Hybrid Networks

Improving Deep Learning Networks via Integrating two views of Images

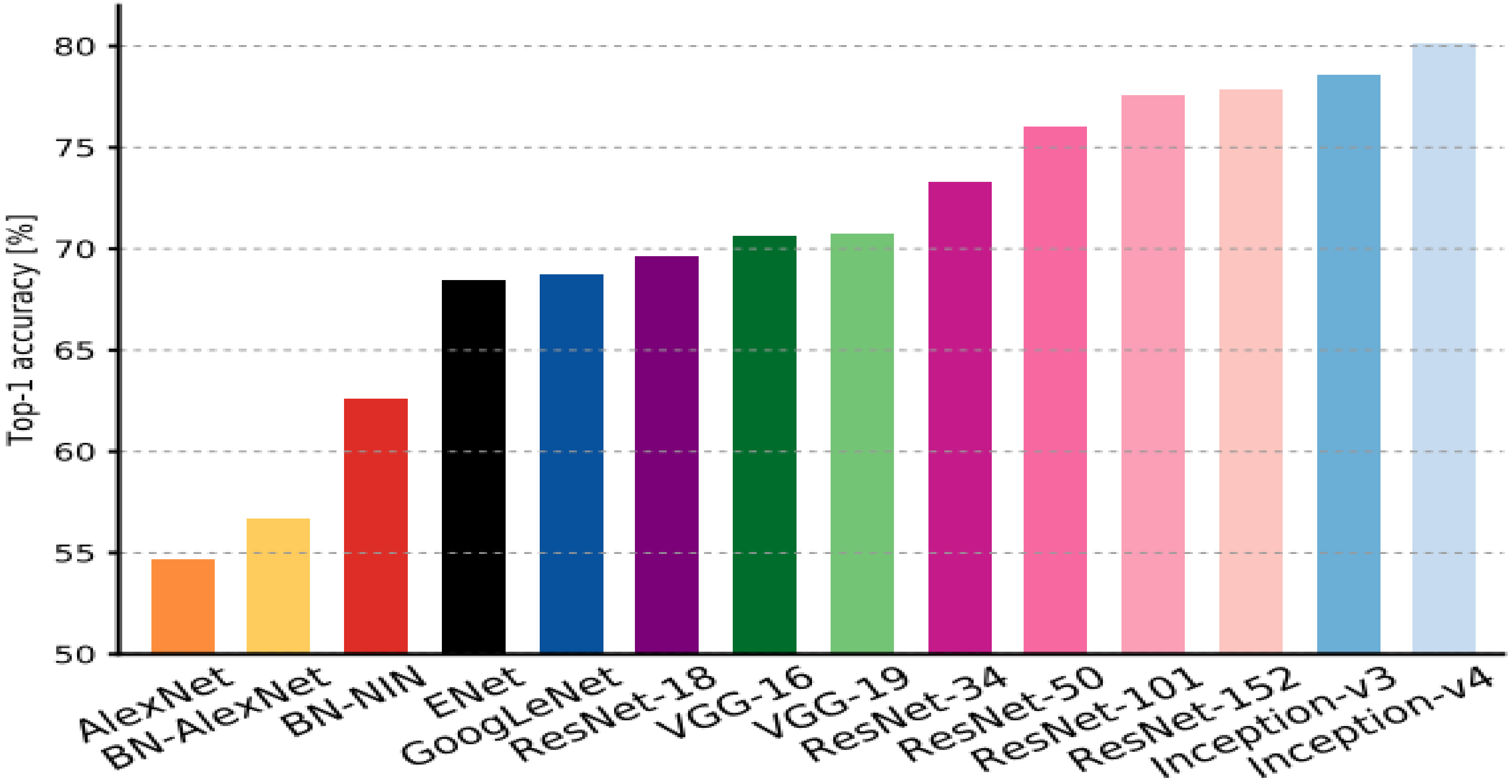
Sunny Verma[1,2], Chen Wang[2], Liming Zhu[2],and Wei Liu[1]

1: Advanced Analytics Institute, University of Technology, Sydney, Australia

2: Architecture and Analytics Platforms, CSIRO, Data61

Motivations

Deep Models have advanced image recognition field substantially



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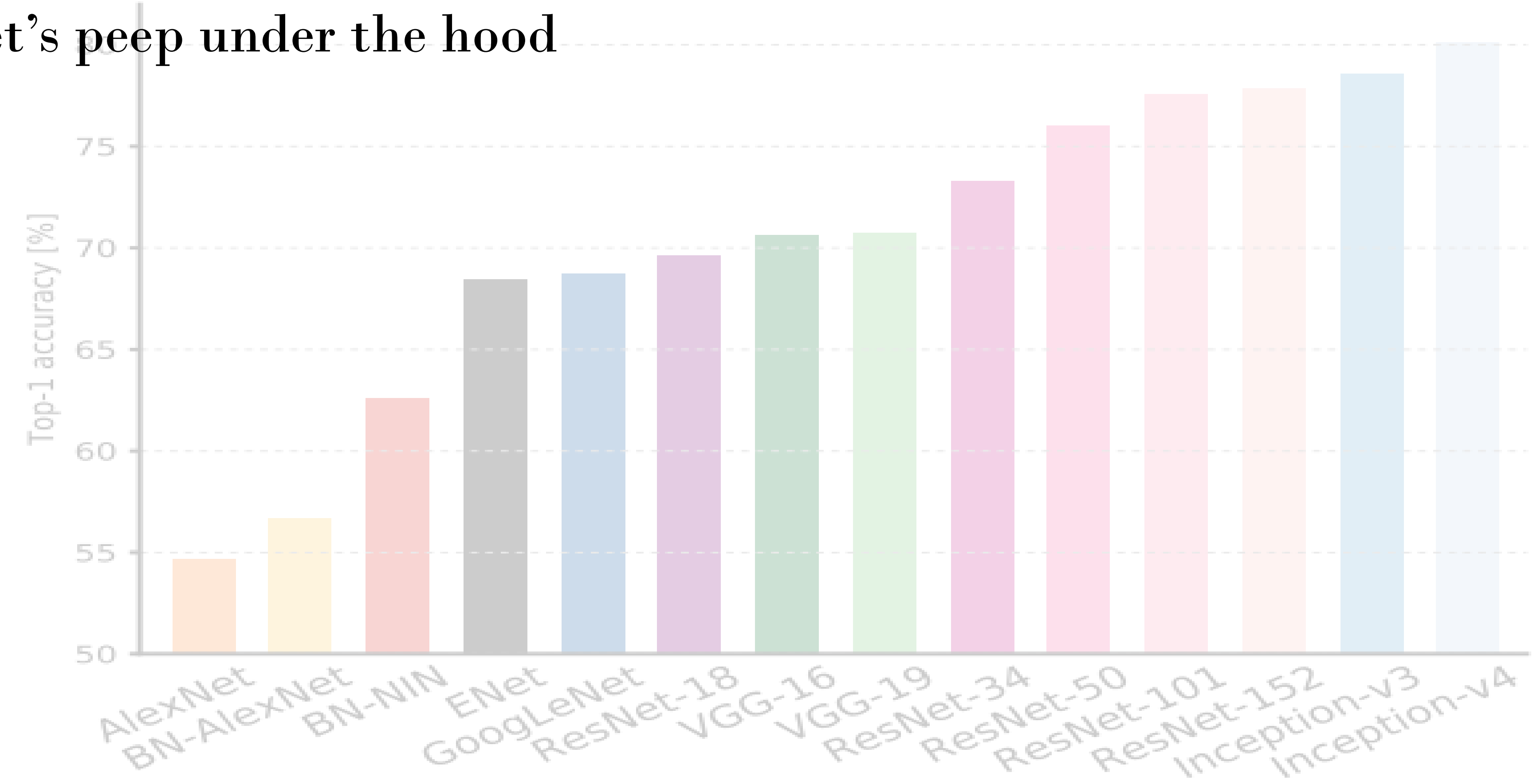

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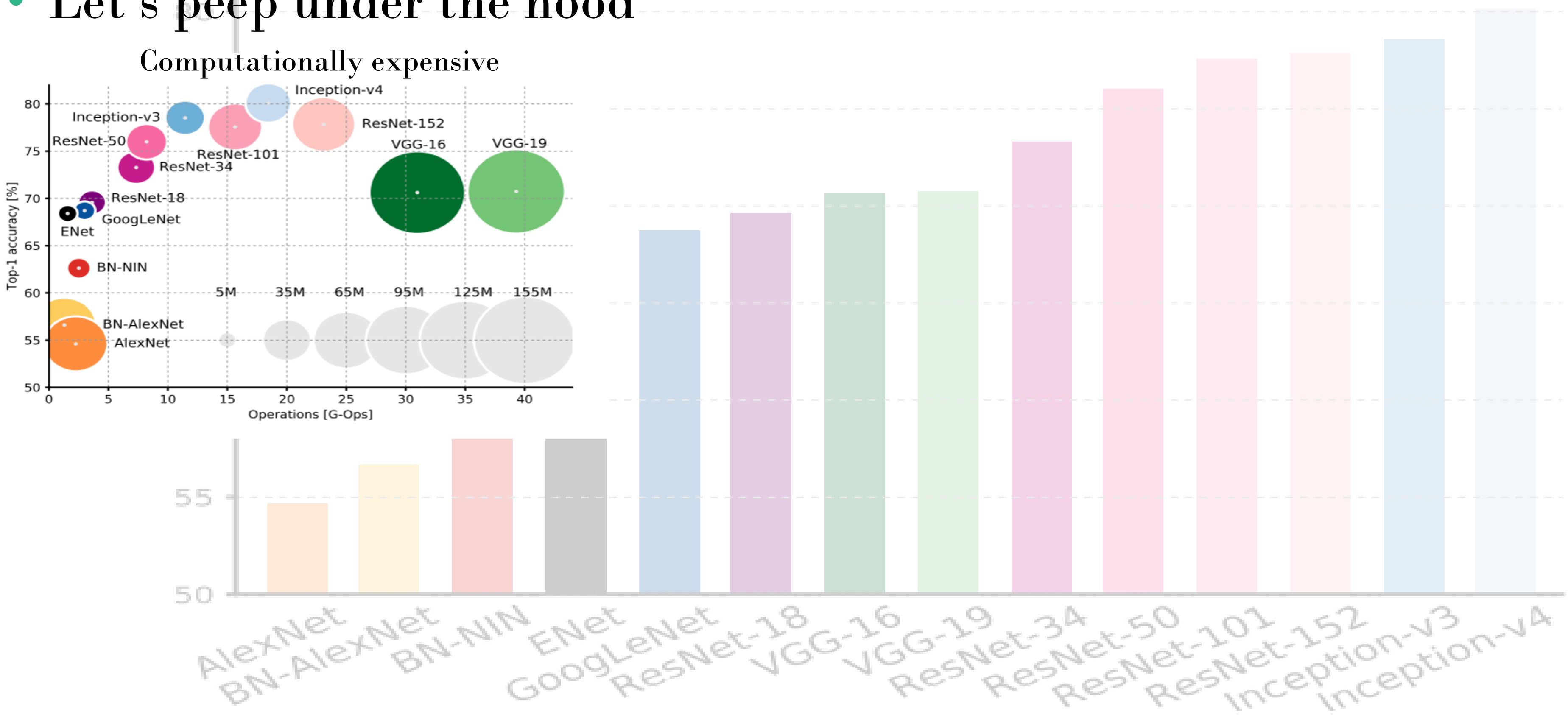

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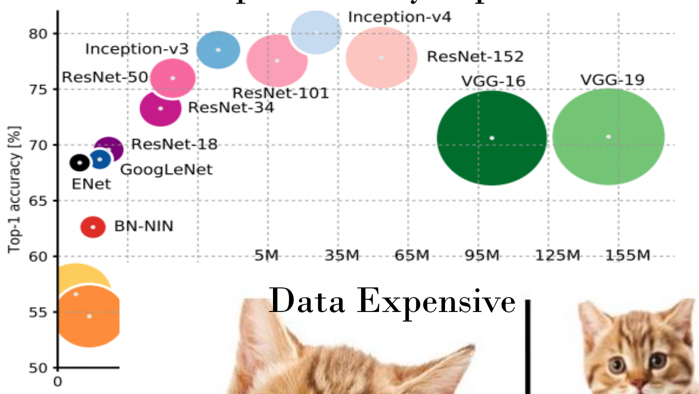
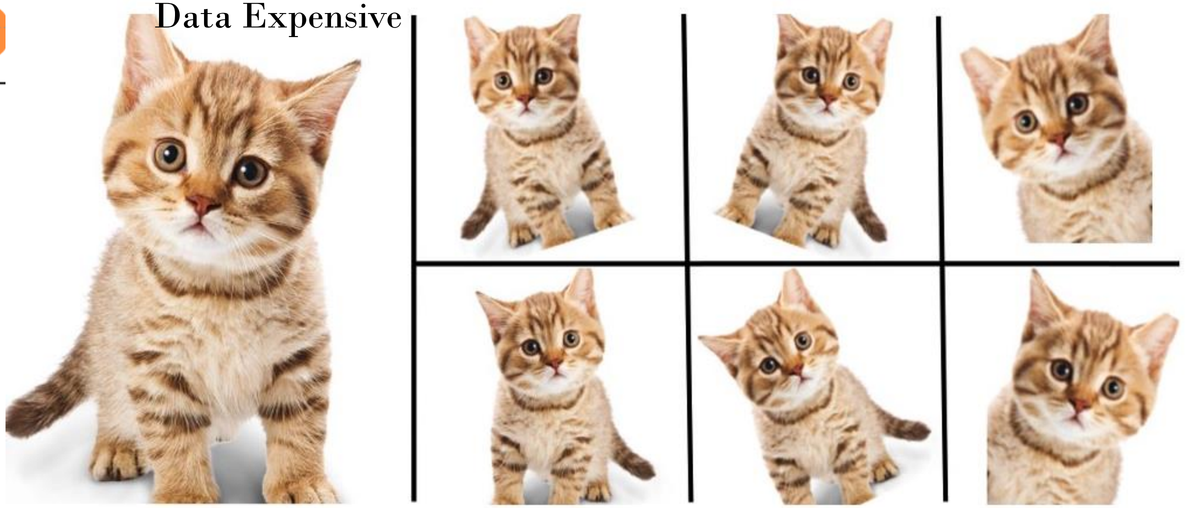


Data Expensive



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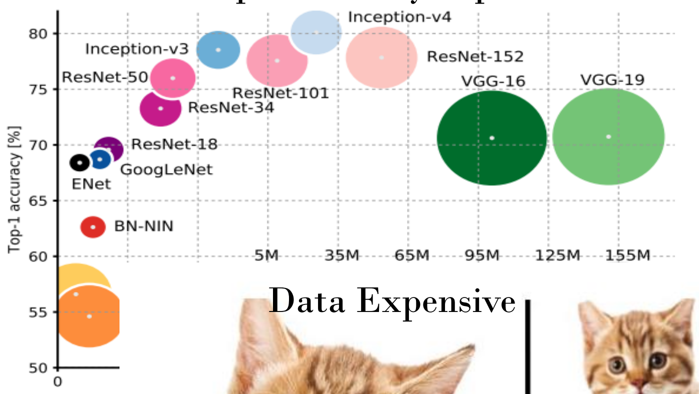

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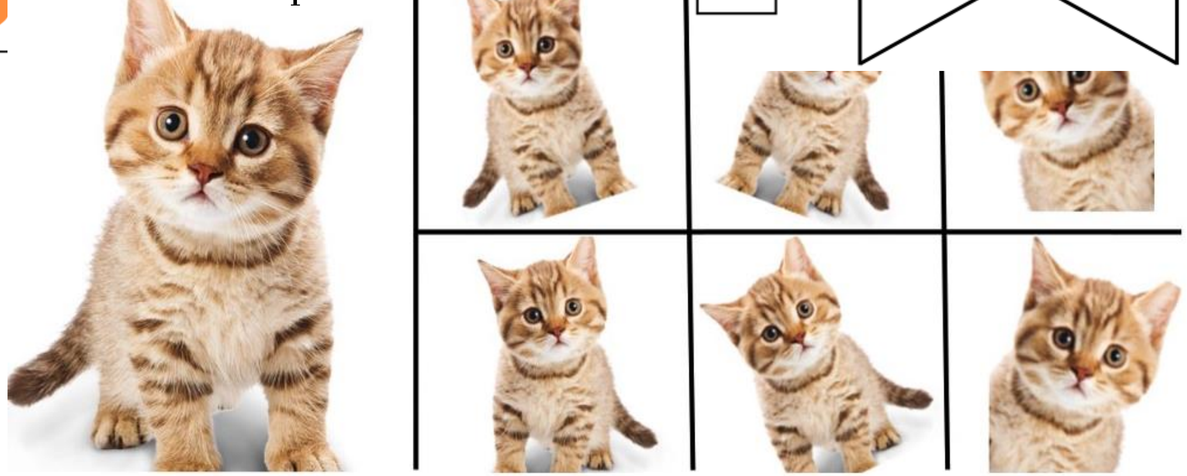

