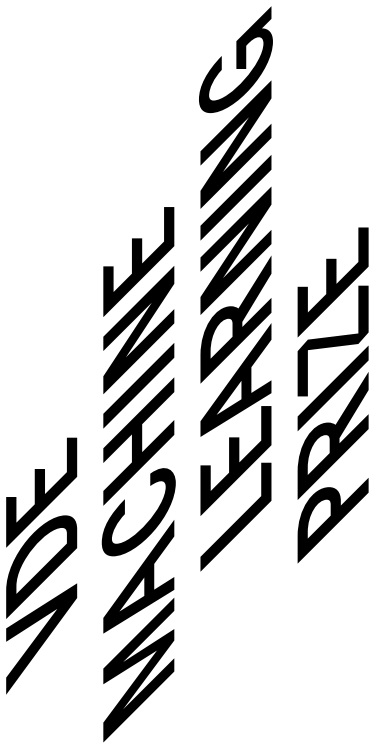


VDE MACHINE LEARNING PRIZE

Sehr geehrte Teilnehmende, liebe Preisträgerinnen und Preisträger,

Maschinelles Lernen und künstliche Intelligenz verändern wie wir arbeiten, forschen und Probleme lösen. Schleswig-Holstein setzt dabei auch mit dem Machine Learning Degree von opencampus.sh auf praxisnahe Bildung und starke Netzwerke. Der MLD wird vom Digital Learning Campus mit Mitteln der EU gefördert und unter www.dlc.sh für jeden Bürger und jede Bürgerin erreichbar und nutzbar sein.

Die heute ausgezeichneten Projekte zeigen, was möglich ist, wenn kluge Köpfe gemeinsam an neuen Lösungen arbeiten. Mein Dank gilt allen Beteiligten, besonders der Prof. Werner Petersen Stiftung und dem VDE, für ihre Unterstützung. Allen Teilnehmenden wünsche ich spannende Einblicke und den Preisträgerinnen und Preisträgern weiterhin viel Erfolg!

Guido Wendt, Staatssekretär im Ministerium für Allgemeine und Berufliche Bildung, Wissenschaft, Forschung und Kultur.

NOMINATED PROJECTS
ADVANCED INNOVATOR PRIZE

NOMINATED PROJECTS
EXCELLERATING INNOVATOR PRIZE

The projects presented in this booklet were created by participants in our various Machine Learning courses.

These courses are made possible through the generous support of the Digital Learning Campus and the dedication of our volunteers, who work for us as course instructors and share their expertise in their free time to foster a strong learning community. With the support of the VDE and the Werner-Petersen-Stiftung, we aim to recognize the hard work of our students and celebrate their innovative solutions to real-world challenges. The following pages showcase a range of projects that highlight creativity, technical excellence, and the practical application of machine learning in diverse fields.

We hope this collection inspires future learners and underscores the importance of accessible education open for everyone in shaping the next generation of AI practitioners.

Dr. Anna-Lena Hansen, Coordinator Machine Learning Degree opencampus.sh

Prof. Dr. Werner – Petersen – Stiftung

Die Prof. Dr. Werner – Petersen – Stiftung will positive Entwicklungsprozesse anschieben, indem sie mit einem besonderen Akzent in den Natur- und Ingenieurwissenschaften Aufbau und Stärkung der Fähigkeiten und Fertigkeiten junger Menschen und insbesondere des wissenschaftlichen Nachwuchs fördert und somit Forscher- und Entdeckerdrang gerade in der jungen Generation stärkt, vorhandene Expertise und bestehende Kompetenzen sowie Forschung und Lehre stützt und durch gezielte Maßnahmen auch deren internationale Anbindung und den Austausch mit anderen Regionen fördert, die Voraussetzung für die Umsetzung von Forschungsergebnissen zur Entwicklung innovativer Lösungsansätze stärkt, durch die Beschaffung von Mitteln für wissenschaftliche und technische Einrichtungen oder Forschungseinrichtungen zur Verbesserung von Rahmenbedingungen beiträgt.

