

AutoSNAP: Automatically Learning Neural Architectures for Instrument Pose Estimation

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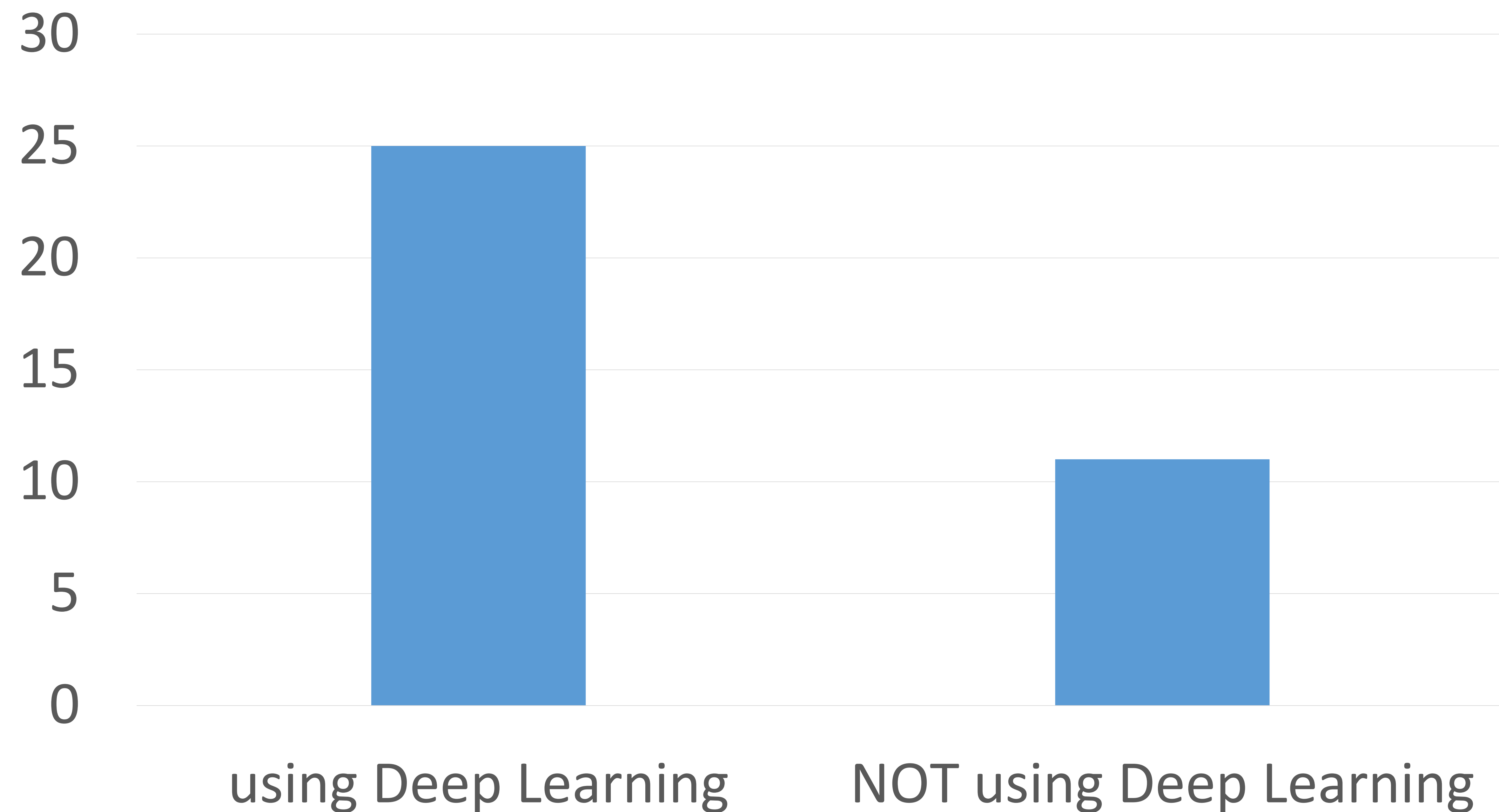


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CAI papers at MICCAI 2020



Variety of Tasks in CAI

- Instrument Pose Estimation
- Trajectory Planning
- Video Analysis

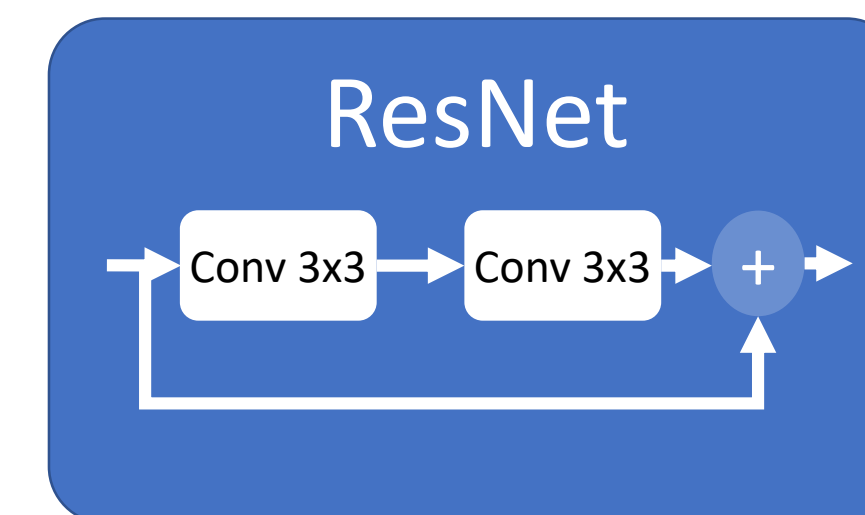
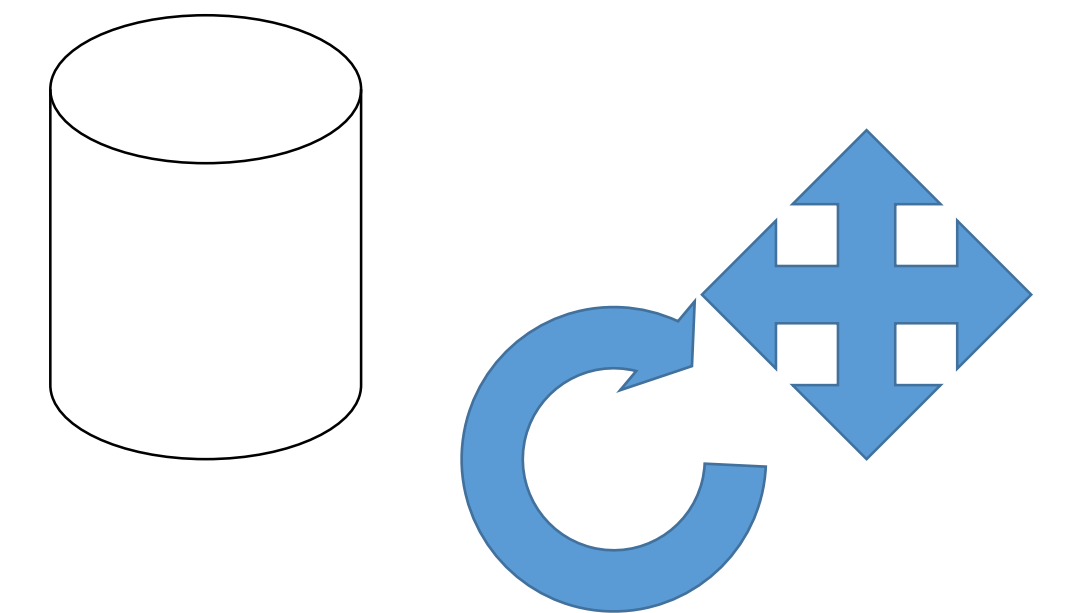
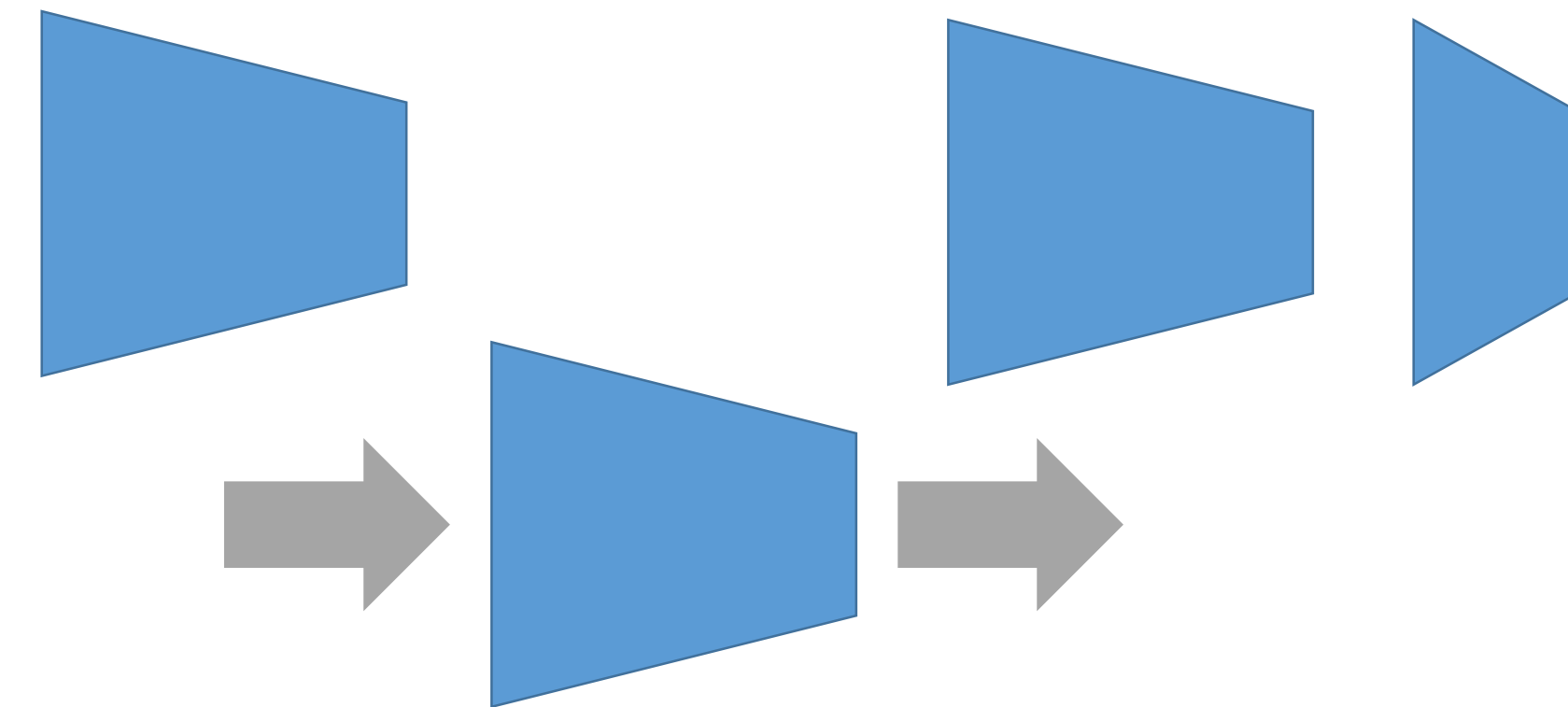
Learning for CAI

