DrWhy.AI - Tools for Explainable Artificial Intelligence

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AISC, 11.11.2020

DALEX

moDel Agnostic Language for Exploration and eXplanation

Python 663 100

DrWhy

DrWhy is the collection of tools for eXplainable AI (XAI). It's based on shared principles and simple grammar for exploration, explanation and visualisation of predictive models.

R 398 51

modelStudio

Interactive Studio for Explanatory Model Analysis

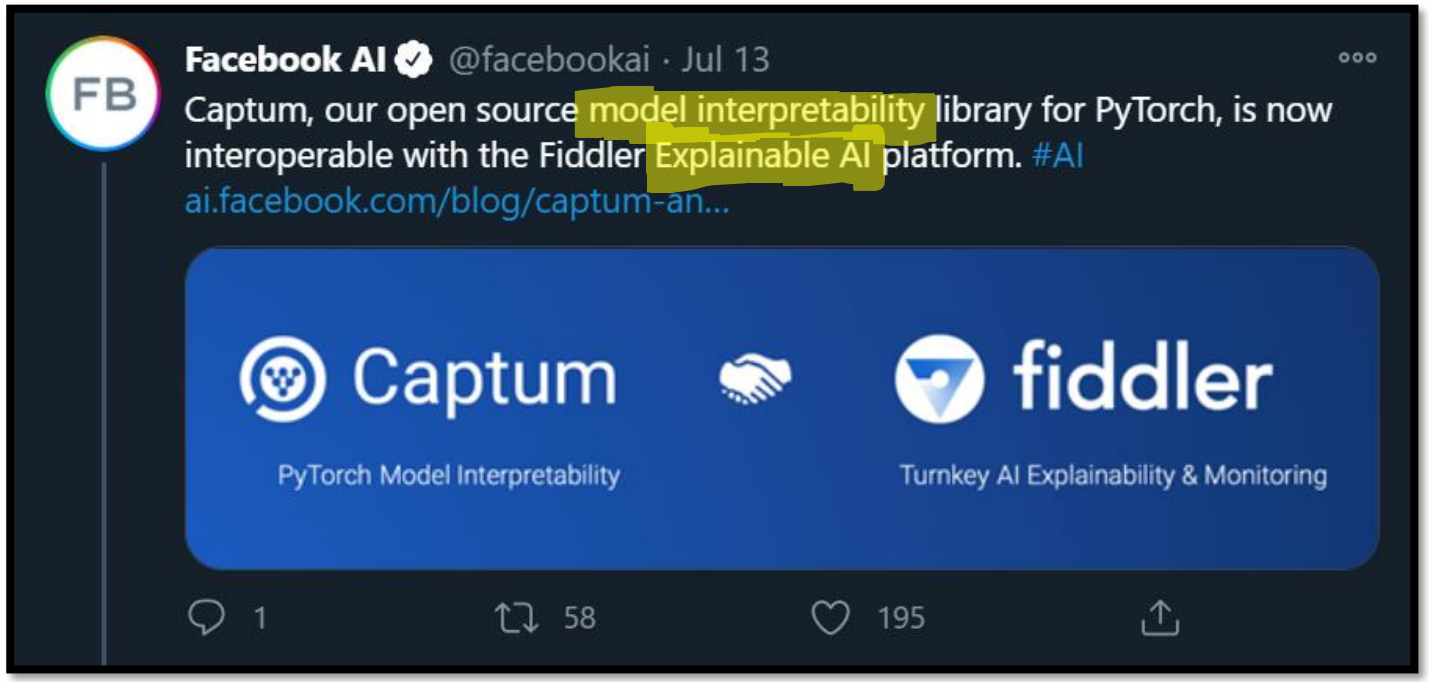
R 138 17

```
hbaniecki:~$ whoami
Research Software Engineer at Data Lab lead by Przemyslaw Biecek
Data Science Student at Warsaw University of Technology
Interested in Explainable AI and model-human interaction
Developing and maintaining the DrWhy.AI universe
Packages: DALEX & modelStudio & more
```


https://linkedin.com/in/hbaniecki

MI

The semantics of Explainable AI (XAI)

- **IBM**: A set of capabilities and methods used to describe an AI model, its expected impact and potential biases.
- **Microsoft**: *model interpretability*
- 

Fit interpretable models. Explain blackbox machine learning.

machine-learning interpretability gradient-boosting blackbox scikit-learn xai interpretml interpretable-machine-learning machine-learning-interpretability interpretable-ai transparency iml interpretable-ml explainable-ml explainability bias ai artificial-intelligence explainable-ai

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Explainable AI (XAI)

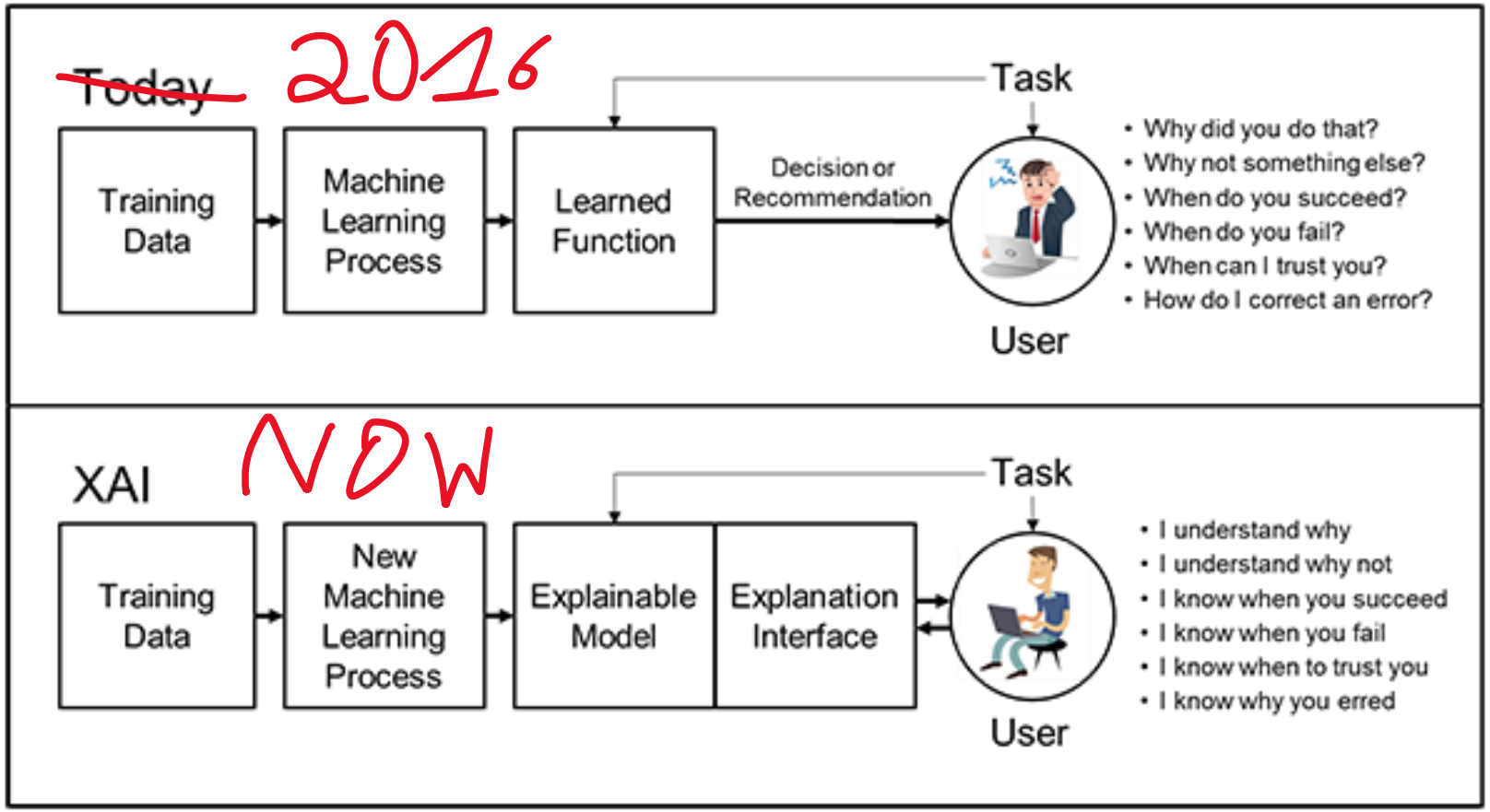
Google:
Tools and frameworks to understand and interpret your machine learning models.

https://cloud.google.com/explainable-ai

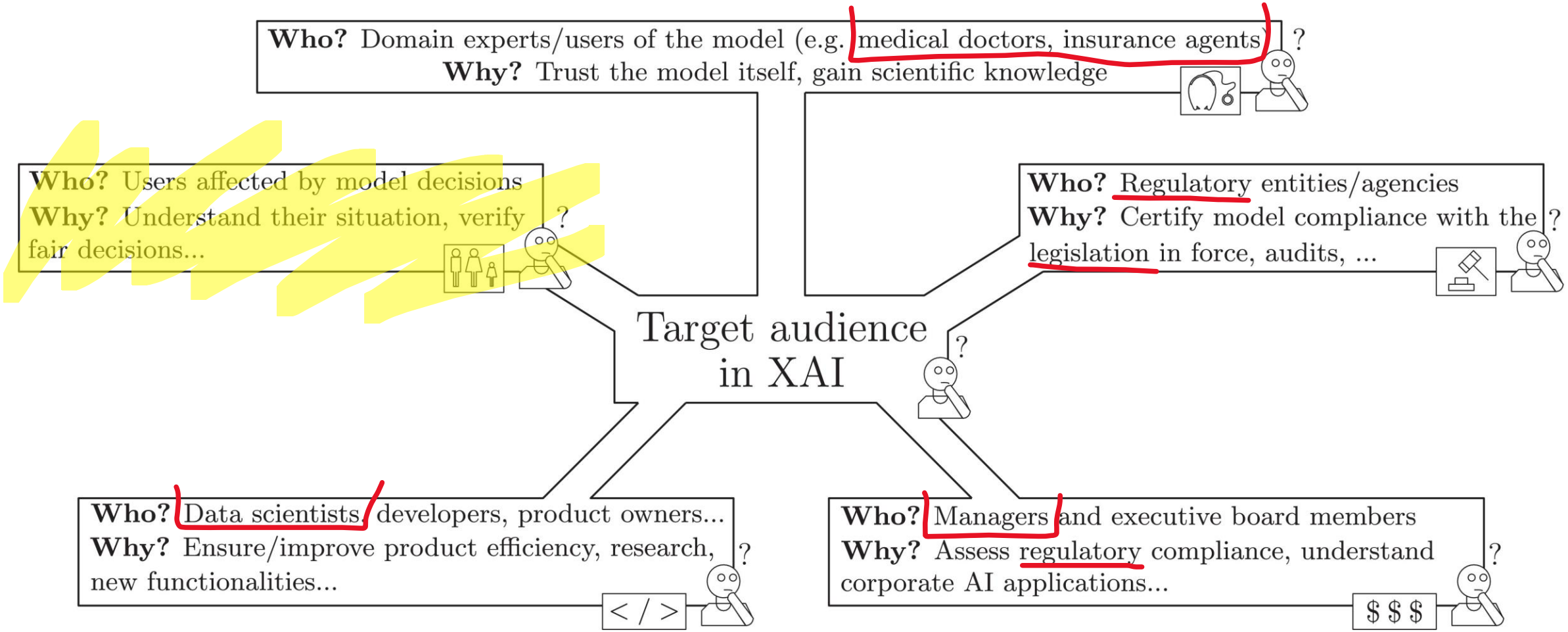
Invest in XAI research 2017-21

DARPA (Defense Advanced Research Projects Agency)

