Here are **50 multiple-choice questions (MCQs)** of all levels (easy, medium, hard) based on your uploaded document on **Vector Norms**.

🟢 **Easy Level (1–20)**

1. **What is a vector norm?**
    A) A scalar product
    B) A function returning the magnitude of a vector
    C) A function that returns the direction of a vector
    D) A matrix product
    Ans: B

2. **What does the L0 norm count?**
    A) All elements in a vector
    B) All zero elements
    C) All non-zero elements
    D) Square of elements
    Ans: C

3. **Which norm is also called the Mean Absolute Error?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) Max norm
    Ans: B

4. **Which norm is referred to as Euclidean distance?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) Squared L2 norm
    Ans: C

5. **Which norm returns the largest absolute value element in a vector?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) Max norm
    Ans: D

6. **The output of a vector norm is always:**
    A) Positive
    B) Negative
    C) Zero
    D) Complex

Ans: A

7. **Which vector norm does not involve a square root?**
   A) L1 norm
   B) L2 norm
   C) Squared L2 norm
   D) Max norm
   Ans: C

8. **Norm functions are derived from:**
   A) Loss functions
   B) Derivatives
   C) The p-norm equation
   D) Dot products
   Ans: C

9. **Which norm has the most computational simplicity for derivative calculations?**
   A) L2 norm
   B) L1 norm
   C) Squared L2 norm
   D) Max norm
   Ans: C

10. **What is the domain of the p in p-norm functions?**
    A) $p \geq 0$
    B) $p > 2$
    C) $p \geq 1$
    D) $p \leq 0$
    Ans: C

11. **The L2 norm is most commonly used because it represents:**
    A) Max error
    B) Manhattan distance
    C) Euclidean distance
    D) Hamming distance
    Ans: C

12. **Max norm is also referred to as:**
    A) Infinity norm
    B) Squared norm
    C) Zero norm
    D) Mean norm
    Ans: A

13. **In L1 norm, the output is computed using:**
    A) Sum of absolute values
    B) Sum of squares
    C) Max element

D) Count of non-zero elements
Ans: A

14. **L2 norm is also known as:**
    A) Mean squared error
    B) Manhattan norm
    C) Root mean squared error
    D) Infinity norm
    Ans: C

15. **The squared L2 norm simplifies calculations because:**
    A) It avoids absolute values
    B) It avoids logarithms
    C) It avoids square roots
    D) It avoids subtraction
    Ans: C

16. **Which of the following is not a vector norm?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) Dot product
    Ans: D

17. **Which norm is mostly used to measure model loss in regression?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) L-infinity norm
    Ans: C

18. **L1 norm varies:**
    A) Quadratically
    B) Exponentially
    C) Linearly
    D) Logarithmically
    Ans: C

19. **Norms are essential for which step in Machine Learning training?**
    A) Feature selection
    B) Hyperparameter tuning
    C) Loss computation
    D) Visualization
    Ans: C

20. **If a vector has all zero elements, its L2 norm is:**
    A) Infinity
    B) One

C) Zero
D) Undefined
Ans: C

🟡 Medium Level (21–40)

21. **What is the main drawback of the L2 norm in deep learning optimization?**
    A) Non-differentiability
    B) Harder gradient computation
    C) Too sparse
    D) Not smooth
    Ans: B

22. **The L0 norm is not a true norm because:**
    A) It returns complex numbers
    B) It is non-differentiable
    C) It doesn't satisfy the triangle inequality
    D) All of the above
    Ans: C

23. **Which norm is best when dealing with sparse data vectors?**
    A) L2 norm
    B) L1 norm
    C) Squared L2 norm
    D) L-infinity norm
    Ans: B

24. **When p approaches infinity, p-norm becomes:**
    A) Zero norm
    B) L1 norm
    C) L2 norm
    D) Max norm
    Ans: D

25. **Which norm is best suited for outlier-robust models?**
    A) L0 norm
    B) L1 norm
    C) L2 norm
    D) Squared L2 norm
    Ans: B

