Research Practice Projects

Introduction

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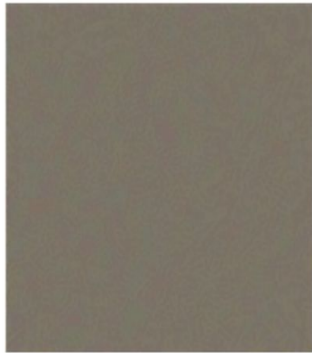
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Research Interests

Formal Methods with applications in

Artificial Intelligence and **Cloud Computing.**

stop sign
Confidence: 0.9153

Adversarial perturbation

flowerpot
Confidence: 0.8374

Project 1

Project 2

Making AI Efficient and Safe: Training and Verifying Binarized Neural Networks

Introduction

Did you know that your smartphone could run advanced AI models without draining its battery?

Did you know that autonomous cars run advanced AI models to interpret the surrounding?

Binarized Neural Networks are a groundbreaking approach that makes AI more efficient and accessible.

(Binarized) Neural Networks

- A neural network is a set of algorithms modeled after the human brain that is designed to recognize patterns.
- Traditional neural networks use floating-point numbers for weights and activations.
- Binarized Neural Networks (BNNs) use binary values (0s and 1s) for weights and activations.
- This significantly reduces memory usage and computational power.

Research Project Overview

Objectives:

- Develop architectures to train BNNs effectively.
- Verify the robustness of BNNs.

Key Findings:

- BNNs can achieve comparable accuracy to traditional neural networks in certain tasks with much lower computational requirements [1].
- Verification methods help in identifying and mitigating potential security issues due to lack of robustness in the BNN models [2].

[1] Andreea Postovan and Mădălina Eraşcu. Benchmarking Local Robustness of High-Accuracy Binary Neural Networks for Enhanced Traffic Sign Recognition. Working Formal Methods Symposium (FROM) 2023 (EPTCS proceedings).

[2] Andreea Postovan and Mădălina Eraşcu. Architecturing Binarized Neural Networks for Traffic Sign Recognition. 32nd International Conference on Artificial Neural Networks (ICANN 2023) (Springer LNCS Proceedings).

Investigating the Characteristics of Datasets Used in Supervised Learning Graph Neural Networks

Introduction

Imagine trying to teach a child to recognize different animals using blurry photos and incomplete information. How effective would that be? This is similar to the challenge faced in supervised learning when datasets are not well-prepared.

Understanding the characteristics of datasets is crucial for developing accurate and reliable machine learning models.

Importance of Datasets in Supervised Learning

Supervised learning is a type of machine learning where a model is trained on labeled data. The goal is to predict the output for new, unseen data.

The quality and characteristics of the dataset directly impact the performance of the model. Poor-quality data can lead to inaccurate models.

From https://www.geeksforgeeks.org/supervised-unsupervised-learning/
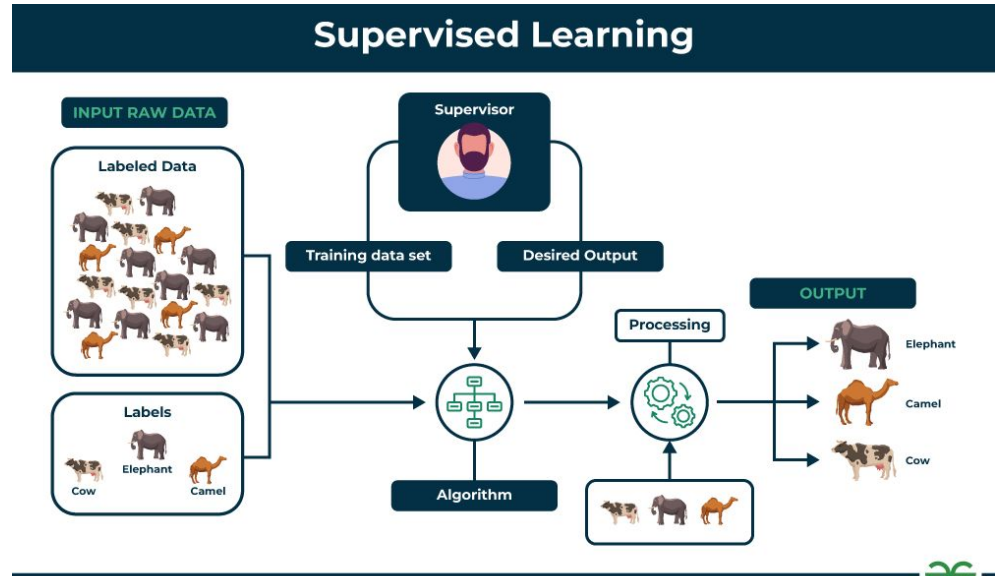
Research Project Overview

Objectives:

- Our research aims to identify key characteristics of datasets that influence the performance of supervised learning models [1].

Key Findings:

- Data Quantity: Larger datasets generally lead to better models, but there's a point of diminishing returns.
- Diversity and Representation: Diverse datasets that represent all possible scenarios improve model robustness.

[1] Thomas Bartz-Beielstein et al. Benchmarking in Optimization: Best Practice and Open Issues. https://arxiv.org/pdf/2007.03488
[2] Eduard Laitin and Mădălina Eraşcu. Fast and Exact Synthesis of Application Deployment Plans using Graph Neural Networks and Satisfiability Modulo Theory. International Joint Conference on Neural Networks 2024 (IJCNN 2024), part of IEEE WCCI 2024 (IEEE Proceedings)

Application

Send an email to madalina dot erascu at e-uvt dot ro with

- CV,
- application letter and
- transcript of records

by June 15th.

The results will be announced by July 1st. The practice will start on July 15th or when you are finished with the exams.