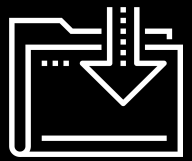
Ensemble Methods and Regressions

Data Boot Camp

Lesson 19.3



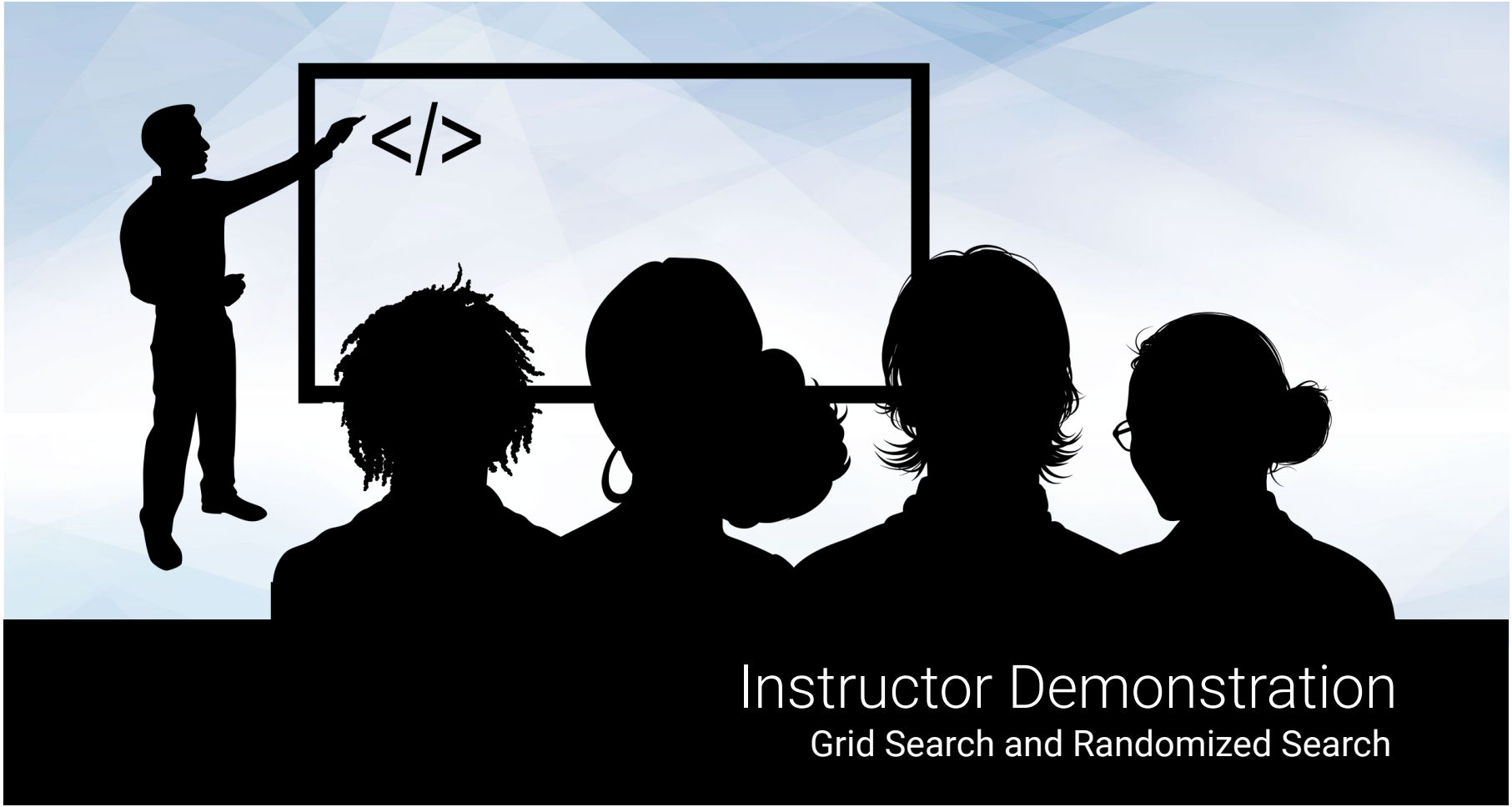
Class Objectives

By the end of this lesson, you will be able to:

Calculate and apply bagging and boosting methods to create and use ensemble algorithms.

Apply regularization parameters for regressions and select the appropriate parameters for a specified problem.

Use Random Forests and LASSO regressions to aid the feature selection process.



Instructor Demonstration

Grid Search and Randomized Search

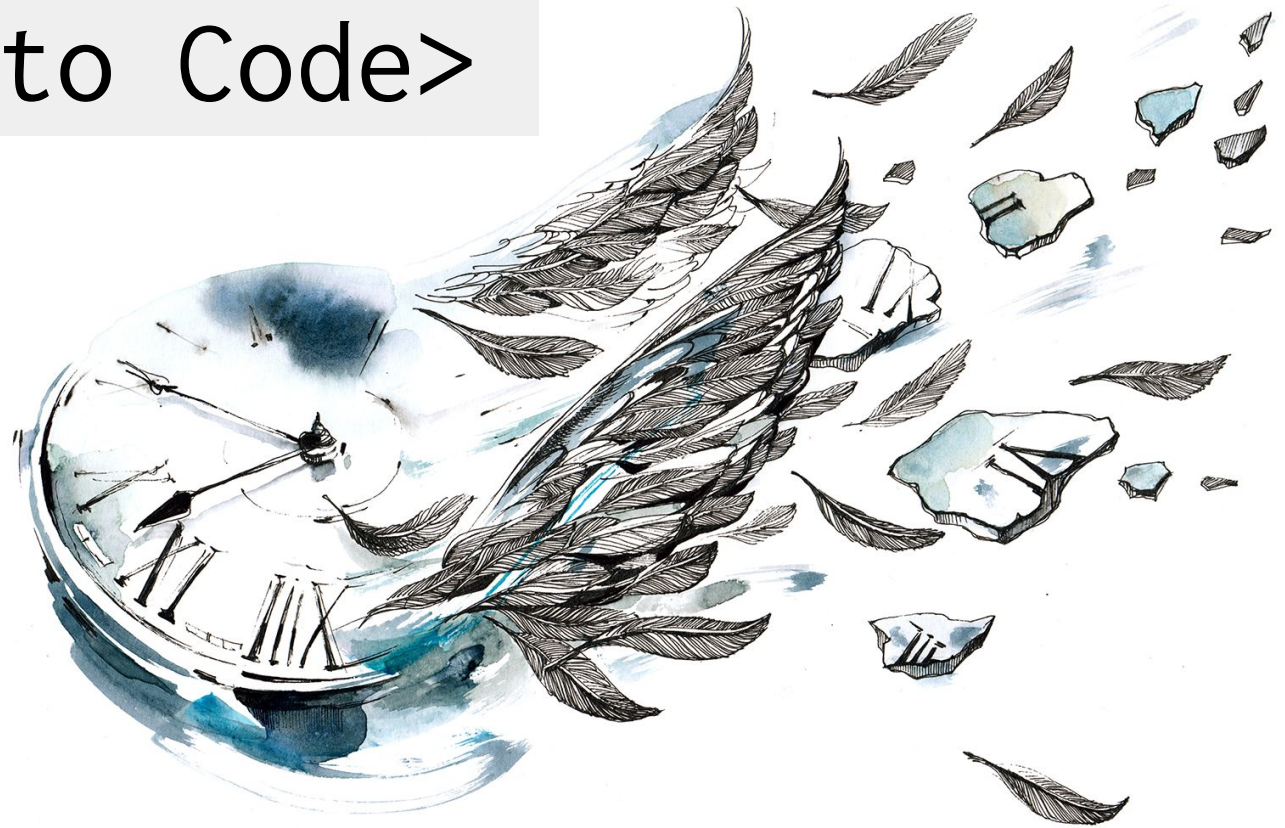
Instructor Do: Grid Search and Randomize Search