Verband der Elektrotechnik Elektronik Informationstechnik e.V. (VDE)

Der VDE, eine der größten Technologie-Organisationen Europas, steht seit mehr als 130 Jahren für Innovation und technologischen Fortschritt. Als einzige Organisation weltweit vereint der VDE dabei Wissenschaft, Standardisierung, Prüfung, Zertifizierung und Anwendungsberatung unter einem Dach. Das VDE Zeichen gilt seit 100 Jahren als Synonym für höchste Sicherheitsstandards und Verbraucherschutz. Wir setzen uns ein für die Forschungs- und Nachwuchsförderung und für das lebenslange Lernen mit Weiterbildungsangeboten „on the job“. 2500 Mitarbeiter an über 60 Standorten weltweit, mehr als 100.000 ehrenamtliche Experten und rund 1.500 Unternehmen gestalten im Netzwerk VDE eine lebenswerte Zukunft. Sitz des VDE (Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.) ist Frankfurt a. M.

Digital Learning Campus

Der Digital Learning Campus (DLC) ist eine Fördermaßnahme aus dem Landesprogramm Wirtschaft, das aus Mitteln des Landes sowie aus EFRE-Mittel der EU gespeist wird. Insgesamt werden in den kommenden fünf Jahren landesweit 37,5 Millionen Euro investiert.

Im DLC entstehen an den Hochschulstandorten Kiel, Lübeck, Flensburg und Heide physische Lernorte, Labore und Anwendungszentren für digitale Anwendungen und Technologien. Thematische Klammer ist das Thema Future Skills und damit das Erlernen und Ausprobieren von Zukunftskompetenzen.

Die Hochschulen arbeiten dabei mit Partnern aus Wirtschaft und Gesellschaft bildungsbereichs- und branchenübergreifend zusammen. Der DLC steht allen offen: Studierenden, Lehrenden, Unternehmerinnen und Unternehmer, Gründerinnen und Gründer, Selbstständigen, Beschäftigten und Schülerinnen und Schülern.

opencampus.sh

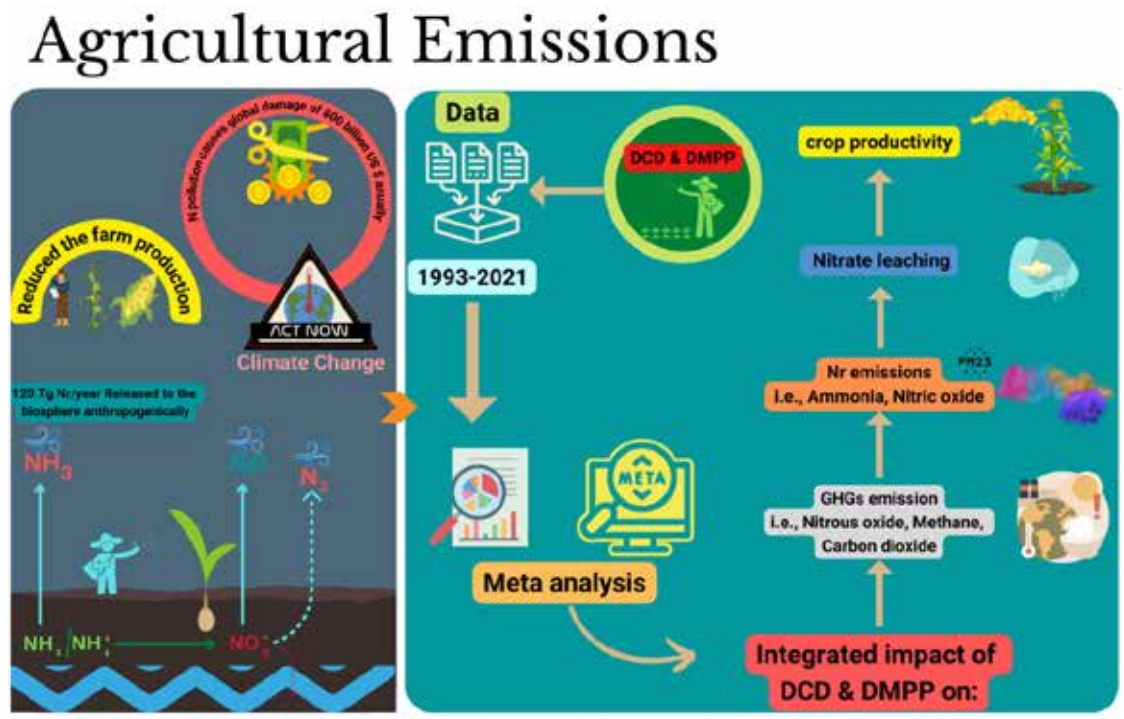
Opencampus.sh ist die Dachmarke des gemeinnützigen Vereins Campus Business Box e.V. Er bietet eine Vielzahl an (Weiter-)Bildungsmöglichkeiten, Unterstützungen und Netzwerkangebote für Gründer:innen, Kreative und neugierige Menschen jeden Alters ohne Unterscheidung zwischen Bildungsstatus und Herkunft. Die Angebote sind kostenlos und offen für alle.

