PERSONAL DETAILS

First name : Isak
Surname : Åkesson
Date of birth : 93-09-14
Place of residence : Halmstad, Sweden
Nationality : Swedish

EDUCATION & COURSES

Institute	Period	Education & Projects	Diploma
HALMSTAD UNIVERSITY	2018 – 2023	**Civilingenjörsexamen Intelligenta System** **Master of Science in Engineering**	Soon
HALMSTAD UNIVERSITY	2018 - 2023	**Data Mining Project for Voi e-scooter Company:** Developed a pipeline to do statistical inference on sensor data collected from Voi e-scooter. **Skillset:** General Python, *Supervised* - and *Unsupervised Learning*, Scikit Learn, Pandas, Matplotlib, Bokeh, Seaborn	Yes
		Deep Learning project: *Developed a CNN birds classifier 475 labels using Python* **Skillset:** General Python, Pytorch	Yes

		Artificial Intelligence project: *Developed a Poker agent based on Regression and Monte Carlo simulation using Python. First place award in tournament* **Skillset:** General Python, Machine Learning,Statistics	Yes
Institute	**Period**	**Education & Projects**	**Diploma**
HALMSTAD UNIVERSITY	2018-2023	**Robotics project:** *Developed an autonomous vehicle that picks up colored objects and brings them back to a goal destination.* **Skillset:** Sensor Fusion, Odometry and general Python	Yes
		Smart Green House Project: *Developed a prototype env. by combining sensors such as temperature, photoresistors and servomotors.* **Skillset:** Embedded C and hardware architecture for microcontrollers	Yes
		Bachelor thesis: *Developed a new Image method for microscopy in Healthcare settings without using existing Auto-Focusing techniques* **Skillset:** *Matlab, Fourier transforms, optics*	Yes
		Master thesis: *Developed an XAI method in Predictive Maintenance* for black box models by combining existing gradient based techniques such as Expected Grad CAM. Creates a high resolution Class Activation	Yes

		Map of what features in original space weigh most important into the model's prediction. **Skillset:** *General Python, Pytorch, Seaborn, Matplotlib,Literature Review,Calculus*	
Hobby Project at home	2021	**Autonomous robot:** I built an autonomous robot in my apartment that randomly moves around in a path. Ultrasonic sensors were used to prevent the agent from colliding with nearby objects	Yes

Projects are described in more detail in the appendix Portfolio.

WORK EXPERIENCE & ADDITIONAL QUALIFICATIONS

Work experience

Company	Period	Department & Function
	June 2022 – Aug 2022	**Summer internship:** *Supply operator* Verification of communication buses, involved testing
	2016-2020	**Forklift driver:** Wholesale
	Aug 2019 – Oct. 2021	**Supplemental Instructor in Mathematics** *Guiding and helping first year engineering students through Discrete Math, Calculus and Linear Algebra*

Previous work experience is described in more detail in the appendix Portfolio.

Internships

EXPERTISE

	Average	Good	Very Good	Excellent
Operating Systems				
Microsoft Windows			X	
Linux		X		
Software/Programming				
C		X		
C++	X			
Python			X	
Java	X			
Libraries				
Visualization tools (matplotlib, seaborn etc)			X	
Machine Learning tools(Pytorch, TensorFlow,etc)			X	
Pipelines				
Lean Production		X		
Ex. Agile Development		X		

LANGUAGE SKILLS

Language	Speaking	Writing
Swedish	Native	Native
English	Advanced	Advanced

EXTRACURRICULAR ACTIVITIES

- I like to keep up to date with current SoA algorithms in Machine Learning in literature. I attend online lectures when available, ie. I get noticed through LinkedIn about new Data Science topics.

HOBBIES

- Exercise - I like to keep my body healthy and active to minimize my risk of getting sick in the future. My typical routine is centered around weight lifting but I do commit to cardiovascular exercises at least two days a week.