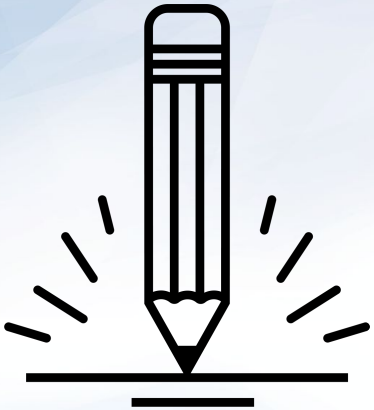
- Simply put, hyperparameters allows you to customize how algorithms behave to a specific dataset.
- Different from parameters, hyperparameters are specified by you and not by an internally learning algorithm.
- Picking the best hyperparameters for a model can be difficult, therefore we use **random or grid search strategies** for optimal values.

Instructor Do: Grid Search and Randomize Search

- **Via Grid Search:**
    - A brute-force search paradigm approach where we specify a list of values for different hyperparameters, left for the computer to evaluate the model performance for each combination of those to obtain the optimal set.
- **Via Random Search:**
    - Similar to a grid search in many different ways, we still define an estimator, which hyperparameters to tune and the range of values for each hyperparameter. Also, we still set a cross-validation scheme and scoring function. Nevertheless, when it comes to undertake the search, rather than trying every single combination, you randomly sample N combinations and try these out.

<Time to Code>





Activity: Grid Search

In this activity, you will use `GridSearchCV()` and `RandomizedSearch()` to choose the parameters for a KNN model on the Pima Diabetes dataset.

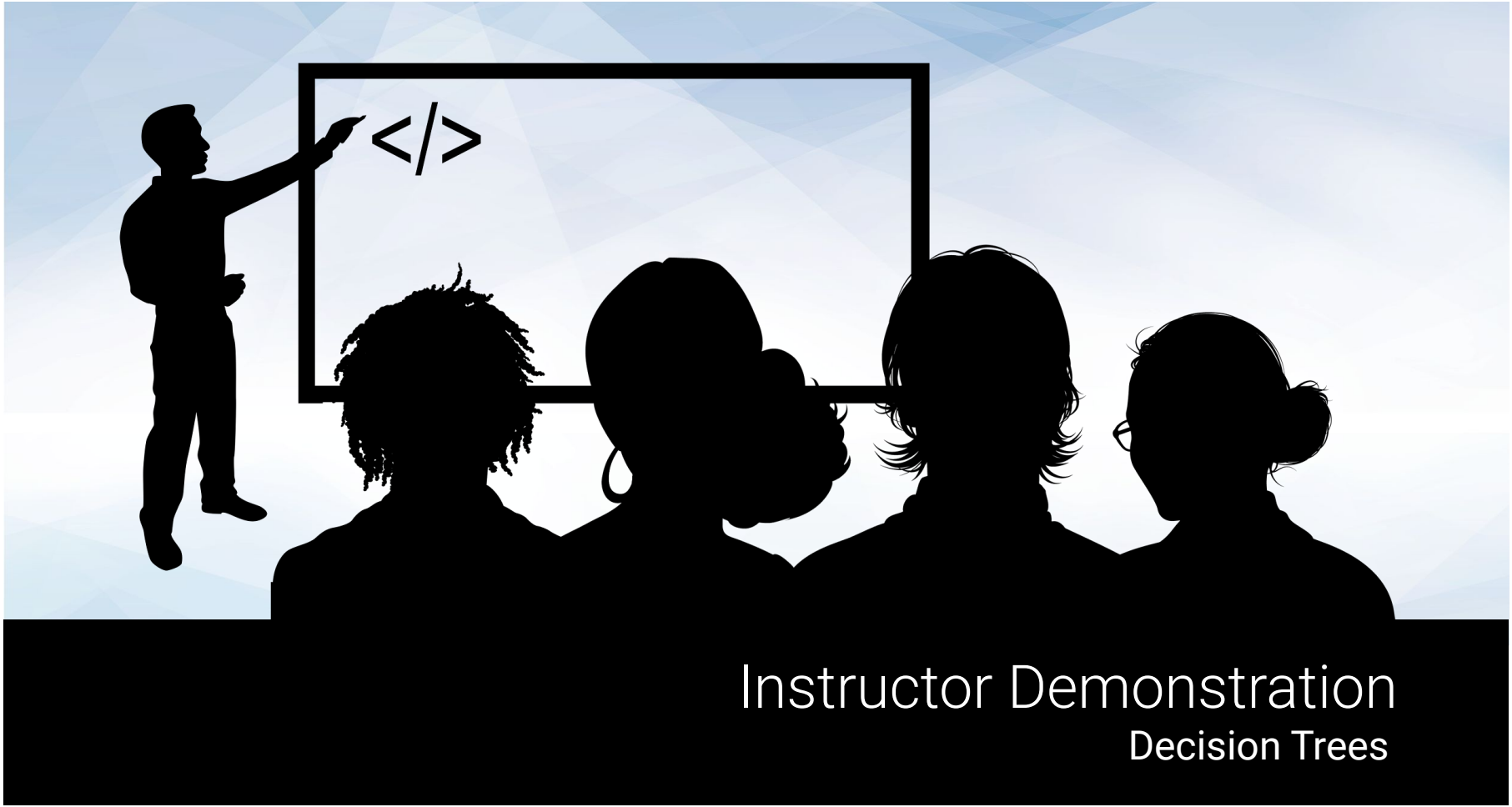
Suggested Time:
15 Minutes

Instructions:

Activity: Grid Search

1. Use the provided starter code, and apply `GridSearchCV()` and `RandomizedSearchCV()` to a `KNeighborsClassifier` model. Change the `n_neighbors` and `leaf_size` parameters.
2. You can use any values that you want to try, but the notebook comments include suggested values.
3. Print the best parameters and the best score for both tuned models.
4. Calculate the predictions by using one of the tuned models and the `X_test` data, and then print the classification report.