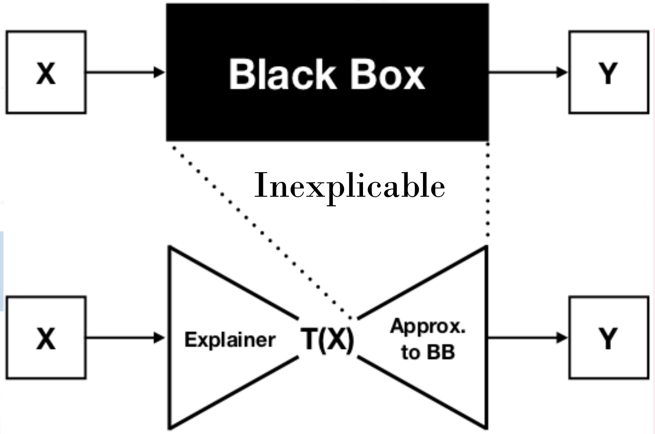

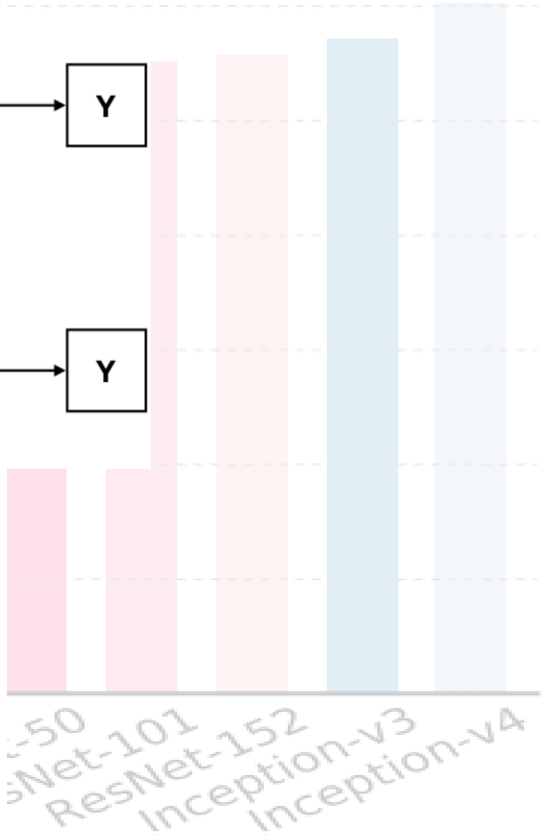

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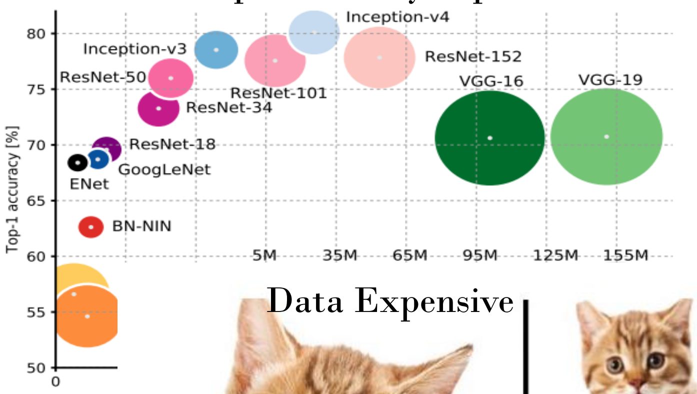

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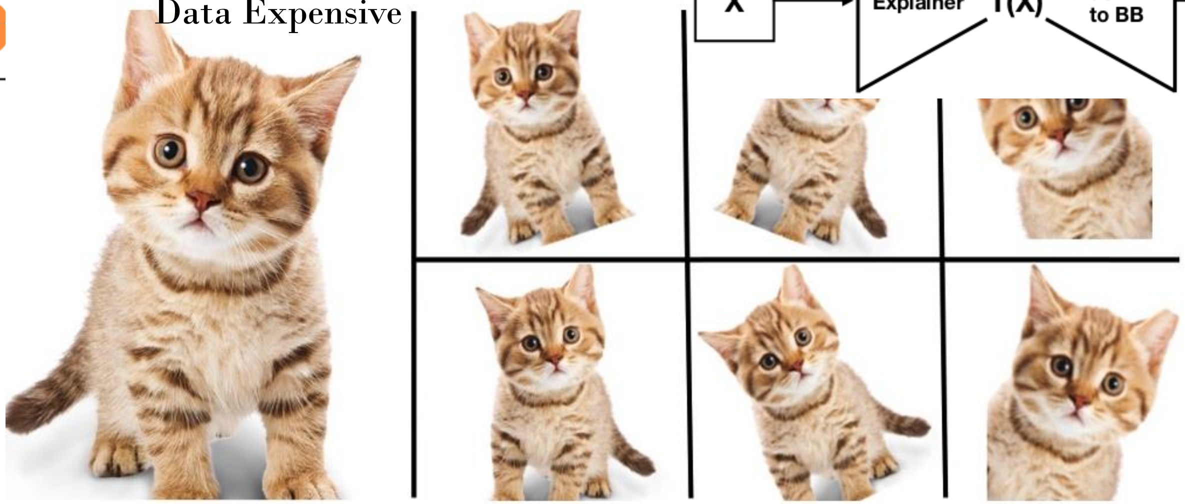
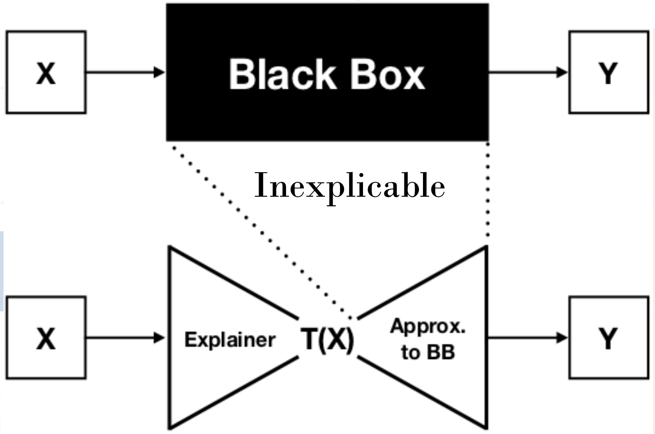
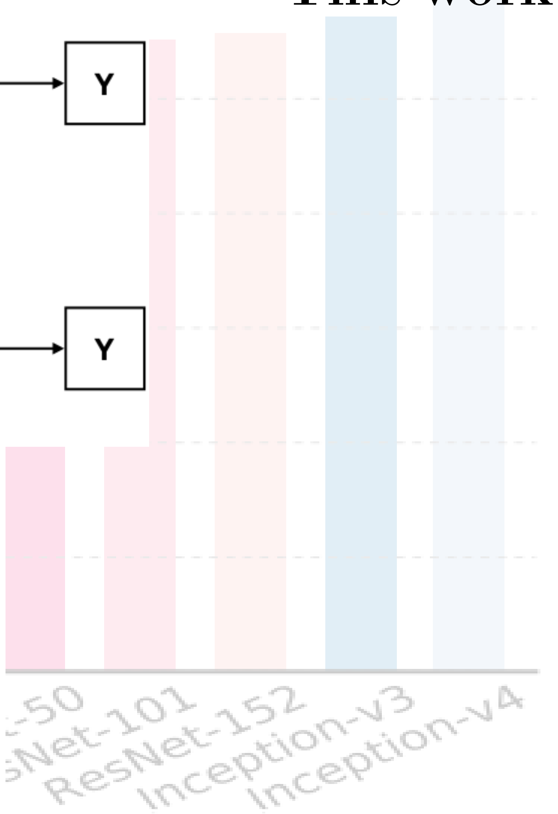




- This work



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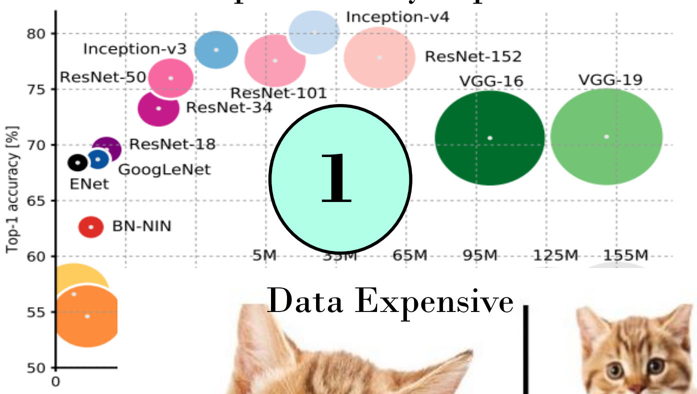

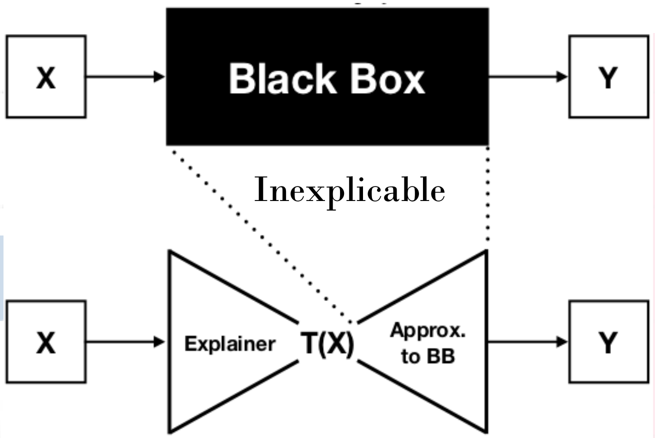

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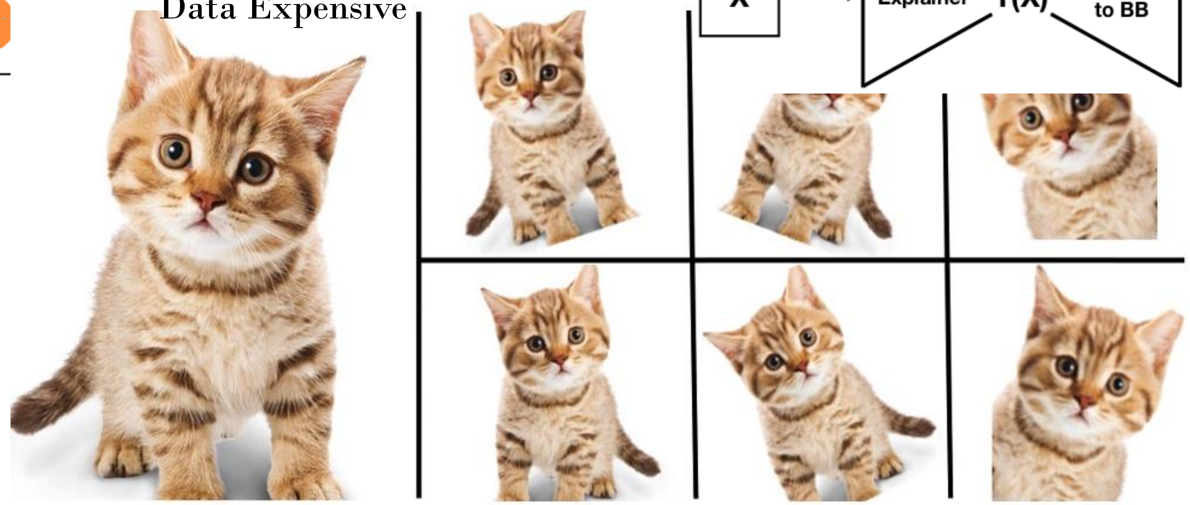

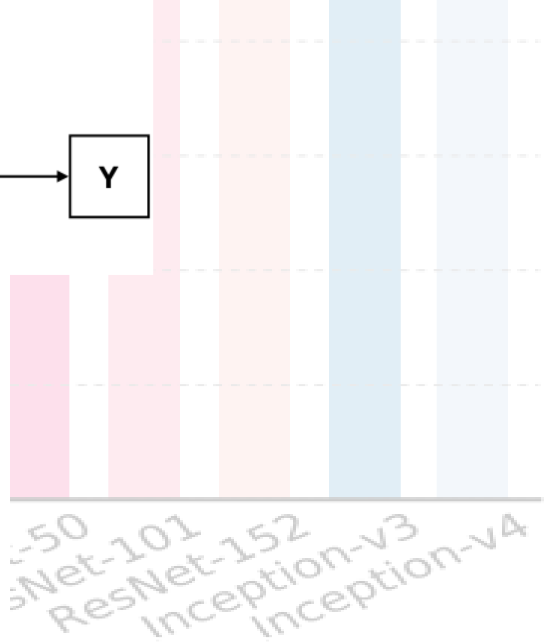

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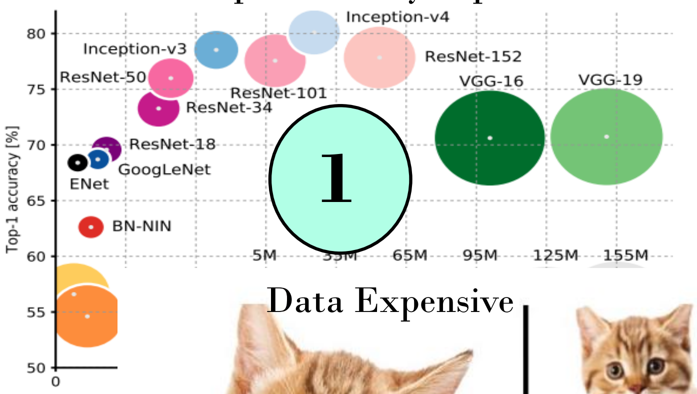

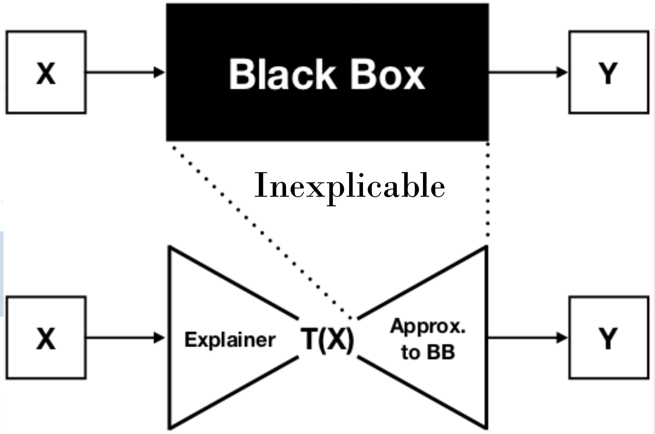

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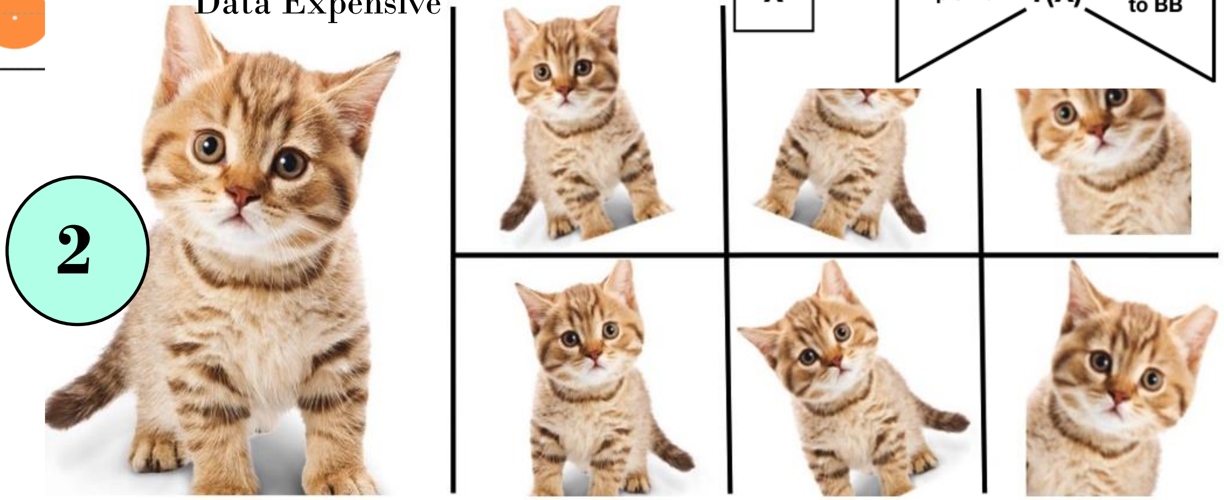

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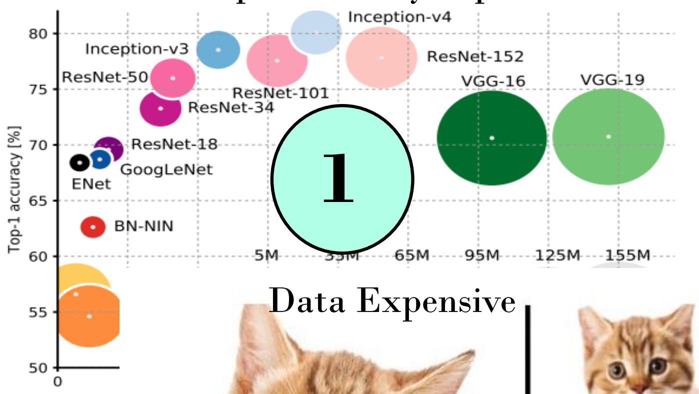

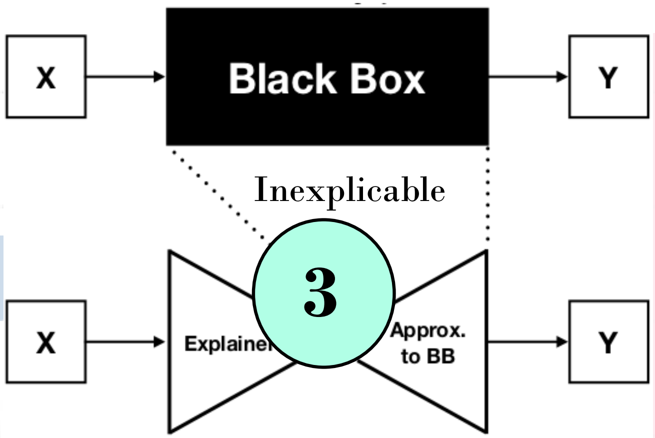

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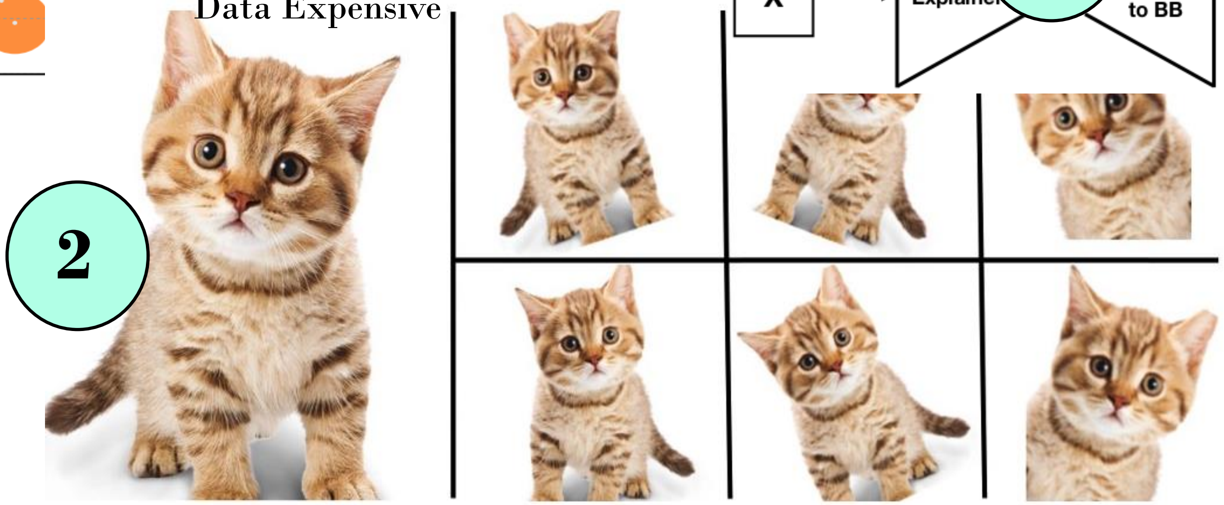

