UNIVERSITY of WASHINGTON

LIMEaid

Local Interpretable Model-agnostic Explanations (LIME)

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M.S. Data Science

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Interpretability in Machine Learning

Some highly accurate models are not “explainable”

- Neural networks, random forests

Why is this a problem?

- Bias, not obvious
- High test set accuracy but poor results in the field
- Policy or law demands an explanation of any decision

Solution: model-agnostic local explanations

- Explain one instance, not entire model
- Fit a simple model to explain a small section of decision space

LIMEaid: A LIME solution for tabular data

LIMEaid explanations

Input

- A “complex” ML model, fit by sklearn classifier object with .predict
- An instance of data (*x*) and its model output (*f(x)*)
- Probability domain for normalized predictor variables (histograms)

Output

- Sparse linear models (few features), plottable
  List significant features

Analysis/verification

- Comparison to decision trees

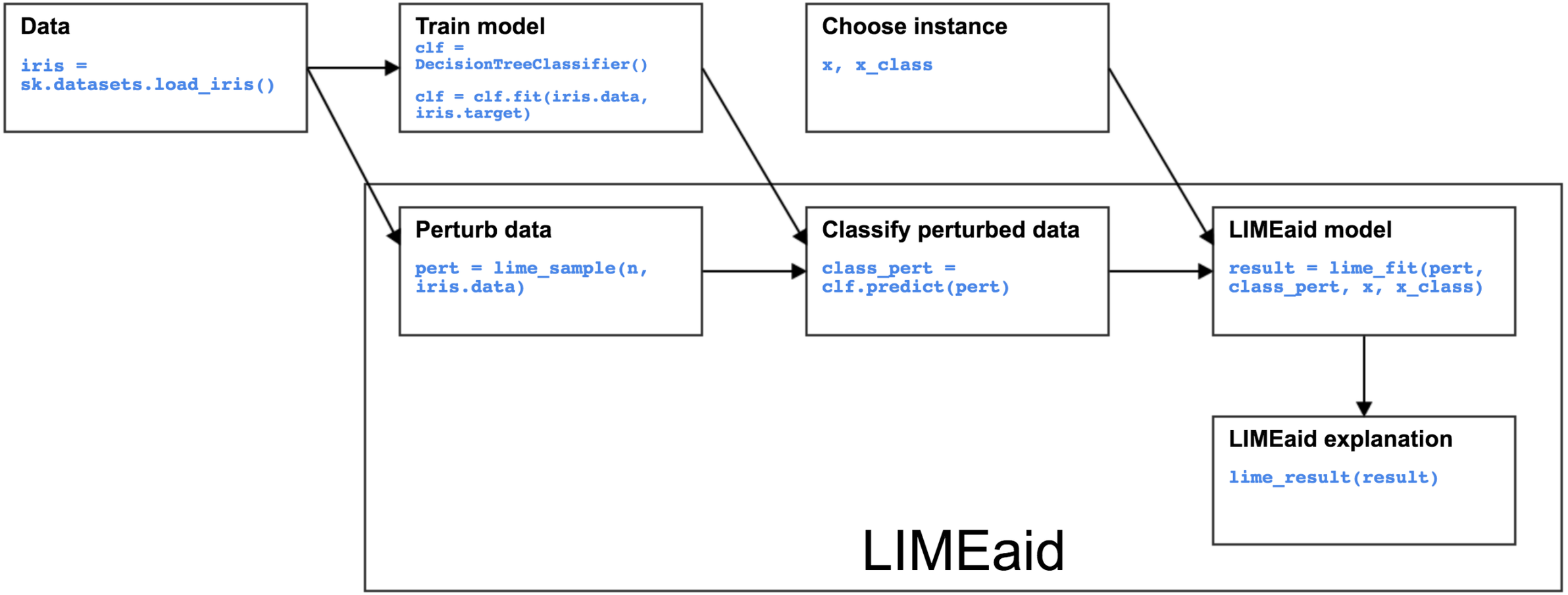
Use Cases

User profile: data scientist with Python programming experience

1. **Model verification scenario**
   - User wants to preempt poor model performance “in the field”
   - Use LIMEaid to sample test dataset
   - Show most significant features for decision
   - Tune or replace model if spurious correlation or other issues

2. **Decision explanation scenario**
   - Classification has already been made by a model
   - Use LIMEaid to sample whole dataset
   - Produce easy-to-share “two-dimensional” plot of a linear correlation

Design


Data
iris = sk.datasets.load_iris()
Train model
clf = DecisionTreeClassifier()
clf = clf.fit(iris.data, iris.target)
Choose instance
x, x_class
Perturb data
pert = lime_sample(n, iris.data)
Classify perturbed data
class_pert = clf.predict(pert)
LIMEaid model
result = lime_fit(pert, class_pert, x, x_class)
LIMEaid explanation
lime_result(result)
LIMEaid

Data

Sources

- College Scorecard (data.gov): Annual report of schools and attributes (SAT scores, majors offered, region, cost, public/private/for profit, etc.)
- "Where it Pays to Attend College" (Kaggle.com) obtained from (*Wall Street Journal*), based on Payscale, Inc. (College Salary Report Methodology): Article reporting salaries of graduates, salaries by major, etc.