Let's Review

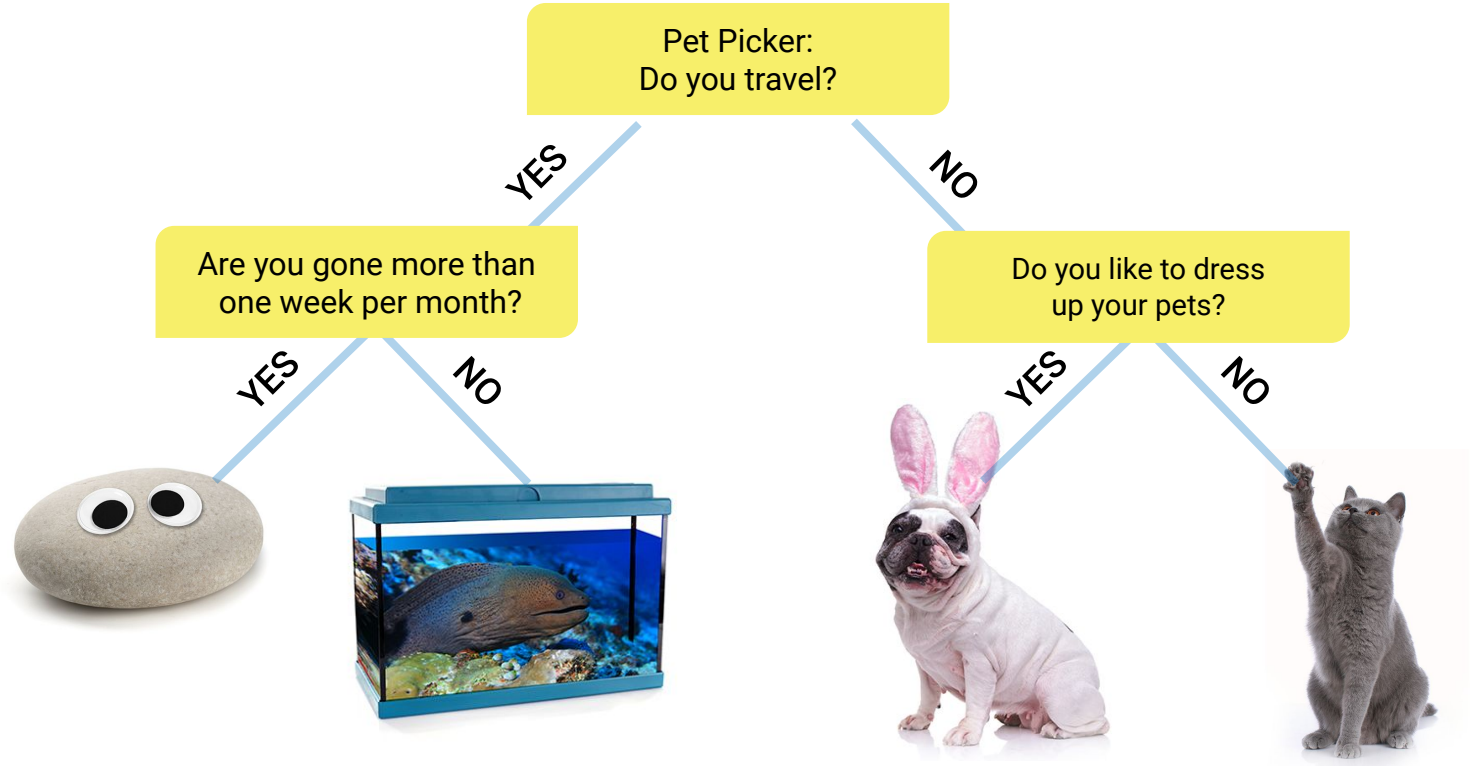


Instructor Demonstration

Decision Trees

Decision trees encode a series of true/false questions

Instructor Do: Decision Trees



Instructor Do: Decision Trees

These true/false questions can be represented with a series of if/else statements

Do you travel?

Yes Travel:

Are you gone for more than one week per month?

Yes: Pet Rock

No: Pet Fish

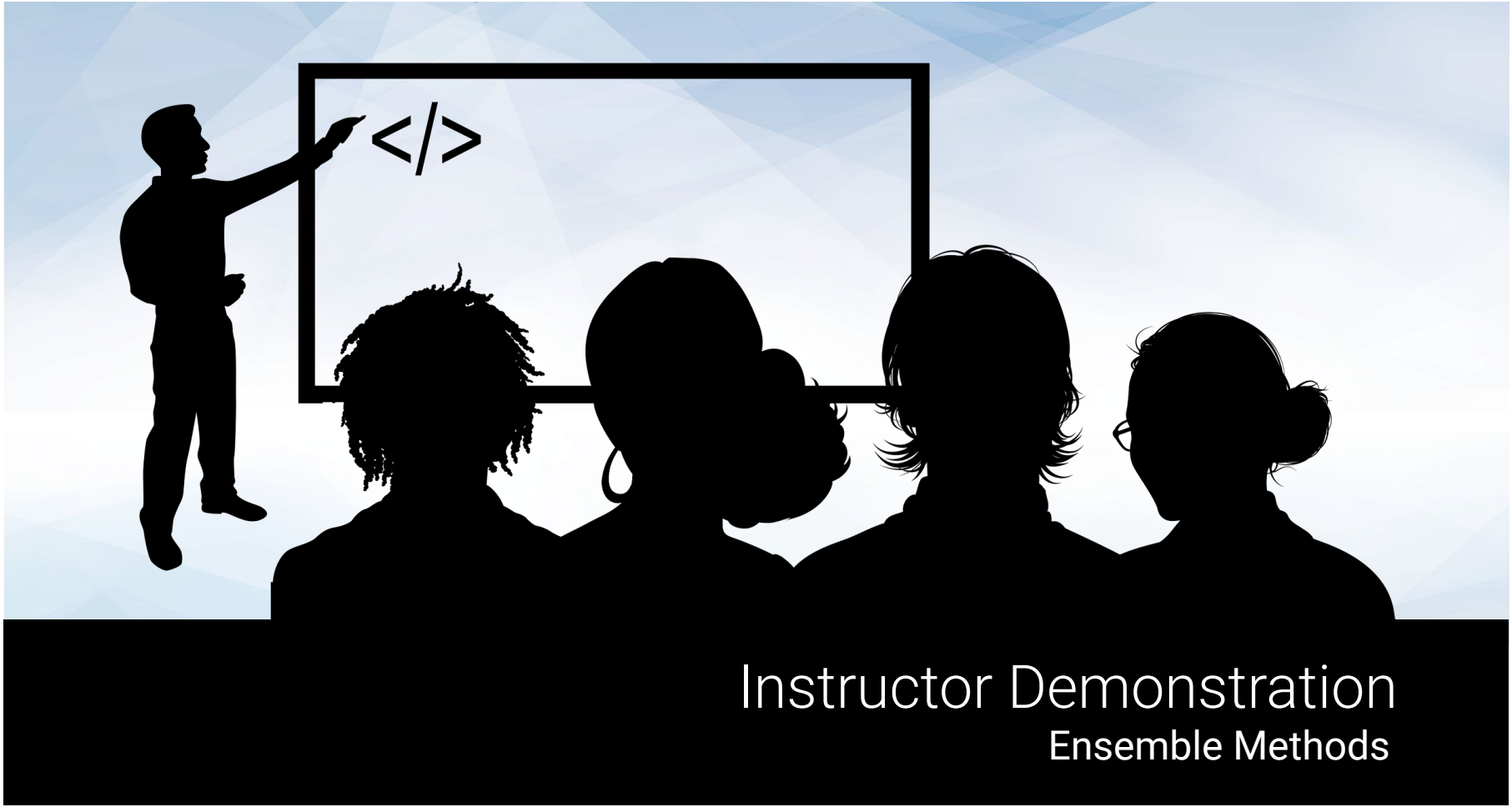
No Travel:

