



mibuso.com

# How to make AI work for your Business... Central

Dmitry Katson

When you are passionate about  
Microsoft Dynamics NAV/365 Business Central



# About this guy on the stage

## Dmitry Katson, MVP

- 15Y of NAV experience
- 2Y of BC experience 😊
- 3Y of AI experience
- Lives in St. Petersburg, Russia
- Father of 2





# Before we start

- Take a selfie
- Send it to [navtechdays19@gmail.com](mailto:navtechdays19@gmail.com)
- ...if possible, not more than 1mb



- We will see magic at the end

{ If your customer/manager or... wife 😊

{ Ask you to solve some case ...

Like, "how many items i will sell next week? ... or buy"

{ What do you normally do?

# In the past ... and in 92% cases today

Consultant, ask business owner "What influence on <fill\_here>?"



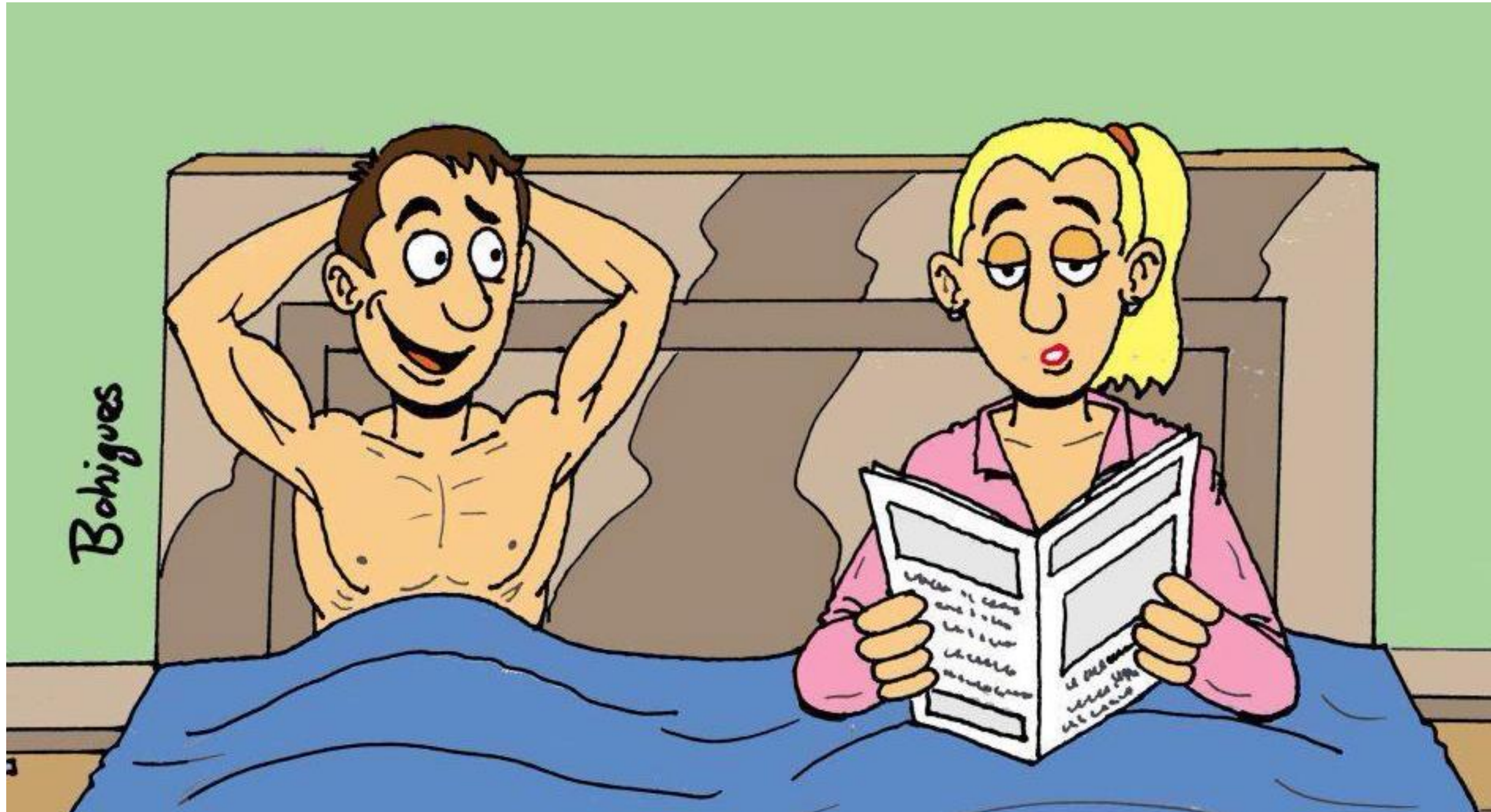


# Then, there is a brainstorm phase



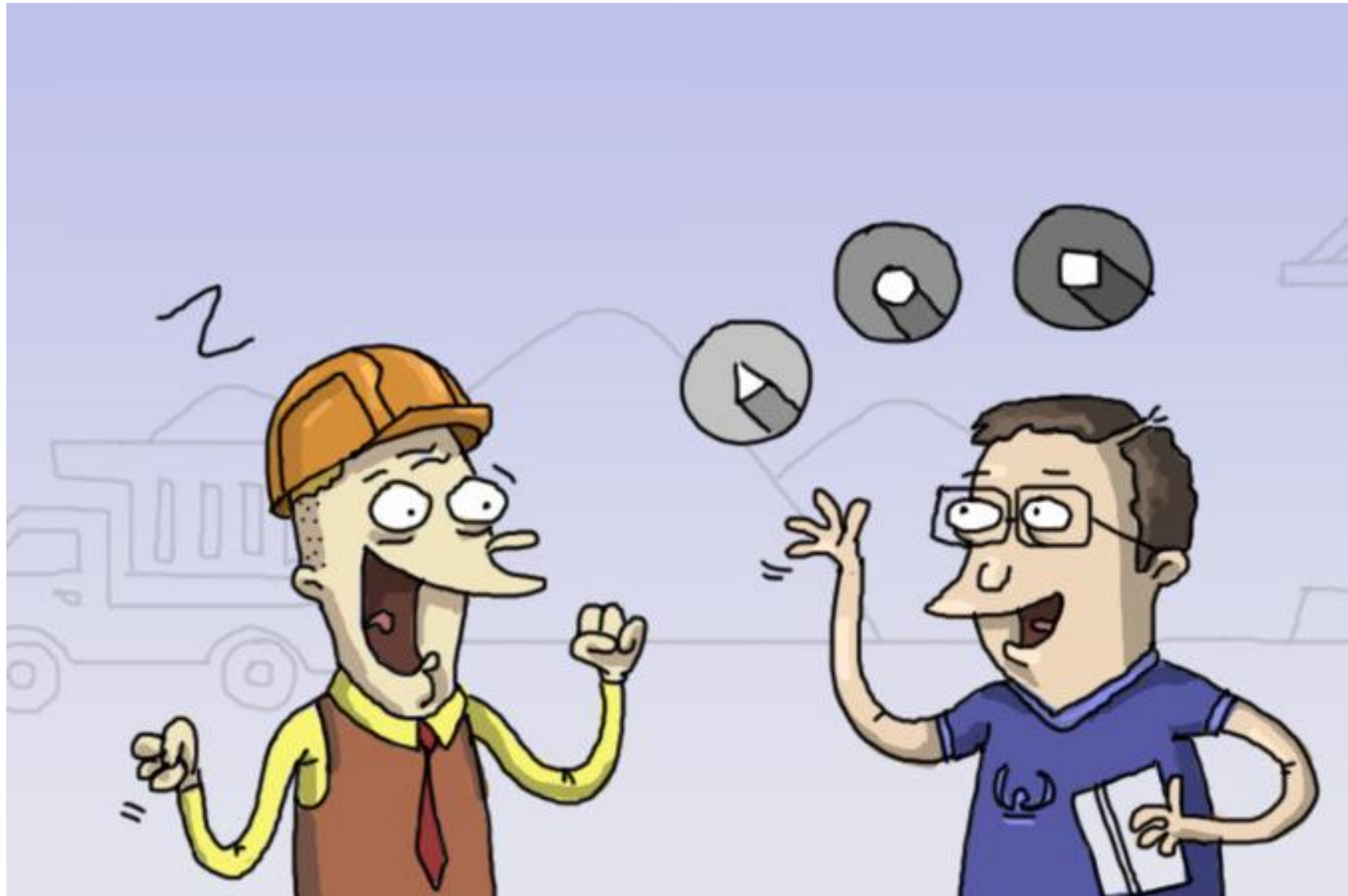


# Then, you end-up with the final solution





# Then, you end-up with the final solution





# And the final solution is an algorithm

(If “item” = ‘pudding’)

AND (If “Weekday” = ‘Saturday’ )

AND (If “localEvent” = ‘Children Day’ )

AND ( if if if...)

Then “Item\_Sales\_Forecast” = 120

ELSE ( if if if...)

Then ...





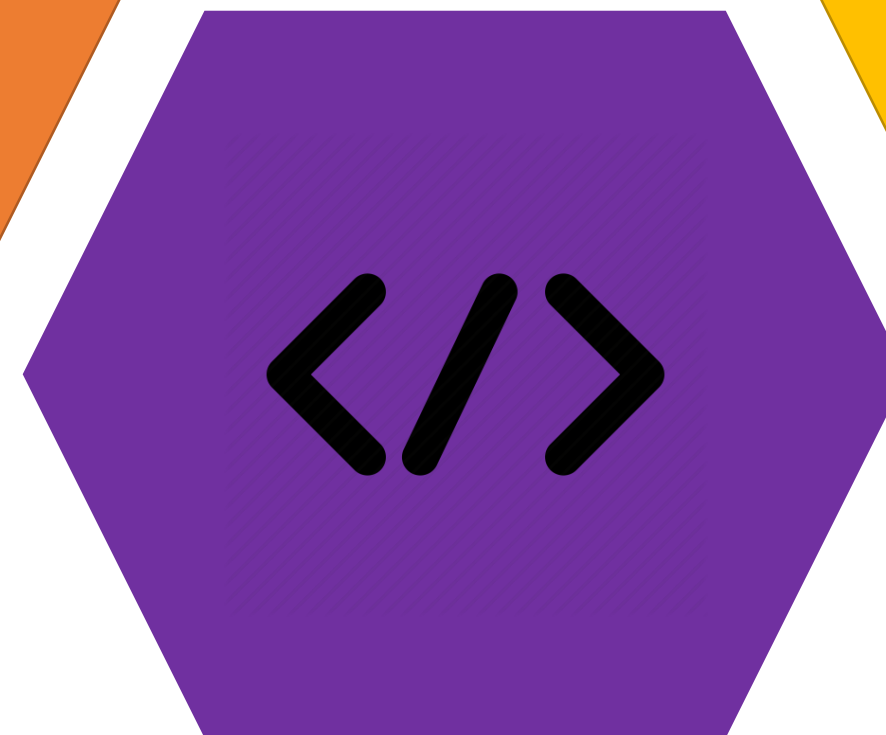
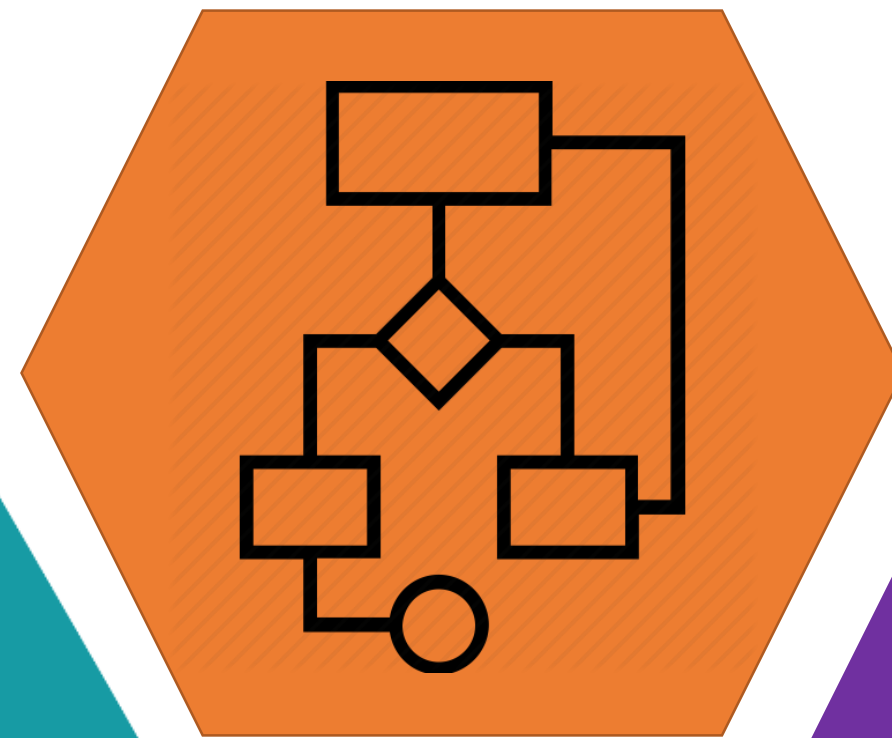
# That's the classical dev approach

Define algorithm

Test



Define Question



Code



Release



# Do we have an alternative?





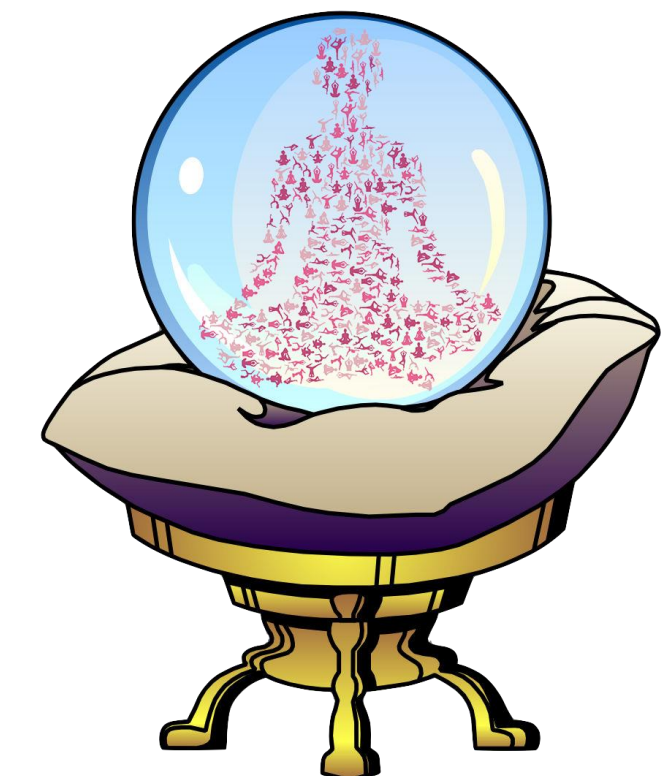
# Yes ... and the answer is data

[illegible]

# Machine Learning



## Predictive Model





# When you have a model... you know the Future

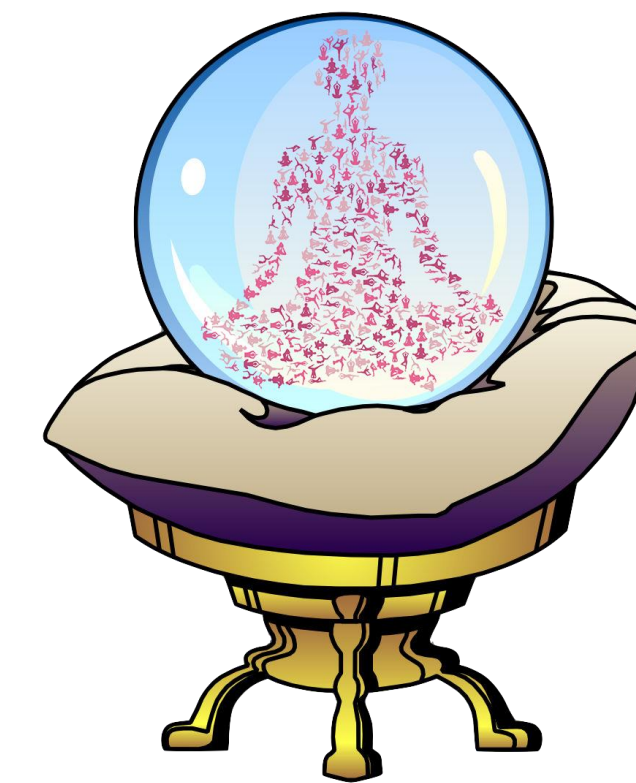
features

[illegible]

predictions

[illegible]

