	Mr. P								
145	Robotics	Drama Club	Morning	Ms. Q								
146	Robotics	Cooking Club	Afternoon	Mr. R								
147	Robotics	Debate	Evening	Mr. S								
148	Robotics	Drama Club	Morning	Ms. T								
149	Robotics	Cooking Club	Afternoon	Mr. U								
150	Robotics	Debate	Evening	Mr. V								
151	Robotics	Drama Club	Morning	Ms. W								
152	Robotics	Cooking Club	Afternoon	Mr. X								
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24												

Question 02 - Orchard ERD

A fruit orchard company manages multiple orchards across different regions of Pakistan. Each orchard specializes in cultivating a variety of fruits (e.g., mango, orange, apple, guava, etc). Each orchard has a location (city, province) and is managed by a designated orchard manager.

Every orchard must hold a government-issued license to operate. Each orchard has exactly one license, and each license belongs to exactly one orchard. For each license, the system records the license ID, issue date, and expiry date.

Every orchard is divided into multiple plots of land. Each plot is used to cultivate exactly one type of fruit, but the same fruit may be grown in different plots (sometimes even within the same orchard). Each plot has information about its soil type, area (in acres), and year it was first cultivated.

Each fruit type has details such as fruit name, season, and average yield per acre. Fruits are harvested multiple times in a year. For each harvest, the system keeps track of the date, the quantity harvested (in kg), and the plot it came from.

The orchard company employs multiple workers. Each worker is assigned to one orchard but may be rotated between different plots within that orchard. Workers can be specialized (e.g., irrigation, pesticide application, harvesting), and the system stores each worker's name, CNIC, contact, and specialization. Workers are supervised by orchard managers, but an orchard manager may supervise multiple orchards.

The company sells fruits in bulk to different buyers (wholesalers, retailers, and/or exporters). For each sale, the system stores the buyer details (name, type, contact), the fruit type sold, the quantity sold, the price per kg, and the date of sale. Sometimes, a single sale can include multiple fruit types.

Management is interested in generating the following reports:

- Annual yield per fruit type per orchard
- Which orchard produces the most fruit of a given type
- Productivity of workers in terms of harvested quantity
- Sales trends of different fruit types across years
- The contribution of each orchard to total revenue

- Expiring orchard licenses in the upcoming year

Based on the above scenario, construct an Entity-Relationship Diagram (ERD) that includes:

- Entities with appropriate attributes (identify primary keys and foreign keys).
- Relationships among entities with appropriate cardinalities.
- Any assumptions you make to clarify ambiguities in the scenario.

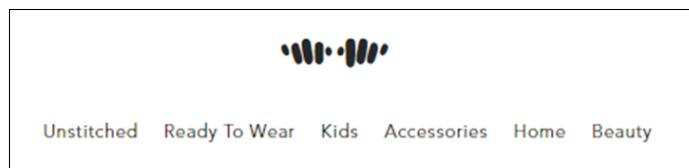
Question 03 - Khaadi ERD

Khaadi is one of the most popular fashion brands in Pakistan. You have been assigned the task of designing a data model for their online product catalog. The business details are provided below. Your task is to construct a normalized data model that includes:

- Entities, attributes, primary keys (PKs), and foreign keys (FKs)
- Relationships and their cardinalities

Business Details

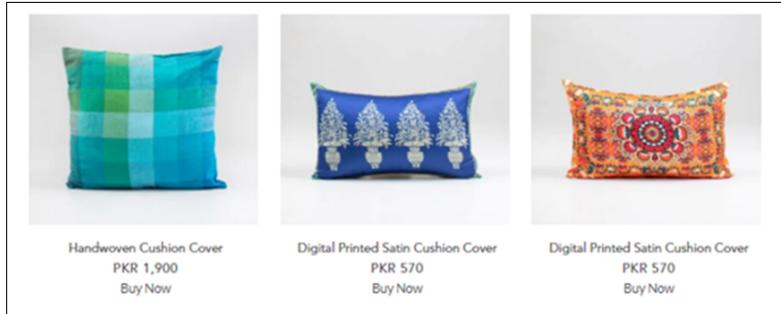
Khaadi's catalog is organized into various departments as is evident from their website:



Each department contains multiple categories and sub-categories. A category can belong to multiple departments. A sub-category can belong to multiple categories.

Unstitched	Ready To Wear	Kids	Accessories	<u>Home</u>	Beauty
Bedroom	Bathroom	Dining Room	Cushion Covers	Kids Collection	
Bed Covers	Shower Curtain	Table Covers	Digital Printed	Bed Sheets	
Bed Sheets	Towels	Table Runners	Embroidered	Cushion Covers	
Duvet Covers		Placemats	Handwoven	Duvet Covers	
Foot Mats		Hot Plates		Fitted Sheet	
Floor Runners		Coasters		Towels	
Pillow Covers		Roti Cloth			
Placemats					
Fitted Sheets					

When a category is selected, the products associated with that category are displayed.



Clicking on a product reveals further details, including the product title, SKU, price, description, size, material, color, and quantity in stock. Certain products are available in multiple sizes, and the system tracks the stock level for each size. If a product is available in multiple sizes, they share the same SKU. The price of a product does not change with size.

A detailed product page for an 'Embroidered Kurta'. The top section shows a model wearing the kurta, the title 'Embroidered Kurta', the price 'PKR 1,824', and the SKU 'SKU BKE19401-Blue'. Below this are four smaller images of the kurta from different angles. A 'Size' section shows options: 2-to-3 (crossed out), 3-to-4, 4-to-5, 5-to-6 (crossed out), 6-to-7, 7-to-8, 8-to-9, 9-to-10, 11-to-12, and 10-to-11. A 'Quantity' selector shows '1'. Below that are 'ADD TO CART' and 'SIZE CHART' buttons. Further down are sections for 'Description' (labeled 'Embroidered Kurta'), 'Details' (Material: Khaddar, Color: Blue), and 'Order by' (phone icon) and 'Share' (social media icons).

Throughout the year, different sales events are launched. During these sales, selected products are offered at discounted prices. To set up a sale, the system specifies a timeline (start and end dates), the products included in the sale, and the percentage discount applied to each product. Not all

products are required to be part of a sale, and different products may have different discount percentages.