Government agency



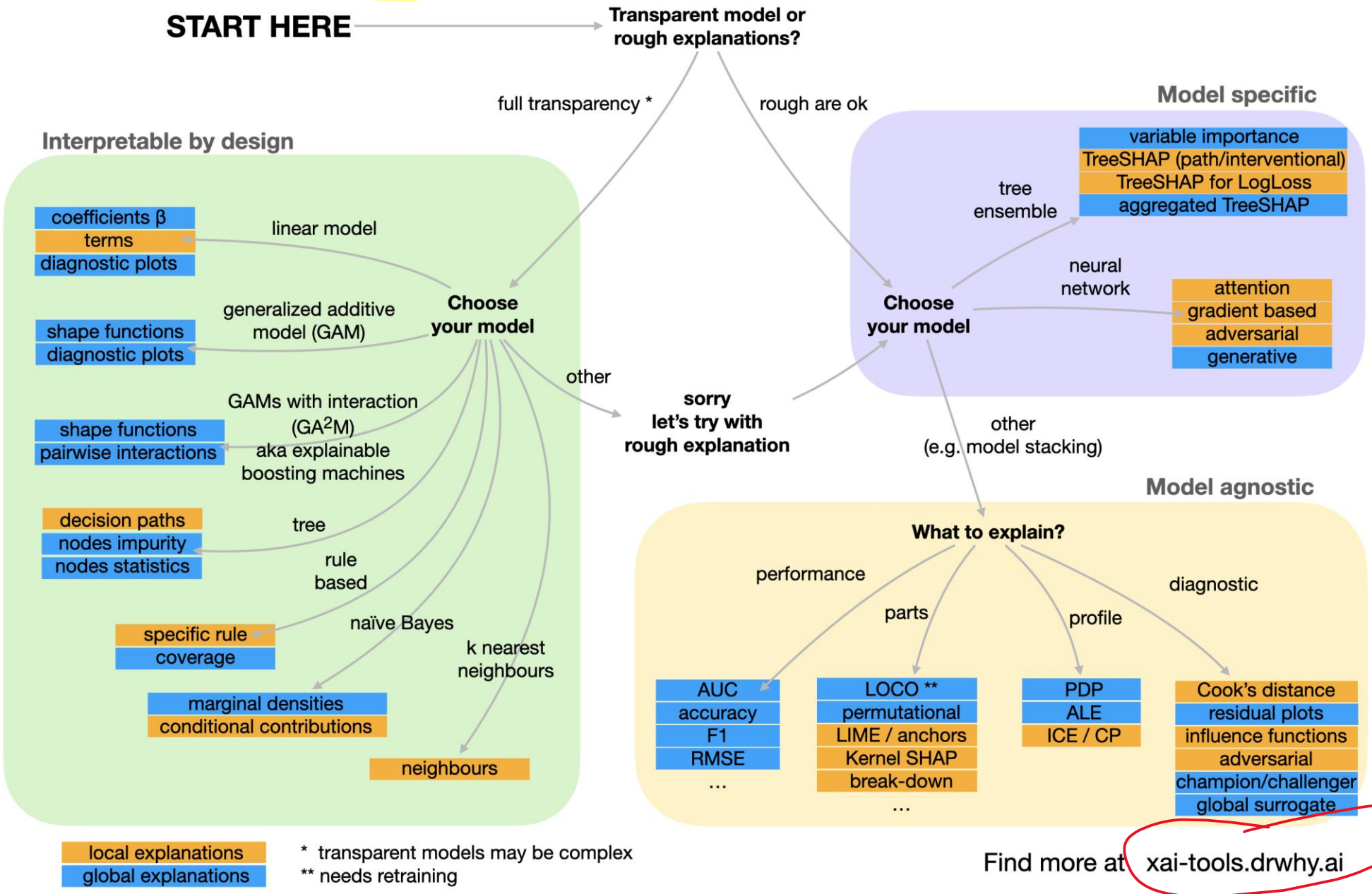
https://www.darpa.mil/program/explainable-artificial-intelligence



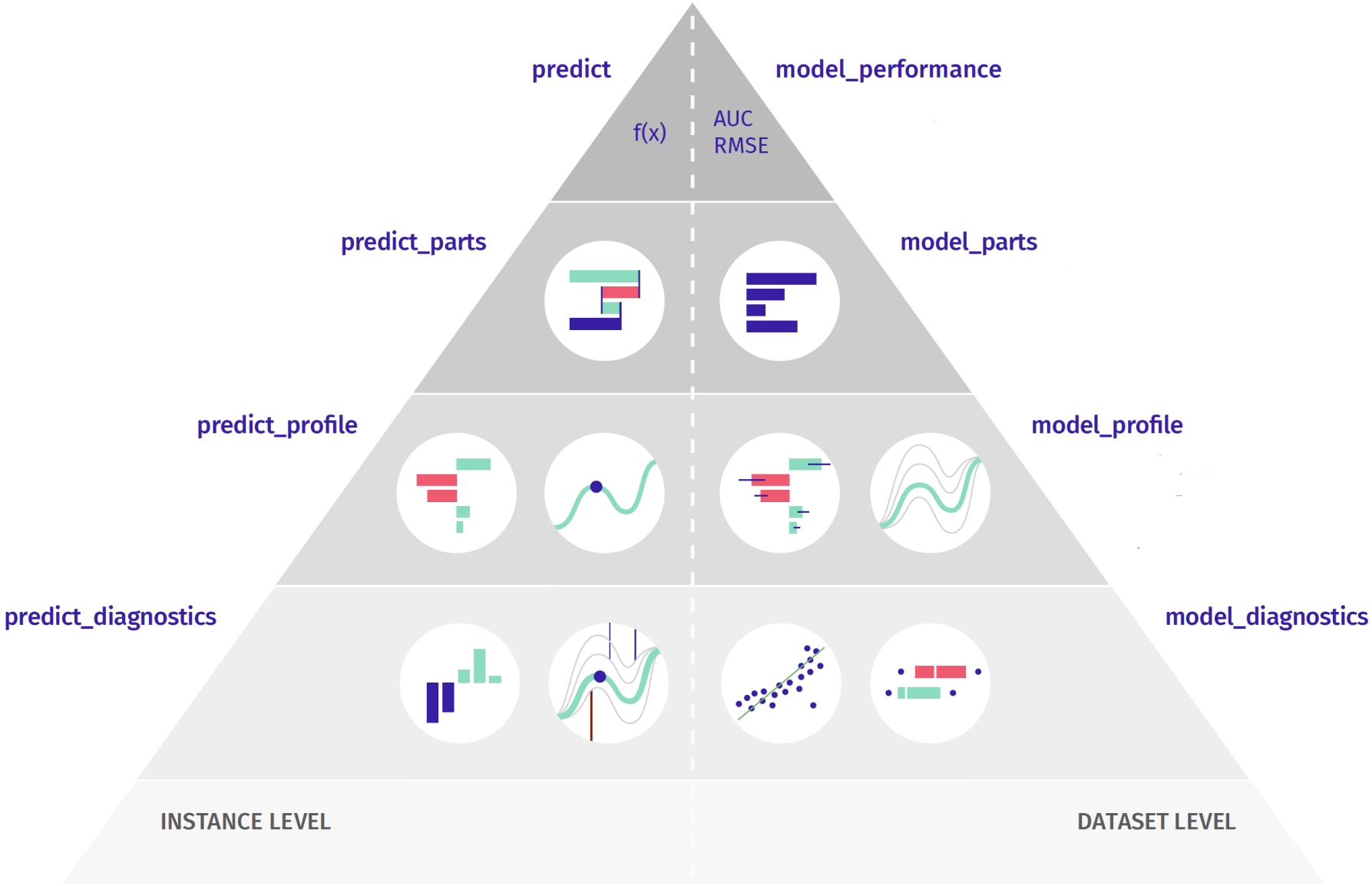
Arrieta, A. B. et al. (2020). Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. *Information Fusion*.

https://doi.org/10.1016/j.inffus.2019.12.012

Maksymiuk, S., Gosiewska, A., & Biecek, P. (2020). „Landscape of R packages for XAI". *arXiv preprint*

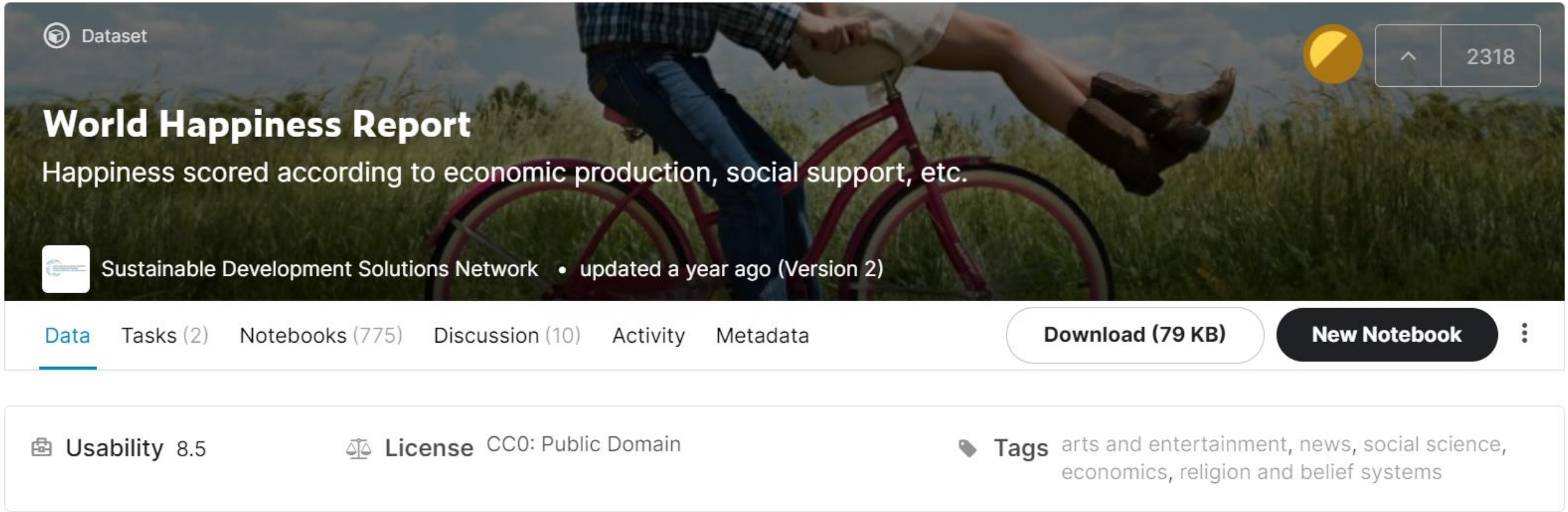


DALEX: moDel Agnostic Language for Exploration and eXplanation



http://dalex.drwhy.ai

Machine learning predictive task

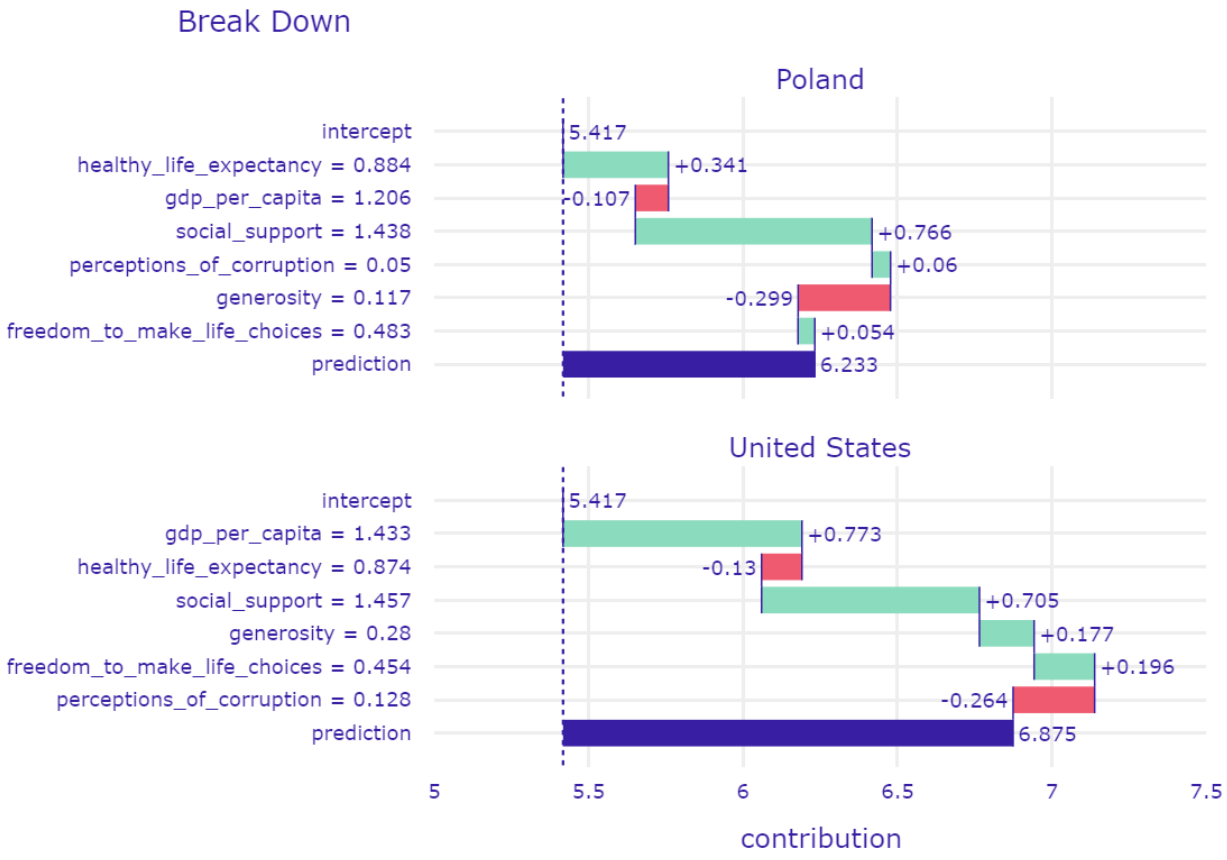


GDP, life expectancy, freedom, social => country happiness score [0, 10]