1. Task Design

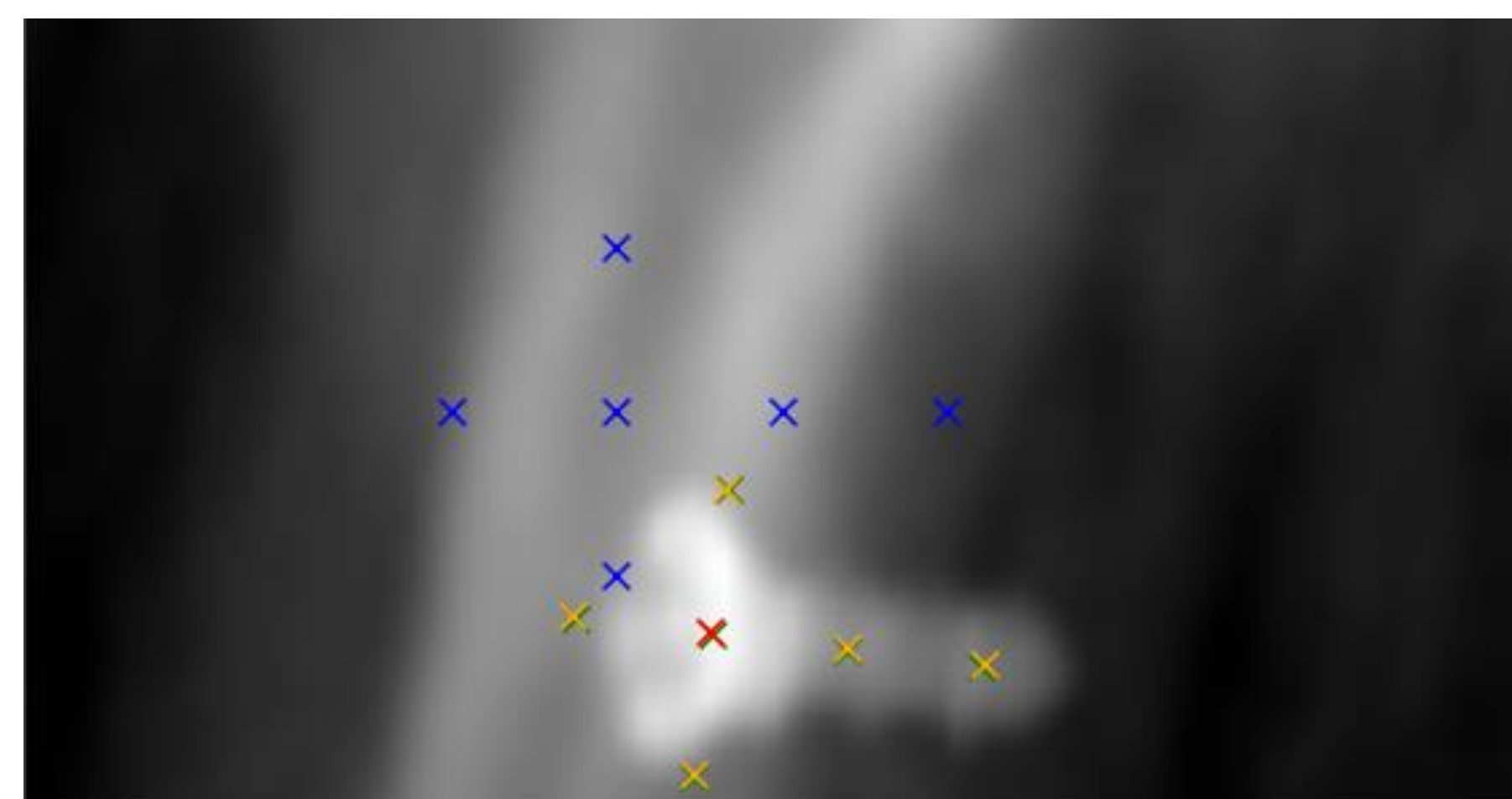
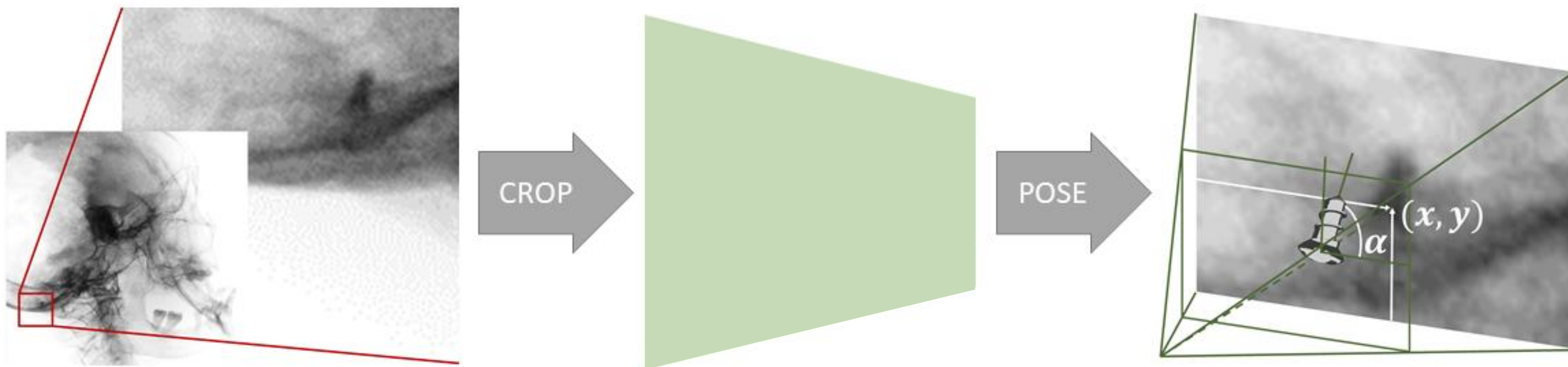
2. Dataset and Augmentation

3. Neural Architecture

(4. Training)

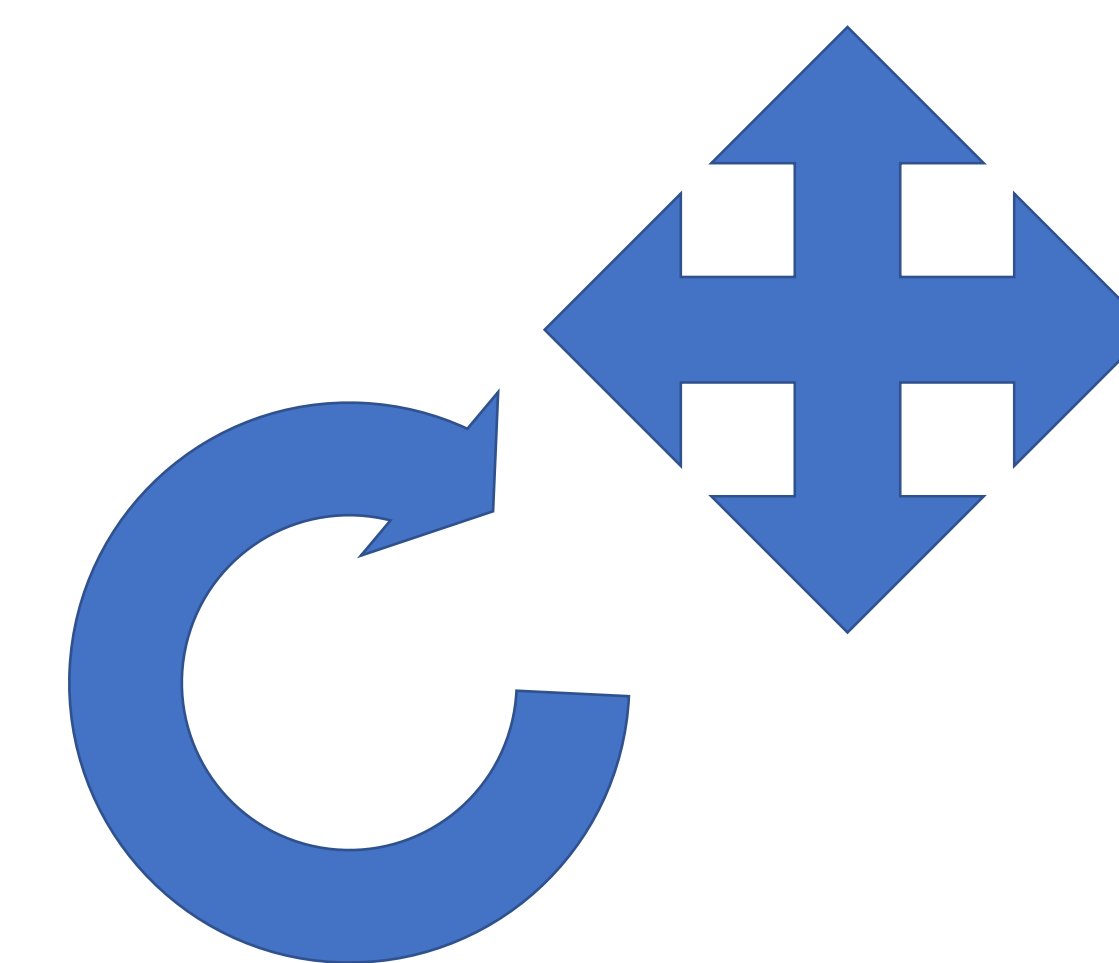


i3PosNet [Kügler IPCAI 2020]



