The Designs of An Efficient Light-Weight Medical Image Classifiers Using NAS-DART Method

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Data Acquisition Methods

- **Sensor/Probe Data**
- **Automated Stereo Images**
- **Big Data Extraction**
- **Data Pre-processing**

Data Storage Strategy

- **Scalability**
- **Accessibility**
- **Latency Issues**
- **Throughput**
- **Parallel Access**

Implemented ML/DL Algorithms

- Gaussian Process, probabilistic model applied to multiclass data to simultaneously solve classification, regression problems
- Unsupervised ensemble model featuring pattern recognition, resolution optimization and highly configurable search pattern
- Design of a Lightweight Neural Network using AutoML (NAS) method

Neural Architecture Search of Echocardiogram Classifiers

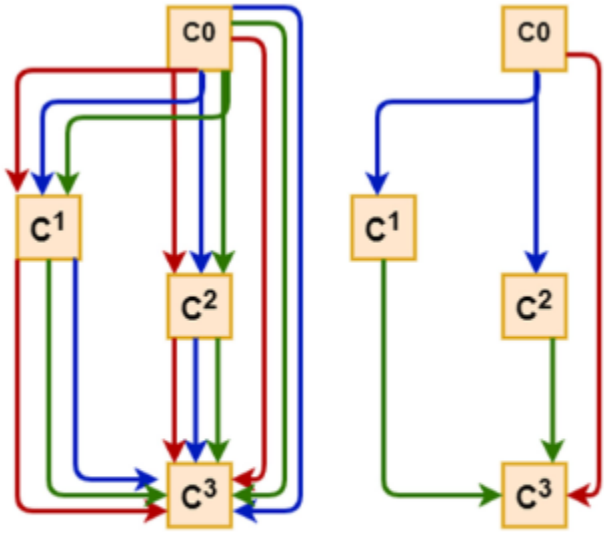
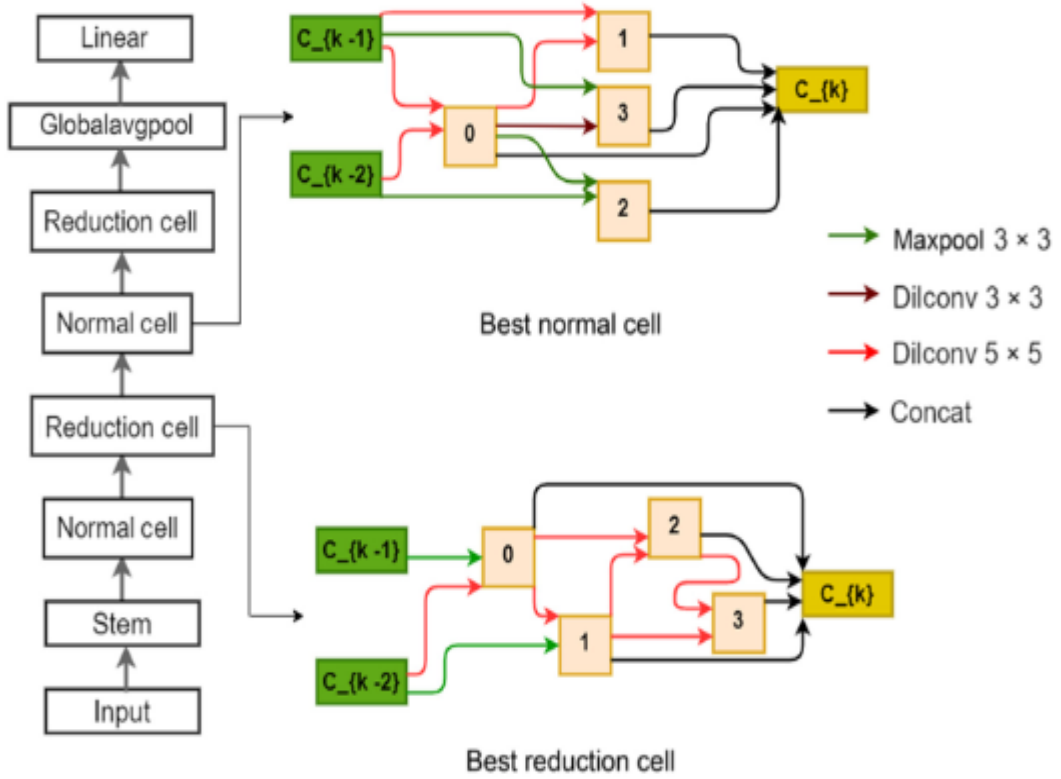
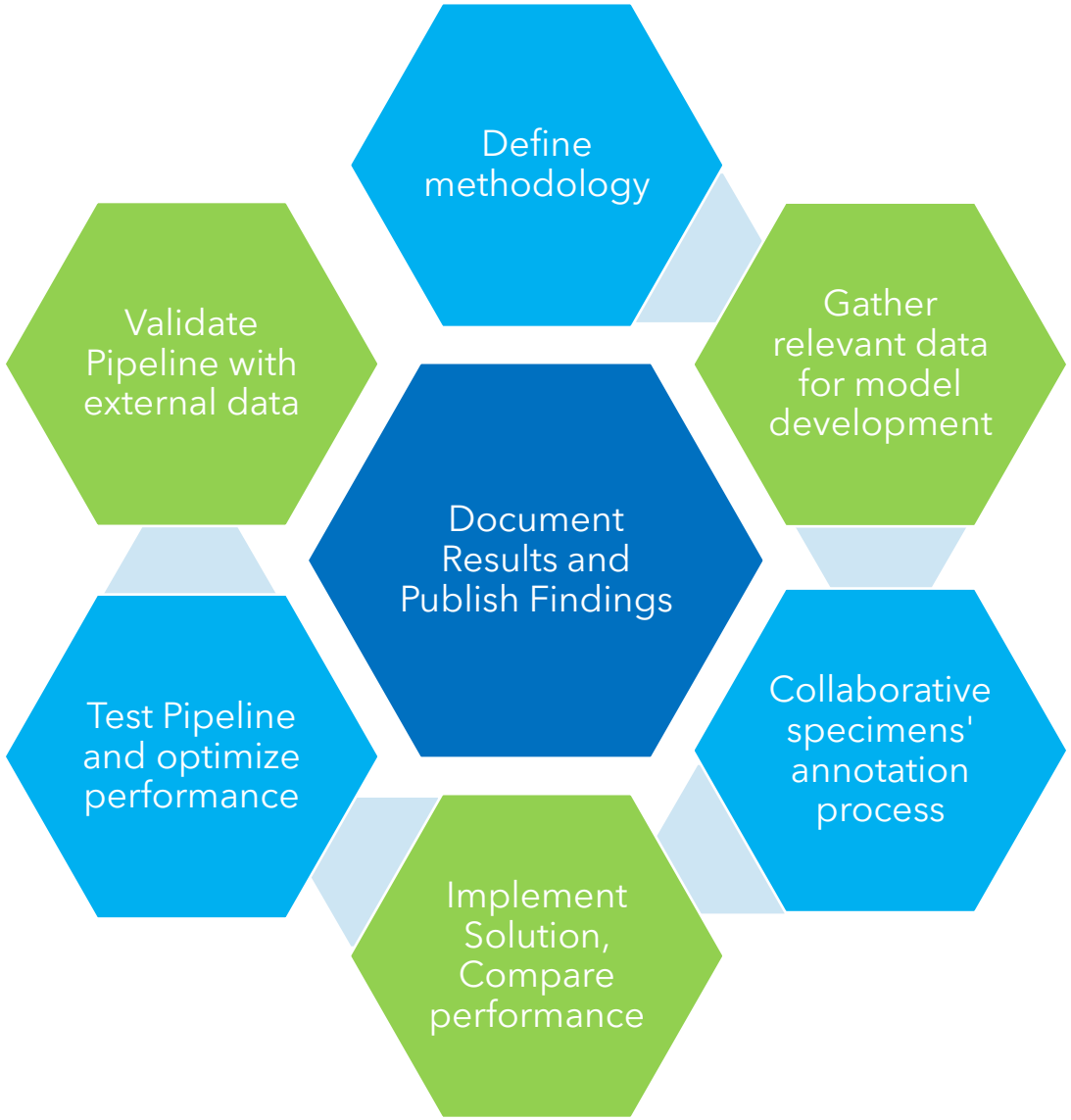


