Neural Architecture Search for Hand Image Recognition

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Abstract

Neural Architecture Search (NAS) is now a well accepted approach for discovering optimized neural network models. In particular, limitations on resources and runtime entail designing efficient NAS schemes. Recently, Differentiable Architecture Search (DARTS) has gained significant popularity as a NAS method. Our work aims to discover an efficient convolutional neural network (CNN) model for a two class classification task on a dataset of hands-images. In this context we envision designing a DARTS scheme adapted to our problem.

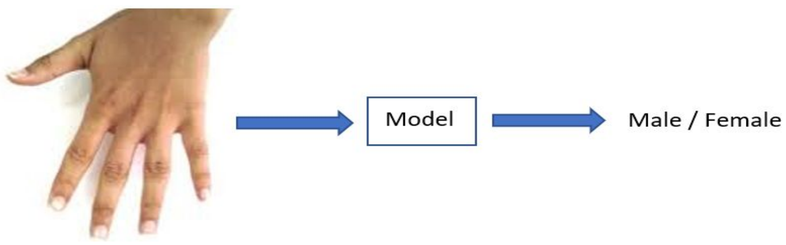


Figure 1: Gender recognition

Preface

In this work, we devise a method for efficiently searching CNNs for gender recognition via hand images.

We attempt to derive an optimal model on 11K hands dataset from the popular neural architecture search method DARTS (Differentiable Architecture Search).

References

[1] Mahmoud Afifi, "11K Hands: Gender recognition and biometric identification using a large dataset of hand images."

[2] Liu, Simonyan, and Yang, "DARTS: DIFFERENTIABLE ARCHITECTURE SEARCH."

[3] Kandukuri, Sakhtivel, and Xie, "Neural Architecture Search For Skin Cancer Detection."

Introduction

Image Classification

- Image classification includes taking an input image and classifying its label.

Aim
This project aims to take a dataset with 11076 training samples for an application of classifying the gender as male or female based on that.

- Architectures such as AlexNet, VGGNet, ZFNet, GoogLeNet are used for classifying images but these prebuilt models may not be optimal, so we switch to NAS.

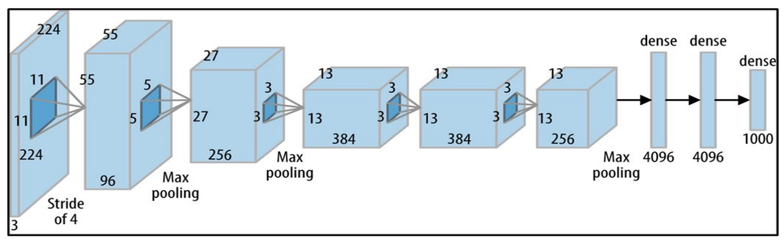


Figure 2: Alexnet Block Diagram "source: oreilly.com"

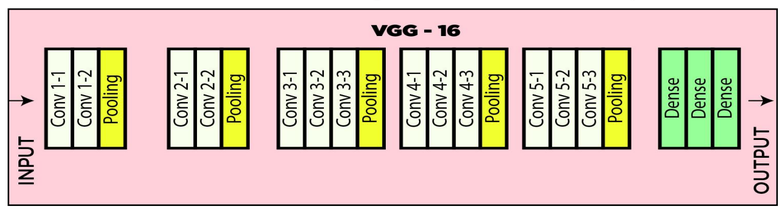


Figure 3: VGGNet "source: GeeksforGeeks"

Differentiable Architecture Search

- DARTS as a NAS method transforms the search space to be continuous which can be optimized using gradient descent.

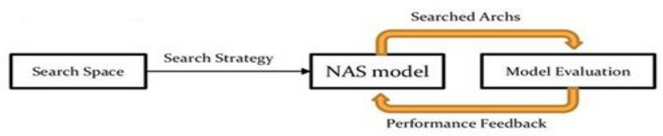


Figure 4: Neural Architecture Search "source: towardsai.net"

- For evaluating architecture gradient, a simple approximation scheme is proposed as below:

$$\nabla_\alpha \mathcal{L}_{val}(\omega^*(\alpha), \alpha)$$
$$\approx \nabla_\alpha \mathcal{L}_{val}(\omega - \xi \nabla_\omega \mathcal{L}_{train}(\omega, \alpha), \alpha) \text{ , where}$$

- ω denotes the current weights maintained by the algorithm, and
- ξ is the learning rate for a step of inner optimization.

