Subject Code: KDS071

PAPER ID-310330

Roll No:

BTECH
(SEM VII) THEORY EXAMINATION 2023-24
ARTIFICIAL INTELLIGENCE

TIME: 3 HRS **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

Q no.	Question	Marks
a.	What is convex optimization, and why is it important in the context of artificial intelligence and machine learning?	2
b.	Explain Duality in Artificial Intelligence.	2
c.	What is the fundamental principle behind gradient-based methods in optimization?	2
d.	Explain the concept of gradient descent. How does it work, and what role does the gradient of the objective function play in finding the optimal solution?	2
e.	Explain the concept of Augmented Lagrangian methods.	2
f.	What is the significance of monotone operators in operator splitting methods?	2
g.	What is Langevin dynamics?	2
h.	Discuss the challenges associated with escaping saddle points in nonconvex optimization problems.	2
i.	Describe a situation where the use of dual optimization methods was beneficial in solving a machine learning problem.	2
j.	Can you discuss a practical use case where nonconvex optimization techniques were employed in machine learning?	2

SECTION B

2. Attempt any *three* of the following: 10 x 3= 30

a.	How does the choice of a specific convex program (e.g., LP, SOCP, SDP) depend on the nature of the optimization problem? Provide insights into when each type of program might be preferred.	10
b.	Explain the concept of Moreau–Yosida regularization and its role in smoothing non-smooth functions. How does it contribute to the convergence of optimization algorithms?	10
c.	What is operator splitting methods in optimization, and how do they differ from traditional optimization approaches?	10
d.	What distinguishes stochastic optimization from deterministic optimization, and why is it particularly relevant in machine learning and large-scale data scenarios?	10
e.	Describe a scenario where the alternating direction method of multipliers (ADMM) was applied to optimize a machine learning model.	10

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SECTION C

3. Attempt any *one* part of the following: 10 x 1= 10

a.	What are the Karush-Kuhn-Tucker (KKT) conditions in the context of convex optimization? How do they help characterize optimal solutions?	10
b.	Provide examples of convex programs, including linear programming (LP), second-order cone programming (SOCP), and semidefinite programming (SDP). How do these differ in terms of their constraints and objectives?	10

4. Attempt any *one* part of the following: 10 x 1= 10

a.	Provide an overview of the Frank–Wolfe method. How does it optimize convex functions with linear constraints, and what are its applications in real-world problems?	10
b.	What is the role of ordinary differential equations (ODE) interpretations in understanding and analyzing optimization methods? Provide an example where ODE interpretations are beneficial.	10

5. Attempt any *one* part of the following: 10 x 1= 10

a.	Provide an overview of the alternating direction method of multipliers (ADMM). How does it handle separable convex optimization problems, and in what scenarios is it particularly effective?	10
b.	Provide an example where the Douglas–Rachford splitting method is well-suited and explain the specific characteristics of the problem that make it a suitable choice.	10

6. Attempt any *one* part of the following: 10 x 1= 10

a.	Describe the stochastic variance reduced gradient (SVRG) method. How does it handle the variance in gradient estimates, and what advantages does it offer in optimizing large-scale problems?	10
b.	Provide an overview of Polyak–Juditsky averaging. In what contexts is it beneficial in stochastic optimization, and how does it contribute to improved convergence?	10

7. Attempt any *one* part of the following: 10 x 1= 10

a.	Describe a real-world application where the use of augmented Lagrangian methods enhanced the optimization of a machine learning model.	10
b.	Can you share a practical use case where a specific optimization technique was applied to address a real-world problem?	10

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