Data Science in Health and Physiology

Data Science · Answer Key · 12 Questions

1. In genomic data science, what is the primary purpose of a Manhattan plot in a Genome-Wide Association Study (GWAS)?

A) To visualize protein folding structures
B) To represent the physical density of neurons in the brain
C) To display the statistical significance of single-nucleotide polymorphisms across the genome
D) To map the blood flow velocity through the carotid arteries

2. Which machine learning technique is most frequently utilized for the automated classification of histopathological images to detect malignancy?

A) Convolutional Neural Networks
B) Linear Regression
C) K-means clustering
D) Principal Component Analysis

3. In the context of processing EEG data, what does the 'Nyquist-Shannon sampling theorem' dictate regarding signal acquisition?

A) The sampling rate must be at least double the highest frequency component of the signal
B) The resolution must exceed 24 bits for neuro-imaging
C) The ambient temperature of the sensor must be below 20 degrees Celsius
D) The electrode impedance must be higher than 10 megaohms

4. When analyzing human metabolic pathways via Flux Balance Analysis (FBA), what is the objective function typically designed to optimize?

A) The total caloric intake of the subject
B) The rate of biomass production
C) The speed of neural signal transmission
D) The oxygen saturation level in the blood

5. What is the primary function of the 'ReLU' activation function in deep learning models applied to medical image recognition?

A) To normalize input pixel values to a zero mean
B) To introduce non-linearity by outputting zero for negative input values
C) To prevent overfitting in small clinical datasets
D) To compress high-dimensional feature maps

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6. Which statistical method is specifically used in bioinformatics to correct for multiple hypothesis testing when identifying differentially expressed genes?

A) Benjamini-Hochberg procedure
B) Standard deviation calculation
C) Simple linear correlation
D) Mode distribution analysis

7. In bioinformatics, what does the FASTA format primarily store?

A) Patient financial billing records
B) Nucleotide or amino acid sequences
C) Real-time heart rate variability data
D) MRI metadata and voxel density

8. What does the 'Area Under the ROC Curve' (AUROC) represent when evaluating a binary classifier's performance in disease screening?

A) The probability of a false positive rate exceeding 50%
B) The sensitivity relative to the inverse of the specificity across all thresholds
C) The average time to process a patient record
D) The variance of the diagnostic test result

9. Which data normalization technique is standard for comparing gene expression levels across samples sequenced at different depths?

A) TPM (Transcripts Per Million)
B) Celsius to Kelvin conversion
C) Linear scaling to 0-1
D) Logarithmic base 10 adjustment

10. In high-throughput drug screening, what is a 'Z-prime factor' used to measure?

A) The quality and robustness of an assay
B) The toxicity of a compound on human liver cells
C) The speed of neural synaptic firing
D) The latency of data transmission in hospital networks

11. What specific type of data structure is commonly used to represent metabolic networks where nodes are metabolites and edges are reactions?

A) Adjacency matrix
B) Linked list
C) Binary search tree
D) Hash map

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12. In the analysis of human posture data using accelerometers, what is the function of a Butterworth filter?

A) To convert analog signals to digital

B) To smooth data by removing high-frequency noise

C) To encrypt the biometric data for privacy

D) To label the activity as 'sitting' or 'standing'

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