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Deep Kernel Machine Optimization

Background

The implementation of deep learning in a wide range of applications has resulted in an ever-increasing complexity of neural network architecture. These network architectures require reconfiguration to support specific applications, particularly in the field of computer vision where an image may contain a variety of objects needing to be classified. In many cases, this limits performance and poses a challenge in providing performance improvements over conventional machine learning solutions due to excessive tuning of hyper-parameters within network architectures.

The utilization of kernel methods has long-standing success in machine learning and have been applied neural networks to the address issues mentioned above. However, current kernel solutions such as state-of-the-art Multiple Kernel Learning (MKL) and Support Vector Machine (SVM) algorithms are similarly computationally intensive, and do not provide straightforward extension to multi-class classifications common in computer vision tasks in which an image may contain hundreds of objects. A method of providing straightforward kernel optimization that can be easily applied to a wide array of computer vision tasks would be desirable.

Invention Description

Researchers at Arizona State University have tackled these issues through the invention of a deep learning kernel optimization system that couples kernel machines with deep learning. The system provides end-to-end learning while being generic to a wide range of issues and limited data. The architecture can even remain static when switching between applications, requiring only the change in kernel representation. This approach achieves consistently better performance than even state-of-the-art solutions like Multiple Kernel Learning by utilizing deep learning for kernel optimization.

Potential Applications

- Image processing
- Cell biology

- Bioinformatics
- Time series data
- Signal processing
- Data Science
- Deep Learning
- Artificial Intelligence

Benefits and Advantages

- Superior Performance – Experimentally proven to provide higher classification accuracy and performance when compared to current state-of-the-art solutions.
- Simplistic – Reduces need for customized network architectures for specific applications
- Versatile – Can be implemented on a variety of deep learning architectures and neural networks for a wide range of applications