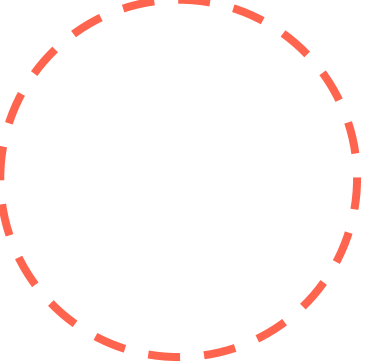
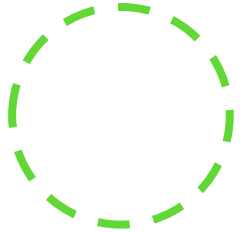
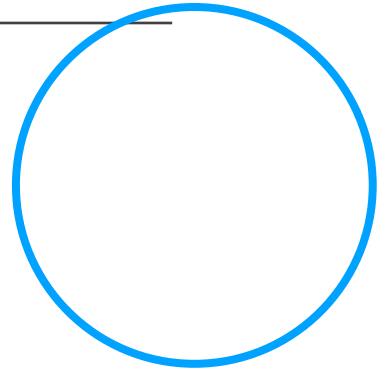


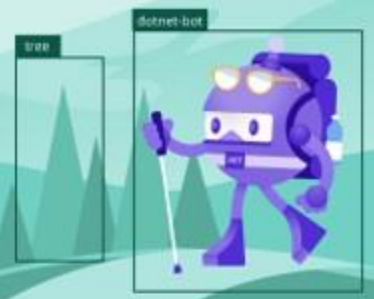


# ML Systems in Vertical Slices

F# & .NET INTERACTIVE 4 THE WIN

The Virtual
# ML .NET
Community Conference

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# HI Y'ALL!

- Software Engineer turned Data Scientist
- Functional Programming Enthusiast
- Working for HAKOM Time Series GmbH (we work with time series!)

# THE INSPIRATION FOR THIS TALK

- Research and Development is a game of pitches
- …as are Startups
- …as is Game Development
- Launching a perfect system does seldomly happen
- Presenting a limited prototype gets feedback and wins the grant money

# WE THINK SYSTEMS, NOT MODELS


- Start with a real problem
- Develop a hypothesis
- Collect enough data for prototype
- Sample and transform data
- Build and evaluate model
- Deploy model
- Test model with consumer and evaluate
- Rinse & Repeat

