Glance and Focus: a Dynamic Approach to Reducing Spatial Redundancy in Image Classification

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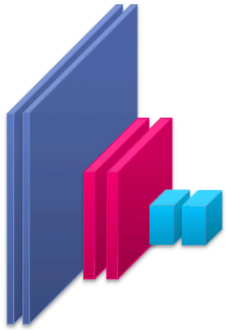
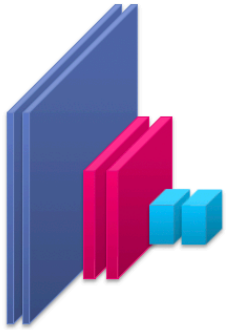
Large Inputs for CNNs

Input Images (224^2, 336^2 and 560^2)	**CNN** (*EfficientNet-B0*)	**Accuracy** (*ImageNet*)	**FLOPs** (*Inference*)
		76.3%	0.39B
		78.1%	0.89B
		**79.6%**	**2.45B**

High resolution inputs give high accuracy.

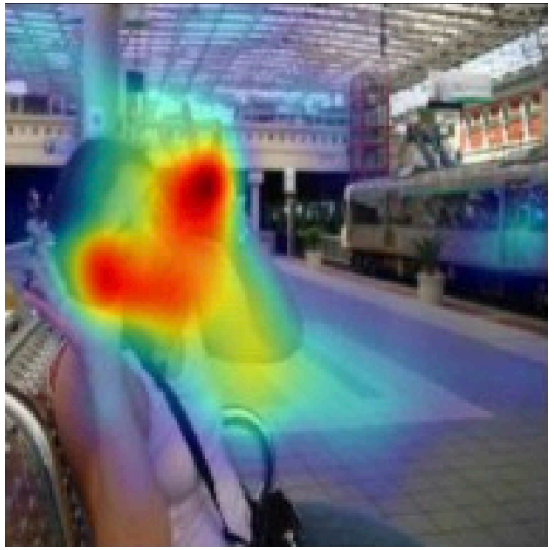
High resolution inputs are **computationally expensive** !

Spatial Redundancy

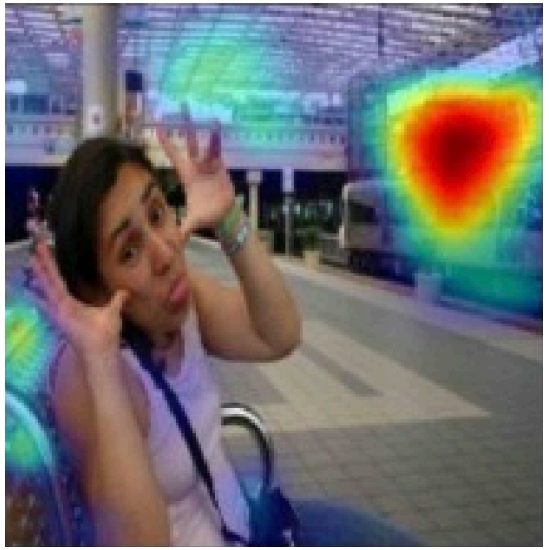
<u>Question:</u> *How do humans recognize objects in large images efficiently?*

- *We (sequentially) attend to some* ***important regions.***

Original Image

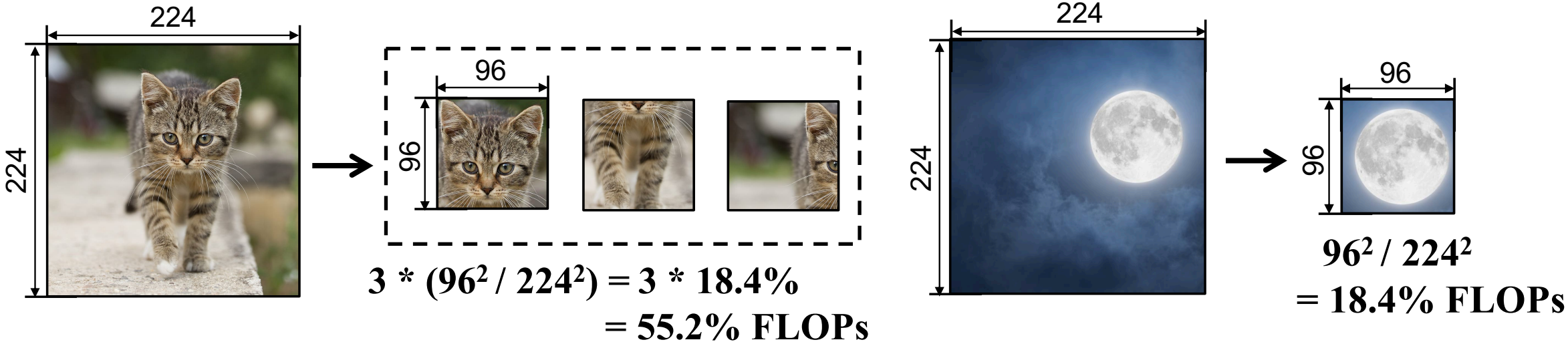


Recognize Person



Recognize Train

Leveraging Discriminative Image Patches



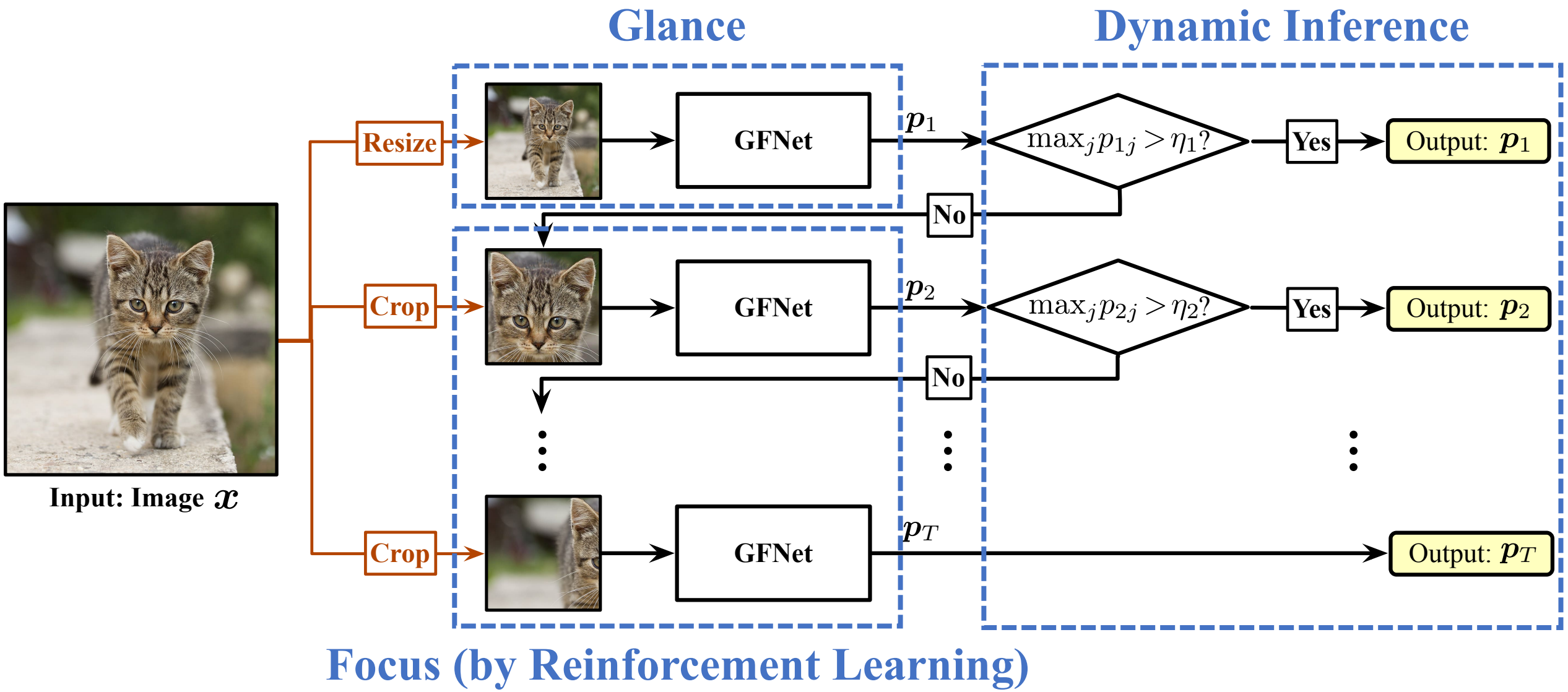
- **Challenge I:** *How to **identify** class-discriminative regions?*