- Nature - I love nature. The presence of such existence can spark interesting ideas and is a great environment to be in when engaging in mindless problem solving.
- Programming - As an engineer it would be weird to not have this one as a hobby.
- Cooking - Recently discovered interest, but I think it's more related to the meditative state it provides.

PORTFOLIO

Data Mining Project/Voi e-scooters/Halmstad University

Situation:
I was provided a dataset from Voi company. The dataset consisted of streamed data from E-scooters, corresponding to: **acceleration**, **heading**, **gps**, **measurements** from **wheel encoders** and **Time stamp**. Our objective was to apply data mining tools to find interesting patterns in the data and build a machine learning pipeline to either classify or predict a continuous value based on the provided features. The project was very information rich and entertaining since theory from previous courses in Data Analysis and Machine Learning were applied in a project with a real work setting environment.

Tasks:
Exploratory Data Analysis - Visualize data and do pre-processing
Train a supervised model - Predict break usage
Unsupervised - Identify different driving styles in users by using PCA and K-means

Actions:
Break usage - Represents important information for business as it implicitly allows to determine and assess maintenance frequency and cost. The first proposed approach used a Linear Regression estimator with feature space mapping using polynomial kernel functions which aims to predict the instantaneous break usage given the GPS

data, together with accelerometer and gyroscope data. The second proposed method was designed to provide better performance metrics compared to the first approach, by tuning the regression problem into a multi-class classification problem with Random Forest.

Different driving styles - Feature extraction was used to create new features based on original feature space. Total driving time, battery droppage in percentage, average speed and total distance were extracted from each ride. The new extracted feature space was then fed into Principal Component Analysis to collapse the 4D space into a 2D space representative for humans to observe.

Results:
Break usage - Approach 1
R2 score of 0.914 and 0.911 on training and test set respectively
Break usage - Approach 2
F1 score of 0.98 and accuracy of 0.99.

Deep Learning project/CNN classifier/Halmstad University

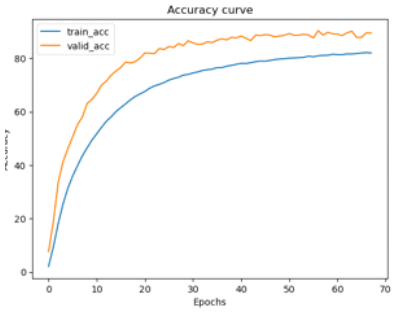
Situation:
I was given the task to find a project in the course **Deep Learning.** I was scrolling through Kaggle and found the BIRDS 475 SPECIES dataset consisting of 475 different birds.

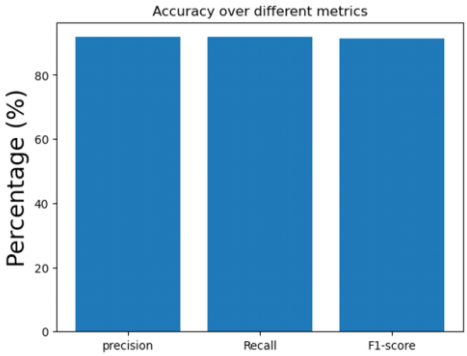
Tasks:
Build a CNN model that effectively can classify the different labels with as minimum as possible given our limited time frame of two weeks. Accelerated GPUs were used to train our model on CUDA devices to speed up training time. The training was done using PyTorch.

Actions:
1. Data pre-processing
2. Set up training pipeline
3. Evaluate

Results:

I found five convolutional layers to be the best given the trade off between accuracy and training time. The model is somewhat a modified version of ResNet. After 80 minutes of training and around 67 epochs the model reached convergence and returned a test accuracy of 0.92. Furthermore, other evaluation metrics were performed such as Precision, Recall and F1- score since the data set had no doubt unbalanced classes which I observed during the pre-processing part. The model received a precision score of 0.917, Recall score of 0.917 and F1-score of 0.914.





