Data modelling projects from an idea to production with the help of Python

Martyna Urbanek-Trzeciak - PyData Warsaw - 2019

Agenda

December
12
2019

- Intro (me, Fandom & data)
- ML process with Python
  - Idea
  - Data preparation
  - Data modelling
  - Communication of the results
  - Implementation on production
  - Monitoring of model performance
- Questions

Goal

- **Know which Python libraries are helpful on each step in machine learning projects**
  - **Fandom set up example**
- **Machine learning projects are no magic and we should not treat it like it**
  - **And we can achieve good results with simple solutions**

Intro

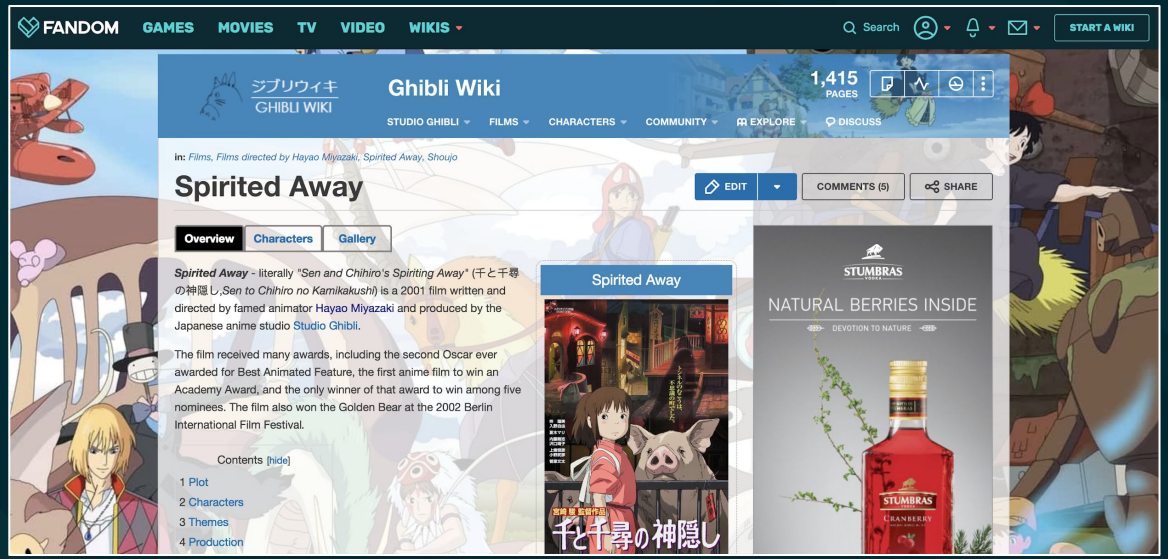
Martyna Urbanek-Trzeciak

- MSc in Biotechnology, PhD in Biochemistry & MSc in Computer Science
- In FANDOM for over 2.5 years as data analyst (working mostly with Ad Engineering team)

Fandom

- **Entertainment (mostly) wikis**
- **Thousands of**
  - **Communities**
  - **Pageviews**
  - **Users**

Intro



What we like ;)