  (***without*** *ground truth bounding boxes*)

- **Challenge II:** *How to determine the **number** of class-discriminative regions?*

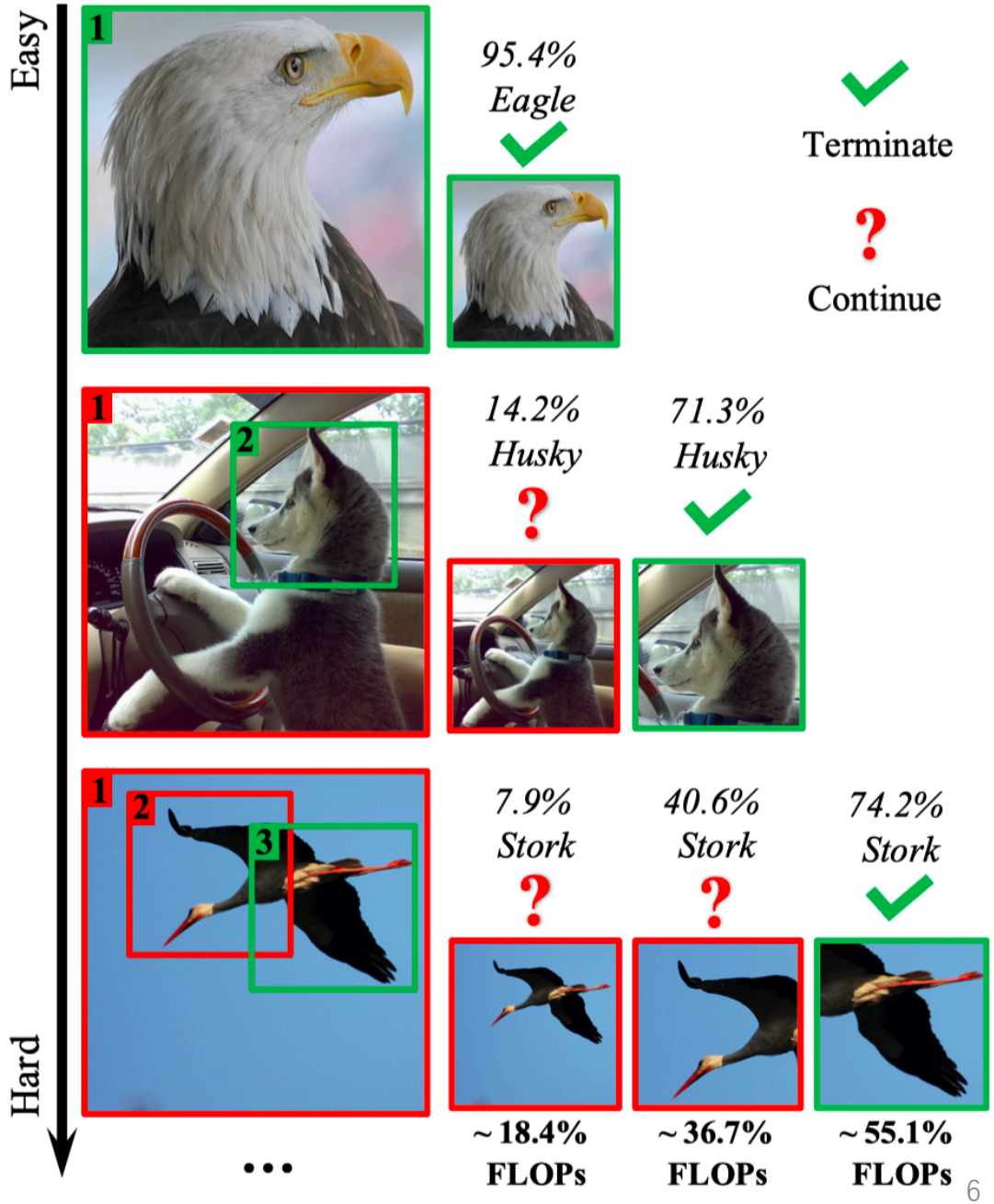
  (*to **adaptively** allocate computation across different inputs*)