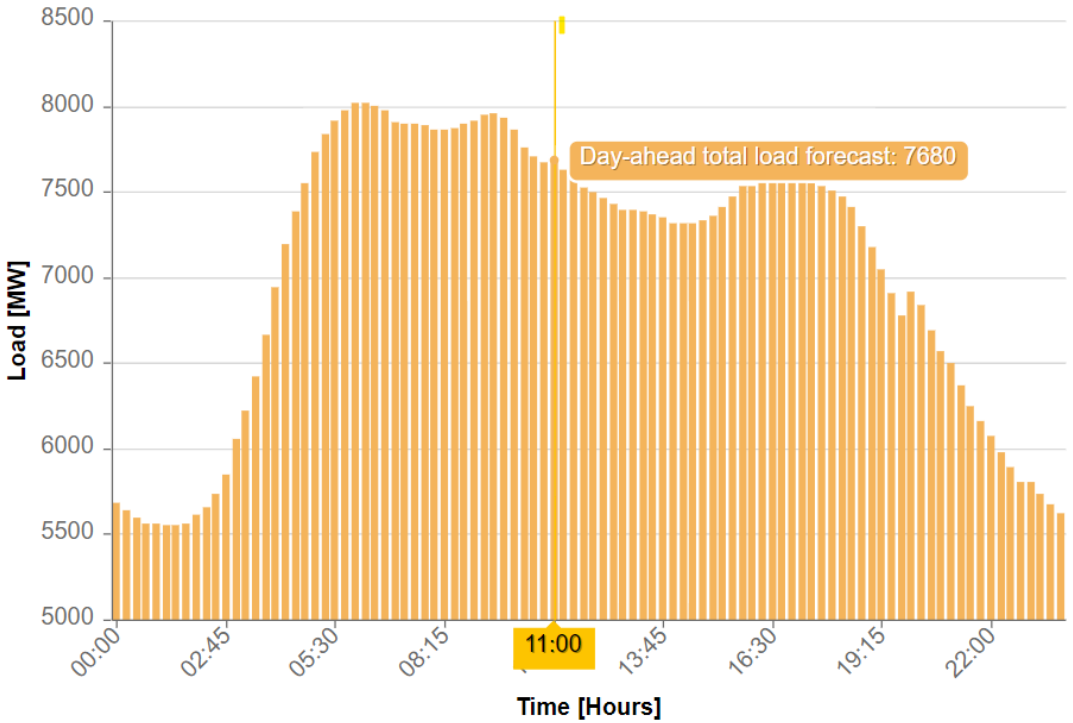
Source: https://xkcd.com/1838/

# The Problem Statement

PLEASE START HERE

# WE WANT TO FORECAST ENERGY LOAD

- As an Energy Provider…
- I want to forecast energy load…
- At least a day ahead at an hourly rate
- In order to buy/produce the right amount at the best price