GAME OF THRONES


Rick and Morty


STAR WARS


NARUTO
-ナルト-

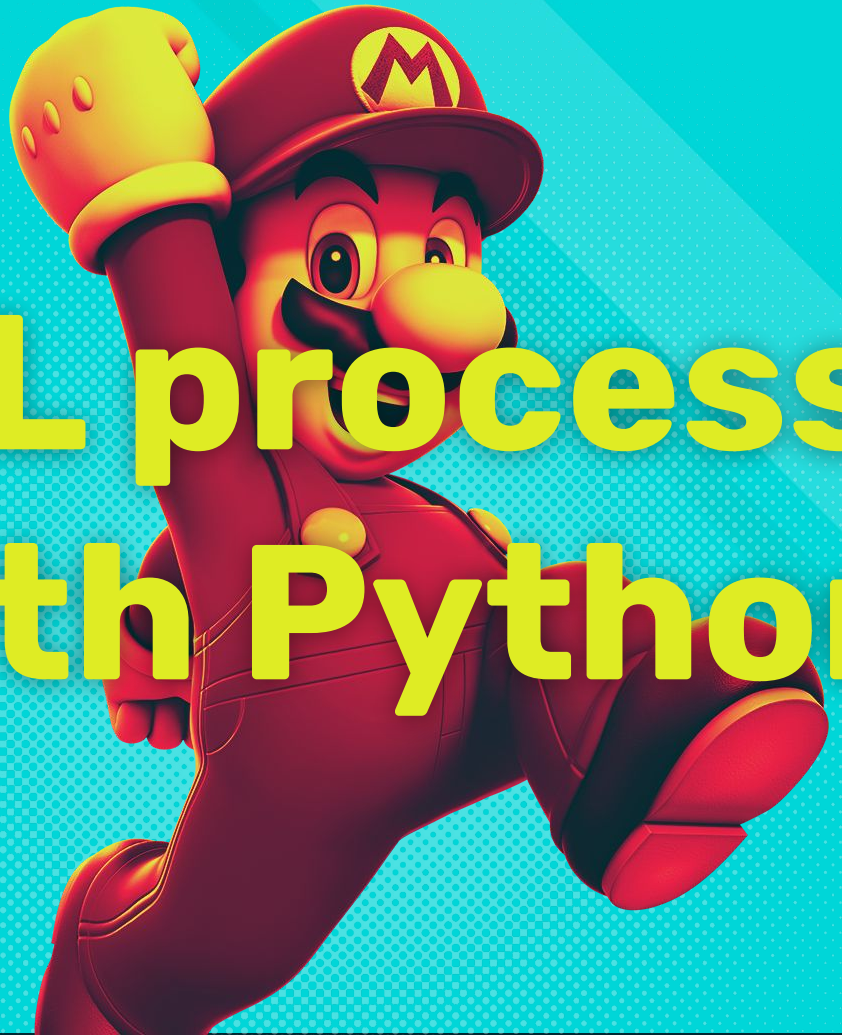

Pretty Little Liars

We love data!

Data

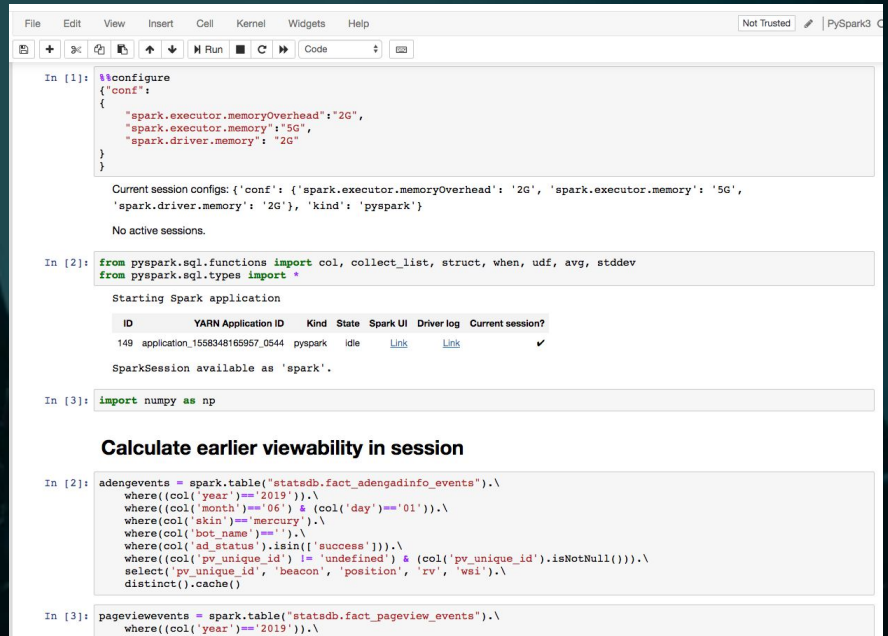
- Data Warehouse
- Google Analytics
- Firebase
- Google Ad Manager
- Krux
- Third party partners data
- ...