Do you like to dress up your pet?

Yes Dress Up: Pet Dog

No Dress Up: Pet Cat

```
if (travel):
  if (time > week):
    print("Rock")
  else:
    print("Fish")
else:
  if (dress_up):
    print("Dog")
  else:
    print("Cat")
```



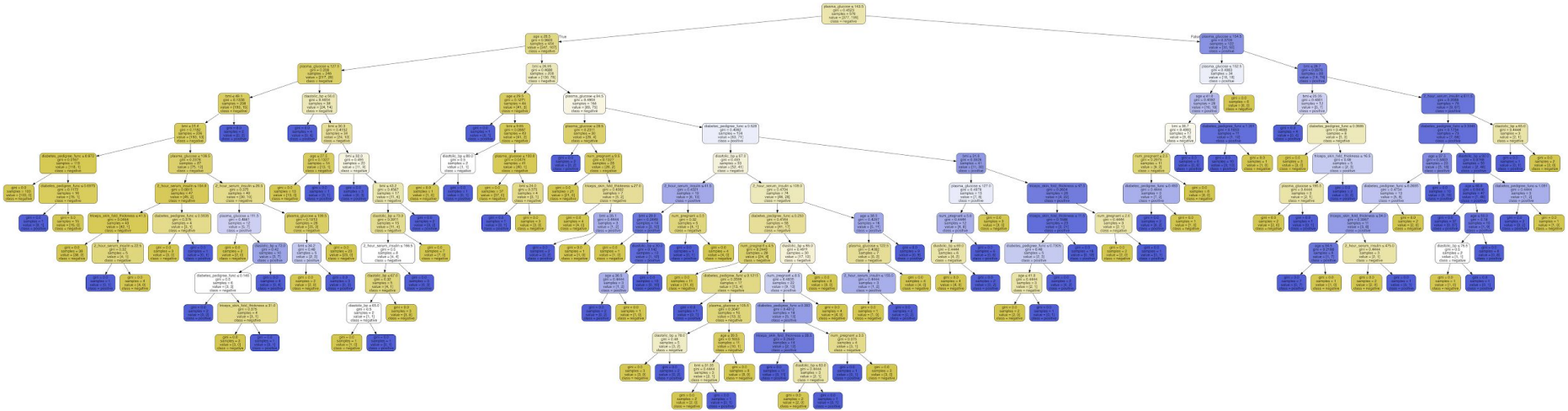
Instructor Demonstration

Ensemble Methods

Decision trees Complexity

Instructor Do: Ensemble Methods

- Decision trees can become very complex and may not generalize well.

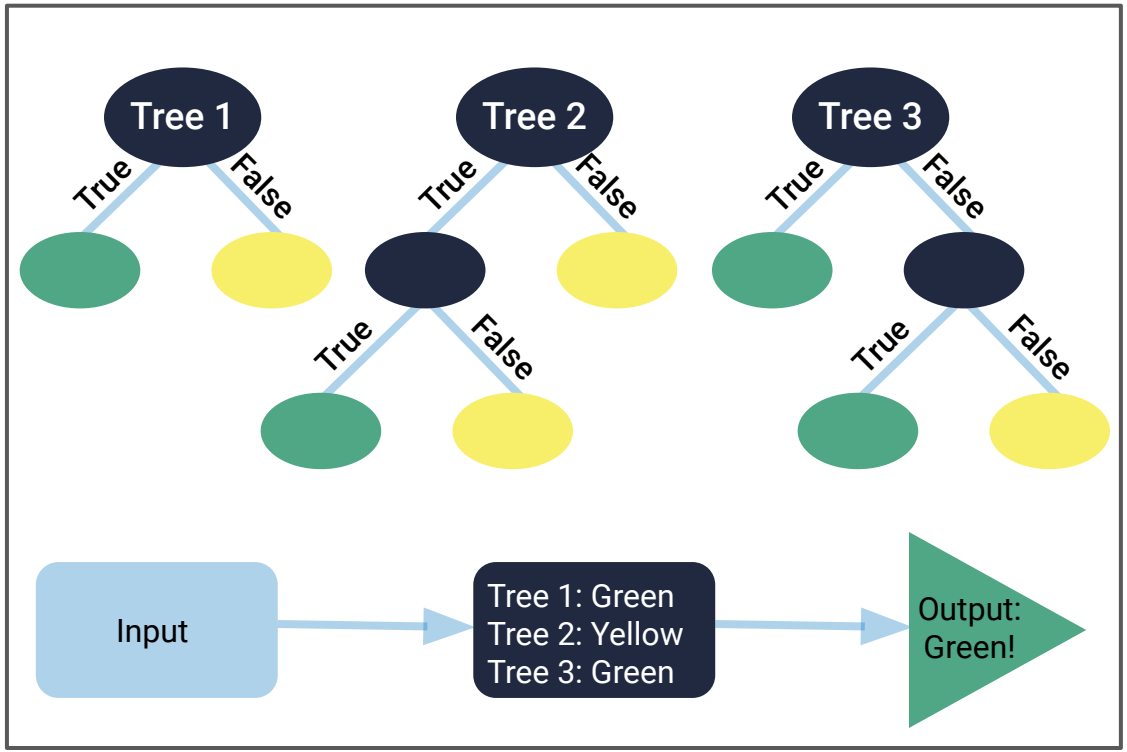


Instructor Do: Ensemble Methods

- Instead of one complicated algorithm, make a lot of random simple algorithms, and get their consensus.