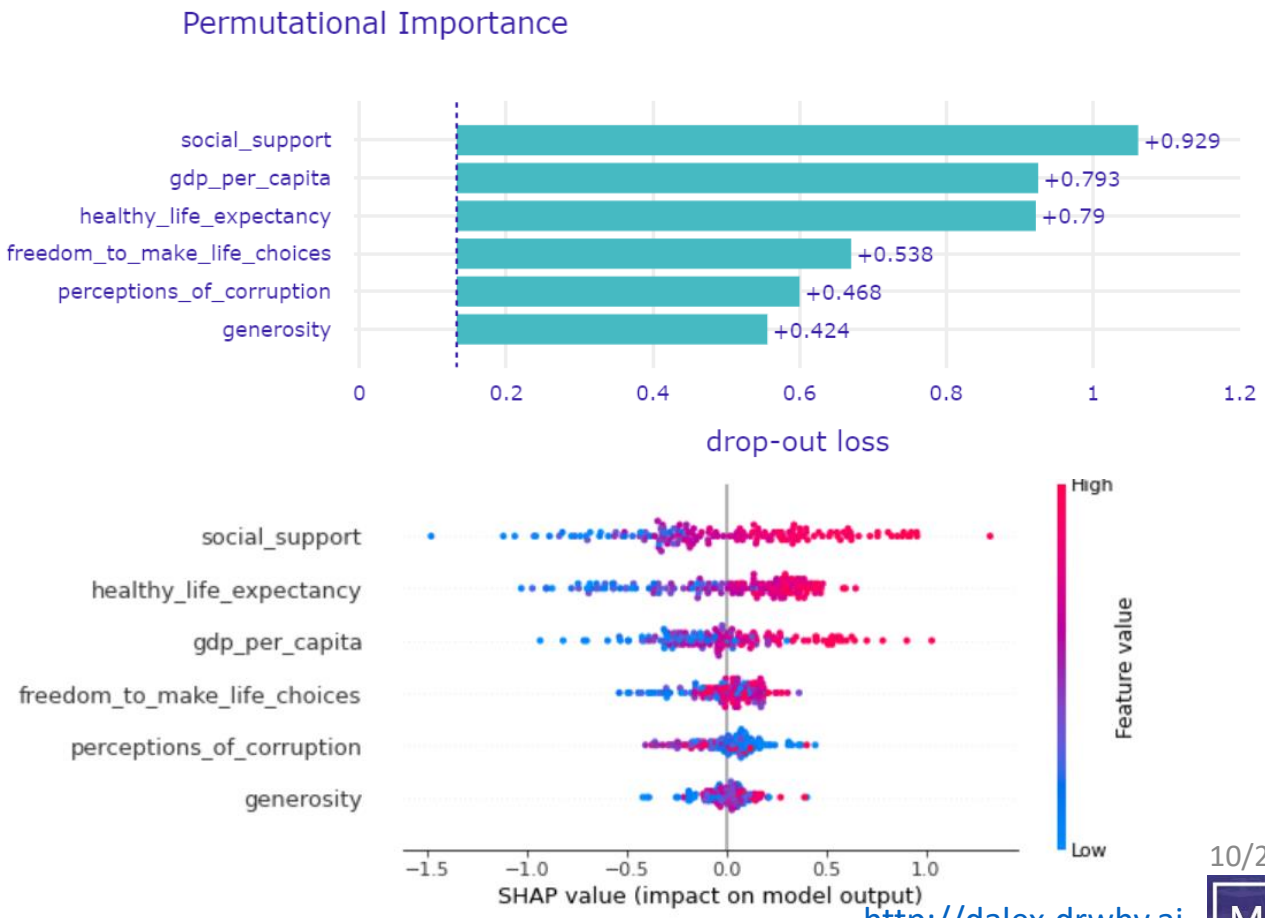
https://www.kaggle.com/unsdsn/world-happiness

parts

predict_parts



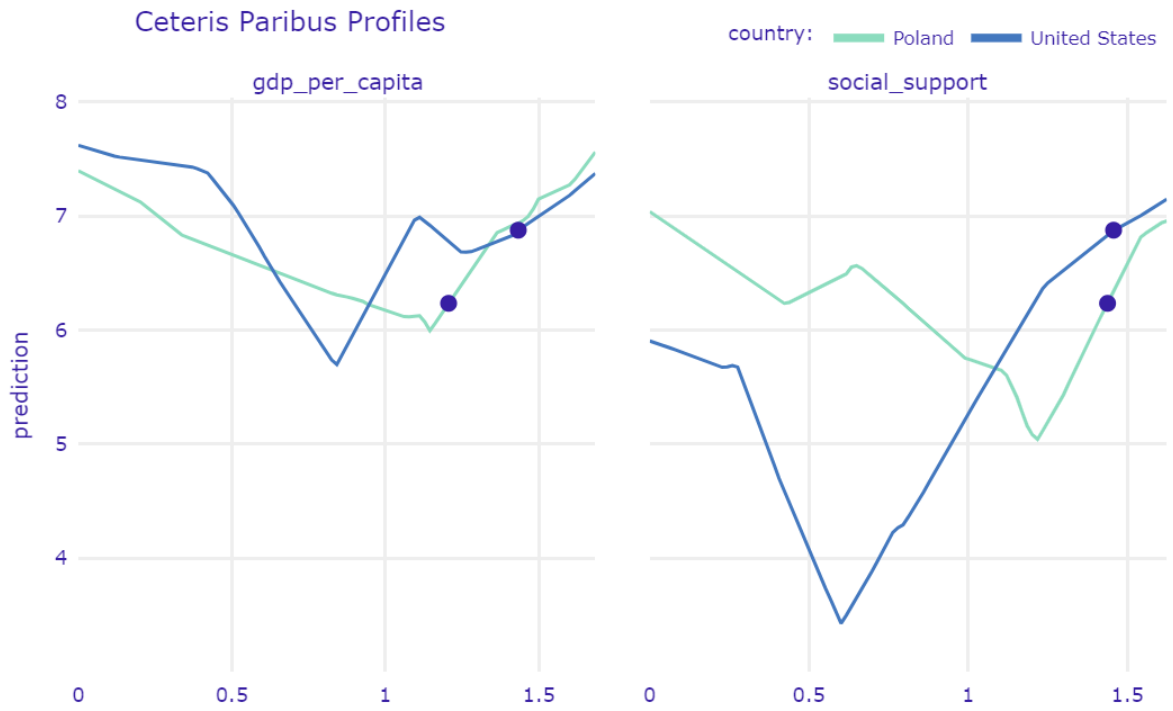
model_parts



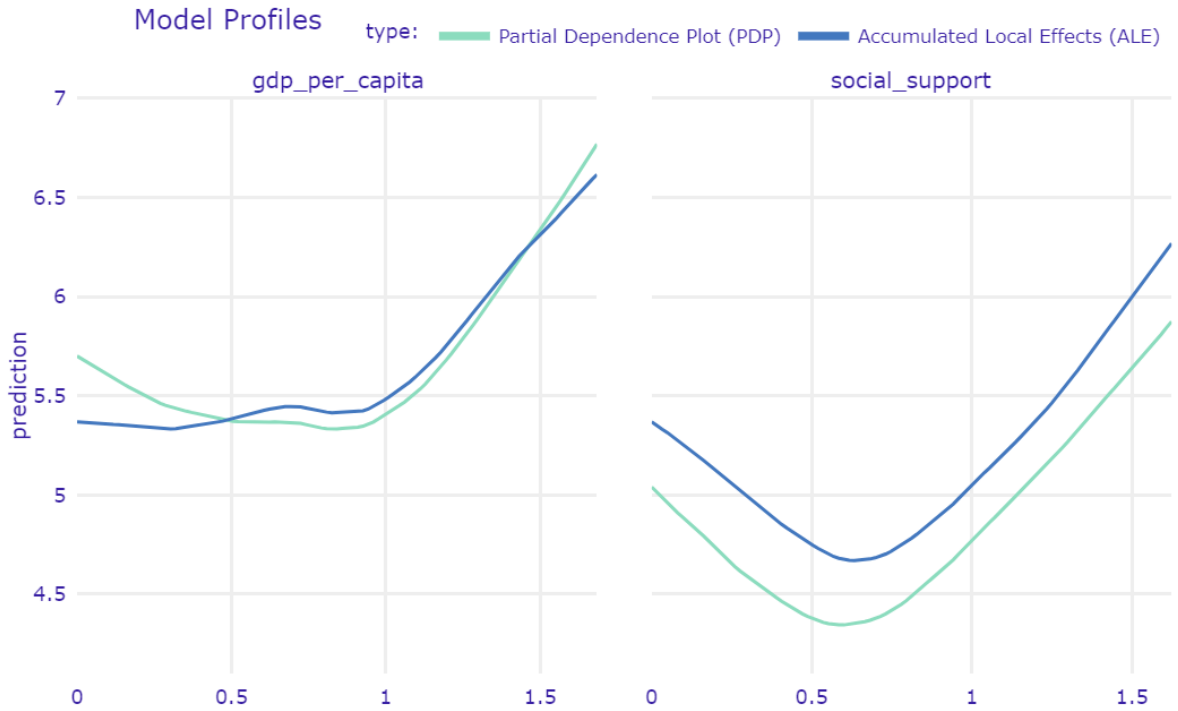
http://dalex.drwhy.ai

profile

predict_profile



model_profile



http://dalex.drwhy.ai

pip install dalex

import dalex as dx

MODEL

- scikit-learn
- tensorflow, keras
- xgboost, lightgbm
- ANY

DATA

- pandas
- numpy

dx.Explainer

METHODS

predict/model + parts/profile/diagnostics/surrogate/performance

EXPLANATIONS

- result attribute (pandas)
- plot method (plotly)

http://dalex.drwhy.ai

Explainer

```python
# 0. package
import dalex as dx

# 1. data
X, y = ...

# 2. model
model = ...
model.fit(X, y)

# 3. explainer
explainer = dx.Explainer(model, X, y)
```