ML process with Python



Idea

- During data analysis we can observe interesting trends in data and find weak points of performance that could be improved with data modelling
- Setup and Python libraries:
  - Jupyterhub
  - Pyspark3
  - Pandas, Numpy
  - Matplotlib, seaborn
  - Bokeh, plotly
  - Sroka



File Edit View Insert Cell Kernel Widgets Help — Not Trusted — PySpark3

Run — Code

In [1]:
```
%%configure
{"conf":
{
    "spark.executor.memoryOverhead":"2G",
    "spark.executor.memory":"5G",
    "spark.driver.memory": "2G"
}
}
```

Current session configs: {'conf': {'spark.executor.memoryOverhead': '2G', 'spark.executor.memory': '5G', 'spark.driver.memory': '2G'}, 'kind': 'pyspark'}

No active sessions.

In [2]:
```
from pyspark.sql.functions import col, collect_list, struct, when, udf, avg, stddev
from pyspark.sql.types import *
```

Starting Spark application

ID	YARN Application ID	Kind	State	Spark UI	Driver log	Current session?
149	application_1558348165957_0544	pyspark	idle	Link	Link	✔

SparkSession available as 'spark'.

In [3]:
```
import numpy as np
```

Calculate earlier viewability in session

In [2]:
```
adengevents = spark.table("statsdb.fact_adengadinfo_events").\
    where((col('year')=='2019')).\
    where((col('month')=='06') & (col('day')=='01')).\
    where(col('skin')=='mercury').\
    where(col('bot_name')=='').\
    where(col('ad_status').isin(['success'])).\
    where((col('pv_unique_id') != 'undefined') & (col('pv_unique_id').isNotNull())).\
    select('pv_unique_id', 'beacon', 'position', 'rv', 'wsi').\
    distinct().cache()
```

In [3]:
```
pageviewevents = spark.table("statsdb.fact_pageview_events").\
    where((col('year')=='2019')).\
```

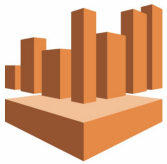

Sroka
Open-source Python library

Sroka (polish name of magpie) Python open-source library published by **FANDOM** enables gathering data in the **same format** from **different data sources** within **single Python script**.

“In Italian, British and French folklore, magpies are believed to have a penchant for picking up shiny items (...). In Sweden, it is further associated with witchcraft.”

-Wikipedia

Google Analytics



Amazon
Athena

Google
Sheets

Idea

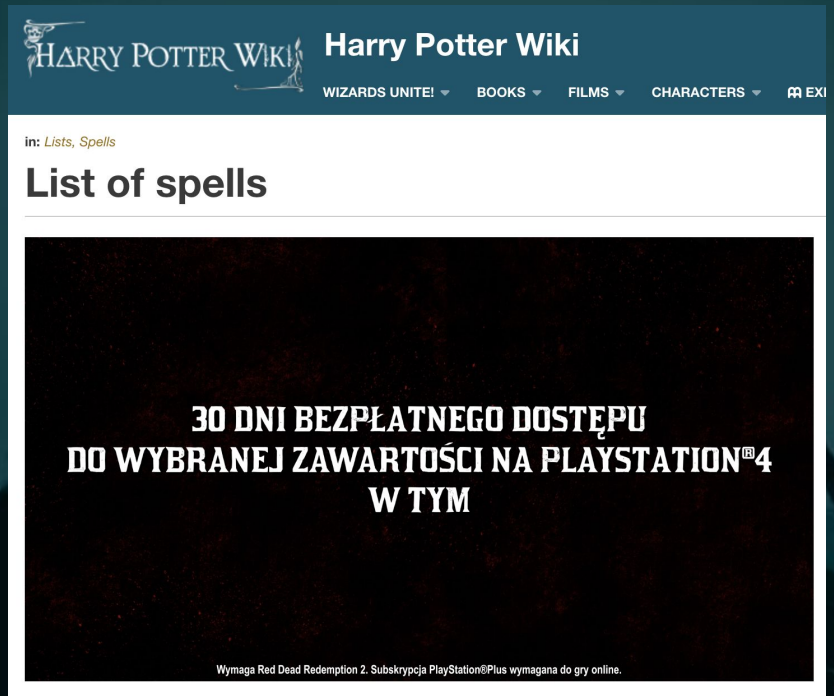
Example:

- Video completion rate - how many videos were watched to the end from all videos that started
- Trigger for analysis: Why video ad completion rate differ between ad campaigns? (besides e.g. length of ad)
- We observe that ad video completion rate differs between users, type of pages, communities, videos before which ad is played - can we capture it? Can we predict “better traffic” for video ads?

Goal

Predict “better” traffic that will have **higher video ad completion rate.**

Predict pageviews on which **user will complete video ad.**

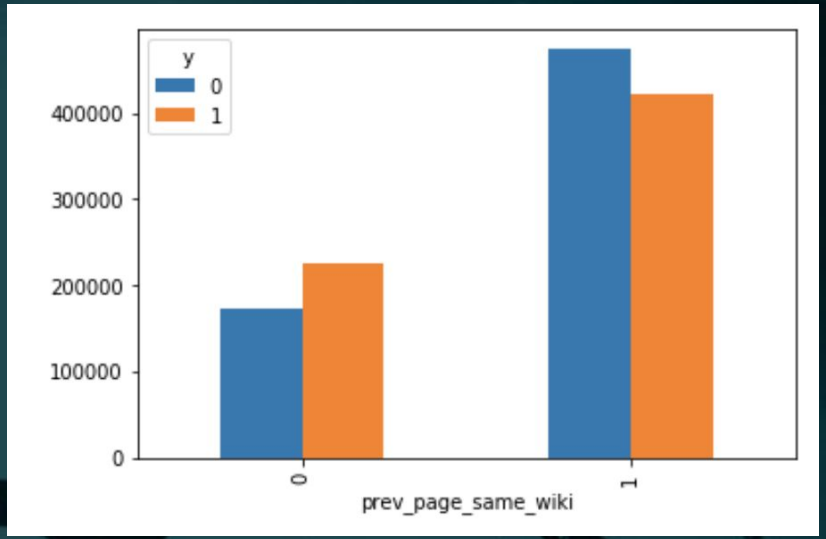


Data preparation

- What features should be included?
- How features need to look like based on the algorithm we want to try out?
  - Will it be usable if we want to try different algorithms?
- Do we have all information we need
  - What simple features should we use?
  - Should we create new complex features?
  - Should we implement new events for feature creation?

Data preparation

- Setup and Python libraries:
  - Jupyterhub
  - Pyspark3
  - Pandas, Numpy
  - Matplotlib
  - Sroka
  - Sklearn
-




```
In [35]: selector = SelectKBest(chi2, k=50).fit(X_train, y_train)
         X = selector.transform(X_train)
         indices = selector.get_support(indices=True)
         X_test_new = X_test.iloc[:, indices]
```

Data modelling

- Are we able to find a pattern?
- Can we predict outcome correctly?
- Python libraries:
  - Sklearn
  - Tensorflow
  - PyTorch
  - ...
-

Data modelling

- Start simple - create benchmark for the model

In [31]:
```
model = LogisticRegression(fit_intercept=True, random_state=24, class_weight='balanced', C=100,
                           max_iter=10000)
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

print(classification_report(y_test, y_pred, digits=5))
print(confusion_matrix(y_test, y_pred))
```

- It is great to know what is our business benchmark (current situation?)