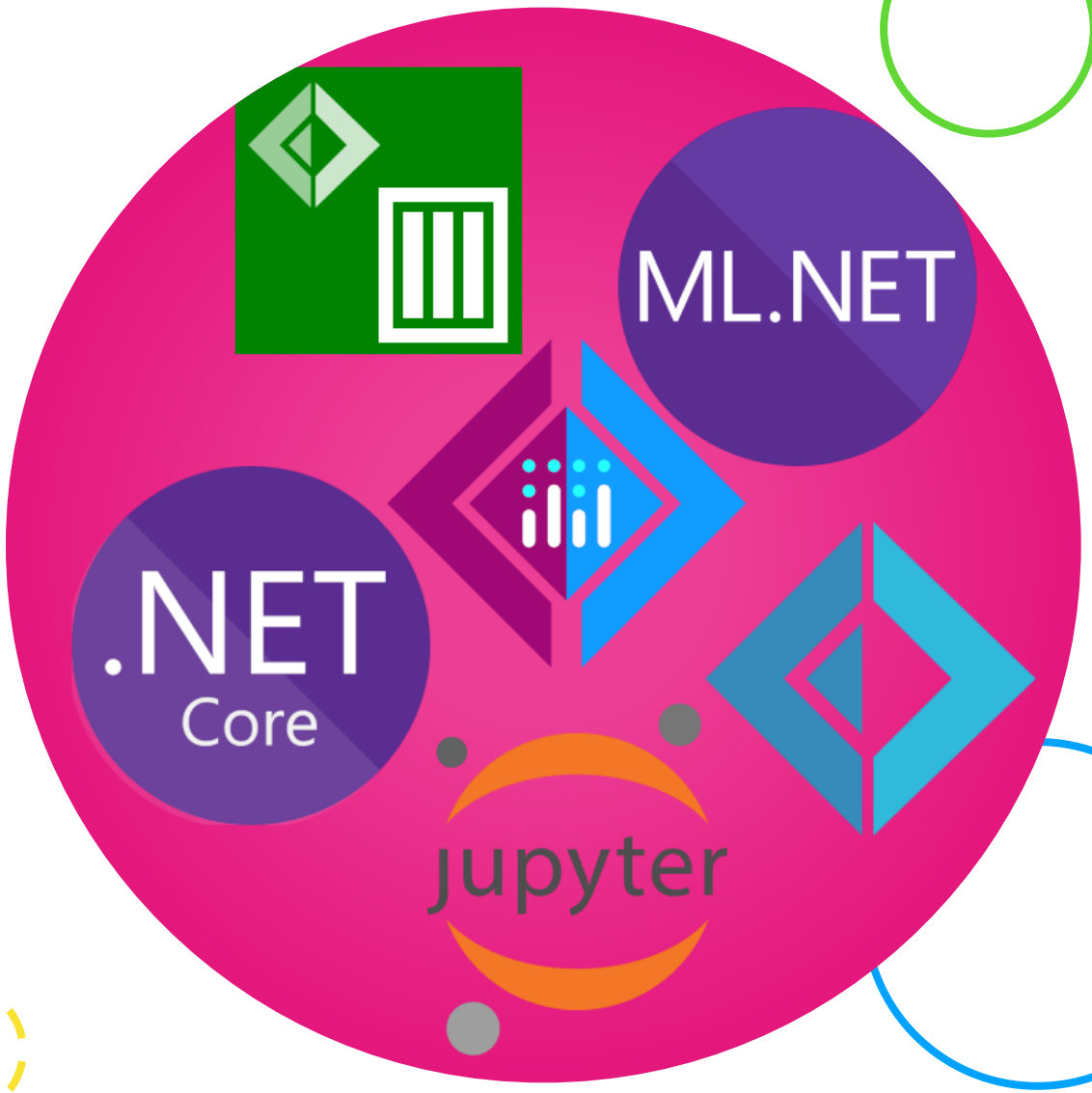

Source: https://transparency.entsoe.eu/load-domain/r2/totalLoadR2/show

# The Tools

STANDING ON THE SHOULDERS OF GIANTS

# INTERACTIVE AND CONCISE

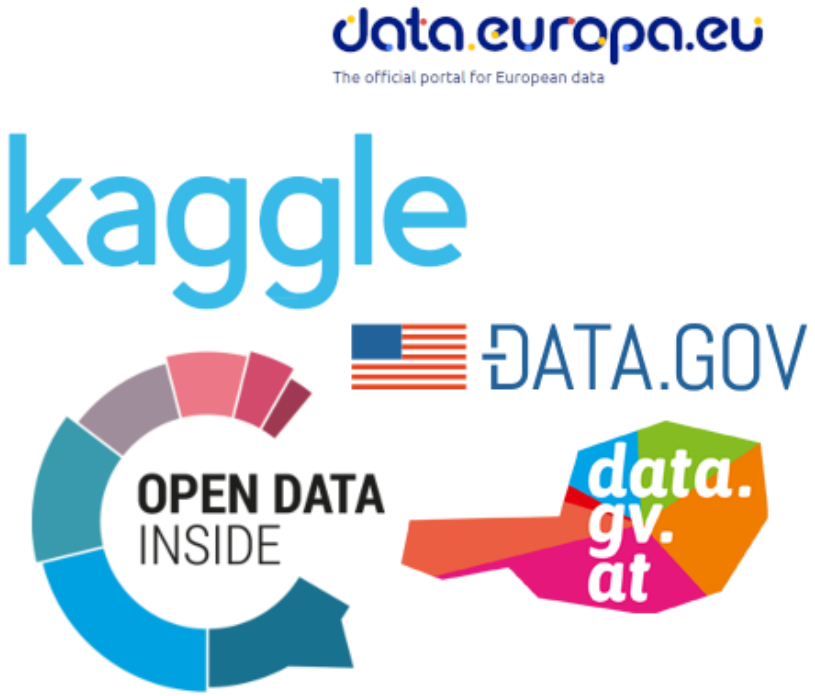
- Interactive Programming makes for fast iterations
- F# is expressive and concise
- Plotly.NET is pretty and interactive
- Deedle provides data frames and time series functions
- ML.NET for modelling
- .NET Core is a rock solid, enterprise ready™ and performs very well



