INTRODUCTION TO AI & TURF MODELLING

AGENDA

Introduction to Artificial Intelligence:

- What is AI?
- AI branches
- Popular AI applications

AI for turf management:

- Golf turf industry challenges
- AI use-cases and feasibility
- Time series analysis for turf grass maintenance

SOMETHING ABOUT ME

Engineer in physics specializing in computational science

Worked with software last 15 years

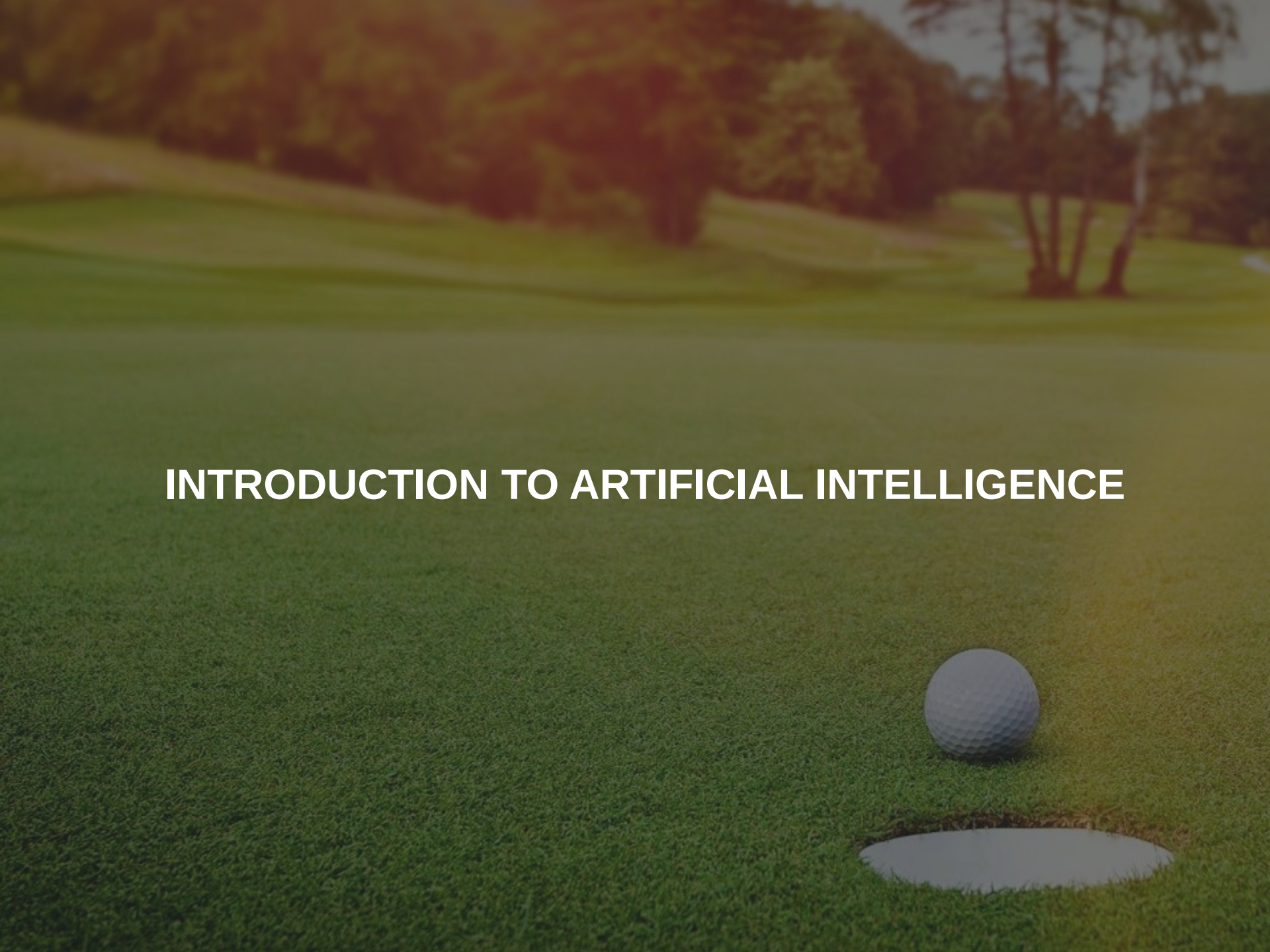
- Ericsson
- Trade in Sports - Sports Tech startup
- SVEA Bank