## Predictive Model

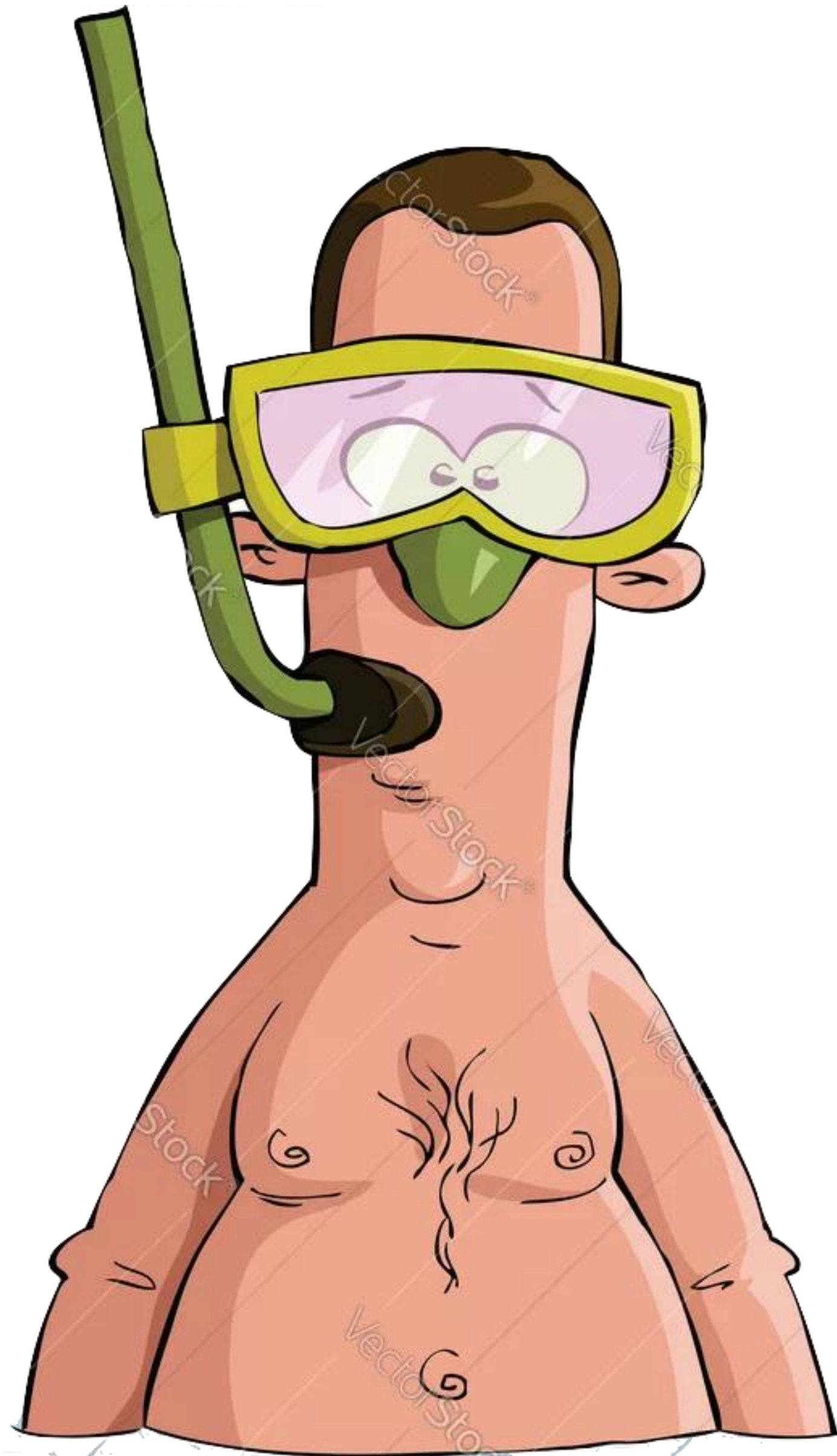


# ...without any code development

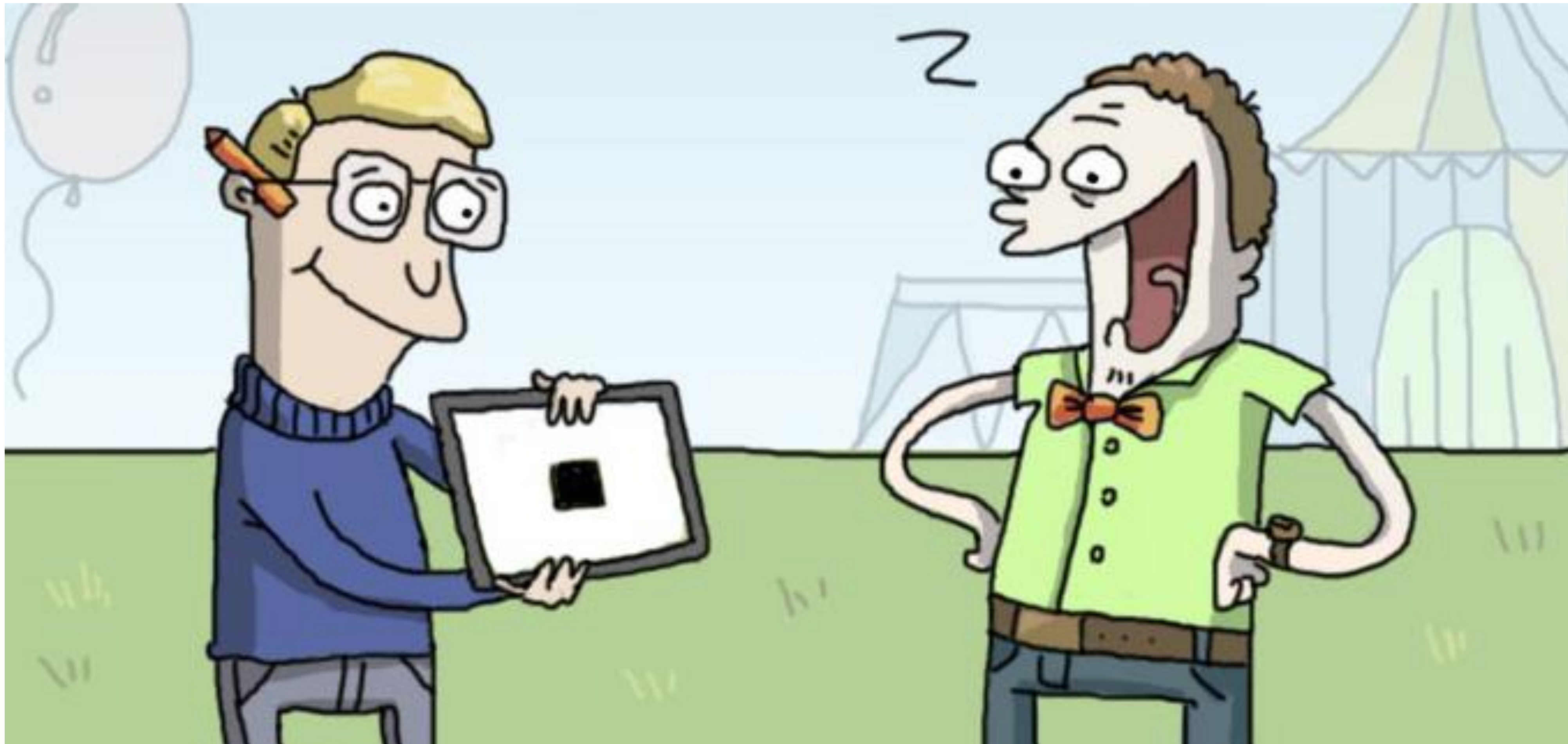




# well...almost

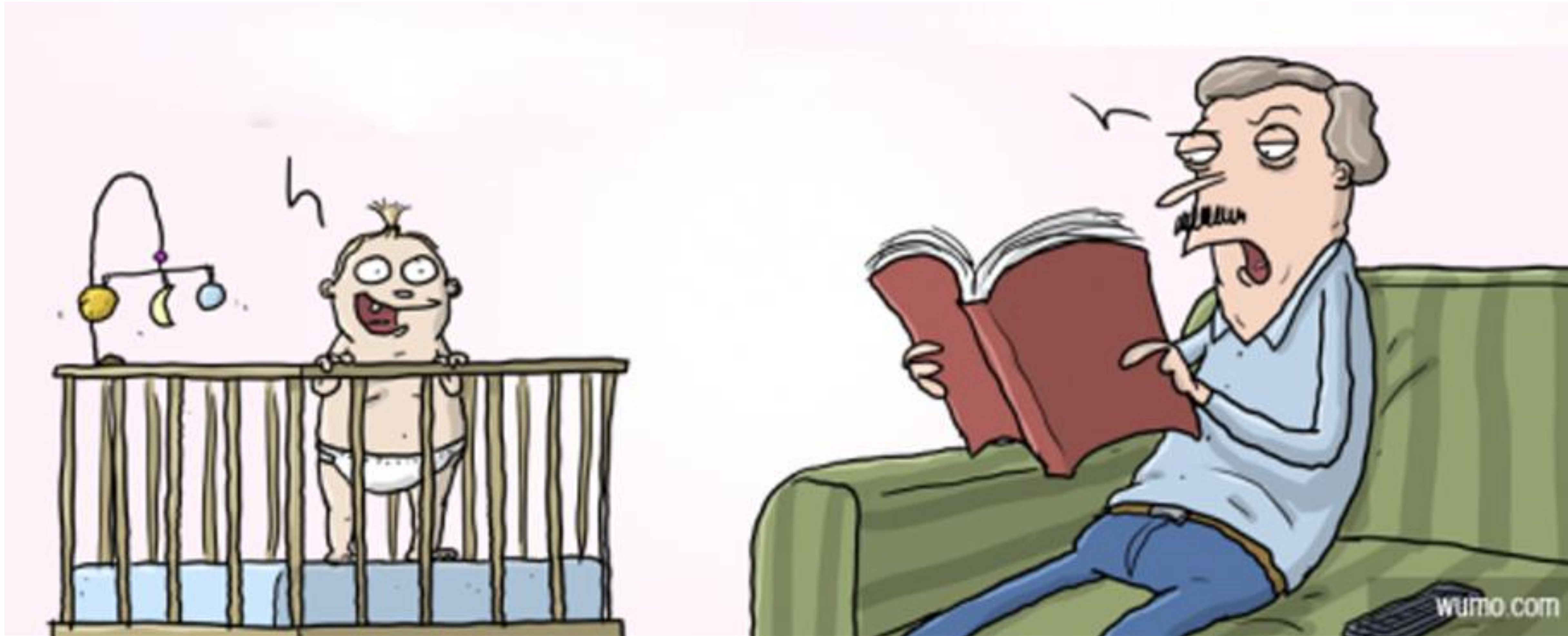


# All the “if-else stuff” is done by Artificial Intelligence





# Ok, Let's learn something new



# The definitions

- Artificial Intelligence (AI)
- Machine Learning (ML)





Artificial Intelligence (AI) –  
tasks that are characteristic of human intelligence

- Language and speech understanding
- Recognizing objects and sounds
- Prediction etc.

Machine Learning (ML)  
a way of achieving AI

- Algorithms  
Education from data

**computers "learn" from data**

HYBRID





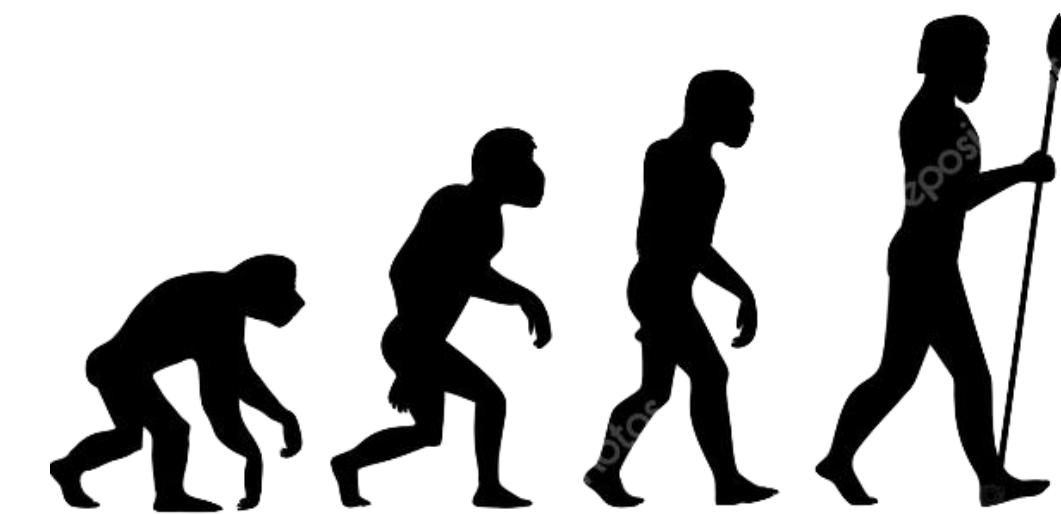
# Why AI became so popular?

We have **too much data** digitally available, so we can **train AI** effectively





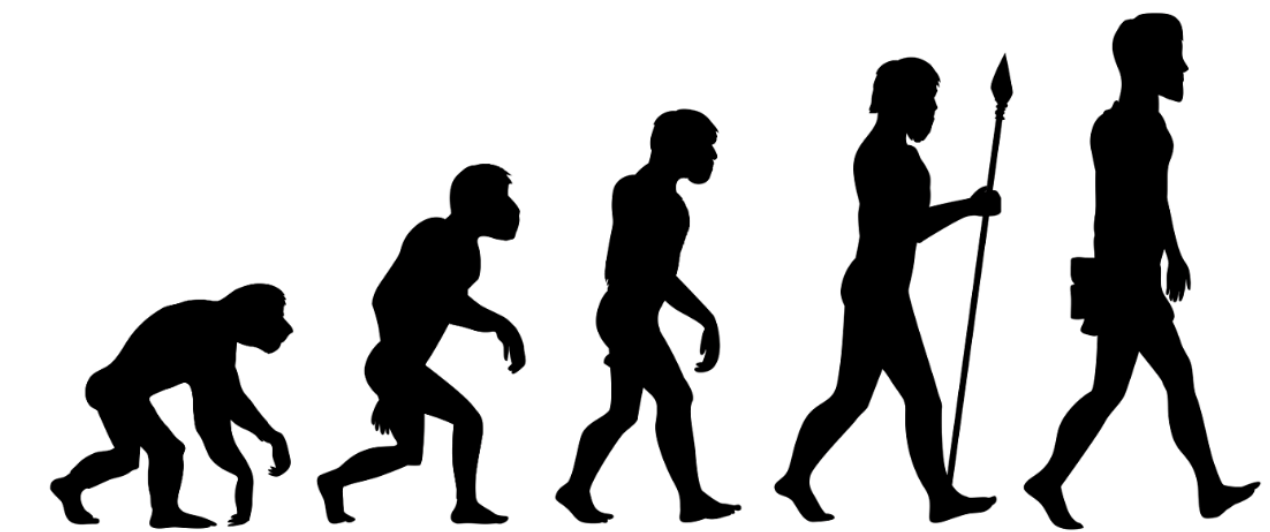
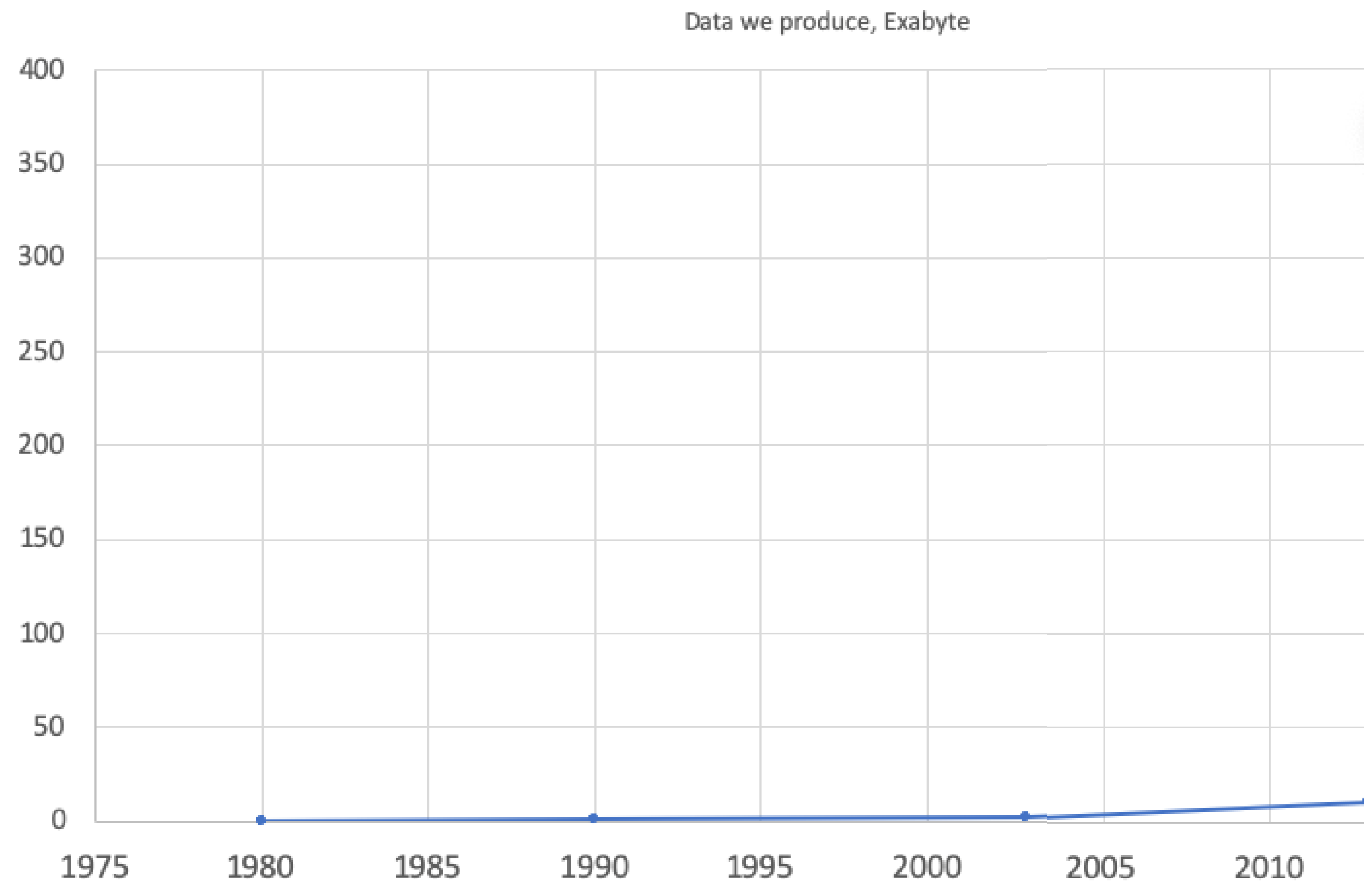
# 2003