A Two-stage Framework

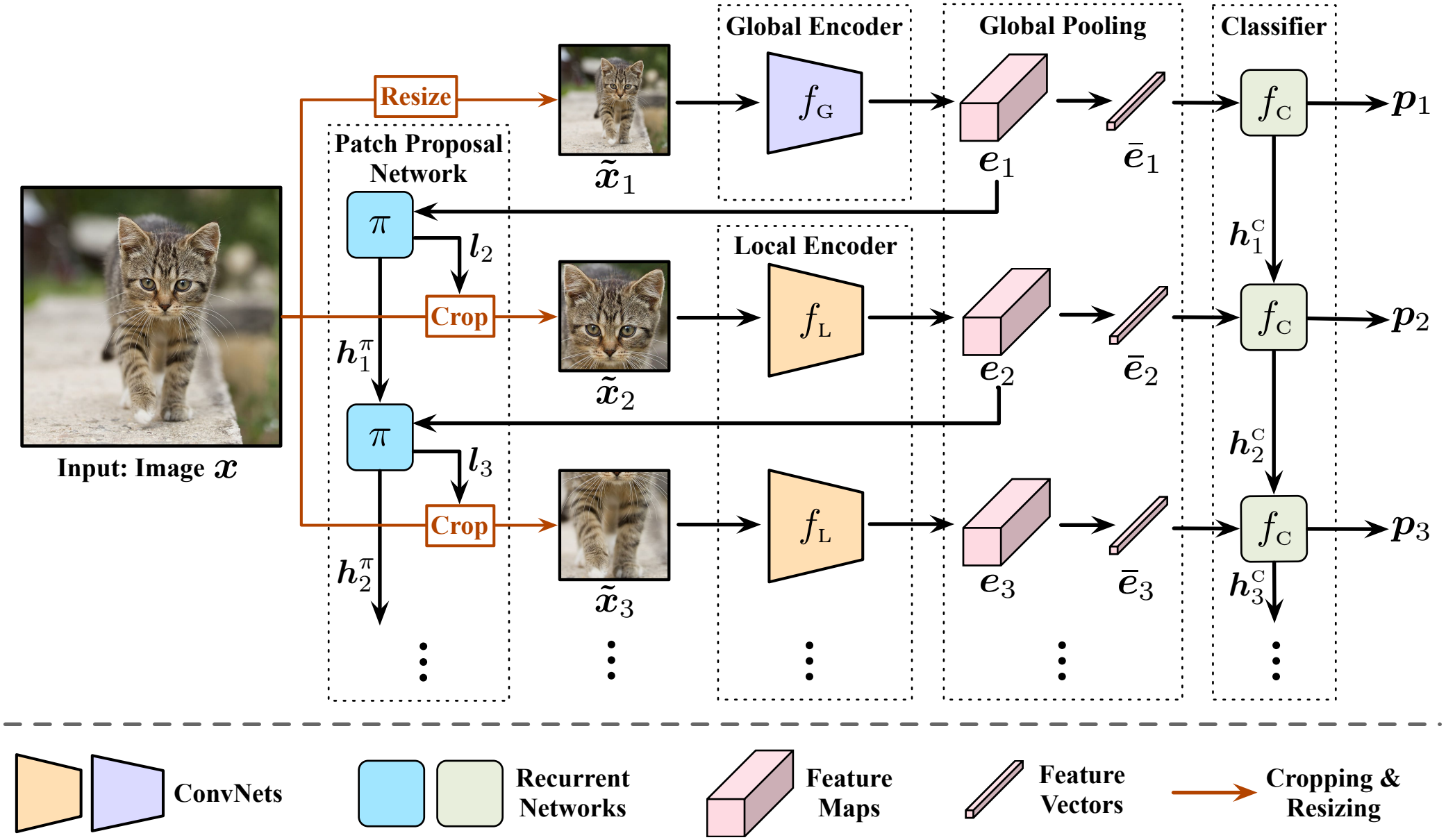


Dynamic Inference

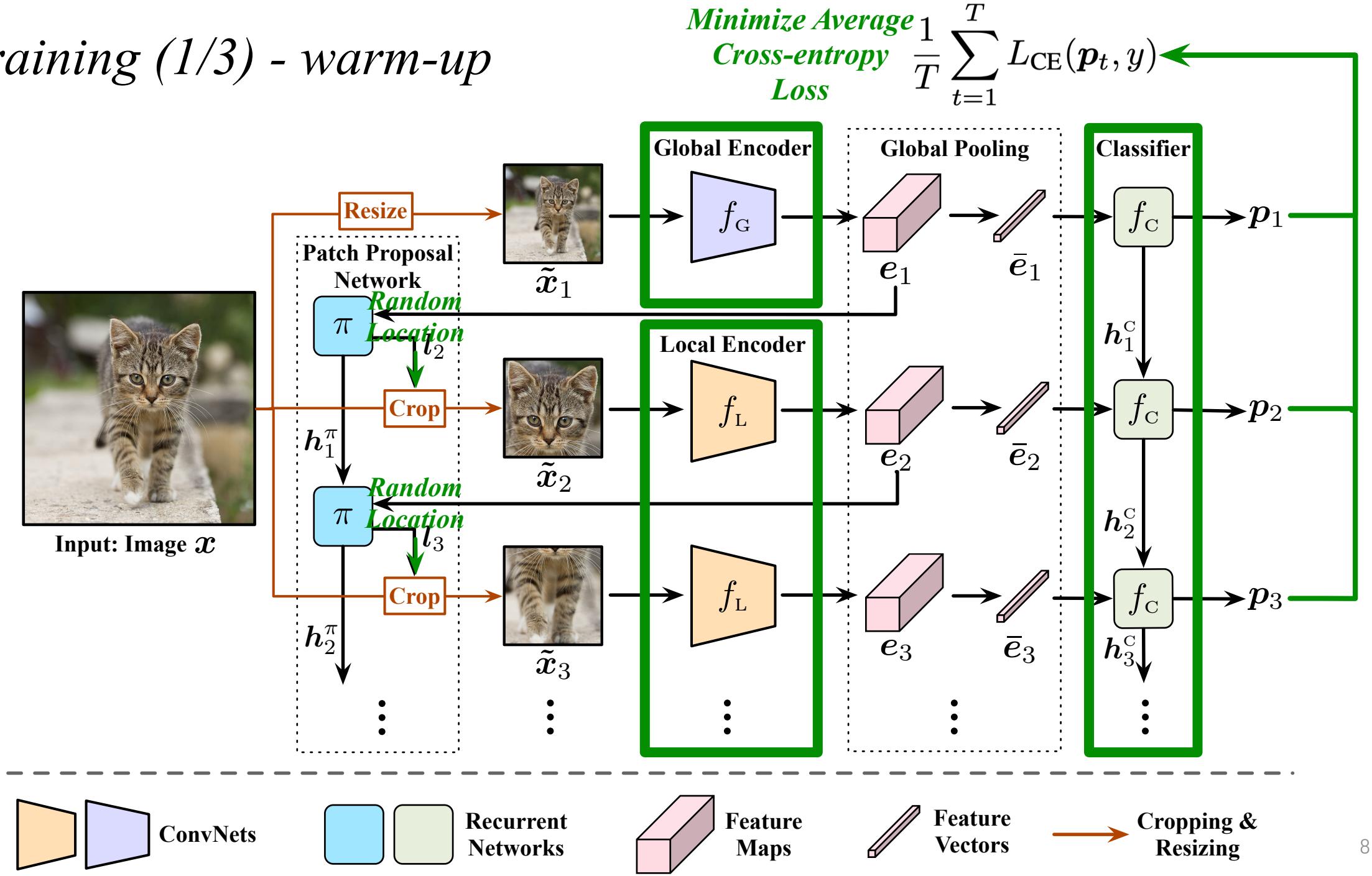
- Allocating computation **unevenly** across different samples



