1. **AI-Driven Robotic Navigation: Deep Learning for Agricultural Perception and Control**
   Introduction:
   This thesis proposal leverages state-of-the-art deep learning techniques to revolutionize autonomous navigation in agricultural robotics. Drawing inspiration from cutting-edge research in wheat head counting using deep convolutional neural networks, the study integrates a deep learning-based segmentation model into a comprehensive perception system. High-resolution agricultural imaging data are employed to detect and quantify critical features—such as wheat heads—to generate precise maps essential for yield estimation and crop health monitoring. These maps are fused with multi-sensor data (including LiDAR and GPS) to continuously update navigational information, enabling real-time, adaptive path planning within simulated environments. Rigorous evaluations on platforms like ROS with Gazebo pave the way for seamless transitions from virtual testing to real-world robotic deployment.

2. **Deep Learning-Based Stock Market Forecasting**

   Introduction:
   Financial markets are inherently dynamic and unpredictable, presenting a formidable challenge for accurate forecasting. This thesis proposal aims to harness the power of deep learning to predict stock prices and market trends using historical data from the New York Stock Exchange. The dataset comprises daily trading information—such as opening and closing prices, highs, lows, and trading volumes—for a broad range of stocks over several years. The rich temporal patterns within this data offer an ideal setting for advanced time-series forecasting models, particularly those based on recurrent neural networks (RNNs) and Long Short-Term Memory (LSTM) architectures. The study will delve into state-of-the-art deep learning techniques implemented in Python to capture underlying market dynamics and deliver actionable insights into future price movements.

3. **Forecasting Space Weather: Solar Flare Prediction**
   Introduction:
   Addressing the imperative need to protect satellites and astronauts from harmful solar radiation, this thesis proposal focuses on forecasting solar flare intensity. Utilizing a dataset enriched with magnetic field measurements from the Sun and detailed time-series analysis (e.g., sunspot evolution over 72 hours), the study predicts solar flare magnitudes ranging from minor events to extreme outbursts. By capturing the non-linear interactions inherent in solar magnetic dynamics, the approach provides critical insights for space mission planning and satellite safety. Extensions include integrating attention mechanisms to pinpoint crucial time windows and benchmarking against convolutional models for enhanced spatial pattern analysis.

4. **Predicting Wildfire Spread with Environmental Data**
   Introduction:
   Confronting the urgent challenges posed by climate change-induced wildfires, this

thesis proposal aims to predict wildfire spread rates by combining historical wildfire records with environmental data—such as temperature, humidity, terrain characteristics, and vegetation cover. By employing a Multilayer Perceptron (MLP) to model complex, non-linear interactions among these variables, the study seeks to forecast fire spread (in acres per hour) with high precision. The ultimate objective is to generate real-time risk assessments and interactive risk maps, thereby empowering firefighters and emergency responders with actionable insights.

5. **Predicting Arctic Sea Ice Extent Using Multilayer Perceptrons and Climate Data**
   Introduction:
   This thesis proposal investigates future changes in Arctic sea ice by analyzing historical measurements in conjunction with critical climate variables, including temperature, atmospheric CO_2 levels, and surface albedo. An MLP is employed to model the non-linear dynamics driving ice melt, with the aim of predicting shifts in ice coverage (in million km^2). The anticipated findings are expected to offer pivotal insights into global climate change, inform effective climate mitigation strategies, and deepen our understanding of environmental transformations on a planetary scale.

6. **Predicting Alzheimer's Disease Progression from MRI Scans**
   Introduction:
   Focusing on the early detection and intervention of Alzheimer's disease, this thesis proposal utilizes preprocessed MRI scans transformed into detailed brain imaging features (such as gray matter density and hippocampal volume) to classify disease stages—from Mild Cognitive Impairment to Severe Dementia. An MLP, augmented by transfer learning techniques that incorporate pre-trained convolutional network weights, is deployed to enhance diagnostic accuracy. Additionally, the integration of genetic markers is explored to tailor and personalize predictive outcomes.

7. **Predicting Muscle Hypertrophy from Resistance Training Variables**
   Introduction:
   This thesis proposal examines the non-linear relationships between resistance training variables and muscle growth. By utilizing a dataset comprising metrics such as training load, volume, rest intervals, and exercise type, the study employs an MLP with features including 1RM percentage, time under tension, and training frequency to predict muscle hypertrophy (e.g., biceps cross-sectional area). The methodology is benchmarked against traditional sports science formulas, with prospective extensions to incorporate wearable recovery data and develop an adaptive workout planner.

8. **Classifying NBA Player Positions**
   Introduction:
   Delving into the realm of sports analytics, this thesis proposal classifies basketball players into positions (Guard, Forward, Center) based on performance statistics such as rebounds, assists, and points. Advanced multi-class classification techniques—including Logistic Regression and Support Vector Machines (SVM)—are utilized in

conjunction with dimensionality reduction methods like PCA to identify the key metrics defining player roles. This innovative analysis offers a fresh perspective on traditional position classifications, reflecting the evolving dynamics of modern basketball.

9. **Predicting Rental Prices for Online Accommodations**
   Introduction:
   Exploring the intersection of real estate and data science, this thesis proposal aims to accurately predict rental prices for online accommodations. By leveraging a dataset containing detailed information on location, amenities, and customer reviews, the study applies regression models—from Linear Regression to Gradient Boosting—to forecast prices. In addition, the integration of geospatial analysis tools facilitates the visualization and interpretation of rental price distributions across urban landscapes, thereby providing valuable insights for travelers seeking optimal deals.

10. **Theoretical Foundations and Innovations of Kolmogorov-Arnold Networks in Deep Learning**

    Introduction:
    The Kolmogorov-Arnold Networks (KAN) architecture is inspired by the Kolmogorov-Arnold representation theorem, which asserts that any multivariate continuous function can be decomposed into a finite sum of univariate functions. This groundbreaking insight offers a new perspective on function approximation and representation learning in deep neural networks. This thesis proposal aims to establish a rigorous theoretical framework for KANs, investigating their approximation capabilities, convergence properties, and potential advantages over traditional architectures.

11. **Unveiling the Power of Transformers: A Theoretical Study of Attention Mechanisms and Their Dominance in Deep Learning**
    Introduction:
    The transformer architecture has dramatically reshaped the landscape of deep learning and artificial intelligence. Since its introduction by Vaswani et al. in 2017, transformers have become the backbone of numerous state-of-the-art models, most notably OpenAI's ChatGPT. By leveraging attention mechanisms, transformers have surpassed traditional architectures in handling sequential data, enabling unprecedented advancements in natural language processing (NLP), computer vision, and beyond.
    ChatGPT, a prime example of transformer-based models, has demonstrated remarkable capabilities in understanding and generating human-like text. Its success epitomizes how transformers have taken over the deep learning world, pushing the boundaries of what machines can achieve in language comprehension and generation.
    This theoretical thesis aims to delve deep into the transformer architecture and its attention mechanisms, exploring how they have revolutionized deep learning. By examining the mathematical foundations and operational principles, the study will highlight the reasons behind the widespread adoption of transformers and their transformative impact on AI.