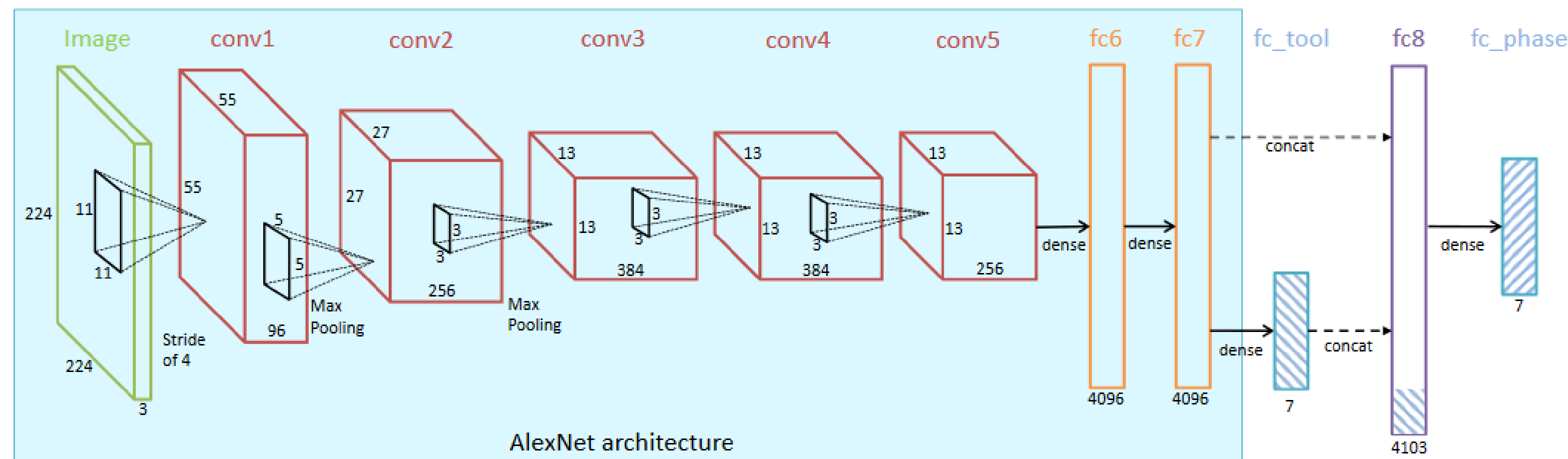
2 Datasets

- Synthetic
- Real

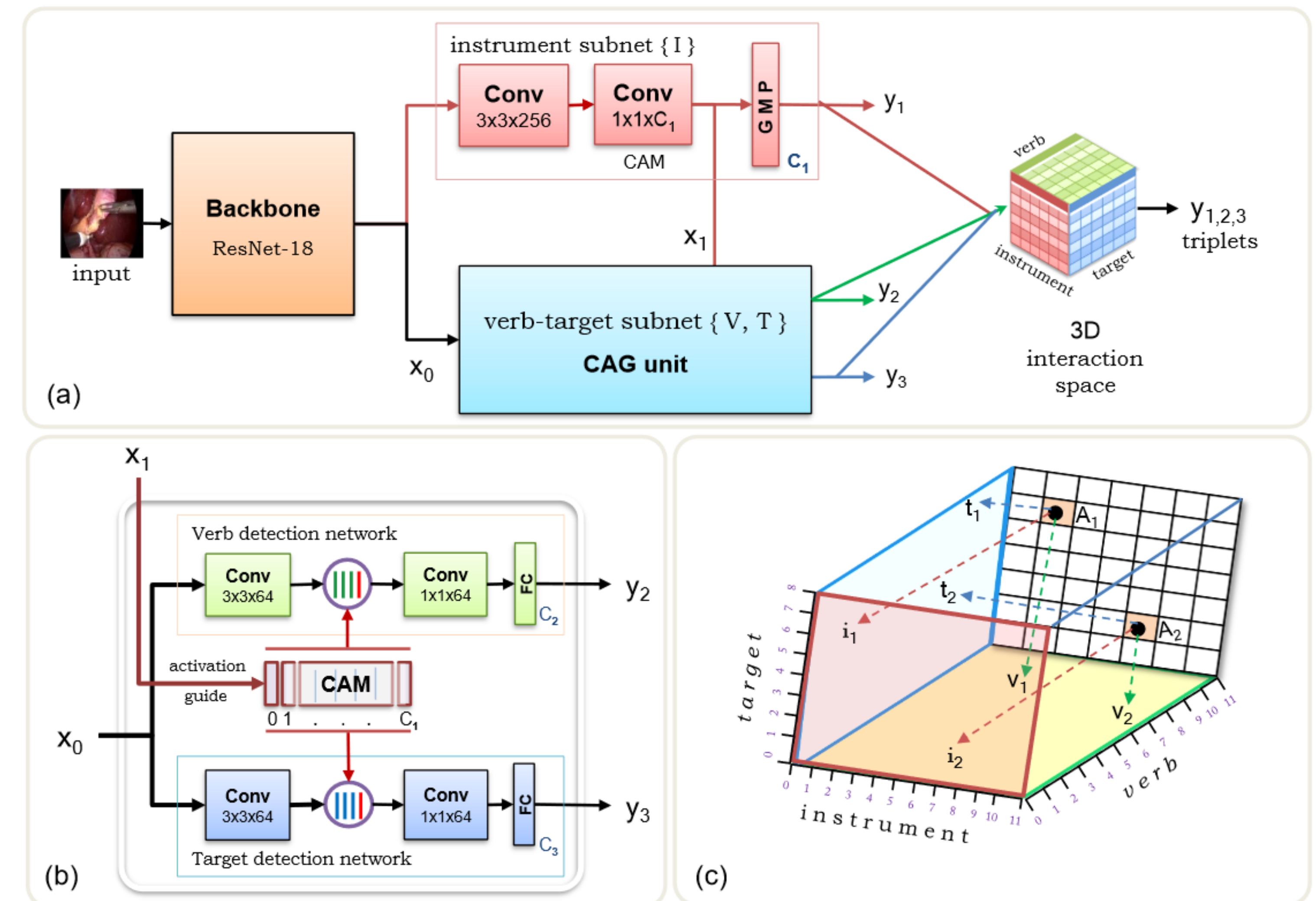


Transfer of neural architectures in CAI

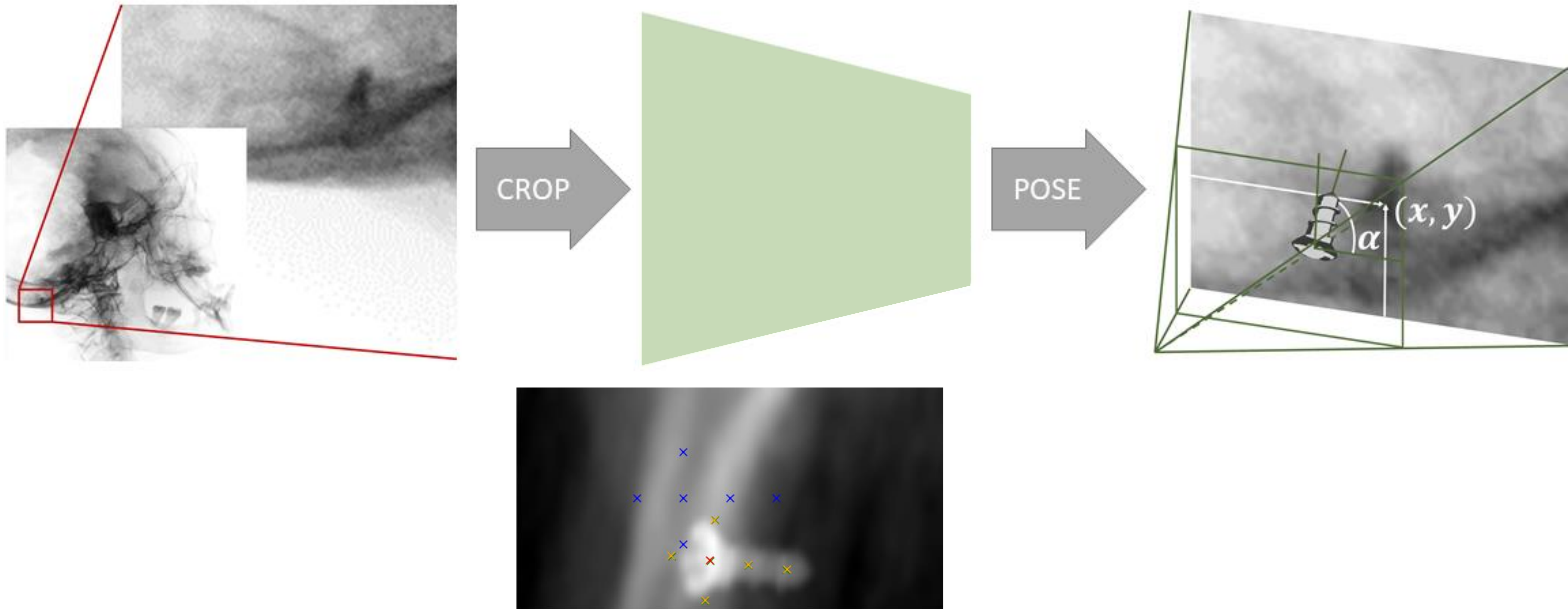
- EndoNet [Twinanda 2016]