In [55]:
```
model = DummyClassifier(strategy='most_frequent')
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

print(classification_report(y_test, y_pred, digits=5))
print(confusion_matrix(y_test, y_pred))
```

Data modelling

- Iterate and improve - process can (and at least partially should) be automated
  - Various algorithms
    - Logistic regression
    - Decision Tree
    - SVM
    - NN
  - Various parameters
  - Various features set
    - All vs selected set
- Know when to stop

Communication of the results

n=165	Predicted: NO
Actual: NO	TN = 50
Actual: YES	

Class 1 Actual	
Class 2 Actual	

	Pregnant
	True Positive
	False Negative

https://jovianlin.io/confusion-matrix/
https://towardsdatascience.com/taking-the-confusion-out-of-confusion-matrices-c1ce054b3d3e
https://www.geeksforgeeks.org/confusion-matrix-machine-learning/
https://whatis.techtarget.com/definition/confusion-matrix

Communication of the results

Do we have a success? - Business interpretation

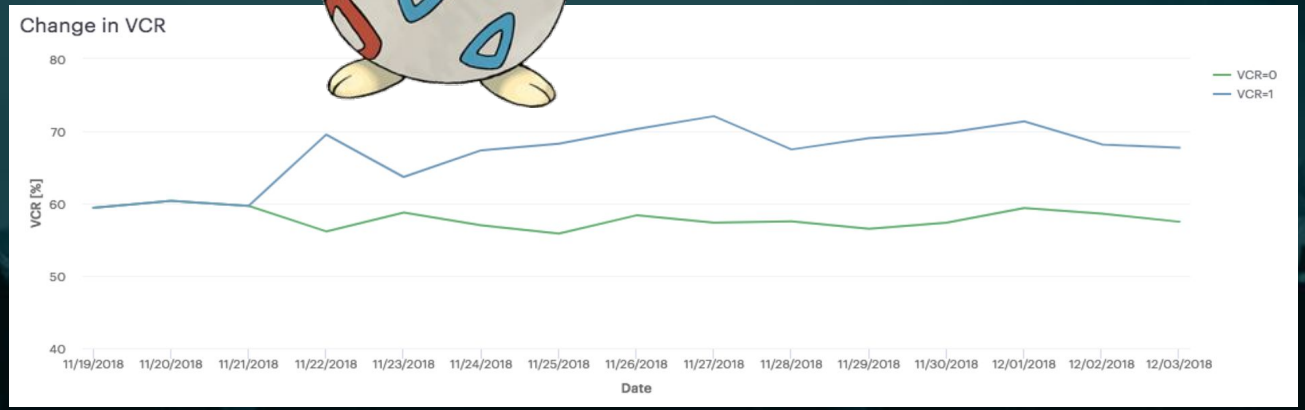
We divide our video watching users into two groups, based on our prediction:

- people are likely to watch ad (52% people, with 62% VCR)
- people probably won't watch an ad (48% people, with 52% VCR)

Initially was 57,5% VCR, so **we improved it by 4,5 pp**. VCR difference between groups is 10 pp.