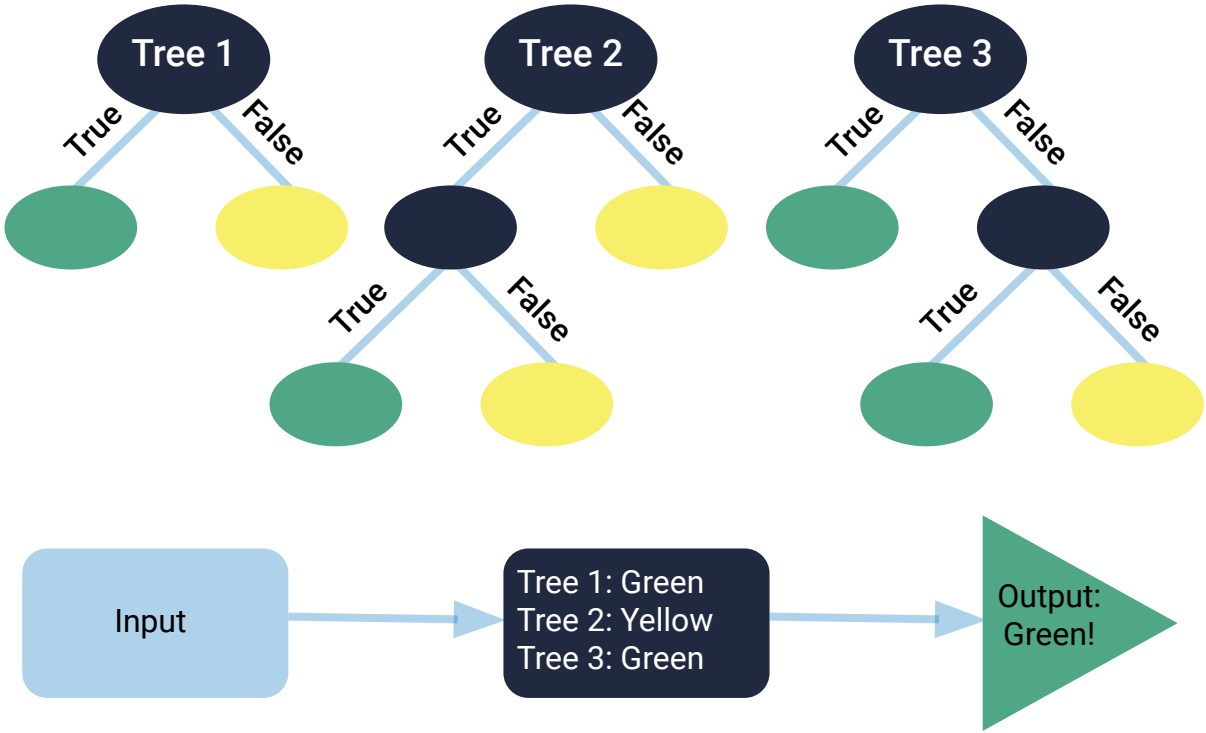
Instructor Do: Ensemble Methods

- Instead of a single, complex tree, a random forest algorithm will sample the data and build several smaller, simpler decisions trees (i.e., a forest of trees).
- Each tree is much simpler because it is built from a subset of the data.
- Each tree is considered a “weak classifier” but when you combine them, they form a “strong classifier.”

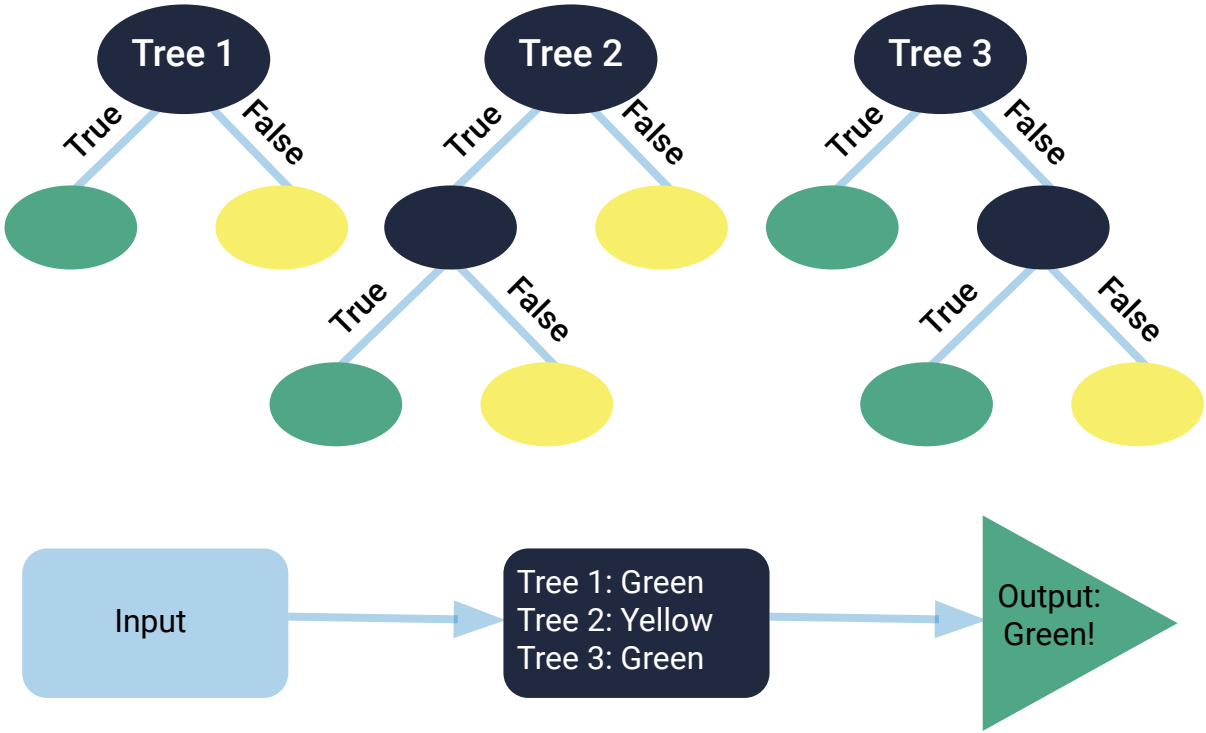


Extremely Random Forests

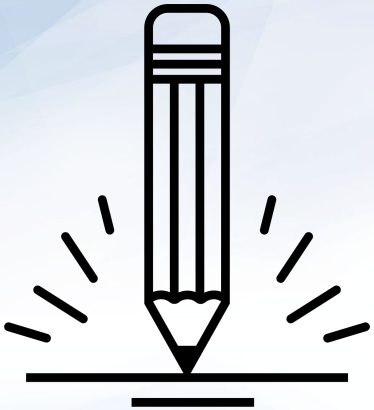
Instructor Do: Ensemble Methods



Instructor Do: Ensemble Methods



Questions?



Activity: Bag and Boost

In this activity, you will apply three aggregate classifiers to predict diabetes from the Pima Diabetes dataset.