## 2 Exabytes

\* 1 Exabyte = 500 Million DVD

# 2013

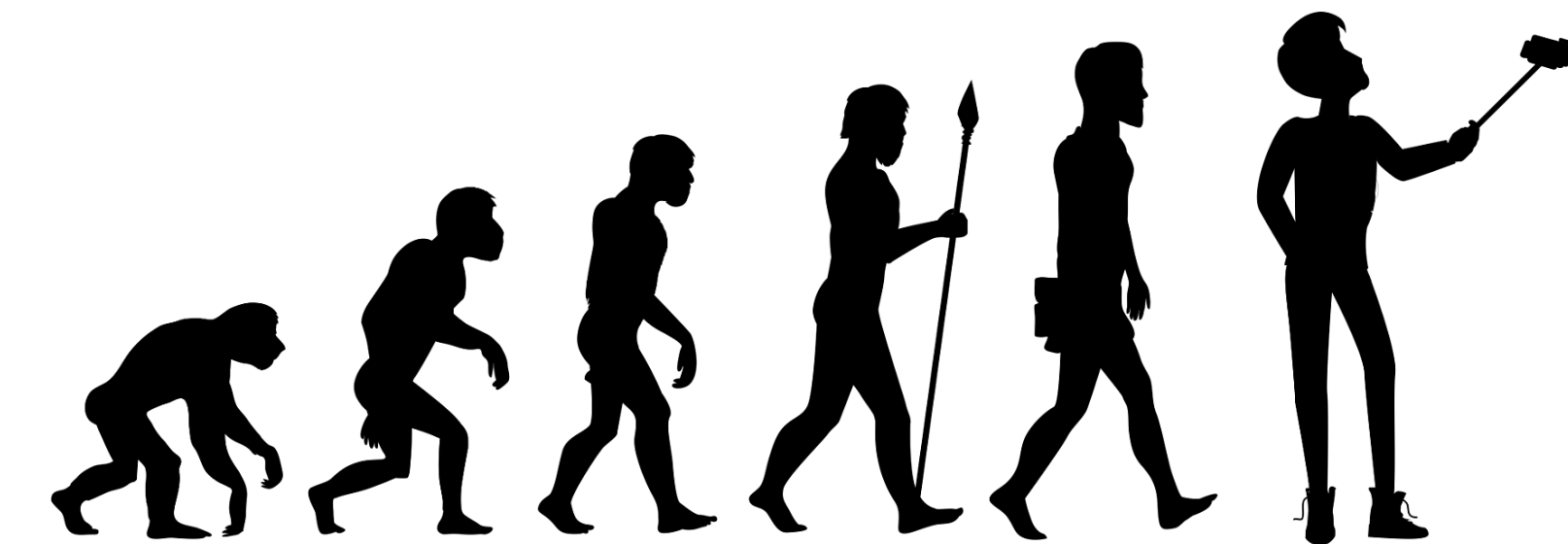
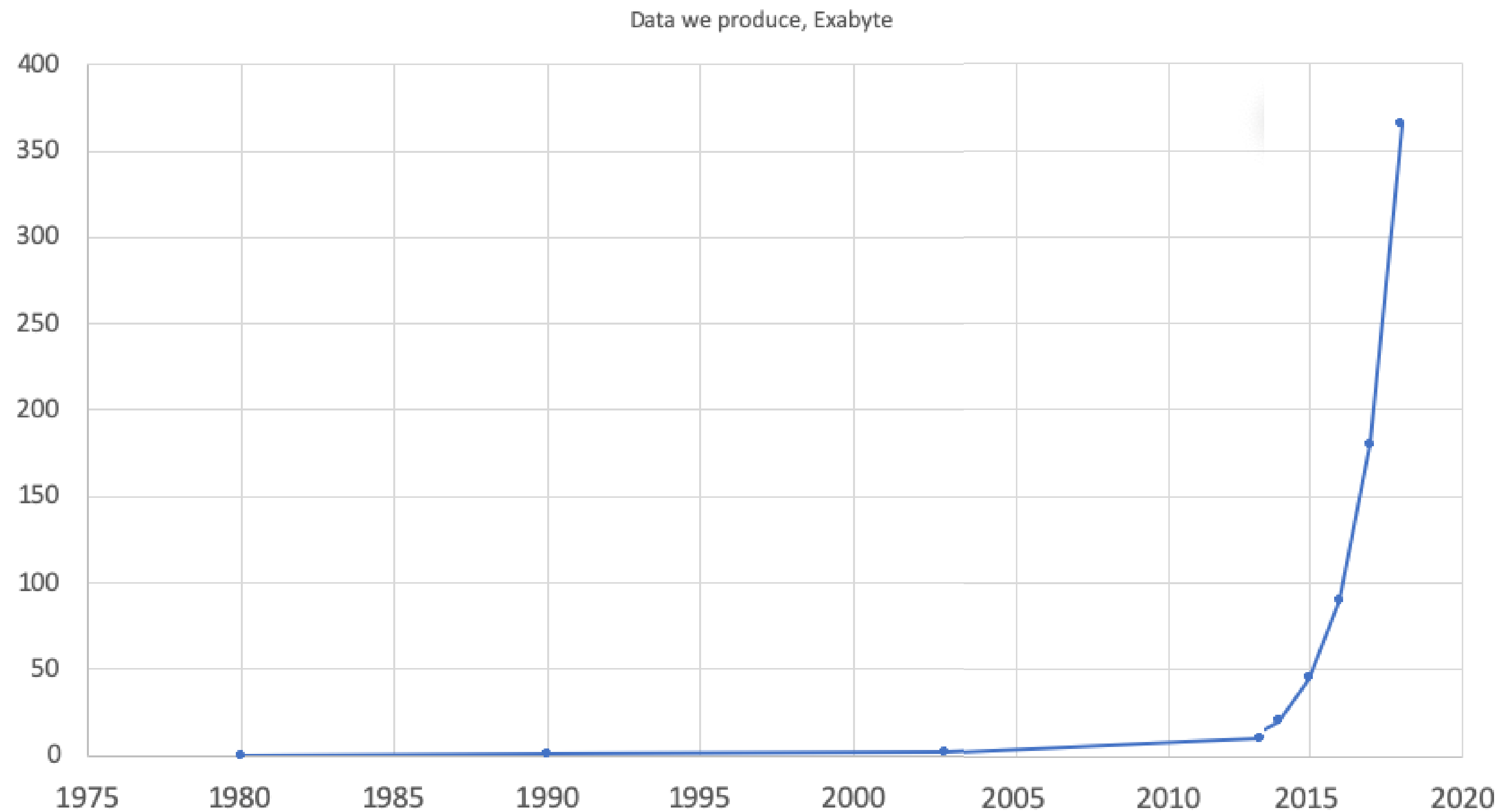


## 10 Exabytes

\* 1 Exabyte = 500 Million DVD



# 2019



## 715 Exabytes

\* 1 Exabyte = 500 Million DVD

# Where AI can be applied?





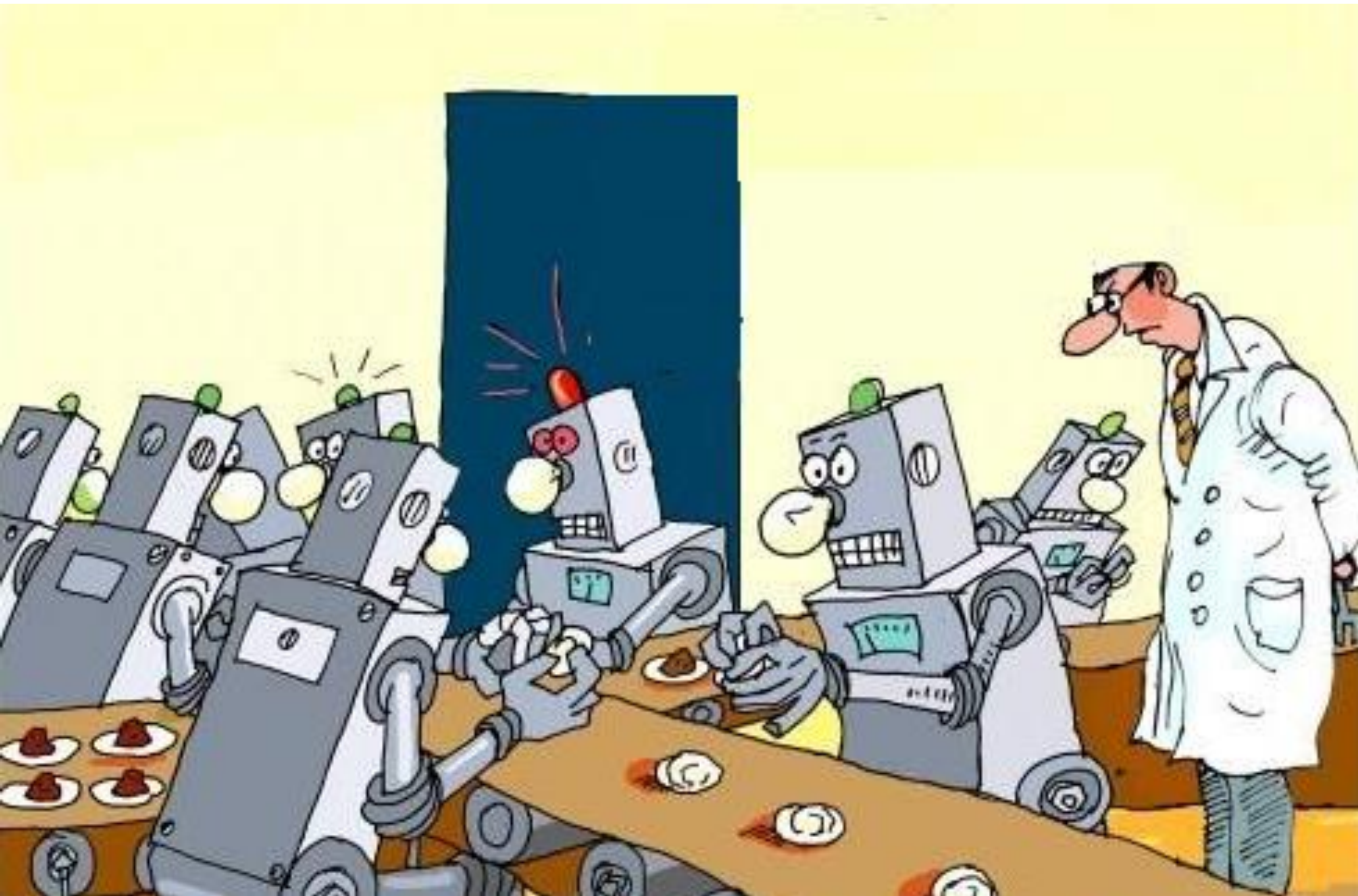
# Food industry



- Growing food
- Yield forecast
- Product quality analysis
- Cooking
- Shelf life forecast
- Forecast of food demand
- etc.



# Production



- Equipment failure forecast
- Preventive service
- Product quality analysis
- Robotics
- Inventory forecast
- etc.



# Everywhere!

- Banks
- Medicine
- Service maintenance
- Education
- Marketing
- Finance
- Personnel and Recruiting
- Transport
- Games
- Art
- Ecology
- Emergency services

# AI in





# AI API's in Business Central

Time Series

Codeunit 2000 "Time Series Management"

ML Prediction

Codeunit 2003 "ML Prediction Management"

Custom Azure ML

Codeunit 2001 "Azure ML Connector"

Custom Vision

Codeunit 2020 "Image Analysis Management"

# AI API's in Business Central

## Time Series

Inventory & Sales Forecast

Cashflow Forecast

## ML Prediction

Late Payment Prediction

## Custom Azure ML

## Custom Vision

Item image analyzer

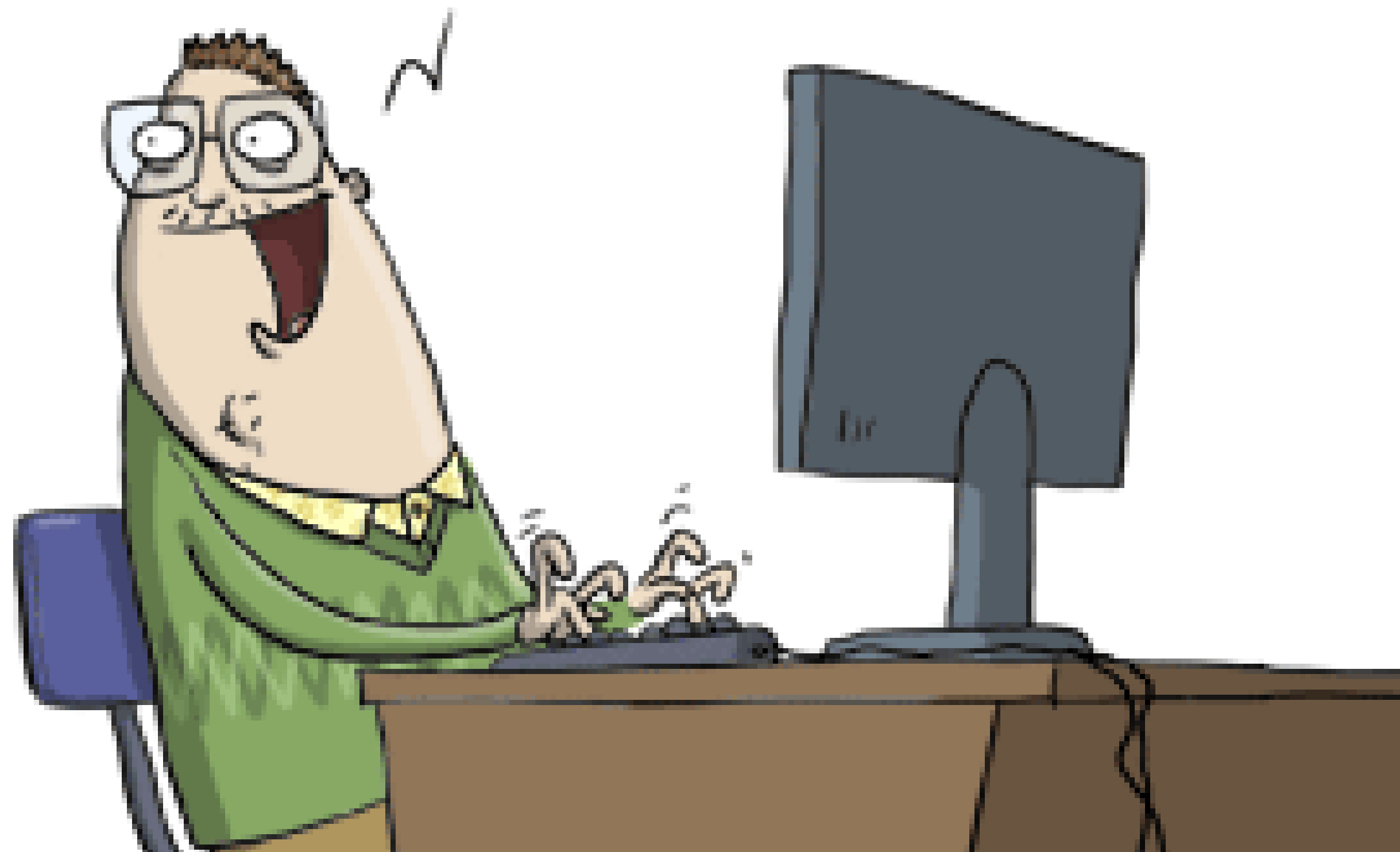
Contact photo analyzer



# Time Series API

- You have data in Business Central (when, what, how much)
- You publish MS model in your Azure, as a web service
- You call this web service from Business Central, using Codeunit 2000

