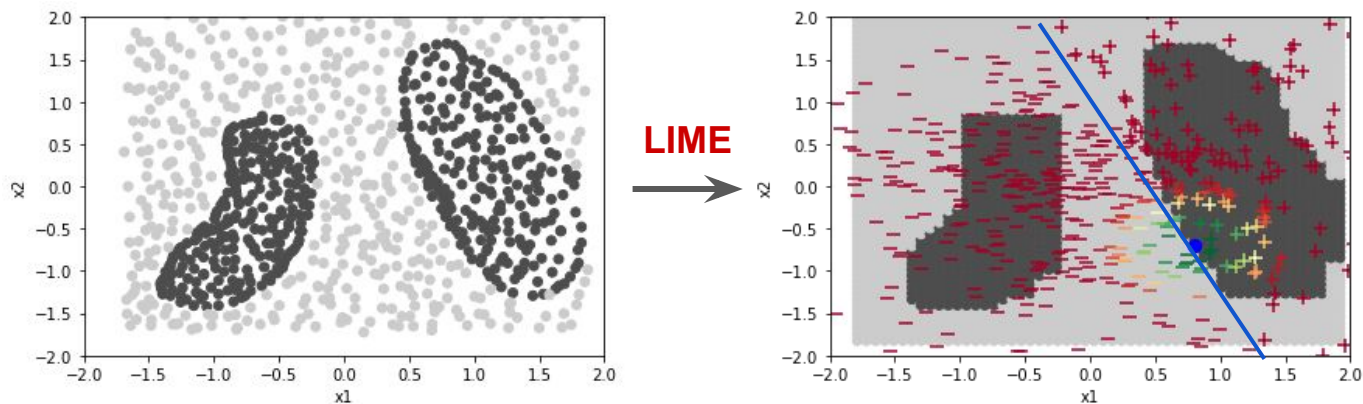


Interpretable Machine Learning with LIME



Cristian Arteaga, arteagac.github.io

The need for interpretability - examples



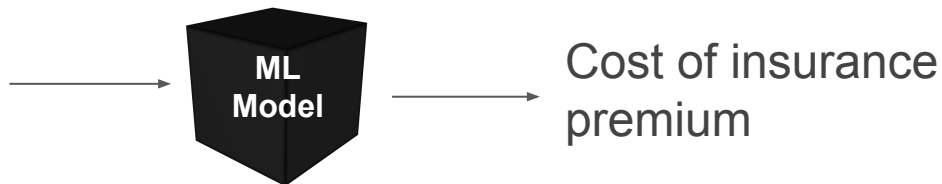
Health Care

- Blood test results
- Symptoms
- Health history of family



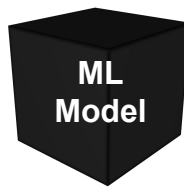
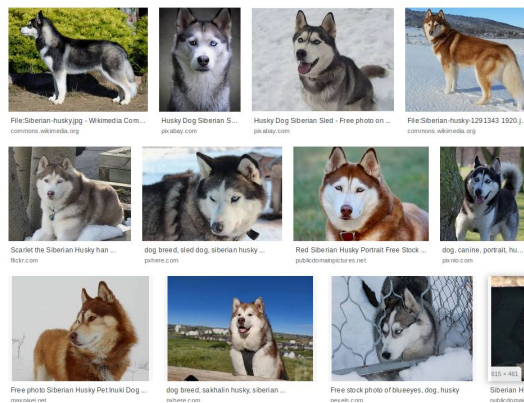
Car Insurance

- Vehicle year and model
- Driving history
- Driver's age



The need for interpretability - examples

Computer Vision



Wolf or Husky?

<http://innovation.uci.edu/2017/08/husky-or-wolf-using-a-black-box-learning-model-to-avoid-adoption-errors/>

Some popular ML interpretability techniques

- **PDP**: Partial Dependence Plots
- **LIME**: Local Interpretable Model-Agnostic Explanations
- **SHAP**: SHapley Additive exPlanations
- **CAM**: Class Activation Mapping

More details:

Molnar, Christoph. "Interpretable machine learning." *A Guide for Making Black Box Models Explainable* 7 (2018).

LIME

Paper: <https://dl.acm.org/citation.cfm?id=2939778>

Why should i trust you?: Explaining the predictions of any classifier

[MT Ribeiro](#), [S Singh](#), [C Guestrin](#) - Proceedings of the 22nd ACM ..., 2016 - [dl.acm.org](#)

Despite widespread adoption, machine learning models remain mostly black boxes. Understanding the reasons behind predictions is, however, quite important in assessing **trust**, which is fundamental if one plans to take action based on a prediction, or when ...

