Stage-Wise Neural Architecture Search

Artur Jordão, Fernando Akio, Maiko Lie and William Robson Schwartz
Smart Sense Laboratory, Computer Science Department
Federal University of Minas Gerais, Brazil

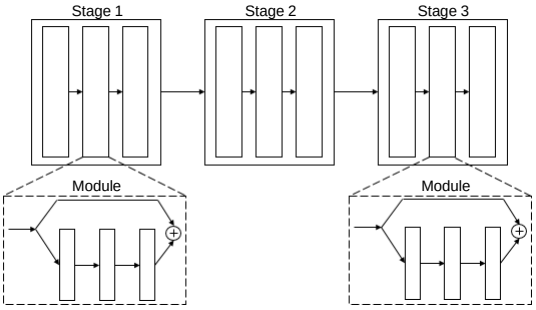
Introduction

- Neural Architecture Search methods are capable of learning to design high-performance convolutional networks automatically
- Current NAS are computationally expensive
  - They evaluate a large number of candidate architectures
- In this work, we propose a simple, effective, and efficient approach to discover convolutional architectures

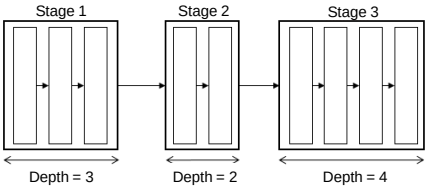
Proposed Neural Architecture Search

Problem Definition

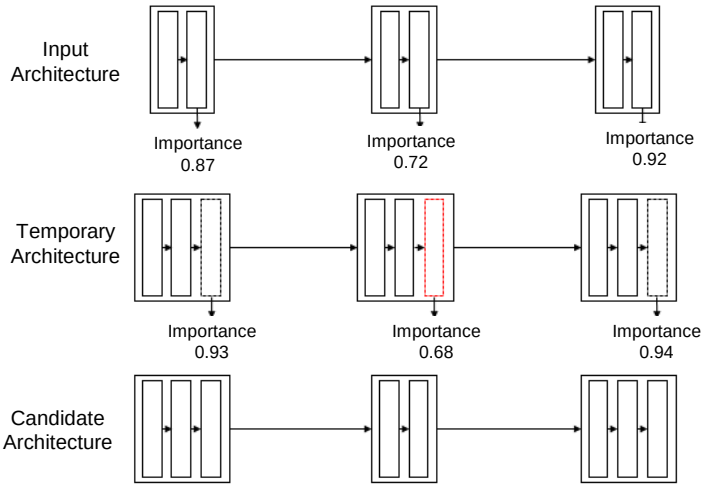
- Structure of modern architectures
  - Depth (number of modules) is the same for all stages



- We propose to learn the depth of each stage based on its importance
  - Stages with low importance are kept shallow
  - Stages with high importance become deeper



Proposed Method



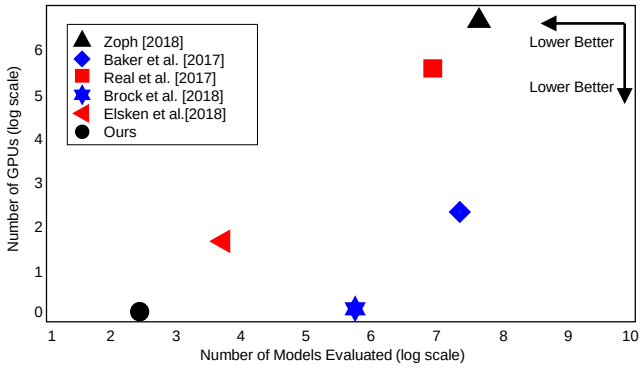
Experiments

Comparison with Human-Designed Architectures

Architecture	Depth	Param. ↓ (Million)	FLOP↓ (Million)	Accuracy↑
ResNet44	44	0.66	97	92.83
Ours (it=1)	**43**	**0.60**	**92**	**93.38**
ResNet56	**56**	0.86	**125**	93.03
Ours (it=3)	59	**0.69**	130	**93.36**
ResNet110	110	1.7	253	93.57
Ours (i=5)	**67**	**0.88**	**149**	**94.27**

Comparison with State-of-the-Art NAS

Model	Evaluated↓ Models	GPUs ↓	Param.↓ (Million)	Accuracy↑
Zoph et al. [2018]	20, 000	800	2.5	94.51
Real et al. [2017]	1, 000	250	5.4	94.60
Dong and Yang [2019]	240	**1**	2.6	**96.25**
Jin et al. [2019]	60	**1**	---	88.56
Ours (it=5)	**11**	**1**	**2.3**	94.74



Conclusions

- We demonstrate that it is possible to design high-performance convolutional architectures by inserting layers based on their importance
- Compared to NAS strategies, our method is more efficient, as it evaluates one order of magnitude fewer models and discovers architectures on par with the state of the art
- Code is available at
  - https://github.com/arturjordao/StageWiseArchitectureSearch

ACKNOWLEDGMENTS

The authors would like to thank the National Council for Scientific and Technological Development – CNPq (Grants 140082/2017-4, 438629/2018-3 and 309953/2019-7) and the Minas Gerais Research Foundation – FAPEMIG (Grants APQ-00567-14 and PPM-00540-17

REFERENCES

Baker et al. (2017). *Designing neural network architectures using reinforcement learning.* In ICML.
Real et al. (2017). Large-scale evolution of image classifiers. In ICLR.
Zoph et al. (2018). *Learning transferable architectures for scalable image recognition*. In CVPR.
Brock et al. (2018). *SMASH: one-shot model architecture search through hypernetworks*. In ICLR.
Elsken et al. (2018). Simple and efficient architecture search for convolutional neural networks. In ICLR.
Dong and Yang et al. (2019). *Searching for a robust neural architecture in four GPU hours*. In CVPR.
Jin et al. (2019). *Auto-keras: An efficient neural architecture search system*. In SIGKDD.