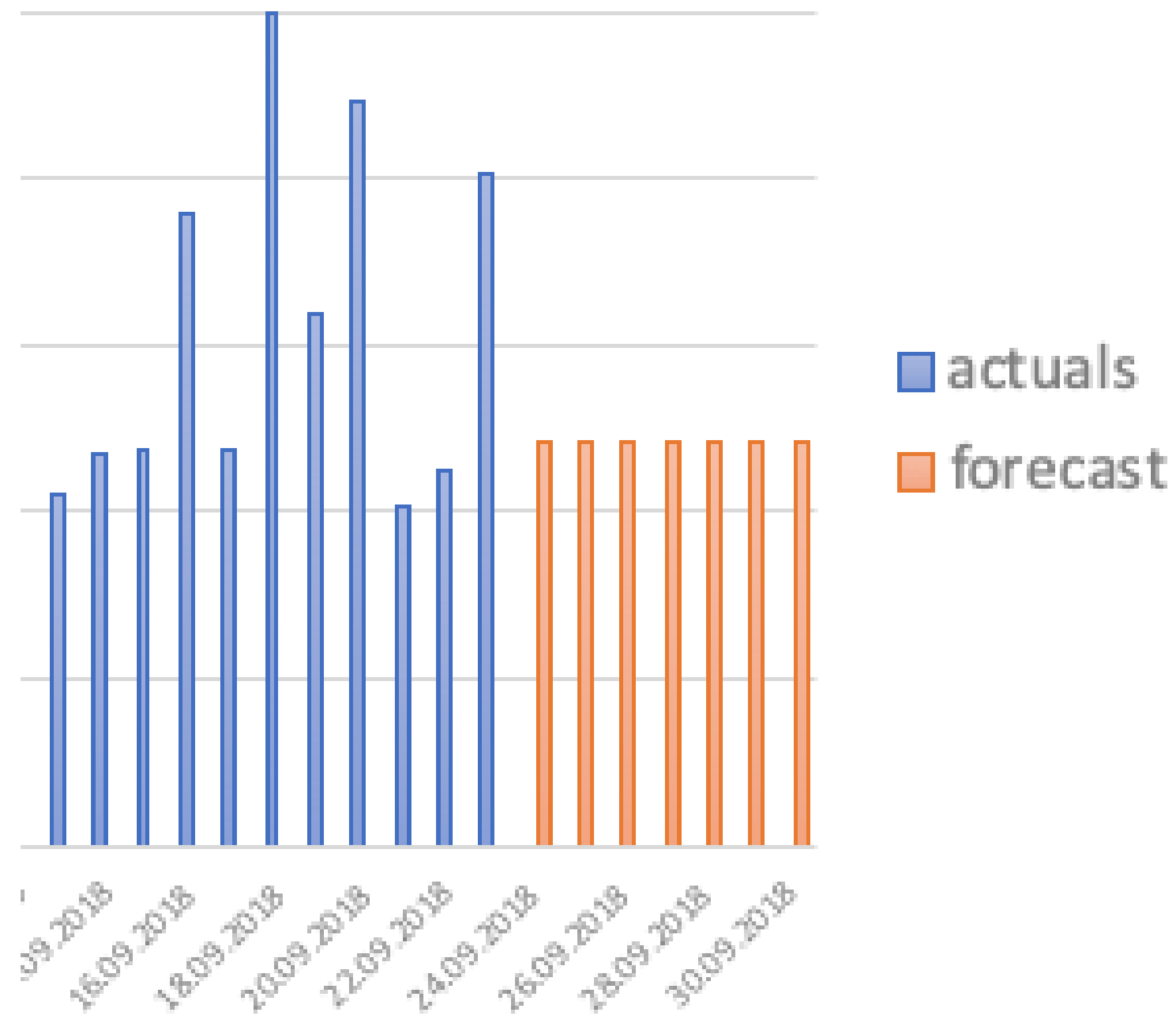
# Time Series API



## Demo



# Time Series API



- Why the forecast does not change?
- Time Series API use only 2 features:
  - Date
  - Item No
- It's NOT enough!
- There is something else, that affects on "Sales"

# ML Prediction API

- You have data in Business Central (when, what, how much, what influence)
- You publish MS model in your Azure, as a web service
- You train your model, using this web service, and save it locally
- You call this web service, using Codeunit 2003, send model and get prediction
- You can get insights about predictions



# ML Prediction API

SALES QUOTE

S-QUO1001 · Trey Research

Process Quote Request Approval | Actions Navigate Report Less options

Quote Create Release Functions Predict Payment

**General** Show more

Customer Name Trey Research

Contact Helen Ray

**Lines** Manage More options

TYPE	NO.	DESCRIPTION	LOCATION CODE	QU.
Item	1936-S	BERLIN Guest Chair, yellow		

**Documents Attached** Documents 0

**Customer Sales History**

1	0	0
Ongoing Sales Blanket Orders	Ongoing Sales Orders	
1	0	0
Ongoing Sales Invoices	Ongoing Sales Return Orders	Ongoing Sales Credit Memos
51	51	0
Posted Sales Shipments	Posted Sales Invoices	Posted Sales Return Receipts

The payment is predicted to be on time, with Medium confidence in the prediction.

OK

```
procedure Train();
var ...
begin
    //Setup connection
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

    //Prepare data for the training
    MLPrediction.SetRecord(RestSalesHistory);

    //Set features
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));

    //Set label
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));

    //Train model
    MLPrediction.Train(MyModel, MyModelQuality);

    //Save model
    Setup.InsertIfNotExists();
    Setup.SetRestaurantModel(MyModel);
    Setup.Validate("My Model Quality", MyModelQuality);
```

# ML Prediction API

## Step 1. Train and save your model

```
procedure Train();
var ...
begin

    //Setup connection
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

    //Prepare data for the training
    MLPrediction.SetRecord(RestSalesHistory);

    //Set features
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_Event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));

    //Set label
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));

    //Train model
    MLPrediction.Train(MyModel, MyModelQuality);

    //Save model
    Setup.InsertIfNotExists();
    Setup.SetRestaurantModel(MyModel);
    Setup.Validate("My Model Quality", MyModelQuality);
```

```
procedure CalculateRestForecast(Item: Record Item)
var ...
begin
    Setup.Get();
    Setup.TestField("My Model");

    //Setup connection
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

    //Prepare data for the forecast
    PrepareData(Item, RestSalesHistory);
    MLPrediction.SetRecord(RestSalesHistory);

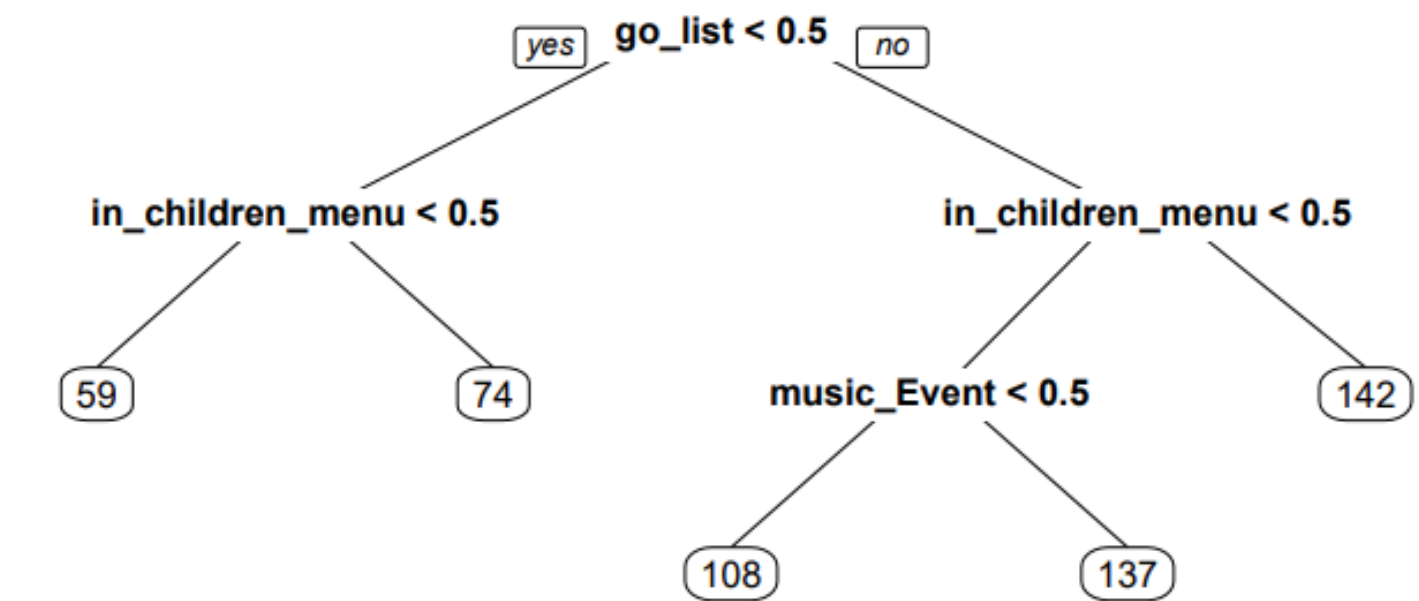
    //Set features
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_Event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));

    //Set label
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));

    //Set confidence field (only for classification models)
    //MLPrediction.SetConfidence(RestSalesHistory.FieldNo(confidence));

    //Predict
    MLPrediction.Predict(Setup.GetRestaurantModel());

    //Save forecast
    SaveForecastResult(RestSalesHistory, TempTimeSeriesForecast);
```





# ML Prediction API

## Step 2. Predict, using trained model

```
procedure CalculateRestForecast(Item: Record Item)
var ...
begin

    Setup.Get();
    Setup.TestField("My Model");

    //Setup connection
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

    //Prepare data for the forecast
    PrepareData(Item, RestSalesHistory);
    MLPrediction.SetRecord(RestSalesHistory);

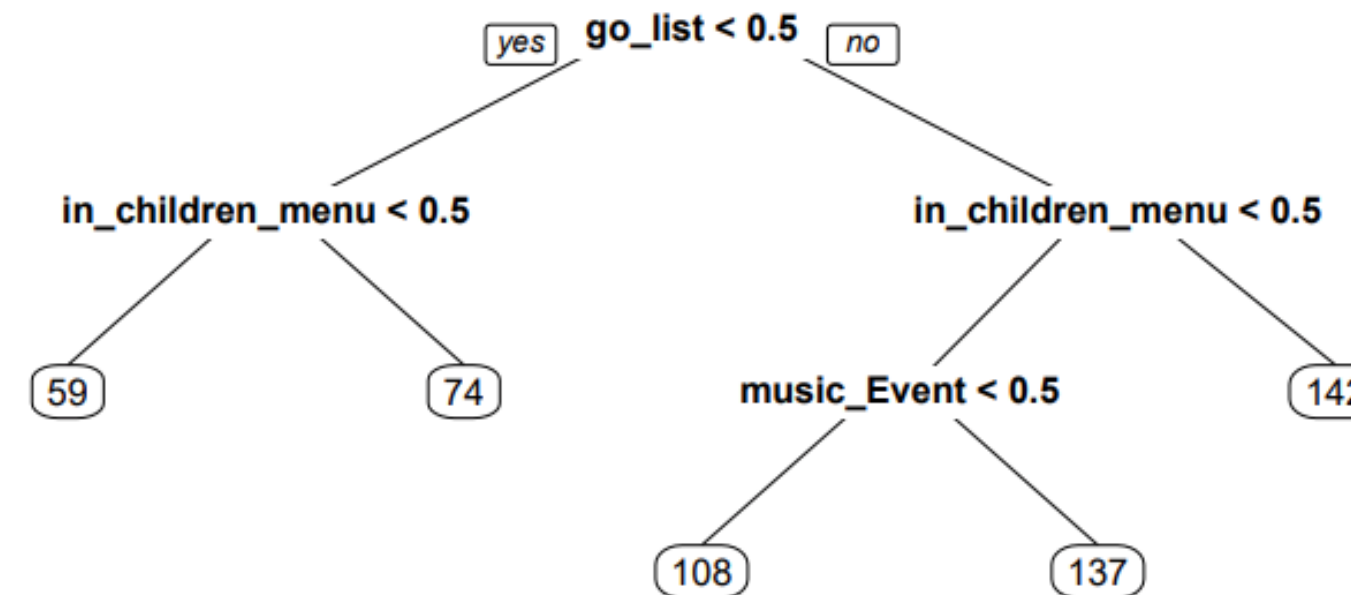
    //Set features
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_Event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));

    //Set label
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));

    //Set confidence field (only for classification models)
    //MLPrediction.SetConfidence(RestSalesHistory.FieldNo(confidence));

    //Predict
    MLPrediction.Predict(Setup.GetRestaurantModel());

    //Save forecast
    SaveForecastResult(RestSalesHistory, TempTimeSeriesForecast);
```

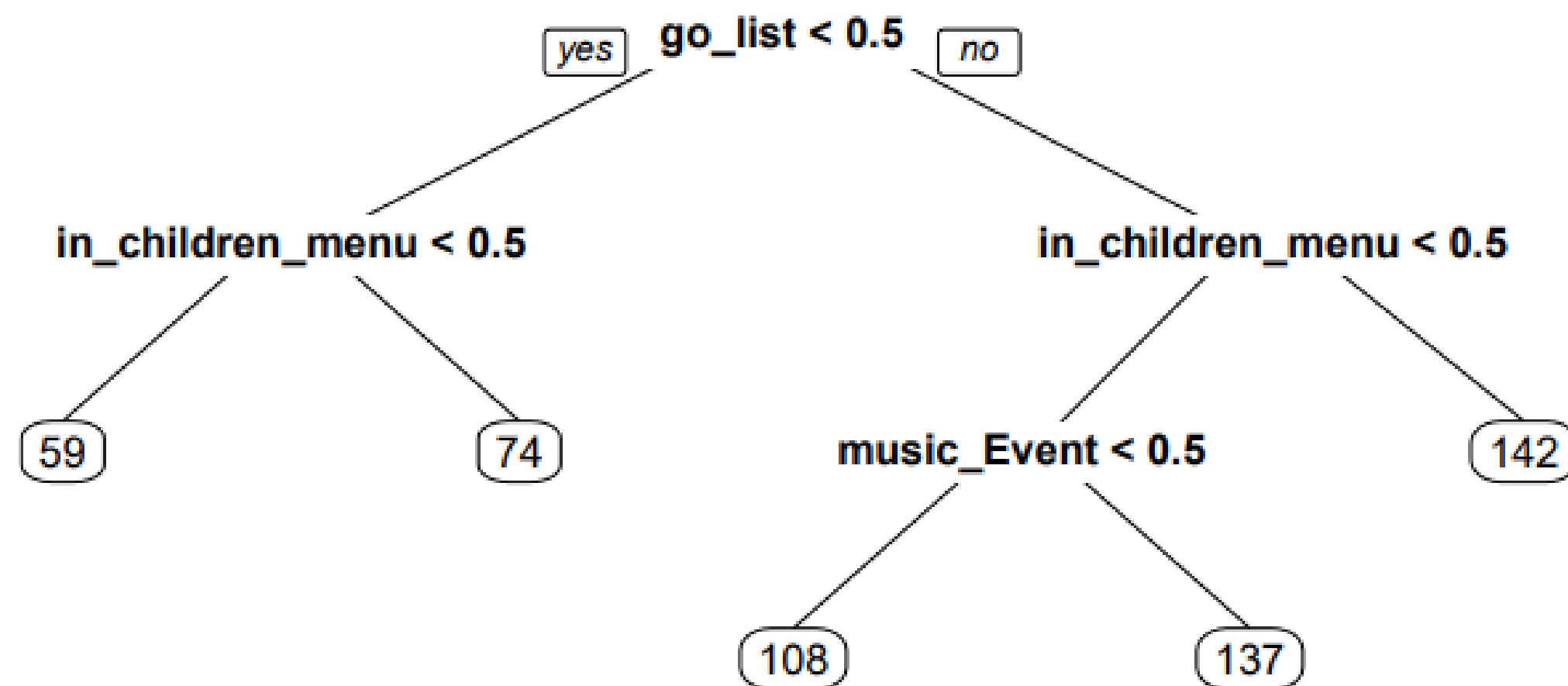


```
//Save model
Setup.InsertIfNotExists();
Setup.SetRestaurantModel(MyModel);
Setup.Validate("My Model Quality", MyModel);
Setup.Validate("My Features", 'in_children_menu');
Setup.Validate("My Label", 'orders');
Setup.Modify(true);
```

```
local procedure GetPlotOfTheModel
var
    Setup: Record "AIR Rest. ML Forecast"
    MLPrediction: Codeunit "ML Prediction"
begin
    Setup.Get();
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);
    PlotBase64 := MLPrediction.PlotBase64;
end;
```

# ML Prediction API

## Step 3. Get insights about predictions



```
procedure DownloadPlotOfTheModel()
var
  MLPrediction: Codeunit "ML Prediction Management";
  PlotBase64: Text;
  Setup: Record "AIR Rest. ML Forecast Setup";
begin
  Setup.Get();
  MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

  PlotBase64 := MLPrediction.PlotModel(Setup.GetRestaurantModel(), Setup."My Features", Setup."My Label");

  MLPrediction.DownloadPlot(PlotBase64, 'rest_sales_prediction');
end;
```

```
"My Features", 'in_children_menu,fest_name,children_event,music_Event,month,day,go_list');
"My Label", 'orders');
```



# ML Prediction API

# Take data

[illegible]

# Train model

```
procedure Train();  
var ...  
begin  
  
    //Setup connection  
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);  
  
    //Prepare data for the training  
    MLPrediction.SetRecord(RestSalesHistory);  
  
    //Set features  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_event));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));  
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));  
  
    //Set label  
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));  
  
    //Train model  
    MLPrediction.Train(MyModel, MyModelQuality);  
  
    //Save model  
    Setup.InsertIfNotExists();  
    Setup.SetRestaurantModel(MyModel);  
    Setup.Validate("My Model Quality", MyModelQuality);  
end
```