☆ 77 Cited by **1689** Related articles All 16 versions

GitHub: <https://github.com/marcotcr/lime>

The screenshot shows the GitHub repository page for 'lime' by marcotcr. The browser address bar displays 'https://github.com/marcotcr/lime'. The repository name 'marcotcr / lime' is shown at the top left. On the right, statistics are displayed: 'Used by 288', 'Watch 270', 'Unstar 6,392' (highlighted with a red box), and 'Fork 993'. Below these, navigation tabs include 'Code', 'Issues 17', 'Pull requests 8', 'Projects 0', 'Wiki', 'Security', and 'Insights'. The repository description is 'Lime: Explaining the predictions of any machine learning classifier'. At the bottom, a summary bar shows '436 commits', '5 branches', '17 releases', '35 contributors', and 'BSD-2-Clause' license.

Used by	Watch	Unstar	Fork
288	270	6,392	993

Lime: Explaining the predictions of any machine learning classifier

Commits	Branches	Releases	Contributors	License
436	5	17	35	BSD-2-Clause

LIME: Local Interpretable Model-Agnostic Explanations

Local

Explanations are locally faithful instead of globally.

Interpretable

Humans are limited by an amount of information that can be processed and understood.

e.g. The weights of a neural network are not meaningful for a human.

Model-Agnostic

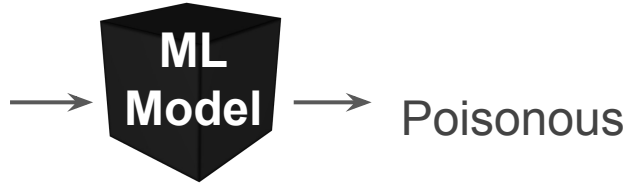
Any machine learning algorithm can be used as predictive model. Works with text, image and tabular data.

Explanations

Artifacts that provide an understanding between input to a ML model and the model's prediction.

LIME for Tabular Data Classification

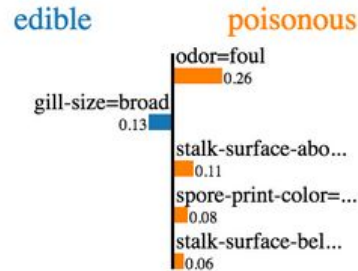
Mushroom
Characteristics
(Odor, size, etc.)



Why?

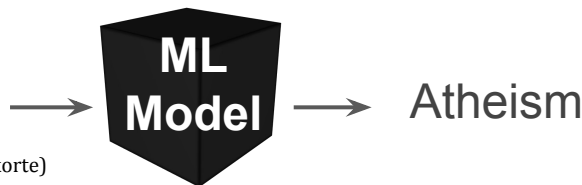
Because

**LIME
Explanations**



LIME for Text Classification

From: conor@owl.net.rice.edu (Conor Frederick Prischmann)
Subject: Re: Genocide is Caused by Theism: Evidence?
Organization: Rice University
Lines: 23
In article [c60A0s.DvI@mail.cc.fsu.edu] deKorte@dirac.scri.fsu.edu (Stephen L. Dekorte) writes:
I saw a 3 hour show on PBS the other day about the history of the



Text with highlighted words

From: conor@owl.net.rice.edu (Conor Frederick Prischmann)
Subject: Re: **Genocide** is **Caused** by Theism : Evidence?
Organization: **Rice** University
Lines: 23

In article [C60A0s.DvI@mail.cc.fsu.edu] deKorte@dirac.scri.fsu.edu (Stephen L. DeKorte) writes:

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From: deKorte@dirac.scri.fsu.edu (Stephen L. DeKorte)
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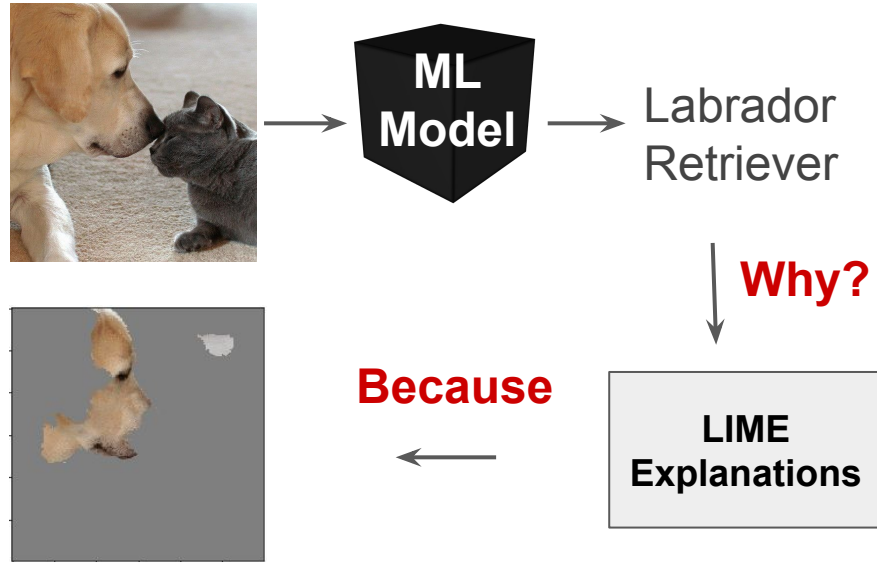
NOT atheism atheism

Because

Why?