Last 3 years Artificial Intelligence within steel industry

Passionate about golf courses

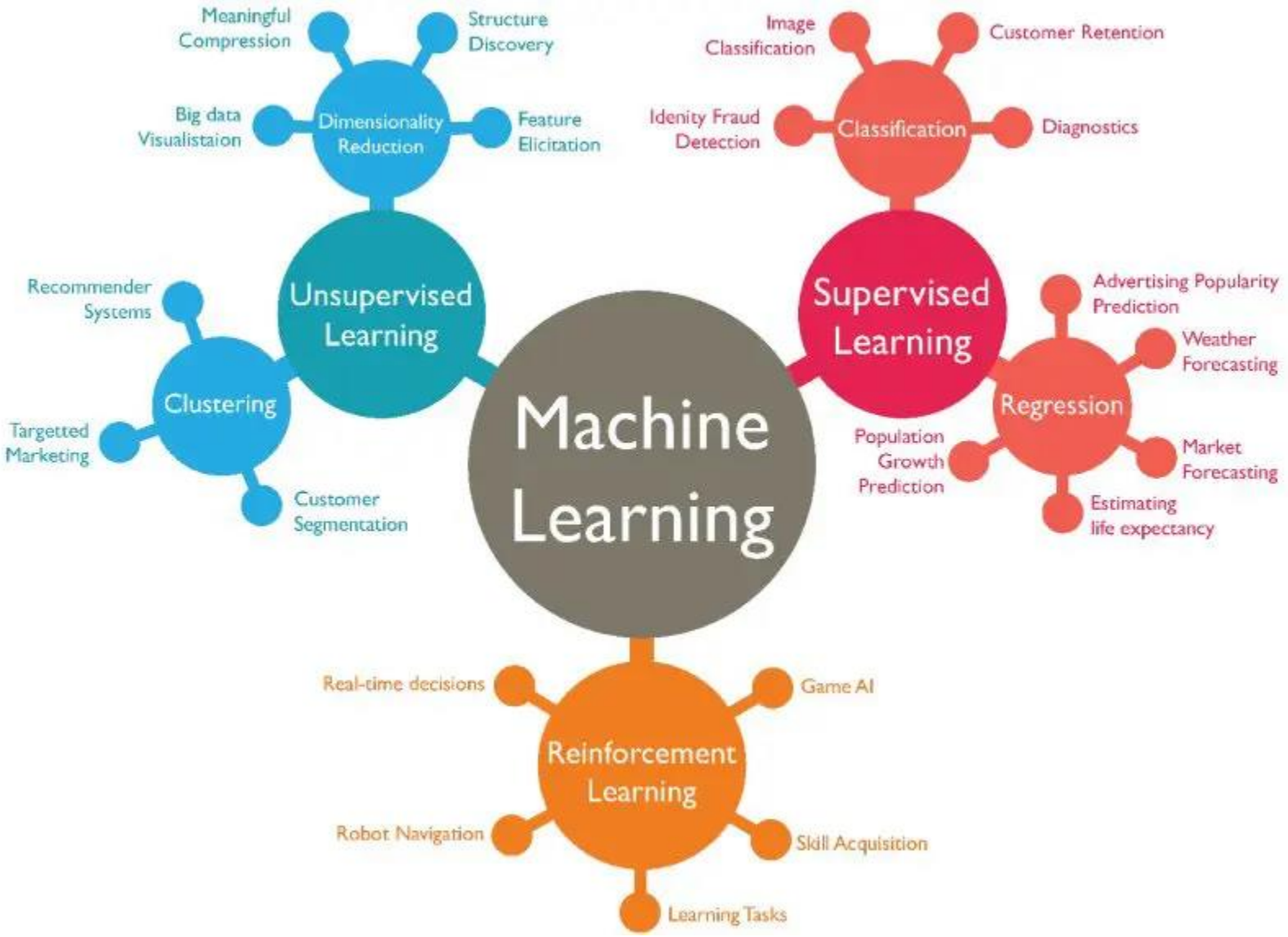
Football youth team coach and proud father of two future DIF strikers