# Predict

```
procedure CalculateRestForecast(Item: Record Item)
var ---
begin
    Setup.Get();
    Setup.TestField("My Model");

    //Setup connection
    MLPrediction.Initialize(Setup.getMLUri(), Setup.getMLKey(), 0);

    //Prepare data for the forecast
    PrepareData(Item, RestSalesHistory);
    MLPrediction.SetRecord(RestSalesHistory);

    //Set features
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(in_children_menu));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(fest_name));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(children_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(music_event));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_month));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_day));
    MLPrediction.AddFeature(RestSalesHistory.FieldNo(s_go_list));

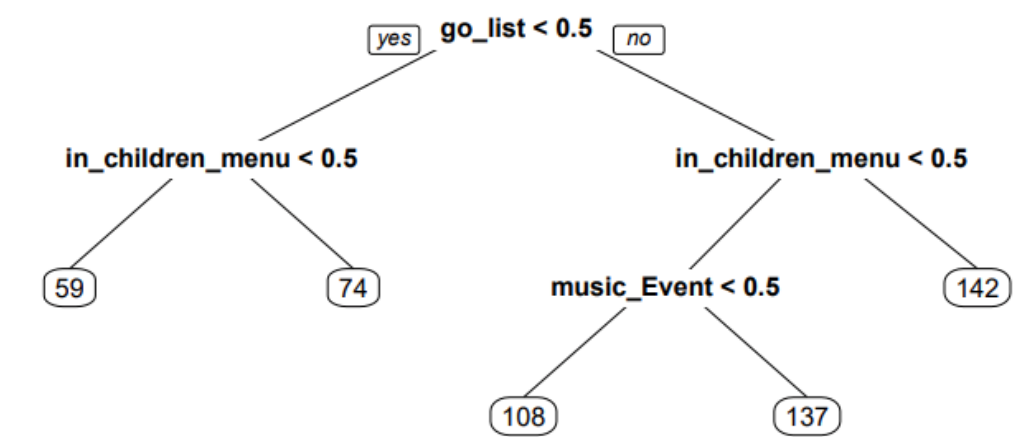
    //Set label
    MLPrediction.SetLabel(RestSalesHistory.FieldNo(orders));

    //Set confidence field (only for classification models)
    //MLPrediction.SetConfidence(RestSalesHistory.FieldNo(confidence));

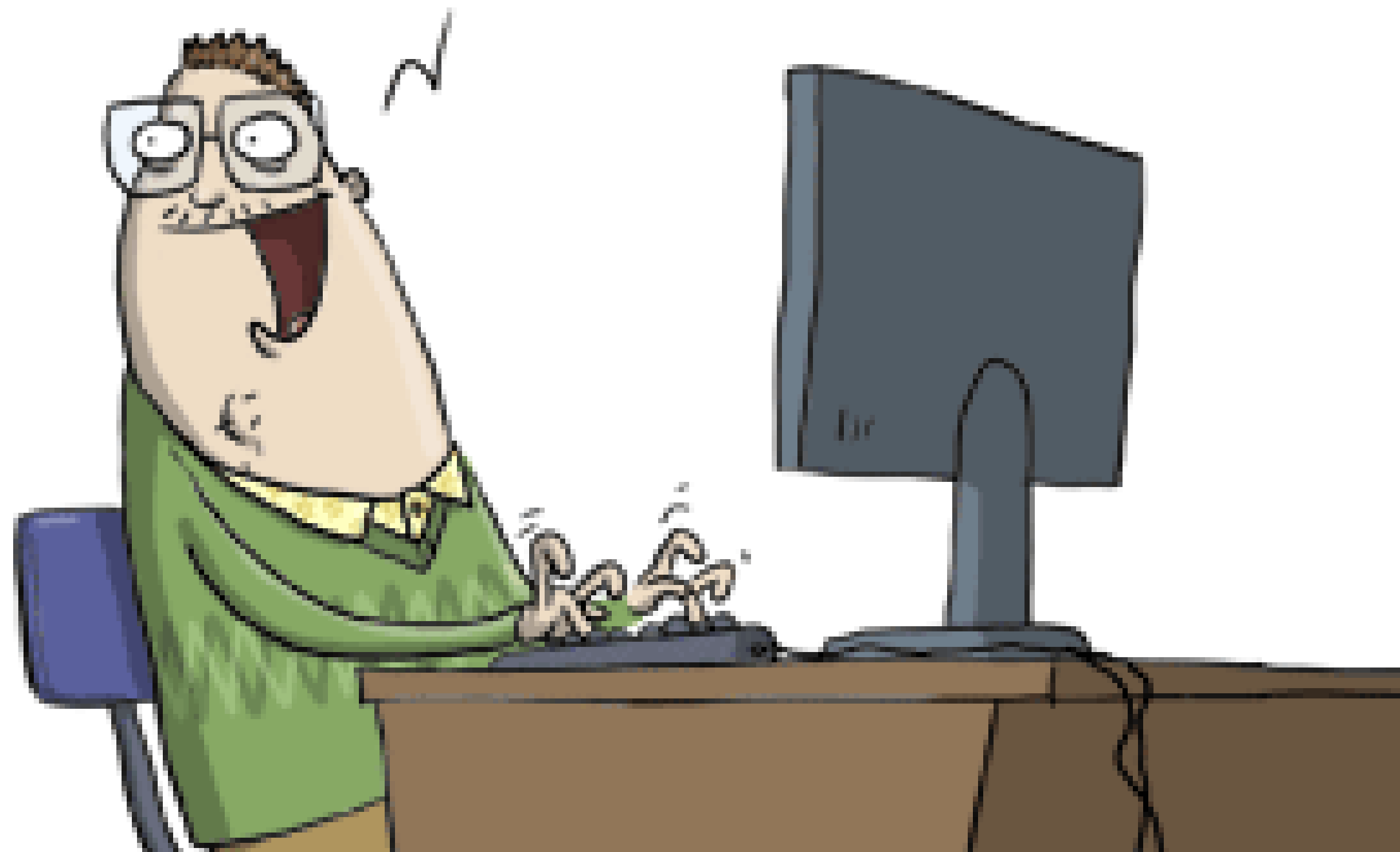
    //Predict
    MLPrediction.Predict(Setup.GetRestaurantModel());

    //Save forecast
    SaveForecastResult(RestSalesHistory, TempTimeSeriesForecast);
```

# Research



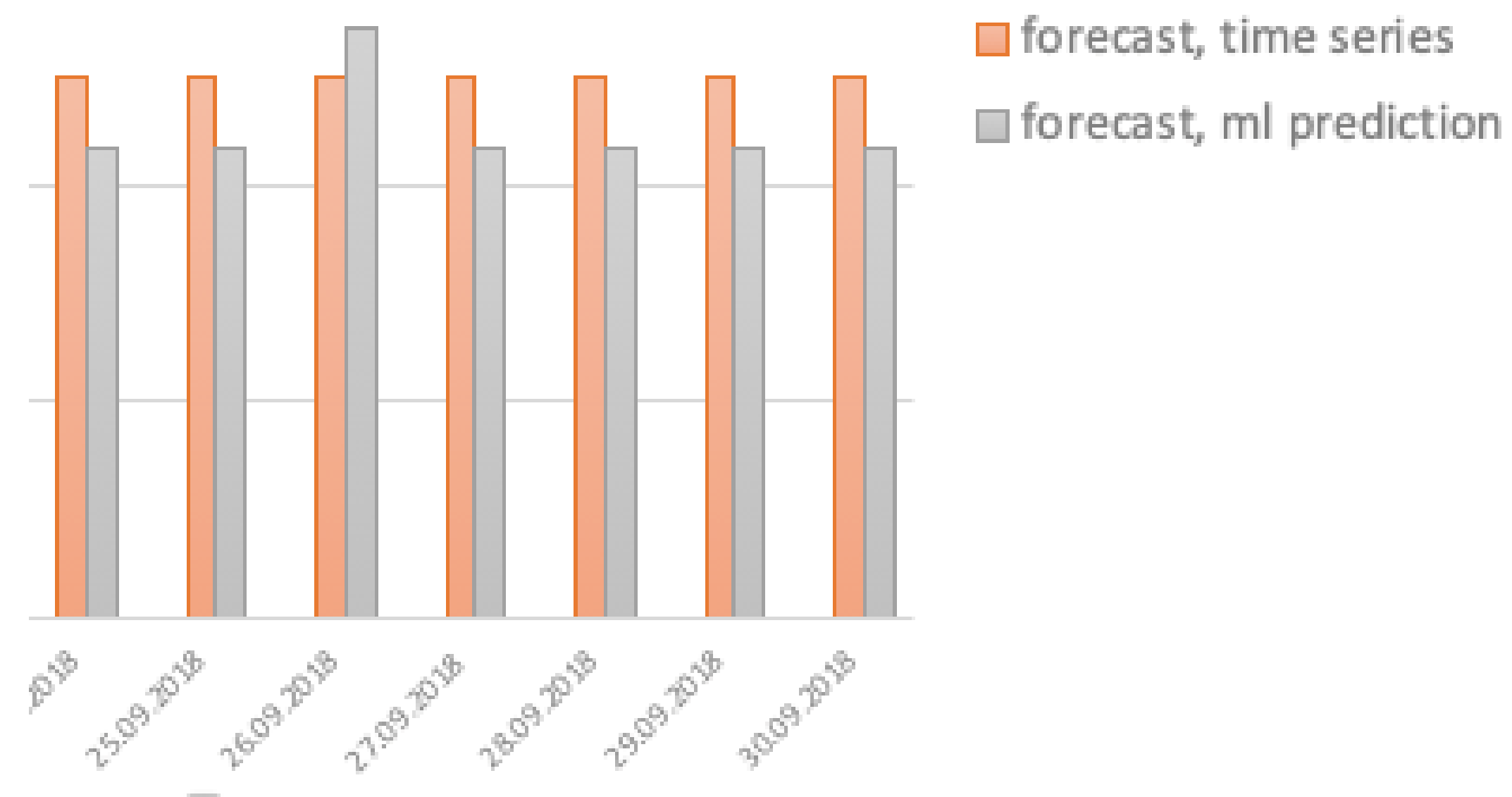
# ML Prediction API



## Demo



# 'Time Series' vs 'ML Prediction'



## Why the ml prediction forecast changes?

- It uses Tree-regression 'annova' algorythm
- We use 6 features, instead of 2

## Can we increase model quality?

- Yes.
- Add more features. Use custom build ML model

# Custom Azure ML API

- You build your model in Azure ML Studio, outside from Business Central
- You publish it as a web service
- You call this web service from Business Central, using Codeunit 2001