Merge

- Significant cleaning, reformatting to match sets on college name
- String manipulation, removal of hyphens, abbreviations, region names, etc.

More

- Sklearn's provided "Iris" data

Models

Scikit-learn classifiers that predict probabilities (predict_proba implemented)

Multiclass logistic regression (sklearn.linear_model.LogisticRegression)

- 85% accuracy on College data

Random Forest (sklearn.ensemble.randomforestclassifier)

- 65% accuracy on College data

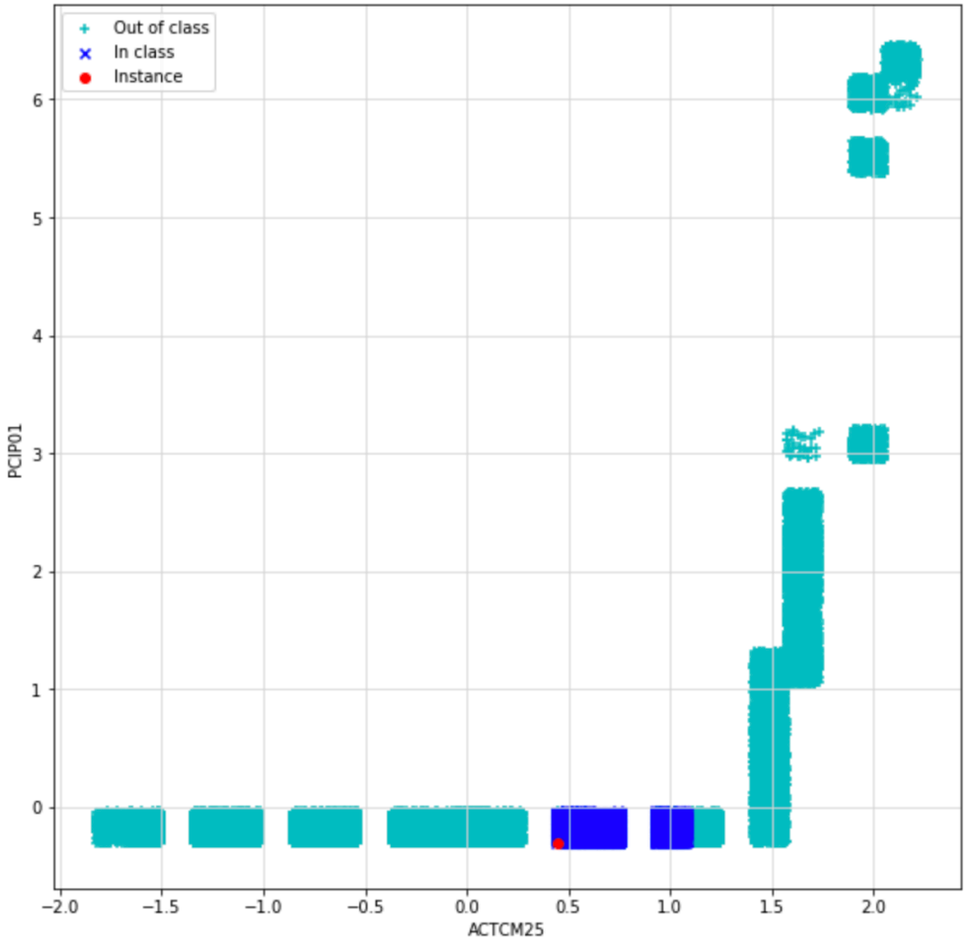
Decision tree (sklearn.tree)

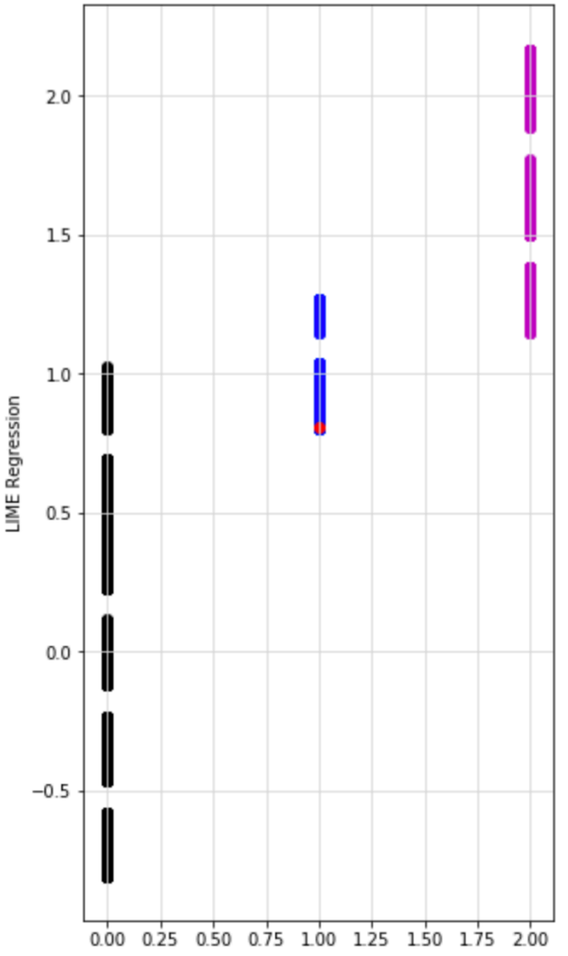
- 65% accuracy on College data

Models not tuned for improved accuracy (default settings)