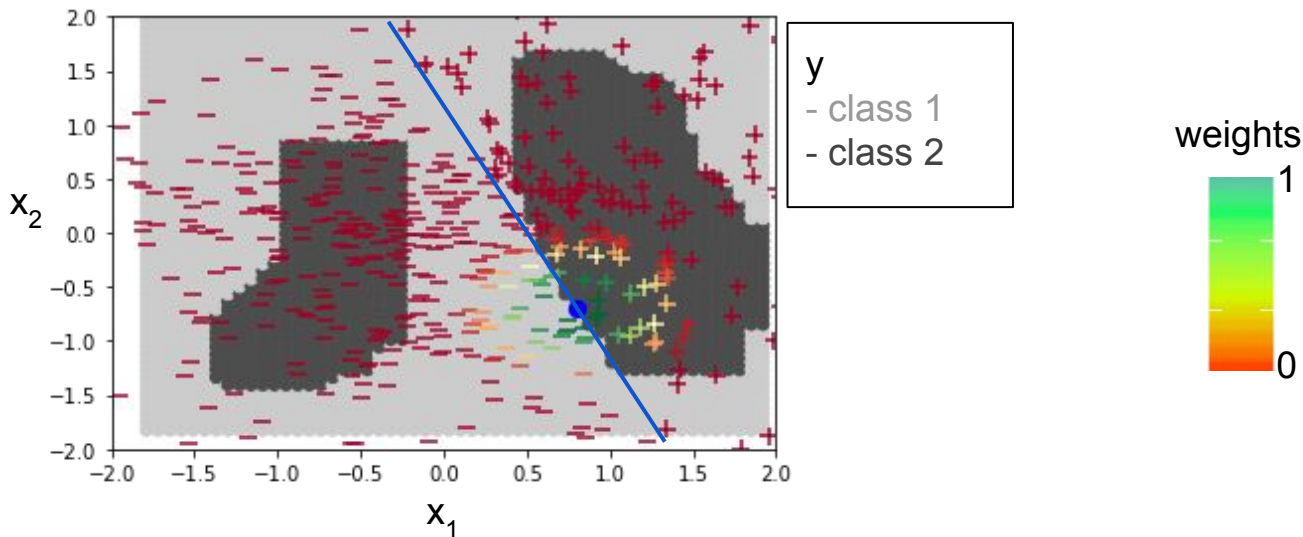
LIME
Explanations

LIME for Image Classification



How LIME works?

Fit a **local** interpretable (simpler) model around the instance to be explained.

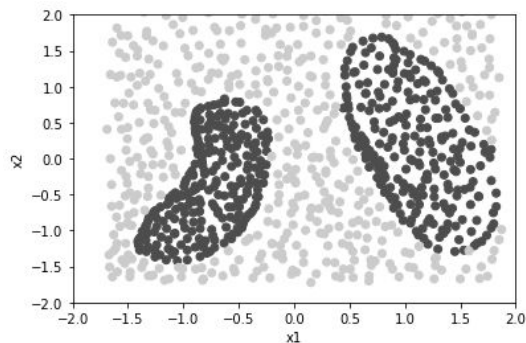


How LIME works?

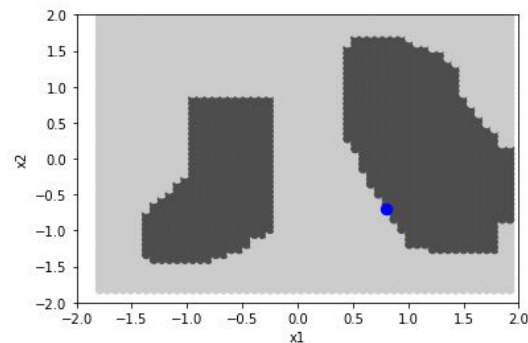
Data:

$\mathbf{X} = \{x_1, x_2\}$ y = labels (gray or black)

Data Generation Process



ML (Random Forest) Prediction

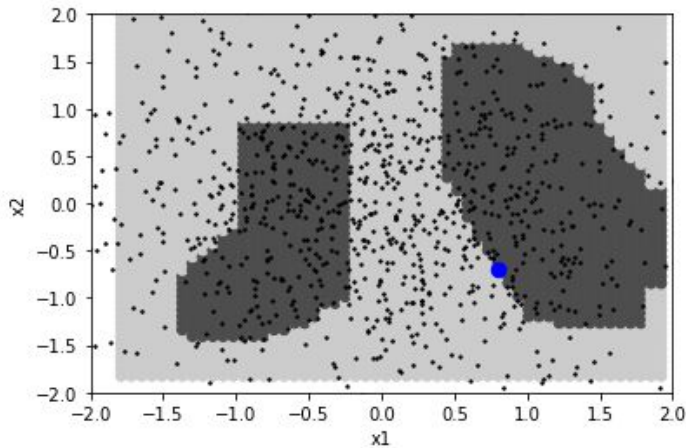


Task: Explain classifier's prediction on **one instance** (blue dot).