Artificial Intelligence project/Poker tournament/Halmstad University

Situation:
We were given the task to develop an agent named Cesar, that performs well in a game of a modified version of Poker called *5 card draw poker game*. The agent competed in a tournament with all other students that participated in the course. Two students per group. Each group was randomized into 6 clusters such that those groups in cluster A competed against each other in a game of poker. The winner of cluster A would then compete against the winners of cluster B, C and so on. Moreover, the inference of each calculation had to be constrained to a specific time, thus a boundary between model complexity and time efficiency had to to be adjusted, if the latter was not met you'd get timed out, equivalent to withdrawing and essentially losing.

Task:
1. Constant time 5-card poker hand evaluator: To compute optimal draws, a fast hand evaluator was implemented that operates in constant time.

2. Opponents' Hand Estimation: The agent estimates opponents' hand strength using a linear regression model fitted with historical data available through the Memorizer module.

3. Memorizer module: This module records and stores all events from the driver client, enabling data management and acting as a basic Data Access Layer for the agent's logic components.

4. Monte Carlo Draw Estimation: To maximize the agent's utility during the draw phase, the agent uses Monte Carlo simulation with repeated random sampling to compute the optimal draw policy.

5. Regression models: Linear and polynomial regression models were tested to predict the hand strength of opponents, with the simpler linear model chosen due to time constraints and avoiding overfitting.

Results:
1. Preliminary testing phase: The agent achieved a win-rate of 96% against a Random Adversarial Agent and 98% against a Reflex Agent.

2. Pre-tournament phase: Caesar achieved a win-rate of 83.3%

3. Final tournament: Caesar had a lower win-rate of 4 out of 6 due to errors involved in parameter exploration. Despite the high computation overhead, the agent showed promising results, winning both tournaments and securing first place.

Robotics project / Halmstad University

Situation:
This project revolves around constructing a robot with the capability to pick up colored cubes on a map and relocate them to a specified area. By integrating sensor fusion, we combined data from LiDAR and odometry to minimize location uncertainty. Additionally, morphological filters were employed to identify colored objects, with computations estimating the remaining distance to the robot. A kinematic model was then constructed to calculate the distance at which the robot needs to stop before picking up the object.

Tasks:
The primary task was the construction of a robot capable of identifying, picking up, and relocating colored cubes within a given map. We achieved this through the application of sensor fusion, incorporating data from LiDAR and odometry to enhance the accuracy of the robot's localization.

Morphological filters were then utilized to detect the colored objects within the environment, alongside calculations that estimated the distance between the robot and these objects. Subsequently, a kinematic model was developed to determine the optimal distance at which the robot should halt prior to picking up the objects.

Results:
The outcome of the project was a successful construction of a robot with the distinct ability to identify, pick up, and relocate colored cubes. Through the application of sensor fusion, the robot's localization accuracy was significantly improved. The utilization of morphological filters, alongside the kinematic model, allowed for precise identification and handling of objects. This advanced robotics project demonstrates the potential of integrating complex technologies for optimized automation in diverse environments.

Smart Green House Project / Halmstad University

Situation:
The project aims to monitor and control a greenhouse climate, with a focus on maintaining temperature and light intensity. The temperature should be maintained between 20-25 degrees Celsius. The system will track the sun, control motorized mirrors and shades, and manage a lighting system to maintain a healthy light to darkness ratio for the plants.

Task:
1. Calendar and Time Configuration:
- Utilize the Microchip (Atmel) SAM3X8E - ARM embedded computer platform (Arduino Due) and SysTick as a base for the calendar.
- Allow users to configure date and time using a keypad and display.
- Represent the date in DD/MM/YYYY format and time in hh:mm:ss format (24-hour clock system).

2. Temperature Recording and Data Management:
- Record temperature periodically every minute for seven days.
- Timestamp each recorded temperature.
- Manage data using linked lists, deleting old recordings if the system memory buffer is full.

3. Data Presentation:
- Display minimum, average, and maximum temperature values for each day on an LCD screen.
- Show timestamps for maximum and minimum values.