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  3. Fairly Interpretable

Challenges

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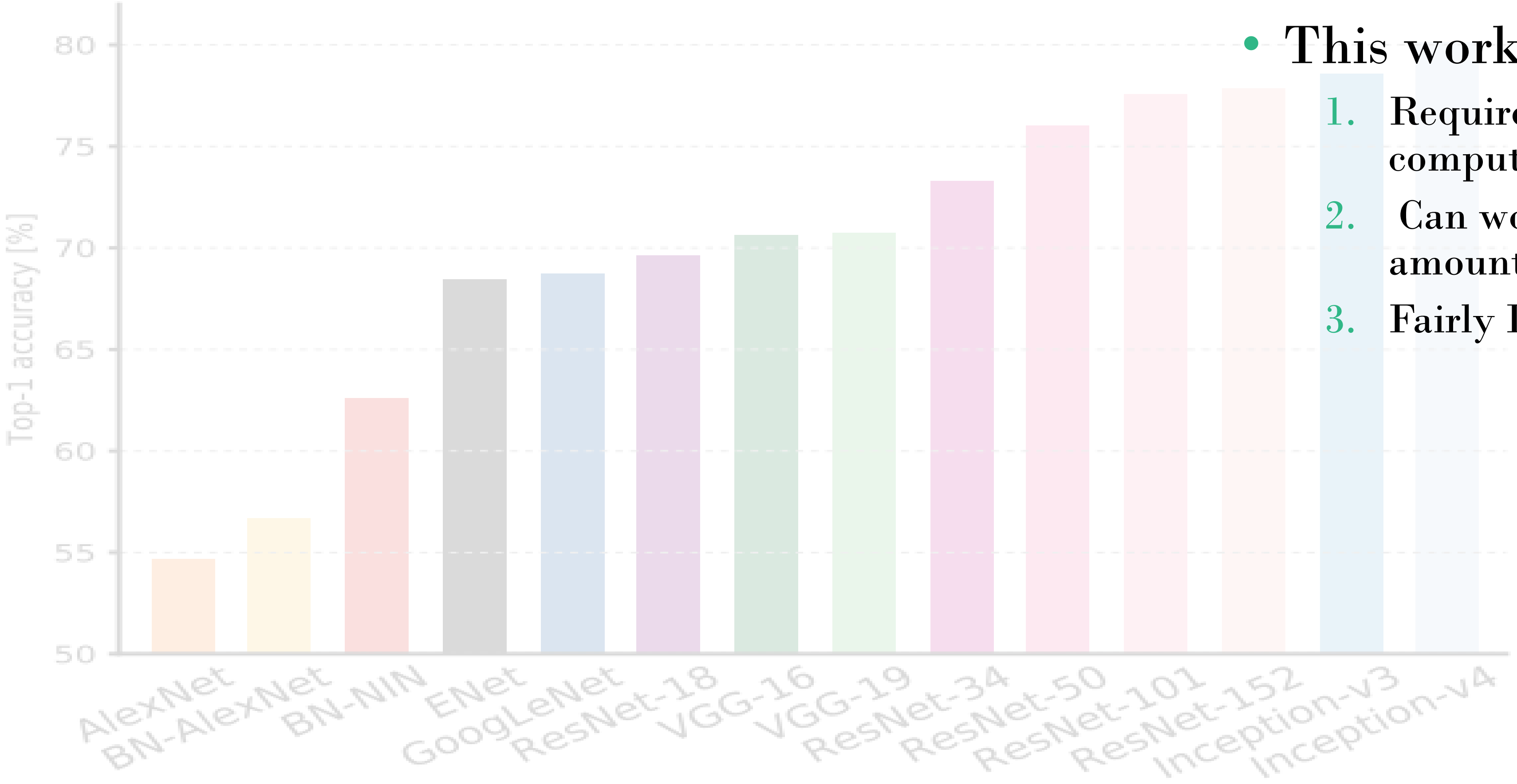

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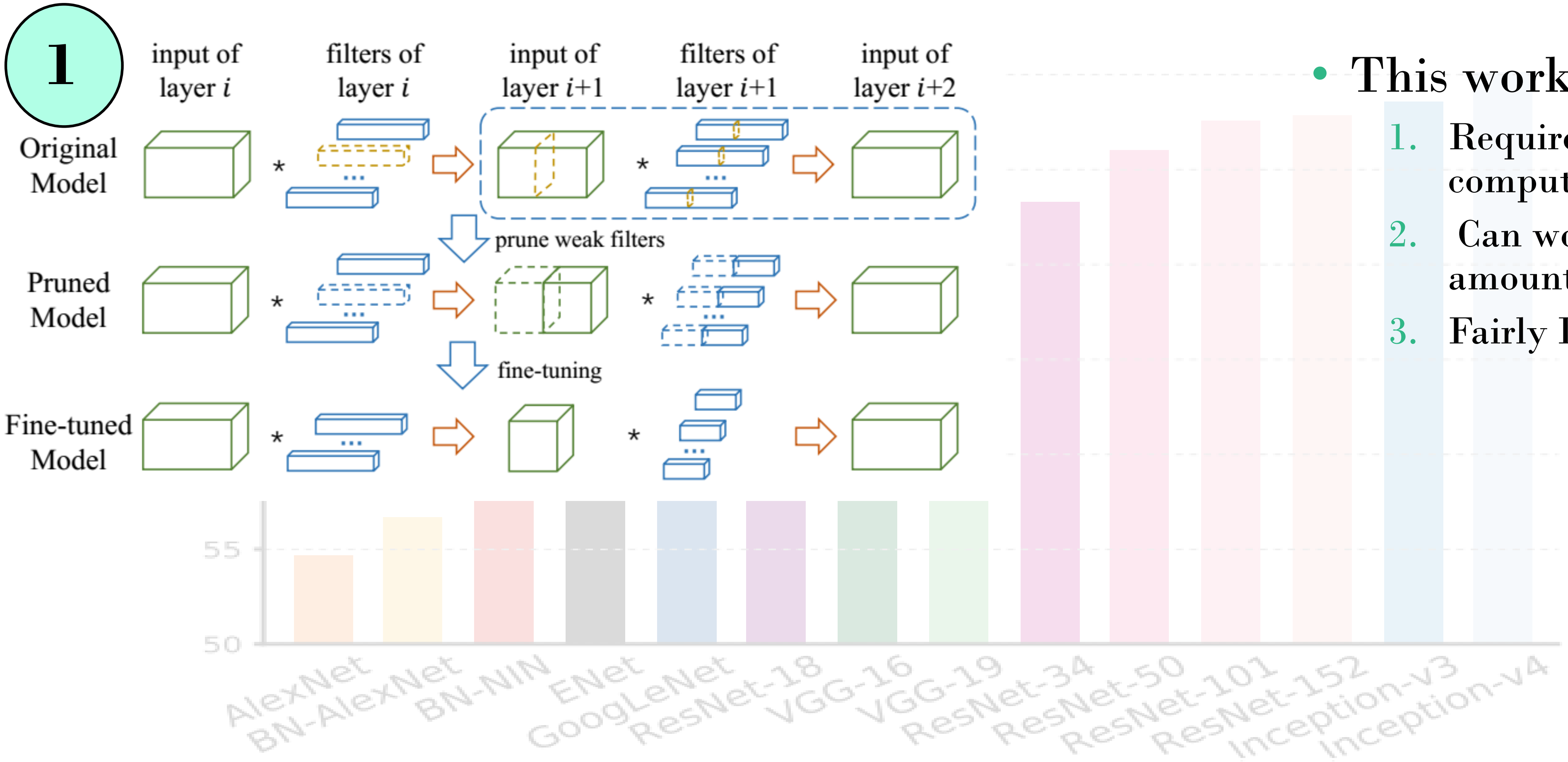

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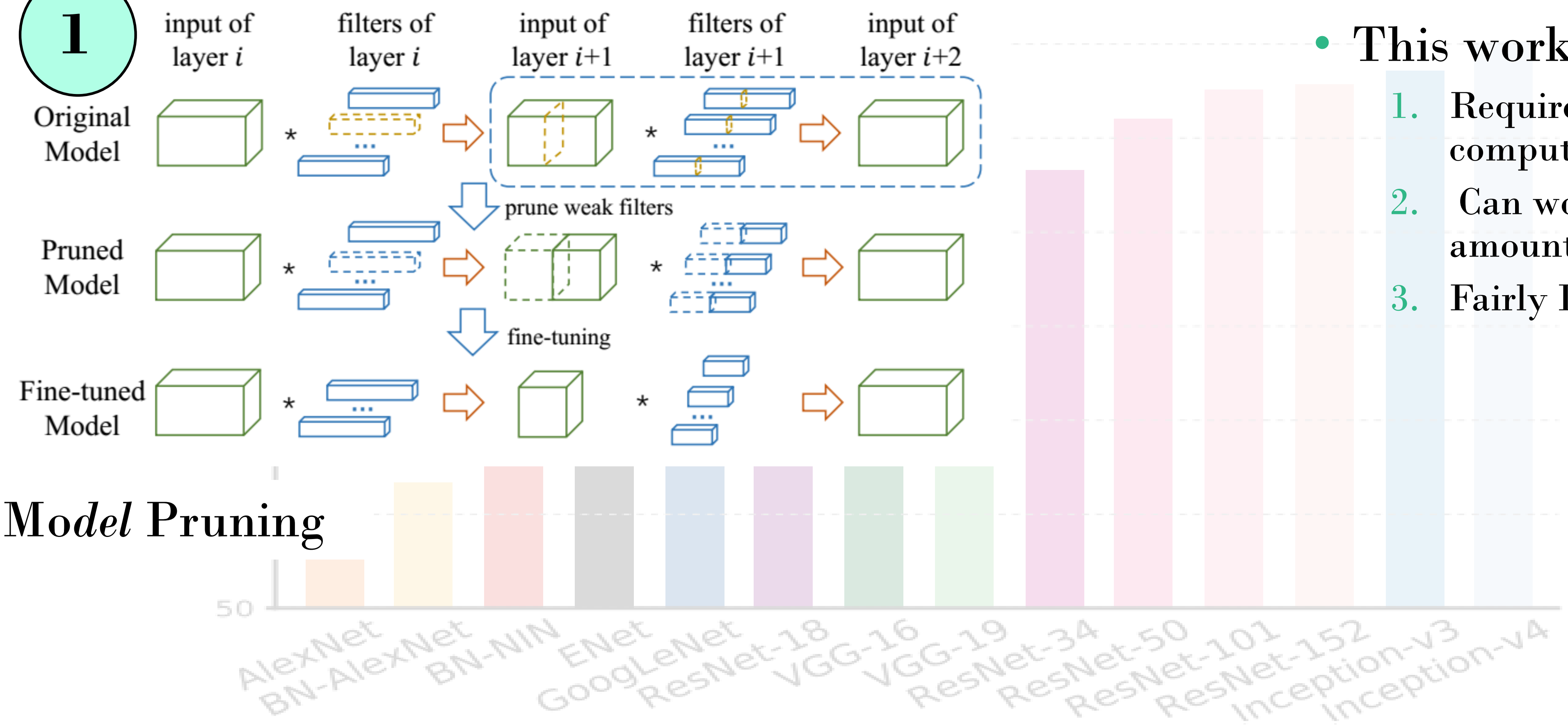

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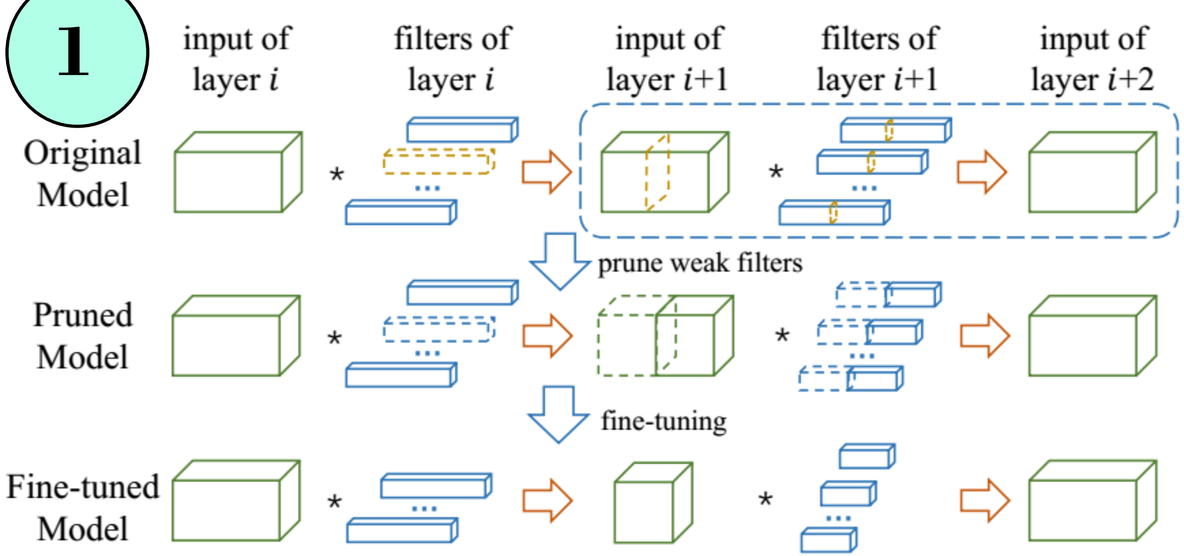

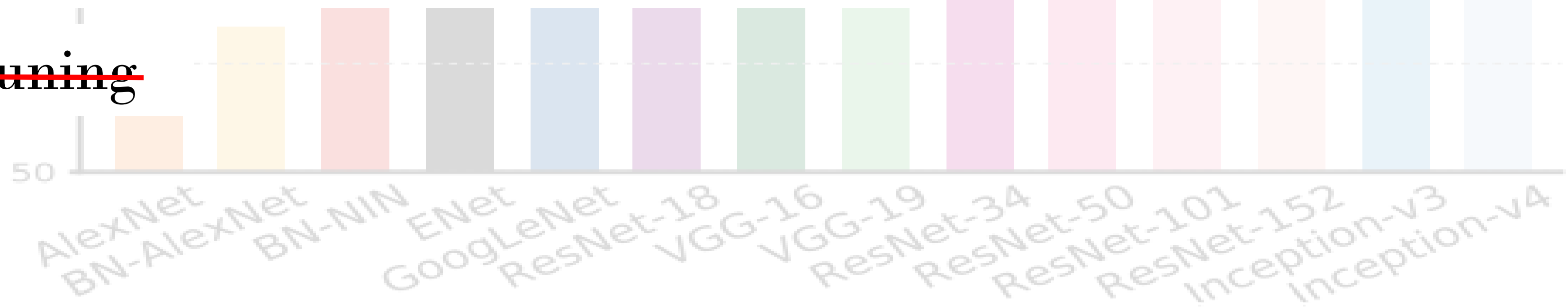

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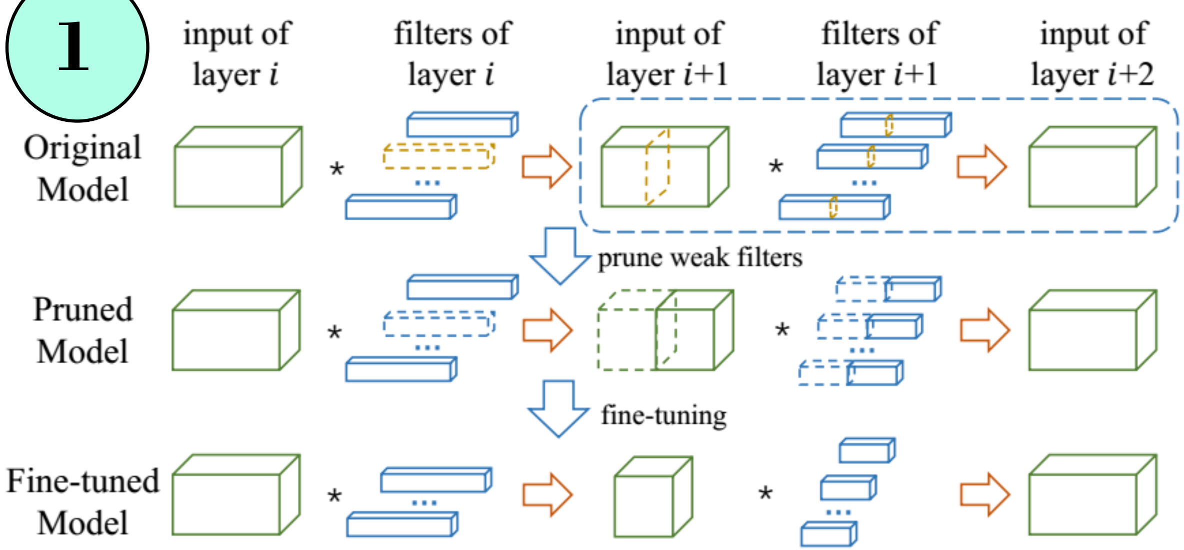

