

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
Sessional Examination, September 2025
M.Tech. in Data Science, Semester – I
6CS302CC25 – Data Science System Design

Roll /
Exam No. 25MCD0005

Supervisor's Initial
with Date

Time: 2 Hours

Max Marks :50

- Instructions: 1. Attempt all questions.
2. Figure to right indicate full marks
3. Draw neat sketches wherever necessary.
4. Assume necessary data wherever required, and indicate clearly.

Q.1 Answer the following

[14]

CO1

- (A) Explain Data Science, and Data Science System . Briefly explain (8)
BL1 key components of Data science systems.
- (B) A hospital wants to reduce patient readmissions. Someone suggests (6)
BL6 using ML to predict whether a patient will be readmitted within 30 days after discharge. They think they can train a model on past patient records (age, diagnoses, treatments, length of stay, etc.). After training the model, they want to flag high-risk patients at discharge so doctors can schedule extra follow-ups. How should they frame their problem in ML terms?

Q.2 Do as Directed

[18]

CO3

- (A) A batch data pipeline performs heavy feature engineering and feeds (6)
BL3 a feature store for model training. Which of following two system designs is better in terms of availability? Justify you answer by comparing availability of single worker as well as availability of total pipeline.

System A: Three worker nodes working in parallel with same capability, where each worker node fails once every 5000 hours of operation approximately. When a failure occurs, it takes about 20 hours to detect, repair, and restore.

System B: Five worker nodes working in parallel with same capability, where each worker node fails once every 10000 hours of operation approximately. When a failure occurs, it takes about 100 hours to detect, repair, and restore.

- (B) A data science team deploys a machine learning model inference service on a single server, which handles up to 500 inference requests per second. During peak hours, the incoming request rate can reach 1500 requests per second. Answer following questions with respect to this system design with necessary diagrams (6)
- BL6
- What is the scalability limitation of the current system?
 - Suggest a horizontal scaling solution to handle the peak load.
 - Propose system design with additional components to improve scalability further.
- (C) A company has deployed a recommendation system for an e-commerce platform. The system collects user interactions in real-time and updates product recommendations. If the system is distributed across multiple data centers, how would the CAP theorem (Consistency, Availability, Partition tolerance) influence your design choices for the recommendation system? Which trade-offs would you make and why? (6)
- BL2

Q.3 Do as Directed

[18]

CO4

- (A) A fashion retail company has a machine learning model that predicts whether a clothing item will be “in fashion” next season. Multiple clients need to use this service: (6)
- BL4
- Mobile app: quick predictions, minimal data transfer
 - Web dashboard: flexible queries with detailed analytics
 - Internal system: batch predictions for inventory
- Which API style would you choose for exposing the prediction service: REST or GraphQL? Justify your choice based on the client requirements.
- (B) A hospital system has built a machine learning model to predict patient risk for complications based on medical records, lab results, and real-time monitoring devices (e.g., heart rate, blood pressure). Data sources include: (6)
- BL2
- Electronic Health Records (EHRs) – updated daily
 - Lab test results – updated every few hours
 - Real-time monitoring devices – continuous data streams
- The hospital wants to update patient risk scores for doctors and dashboards. Should the hospital use batch processing or stream processing or hybrid approach to update patient risk scores? Justify your choice.
- (C) Explain Cross Industry standard process for Data Mining with help of suitable diagram (6)
- BL1