4. Light Management and Sun Tracking:
- Control motorized mirrors and shades to maintain a 16-hour light and 8-hour darkness ratio for plant growth.
- Utilize a photo sensor to track the sun and reflect sunlight inside the greenhouse.
- Implement a lighting system (modeled by an LED) to compensate for the lack of sunlight during winter.

5. Temperature Control and Alarm System:
- Maintain the greenhouse temperature within user-configurable upper and lower limits.
- Raise an alarm (LED or blinking message on LCD) if temperature limits are crossed.
- Require manual user acknowledgment and reset for the alarm.

6. Fast Mode Simulation:
- Create a fast mode for testing purposes, simulating 30 minutes of real-time in one second.

Results:
Fully working Smart Green House Environment accord to the given tasks above

Bachelor Thesis / Halmstad University

Situation:
This bachelor's thesis introduces a ground-breaking imaging method designed to enhance microscopy, in collaboration with a company that focuses on healthcare technology. The company name can not be stated due to the signed NDA.
Moving away from the traditional auto-focus mechanism that captures images from a directly overhead perspective, this innovative technique employs a dual-party system: a camera with a fixed angle and a variable stage to maneuver the sample. This fresh approach allows for a range of focus levels, thereby creating more detailed and comprehensive imaging outcomes.

Tasks:
Our process began with the implementation of a variable stage to facilitate controlled movement of the sample. This was paired with a camera set at a fixed angle to capture images, an arrangement that deviated from the conventional vertical, auto-focused methods typically employed in microscopy. The variable stage was programmed to shift positions, allowing the camera to capture images from multiple focus levels. This eventually led to the development of an extensive image characterized by optimal sharpness.

Further, our method integrated a Laplace filter to locate pixels with the highest focus. From each image, we then extracted a sequence of these focused pixels to construct a new, composite image.

Results:
The results of this innovative imaging technique were highly promising. It successfully offered a broader spectrum of focus levels compared to traditional auto-focus microscopy, allowing for the development of a large, comprehensive image with optimal sharpness. The utilization of the Laplace filter, combined with the pixel sequence

extraction from each image, resulted in the creation of a new, high-definition composite image. This pioneering method holds the potential to significantly enhance our understanding of microscopic subjects and contribute to advancements in the field.

Master Thesis / Halmstad University

Situation:
This work presents the development of an Explainable Artificial Intelligence (XAI) methodology in the realm of Predictive Maintenance. The novelty of the approach lies in deciphering 'black box' models by integrating established gradient-based techniques, particularly the Expected Grad CAM. The output of this approach is a high-resolution Class Activation Map that clearly signifies the features in the original space that are most influential in the model's prediction.

Tasks:
The main task involved devising an XAI method to facilitate the interpretation of black box models in Predictive Maintenance. To achieve this, we combined existing gradient-based techniques, with a key focus on the Expected Grad CAM method.

The application of these techniques generated a high-resolution Class Activation Map. This Map was then meticulously analyzed to identify the most critical features in the original space that weigh heavily in the model's predictions, offering a clearer understanding of the decision-making process behind these complex models.

Results:
The developed XAI method proved successful in decoding black box models. It utilized the Expected Grad CAM technique, culminating in a high-resolution Class Activation Map. The major achievement of this method lies in its ability to clearly highlight the most significant features impacting the model's predictions. This improved transparency and comprehension of predictive models can potentially enhance predictive maintenance strategies in various industries.

Hobby Project

Situation:

This work centers on the development of an autonomous robot using Python IDE. The robot was designed to navigate randomly within an apartment space, with ultrasonic sensors integrated to avoid collisions with any objects in its path.

Tasks:

The primary task was to develop an autonomous robot capable of moving randomly within a specified area. The project was carried out using Python IDE, which provided an excellent platform for designing and programming the robot.

To enhance the robot's functionality and safety, ultrasonic sensors were integrated into its system. These sensors served as 'eyes,' allowing the robot to sense and prevent potential collisions with other objects within the apartment.