Mit seinen Initiativen unterstützt opencampus.sh die Gründungslandschaft in Schleswig-Holstein, fördert kreative Veränderungsprozesse und setzt sich für eine innovative und nachhaltige Zukunftsgestaltung ein.

Das multidisziplinäres Team unterstützt so Menschen aus Schleswig-Holstein und darüber hinaus, ihre Ideen und Visionen zu verwirklichen.

NOMINATED
PROJECTS

ADVANCED INNOVATOR PRIZE



Tufail et al. 2023 https://doi.org/10.1007

Forecasting Green-house gases emission from global agricultural land

Forecasting Greenhouse gases emission from global agricultural land

About the team

https://github.com/AammarTufail/time_series_ghgs_emission

Muhammad Aammar Tufail

Project Synopsis

This project addresses one of the most critical environmental challenges of our time: greenhouse gas emissions from agricultural lands. These emissions significantly impact climate change, rising sea levels, ecosystems, human health, and economic consequences. The project aims to forecast greenhouse gases emissions from agricultural land using various machine learning models. Using data from FAOstats, the research focuses on analyzing historical GHG emissions data and developing predictive models to forecast future emissions. The project is particularly significant as GHGs emission forecasting from agricultural soils on a small scale remains a major contemporary challenge.

Course Instructor Statement

Muhammad Aammar Tufail applied both traditional time series models (ARIMA, SARIMA, Prophet) and machine learning techniques (Random Forest, XGBoost, LSTM, GRU) to predict emissions from agricultural land using FAOstats data. His approach effectively analyzed key emission sources, including methane from livestock and nitrous oxide from fertilizers.

This project stands out for its environmental impact, providing insights for emission reduction strategies. Overcoming challenges like multivariate data processing and computational limitations, it bridges machine learning and policy development in an innovative way.

BLOOD CLUCOSE FORECASTING

BLOOD CLUCO FORECASTING

About the team

Anna Dahlhaus

Christopher Kunze

Tim Oldörp

https://github.com/ChristopherKunze-Git/AdvancedTimeSeriesCourse-Engineering-Data