Demo

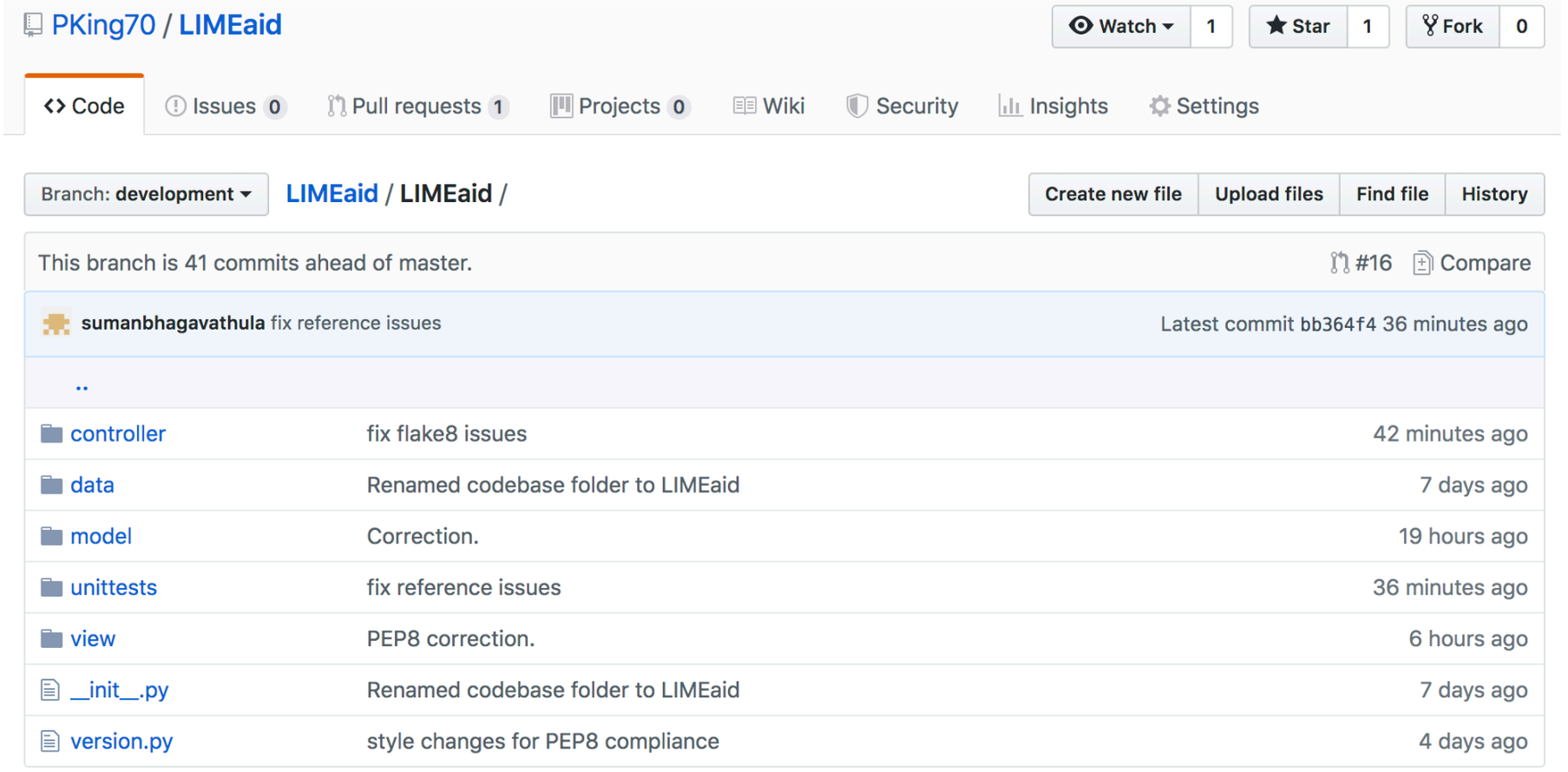
Education data (LIME_Education_ex_notebook.ipynb)





Project Structure

- LIMEaid Github Repo based on Shablona
- Used Model-View-Controller (MVC) codebase architecture



Future Work

- **API support** for data acquisition to support dynamic features:
  - College Scorecard (data.gov) currently published with new features and data dictionary yearly
- **Model tuning** for examples:
  - Currently using defaults, could improve accuracy > 65%
- **Modify penalty** for number of coefficients
- **More data type and model support:** image data, NLP support, support for model objects beyond sklearn classifiers

Questions?