Results:

The result was a successfully developed autonomous robot, programmed via Python IDE, capable of maneuvering randomly within an apartment. The integration of ultrasonic sensors significantly improved the robot's ability to move safely around the space, effectively preventing any collisions with objects in its path. This project highlights the potential of autonomous robotics in household settings, and opens up possibilities for further enhancements and applications.

Hms summer internship

Situation:

During the summers of 2021 and 2022, I engaged in a role at Hms, which involved testing CAN Buses intended for global distribution. The testing process necessitated verifying responses and returned values of the modules under various scenarios, with certain verification procedures, such as LED blinking, requiring visual confirmation. I also had the opportunity to work with an updated system that utilized multi-threading, testing multiple devices simultaneously. While the job didn't necessitate deep technical knowledge, my proactive questioning further enriched my understanding of the system's operations.

Tasks:

My responsibilities at Hms revolved primarily around the testing of CAN Buses, ensuring they were functioning correctly before being sent to customers worldwide. This involved running tests to confirm that the module responded accurately and returned the correct values under different test scenarios.

Part of the verification process required keen visual attention, as some aspects, like the LED blinking, needed to be confirmed with the naked eye. This demanded a high and sustained level of concentration throughout the day. Additionally, during my second summer, I was introduced to an advanced system that employed multi-threading, enabling the simultaneous testing of multiple devices.

Despite the role not requiring deep technical expertise, I frequently engaged with on-site engineers, asking questions to deepen my understanding of the system's workings.

Results:

The experience gained at Hms during the summers of 2021 and 2022 was enriching. I successfully conducted a range of tests on CAN Buses, honing my attention to detail, and ensuring the products met quality standards before reaching customers. The opportunity to work with a multi-threading system broadened my knowledge about concurrent device testing and multi-threading topics. The proactive engagement with engineers added a learning dimension to the role, enhancing my grasp of system operations.

Martin och Servera

Situation:
Before and at the start of my studies (2016-2018), I was employed full time in the wholesale department at Martin och Servera. In my introductory semester to Engineering, from January 2018 to August 2018, I managed to work full time while also studying full time. This was quite challenging, but it helped me develop strong time management skills. Once my engineering program commenced in August 2018, I transitioned to a part-time role, which I maintained until June 2020.

Task:
The main task involved collecting different goods the customer had ordered.

Results:
During this period, I significantly improved my communication skills and learned valuable lessons in time management, particularly while juggling work and my initial years of study. Detailed weekly planning became essential to fulfill monthly requirements. We had a set target of collecting an average of 55 goods per hour each month, and I consistently managed to exceed this benchmark.

Supplemental Instructor in Mathematics

Situation:
Following my first year in the engineering program, the university offered job positions to students who had achieved top grades in various math classes. I took up this opportunity as it seemed like a great way to improve my communication skills while helping others get through a tough first year.

Planning each week in advance was necessary to align with the students' schedules. Additionally, I had to book a classroom each week. Given this, we had a check-in meeting with our employer every Monday to review our progress and discuss how things were going.

Task:
I was helping first-year students with their math courses, including Discrete Math, Linear Algebra, and One-dimensional Analysis. It was great to hear the students appreciate my help. Our usual method was to solve various problems on the whiteboard. I'd call different students to solve the problem.

I didn't give the answers directly. Instead, I wanted to see how their teamwork skills improved over time. I always told them to ask their teammates for help with the problem, not me.

The change I saw during this time was incredible. At first, I noticed students were shy and scared of making mistakes. They usually sat in small groups of two or three. But quickly, they all started working together in larger groups. They solved problems on their own, just by talking with each other, without my help.

Results:
I served as an SI-teacher for two years, during which most of the students successfully passed their various math exams. As a token of appreciation, I even received a cake during my final lecture, most importantly I made really good friends and myself grew a lot as a person.

PUBLICATIONS

- **Bachelor thesis -** https://www.diva-portal.org/smash/get/diva2:1571538/FULLTEXT02.pdf

- **Master thesis -** https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1786127&dswid=-8591