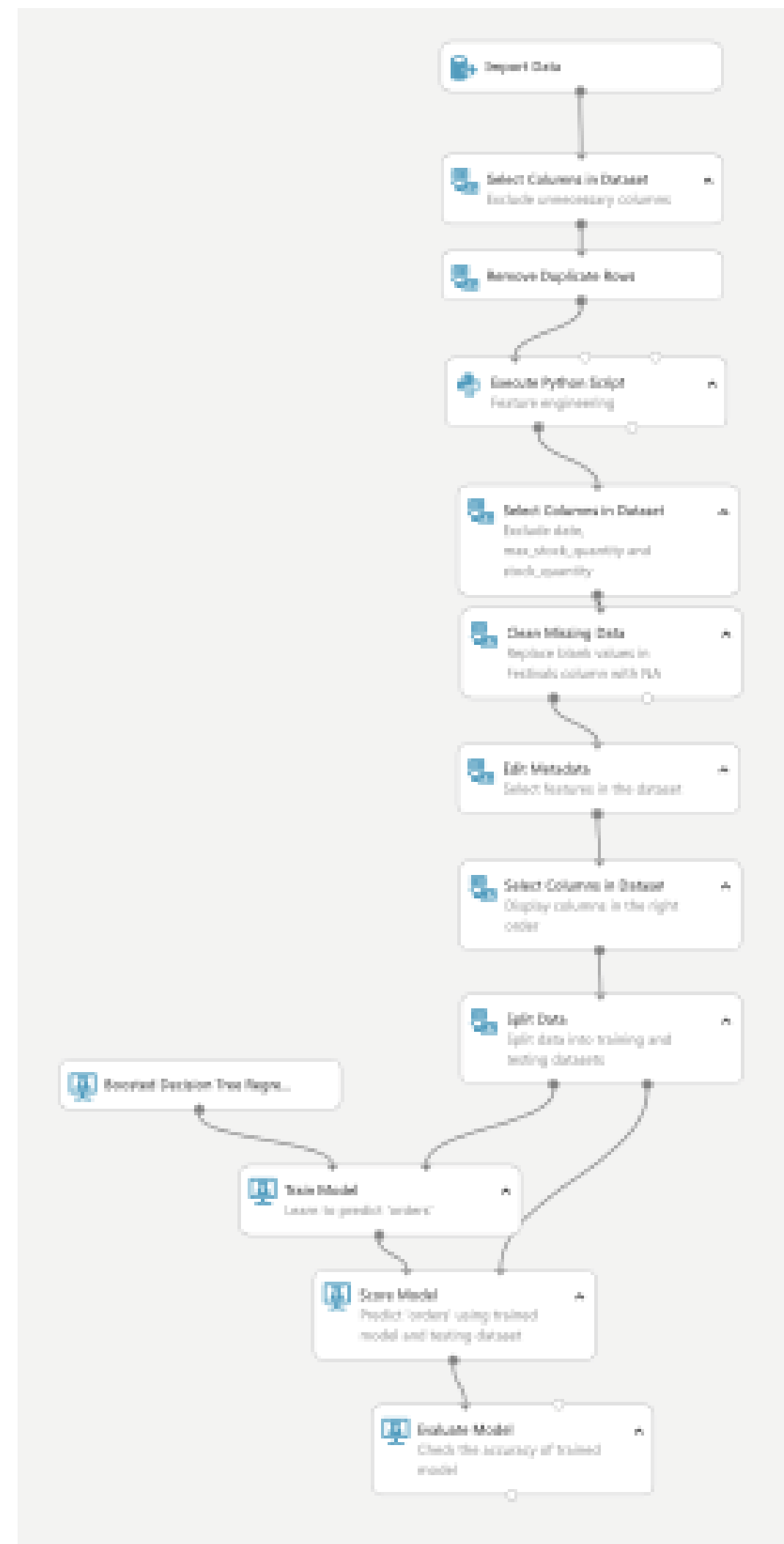
# Custom Azure ML API

## Machine Learning process



<https://youtu.be/BRDiV2xygSI>

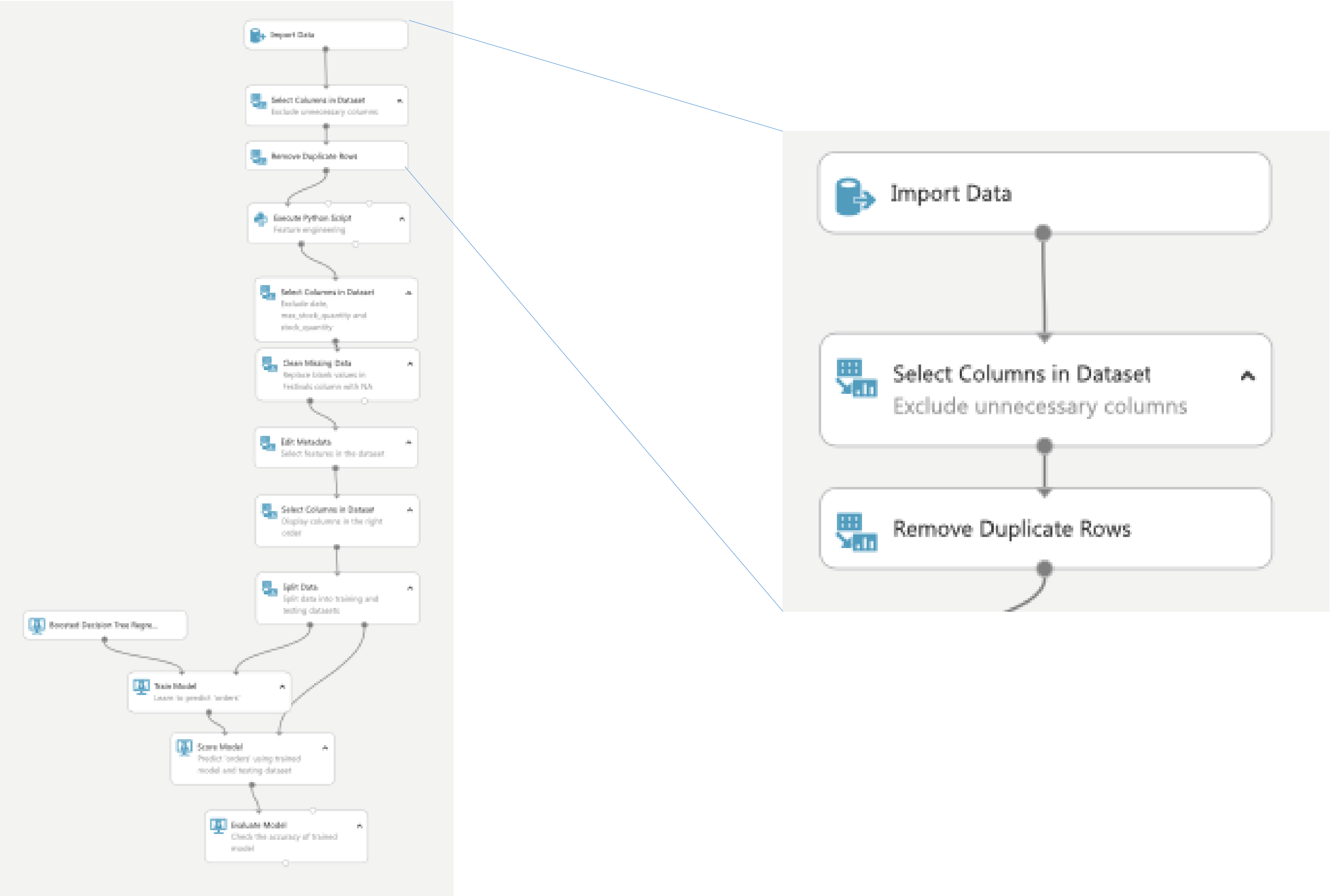
# Custom Azure ML API



Build your own ML Model

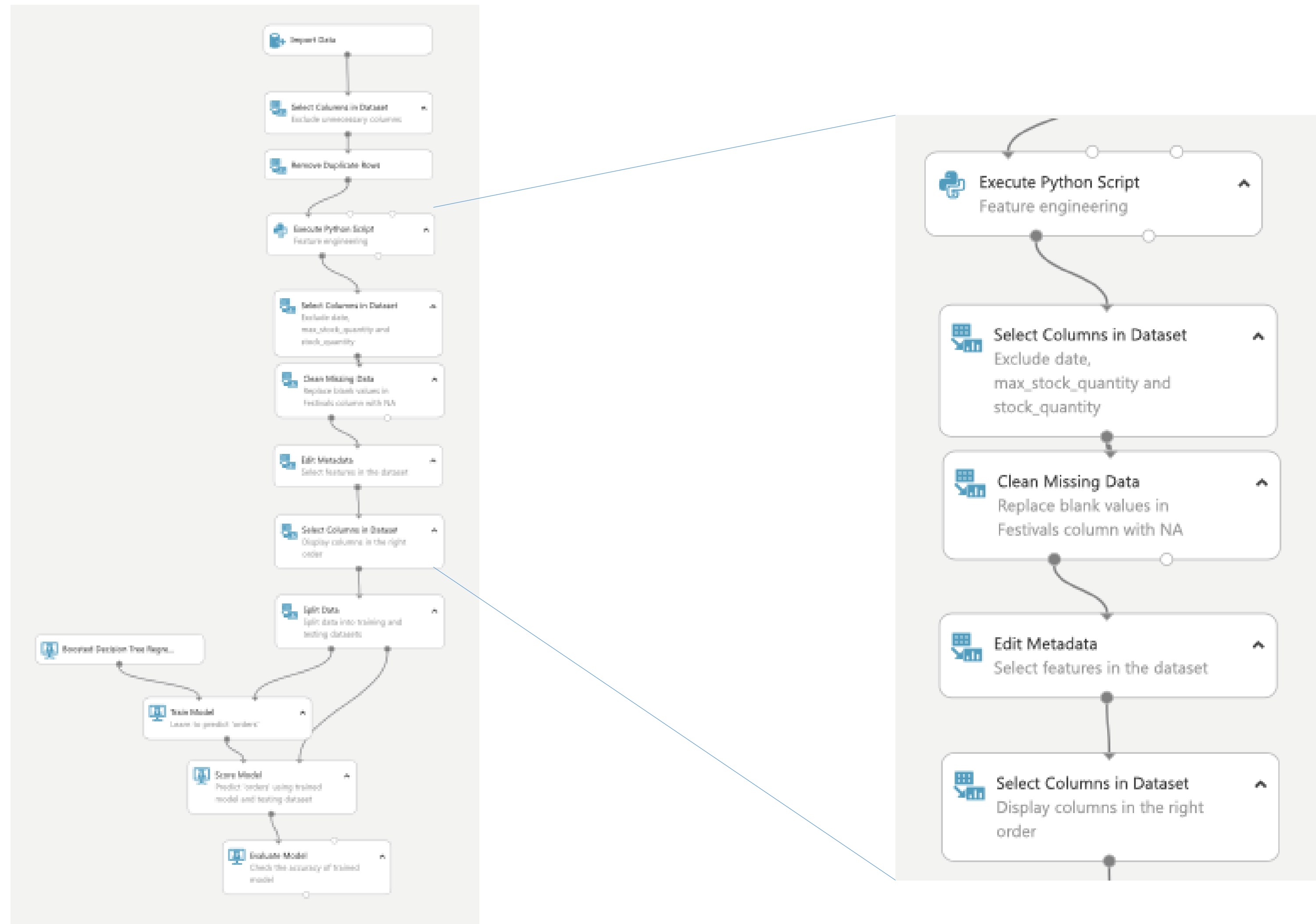
# Custom Azure ML API

Get and clean data



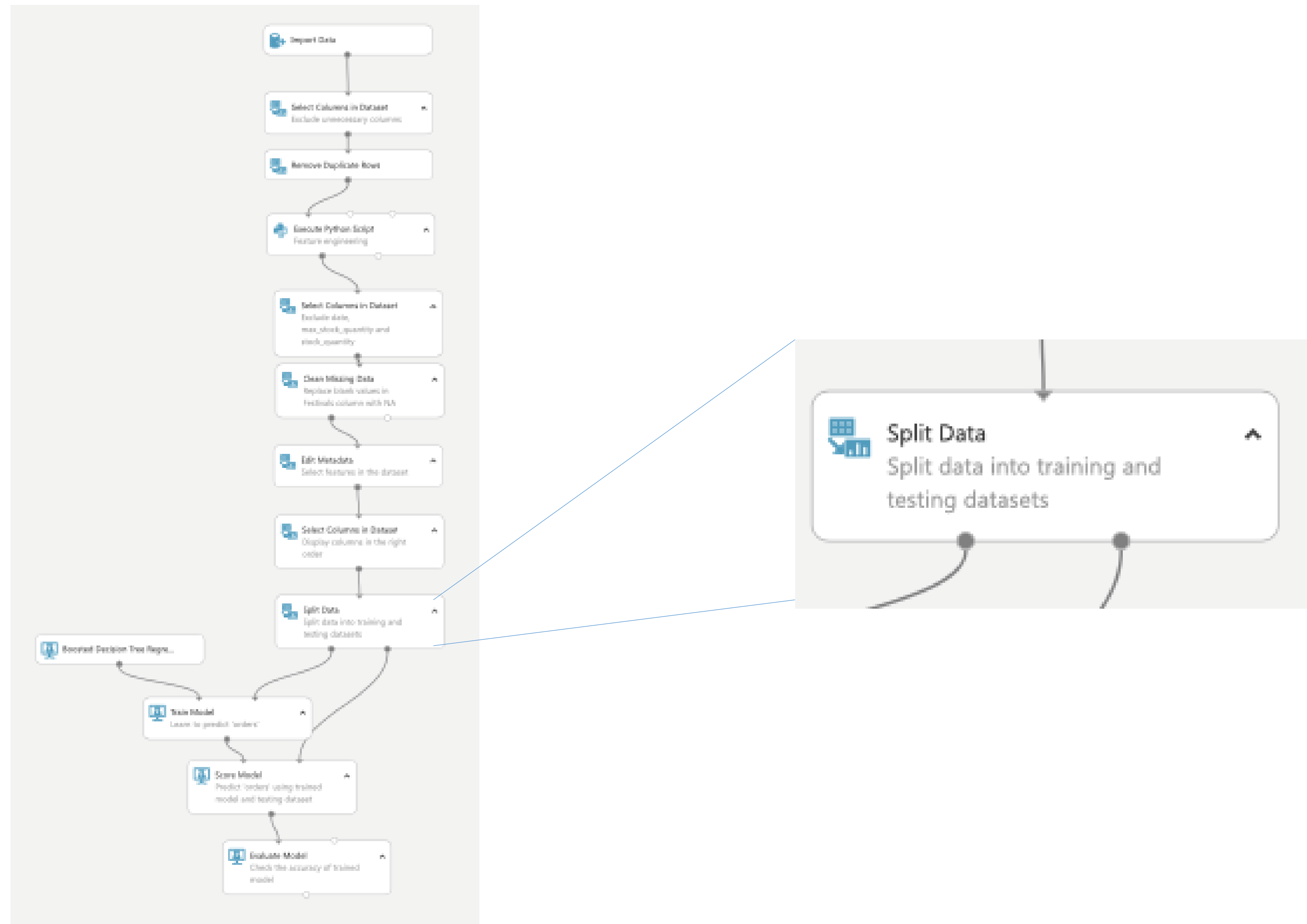


# Custom Azure ML API



- Generate new features