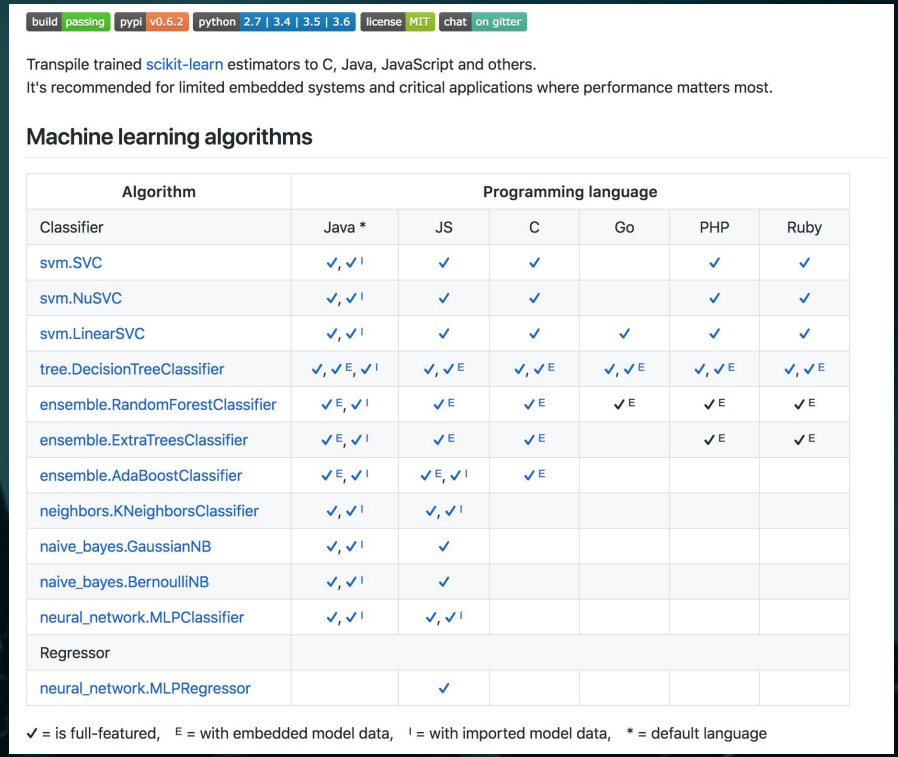
Communication of the results

- Python libraries:
  - Jupyterhub
  - Pandas
  - **Matplotlib, seaborn**
  - Sroka



Implementation on production

- Java script-based ML :)
- Python libraries:
  - sklearn-porter



build passing | pypi v0.6.2 | python 2.7 | 3.4 | 3.5 | 3.6 | license MIT | chat on gitter

Transpile trained scikit-learn estimators to C, Java, JavaScript and others.
It's recommended for limited embedded systems and critical applications where performance matters most.

Machine learning algorithms

Algorithm	Programming language					
Classifier	Java *	JS	C	Go	PHP	Ruby
svm.SVC	✓, ✓[I]	✓	✓		✓	✓
svm.NuSVC	✓, ✓[I]	✓	✓		✓	✓
svm.LinearSVC	✓, ✓[I]	✓	✓	✓	✓	✓
tree.DecisionTreeClassifier	✓, ✓[E], ✓[I]	✓, ✓[E]	✓, ✓[E]	✓, ✓[E]	✓, ✓[E]	✓, ✓[E]
ensemble.RandomForestClassifier	✓[E], ✓[I]	✓[E]	✓[E]	✓[E]	✓[E]	✓[E]
ensemble.ExtraTreesClassifier	✓[E], ✓[I]	✓[E]	✓[E]		✓[E]	✓[E]
ensemble.AdaBoostClassifier	✓[E], ✓[I]	✓[E], ✓[I]	✓[E]			
neighbors.KNeighborsClassifier	✓, ✓[I]	✓, ✓[I]				
naive_bayes.GaussianNB	✓, ✓[I]	✓				
naive_bayes.BernoulliNB	✓, ✓[I]	✓				
neural_network.MLPClassifier	✓, ✓[I]	✓, ✓[I]				
Regressor						
neural_network.MLPRegressor		✓				

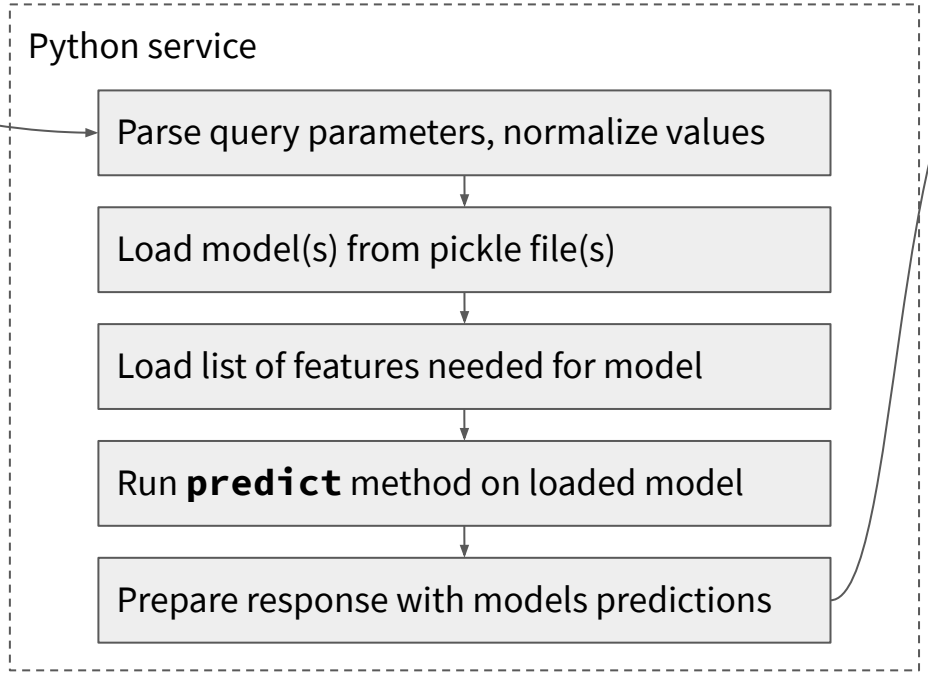
✓ = is full-featured, [E] = with embedded model data, [I] = with imported model data, * = default language