- Tripnet [Nwoye 2020]

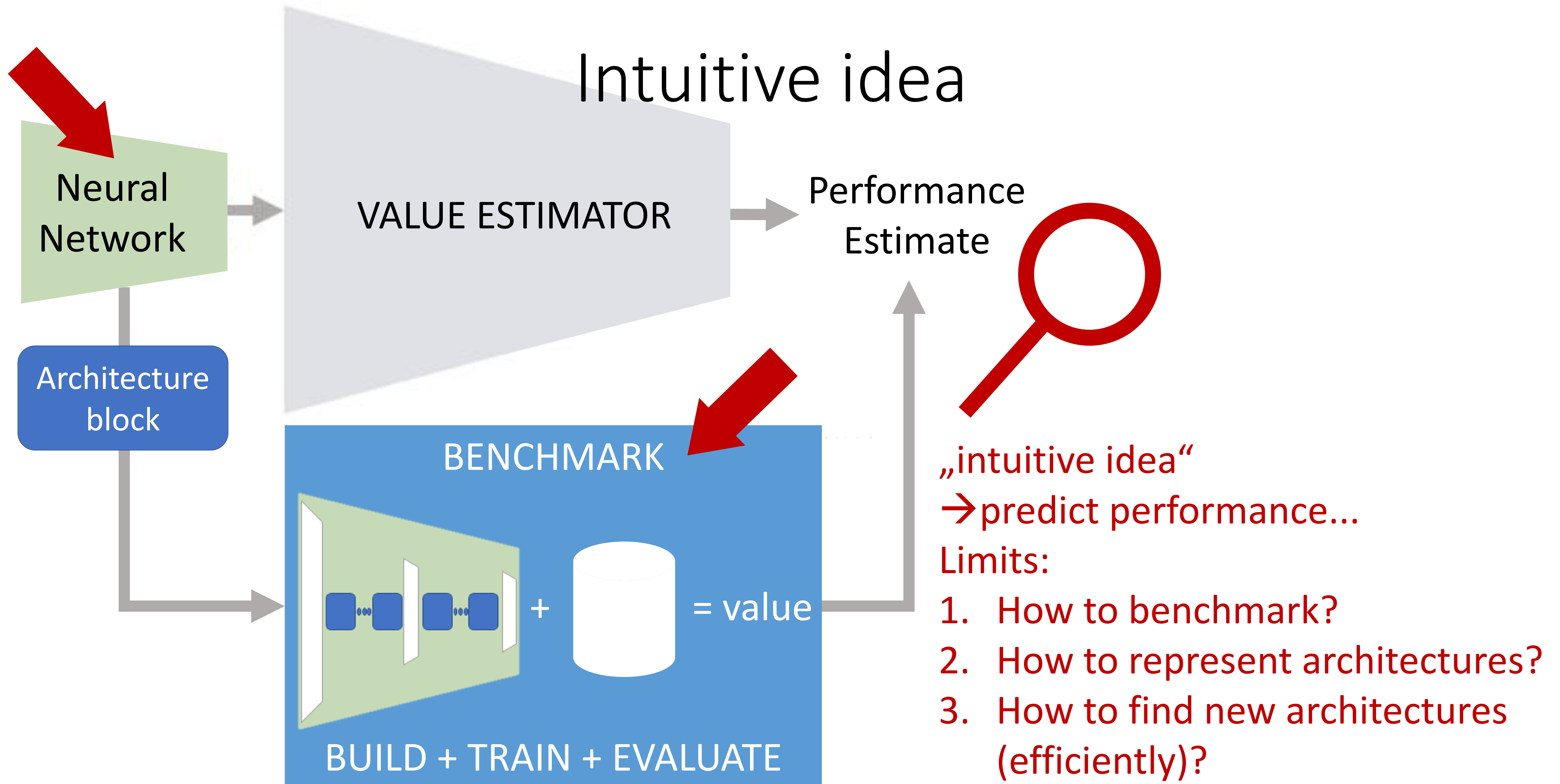


i3PosNet [Kügler IPCAI 2020]