Fig. 3 Schematic of a DARTS cell. Left: a computational cell with four nodes $C^0 - C^3$. Edges connecting the nodes represent some candidate operations (e.g., 5×5 convolution, 3×3 convolution, and max-pooling shown in Fig. 3 by red, blue, and green lines, respectively). Right: the best-performing cell learnt from retaining the optimal operations. Figure inspired by Elsken et al.[43]



Achieved Research Objectives

- Highly configurable light-weight model to fit point of care application and for the deployment of medical emergency utility.
- With minimal memory and storage requirement, provide effective characterization and identification of pathological element within a given ultrasound image.
- Analyze and determine the optimum resolution required for cardiac classification of pathologies and anatomical influences.



Research Outcomes

- The **2-Cell DART** model was validated against known models with best spatial resolution of 128x128: DenseNet201, ResNet18 and VGGN16 achieved 93.8%, 92.9% and 93.2% respectively.
- The derived lightweight model (**CardioZAL**) outperformed the chosen state-of-the-art models on 2D echo cine loop video in terms of inference speed (1.75ms), and accuracy (96.9%) with inference speed of 11.8ms and mean model error of 0.24 +/- 0.0037.

Research Impacts

- Clinical Antenatal Investigations
- Medical Emergencies (point of care scenarios)
- Ultrasound Image Classification
- Cardiac prognosis and risk factor treatment
- Obstetrician & Gynaecological investigation

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