Implementation on production

- Bill the lizard - runs HTTP Python server that can use trained models to predict result based on features given in query params.

Service for machine learning models

Request: /predict?models=foo&feature1=value1&feature2=value2&...



Response:

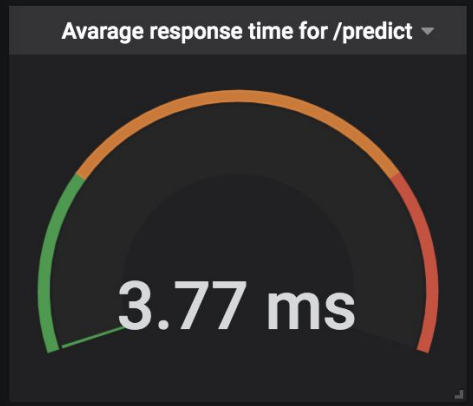
```
{
    "model_name": {
        "result": 1,
        "version": "1.0.0"
    }
}
```

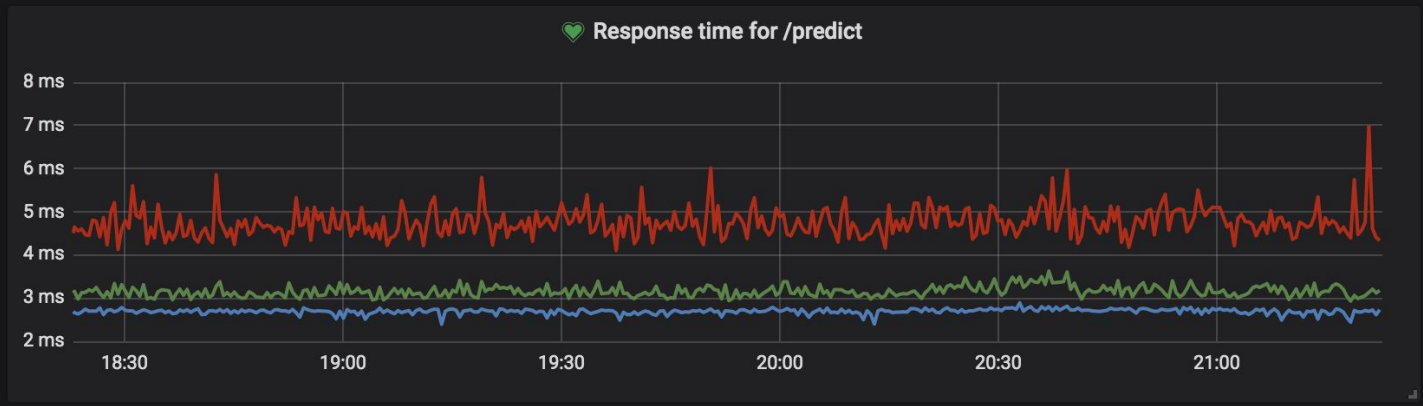
Implementation on production

- Python libraries, among others:
  - Flask
  - scikit-learn
  - Scipy, numpy
  - Joblib
  - Marshmallow
  - Webargs
  - Gunicorn