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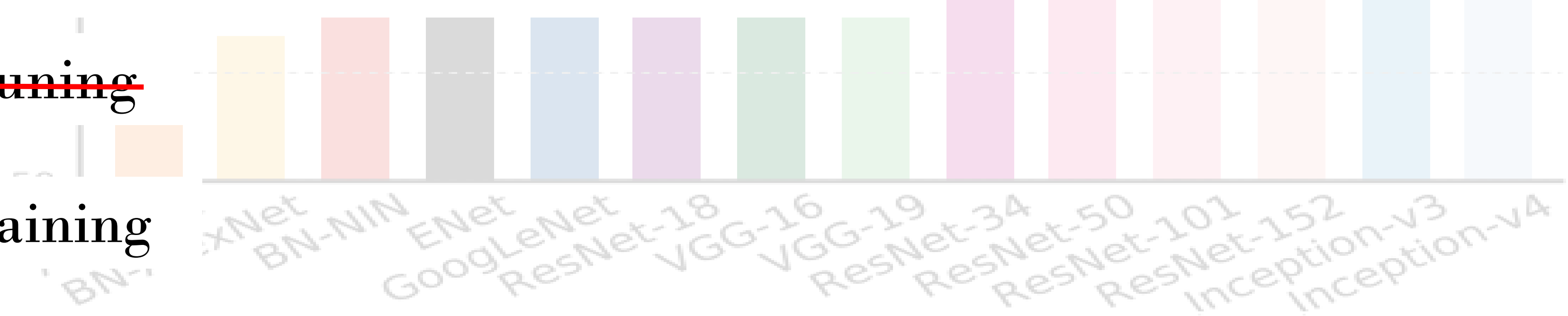

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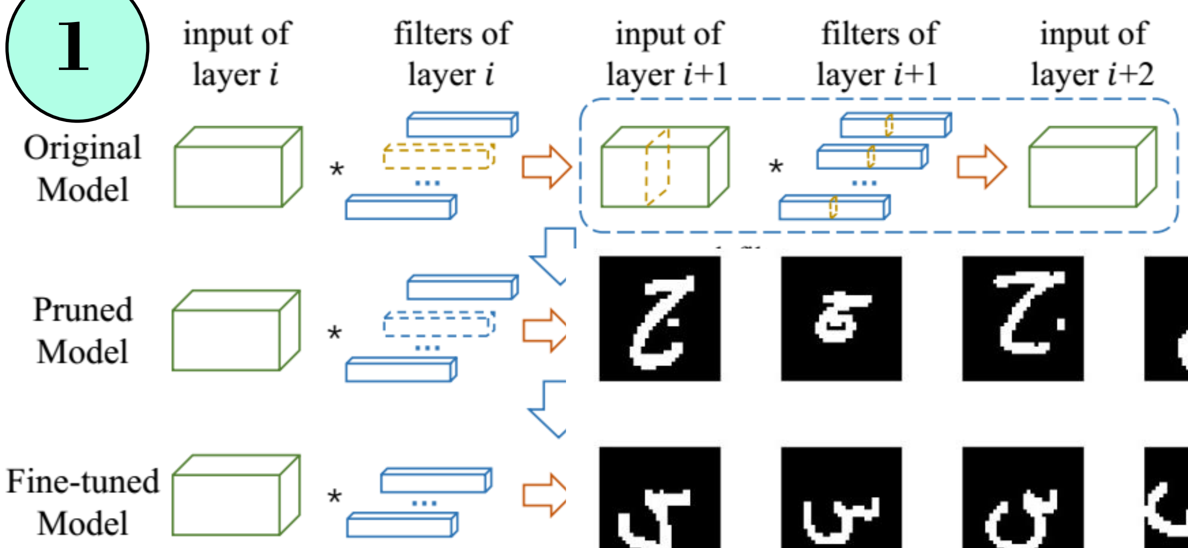

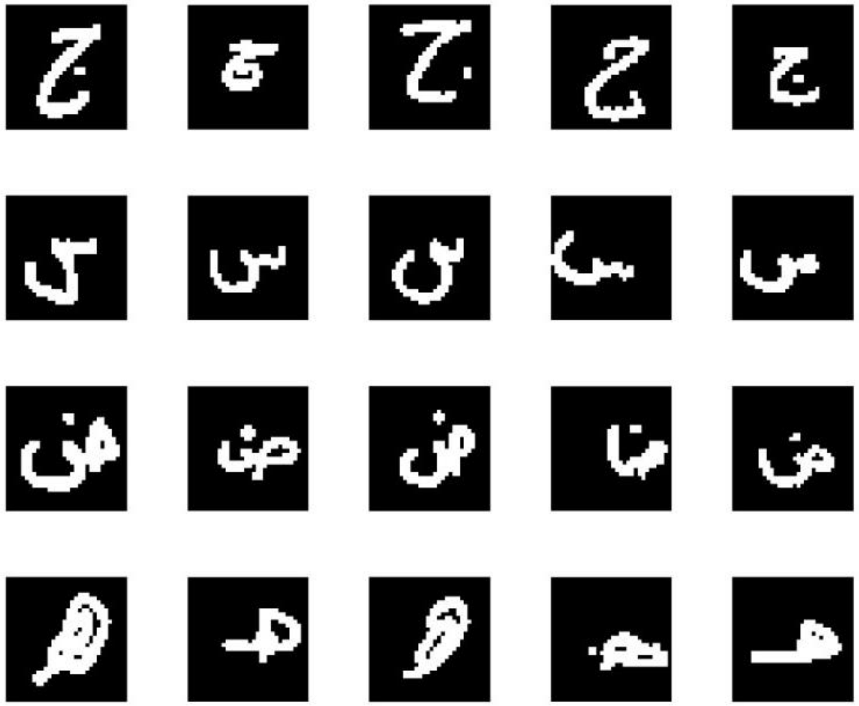

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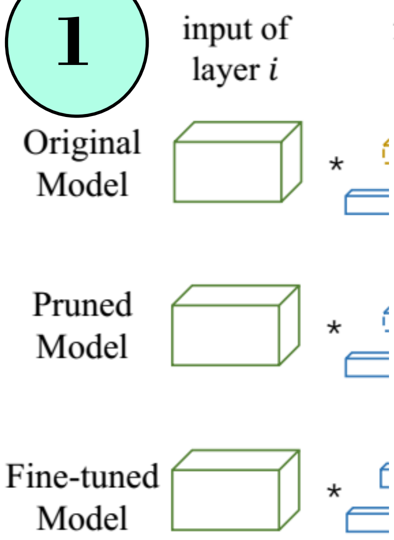

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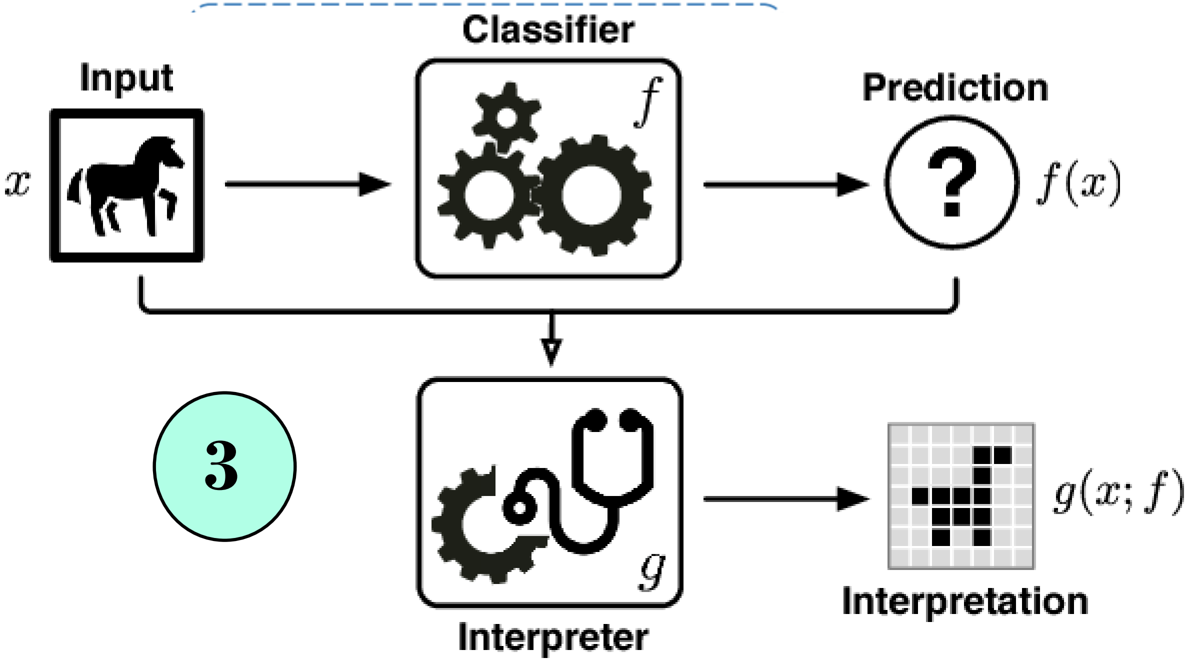

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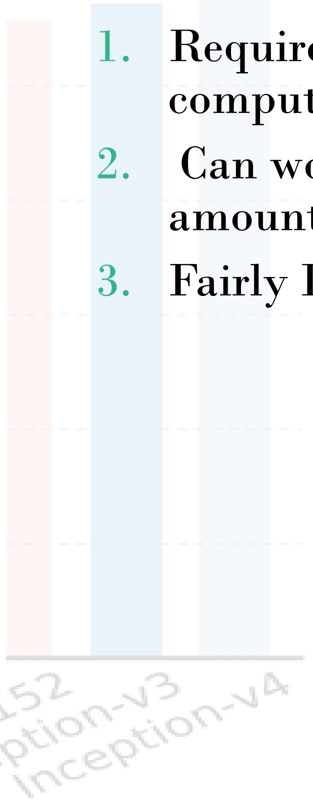

Importance

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Environment Independent

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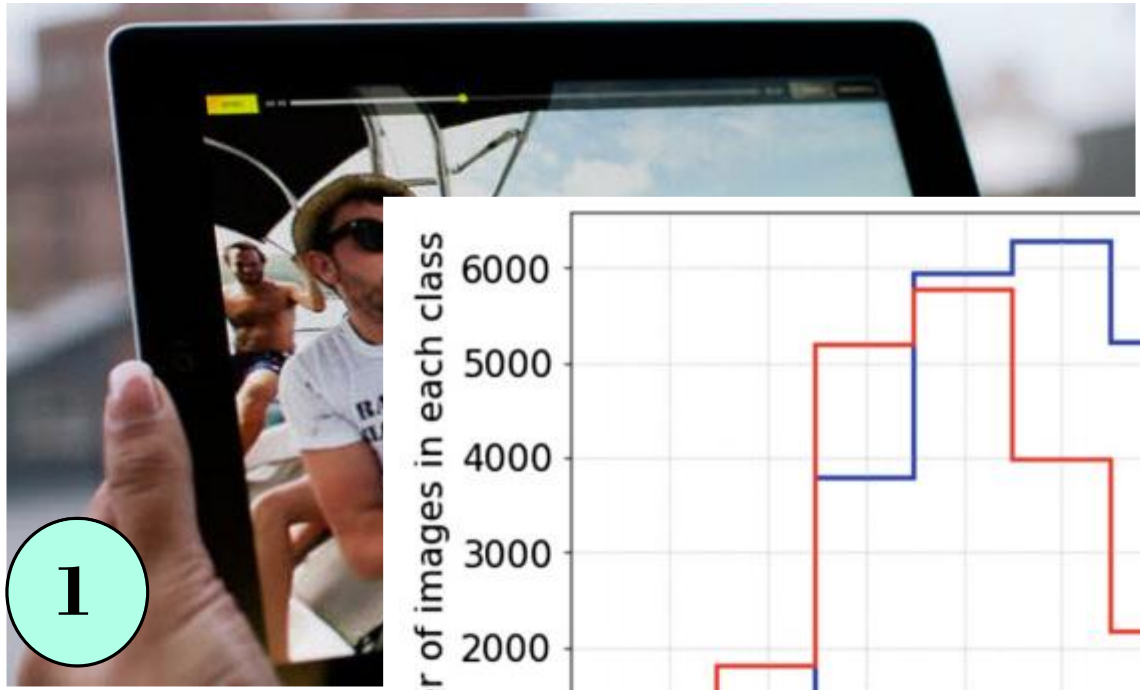

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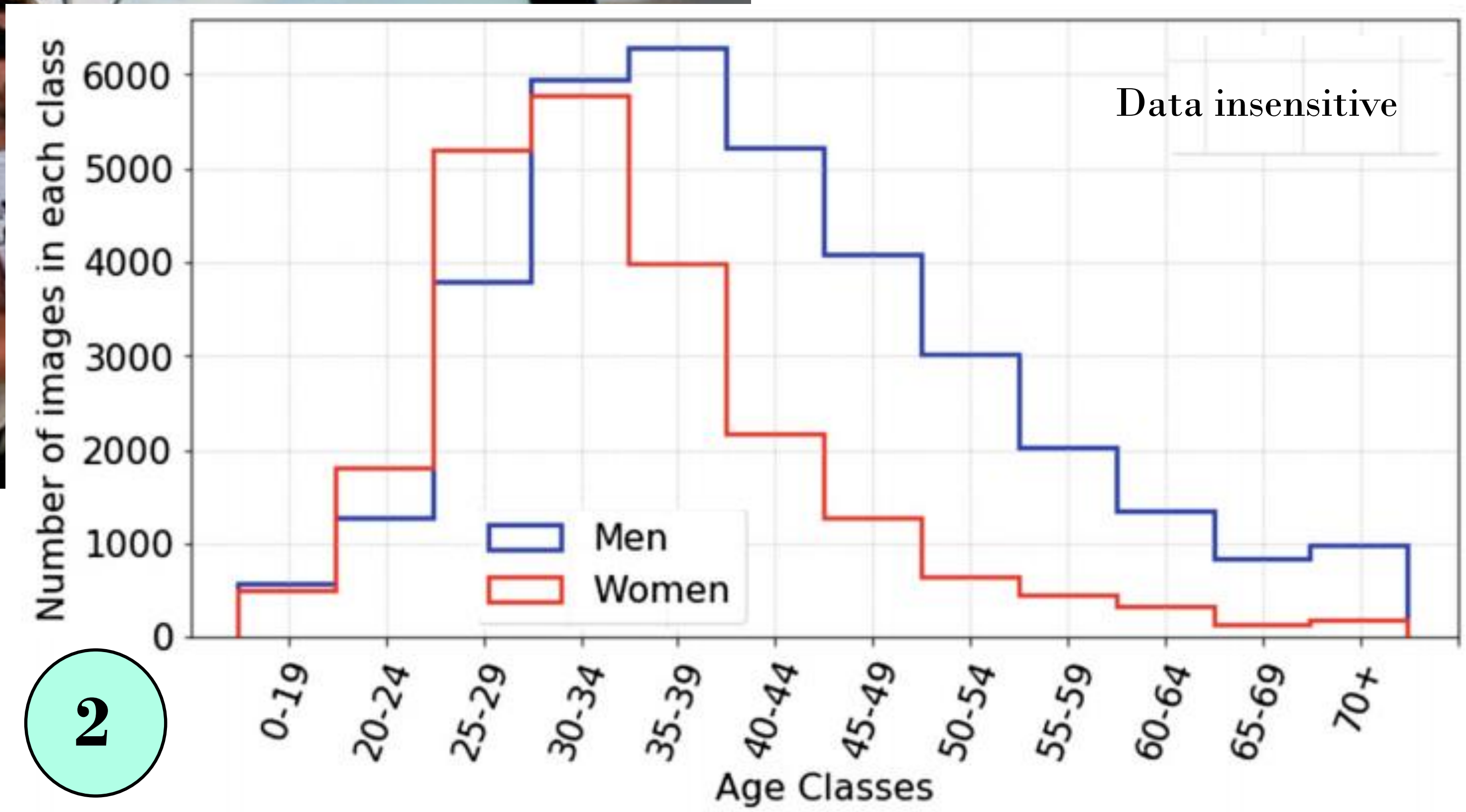

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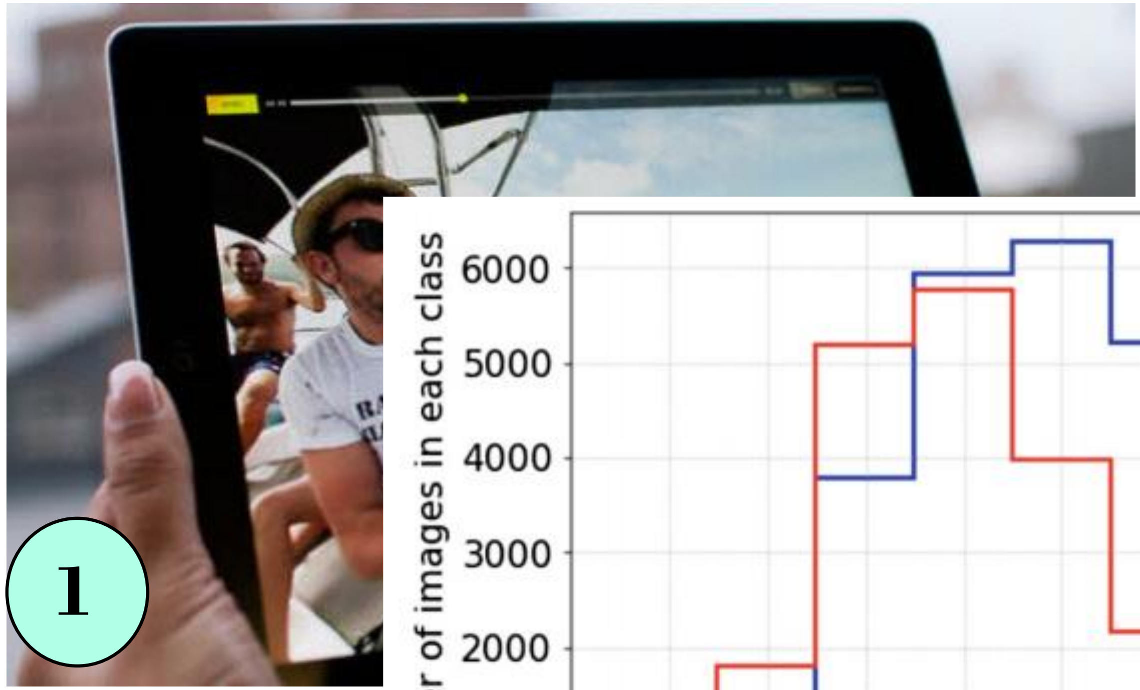