≈ 50 GPU days

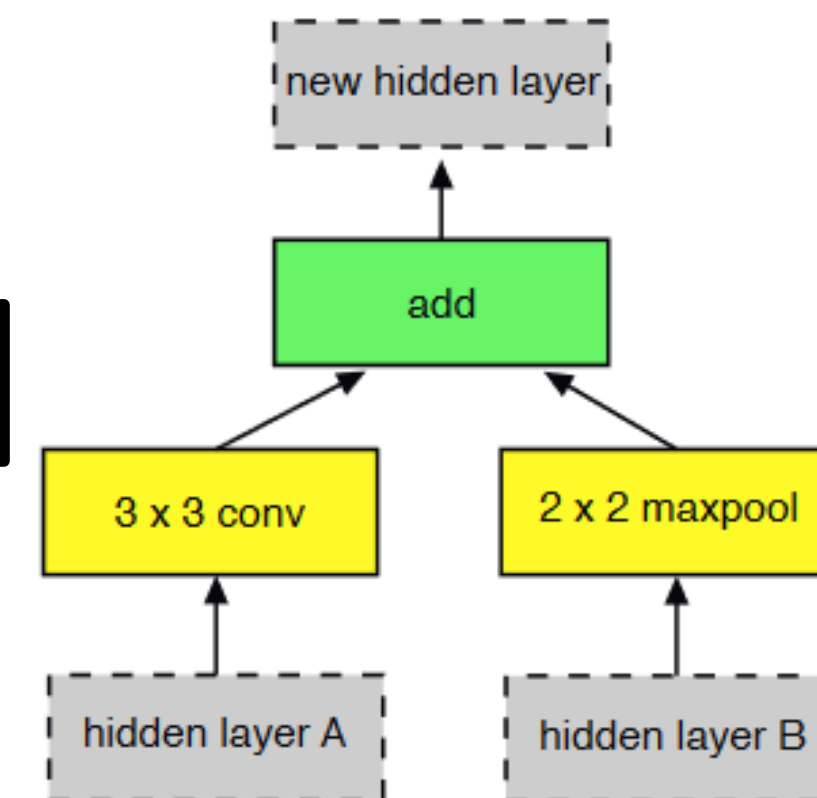
Intuitive idea



NAS approaches

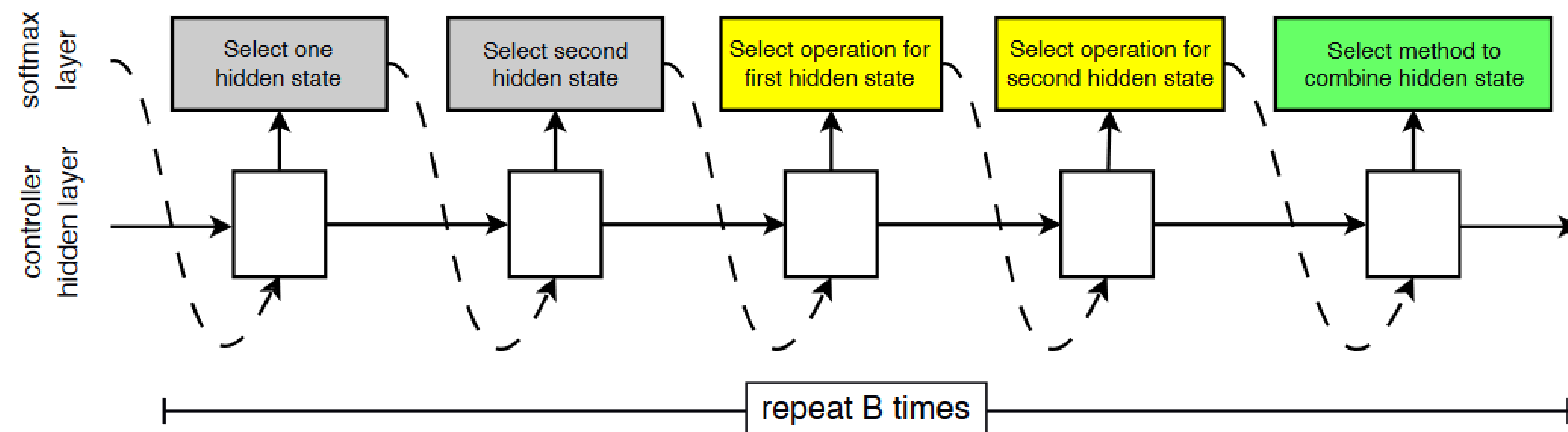
Discrete

- NASNet [Zoph 2018]
- TEST → IMPROVE

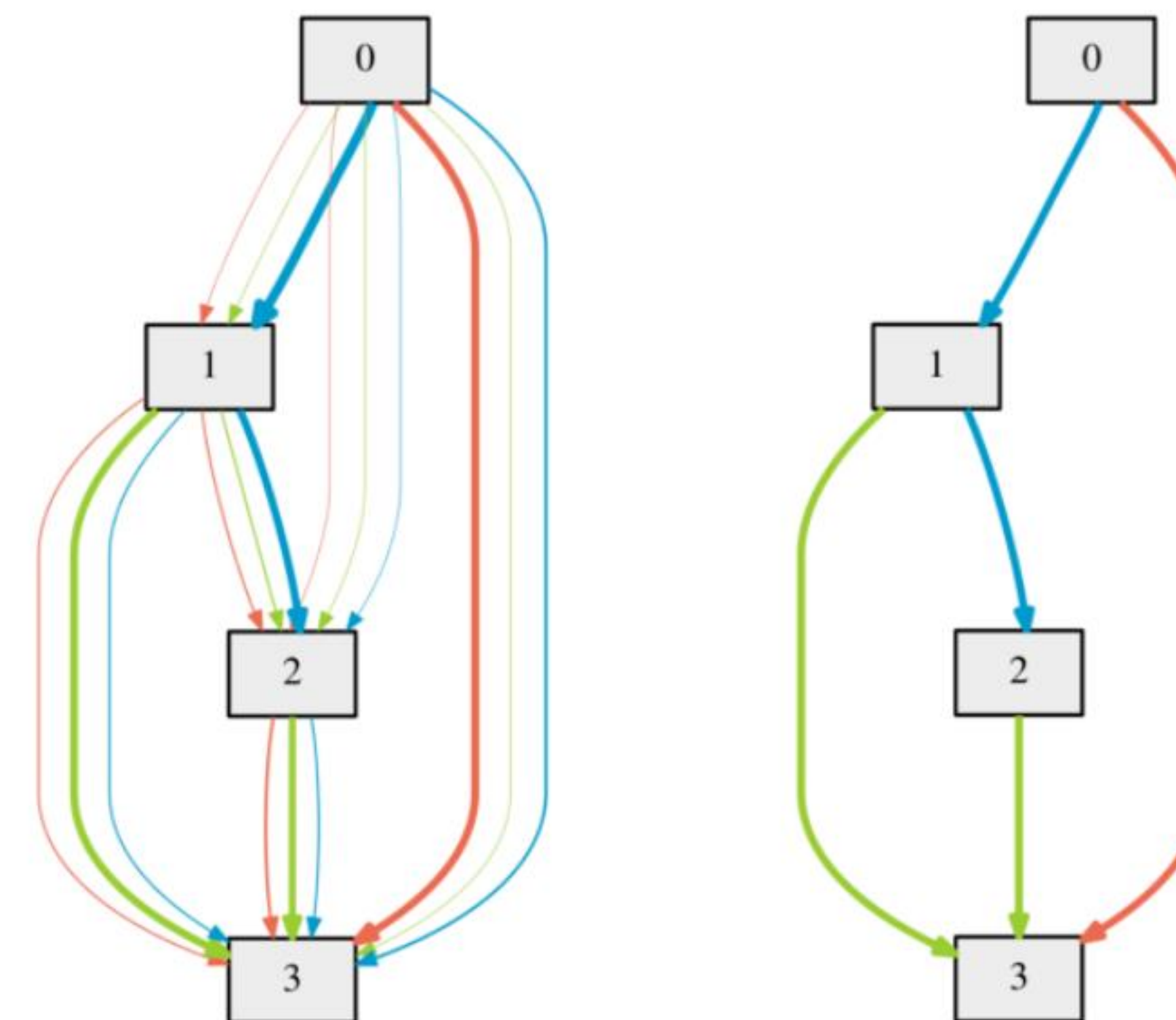


Continuous

- DARTS [Liu 2019]
- LEARN ALL POSSIBILITIES



≥ 200 GPU days



Method Contributions

1. Neural Architecture representation
2. Search Method

Symbolic Neural Architecture Pattern

Symbols

Conv 1x1

BRANCH

Conv 3x3

MERGE (add)

DW-Conv 3x3

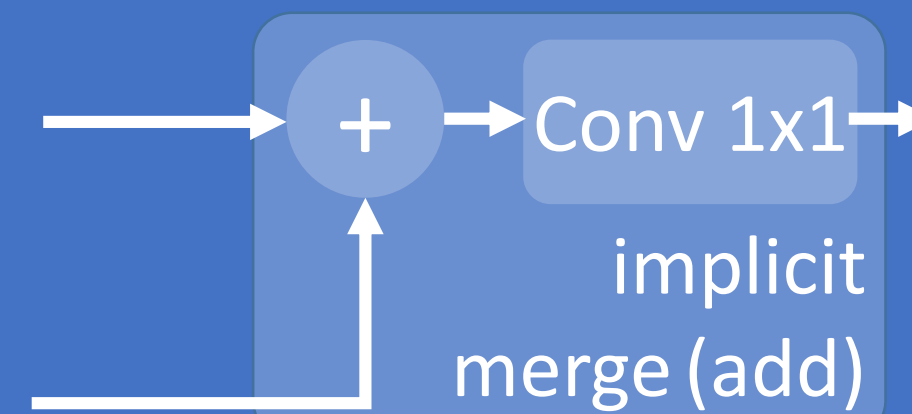
SWITCH

DWS-Conv
3x3

Max-Pool

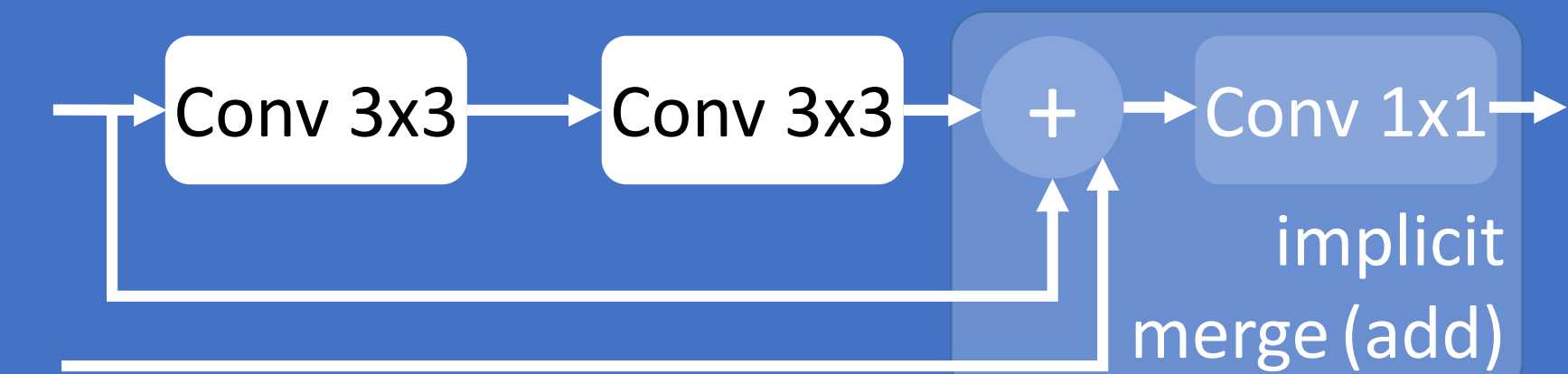
Blank SNAP

“ ”