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

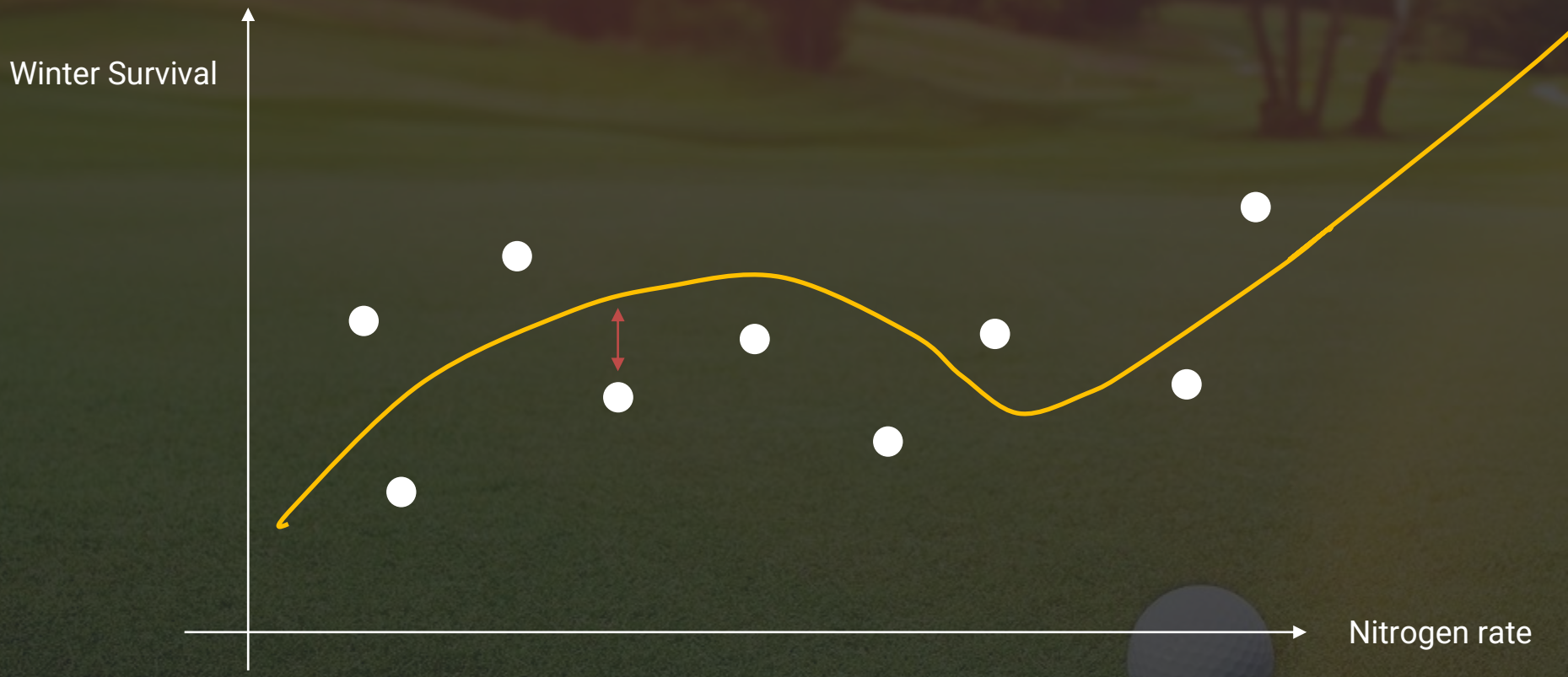


WHAT IS AI?