Suggested Time:
15 Minutes

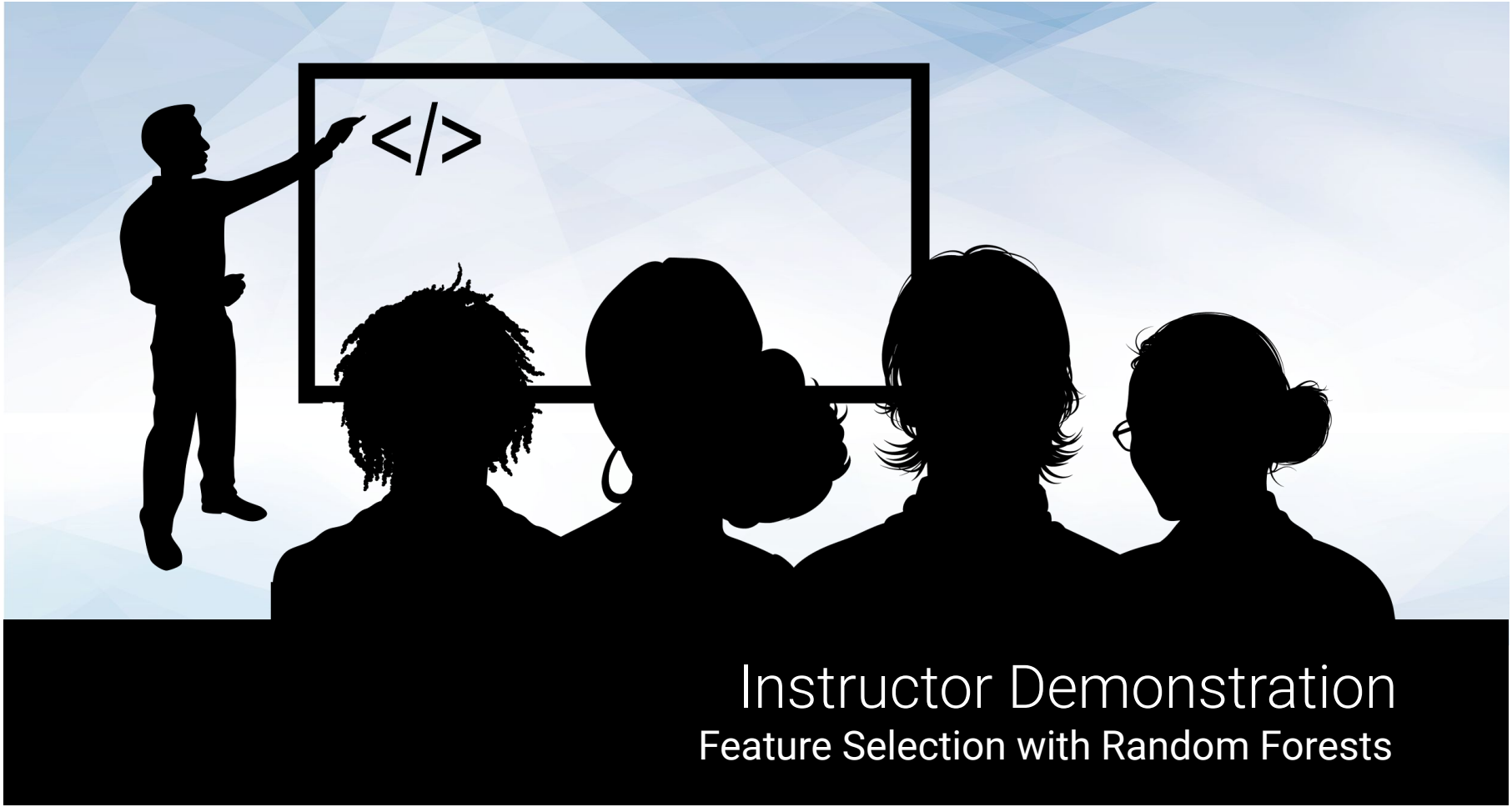
Instructions:

Activity: Bag and Boost

- ➔ Import a Random Forests classifier, and then fit the model to the data.
- ➔ Import an Extremely Random Trees classifier, and then fit the model to the data.
- ➔ Import an Adaptive Boosting classifier, and then fit the model to the data.
- ➔ Calculate the classification report for each model. Also, calculate the score for both the training and the testing set. Compare the performance of the three models.

- **Bonus:**
  - Refactor to reduce repetitive code. Create a function that takes in a model and a dataset and prints a classification report to compare different models.
  - Choose one of the models, and then read the scikit-learn documentation. Use your newly created function to try different parameters. Can you improve the model?

Let's Review



Instructor Demonstration

Feature Selection with Random Forests

Instructor Do: Feature Selection with Random Forests

➔ Machine Learning models can be “confused” by an overabundance of features, fitting to the noise of irrelevant features.

- Feature Selection is a process of selecting a subset of relevant features, reducing the width of our dataset.

- There are many reasons to perform feature selection.
  - Simplified models are less likely to overfit,
  - Simplified models reduce training time,
  - Simplified models are easier to interpret, etc.

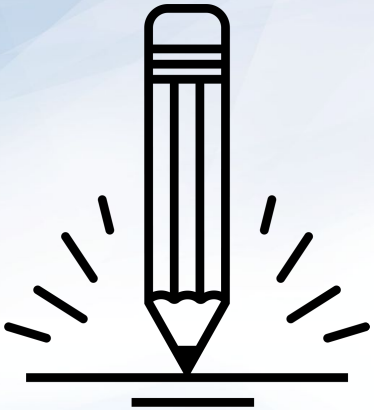
- There are many ways to perform feature selection. One technique uses the information from a Random Forest model.

Instructor Do: Feature Selection with Random Forests

- Remember, Random Forests use decision trees that try to select the best feature at every split.

- Therefore, how often a feature gets selected over the whole Random Forest model gives us an indication of how important that feature is.

- Feature importances are accessible after fitting a RandomForestClassifier in scikit-learn with the feature_importance



Activity: Finding the Features From the Trees

In this activity, you will apply three aggregate classifiers to predict diabetes from the Pima Diabetes dataset.

Suggested Time:
15 Minutes

Instructions:

Activity: Finding the Features from the Trees

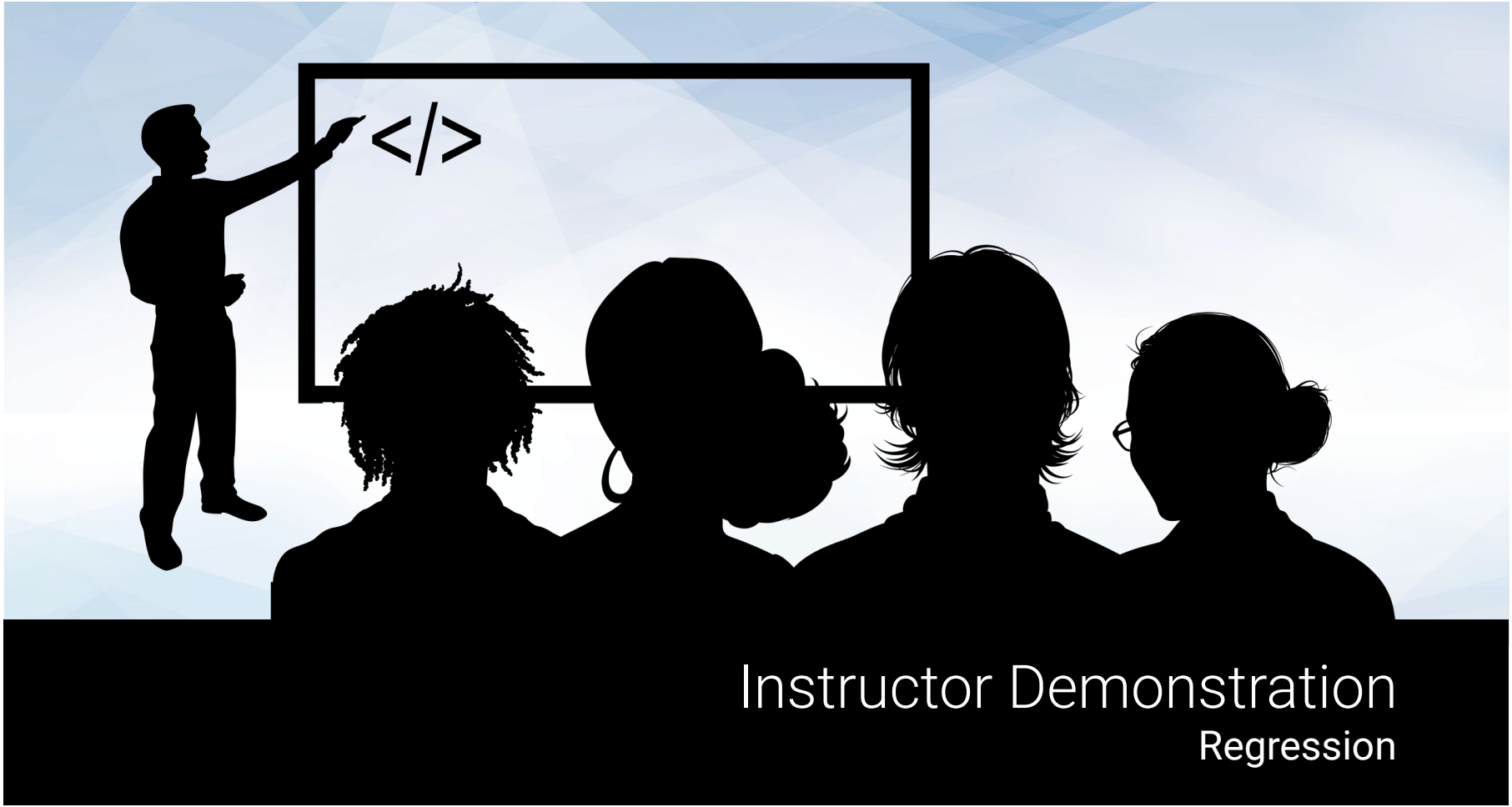
1. Import the arrhythmia data, and then fit a Random Forests model to the scaled and split data.
2. Import SelectModel to extract the best features from the Random Forests model.
3. Fit a logistic regression to the original dataset, and then print its score.
4. Fit a logistic regression to the selected dataset, and then print its score.
5. Compare the scores of the two logistic regression models.

Let's Review

Countdown timer

40:00

(with alarm)



Instructor Demonstration

Regression

Instructor Do: Regressions

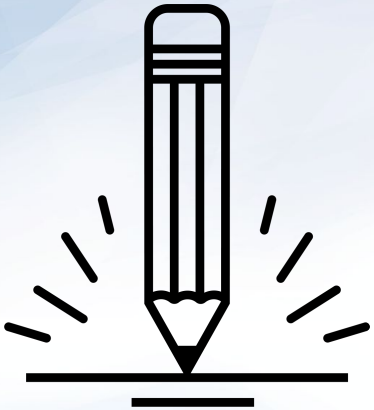
The Regressions we know...

- Regressions are models that output continuous values.

Regularization

- We've already seen Linear Regression before, and it is still the basis of the first regression models we are going to look at.
  - Ridge regression
  - Lasso regression
  - ElasticNet regression

- Ridge, Lasso, and ElasticNet all add "regularization" terms to a regular linear regression model.
  - The regularization terms at the size of the coefficients of the model.
  - Adding the regularization terms to the model helps keep the coefficients of the model more consistent.



Activity: Regularized Regression

In this activity, you will use regularized models to predict the housing prices of buildings in Tehran.

Suggested Time:
15 Minutes

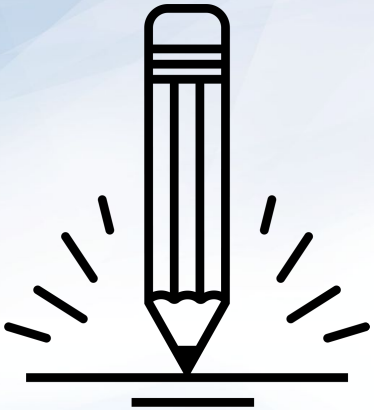
Instructions:

Activity: Finding the Features from the Trees

➔ For each of the following four regression models, import the model from scikit-learn, fit the model to the data, and then print the model's score:

- Linear Regression
- LASSO
- Ridge
- ElasticNet

Let's Review

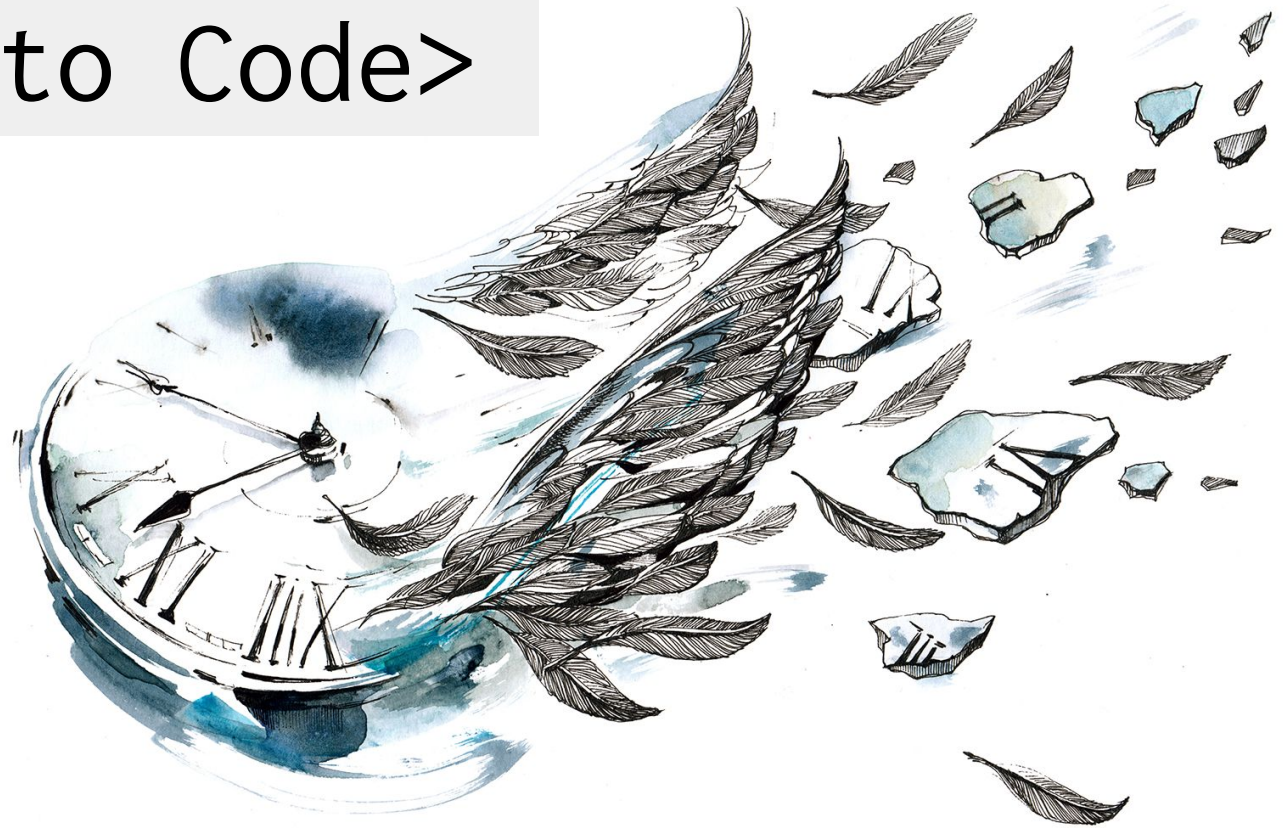


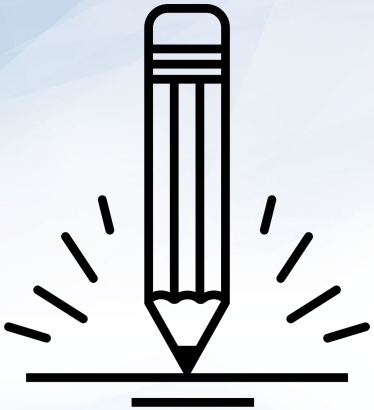
Everyone Do: Feature Selection with LASSO

In this activity, we will select features from the LASSO model to improves the linear regression from a weak model.

Suggested Time:
10 Minutes

<Time to Code>





Activity: Feature Selection with LASSO

In this activity, you will use regularized models to predict the housing prices of buildings in Tehran.

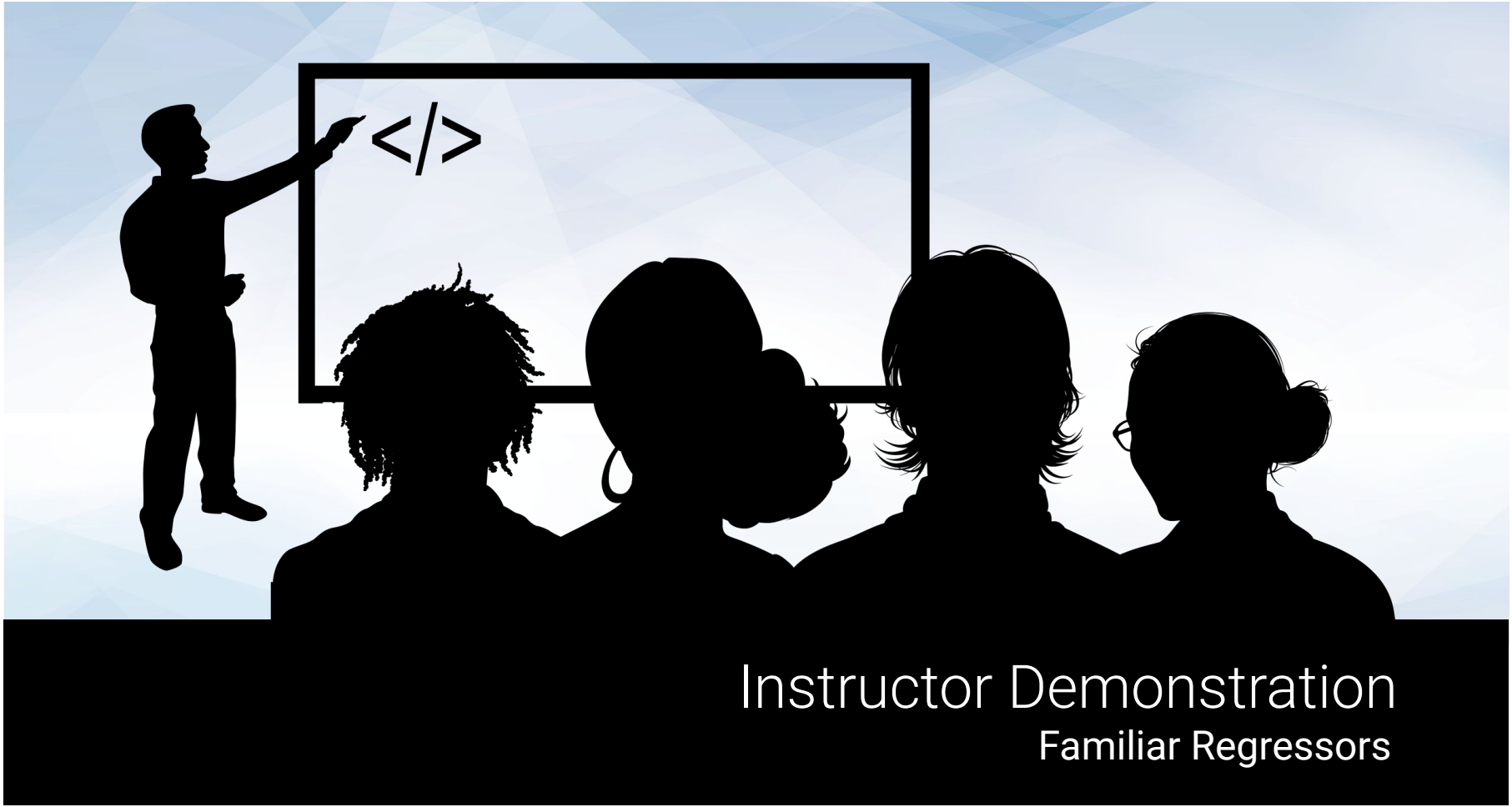
Suggested Time:
15 Minutes

Instructions:

Activity: Feature Selection with LASSO

1. Fit a linear regression to the imported and split dataset. Print the score of the model.
2. Fit a LASSO regression model to the imported and split dataset.
3. Import SelectModel to extract the best features from the LASSO model.
4. Fit a new linear regression to the data with only the selected features (by using SelectModel). Print the score of the model.
5. Compare the scores of the two linear regression models.

Let's Review



Instructor Demonstration

Familiar Regressors

<Time to Code>