# Getting Data

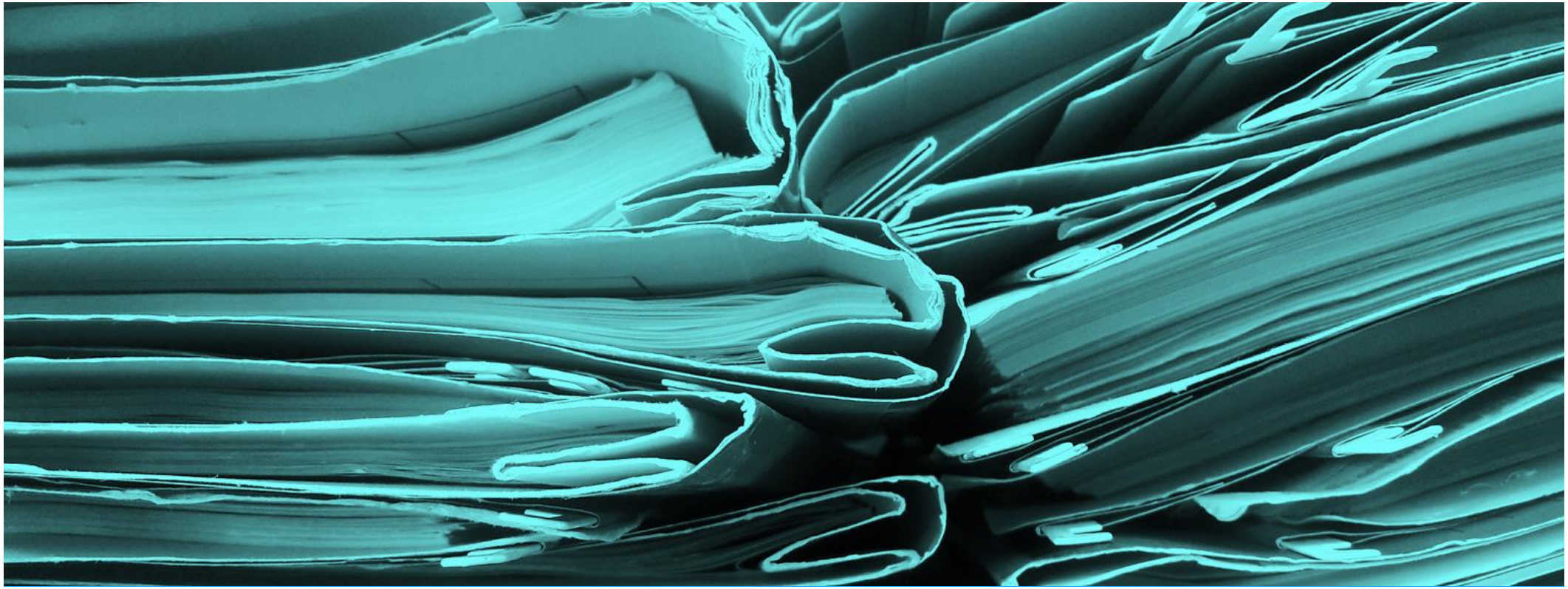
BECAUSE WE NEED SOMETHING TO WRANGLE

# PITCH WITH REAL DATA




- Benchmark datasets are fun but not always useful
- There is an abundance of open data
- This data is usually not super pretty
- That is a good thing – actually
- Kaggle can be a decent first step