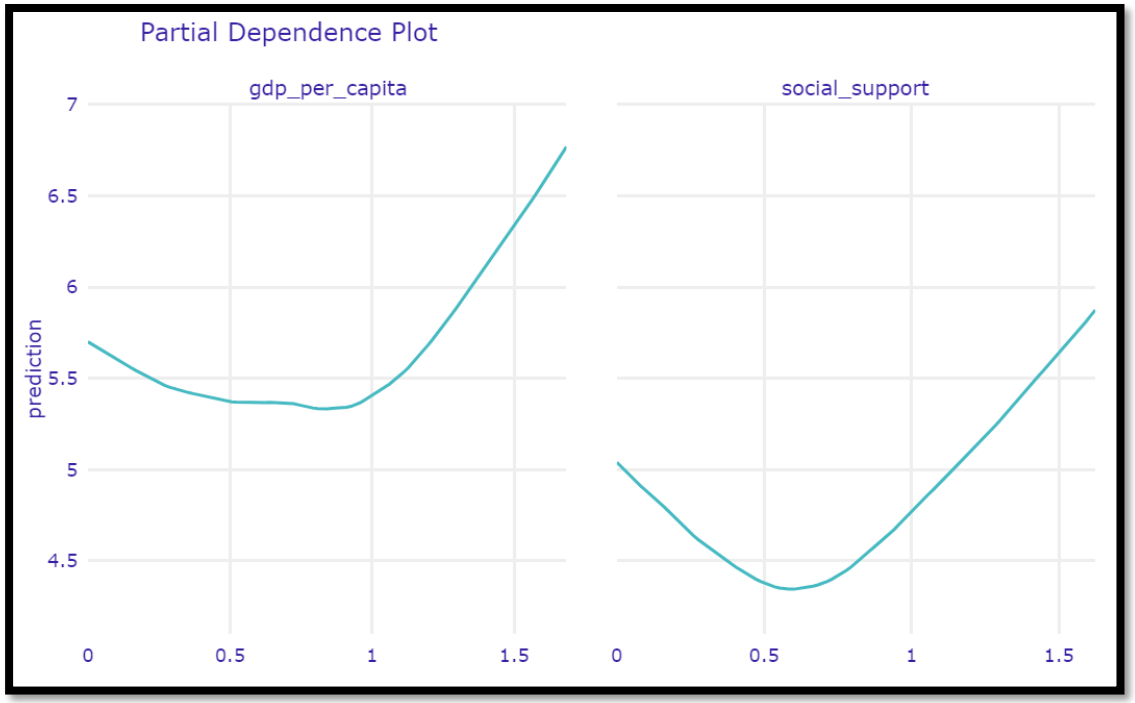
```
Preparation of a new explainer is initiated

  -> data              : 156 rows 6 cols
  -> target variable   : Argument 'y' was a pandas.Series. Converted to a numpy.ndarray.
  -> target variable   : 156 values
  -> model_class       : tensorflow.python.keras.engine.sequential.Sequential (default)
  -> label             : custom label
  -> predict function  : <function yhat_tf_regression at 0x000001D7649554C0> will be used
  -> predict function  : accepts pandas.DataFrame and numpy.ndarray
  -> predicted values  : min = 2.86, mean = 5.42, max = 7.73
  -> model type        : regression will be used (default)
  -> residual function : difference between y and yhat (default)
  -> residuals         : min = -0.616, mean = -0.0103, max = 0.555
  -> model_info        : package tensorflow

A new explainer has been created!
```

model

```
# 4. examine
explainer.model_performance()

# 5. explain
explainer.model_parts().result

# 6. explore
explainer.model_profile().plot()
```

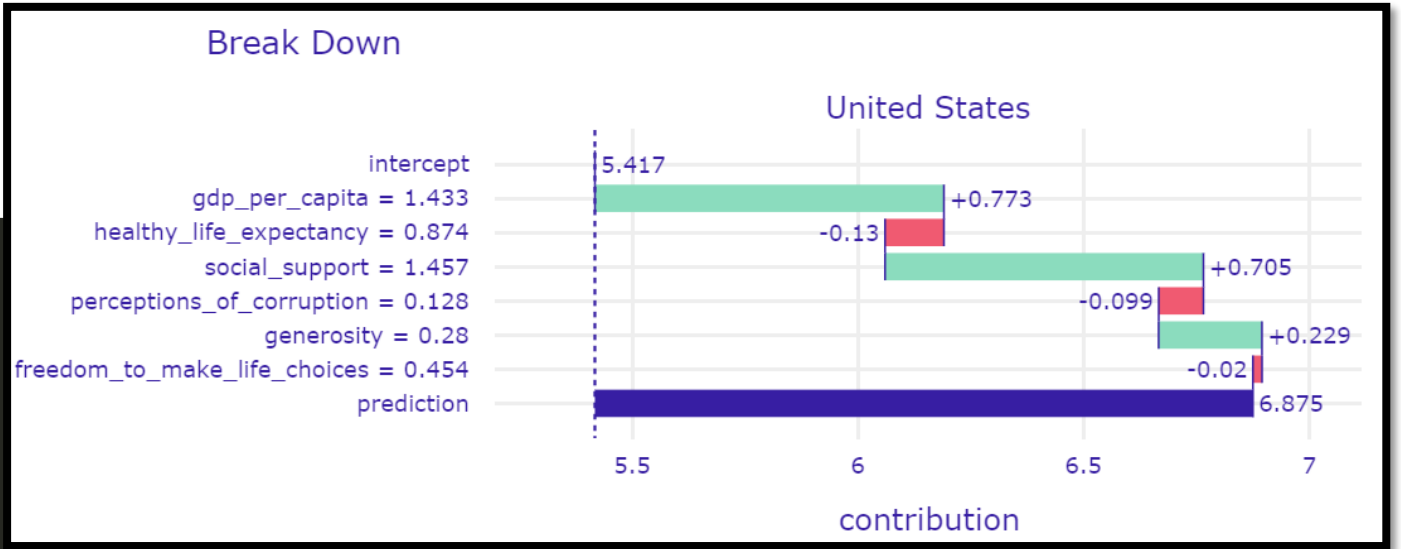
	mse	rmse	r2	mae	mad
	0.017569	0.132549	0.985729	0.072329	0.03636

	variable	dropout_loss	label
0	_full_model_	0.132549	custom label
1	generosity	0.567029	custom label
2	perceptions_of_corruption	0.572801	custom label
3	freedom_to_make_life_choices	0.665235	custom label
4	gdp_per_capita	0.888245	custom label
5	healthy_life_expectancy	0.917414	custom label
6	social_support	1.046778	custom label
7	_baseline_	1.557307	custom label

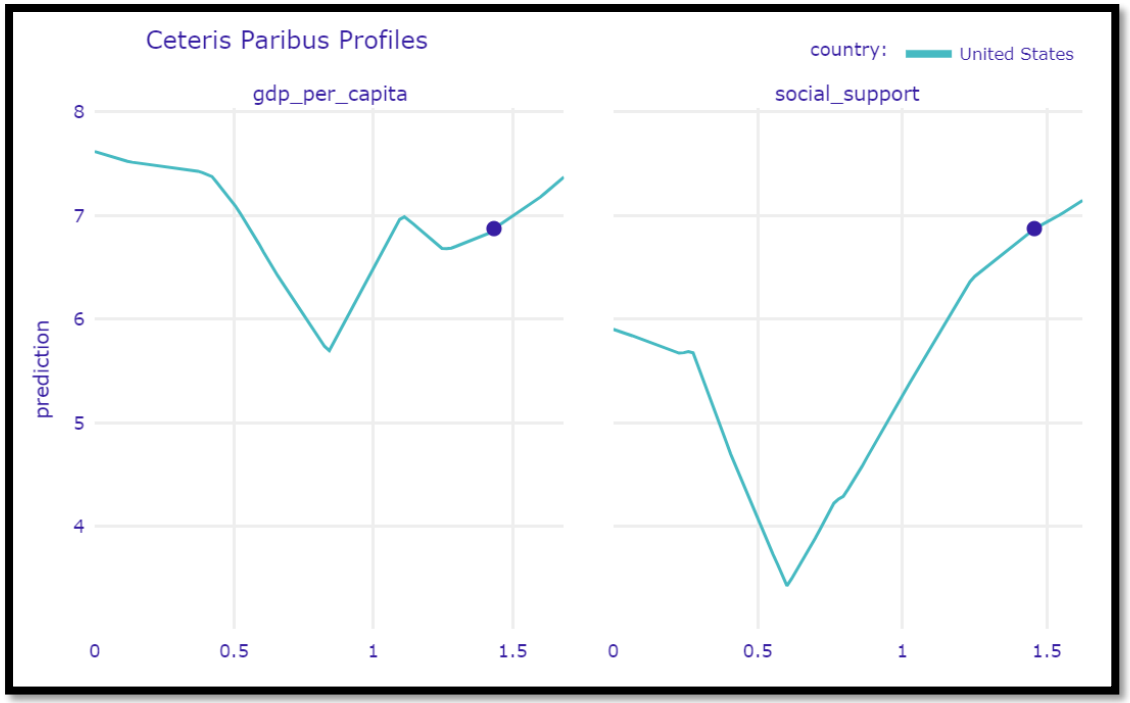


predict

```python
# 7. observation
obs = ...
explainer.predict(obs)

# 8. why?
explanation = explainer.predict_parts(obs)
explanation.result
explanation.plot()

# 9. what if?
explainer.predict_profile(obs).plot()
```