- AI - systems that mimic cognitive functions;
  - See
  - Understand
  - Respond
  - Make recommendations
- Subtask oriented
- Machine learning – computer that learns from data and acts accordingly
- Shallow learning vs. deep learning
- Data + Algorithm - > ML model
- Target variables and features


Machine Learning
Unsupervised Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Supervised Learning
Classification
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Regression
Advertising Popularity Prediction
Weather Forecasting
Population Growth Prediction
Market Forecasting
Estimating life expectancy
Reinforcement Learning
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks

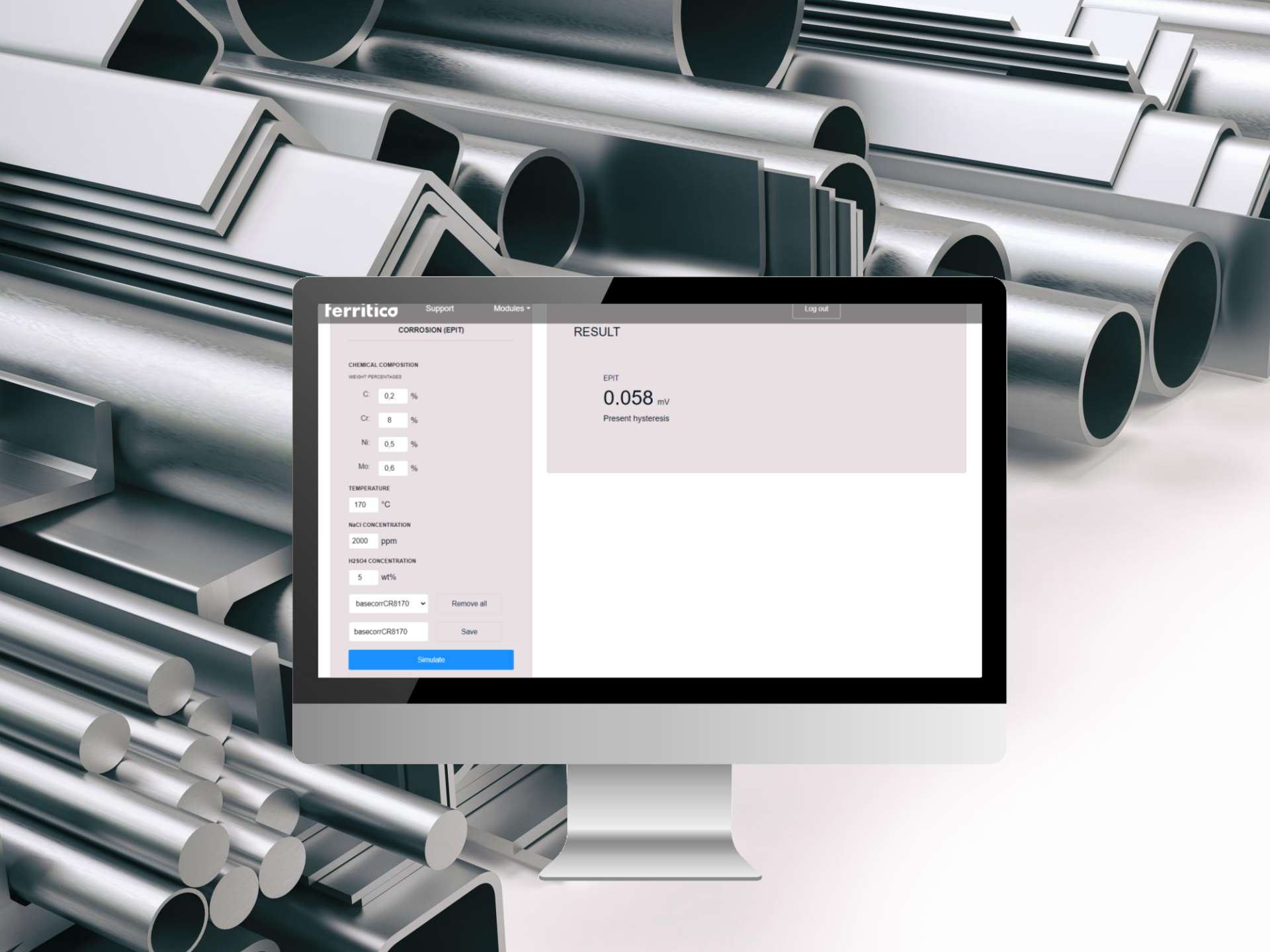
Basic ML concept

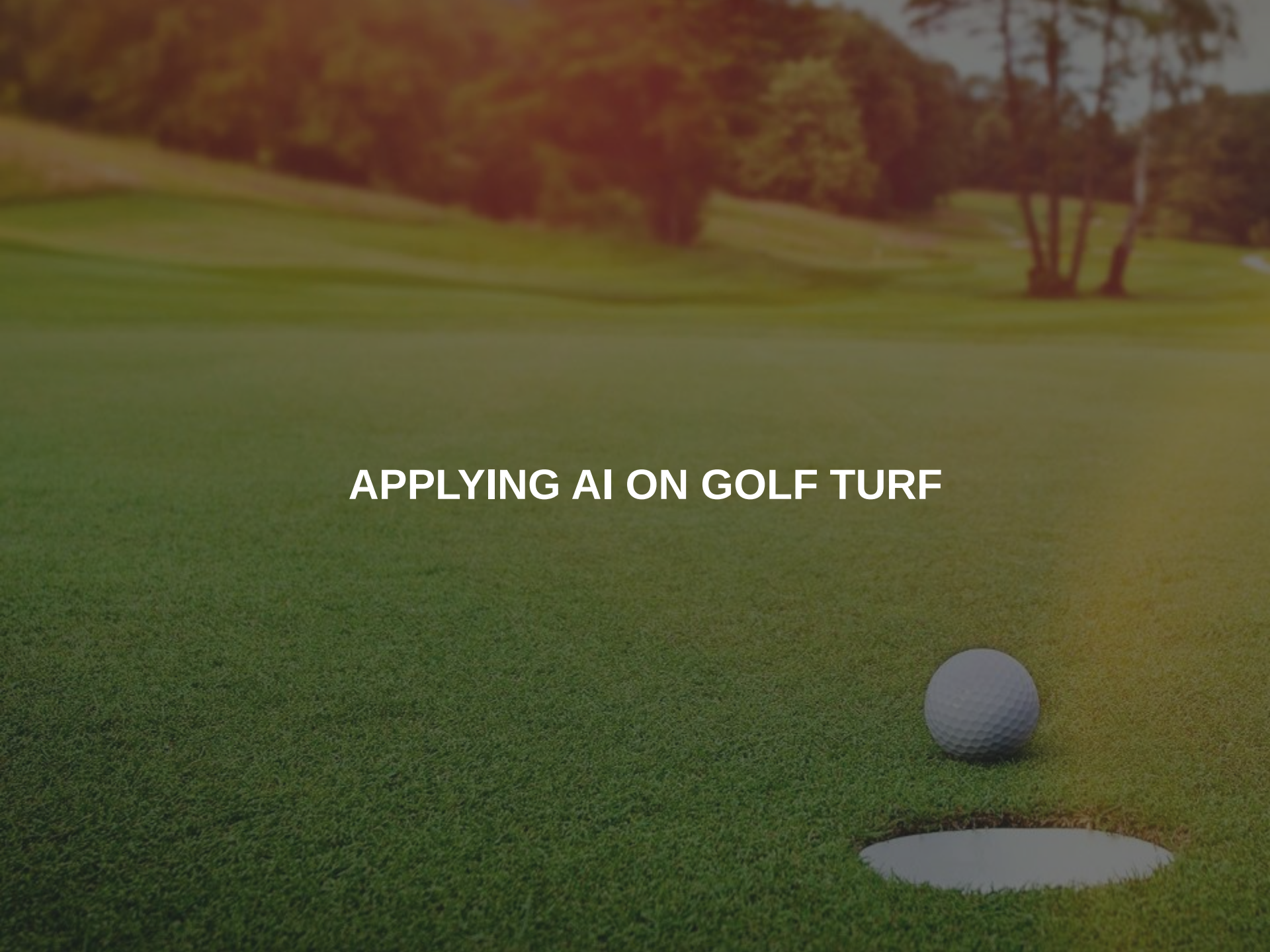


ML is algorithms that generate functions (y = f(x) like fictional yellow polynomial above) from empirical data (white dots above) that enable identification of optimization candidates in the data space. Not very valuable when investigating one parameter (as above) but when considering multiple dimensions with covarying parameters and time series data

Breakthrough: a unique AI model for personal recommendations in online shopping. No data needed.