26. **The p-norm with p=1.5 is:**
    A) Undefined
    B) Equal to L2 norm
    C) Valid and smooth

D) Equal to L0 norm
Ans: C

27. **Which of the following norms leads to non-smooth optimization surfaces?**
    A) L1 norm
    B) L2 norm
    C) L-infinity norm
    D) Squared L2 norm
    Ans: A

28. **Squared L2 norm is preferred when:**
    A) Accuracy is needed
    B) Storage of gradient is prioritized
    C) Max value is of interest
    D) All vector elements are zero
    Ans: B

29. **Which norm leads to Manhattan distance interpretation?**
    A) L0
    B) L1
    C) L2
    D) Max
    Ans: B

30. **The shape of level sets of L2 norm is:**
    A) Square
    B) Ellipse
    C) Circle
    D) Diamond
    Ans: C

31. **The derivative of Squared L2 norm is:**
    A) Hard to compute
    B) Element-wise
    C) Requires the entire vector
    D) Zero
    Ans: B

32. **L1 norm encourages:**
    A) Large weights
    B) Overfitting
    C) Sparsity
    D) Randomness
    Ans: C

33. **The general p-norm equation involves:**
    A) Summing all elements
    B) Taking p-th power and root

C) Multiplying all elements
D) Subtracting elements
Ans: B

34. **Which norm works well for evenly distributed values?**
    A) L0
    B) L1
    C) L2
    D) L-infinity
    Ans: C

35. **Max norm is useful in scenarios needing:**
    A) Robustness to all changes
    B) Uniform thresholds
    C) L0 sparsity
    D) Derivative accuracy
    Ans: B

36. **The p-norm with p = 0.5 is not used because:**
    A) Not positive definite
    B) Not convex
    C) Not differentiable
    D) All of the above
    Ans: D

37. **The L2 norm's root function makes it:**
    A) More robust
    B) More computationally expensive
    C) More sparse
    D) Non-convex
    Ans: B

38. **The equation of L2 norm is similar to:**
    A) Dot product
    B) Euclidean distance
    C) Manhattan distance
    D) Sum of squares
    Ans: B

39. **L-infinity norm is useful when we are interested in:**
    A) Outliers
    B) Smoothness
    C) High dimensional data
    D) The worst-case scenario
    Ans: D

40. **Which of these cannot be minimized using gradient descent directly?**
    A) L1

B) L2
C) L0
D) Squared L2
Ans: C

🔴 Hard Level (41–50)

41. **Which norm corresponds to a unit ball shaped like a diamond?**
   A) L2 norm
   B) L1 norm
   C) L-infinity norm
   D) L0 norm
   Ans: B

42. **What does the triangle inequality ensure in normed spaces?**
   A) Norms stay positive
   B) Distance function remains symmetric
   C) Norms are non-zero
   D) Norm(x + y) ≤ Norm(x) + Norm(y)
   Ans: D

43. **In regularization, L1 is preferred when:**
   A) Few features are important
   B) All features are important
   C) Outliers dominate
   D) Computation must be fast
   Ans: A

44. **Which norm violates differentiability at zero?**
   A) L1
   B) L2
   C) Squared L2
   D) Max norm
   Ans: A

45. **Which of the following is convex?**
   A) L0 norm
   B) p-norm for p ≥ 1
   C) Squared L0 norm
   D) All of them
   Ans: B

46. **A vector norm must satisfy all except:**
   A) Positivity
   B) Homogeneity

C) Linearity
D) Triangle inequality
Ans: C

47. **Which of the following norms is typically non-convex?**
    A) L1
    B) L2
    C) L0
    D) Max
    Ans: C

48. **Max norm is insensitive to:**
    A) Sum of values
    B) Largest entry
    C) Dimension
    D) L1 penalty
    Ans: A

49. **Which is true about p-norm as p increases?**
    A) It becomes smoother
    B) It approximates the max norm
    C) It approximates the L1 norm
    D) It approaches 0
    Ans: B

50. **Norms are central in optimization because they:**
    A) Are differentiable
    B) Can represent loss
    C) Are all convex
    D) Represent vectors
    Ans: B