# DEMO TIME!

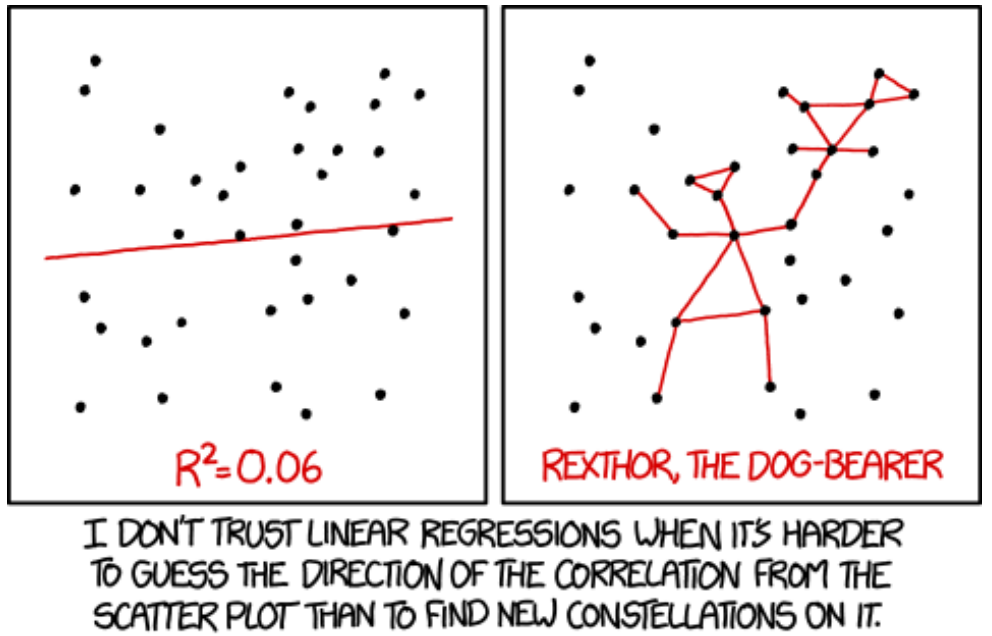


# The Initial Model

SETTING A BASELINE

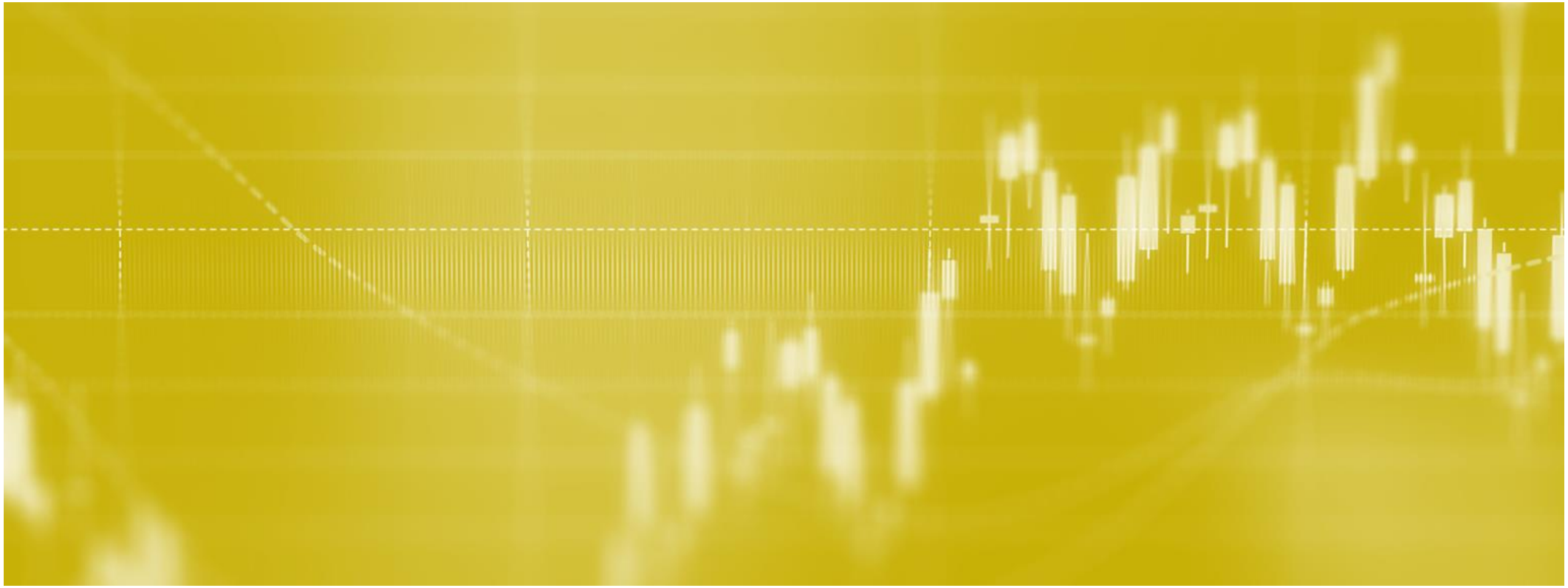
# LINEAR MODELS AND HOW TO WIELD THEM

- Linear models usually offer a good baseline
- …either they are flexible enough to be good
- …or they are really bad and offer a good lower bound
- For systematically stable time series linear models are a good "first throw"