Stylee is a first mover using advanced image AI functionalities to help customers find clothes that fit their personal style (not what others have bought or similar items) and help retailers improve their conversion rates as well as lower the return rates.


ferritico
Support
Modules
Log out
CORROSION (EPIT)
CHEMICAL COMPOSITION
WEIGHT PERCENTAGES
C: 0,2 %
Cr: 8 %
Ni: 0,5 %
Mo: 0,6 %
TEMPERATURE
170 °C
NaCl CONCENTRATION
2000 ppm
H2SO4 CONCENTRATION
5 wt%
basecorrCR8170
Remove all
basecorrCR8170
Save
Simulate
RESULT
EPIT
0.058 mV
Present hysteresis


APPLYING AI ON GOLF TURF

IDEA

Complement experience and trial-and-error based turf management with data driven method:

1. Web application for storing, searching and viewing turf maintenance and research data

2. Machine learning (ML) based web application to simulate i.a.:

    a. Turf grass selection – what is the statistically optimal grass based on geography, soil etc.

    b. Turf maintenance plan - what is the statistically optimal moving height, watering etc. based on historical data

SOLUTION - SIMULATION USE CASES

- Irregular simulations - one-off simulations at construction or irregular renovation or maintenance initiatives:
  - Grass selection at construction or reseeding
  - Winter survival plan – fertilizer and fungicides combinations
- Continuous simulations – daily recipe simulation to optimize the continuous turf maintenance:
  - Watering amount
  - Moving height
  - Rolling
  - Topdressing
  - Fertilization