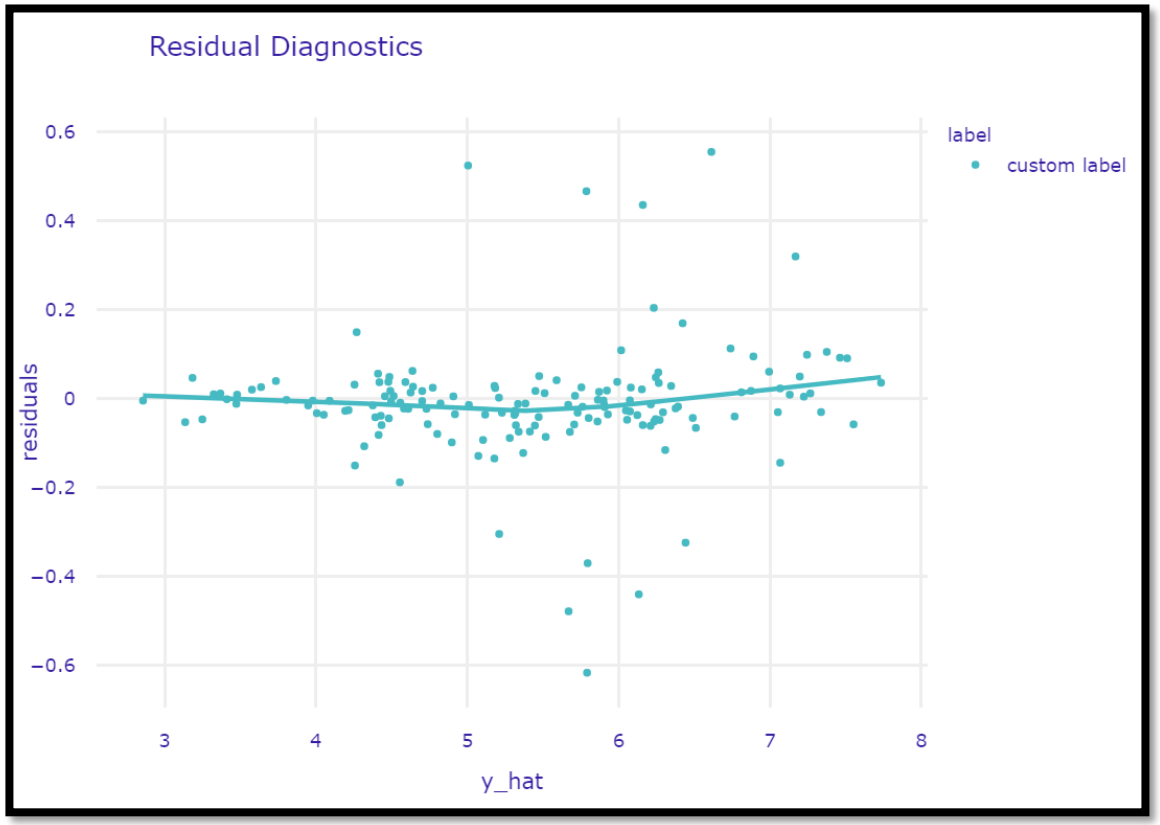


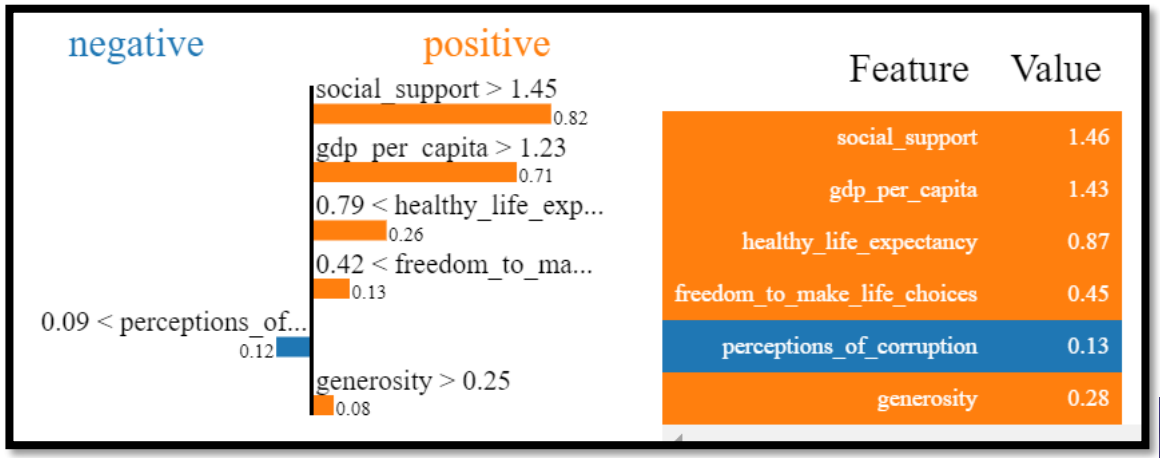
	variable_name	variable_value	variable	cumulative	contribution	sign	position	label
0	intercept	1	intercept	5.417360	5.417360	1.0	7	custom label
1	gdp_per_capita	1.433	gdp_per_capita = 1.433	6.189979	0.772619	1.0	6	custom label
2	healthy_life_expectancy	0.874	healthy_life_expectancy = 0.874	6.059744	-0.130235	-1.0	5	custom label
3	social_support	1.457	social_support = 1.457	6.764811	0.705067	1.0	4	custom label
4	perceptions_of_corruption	0.128	perceptions_of_corruption = 0.128	6.666029	-0.098782	-1.0	3	custom label
5	generosity	0.28	generosity = 0.28	6.894894	0.228865	1.0	2	custom label
6	freedom_to_make_life_choices	0.454	freedom_to_make_life_choices = 0.454	6.874513	-0.020381	-1.0	1	custom label
7			prediction	6.874512	6.874512	1.0	0	custom label

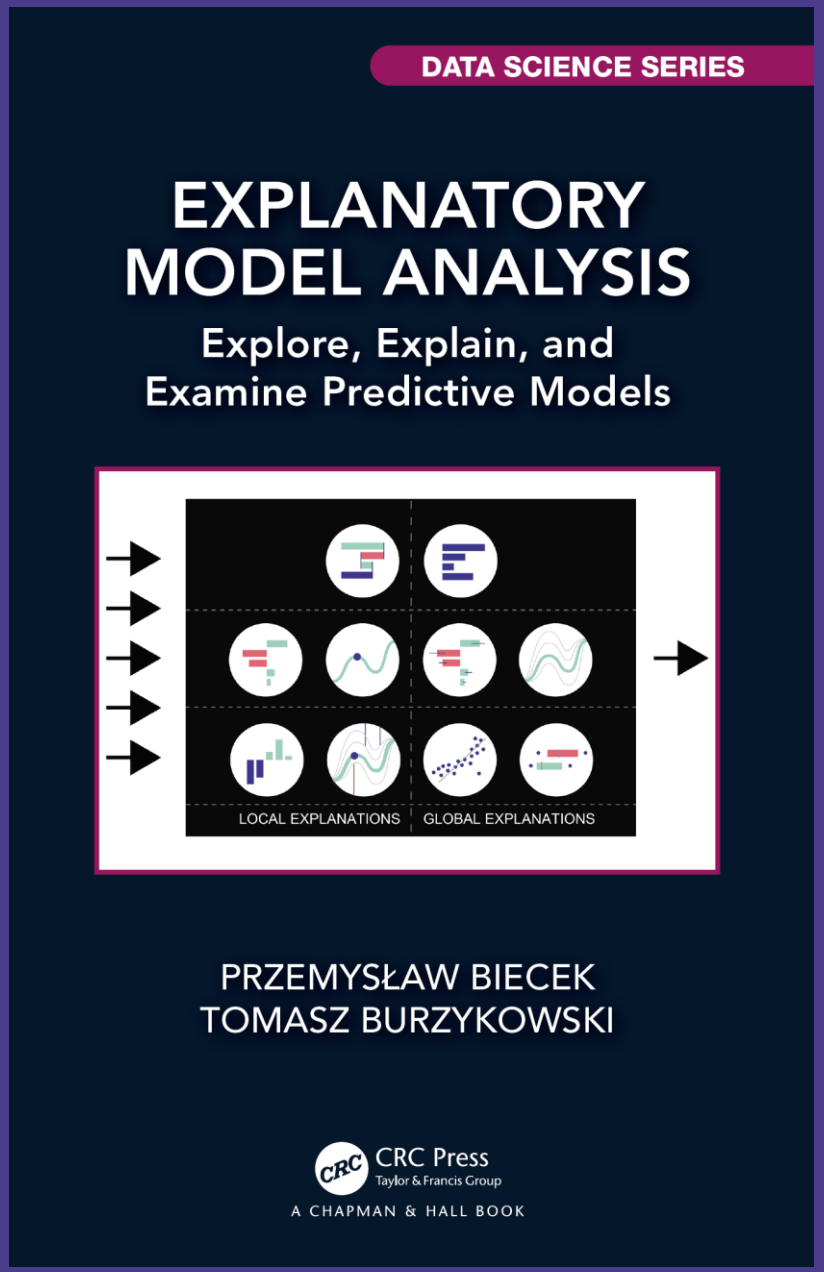


more!

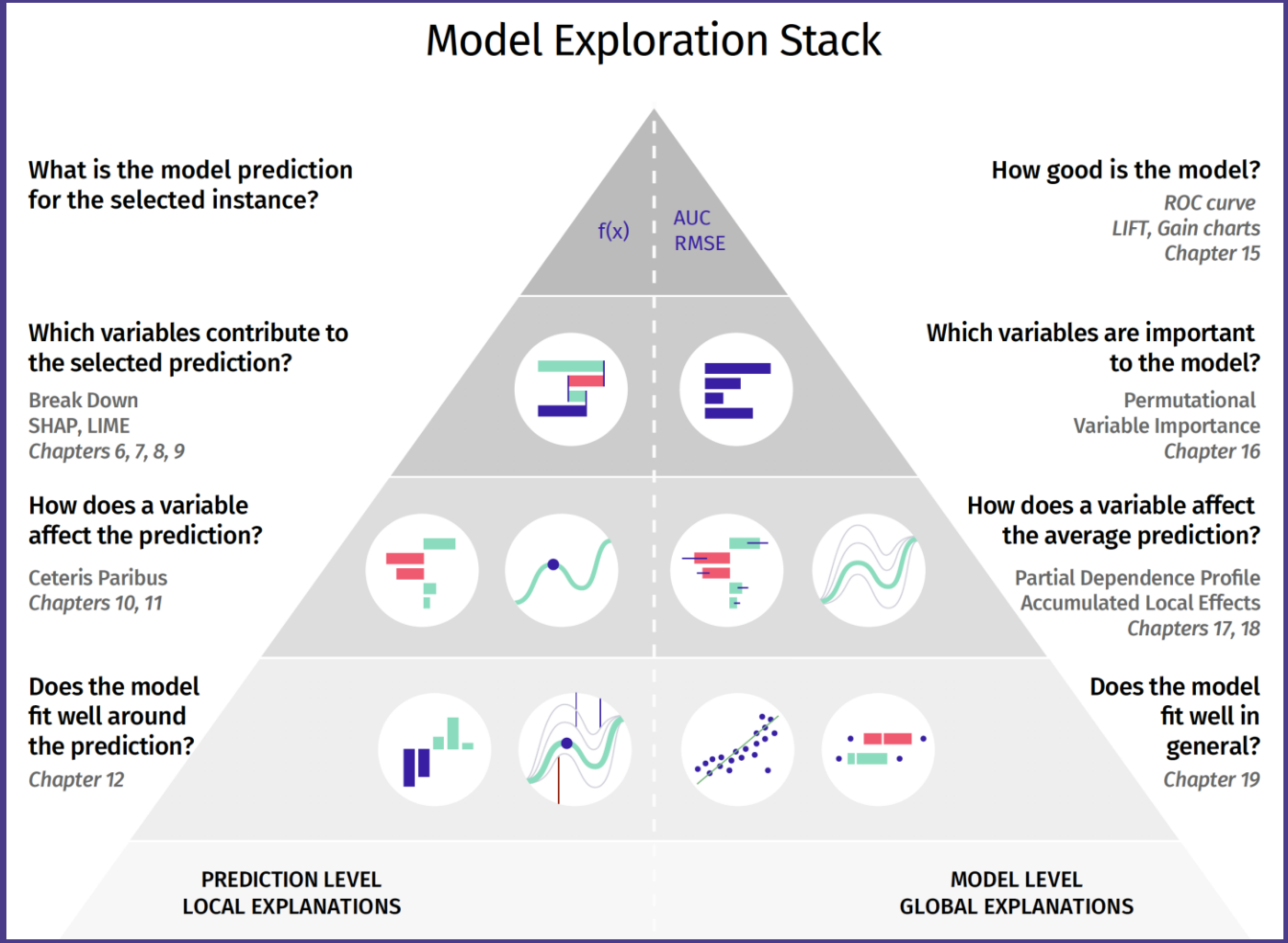
```
# 10. residuals
explainer.model_diagnostics().plot()

# 11. surrogate
tree = explainer.model_surrogate()
tree.plot()

# 13. types
explainer.model_profile(type='accumulated')

# 14. shap
explainer.model_parts(type='shap_wrapper')

# 15. lime
explainer.predict_surrogate(obs)
```



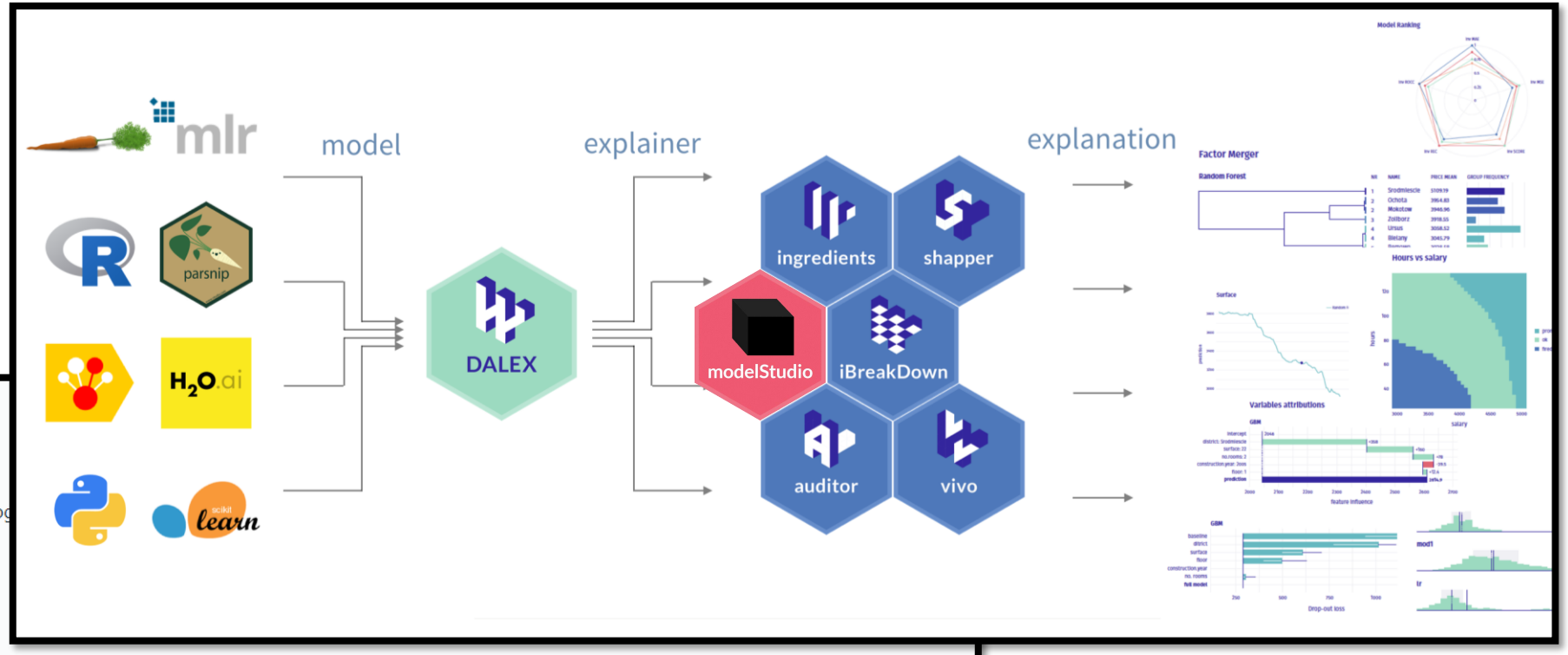




https://pbiecek.github.io/ema/



DrWhy.AI



Model Oriented

MI2DataLab @ Warsaw University of Technolog

Repositories 46 | Packages | People 21

DALEX
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DrWhy
DrWhy is the collection of tools for eXplainable AI (XAI). It's based on shared principles and simple grammar for exploration, explanation and visualisation of predictive models.
R 398 51

randomForestExplainer
A set of tools to understand what is happening inside a Random Forest
R 166 25

modelStudio
Interactive Studio for Explanatory Model Analysis
R 138 17

modelDown
modelDown generates a website with HTML summaries for predictive models
R 101 12