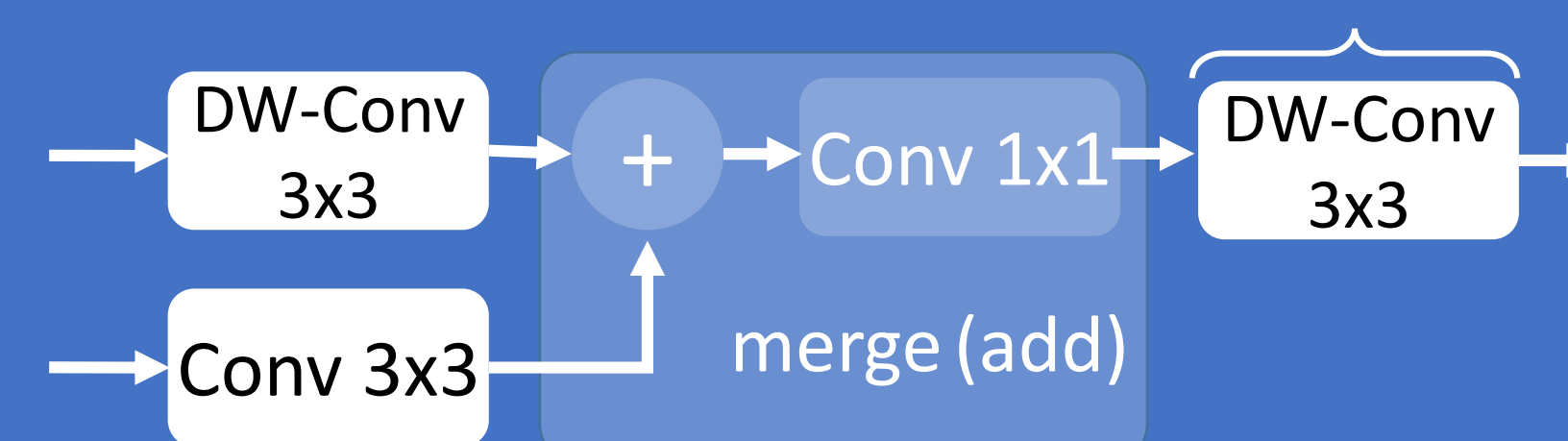
Almost ResNet

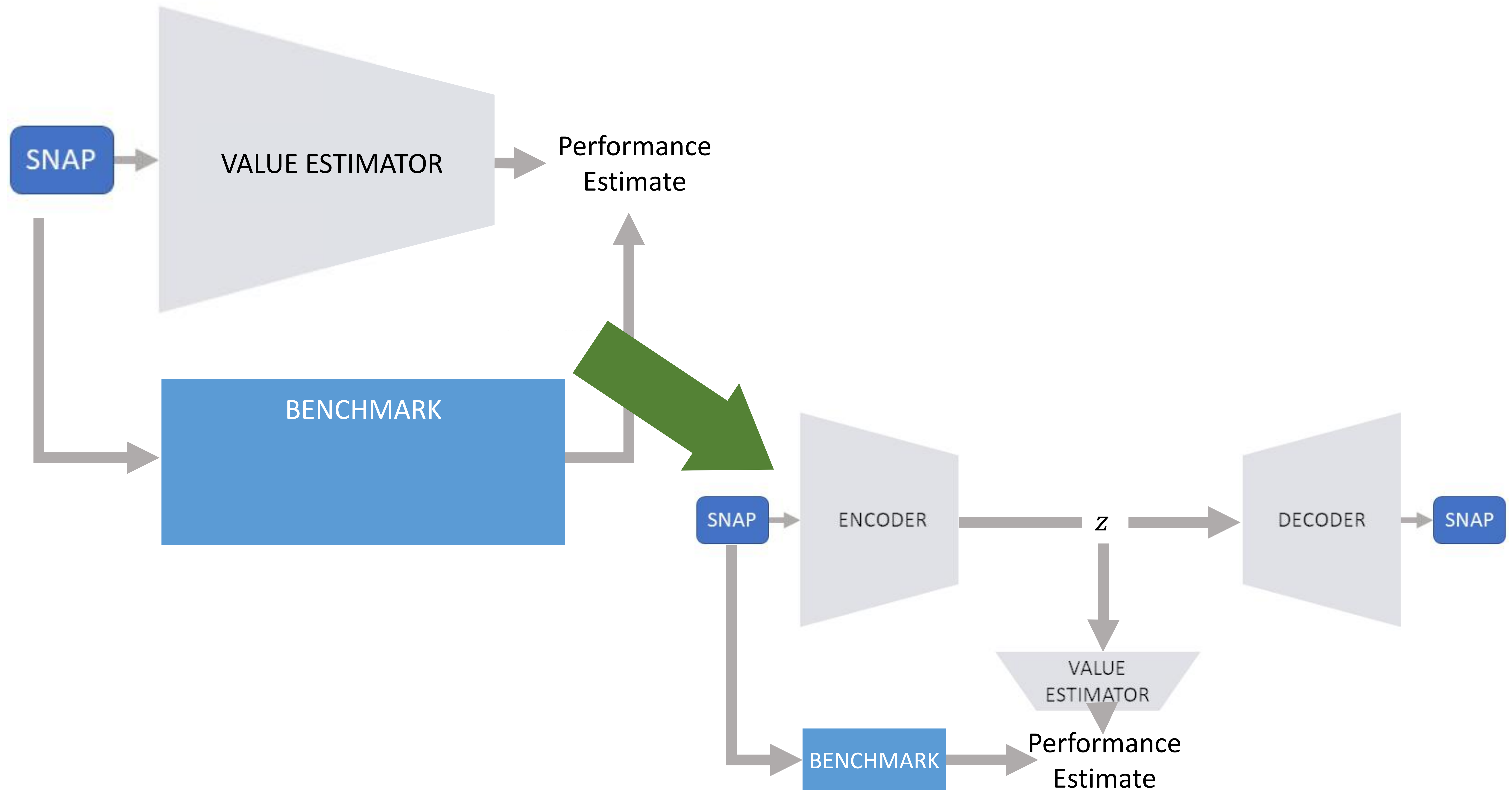
“ BRANCH ; Conv 3x3 ; Conv 3x3 ”

