THE UNIVERSITY OF BUCKINGHAM

An ENAS Based Approach for Constructing Deep Learning Models for Breast Cancer Recognition from Ultrasound Images

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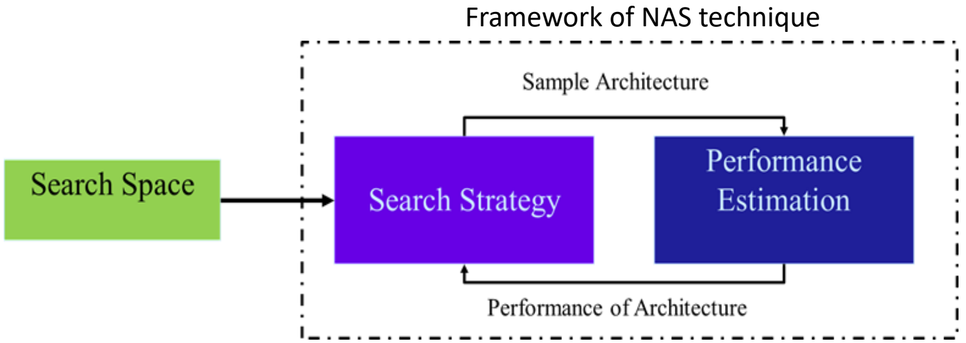
Introduction

Background

- Widespread use of handcrafted CNN architectures (AlexNet, VGGNet, GoogLeNet ,ResNet …etc.)
- CNN architectures: hard to design
- Recent Development: automatic architecture search
  - Neural Architecture Search (NAS)
  - Efficient Neural Architecture Search (ENAS)



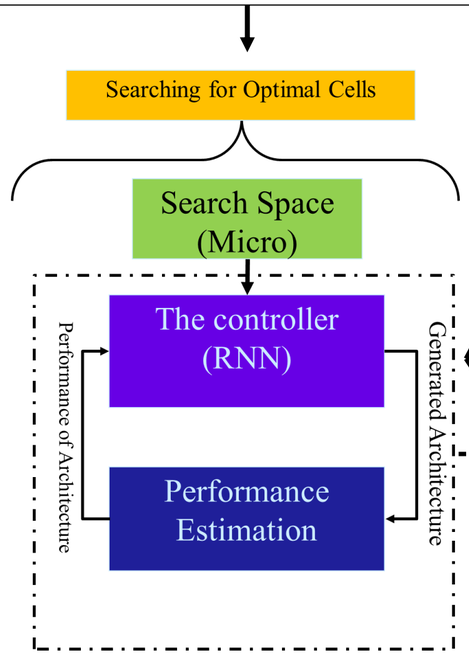
Aim of the Study

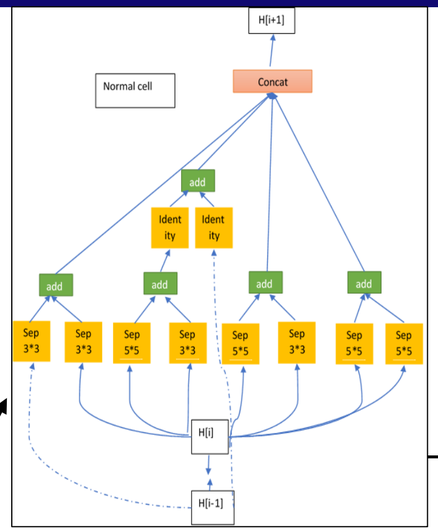
To Investigate effectiveness of ENAS for breast cancer recognition from US images

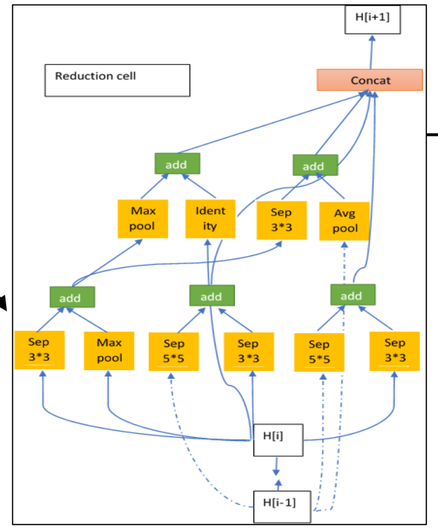
Methods

Hyperparameter setting for Searching:

- Batch size = 8
- Image size =100 × 100
- Other hyperparameter settings: the default values of ENAS

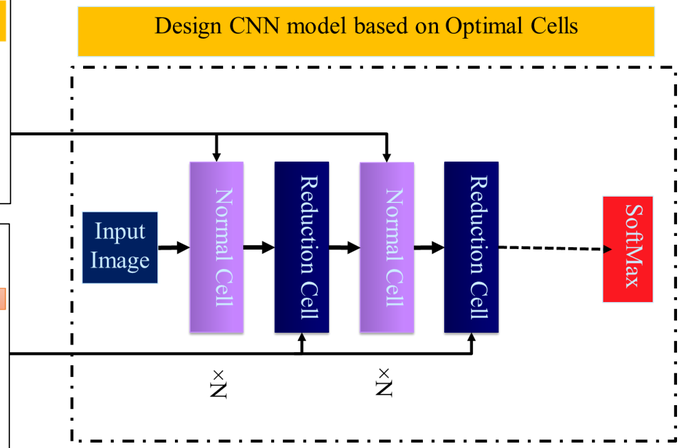






Hyperparameter setting for final CNN Model:

- Batch size = 8
- No. of epochs =100
- Image size =100 × 100
- Other hyperparameter settings: the default values of ENAS



Layers in final architectures:

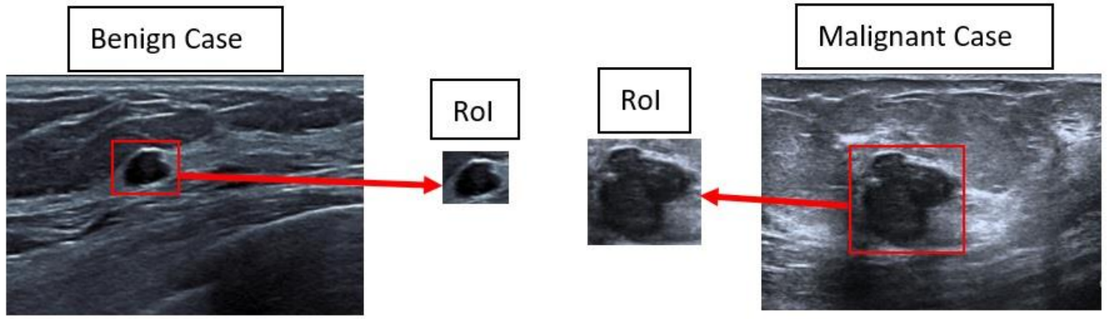
- **ENAS 17** (5*N, R, 5*N, R, 5*N)
- **ENAS 7** (N, R, N, R, 3*N)

Optimal cells(Norman and Reduction) generated by ENAS for Breast Cancer classification

Data and Results

Dataset

- Ultrasound images for breast lesions (262 Benign and 262 Malignant images)
- Different US machine makes



Examples of ultrasound images with labeled region of interest

Data Preparation

- Manual cropping of RoI by radiologist
- Training data augmentation:
  - Geometric Methods: Rotation (90,180 and 270), and Mirroring
  - Singular Value Decomposition (SVD) (25, 35 and 45)
- Bicubic Resizing (100×100)

ENAS Models Performance and Comparison with Models of Other Architectures

Models	TNR	TPR	PR	Accuracy	#Parameters
ENAS 17	86.7%	92.0%	87.5%	**89.3%**	4,251,780
ENAS 7	90.9%	86.7%	91.0%	88.8%	**2,342,484**
AlexNet	51.6%	48.5%	50.0%	50.0%	56,858,656
CNN3 [1]	80.5%	75.6%	84.0%	78.1%	619,202

Concluding Remarks

- Conclusion:
  - Investigated the efficacy of the ENAS approach for designing CNN architectures for breast lesion classification from US.
  - Demonstrated that the ENAS technique reduces human interventions in CNN architecture design.
  - The optimized architectures lead to more accurate classification yet simpler models than hand-crafted alternatives for breast lesion classification.

- Future work:
  - Evaluating ENAS models on external datasets
  - Exploiting ENAS architectures for other types of tumors/lesions from ultrasound images