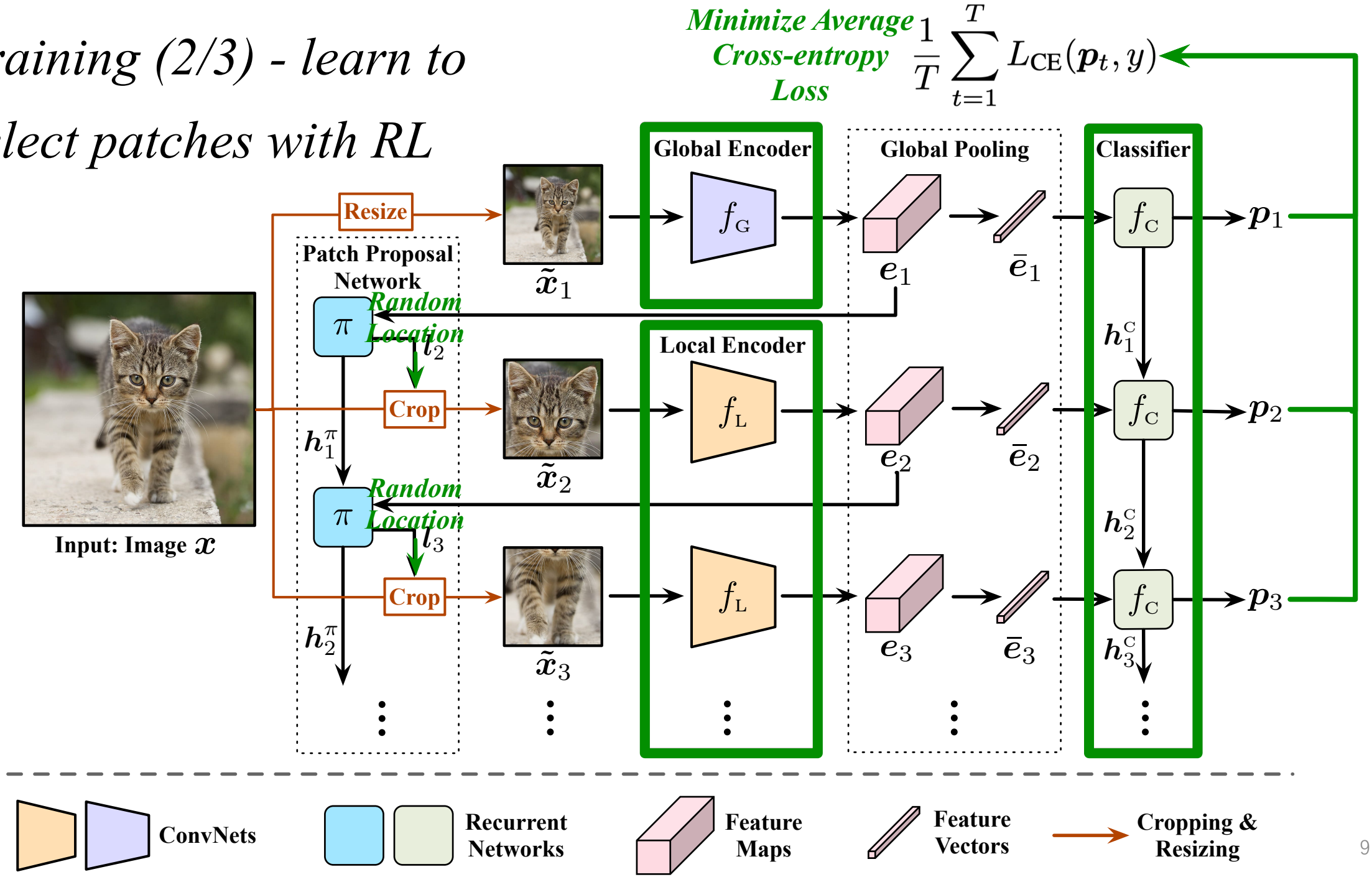
Network Architecture



Training (1/3) - warm-up



Training (2/3) - learn to select patches with RL

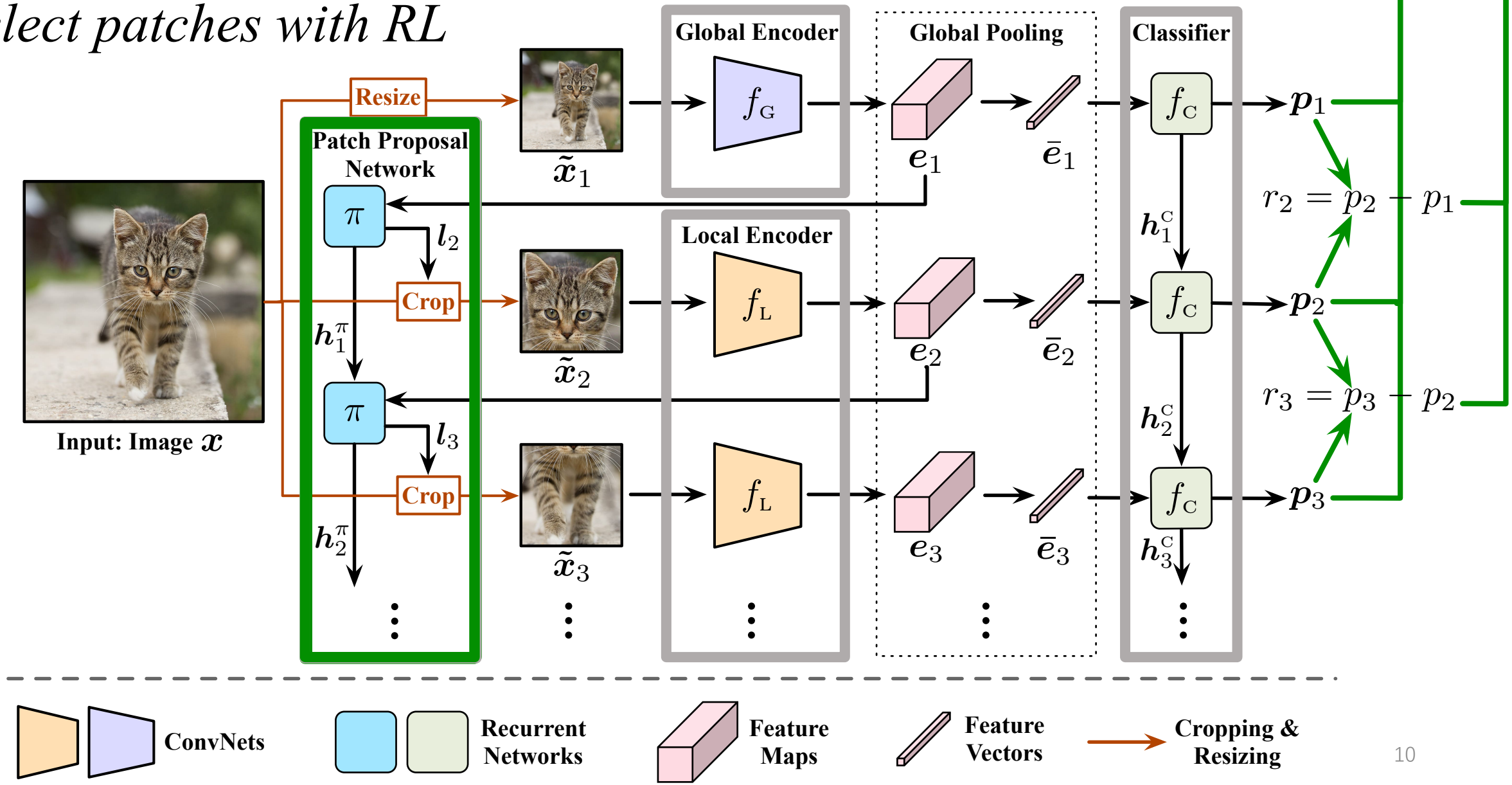


Training (2/3) - learn to select patches with RL