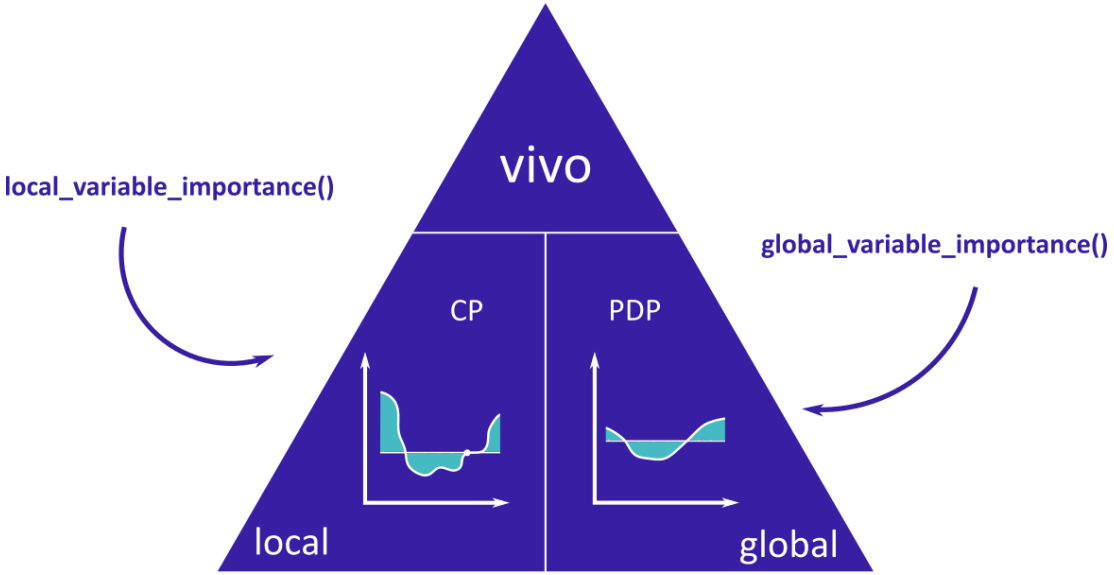
iBreakDown
Break Down with interactions for local explanations (SHAP, BreakDown, iBreakDown)
R 54 9

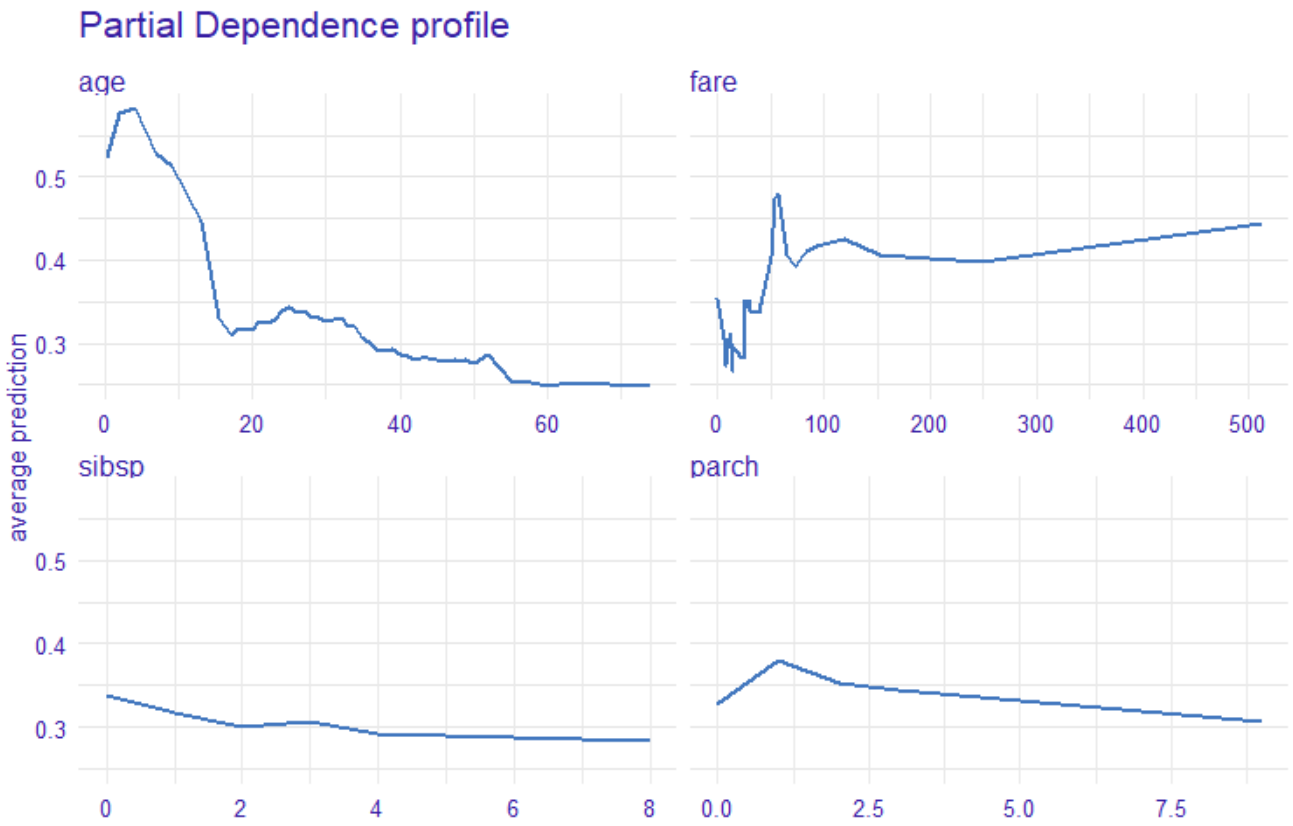
http://drwhy.ai/

MI

vivo

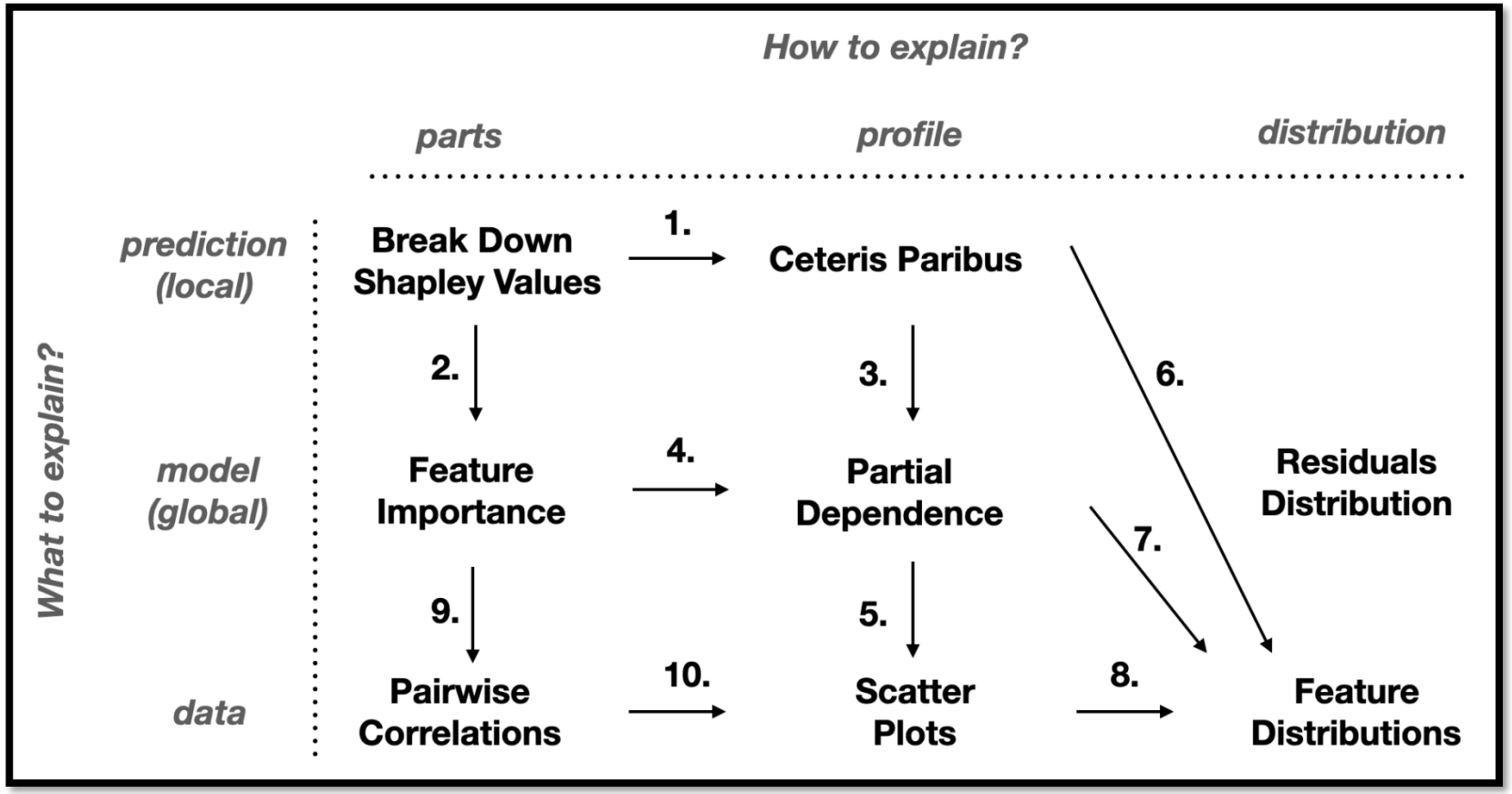
- alternative, model-agnostic way of calculating variable importance
- based on the Ceteris Paribus and Partial Dependence Profiles
- faster, no random component