Source: https://xkcd.com/1725/

# DIRECTLY INTO THE DEMO WE GO!



# Deploy Or It Did Not Happen

THE THING THAT IS REALLY EASY IN .NET

# YOU FIT A MODEL, AND NOBODY CALLS IT…


- …does it really exist?
- .NET isn’t primarily known for Data Science or ML
- But we are brilliant at getting stuff into production
- An MVP needs to be usable if you want to pitch it
- …even if the usage is very limited

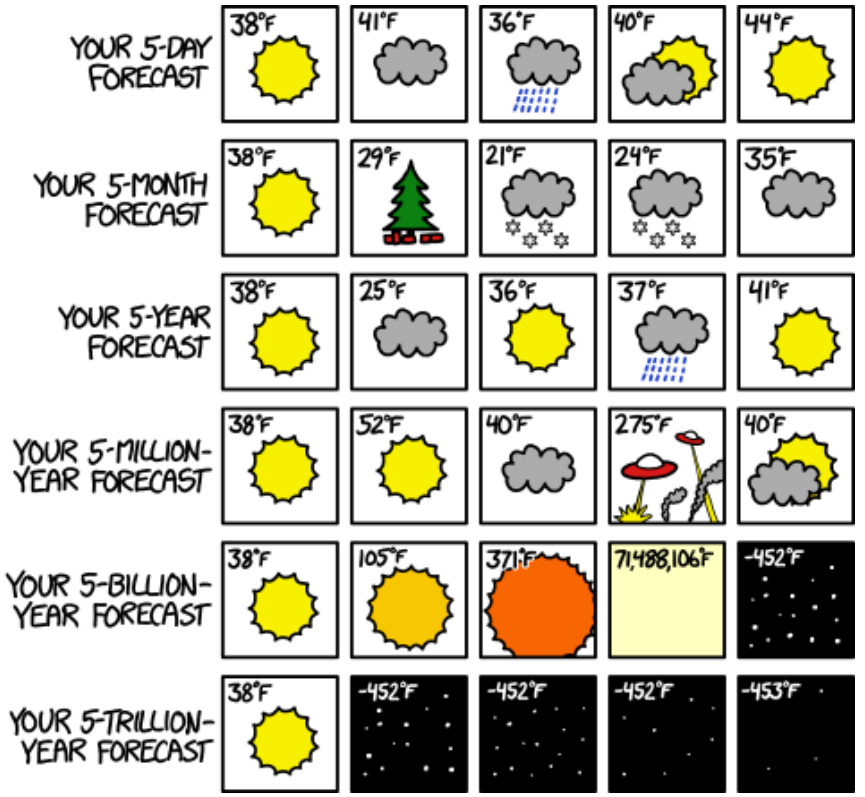
# YOU GUESSED IT… HERE WE GO!