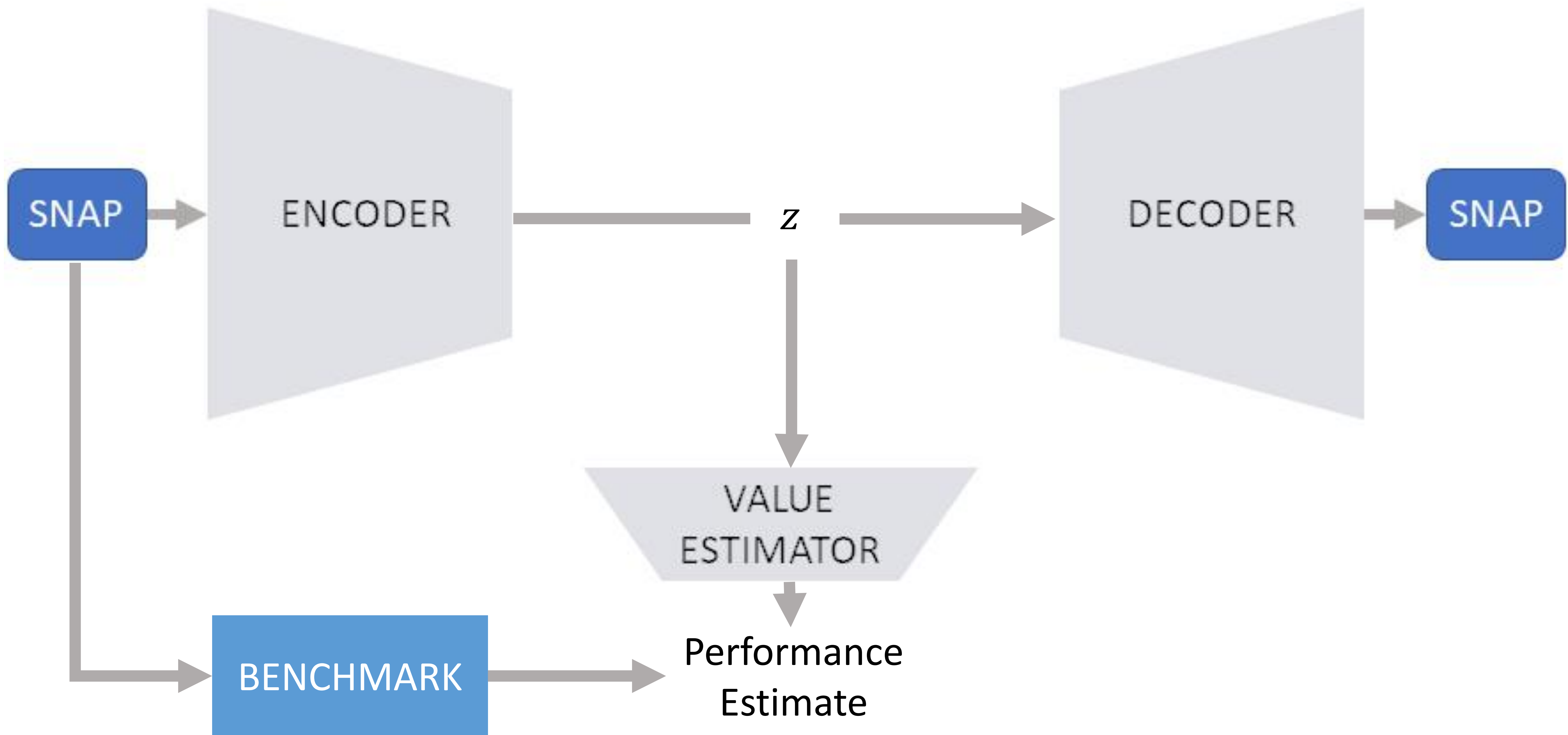


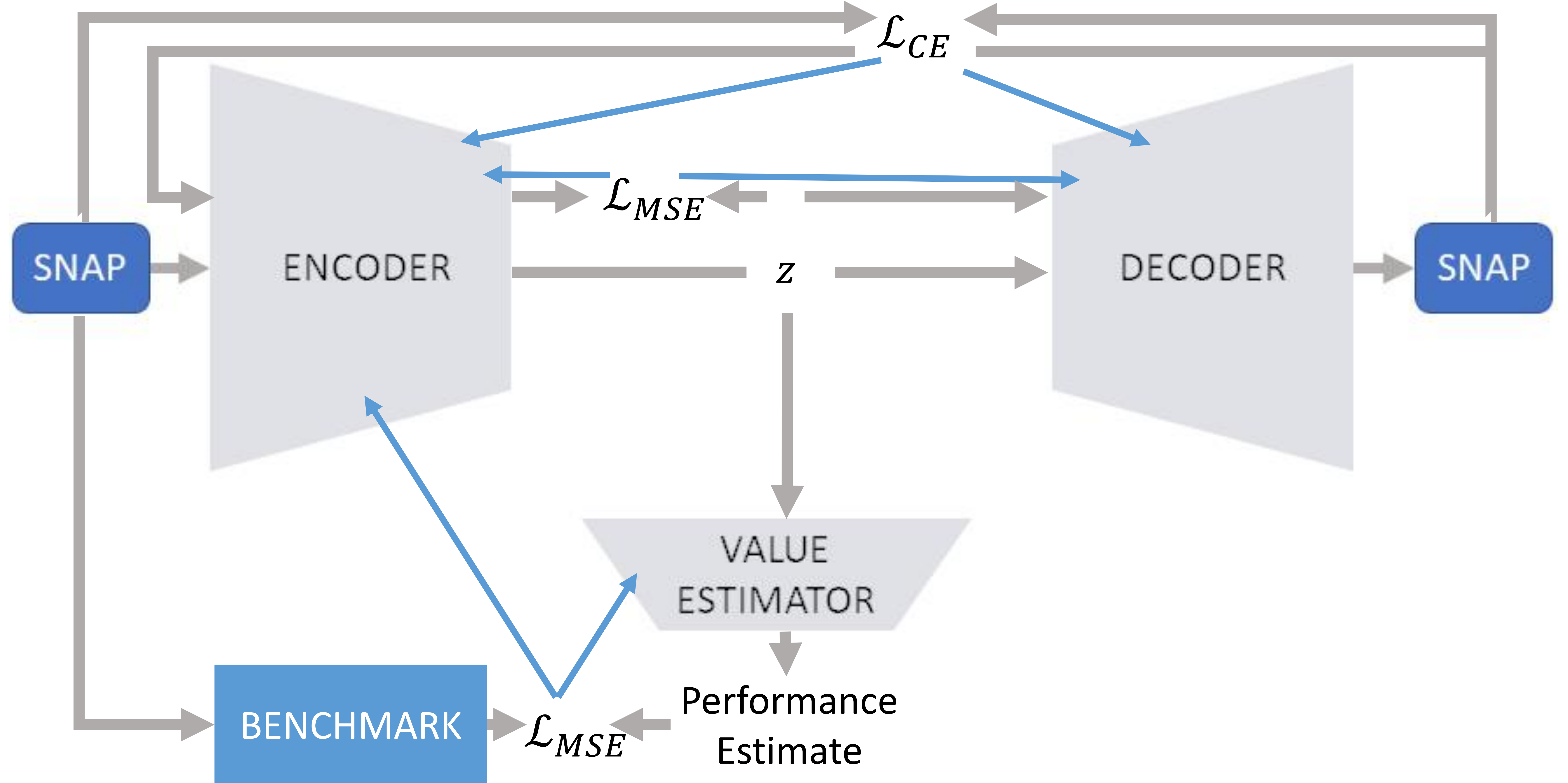
Random SNAP

“ DW-Conv 3x3 ; SWITCH ; Conv 3x3 ;
MERGE ; DW-Conv 3x3 ; DW-Conv 3x3 ”