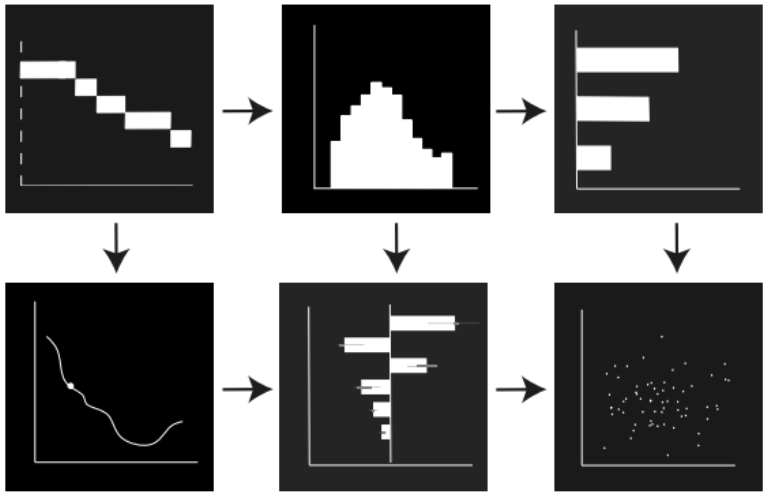
https://github.com/ModelOriented/vivo

Interactive XAI



II generation explanations

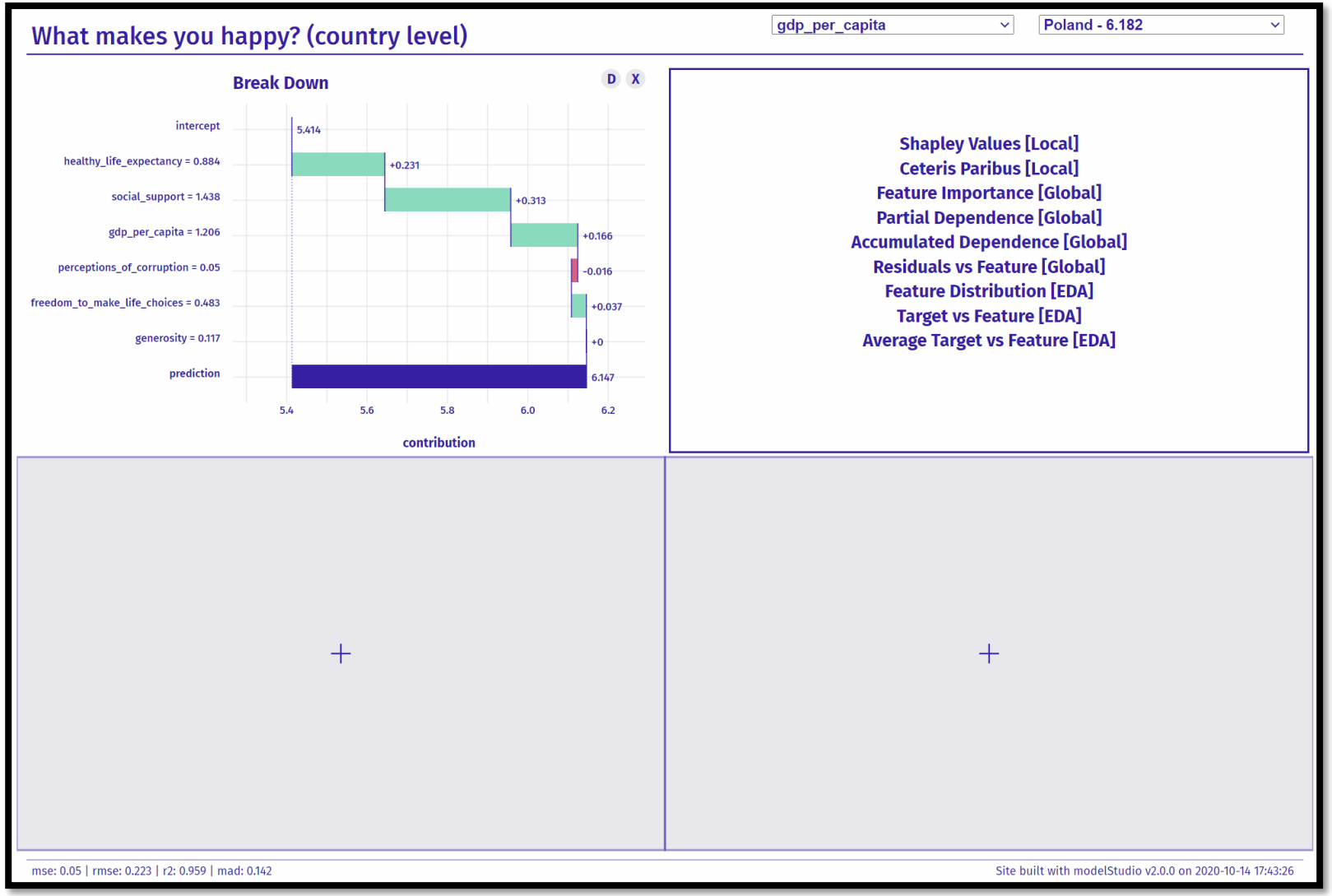
(interactive explanatory model analysis)



https://arxiv.org/abs/2005.00497

modelStudio

- creates a dashboard for interactive Explainable AI
- model explanation and data exploration
- automated calculations
- save & share your analysis



https://github.com/ModelOriented/modelStudio

convenient

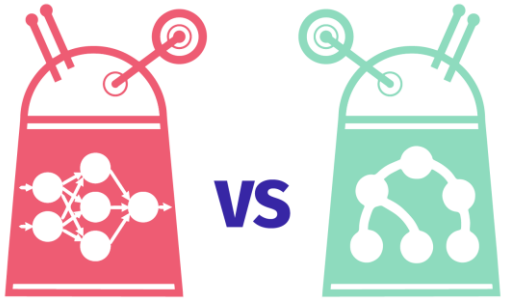
```r
# 0. package
library("DALEX")
library("modelStudio")

# 1. data
X <- ...
y <- ...

# 2. model
model <- ...

# 3. explainer
explainer <- DALEX::explain(model, X, y)

# 4. dashboard
ms <- modelStudio::modelStudio(explainer)
ms
```

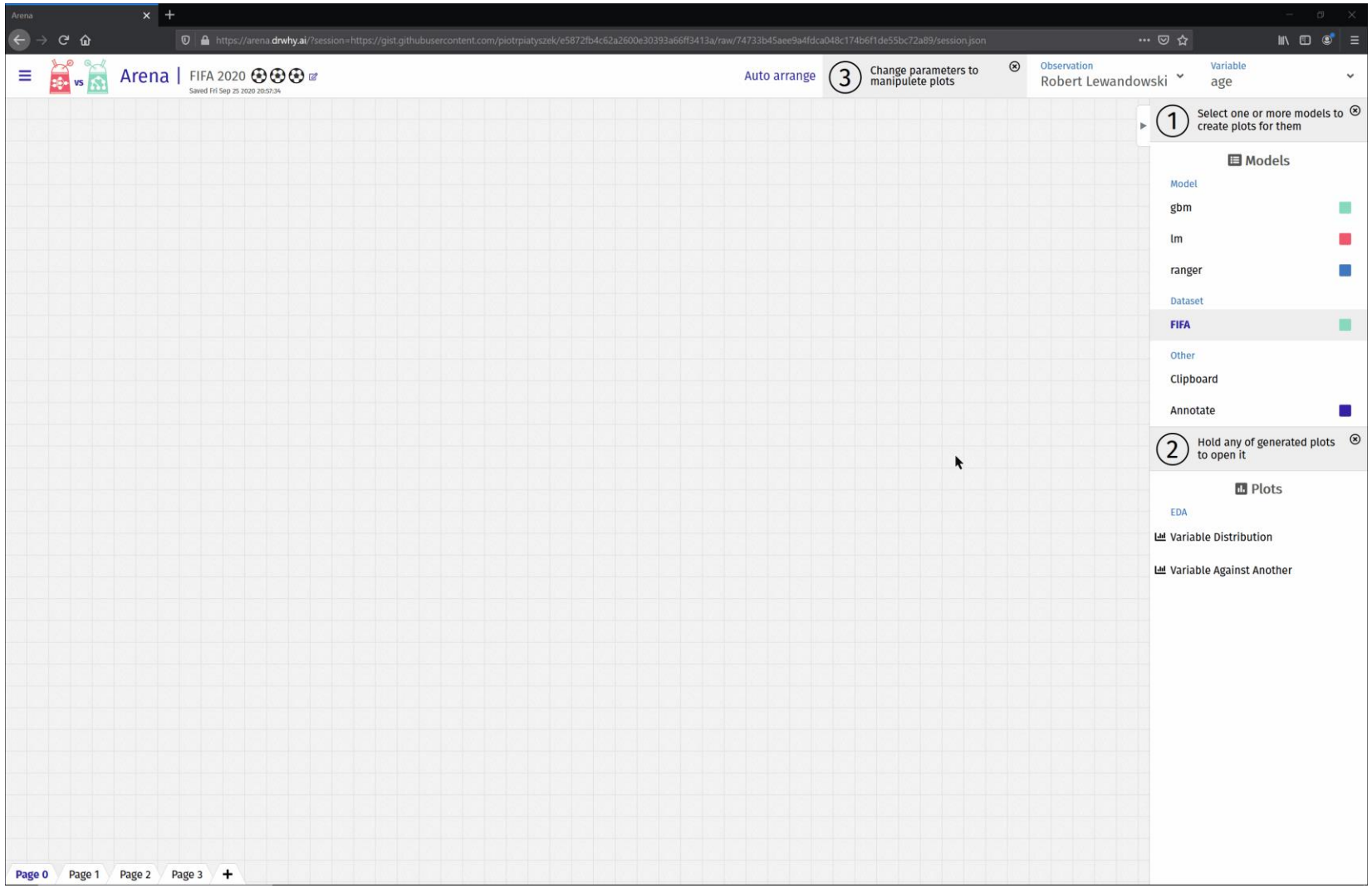
DEMO:

https://pbiecek.github.io/xai-happiness

Arena

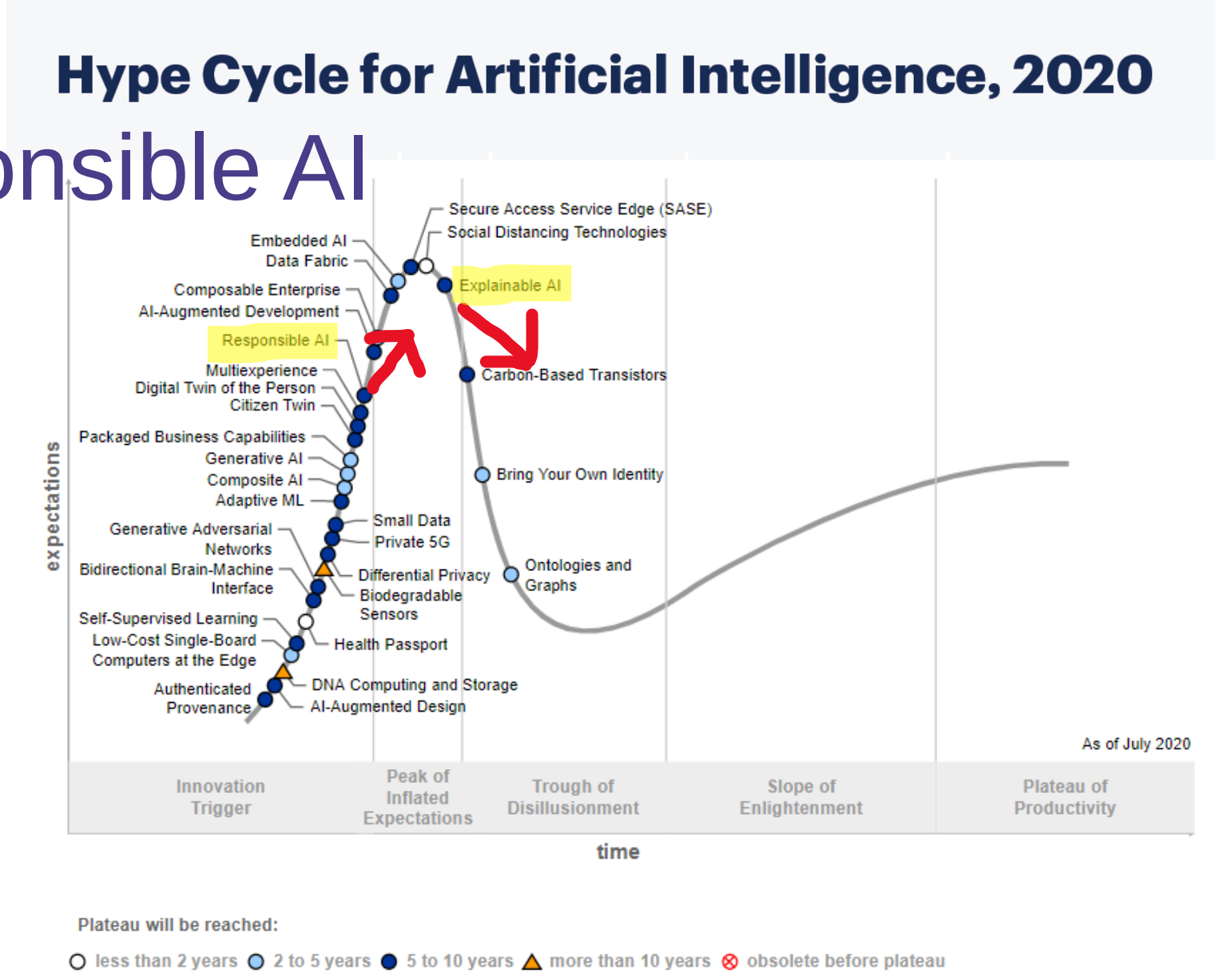
- multiple models!
- multiple datasets!!
- more plots (e.g. fairness)
- pages & cache & …
- R & Python (next version)