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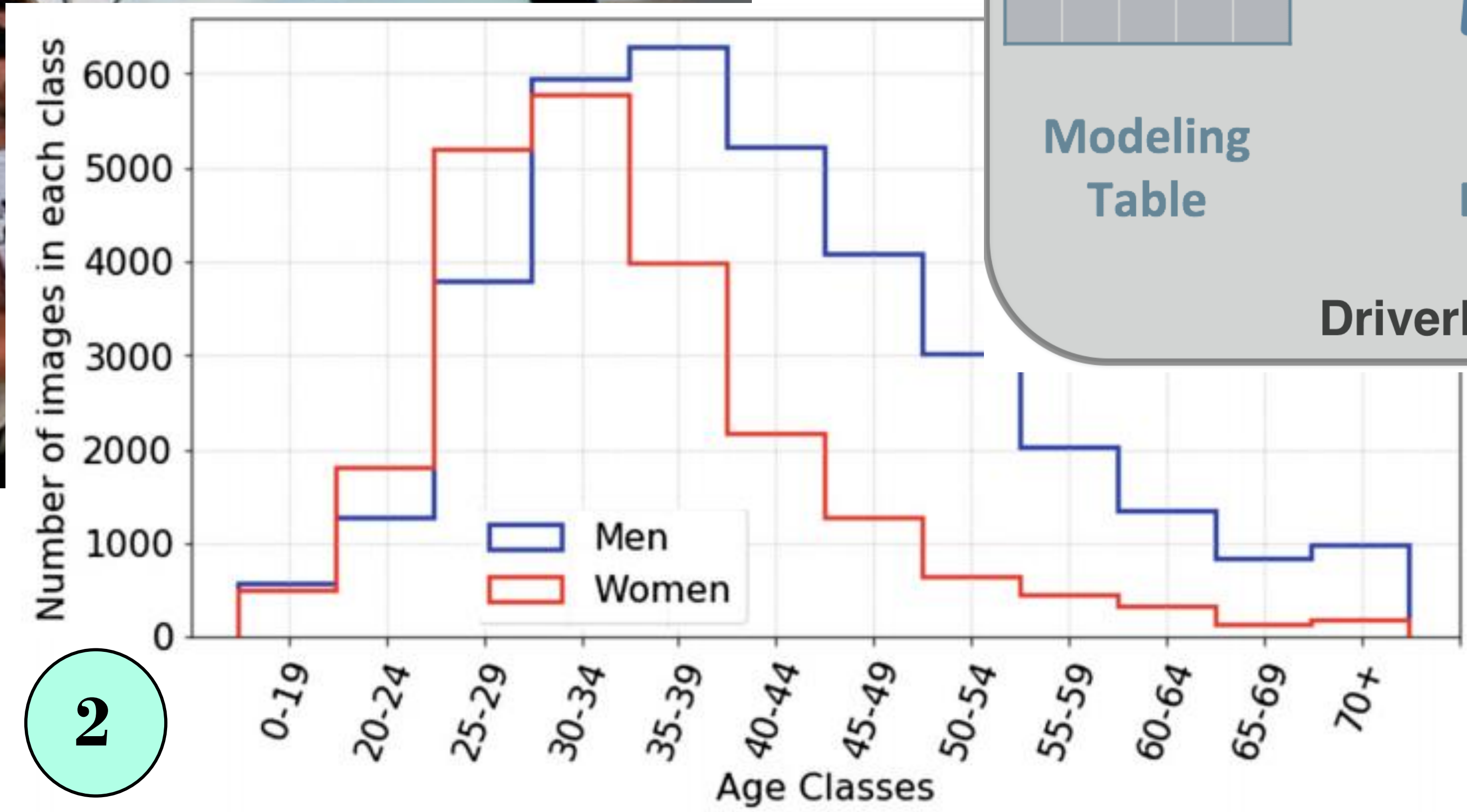

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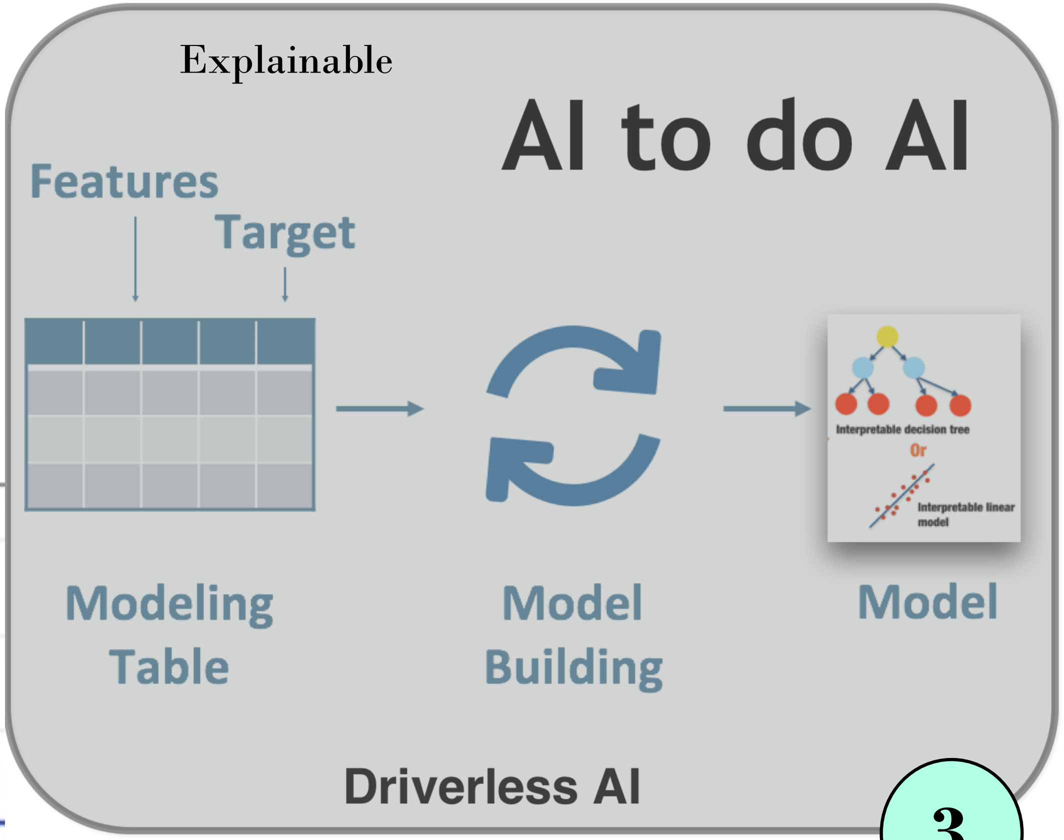
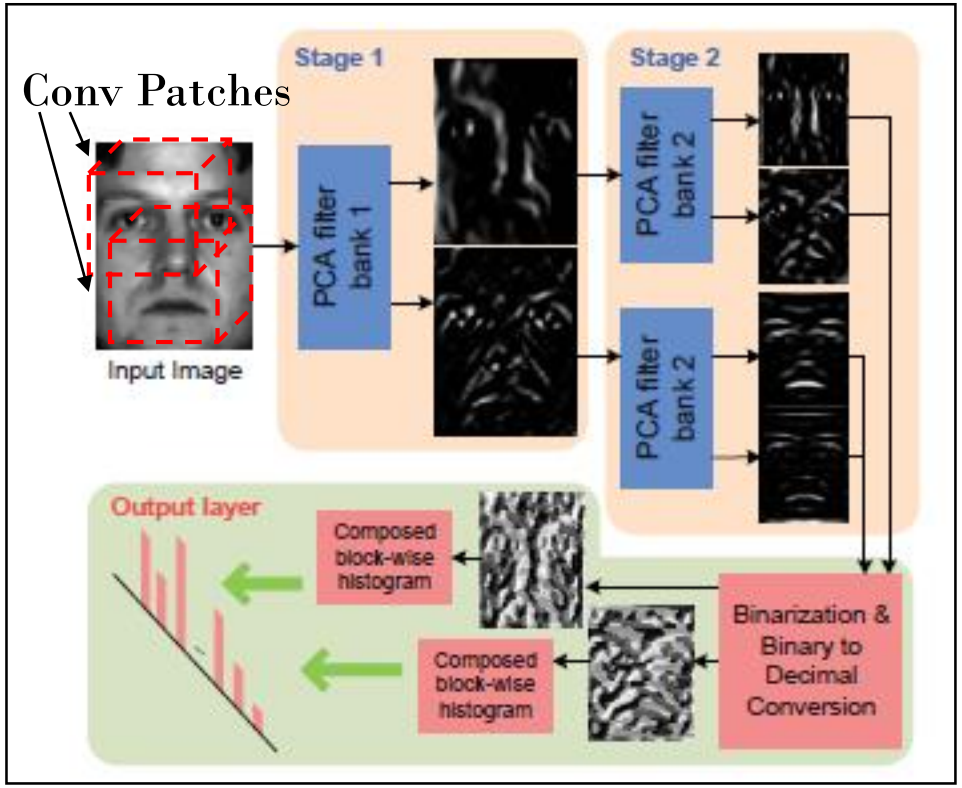


3

Existing Solution

PCANet



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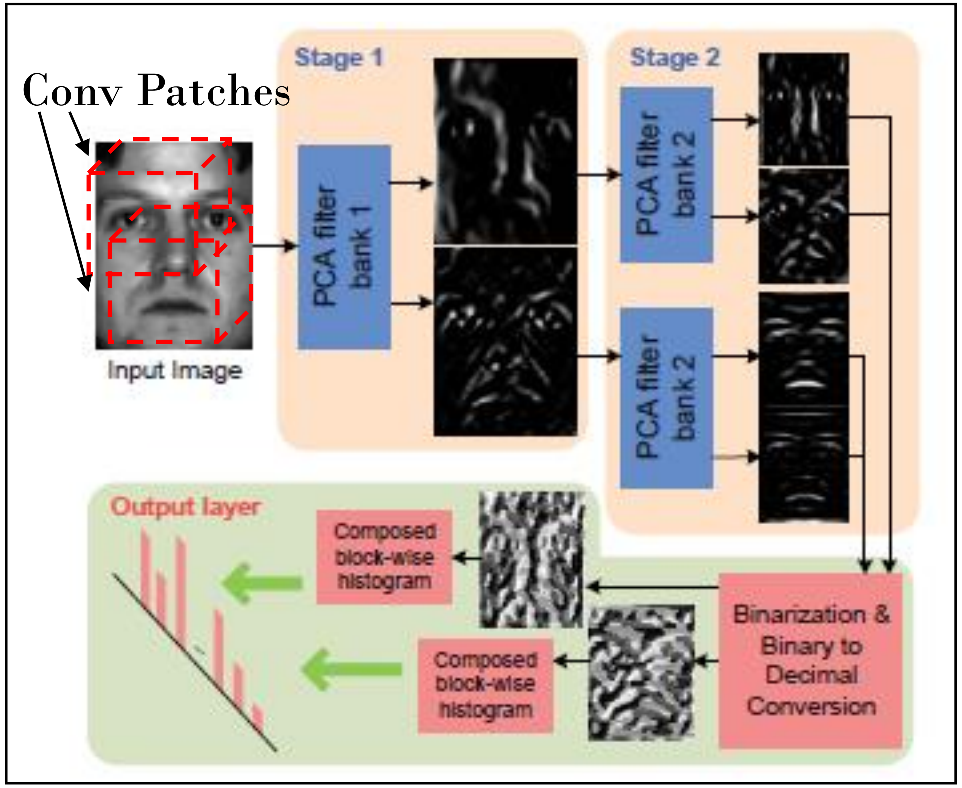

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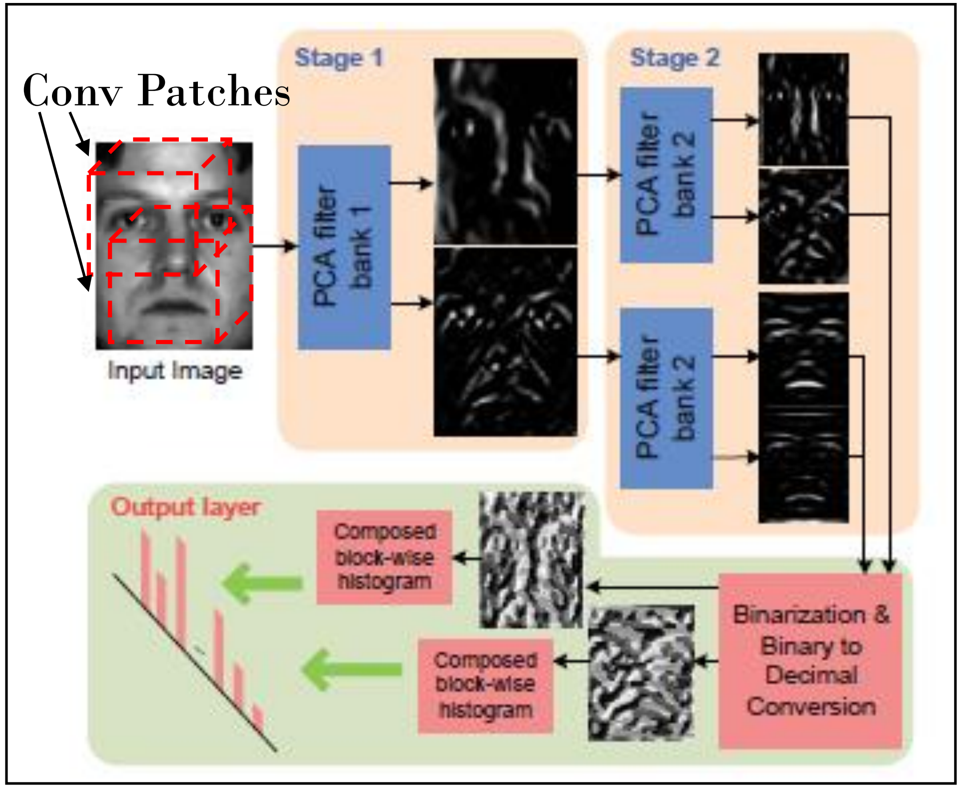

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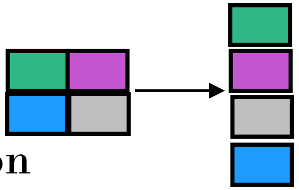

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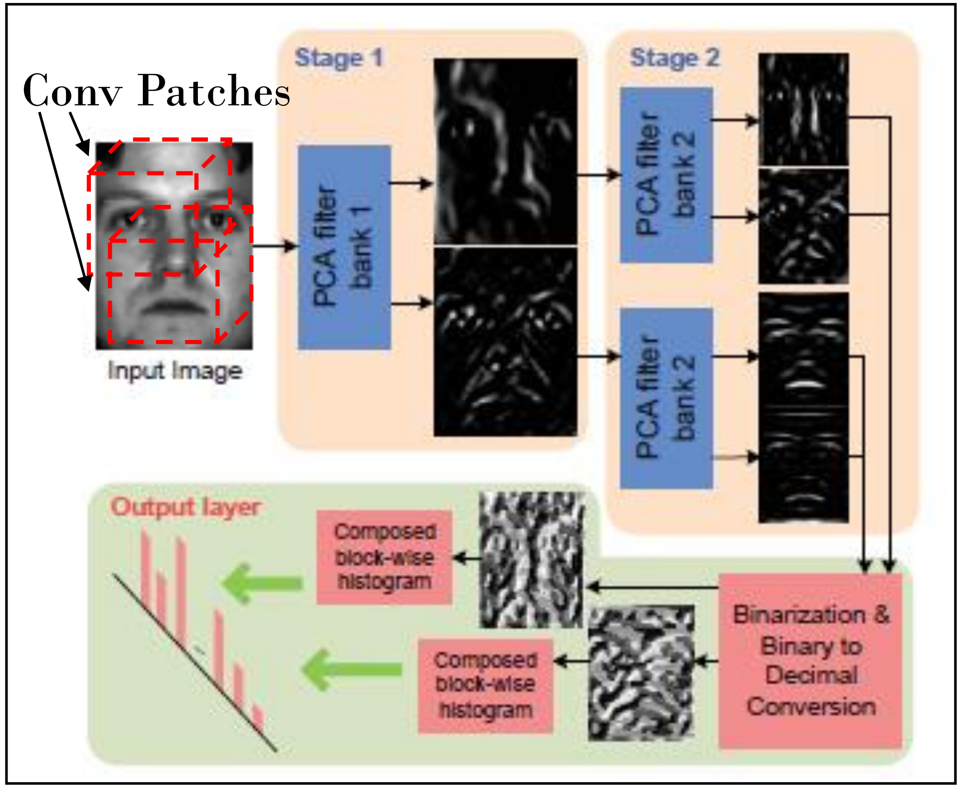