Step 1

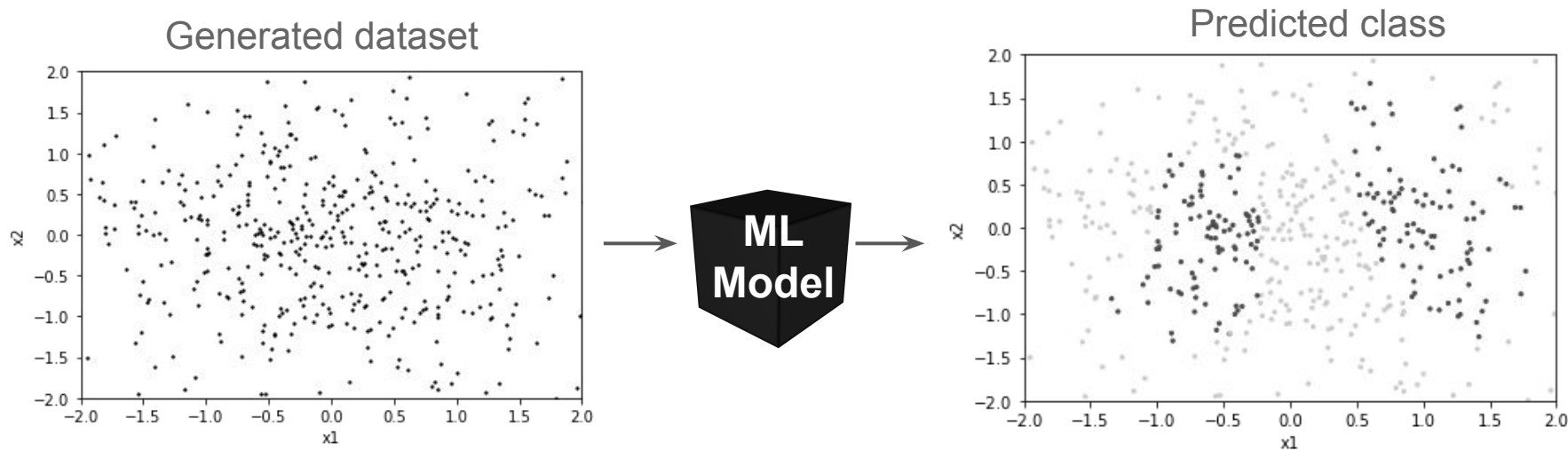
Generate a new dataset by sampling around the instance to be explained.

For tabular data, sampling around the the mean and std. dev. is recommended.



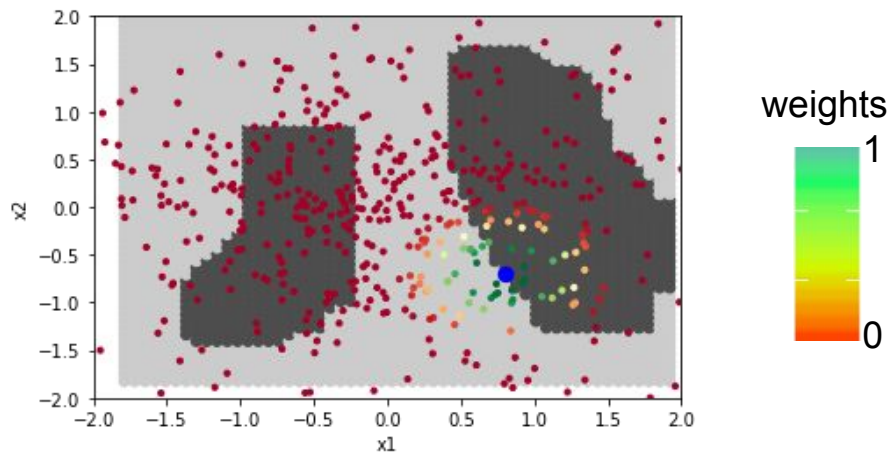
Step 2

Use the machine learning model to predict the classes of the new generated dataset.



Step 3

Use a kernel function to **weight** the importance of each instance of the new dataset on the locality of the instance to be explained.



Step 4

Fit a weighted linear model (blue line) using the **new dataset**, the **predicted classes** for the new dataset and the **weights**. This linear model can be used to explain the prediction