Minimize Average Cross-entropy Loss

Maximize the Discounted Rewards

$$\max_{\pi} \mathbb{E}\left[\sum_{t=2}^{T} \gamma^{t-2} r_t\right]$$

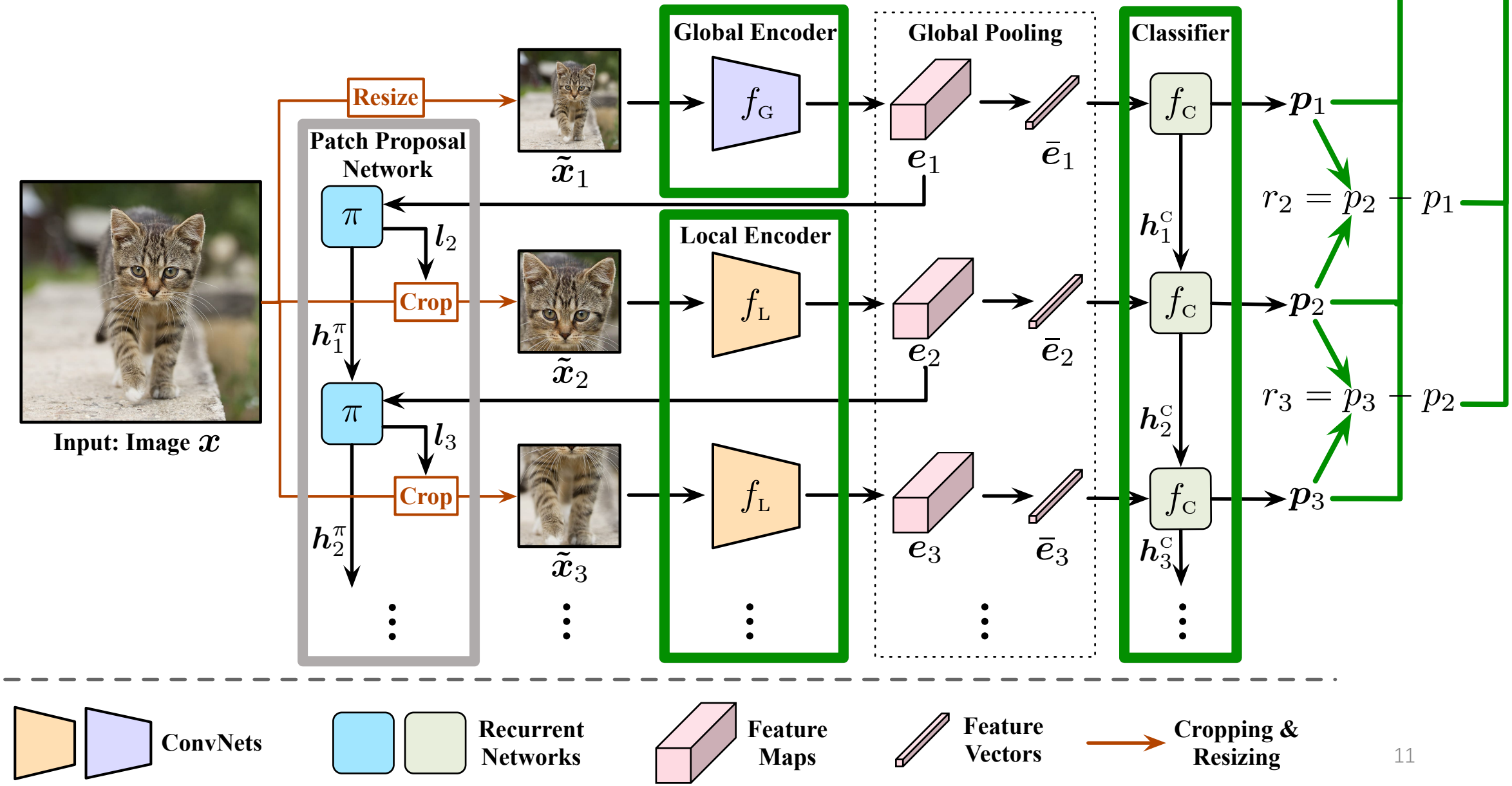


Training (3/3) - finetune CNNs