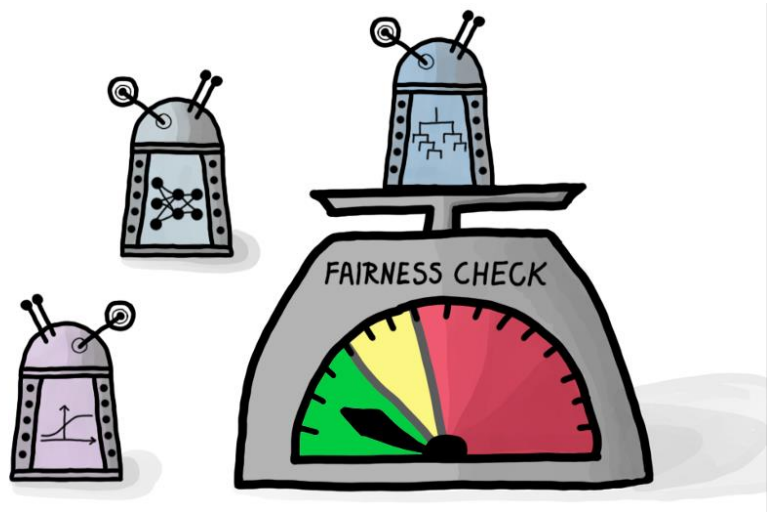
http://arena.drwhy.ai

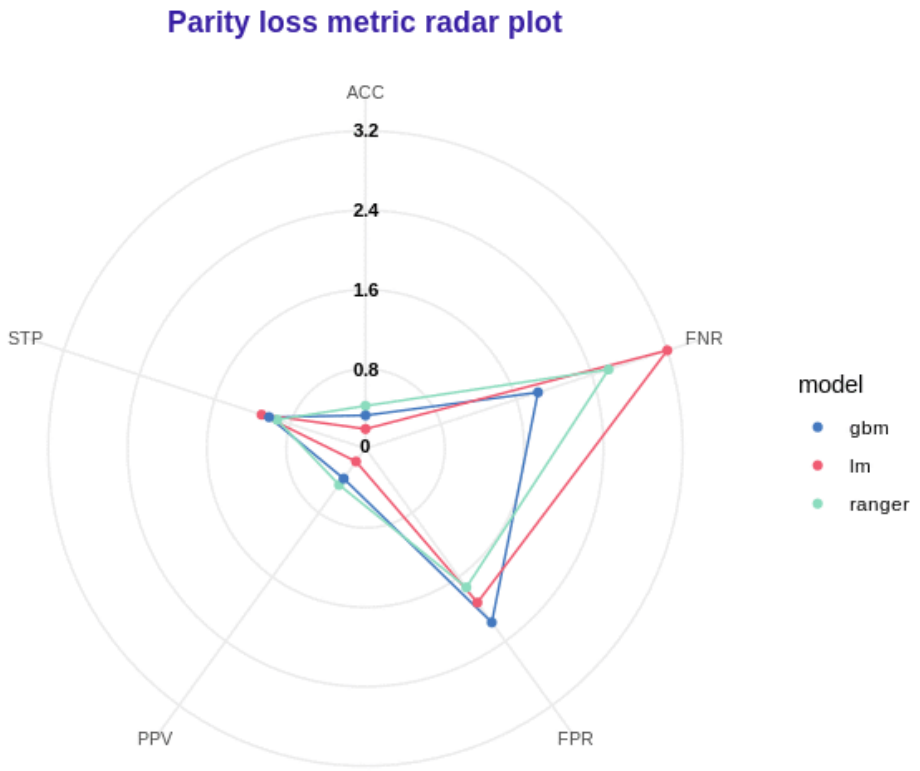
Responsible AI (RAI)



fairmodels

- check model fairness in respect to sensitive categorical variables
- pre- and post- bias mitigation
- compare measures for multiple models
- various techniques and visualisations

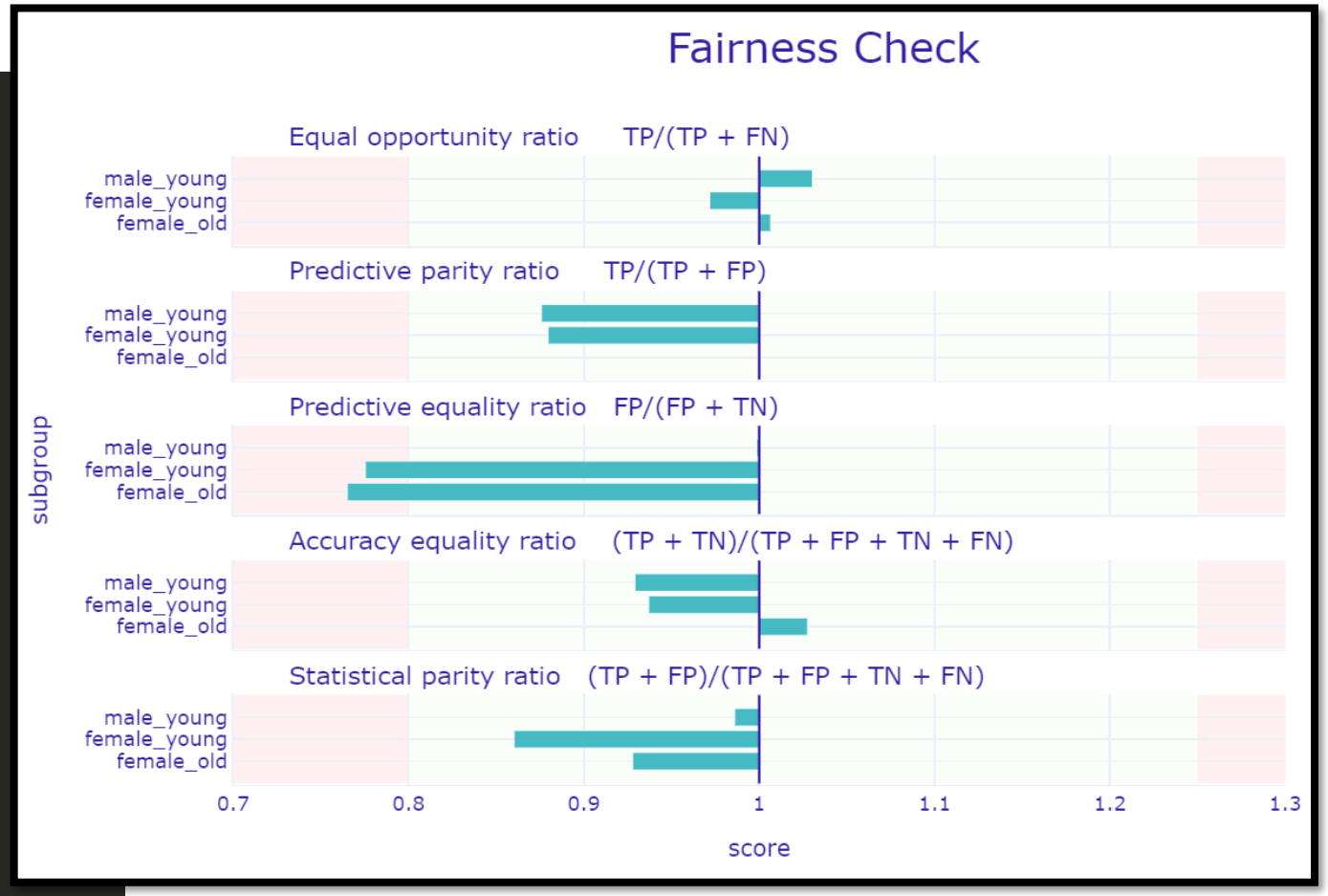




https://github.com/ModelOriented/fairmodels

fairness check

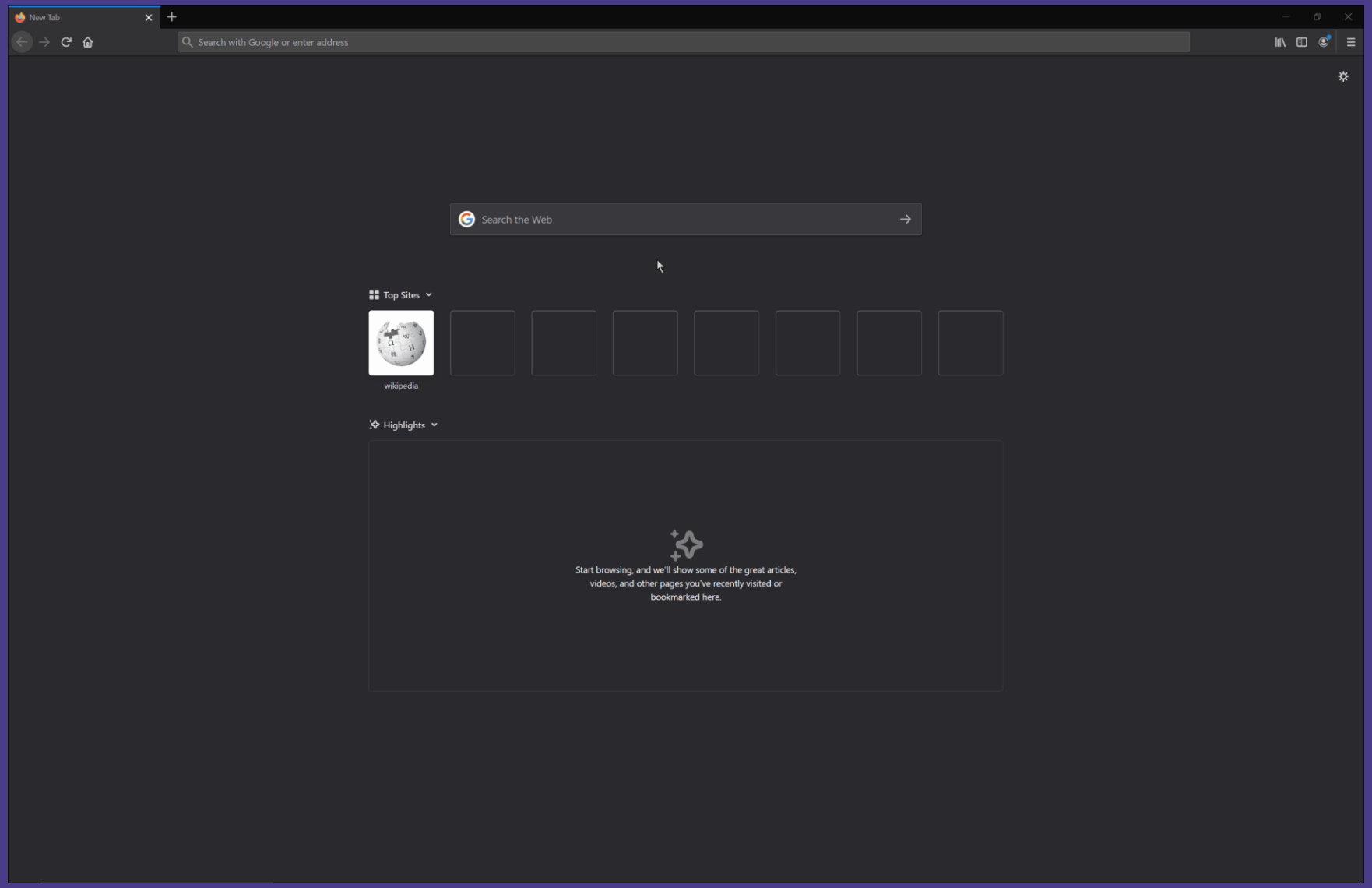
```
# 1. protected variable with subgroups
protected = [race + sex + age for ...]

# 2. priviliged subgroup
priviliged = 'white_male_young'

# 3. fairness
explanation = explainer.model_fairness(
    protected, priviliged
)

# 4. check
explanation.fairness_check()

# 5. explain
explanation.result
explanation.plot()
```



http://dalex.drwhy.ai

DrWhy.AI blog: Responsible ML

https://medium.com/responsibleml



Feedback apprieciated !

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DALEX	dalex.drwhy.ai
DrWhy.AI	drwhy.ai
Blog	medium.com/responsibleml