- Prepare data for training

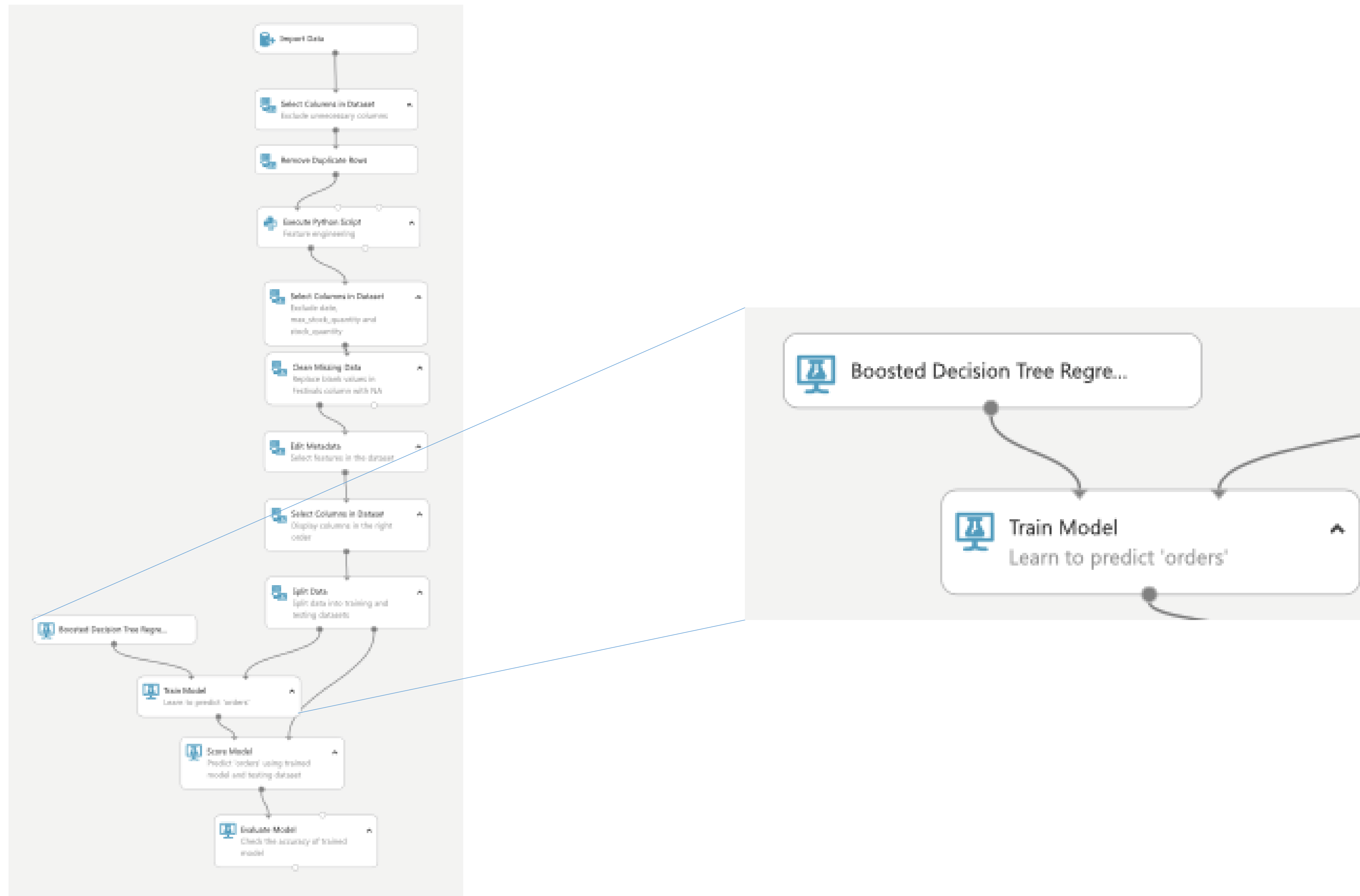
# Custom Azure ML API



Create 2 datasets

- to train
- to test

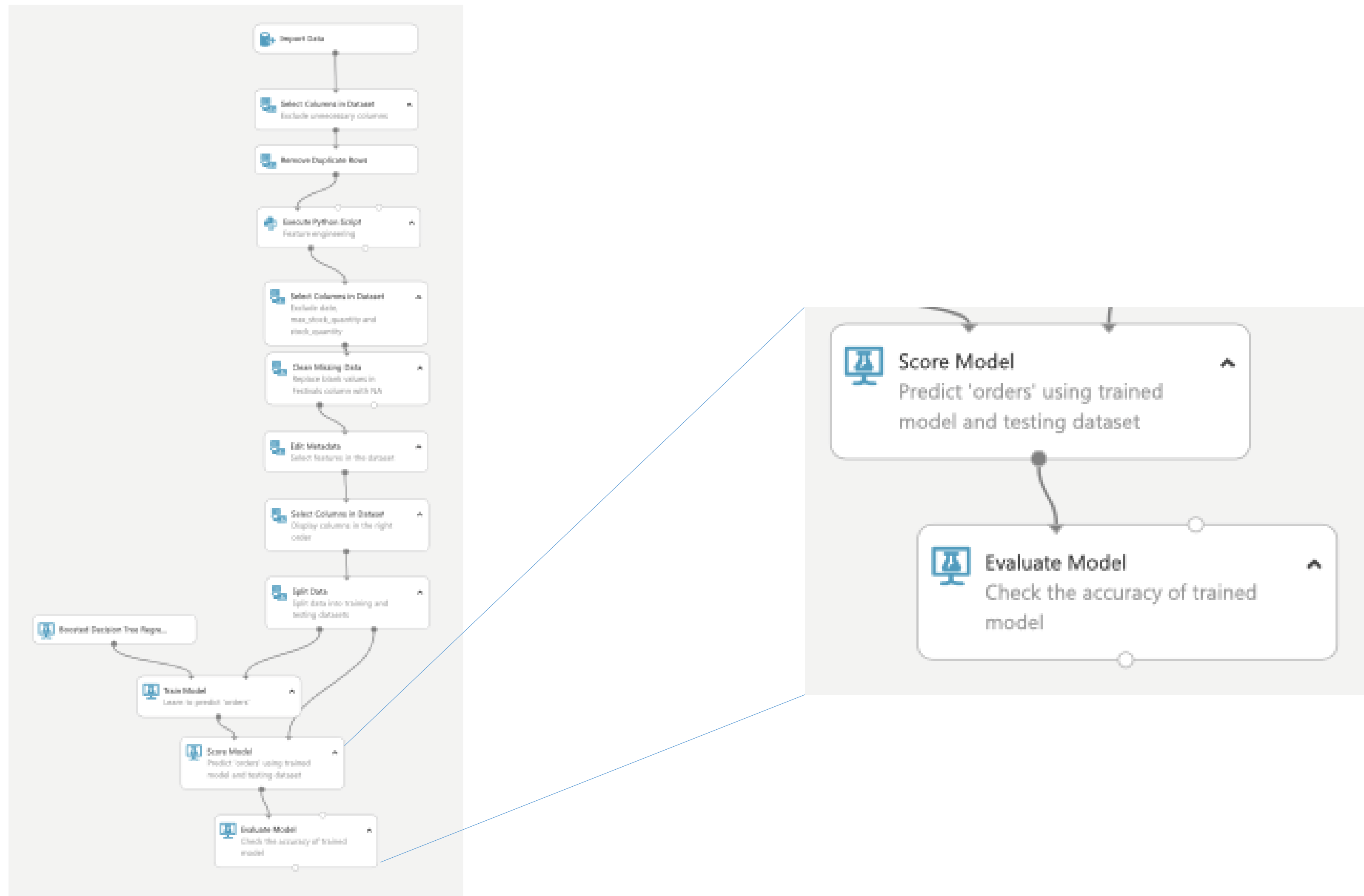
# Custom Azure ML API



Train model

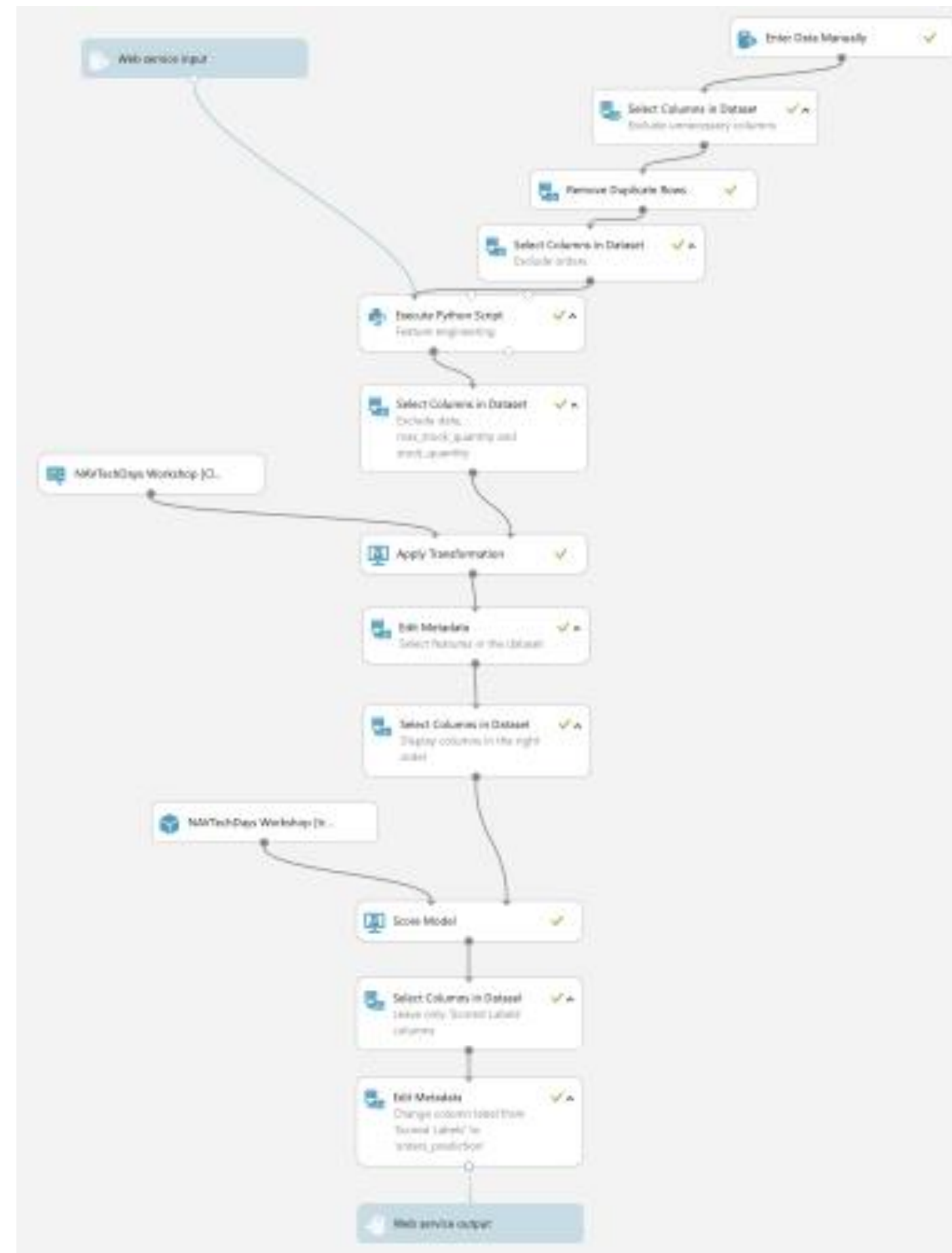


# Custom Azure ML API



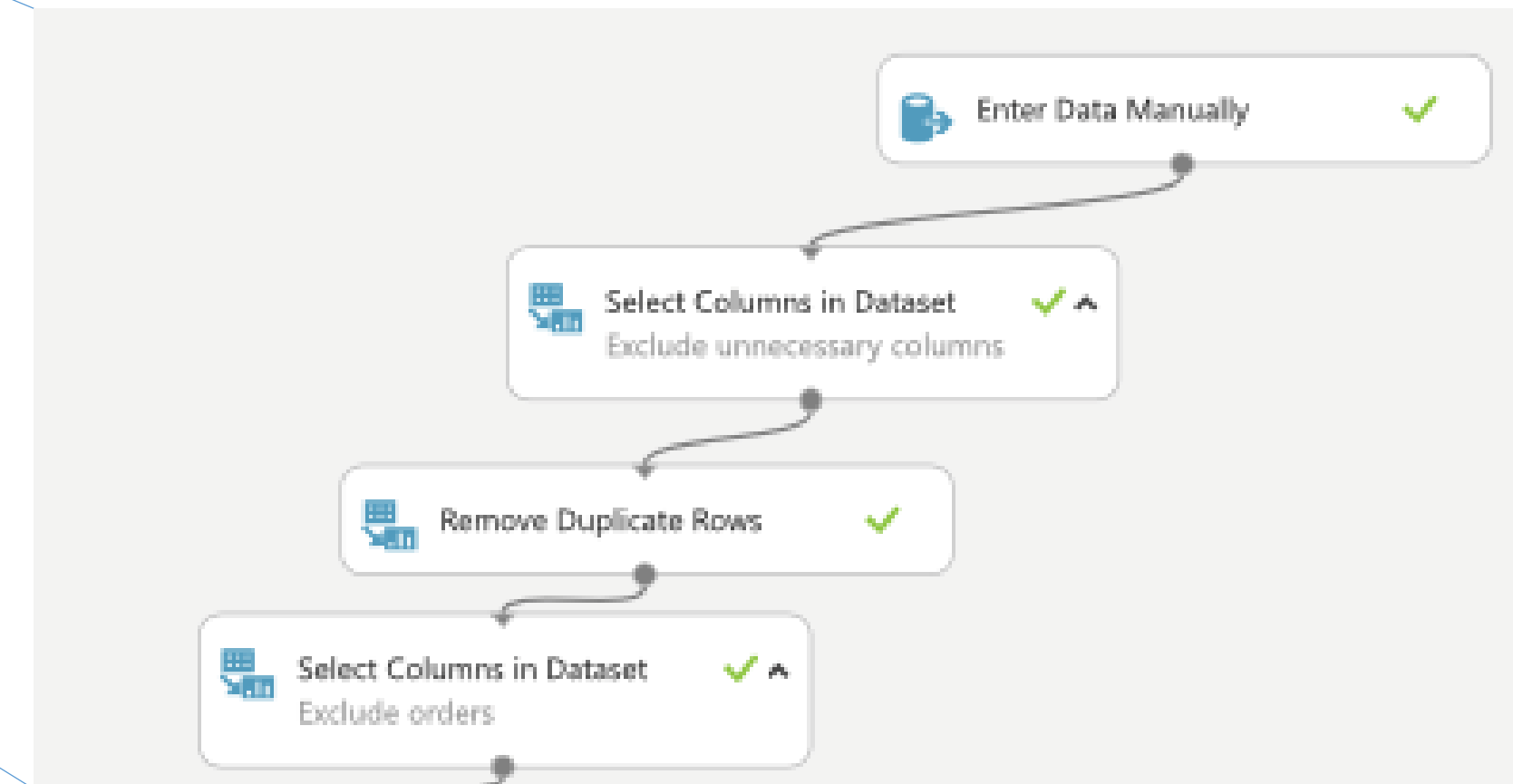
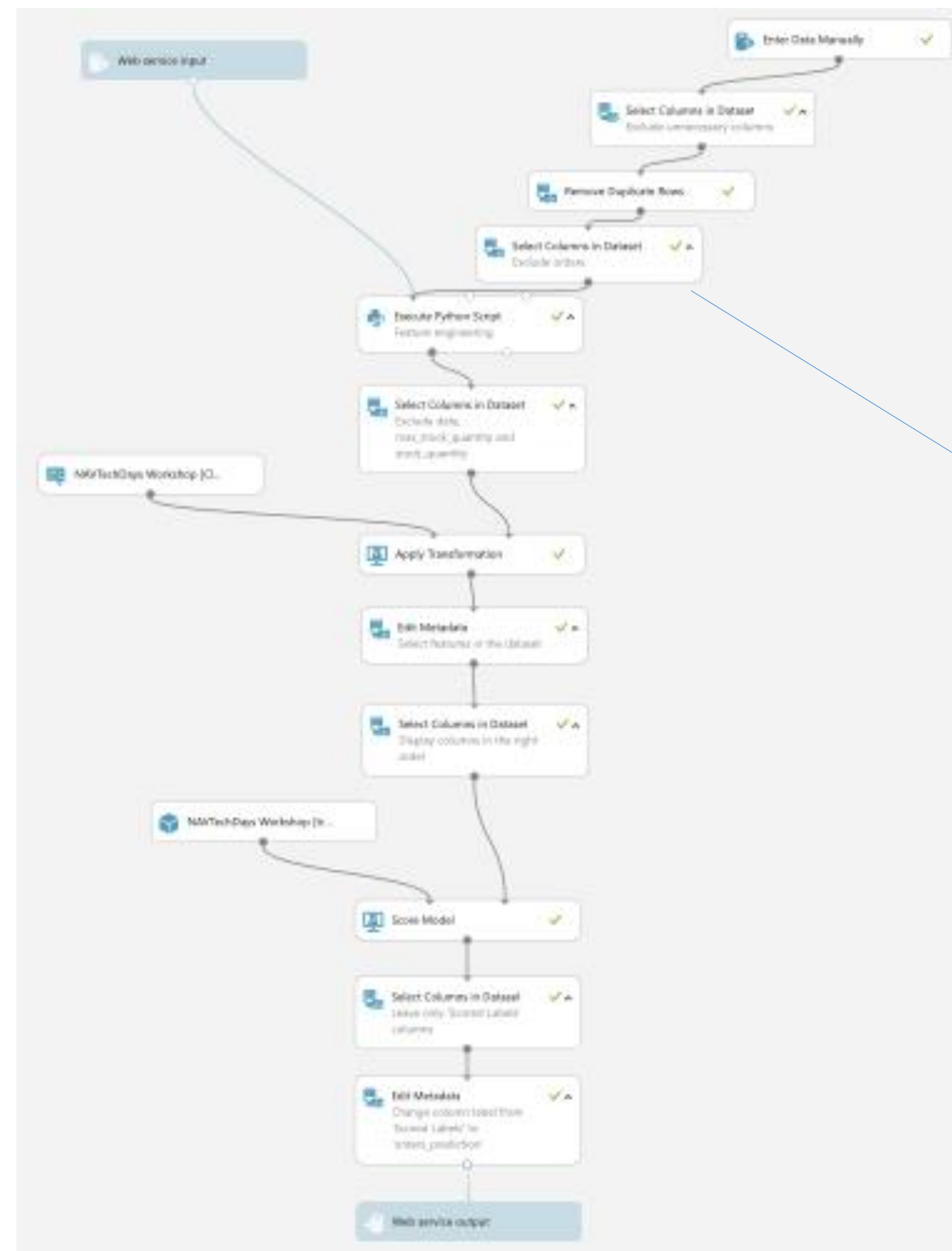
Check model quality