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- Drawbacks
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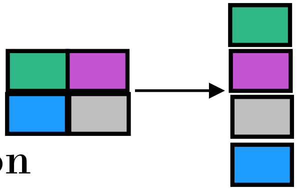
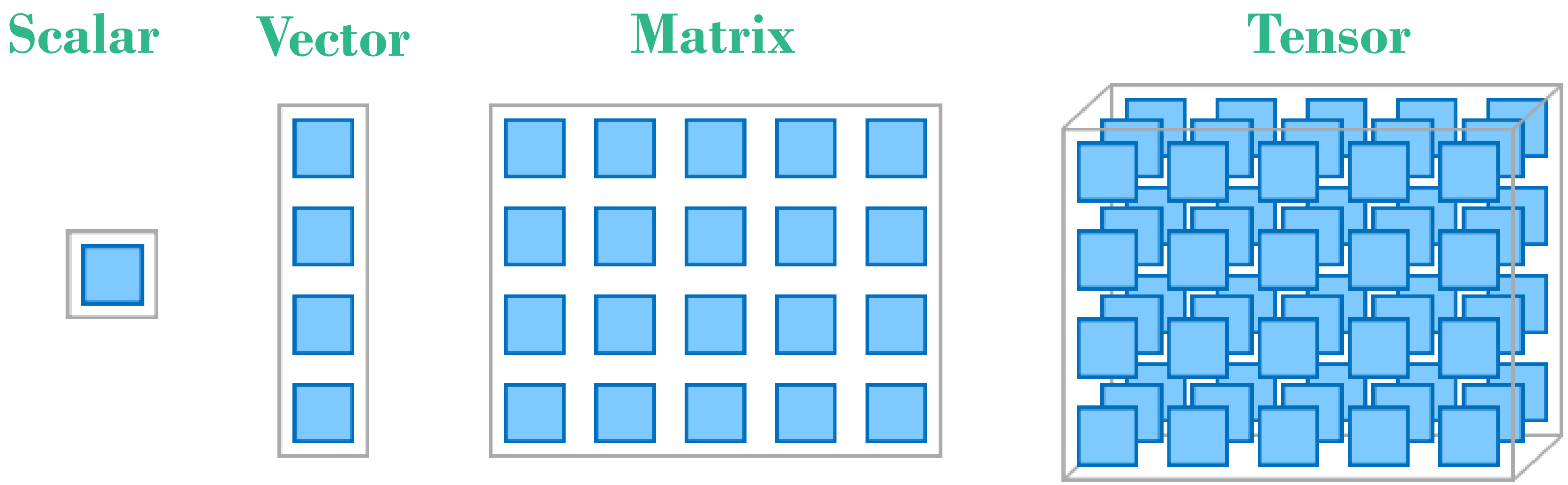
  2. Patch matrix becomes tall/wide.
     - Requires more computational resources
     - Better algorithms



Tensor Network, Preliminaries



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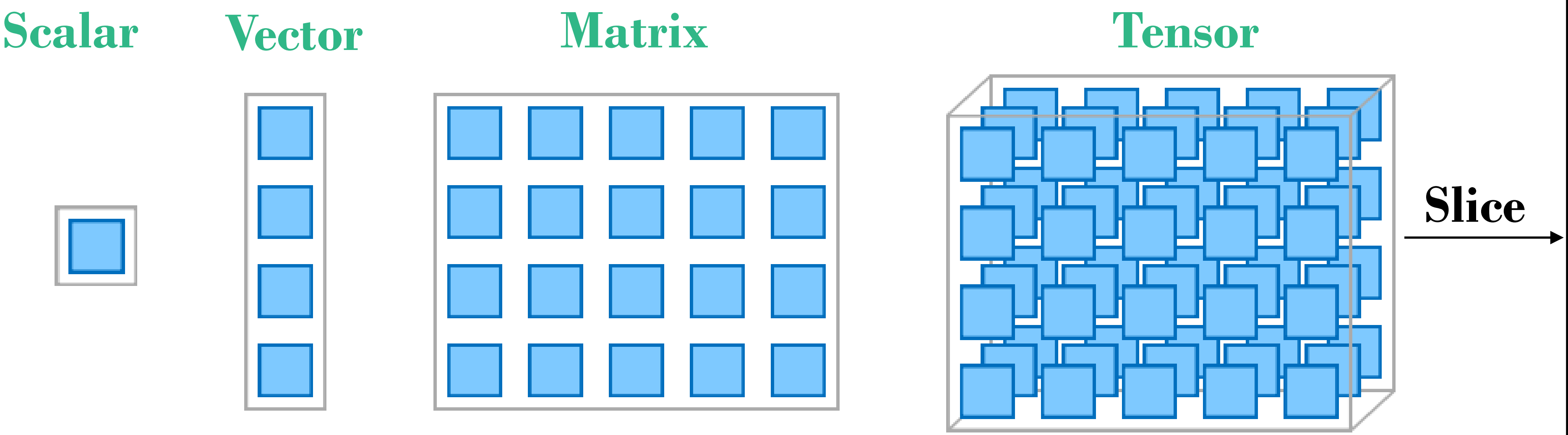

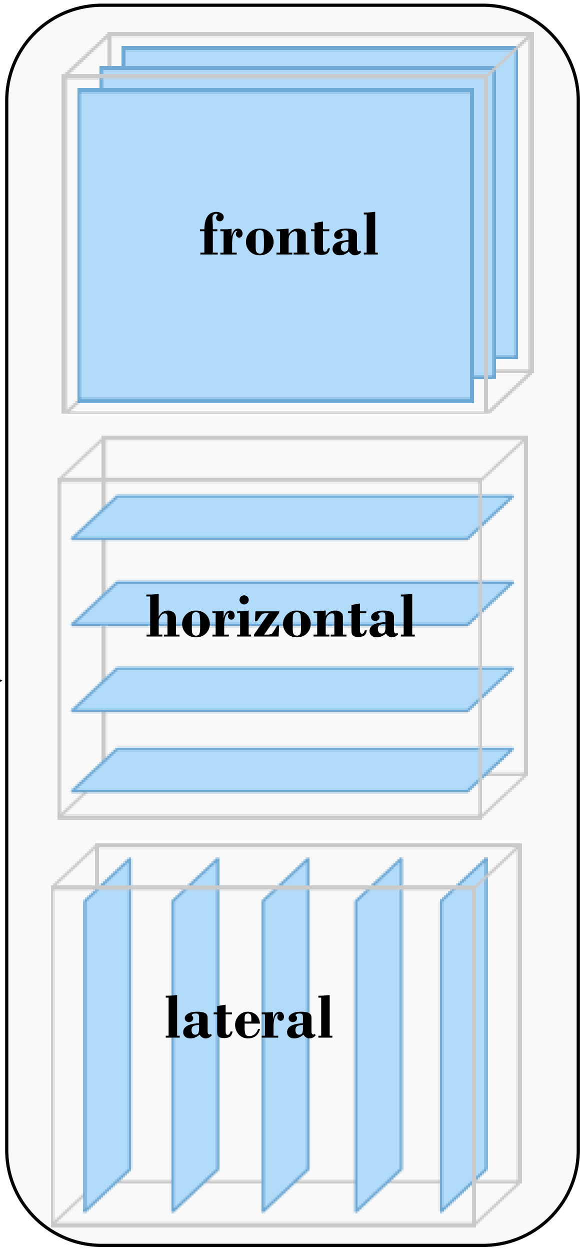

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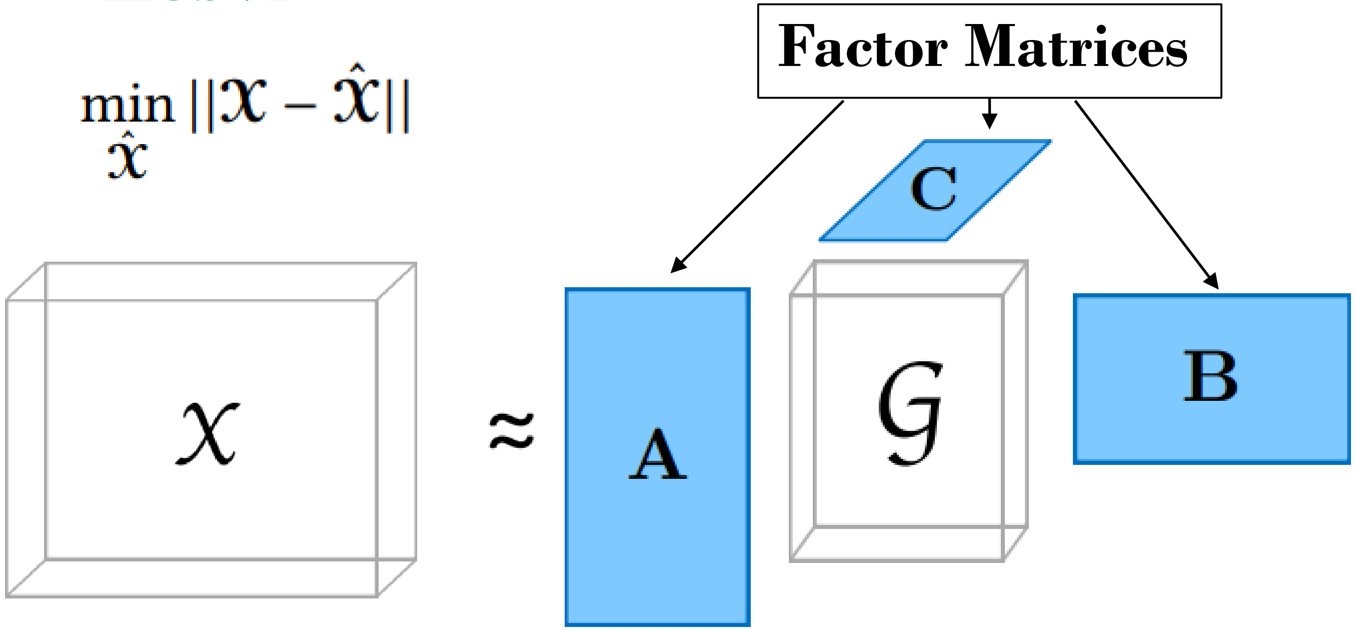
TDNet

HOSVD

$$\min_{\hat{\mathcal{X}}} ||\mathcal{X} - \hat{\mathcal{X}}||$$



Tucker Decomposition

TDNet

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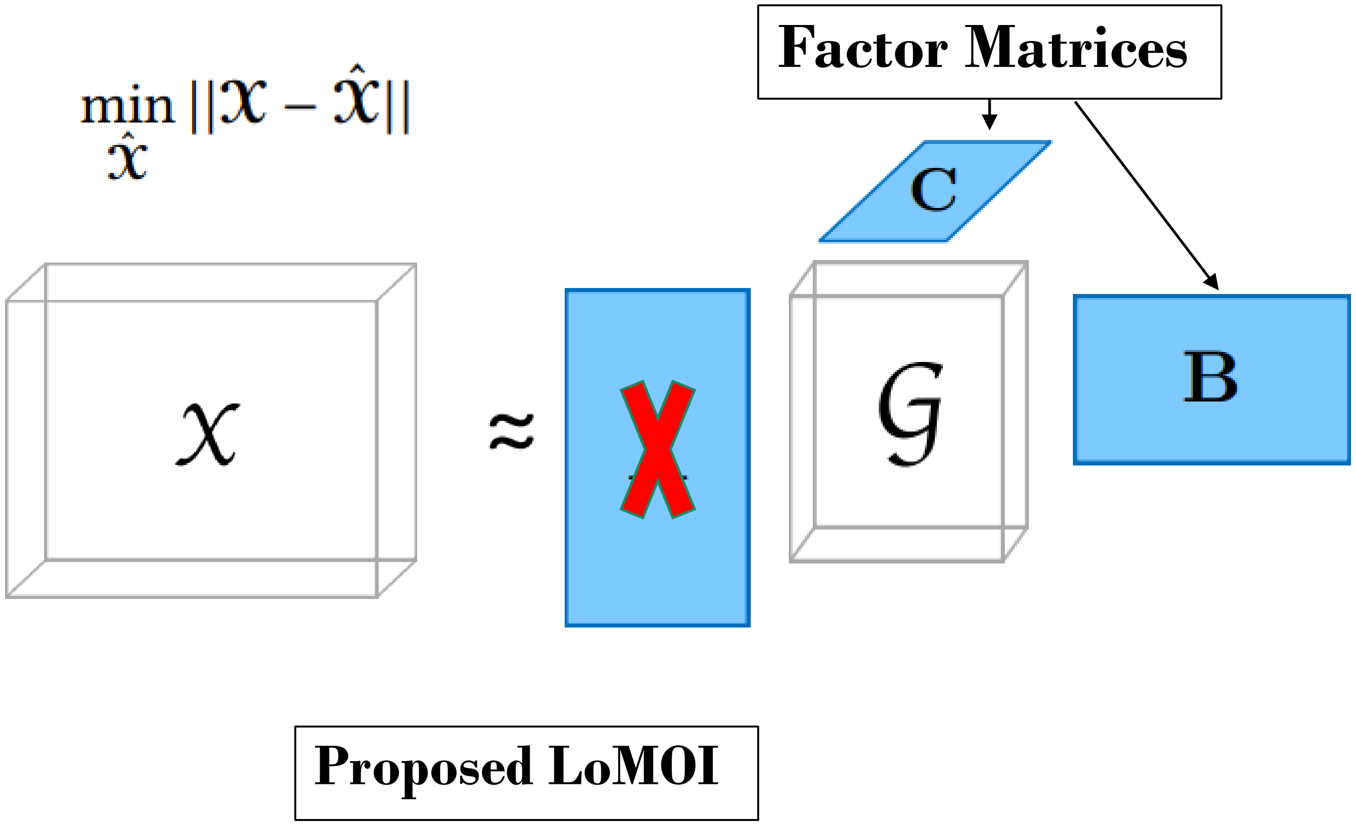

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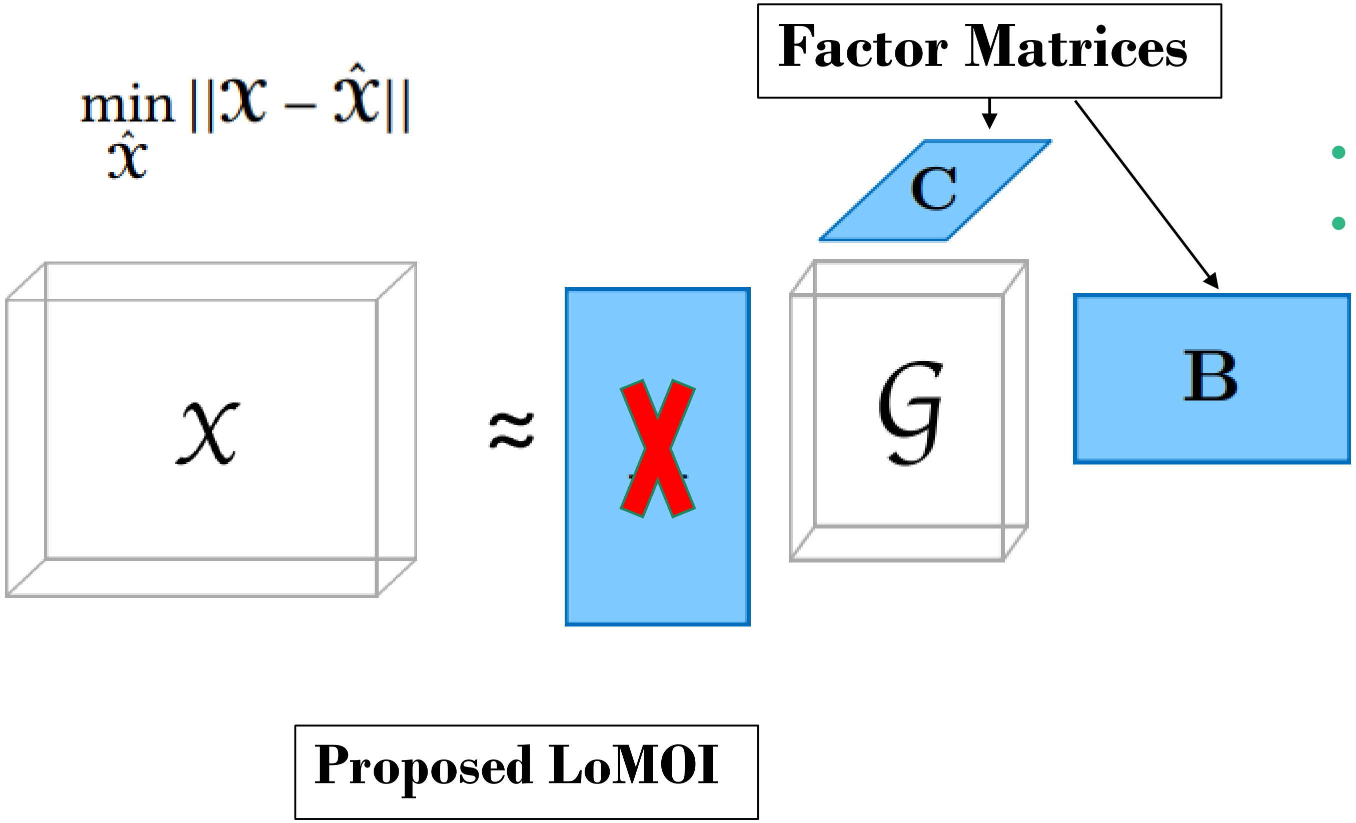

