Roadmap s3:

Cycle 1:

1. **Data cleaning & EDA**
   Missing values, outlier handling
   Pandas for eda & plots
   Feature engineering-1
   Categorical encoding(one-hot, ordinal),scaling and normalisation
2.
   Feature engineering-2
   Feature selection(correlation, mutual information)
   Interaction features
   Linear regression
   Ordinary least squares
   Regularisation(ridge&lasso)
3. Evaluation metrics(mse, r2)
   Classification Basics
   Logistic Regression theory & sklearn
   Metrics: accuracy, ROC-AUC
   linear discrimnant analysis
4. **Decision trees**
   Tree structure & criteria
5. **Random forests**

   RF hyperparameters & feature importance

   k-Nearest Neighbors

Cycle-2:

6. **Bagging and boosting**

   XGBoost, Adaboost

7. **support vectors, SVM**

8. **SVD and related(on TF-IDF, PCA)**

9. **Unsupervised Learning**
   k-Means & hierarchical clustering
   Dimensionality reduction: PCA, t-SNE

10. **Model Validation & Selection**

   Cross-validation strategies
   Learning curves & bias-variance trade-off

Cycle 3:

   11. **Hyperparameter Tuning & Pipelines**
   GridSearchCV, RandomizedSearchCV
   Pipeline & ColumnTransformer, model serialization

   12. **Recommender Systems**
      Collaborative, content-based filtering

     Model Explainability
      SHAP/LIME intro & demos

   13. **Perceptron & Linear Classifier**

   14. **PyTorch Foundations**

   15. **Multi-Layer Perceptron (ANN) Scratch Build**

      MLP architecture, activations (ReLU, sigmoid,tanh)

      Backpropagation,vanishing gradients

Cycle-4:

   16. continuation to 15th day

   17. **Feed-Forward Networks in PyTorch**

      Loss functions, optimizers

   18. **CNN Basics**

   Conv mechanics (kernels, stride, padding), pooling,
   feature maps

   19. BatchNorm, Dropout and other functionalities in cnn

   20. Intro to rnn & attention