# Custom Azure ML API



Publish your own ML Model as a web service

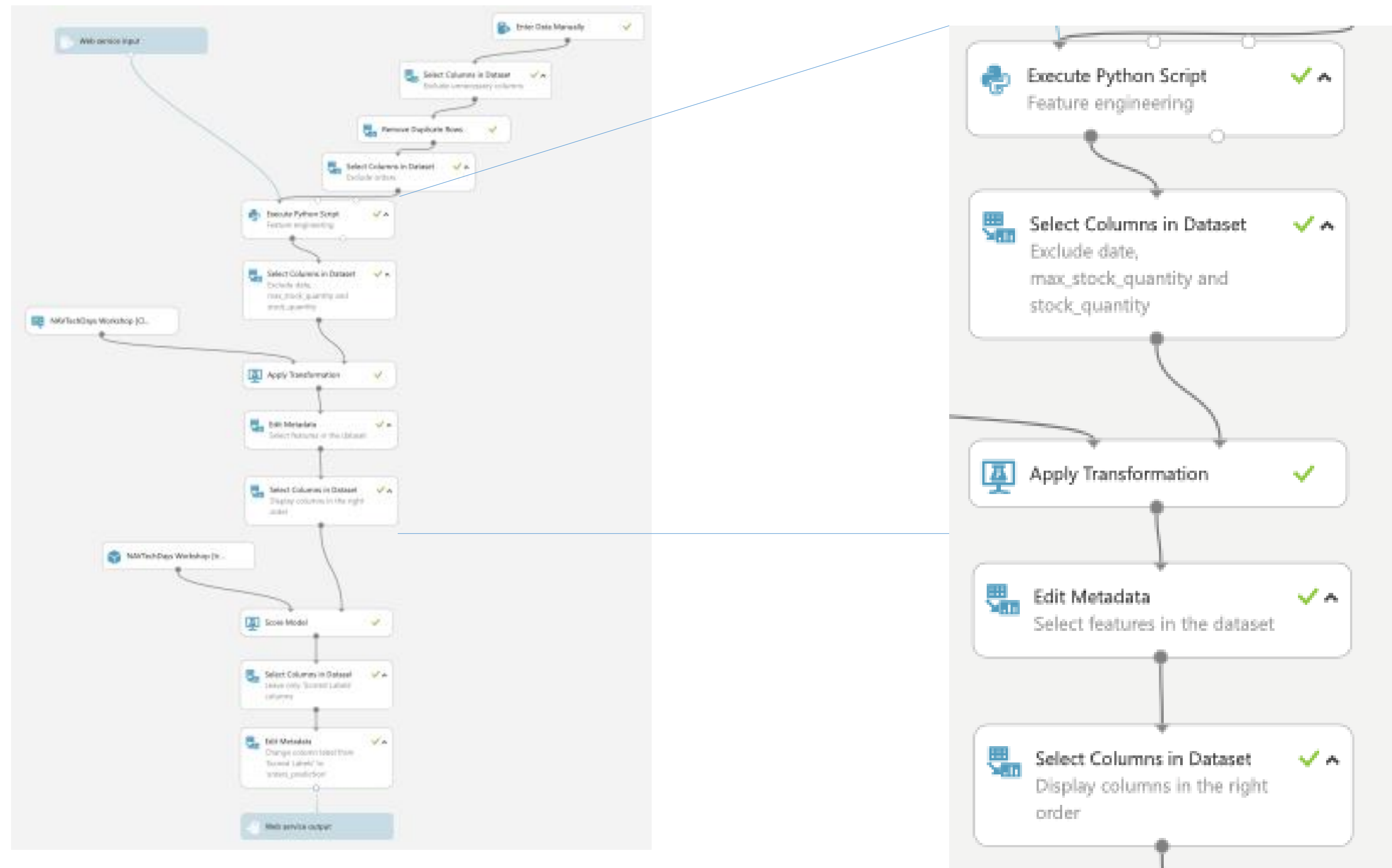
# Custom Azure ML API



Build web service input schema

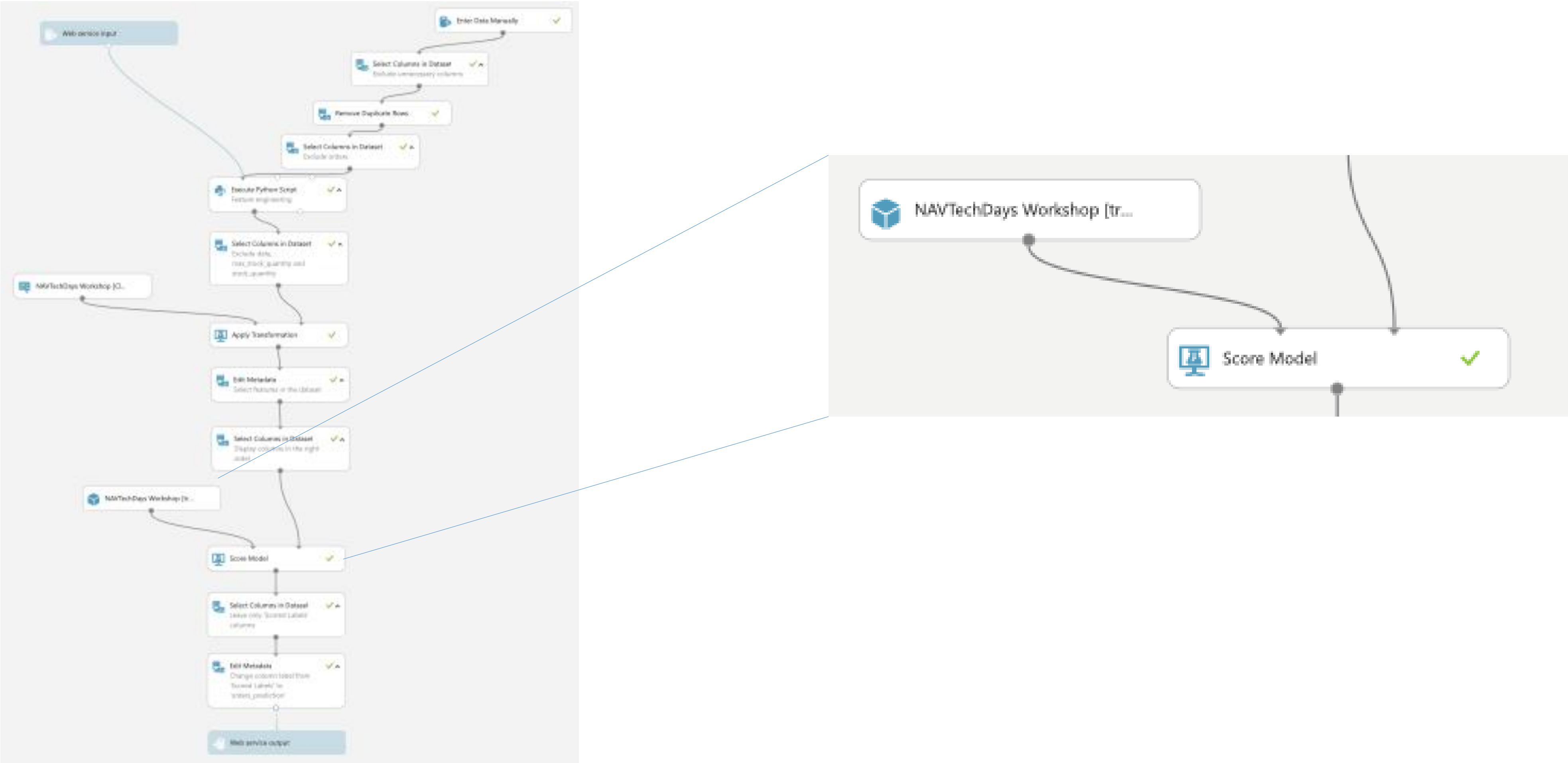


# Custom Azure ML API

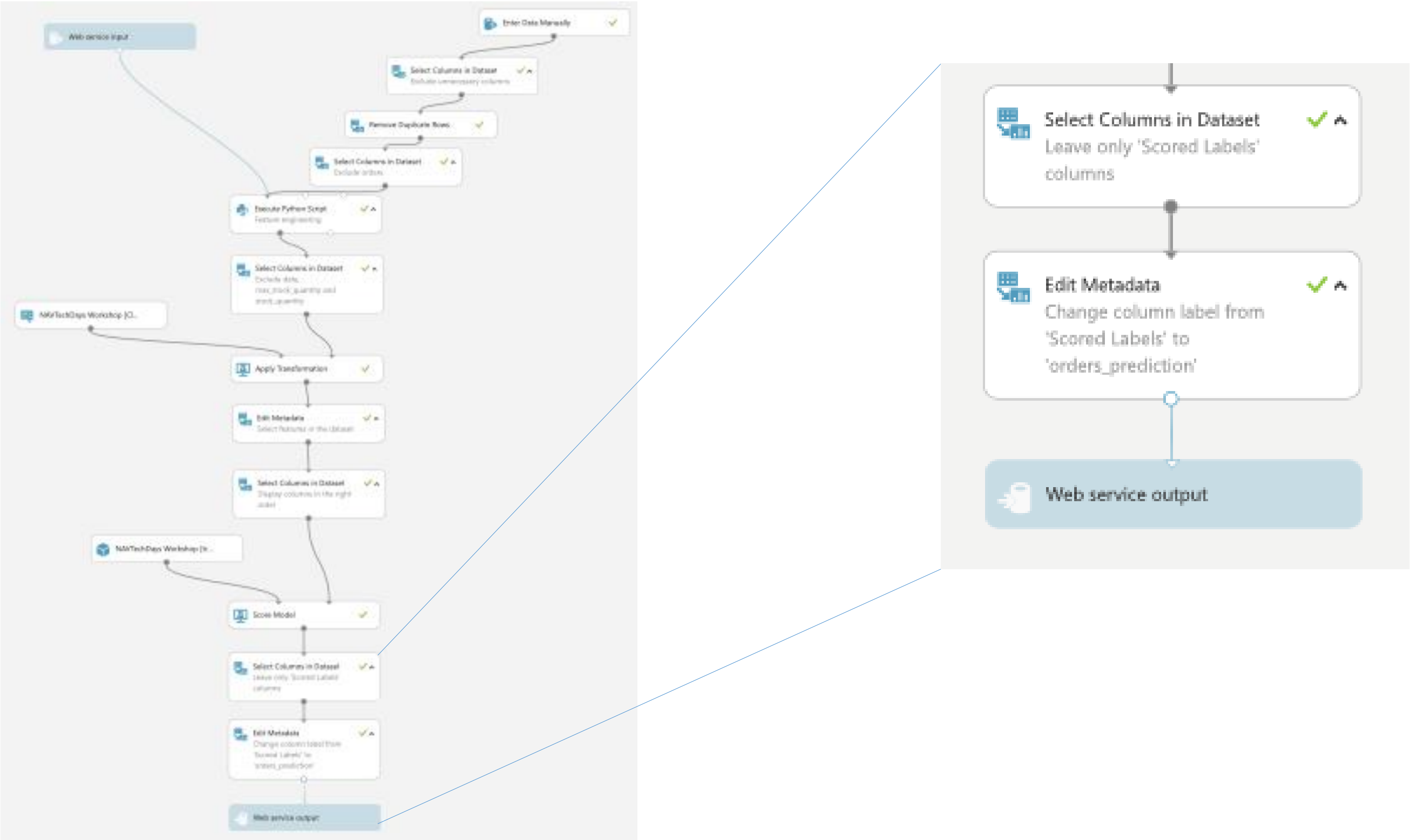


Prepare data for  
predictions

# Custom Azure ML API



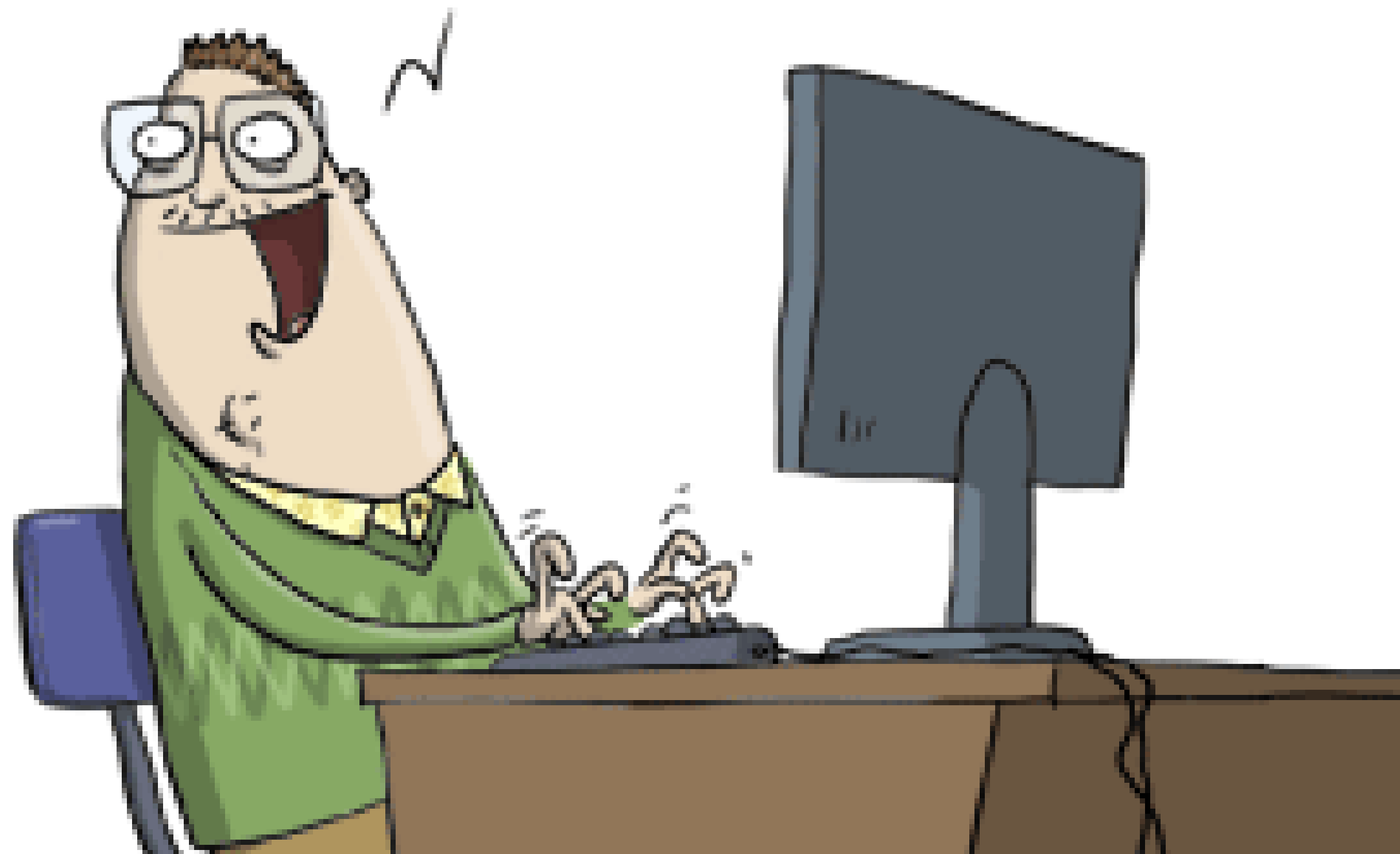
# Custom Azure ML API



Build Web Service  
Output

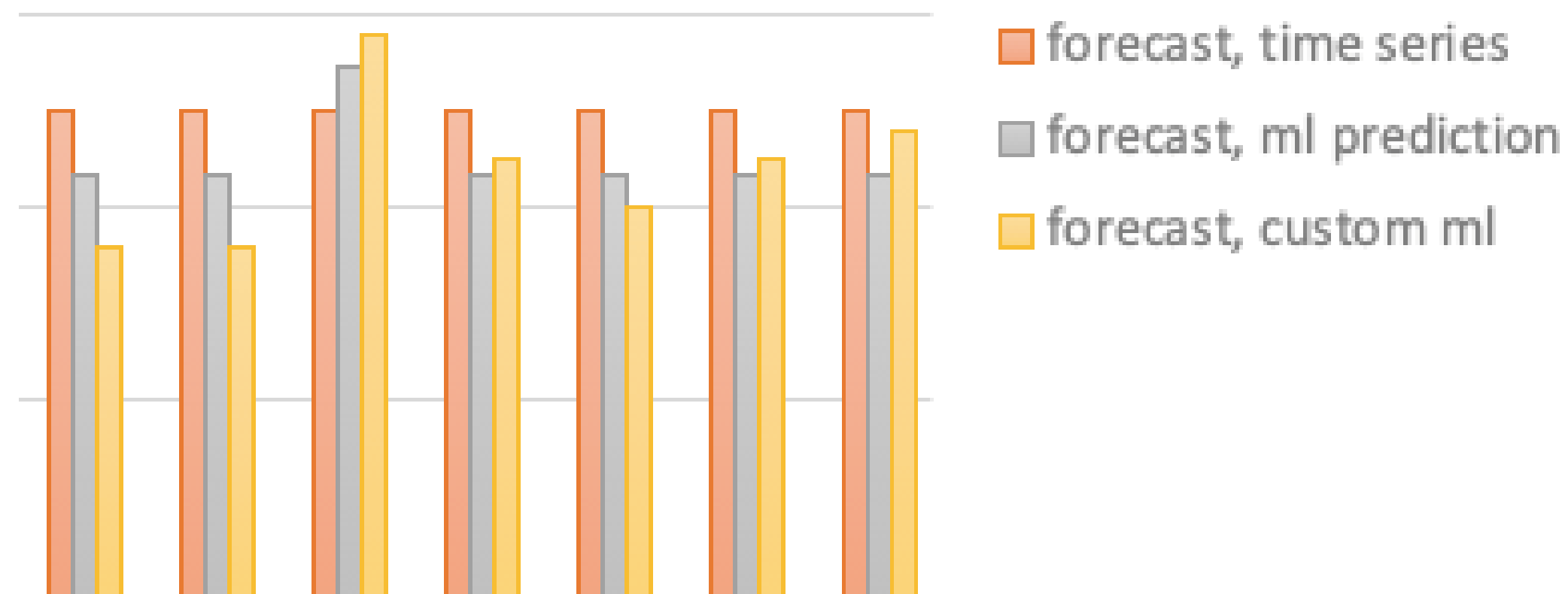


# Custom Azure ML API



## Demo

# 'Time Series' vs 'ML Prediction' vs 'Custom ML'



## Why the custom ml forecast changes?

- It uses Boosted Tree-regression algorithm
- We use 8 features, instead of 2 and 6

## Can we increase model quality?

- Yes.
- Add more features. Change algorithms. Change hyperparameters

# Ok, do you have something really cool?





# Custom Vision API



## Demo



# The real story. US Tanks recognition



**100% accuracy**



# The real story. US Tanks recognition



**Not a tank**



# The real story. US Tanks recognition



Not a tank



Tank



# The real story. US Tanks recognition



It recognized Clouds instead of tanks!



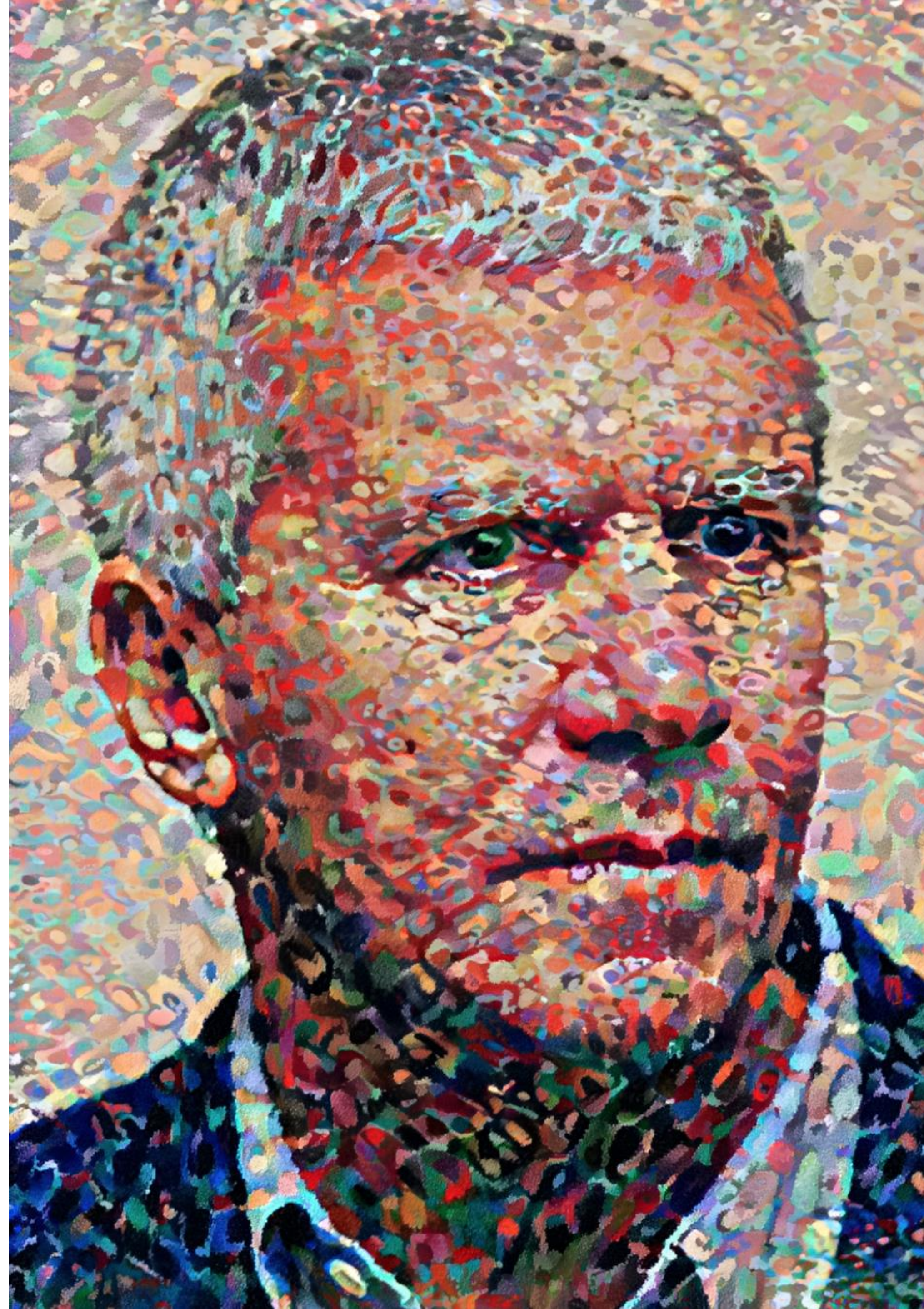
Not a Cloud



Cloud



# AI Art





# Links you should know

- Time Series API Model

<https://gallery.azure.ai/Experiment/Forecasting-Model-for-Microsoft-Dynamics-365-Business-Central>

- ML Prediction API Model

<https://gallery.azure.ai/Experiment/Prediction-Experiment-for-Dynamics-365-Business-Central>

# Additional resources

- Ready solutions

<https://gallery.azure.ai>

<https://azure.microsoft.com/en-us/overview/ai-platform/>

- Your custom solutions

<https://studio.azureml.net>

<https://customvision.ai>

- Auto ML

<https://aka.ms/AutomatedML>

<https://aka.ms/AutomatedMLDocs>





# Now you know, how to implement AI





# Start and have fun!



And remember! AI is not a sex, and you are not a teenager.

So, stop talking about it. Do it!





**Microsoft®**  
Most Valuable  
Professional

# AI 4 BC

# Q&A

- [dmitry.katson@gmail.com](mailto:dmitry.katson@gmail.com)
- <https://twitter.com/DmitryKatson>
- <https://www.linkedin.com/in/dmitry-katson/>



*Thank  
You!*