Intro to Explainability in ML

PDX ML

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Explainability

The idea of how well a human can understand the decision is often called *interpretability* or *explainability*.

Confession

I pulled a bait and switch.

Explainability/Interpretability related to:

- Fairness - (socially) unbiased and not discriminating
- Safety / Reliability - errors are not catastrophic
- Privacy - protecting sensitive information
- Justification - why a decision is good

You might be asked: *What*

What features were used to make this prediction/decision?

- Feature selection and engineering
- Model selection

Or maybe: *How*

- How does the algorithm work?
- How does the input affect the output?
- How are features and outputs correlated?

But *Why* is special

Why was this prediction made?

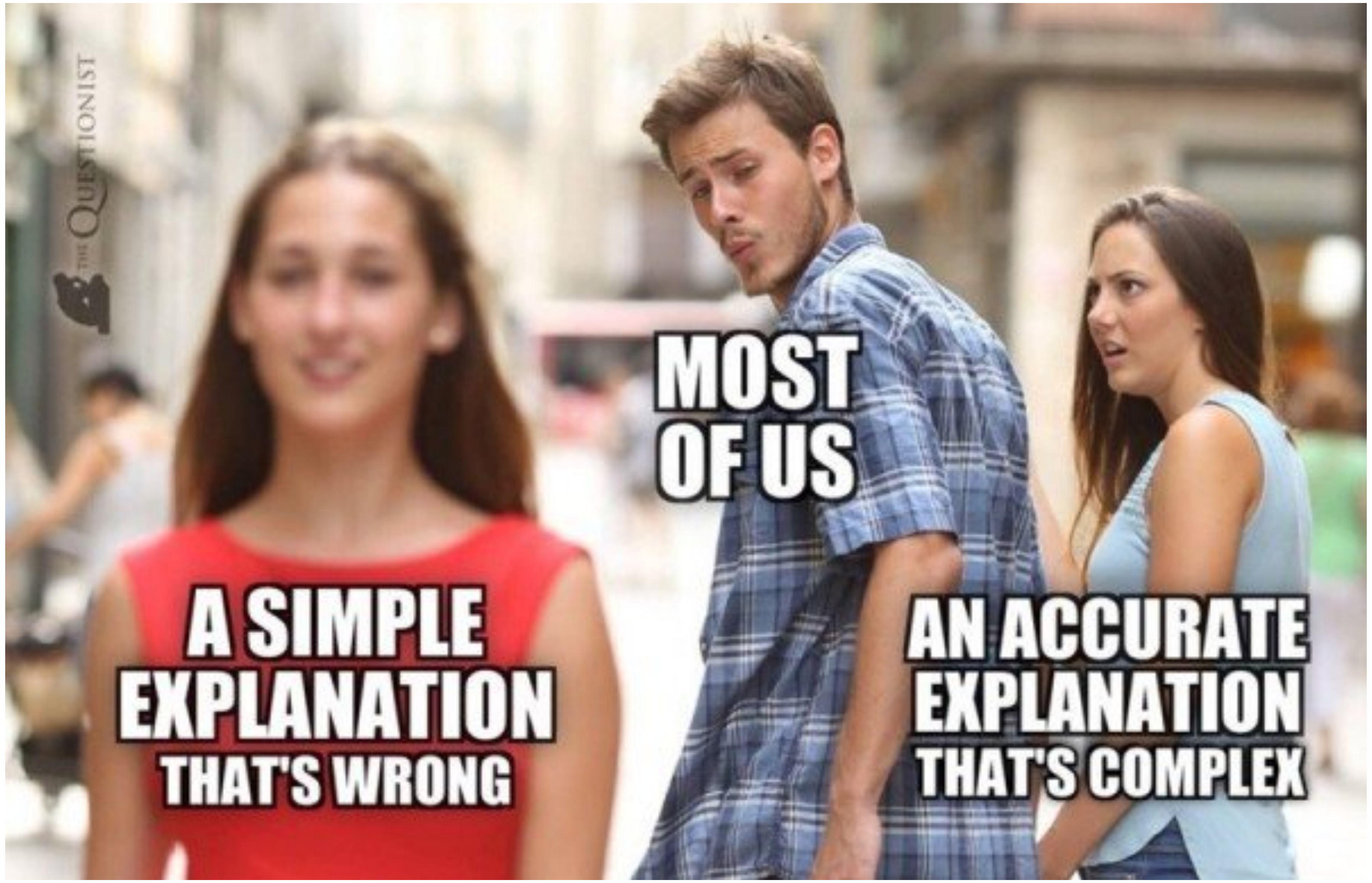
Why should I trust your prediction?