TARGETS

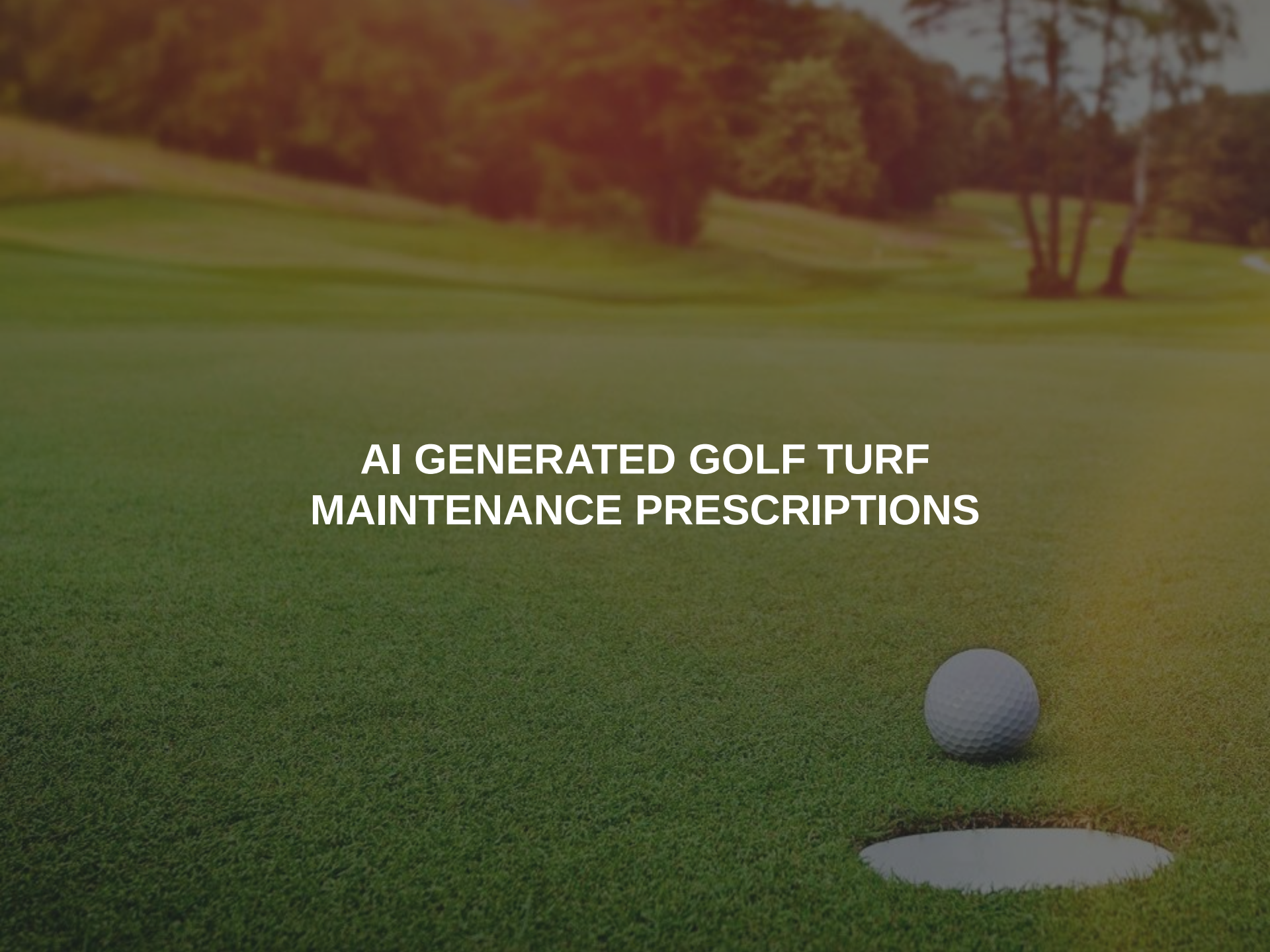
- **Sustainability:**
  - **Smart watering**
  - **Minimize use of pesticide and non eco-friendly chemicals**
- **Quality – turf grass characteristics optimized for the application/use**
- **Cost – optimized maintenance requiring less resources (person-hours, energy, chemicals..)**

TIME SERIES CHALLENGE – A COOKING ANALOGY

“Just like dishes, turf quality depends on its mix of ingredients (fertilizer, grass etc.) in combination with the directions (rolling, mowing etc.).

In contrast to cooking, trial-and-error is inefficient when optimizing turf since the impact of actions can only be observed with delay, i.e. not equivalent to picking up the spoon…”