# Fast Iterations

OR WHY WE SHOULD ALWAYS THINK ABOUT UNCERTAINTY

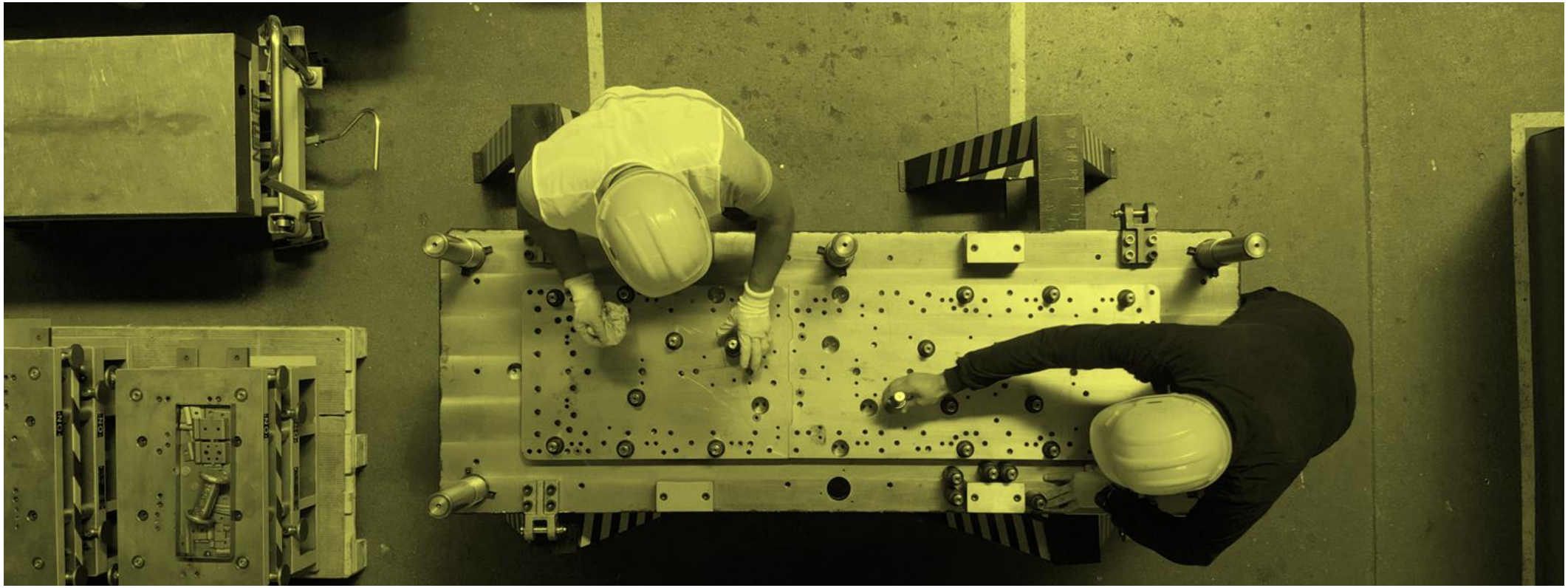
# ALL FORECASTS ARE WRONG…

- …but some are useful
- Currently we are far off the mark
- Worse than that: we don't factor in uncertainty
- ML.NET offers more advanced forecasting models
- As we only have one predictor, we can use Singular Spectrum Analysis




Source: https://xkcd.com/1606/

# BACK TO WORK!



# Where To Go From Here

YOUR SYSTEM'S LIFE AFTER THE PITCH

# POSSIBLE NEXT STEPS

- Implement experiment tracking
  - MLOps.NET
- Get more domain knowledge
- Try new models
  - Hierarchical Time Series Forecasting
  - Recurrent Neural Networks
- Get more (and better) data

# SHAMELESS PLUG!

HAKOM
TIME SERIES

- SQLite and CSV doesn’t scale
- Manage hundreds of thousands of Time Series
- Don’t worry about common Time Series transformation tasks
- Extras like auditing, meta data, compression, etc.
- Years of experience in the field
- Someone you can call if you have a problem

Source: https://xkcd.com/1725/

# USEFUL COMMUNITY LINKS

- HAKOM YouTube Channel
  https://www.youtube.com/channel/UCMxvNphrg6qdYV280i1awxw
- The .NET Discord
  https://aka.ms/dotnet-discord
- The FSharp Foundation Slack
  https://fsharp.org/guides/slack/
- The FsLab GitHub Discussions
  https://github.com/fslaborg/FsLab/discussions

# GET IN TOUCH!

**LinkedIn**
https://www.linkedin.com/in/gregor-beyerle/

**Twitter**
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**Homepage**
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**GitHub**
https://github.com/WalternativE