Leo Simak

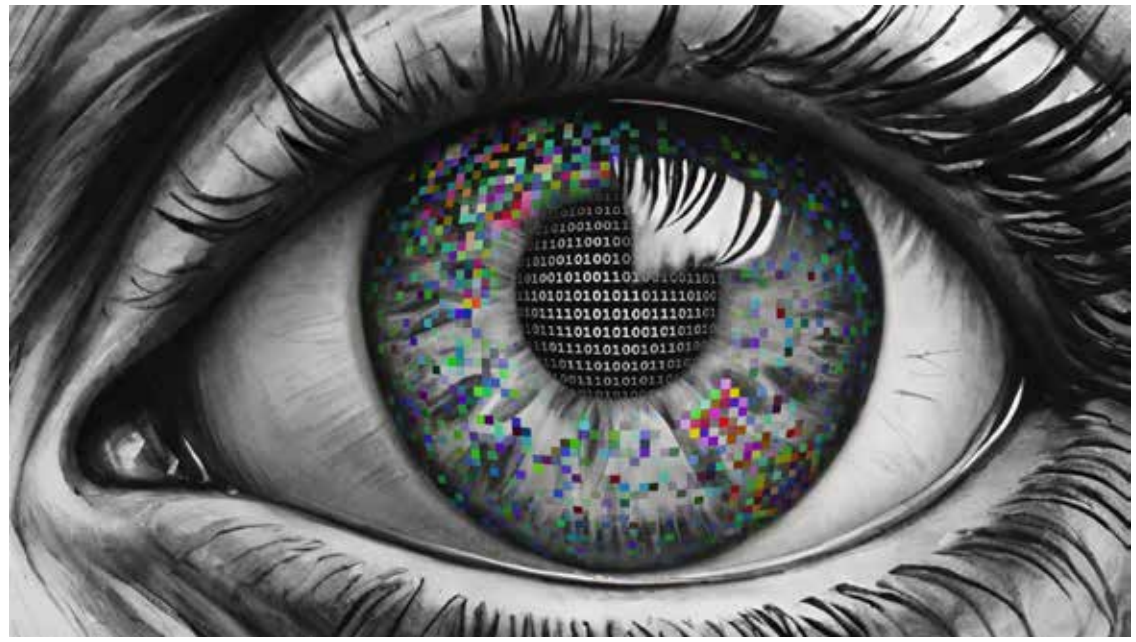
Project Synopsis

This project aims to predict blood glucose levels for Type 1 Diabetes Mellitus (T1DM) patients using continuous time series data. The goal is to forecast glucose levels 1 hour in advance by leveraging various models, including ARIMA, tree-based models, and deep learning architectures. The dataset comprises continuous glucose monitoring (CGM) data, fitness tracker data, insulin dosages, and carbohydrate intake, collected over several days for 25 subjects. The challenge lies in handling missing data, noisy measurements, and interindividual variability in glucose levels. Real-world applications include improving diabetes management and preventing life-threatening conditions like hypoglycemia and hyperglycemia.

Course Instructor Statement

This group gave a stunning presentation. The overall performance was much higher than expected and included various time-series models for the blood glucose levels forecasting.

We really enjoyed the very visual slides which still covered many details with respect to the chosen models. Also, the ability to value and judge critically the model performances, especially in the medical data context, by the group members needs to be acknowledged.



Detection of block structures in Matrix Sparsity Patterns

Detection of block structures in Matrix Sparsity Patterns

About the team

Anna-Valentina Hirsch

Toni Johann Schulze Dieckhoff

https://github.com/AnnaValentinaHirsch/opencampus-precondi-tioner-ai-project

Project Synopsis

The project addresses a fundamental challenge in computational fluid dynamics and numerical mathematics: the efficient solution of large sparse matrix systems. Many real-world phenomena modeled by partial differential equations result in complex matrix systems that require efficient solving methods. The project aims to predict block structures in sparse matrices for constructing Block-Jacobi preconditioners to accelerate the convergence of iterative solvers. The project builds upon the work of Götz et al. (2018) and focuses on forecasting diagonal block locations in large sparse matrices. The goal is to improve the convergence of the Generalized Minimal Residual (GMRES) solver. A Python package called 'matrixkit' was developed for synthetic matrix generation and is available via pip install.

Course Instructor Statement

Anna-Valentina Hirsch and Toni Johann Schulze Dieckhoff successfully applied CNNs and GCNs to detect block structures in sparse matrices, significantly improving GMRES solver convergence—achieving up to a 100x speed-up in the best cases. Their innovative approach, combining machine learning with numerical methods, demonstrates strong potential for accelerating large-scale scientific computations.

This project stands out for its high computational efficiency and practical impact, offering a foundation for further research in AI-driven preconditioning techniques.