AI GENERATED GOLF TURF MAINTENANCE PRESCRIPTIONS



SOLUTION & TARGETS

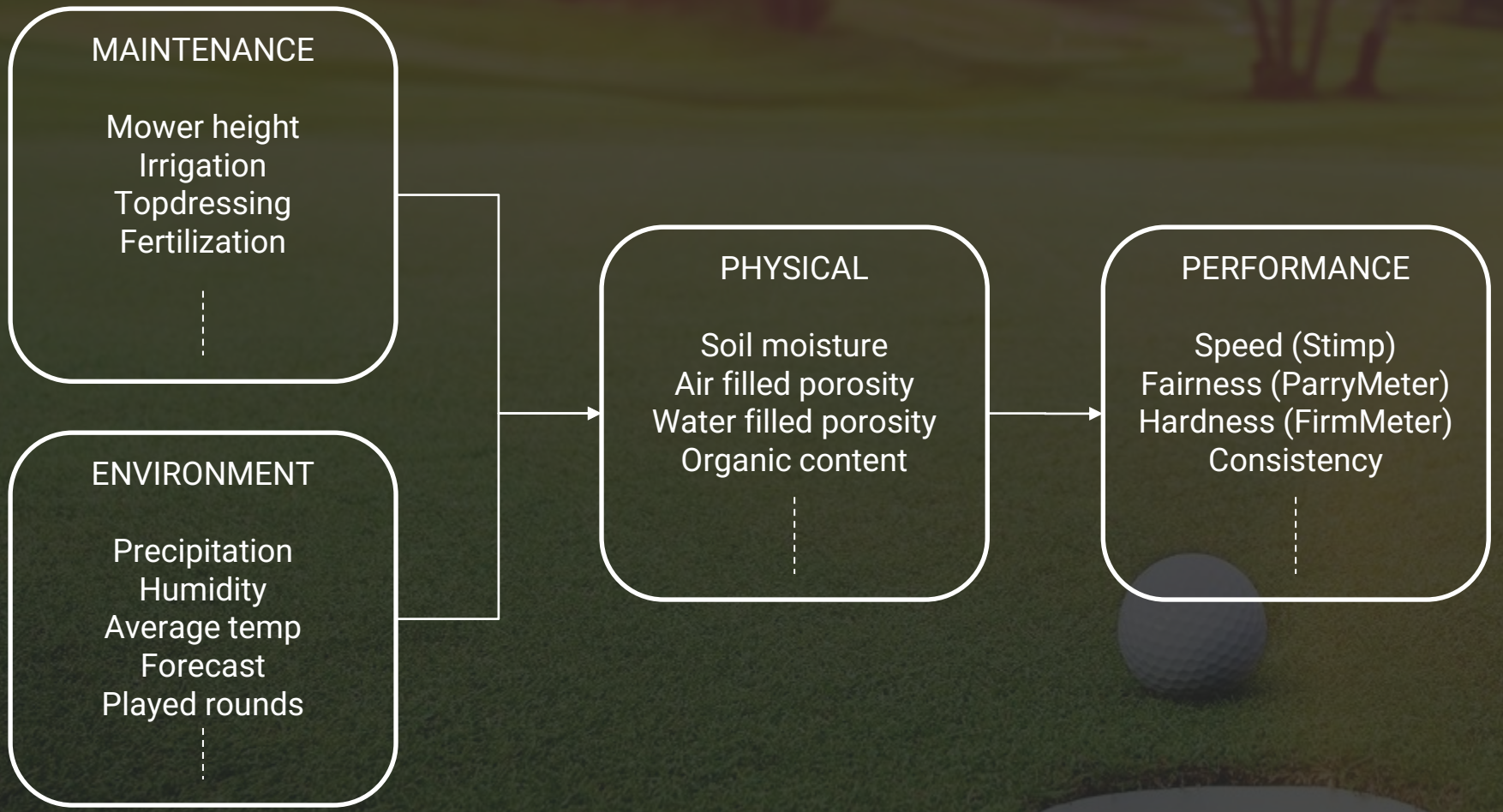
Solution: - Daily recipe simulation to optimize the continuous turf maintenance:

- **Irrigation**
- **Moving height**
- **Rolling**
- **Topdressing**
- **Fertilization**

Targets:

- **Sustainability**
- **Quality**
- **Maintenance cost**

TURF DATA AI MODELLING



TIME SERIES ANALYSIS

- **Time series approach (Recurrent Neural Networks) to provide green maintenance guidelines enabling optimization, i.e. develops ML models to learn correlation between turf data over time**

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Environment	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Maintenance	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Physical	Z1	*Z2*	*Z3*	*Z4*	*Z5*	*Z6*	*Z7*	*Z8*	*Z9*	Z10
Performance	*P1*	P2	P3	P4	*P5*	P6	P7	P8	P9	P10

PREREQUISITES

Data availability – volume and completeness

- **For how long does a greenkeeper need to measure data in order to get statistically valid prescriptions?**
- **What does a greenkeeper have to measure in order to get statistically valid prescriptions?**
- **What is the accuracy of a model, that has learnt from data from one green, on another green on the same course?**

SOLUTION ROADMAP

- Backtest and validate accuracy of RNN model
- Define data requirements and generalizability
- Invert and make solution generative
- Stop asking “What do I get if..?” and ask “How do I get?”

PROOF-OF-CONCEPT PROJECT

- **State-of-the-art analysis -> lessons learned**
- **Software design –** shortlist relevant features to include
- **Collect data**
- **Develop RNN models**
- **Simulation model test**
- **Testing**

COLLABORATION

- System design
- Domain expertise
- Data collection and supply

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