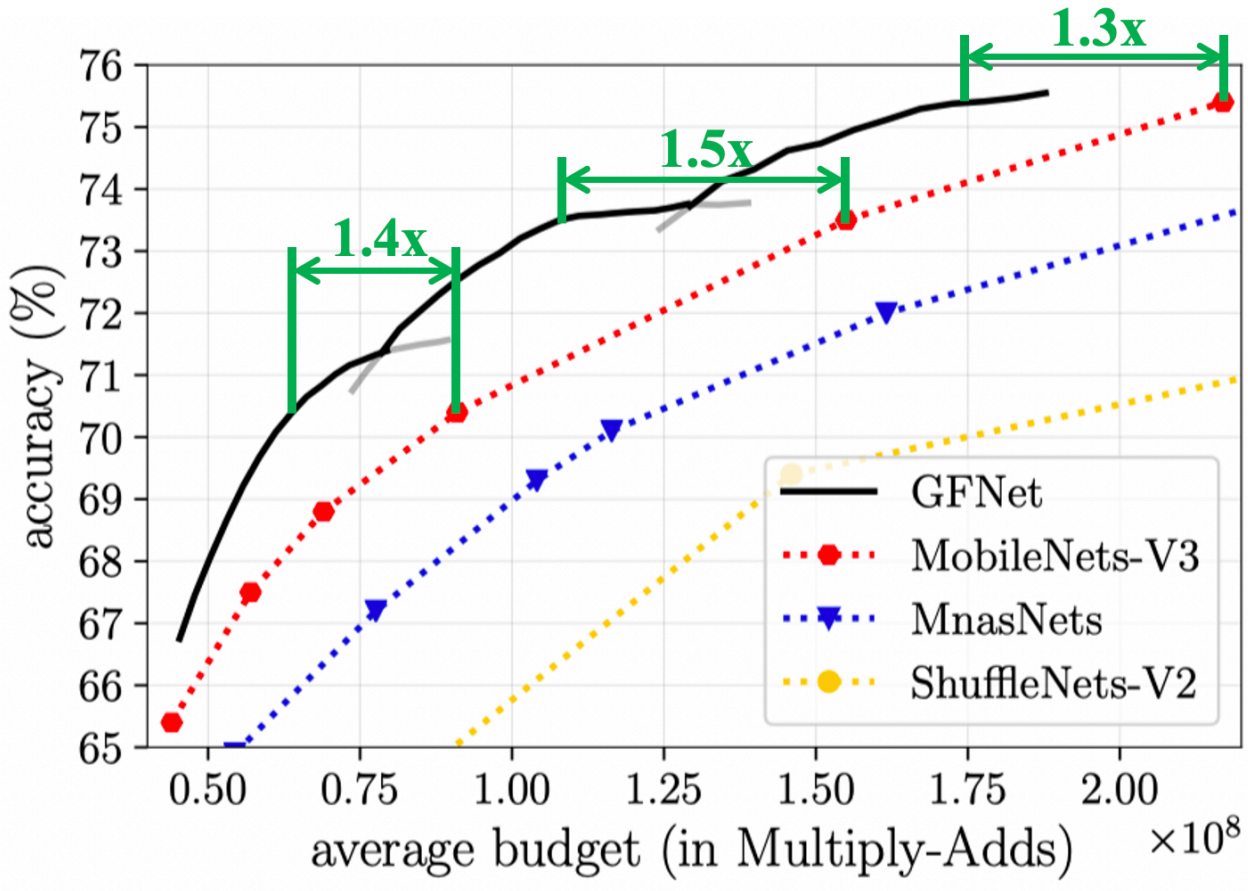
Minimize Average Cross-entropy Loss

Maximize the Discounted Rewards

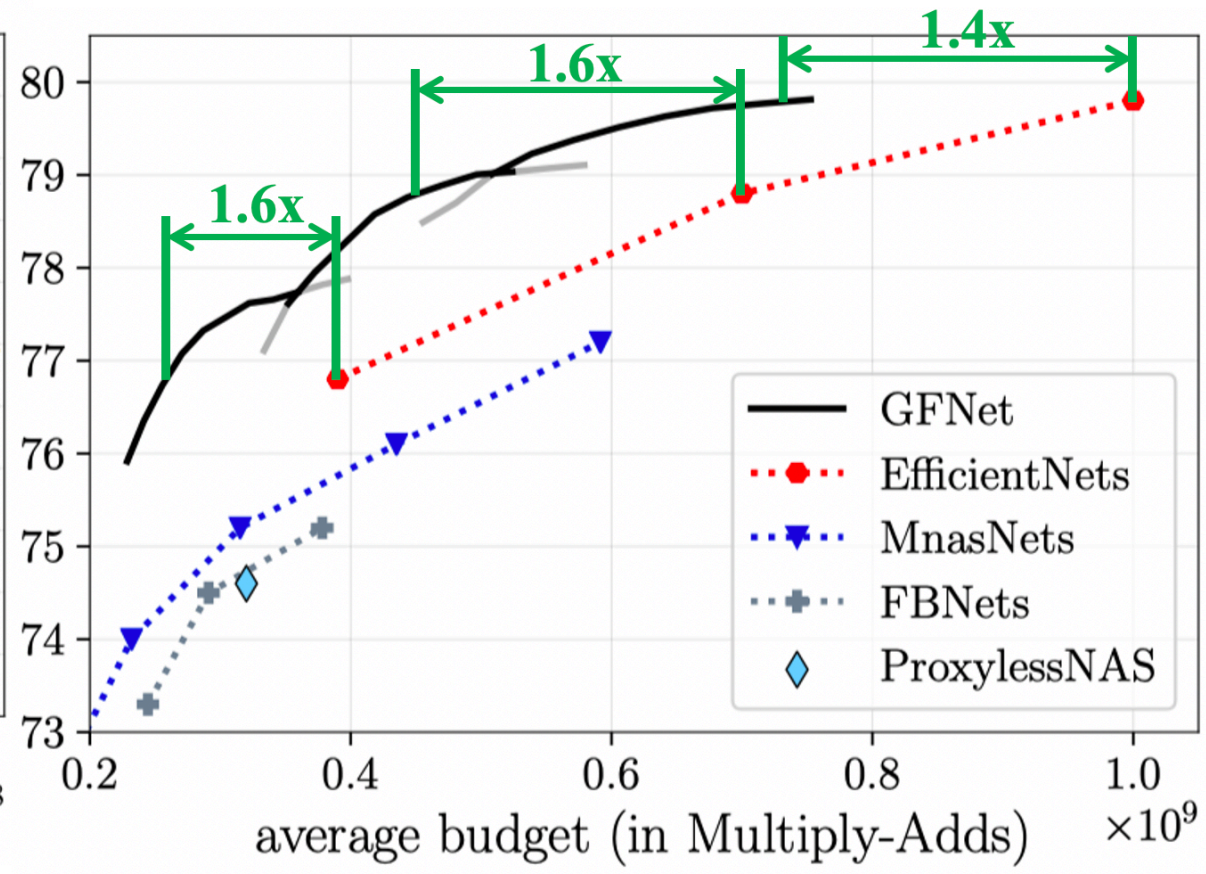
$$\max_{\pi} \mathbb{E}\left[\sum_{t=2}^{T} \gamma^{t-2} r_t\right]$$



Results (FLOPs)