Forecasting Energy Load for Efficient Use of Battery Energy Storage Syste ms

Forecasting Energy Load for Efficient Use of Battery Energy Storage Systems

About the team

Tim Prause

Kadisatou Fané

Cosima Birkmaier

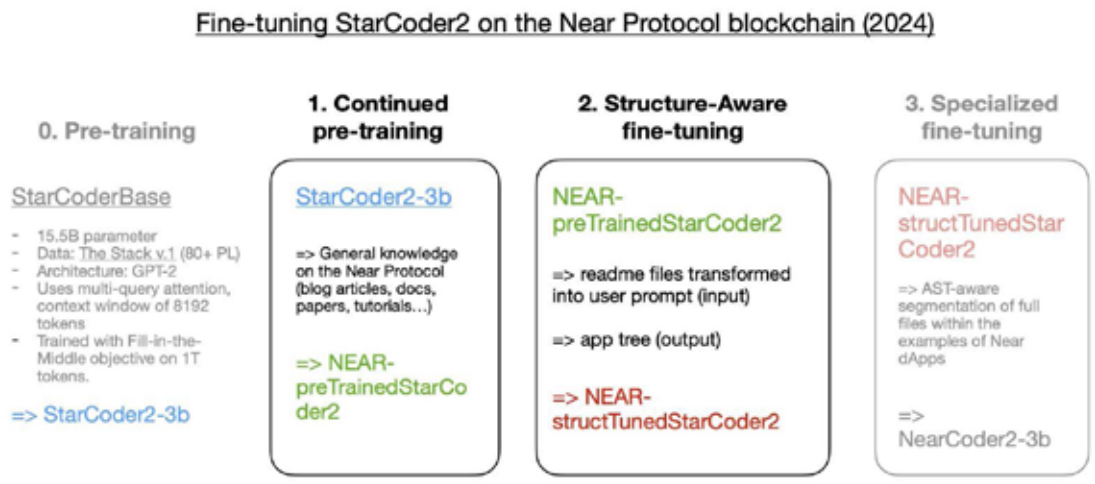
https://github.com/Timson1235/energy-ti-meseries-project

Project Synopsis

This project focuses on predicting energy load to enable more efficient utilization of Battery Energy Storage Systems (BESS). As renewable energy sources become more prevalent, power grids face new challenges that require electricity generation to be flexibly adapted to power consumption. BESS offers a solution by charging when excess energy is generated and discharging when demand exceeds renewable generation. From a financial perspective, these systems can buy energy when prices are low and sell when prices are high. The team's goal was to develop accurate forecasting models for energy load in Germany to support optimal BESS operation and contribute to a more sustainable and efficient power grid.

Course Instructor Statement

This group presented a large set of time series models to cover the energy load prediction task. They managed to integrate almost all model classes which were covered during the lectures in their forecasts. Ranging from baseline models to recent LLM- based approaches like TimesFM. Additionally, they came up with a new unique metric to rank the models with respect to run-time, accuracy and complexity.



NEARCODER – Web3 Code LLM

NEARCODER – Web3 Code LLM

About the team

Kristian Boroz

Anna-Valentina Hirsch

Julien Carbonnell

https://github.com/AnnaValentinaHirsch/Web3CodeLLM

Project Synopsis

NEARCoder is a specialized language model designed to assist blockchain developers working with the NEAR Protocol. The project aims to bridge the gap in Web3 development by providing a powerful coding assistant built on the StarCoder2 model. Born as a course project at opencampus.sh, NEARCoder addresses the challenges faced by developers in the nascent Web3 landscape, particularly with NEAR Protocol development. The project focuses on generating dApp structures and code while leveraging real-world NEAR Protocol projects and documentation for training.

Course Instructor Statement

The project went well beyond the actual project requirements for the LLM Fine-Tuning course by not only fine-tuning an existing LLM but:
→ scraping and processing extensive specialized data from GitHub repositories,
→ implementing a sophisticated training approach combining continuous pre-training with fine-tuning, and further specializing the model through task-specific fine-tuning, and
→ by implementing comprehensive and time-intensive evaluation procedures to ensure model quality and performance