Good (understandable?) explanations

Deep down your boss/client/user wants the explanation to be:

- monotonic
- homoscedastic
- not probabilistic
- contrastive
- selective
- perscriptive
- conformant to social expectations

Almost everyone


THE QUESTIONIST
MOST OF US
A SIMPLE EXPLANATION THAT'S WRONG
AN ACCURATE EXPLANATION THAT'S COMPLEX

Radical Thesis

Explainability and interpretability are two different things.

- Explainability is *why*
- Interpretability is *how*

Unfortunately

Humans want meaning (*why*).

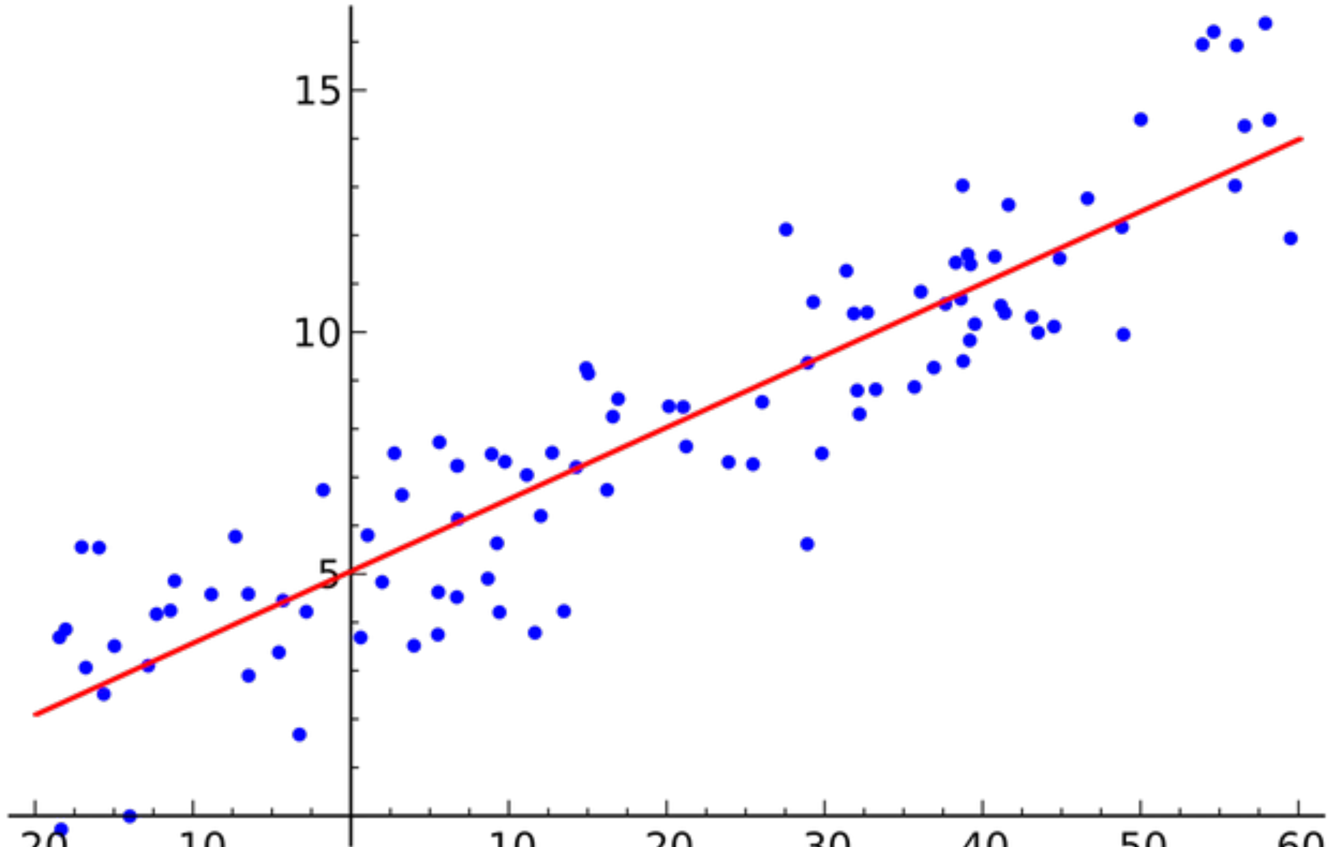
Explainability is understanding the *why* (causation).