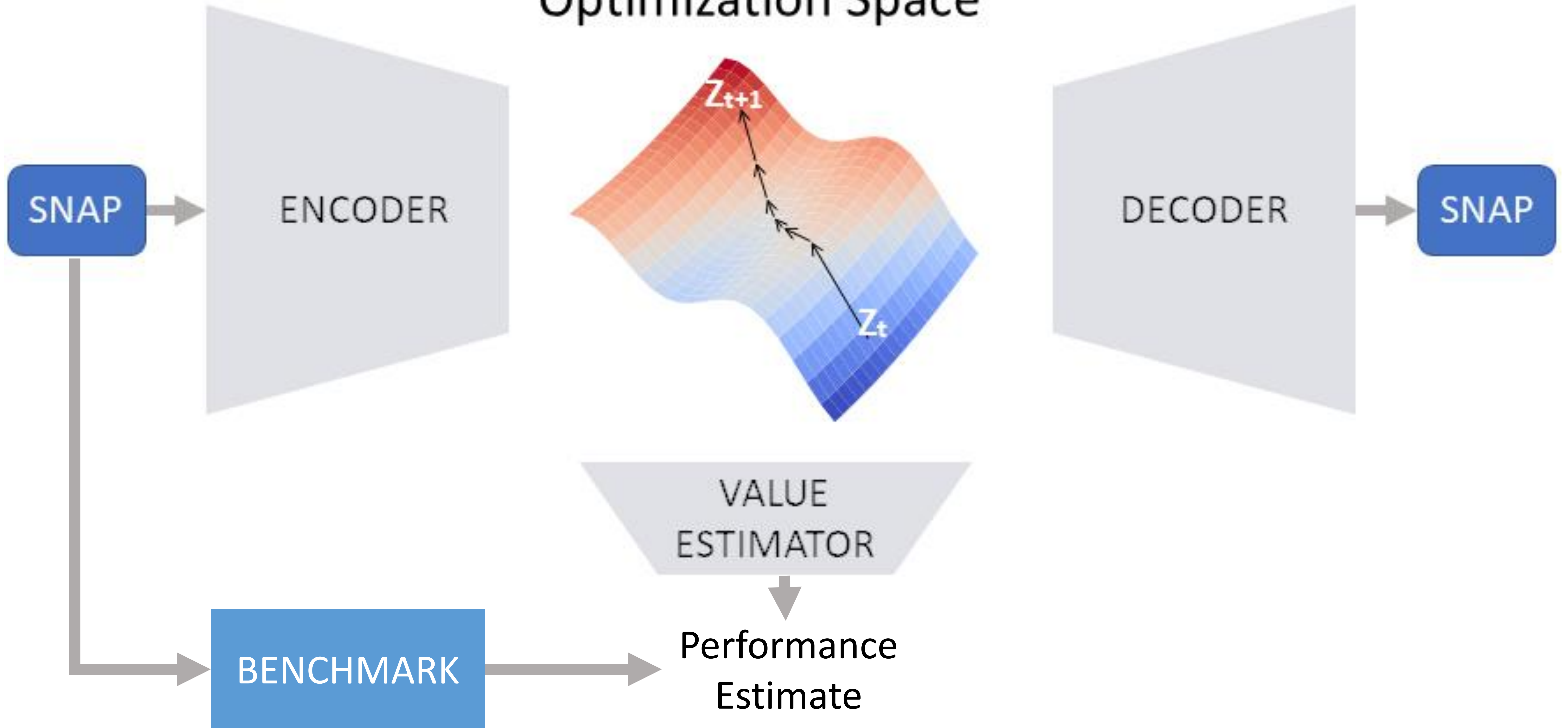






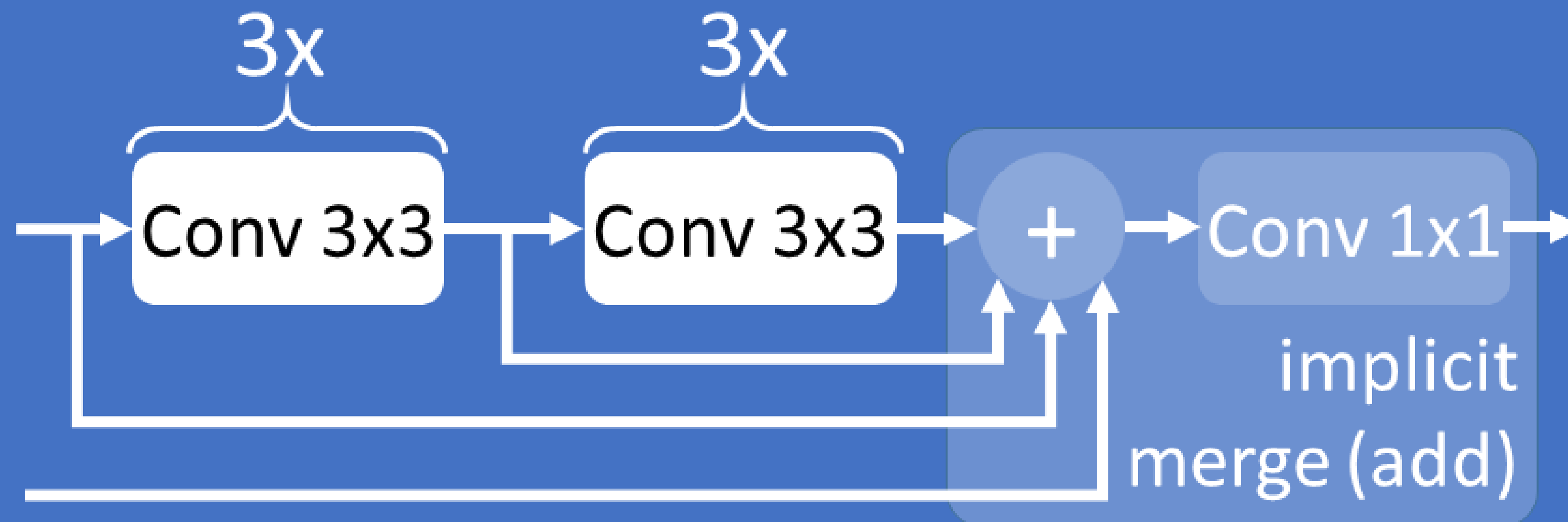


Optimization Space



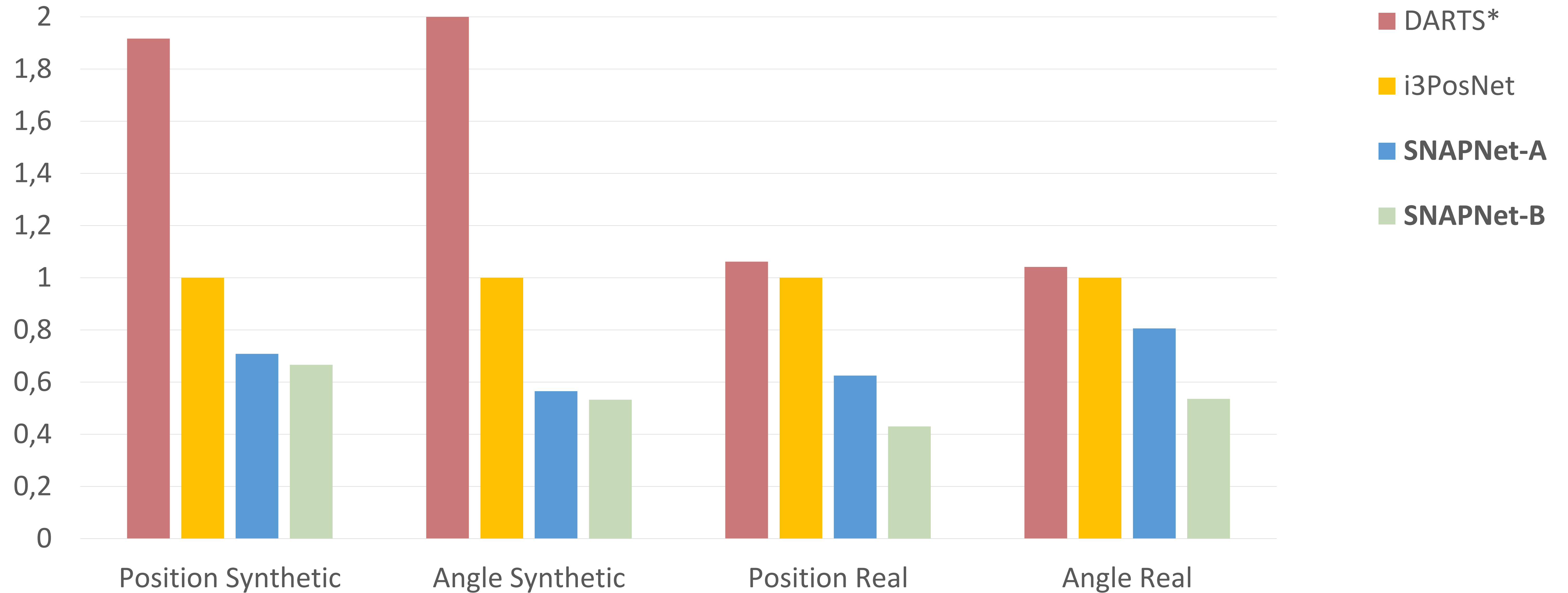
Best SNAP

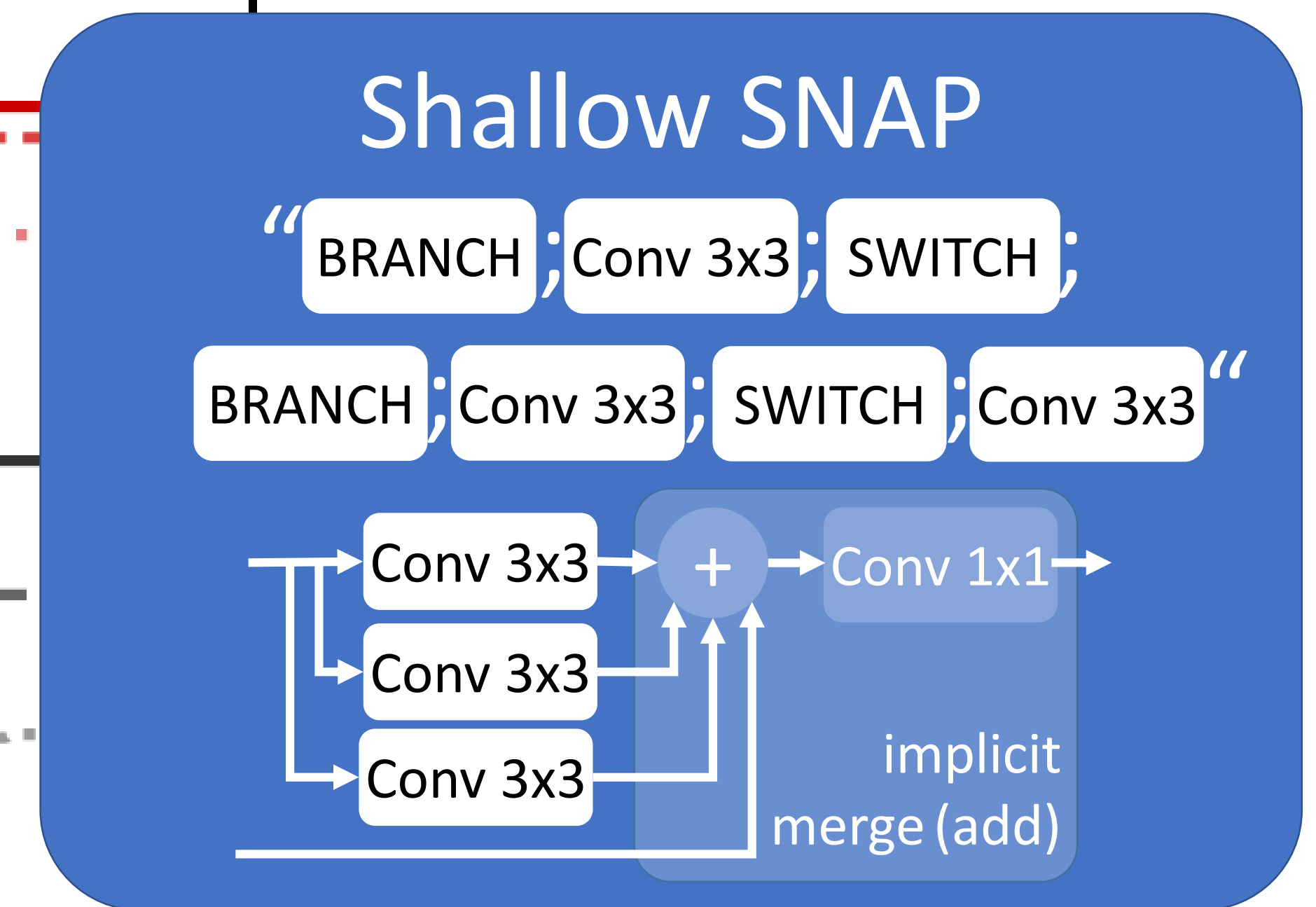
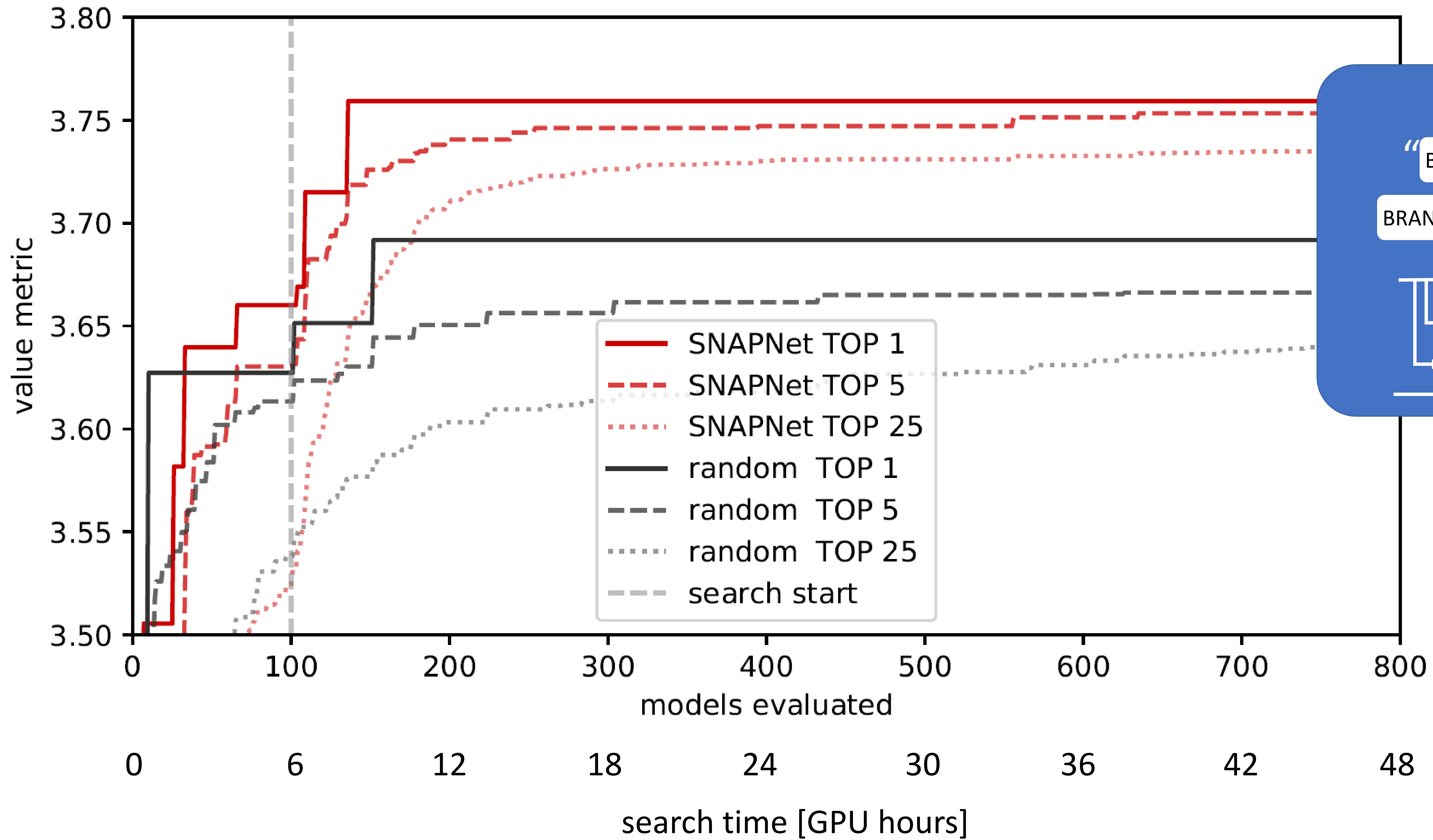
“
BRANCH ; Conv 3x3 ; Conv 3x3 ; Conv 3x3 ;
BRANCH ; Conv 3x3 ; Conv 3x3 ; Conv 3x3”



Pose Estimation Errors

(normalized by i3PosNet/lower is better)





Contributions

- Automatic Learning Neural Architectures for CAI
- SNAP: Architecture representation
- Efficient Search/Optimization
- Significant Performance increase

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<https://autosnap.david-kuegler.de>
github.com/meclabtuda/AutoSNAP