NOMINATED
PROJECTS

EXCELLERATING INNOVATOR PRIZE

Predicting Individual Driving Habits

Predicting Individual Driving Habits

About the team

Maciej Lipski

Sai Mohit

Clifford Daniel

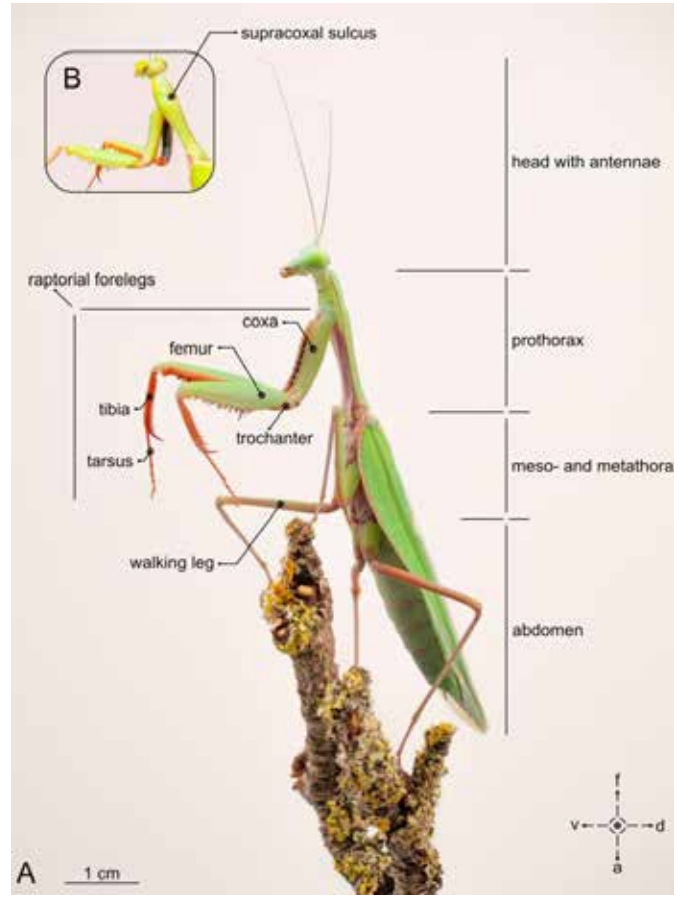
https://github.com/maciejlipski/opencampus_travel_time

Project Synopsis

The project aims to predict cyclists' speed using GPX files collected from Slovenian professional cyclists. Initially conceived as a time estimation project, the research pivoted to speed prediction when initial data proved insufficient for direct time calculations. By leveraging machine learning techniques, the team developed a model that can provide individualized, terrain-dependent speed predictions that adhere to physical laws. The research draws inspiration from multiple sources, including studies on bicycle data-driven applications, hiking travel time models, and bike share travel time modeling. The project addresses the critical challenge of accurately predicting cycling performance by analyzing complex environmental and geographical factors.

Course Instructor Statement

This project successfully tackled the challenge of handling and optimizing extremely large internet datasets, requiring extensive computational resources for data processing. The developed solution not only demonstrates strong technical proficiency but also holds significant practical potential. Its ability to efficiently process vast amounts of data makes it well-suited for integration into a user-facing application, highlighting its real-world applicability and impact.



MantisAI – Identify pivot points between insect leg segments

MantisAI – Identify pivot points between insect leg segments

About the team

Linus Prinz

Fabian Bäumler

Alicem Susam

https://github.com/Insprnz/MantisAI/tree/main

Project Synopsis

Hidden within high-speed video recordings of a praying mantis catching its prey lies a world of complex biomechanical information. Traditionally, tracking the precise movement of insect leg joints required painstaking manual work in video editing software, consuming countless hours of research time. The team's ambitious goal was to develop a machine learning model that could automatically identify and track key pivot points in the mantis's leg movements.

Course Instructor Statement

This project tackled the demanding task of manually labeling the dataset while also exploring and experimenting with different loss functions for keypoint detection—going beyond the standard course material. The developed solution has direct real-world impact, providing valuable support for researchers studying insect biomechanics and advancing the understanding of movement analysis.

