Suggested topics for Project selection

1. Nine Ways to Implement the Binomial Method for Option Valuation in Python
Refer to the journal paper on SIAM Review, Vol. 44, No. 4, pp. 661-677.

2. Comprehensive List of Activation Functions and Their Applications
Research activation functions, such as ReLU, sigmoid, tanh, Leaky ReLU, GELU, ELU, and Swish. Discuss their mathematical formulations, use cases, and real-world appl ications.

3. Comparison of Optimization Techniques: Adam, L-BFGS-B, AdamW, GD, and SGD
Compare the performance, convergence speed, and computational complexity of differ ent optimization techniques on a benchmark dataset or problem.

4. Applications of PCA in Neural Networks
Investigate how Principal Component Analysis (PCA) aids in dimensionality reductio n, feature selection, and data preprocessing for neural networks.

5. Regularization Techniques in Neural Networks
Examine methods like L1/L2 regularization, Dropout, Layer Normalization, Batch Nor malization, and their effects on overfitting.

6. Exploring Transfer Learning with Pretrained Models
Fine-tune a pretrained model (e.g., ResNet) on a custom dataset and analyze its pe rformance.

7. Comparison of Loss Functions for Classification Tasks
Compare different loss functions like cross-entropy, hinge loss, and focal loss on the same dataset.

8. Recurrent Neural Networks (RNNs) and Their Applications
Implement an RNN to solve sequence prediction tasks and discuss limitations like v anishing gradients.

9. GANs: Understanding and Implementation
Present a Generative Adversarial Network (GAN) for generating synthetic images or data, algorithm and logic.

10. Comparing Frameworks: PyTorch vs. TensorFlow
Perform a detailed comparison by building and training the same neural network on both frameworks for a function approximation example.

11. Optimizing Neural Networks for Edge Devices

Study techniques like quantization and pruning to optimize neural networks for deployment on resource-constrained devices.

12. Diffusion models

Study how diffusion models can be used for image generations, denoising and other applications.

13. Reinforcement learning

Study on the principles of reinforcement learning, including key concepts like the exploration-exploitation trade-off, reward systems, and policy optimization. Also study how Q-learning or Deep Q-Networks works.

14. Neural Network Interpretability

Study the challenges and recent efforts on neural network Interpretability. You can survey on different approaches researchers have been exploring on this subject.

15. Attention Mechanisms

Examine how attentional mechanisms are being used in natural language processing or computer vision. Discussing their strengths and weaknesses and highlights how they perform in tasks such as question answering and object detection.

16. Data Augmentation

Discuss various data augmentation methods to improve model generalization. Explain the mathematical principles behind it and its limitations.

… to be continued