

Research Papers on 'machine'

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Paper 1:

Representation and Interpretation in Artificial and Natural Computing

Date: 2025-02-14

Time: 18:57:29

Authors:

Luis A. Pineda

Summary:

- Artificial computing machinery transforms representations through an objective process, to be interpreted subjectively by humans, so the machine and the interpreter are different entities, but in the putative natural computing both processes are performed by the same agent. The method or process that transforms a representation is called here \emph{the mode of computing}. The mode used by digital computers is the algorithmic one, but there are others, such as quantum computers and diverse forms of non-conventional computing, and there is an open-ended set of representational formats and modes that could be used in artificial and natural computing. A mode based on a notion of computing different from Turing's may perform feats beyond what the Turing Machine does but the modes would not be of the same kind and could not be compared. For a mode of computing to be more powerful than the algorithmic one, it ought to compute functions lacking an effective algorithm, and Church Thesis would not hold. Here, a thought experiment including a computational demon using a hypothetical mode for such an effect is presented. If there is natural computing, there is a mode of natural computing whose properties may be causal to the phenomenological experience. Discovering it would come with solving the hard problem of consciousness; but if it turns out that such a mode does not exist, there is no such thing as natural computing, and the mind is not a computational process.

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Paper 2:

Balancing the Scales: A Theoretical and Algorithmic Framework for Learning from Imbalanced Data

Date: 2025-02-14

Time: 18:57:16

Authors:

Corinna Cortes, Anqi Mao, Mehryar Mohri, Yutao Zhong

Summary:

- Class imbalance remains a major challenge in machine learning, especially in multi-class problems with long-tailed distributions. Existing methods, such as data resampling, cost-sensitive techniques, and logistic loss modifications, though popular and often effective, lack solid theoretical foundations. As an example, we demonstrate that cost-sensitive methods are not Bayes consistent. This paper introduces a novel theoretical framework for analyzing generalization in imbalanced classification. We propose a new class-imbalanced margin loss function for both binary and multi-class settings, prove its strong H -consistency, and derive corresponding learning guarantees based on empirical loss and a new notion of class-sensitive Rademacher complexity. Leveraging these theoretical results, we devise novel and general learning algorithms, IMMAX (Imbalanced Margin Maximization), which incorporate confidence margins and are applicable to various hypothesis sets. While our focus is theoretical, we also present extensive empirical results demonstrating the effectiveness of our algorithms compared to existing baselines.

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Paper 3:

Unknown Word Detection for English as a Second Language (ESL) Learners Using Gaze and Pre-trained Language Models

Date: 2025-02-14

Time: 18:57:04

Authors:

Jiexin Ding, Bowen Zhao, Yuntao Wang, Xinyun Liu, Rui Hao, Ishan Chatterjee, Yuanchun Shi

Summary:

- English as a Second Language (ESL) learners often encounter unknown words that hinder their text comprehension. Automatically detecting these words as users read can enable computing systems to provide just-in-time definitions, synonyms, or contextual explanations, thereby helping users learn vocabulary in a natural and seamless

manner. This paper presents EyeLingo, a transformer-based machine learning method that predicts the probability of unknown words based on text content and eye gaze trajectory in real time with high accuracy. A 20-participant user study revealed that our method can achieve an accuracy of 97.6%, and an F1-score of 71.1%. We implemented a real-time reading assistance prototype to show the effectiveness of EyeLingo. The user study shows improvement in willingness to use and usefulness compared to baseline methods.

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