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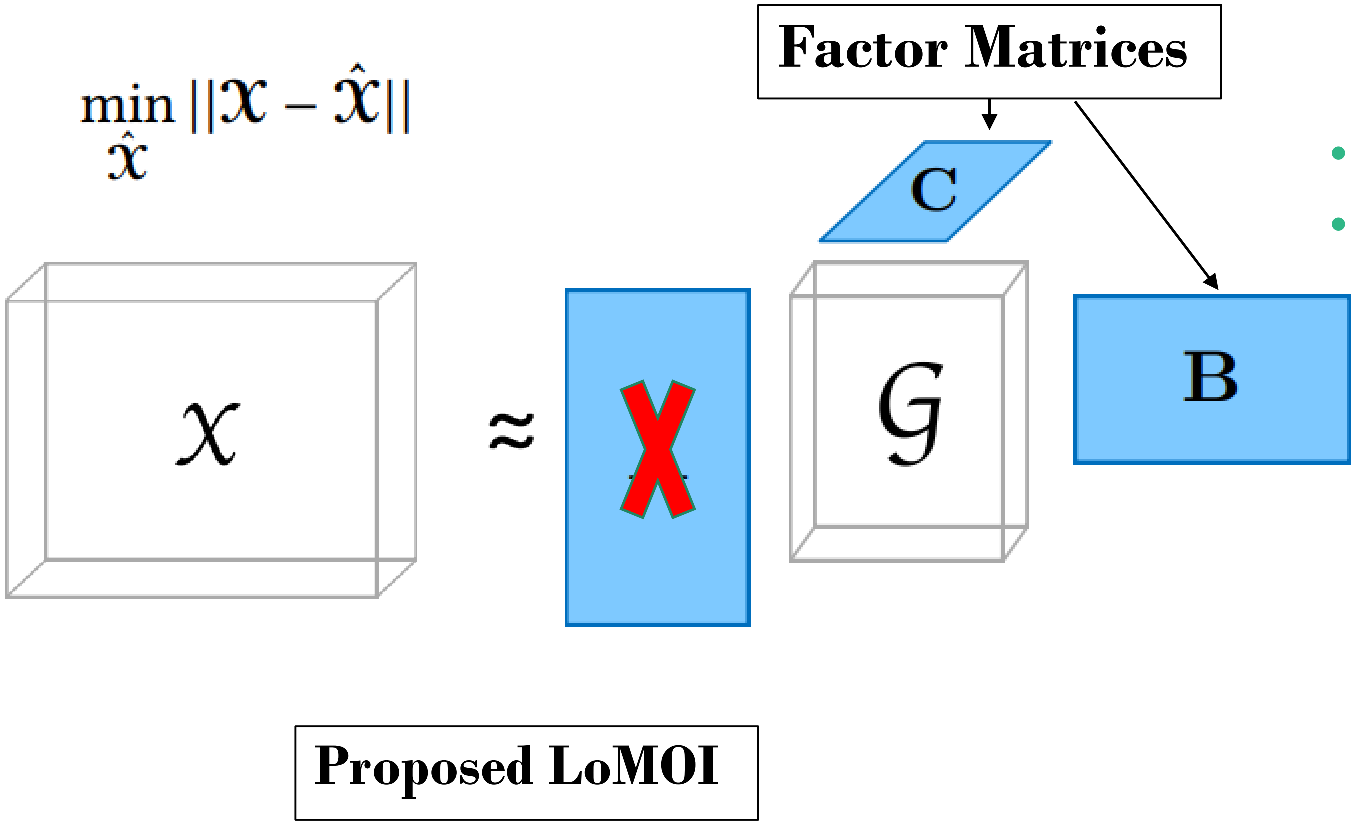

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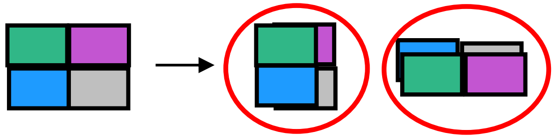

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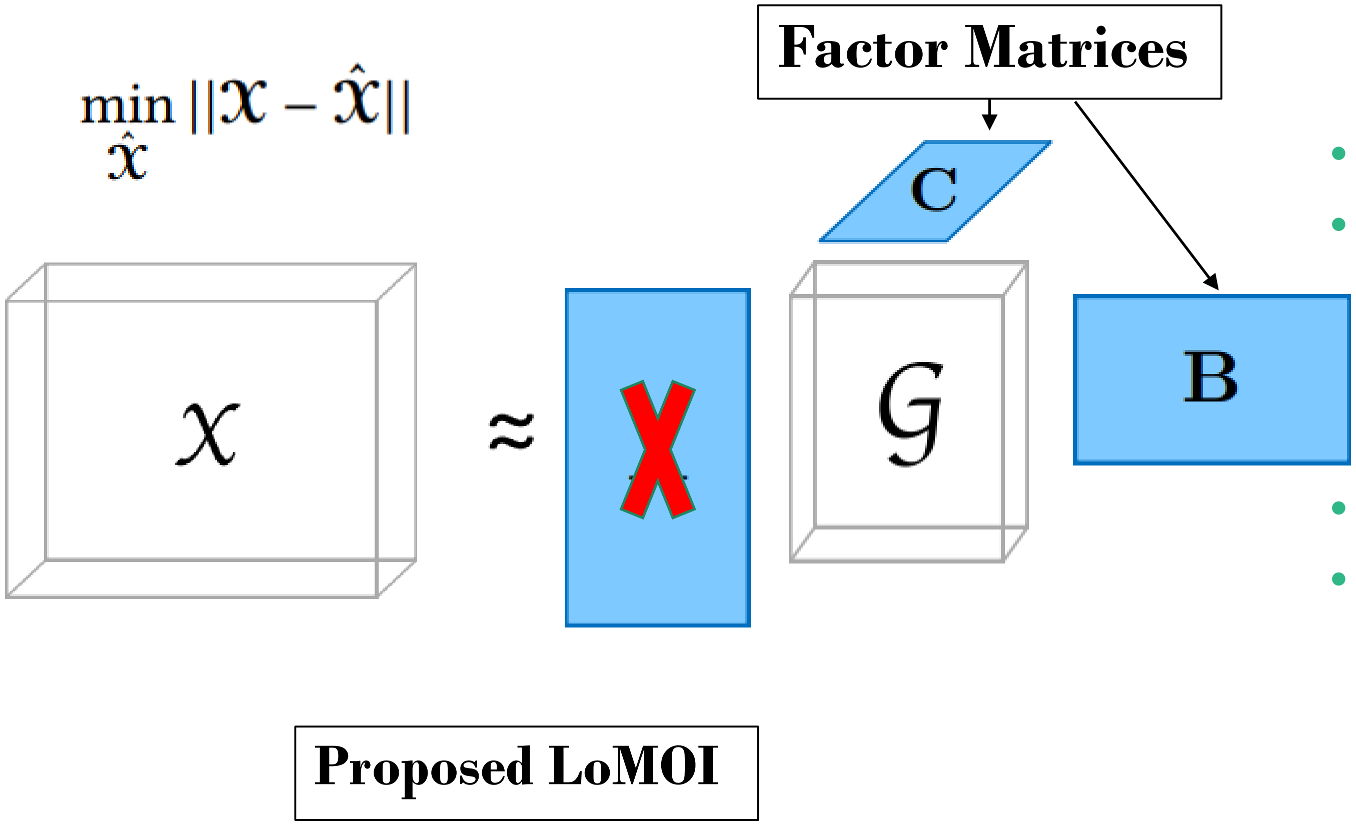

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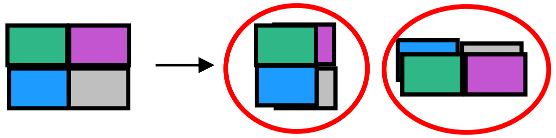
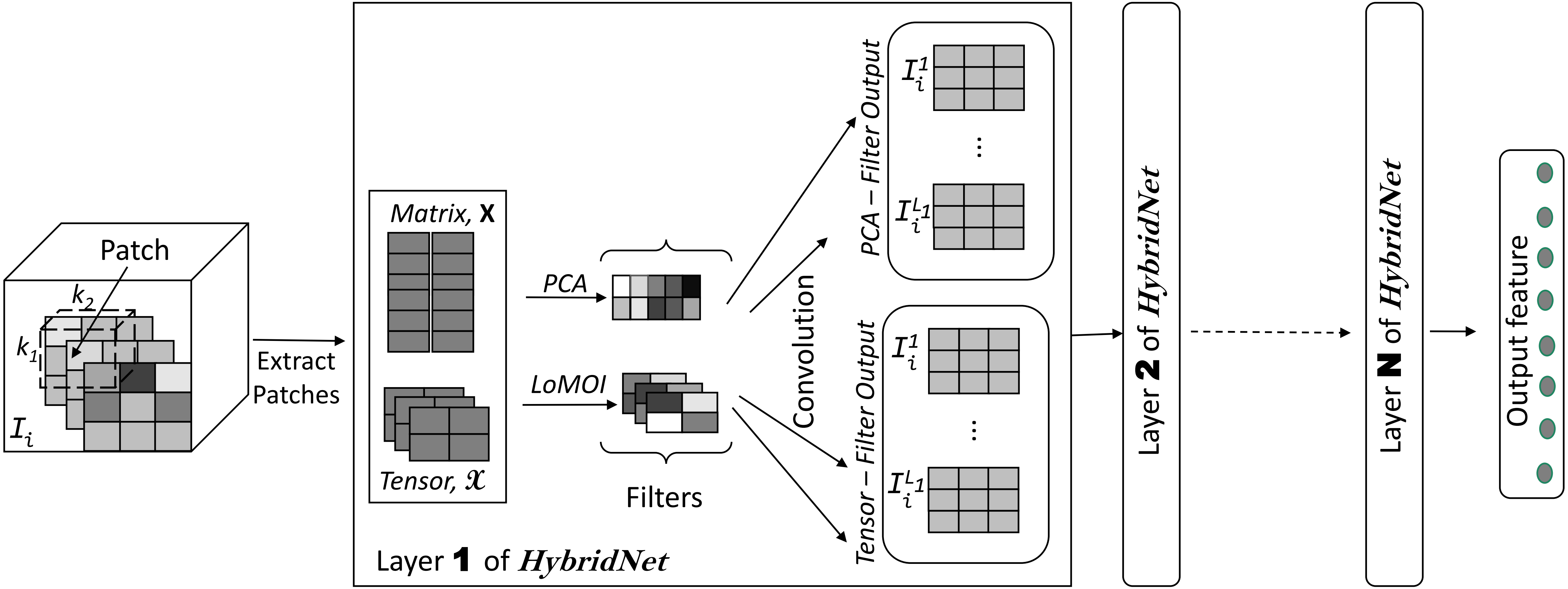


- Computationally less expensive than PCA.
- Captures variations in each mode independently.

Hybrid Networks



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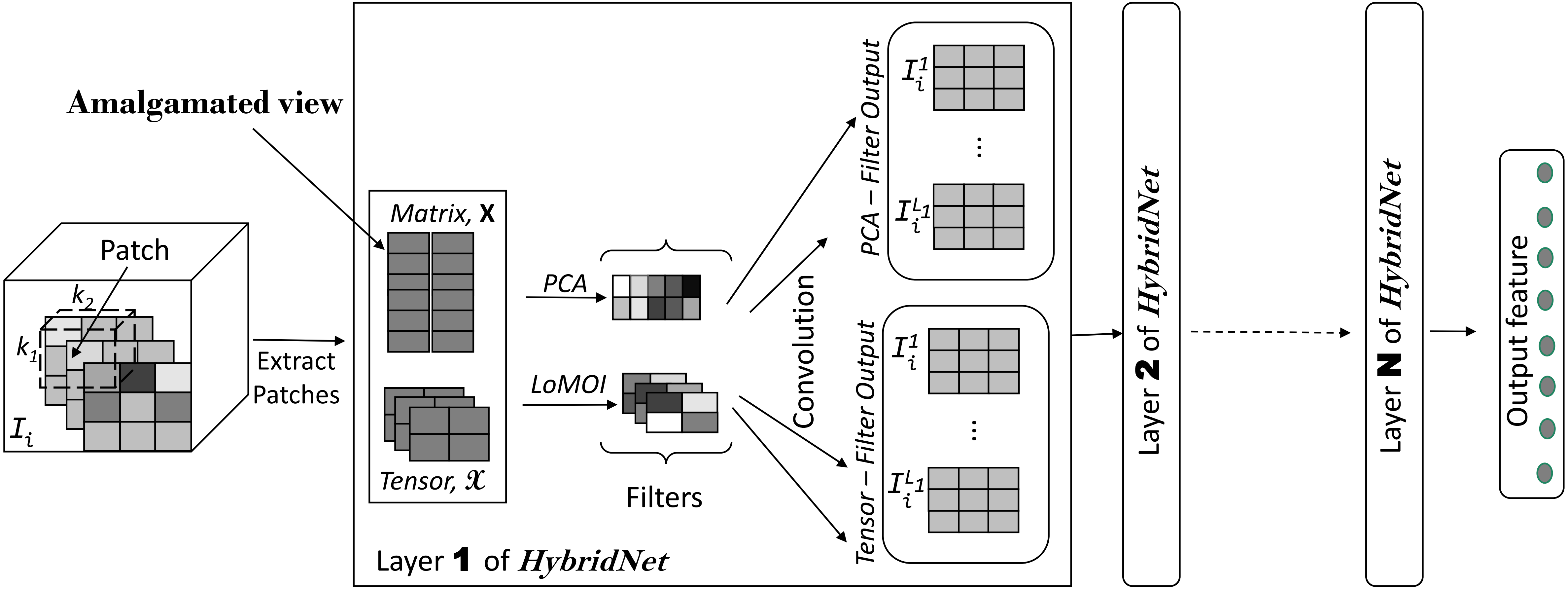

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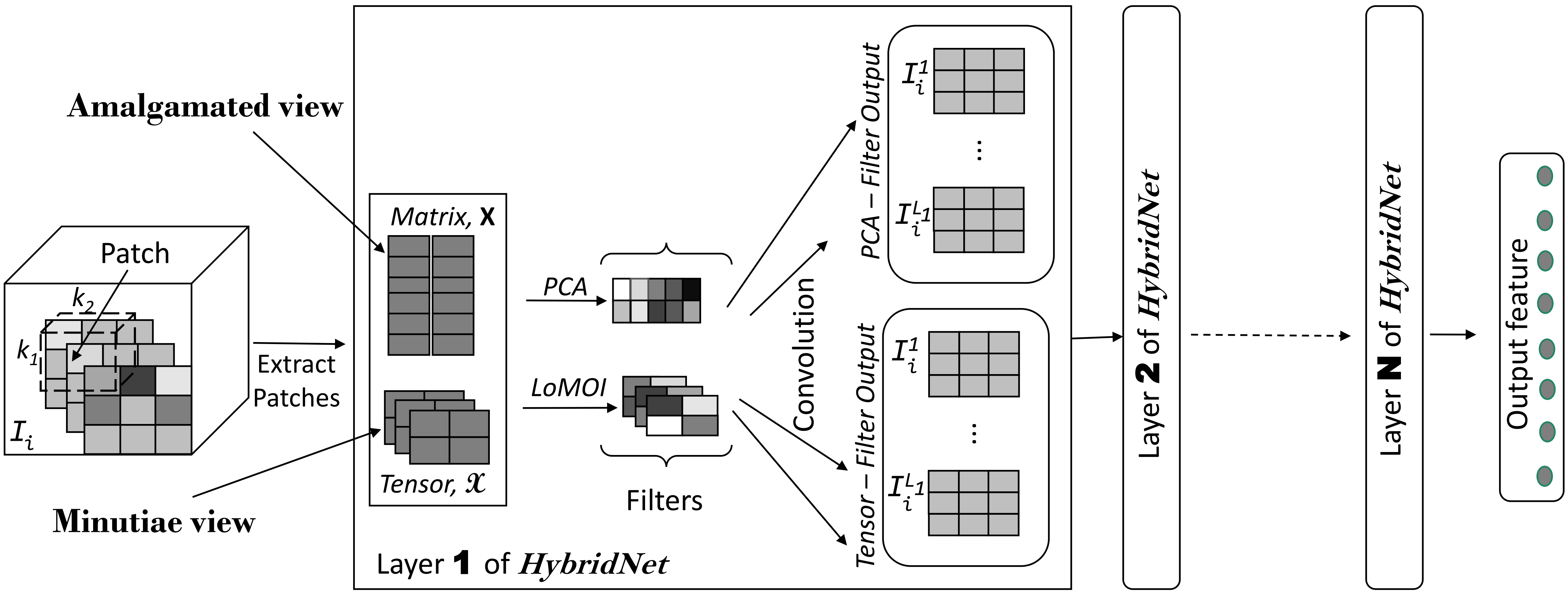
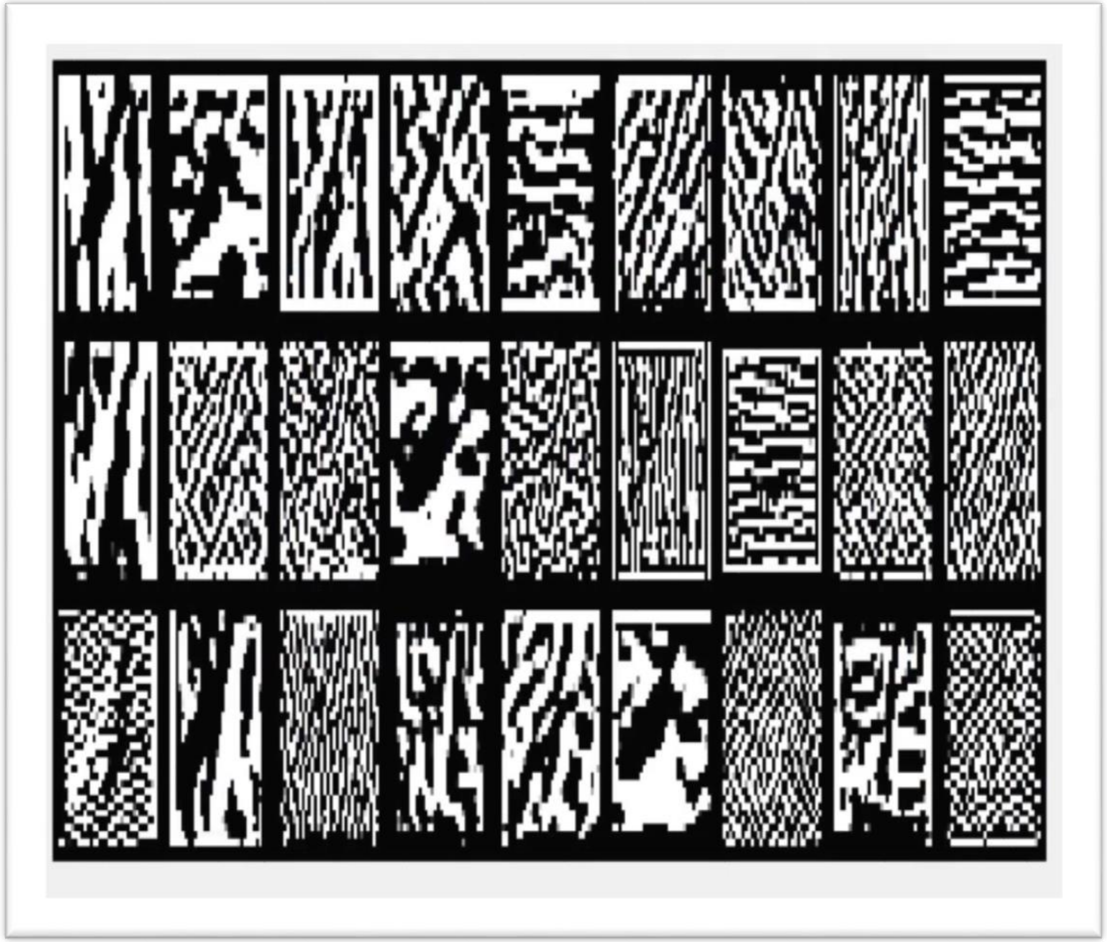