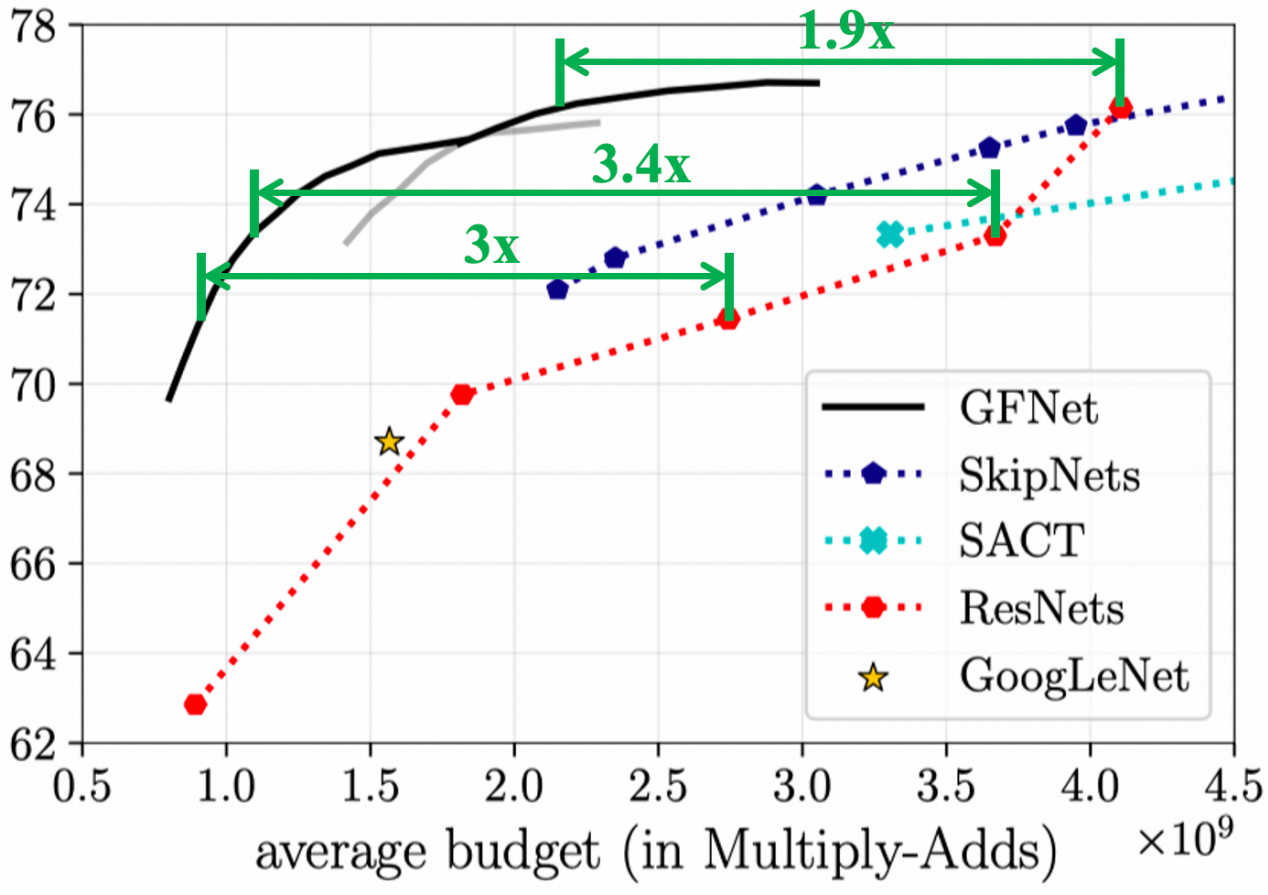


GF-MobileNet-V3



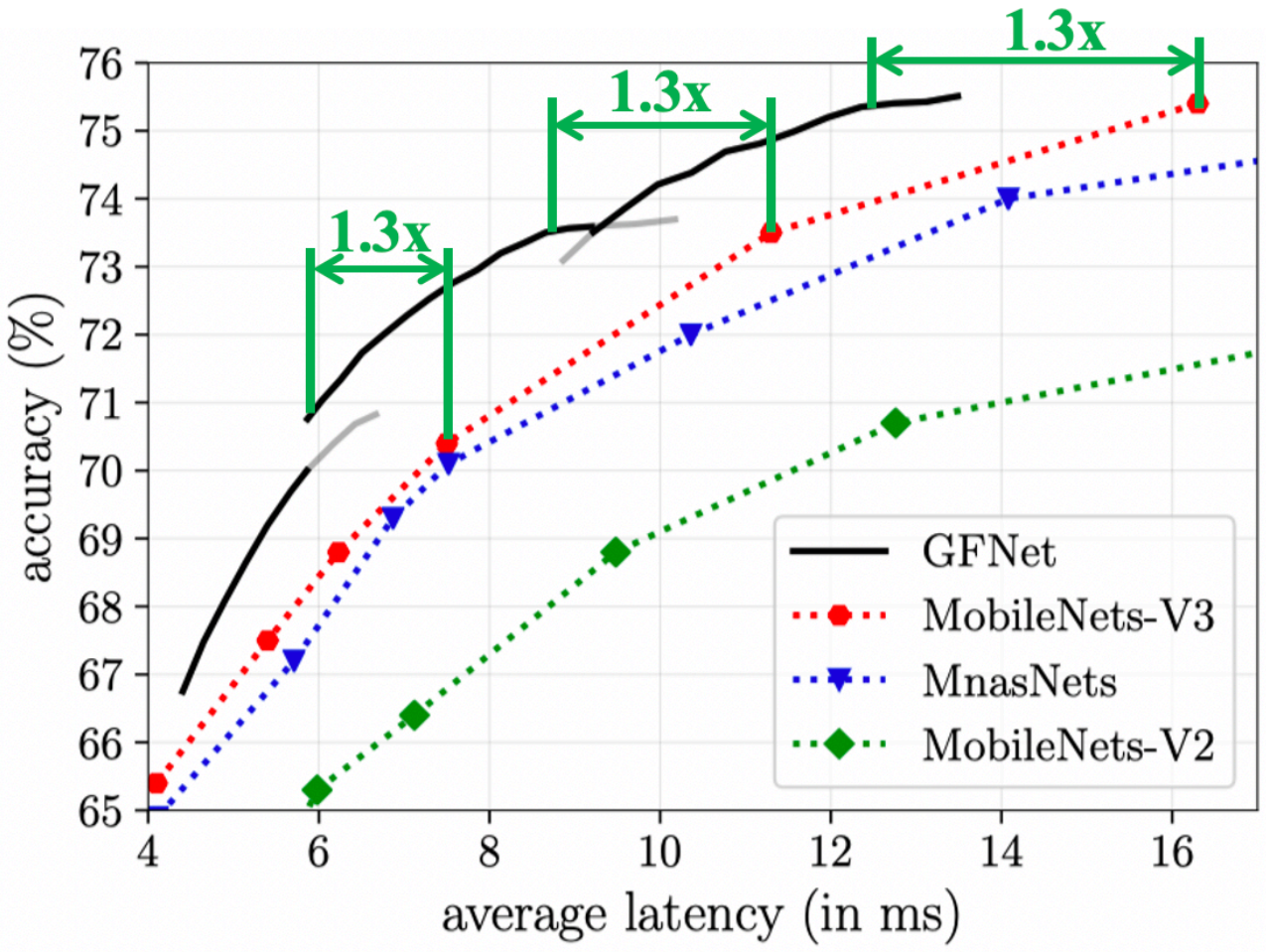
GF-EfficientNet

Results (FLOPs)

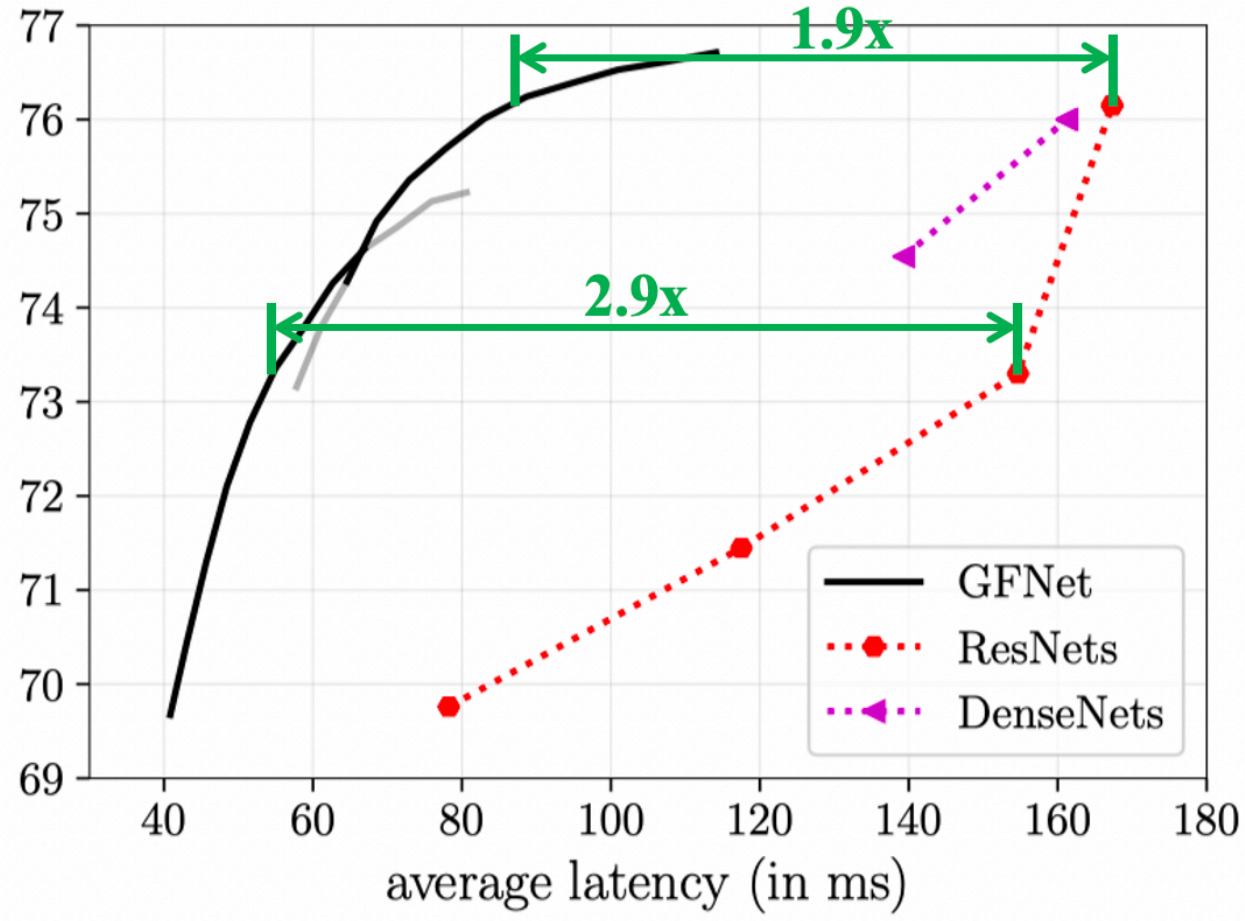


GF-ResNet

Results (iPhone XS Max)