DS/ML deals in correlations.

Interpretability is understanding the *how* (correlations).

Correlation is not Causation.

Example



So, what can we do?

Well …

- Run randomized control trials (?)
- Build structural/causal models (?)
- Understand the correlations the best we can …

Great power / responsibility

Keep in mind the human (mind's) tendencies to:

- want causation
- want to compare and contrast
- want *perscriptive* insight

Understanding the correlations in our models

Approach	Tool	Area
Linear models	coefficients	global
Decision trees / Rules	nodes	global
Tree ensemble	feature importance	global
Feature exploration	permutation importance	global
	Partial Dependence Plot (PDP)	single feature* / global
	Indiv. Cond. Expectation (ICE)	single feature / subsample
Surrogate Models	Local Inter. Model-agnostic Exp. (LIME)	multi feature / local
	Shapley values	multi feature / local

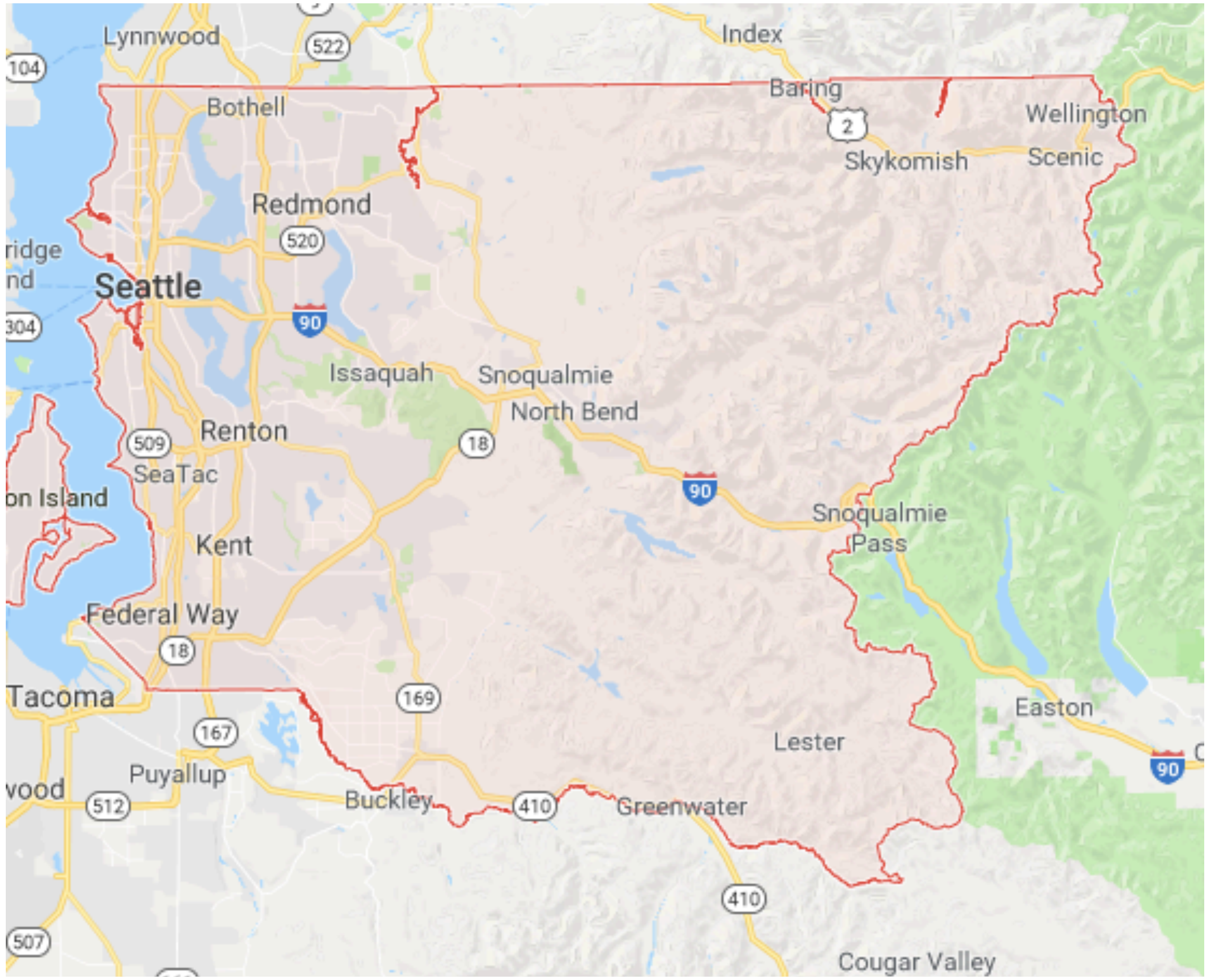
Data: King County Washington home sales

- May 2014 and May 2015
- Kaggle https://www.kaggle.com/harlfoxem/housesalesprediction
- 19 features
- 21,613 observations

Features

id - a notation for a house	date - Date house was sold
price - Price is prediction target	bedrooms - Number of Bedrooms/House
bathrooms - Number of bathrooms/bedrooms	sqft_living - square footage of the home
sqft_lot - square footage of the lot	floors - Total floors (levels) in house
waterfront - House which has a view to a waterfront	view - Has been viewed
condition - How good the condition is (Overall)	grade - overall grade given to the housing unit, based on King County grading system