PLAIN-LANGUAGE CLASSIFICATION

PLAIN-LANGUAGE CLASSIFICATION

About the team

https://github.com/HannesMK/plain-language-classification

Hannes Körner

Project Synopsis

The project aims to classify whether a given German text is in plain language through binary text classification. Plain language is designed to express ideas in an accessible way, with key properties being concise, clear, and free of jargon. The project utilizes data from Toborek et al. (2023), which includes both "Leichte Sprache" (easy language) and "Einfache Sprache" (simple language). The dataset consists of articles scraped from the web with parallel plain and regular language versions. During development, basic deep-learning models showed strong performance in distinguishing between plain and regular language, though a fine-tuned Transformer-based model ultimately achieved the best results.

Course Instructor Statement

Hannes Körner successfully explored text classification for German plain language, utilizing deep learning and transformer-based models. The project demonstrated strong performance, with the fine-tuned GBERT model achieving 93% accuracy, highlighting its potential for automated accessibility verification.

This project stands out for its practical impact, providing a tool for content creators and organizations to ensure accessibility. Overcoming data acquisition and model optimization challenges, it showcases a well-executed approach to an important real-world problem.

Seamount Prediction Based on Bathymetry Data

Seamount Prediction Based on Bathymetry Data

About the team

Sebastian Krüger

Anne-Cathrin Wölfl

André Piper

https://github.com/an-newoelfl/Seamounts/

Project Synopsis

Less than 30% of the seafloor has been mapped with high-resolution technology, making seamount detection a challenging and crucial scientific endeavor. Seamounts are more than just underwater VDE Machine Learning Prize - Nominated Projects| 42 mountains – they are ecological hotspots that play a vital role in marine ecosystems, potentially harbor mineral resources, and can even impact marine navigation and tsunami formation. The team's primary goal was to develop a machine learning model capable of automatically classifying bathymetric images into two categories: "with seamount" and "without seamount". This seemingly simple task conceals immense complexity, as identifying these underwater geological features requires sophisticated image analysis techniques.

Course Instructor Statement

This project demonstrated strong analytical skills by exploring various modeling approaches and data augmentation techniques to improve results. The team showed excellent critical thinking by questioning seemingly high accuracy values, ensuring meaningful insights rather than misleading metrics. The outcomes have direct practical relevance, contributing valuable support to ongoing research in marine geology.

Cardiopathy Classification Using Cine Heart MRI

Cardiopathy Classification Using Cine Heart MRI

About the team

https://github.com/kamisoel/cardiopathy-classification

Leo Simak

Project Synopsis

This project aims to classify patients into specific heart disease categories using Cine Heart MRI data, supporting early and accurate diagnosis with AI-driven analysis.

Problem Statement: Cardiac diseases are a leading cause of mortality worldwide, and early diagnosis is crucial. Traditional diagnostic methods rely on expert interpretation, which can be time-consuming and subjective. This project leverages AI to automate and enhance classification accuracy.

Real-World Impact: Accurate classification of heart disease subtypes enables timely interventions, reducing risks for patients and improving healthcare efficiency. Automating this process can also support clinicians in decision-making, particularly in resource-limited settings.

Inspiration: The project was inspired by the Kaggle AI4I 2024 challenge and the need for AI-driven solutions in medical imaging. The challenge of working with a small dataset while ensuring robust performance provided a valuable research opportunity.

Course Instructor Statement

The Cardiopathy Classification project was pursued at the end of the course as an opportunity to apply newly learned PyTorch and Intermediate ML knowledge. Throughout the project execution, I was particularly impressed by the really well-done critical analysis and evaluation of the results, which led to correct and insightful conclusions for further work. The project was thoroughly and thoughtfully executed, demonstrating a strong understanding of both technical concepts and practical applications in medical AI.

Seizure Detection Wristband

Seizure Detection Wristband

***Note: TinyML (Tiny Machine Learning) is a rapidly growing field that focuses on deploying machine learning models on low-power, resource-constrained embedded devices such as microcontrollers, edge devices, and IoT sensors. Unlike traditional ML, which often relies on powerful cloud-based or server-based systems, TinyML brings intelligence to the edge, enabling real-time data processing, low-latency decision-making, and power-efficient computing.**