Monitoring model performance

- Grafana health check of service

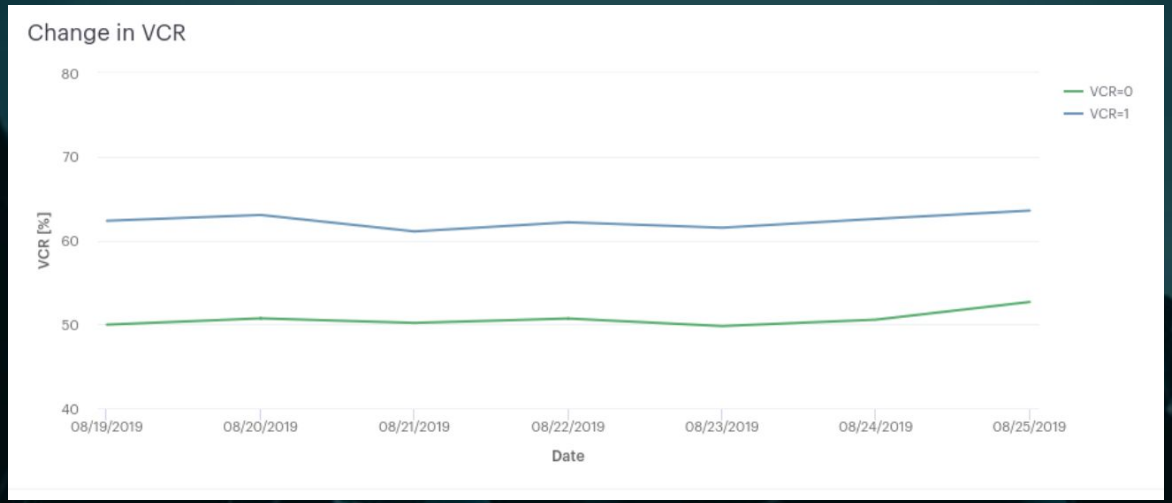




Example data - real traffic

Monitoring model performance

- Model performance:
  - Mode (SQL with Python support) - reporting daily on slack

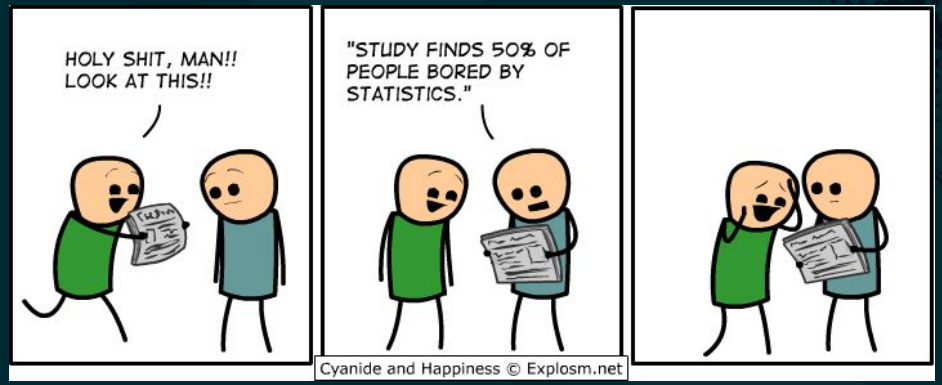


Example data - real traffic

Monitoring model performance

We can observe that model is not changing its behaviour in time

- It’s not worsening in performance with time
- We see actual difference in two predicted groups
- We can observe if groups does not decrease in size
- We can see how model performs when extending roll outs
- We can see that model is still working and predicting (aka health check of service)



Summary

- **Modelling projects are really for everyone and Python is a great programming language to do it with**
- **Github link to the presentation:**
  - https://github.com/martynaut/conferences_meetups/blob/master/pydata_warsaw_121219/PyData_Warsaw_2019_MUT.pdf


Join us!


Openings will be there in Q1
https://www.fandom.com/careers


Go and be data driven!

Questions or feedback?

Thank You

Martyna Urbanek-Trzeciak
Data Analyst
murbanek@fandom.com
github.com/martynaut
linkedin.com/in/martynaurbanek/