sqft_above - square footage of house apart from basement	sqft_basement - square footage of the basement
yr_built - Built Year	yr_renovated - Year when house was renovated
zipcode - zip	lat - Latitude coordinate
long - Longitude coordinate	sqft_living - 15Living room area in 2015(implies-- some renovations) This might or might not have affected the lotsize area
sqft_lot15 - lotSize area in 2015(implies-- some renovations)	

King County


Lynnwood
522
Index
104
Bothell
Baring
2
Wellington
Skykomish
Scenic
Redmond
520
ridge
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Seattle
304
90
Issaquah
Snoqualmie
North Bend
509
Renton
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SeaTac
90
on Island
Snoqualmie
Pass
Kent
Federal Way
18
Tacoma
169
167
Easton
Lester
90
Puyallup
vood
512
Buckley
410
Greenwater
410
507
Cougar Valley

Switch to notebook

Summary

- Explainability vs Interpretability
- Feature permutation - Eli5
- Partial Dependece Plot - pdpbox
- Shapley - shap
- IML for R

Resources

A Survey Of Methods For Explaining Black Box Models
Explanation in Artificial Intelligence
Consistent Individualized Feature Attribution for Tree Ensembles
https://christophm.github.io/interpretable-ml-book/

https://github.com/SauceCat/PDPbox
https://github.com/TeamHG-Memex/eli5
https://github.com/marcotcr/lime
https://github.com/slundberg/shap

https://www.kaggle.com/harlfoxem/housesalesprediction

Thank You!

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Questions?