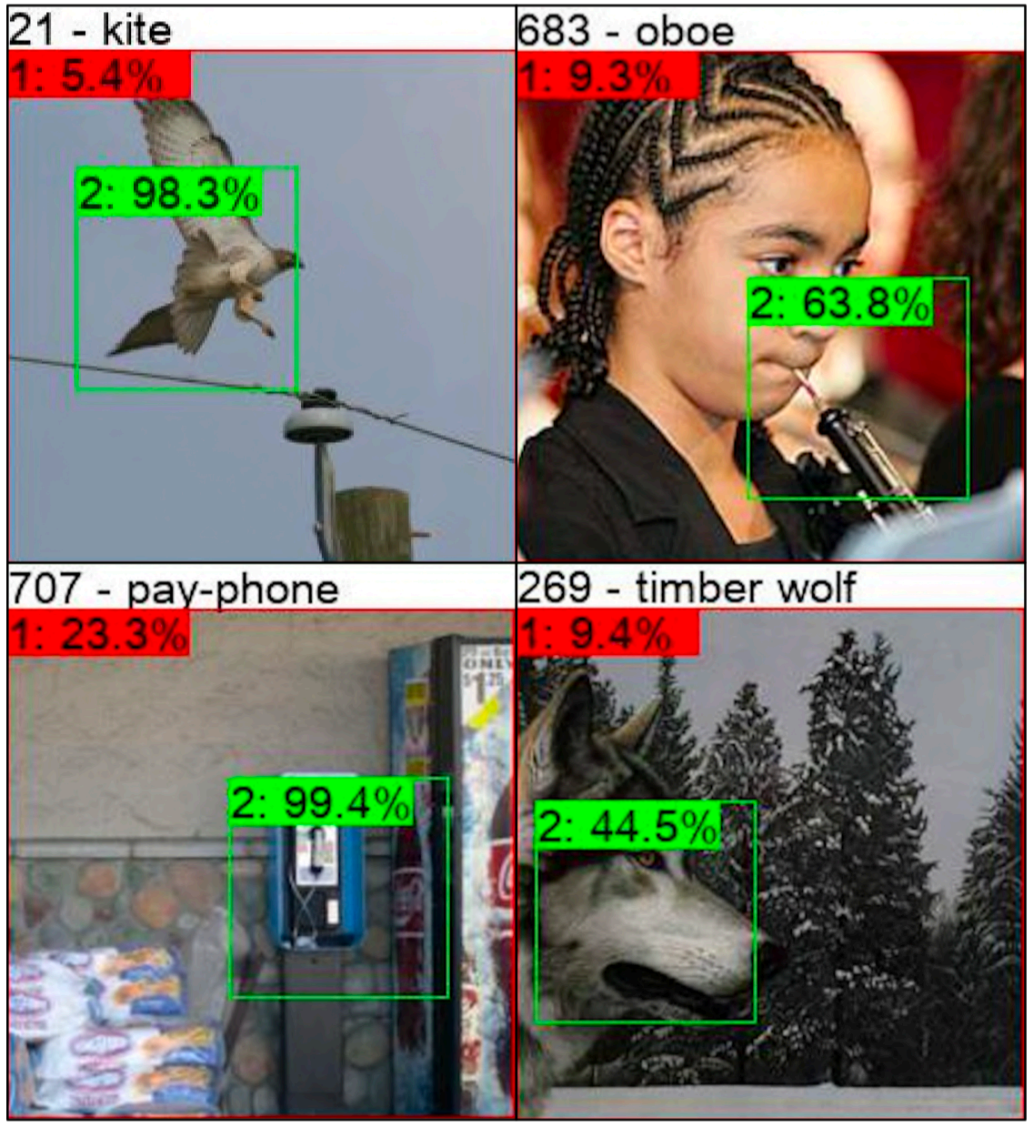


GF-MobileNet-V3

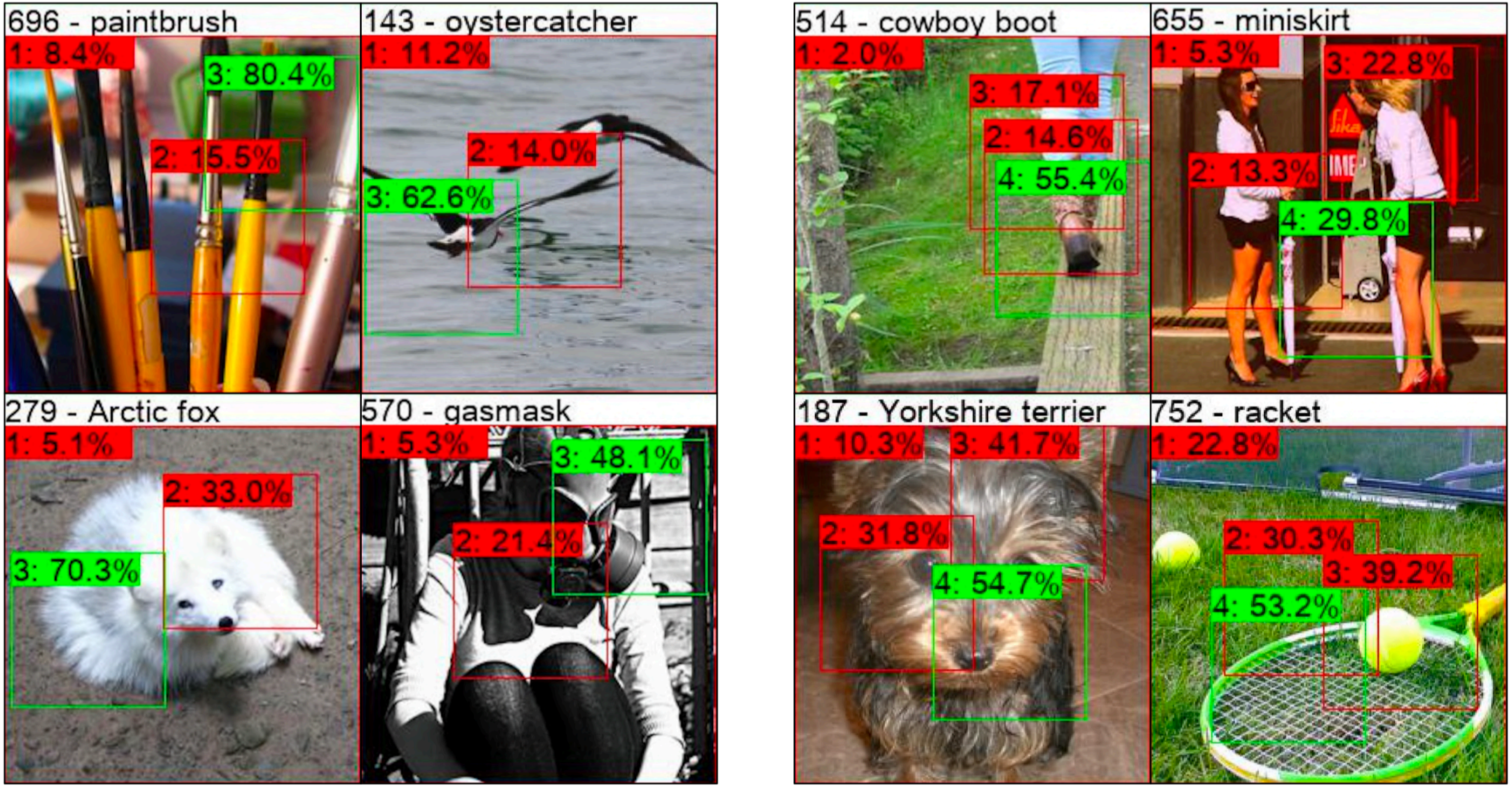


GF-ResNet

Results (visualization)



Results (visualization)



Thank You for the Time!

For more details, please refer to our paper.

Paper

Code

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(My Homepage)