About the team

Tim Prause

Socrates Gebremedhin

https://github.com/Timson1235/TinyMLSeizureDetectionDevice

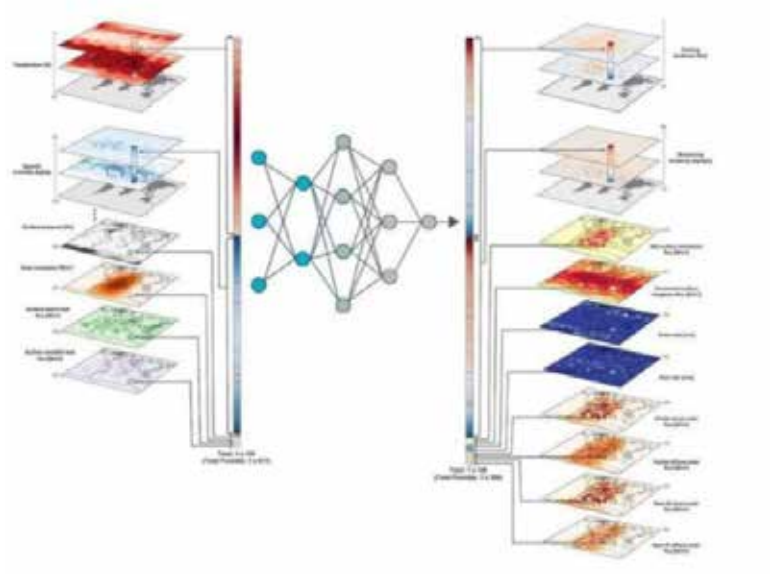
Project Synopsis

This project aims to develop a wearable device for detecting epileptic seizures using TinyML. Current seizure detection devices face limitations: they are large, expensive, not energy-efficient, and often rely on cloud or phone-based processing, which raises privacy concerns. The team's solution proposes a wristband-based device that is lightweight, always on, and specifically designed for epilepsy patients. This non-invasive, motion-based detection system balances accuracy, power efficiency, and real-time reliability while maintaining privacy through on-device processing, reducing latency and costs compared to cloud-based alternatives.

Course Instructor Statement

The project impressively demonstrates how the concepts of TinyML* can be applied in practice. It starts with a problem that can be cost-effectively solved using TinyML.

Throughout the implementation, the participants deeply engaged with the processes and workflows of a TinyML project, continuously developing new solution approaches relevant to the problem context. This project provides a foundation for further development, with the potential to create an open-source product, including hardware, accessible to everyone.



AI-driven Atmosphere small-scale Process modelling for better Climate Prediction

AI-driven Atmosphere small-scale Process modelling for better Climate Prediction

About the team

https://github.com/JanikaRhein/LEAP-Atmos-AI

Janika Rhein

Project Synopsis

The goal of this project is to enhance climate models by developing an AI-based parameterization for small-scale atmospheric processes. This allows for more accurate and computationally efficient climate simulations.

Problem Being Solved: Traditional climate models approximate small-scale processes such as cloud formation and turbulence using empirical parameterizations, which introduce inaccuracies. These errors accumulate over time and limit the precision of climate predictions.

Real-World Applications/Impact: Improving climate model accuracy is crucial for better long-term climate projections, which inform policy decisions, disaster preparedness, and environmental strategies. More efficient simulations also reduce computational costs, making high-fidelity modeling more accessible.

Project Inspiration: This project was inspired by recent advancements in machine learning for scientific applications and the increasing availability of high-resolution climate data from supercomputers.

Course Instructor Statement

This project was undertaken at the end of our course as a culminating application of PyTorch and Intermediate Machine Learning concepts. Despite early challenges with team composition, the project evolved into a solo endeavor, demonstrating remarkable perseverance and dedication. Janika's commitment to completing the project independently is particularly commendable. The integration of climate modeling expertise with machine learning techniques yielded valuable insights into AI's potential in climate predictions. The project successfully addressed a significant challenge in current climate modeling, bringing innovation to the field through deep domain knowledge and thorough data analysis. Notably, this work has helped shape Janika's future research direction as a PhD student, providing a solid foundation for continued exploration in this field. The project not only achieved its technical objectives but also demonstrated the valuable intersection of domain expertise and advanced machine learning applications.