Output from the first layer in Hybrid Networks

PCANet



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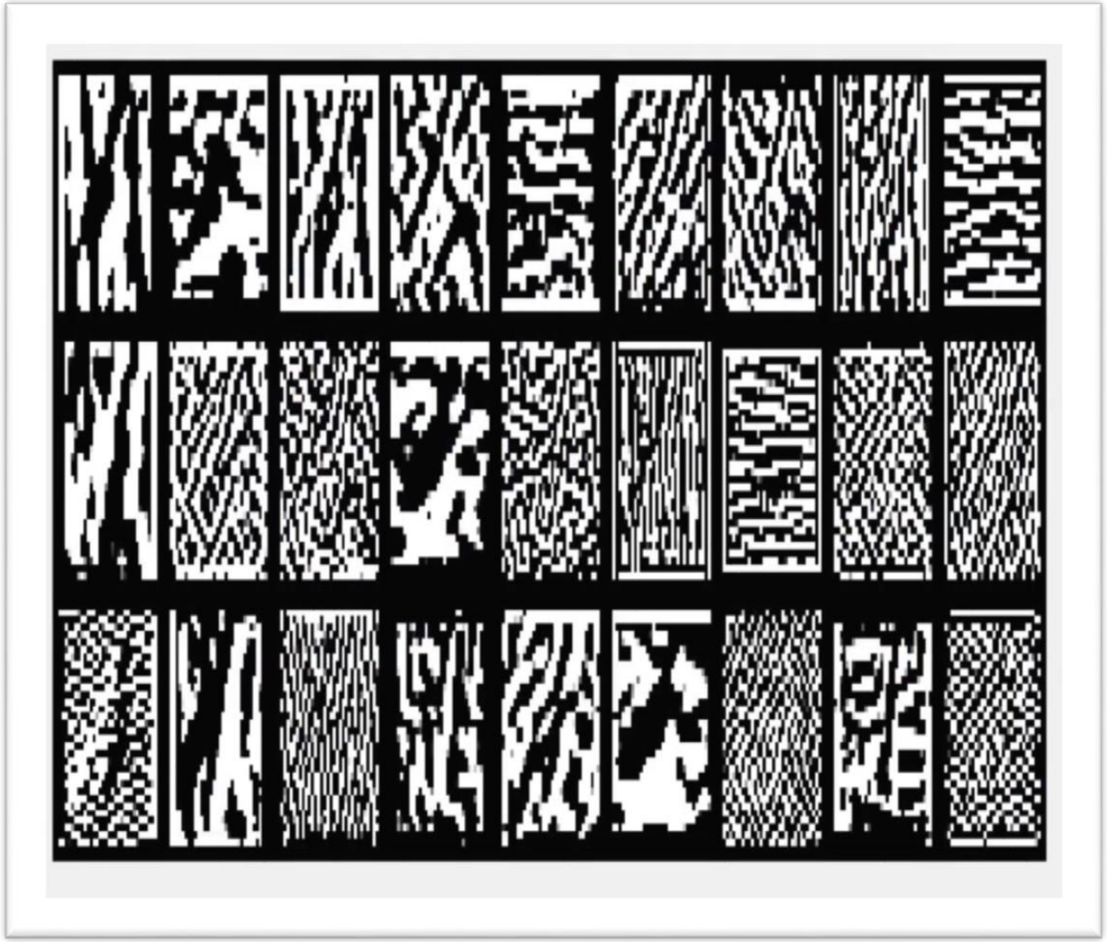
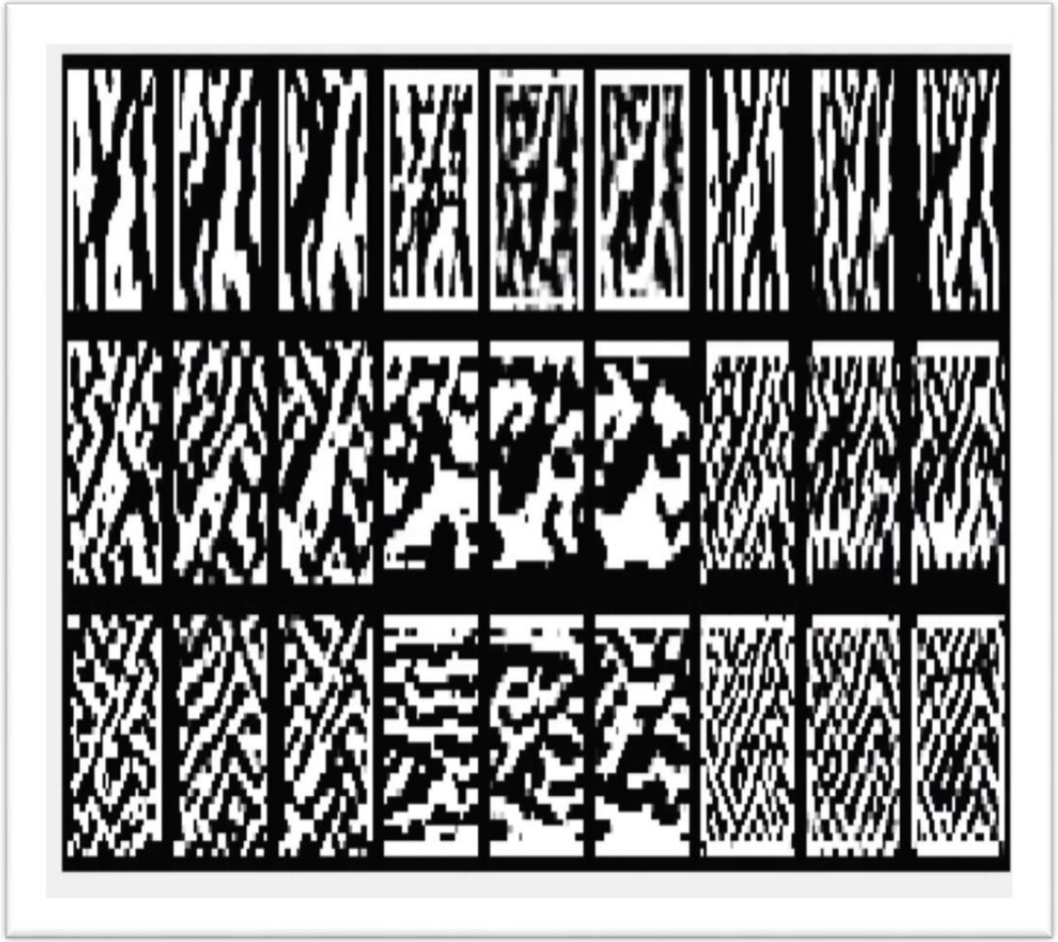
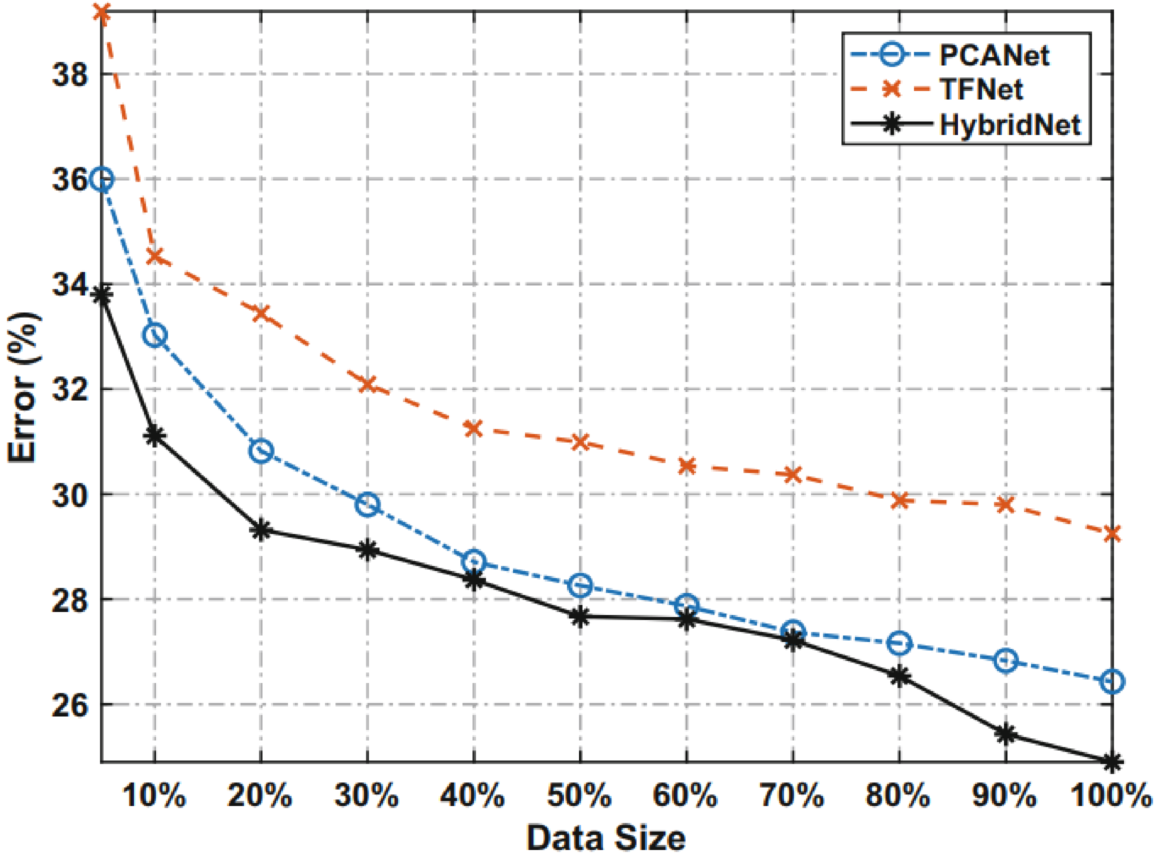


TensorNet



Results

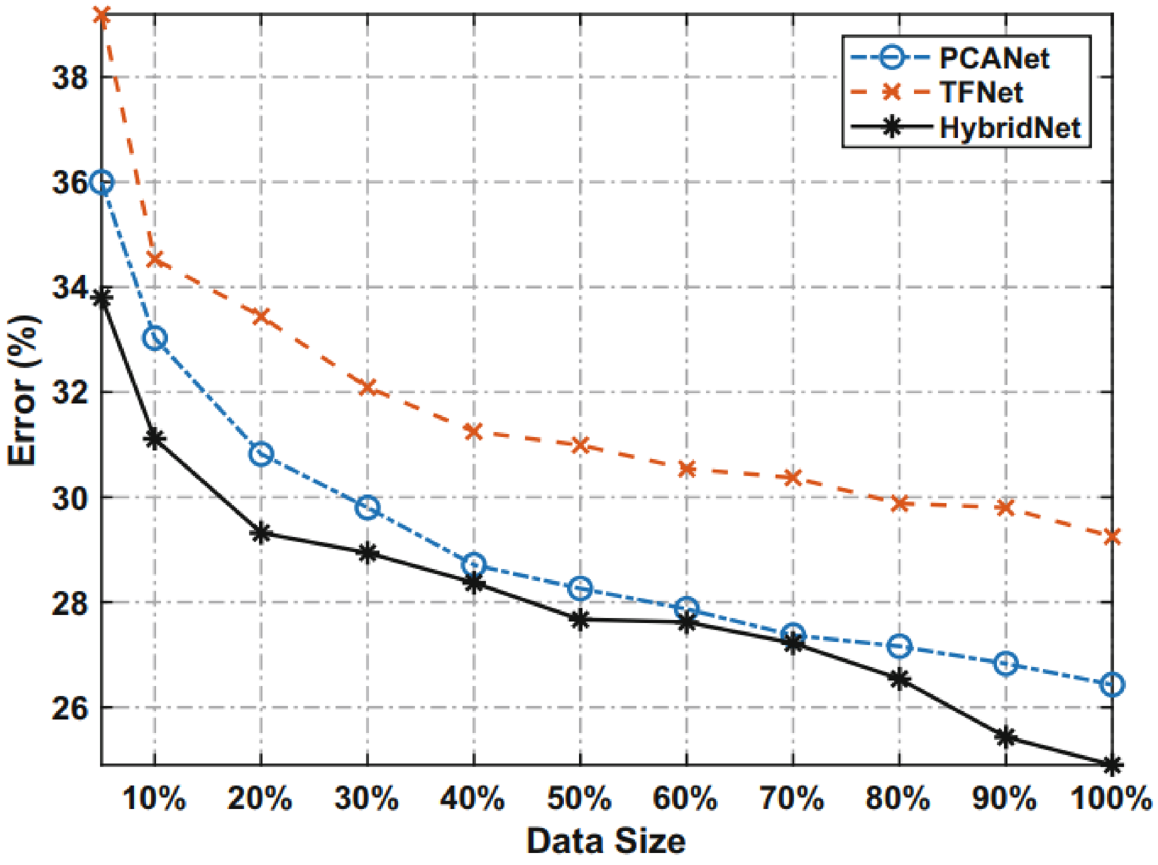
PCANet



CIFAR 10

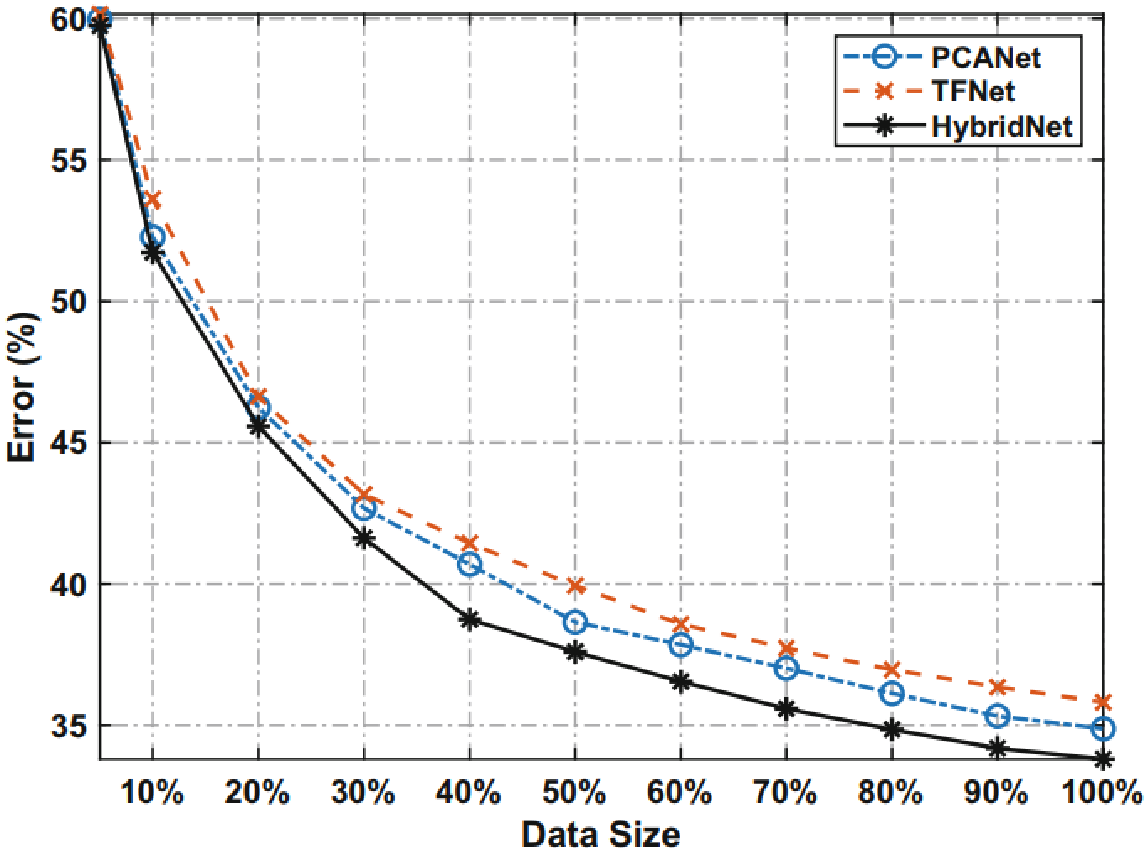
Results

PCANet



CIFAR 10

TensorNet



MNIST bg-img-rot

Contributions

- Contributions and findings
  - Both the amalgamated view and minutiae view of the data are individually insufficient.
  - To preserve the spatial information in the data TDNet is introduced.
  - HDNet is proposed to learn from both the views of the data.

Contributions, Conclusions

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  - Light Weight deep architecture which is unsupervised, fast, and less insensitive to noisy labels
  - Extremely challenging datasets might require more layers and non-linearities.

Contributions, Conclusions, and Future Works

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- Future Works
  - Introduce fusion layer to combine the two networks.
  - Introduction mechanisms to handle rotations in the images.

THANK YOU

Sunny Verma