Methodology

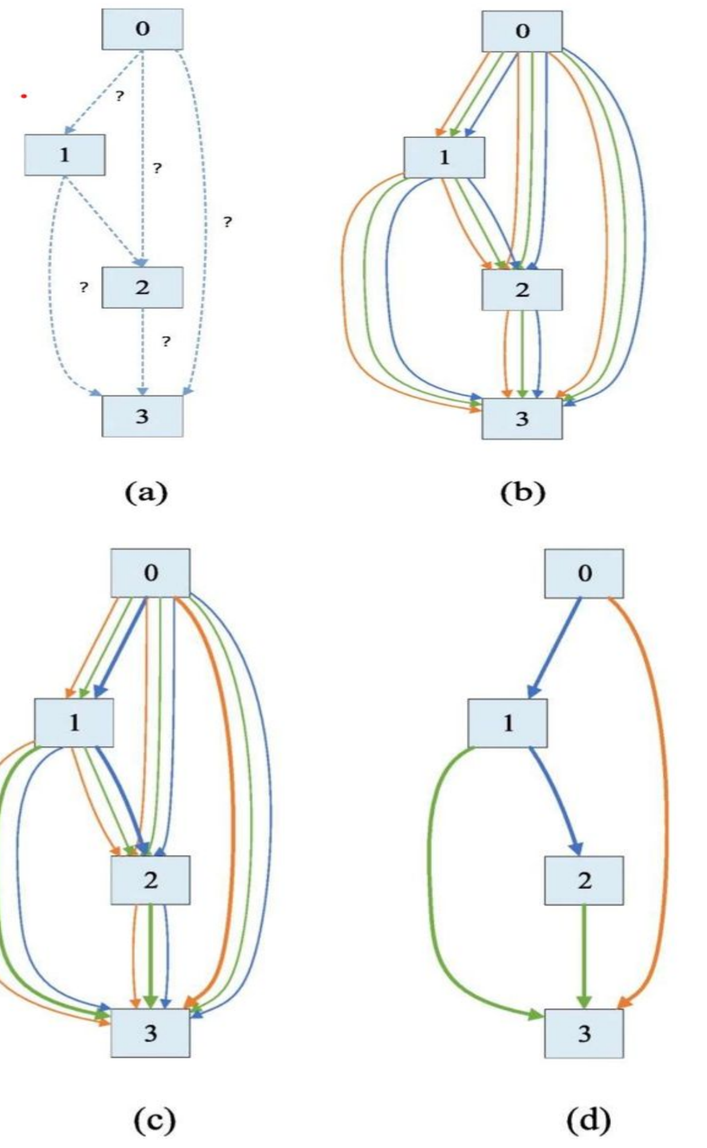
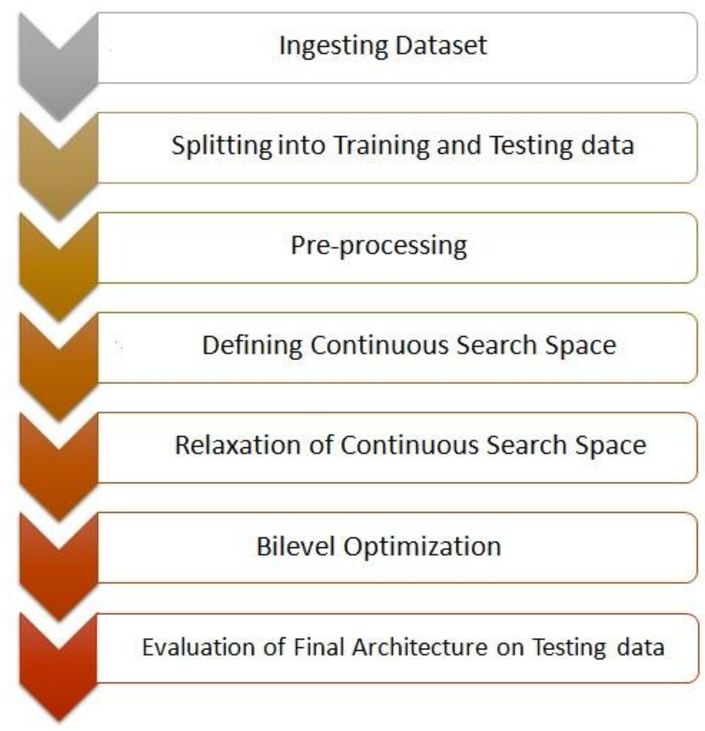


Figure 5: Discovering Neural Architecture by DARTS [2]

The Task Pipeline



Dataset

- The proposed 11K Hands dataset[1] consists of 11,076 hand images of 190 subjects aged between 18 - 75 years. Each image has (1600 × 1200 pixels).
- The metadata of each hand image includes: (i) subject ID, (ii) gender information, (iii) age, (iv) hand skin color and (v) hand side (dorsal or palmar) and logical indicators

Figure 6: Representative example of proposed dataset [1]

Figure 7: Input hand image from 11 K dataset and it's detailed layer generated [1]

Envisioned Goals

- Though this work considers hand images dataset, it is equally applicable to other image datasets.
- We envision to extend this work to make it constrained to incorporate resource constraints such as limited memory and computation power (measuring in floating point operations).
- The present work finds applications in domains such as biometric identification, medical imaging, industrial objects identifications and several others. We envision to apply our approach in one or more such applications.