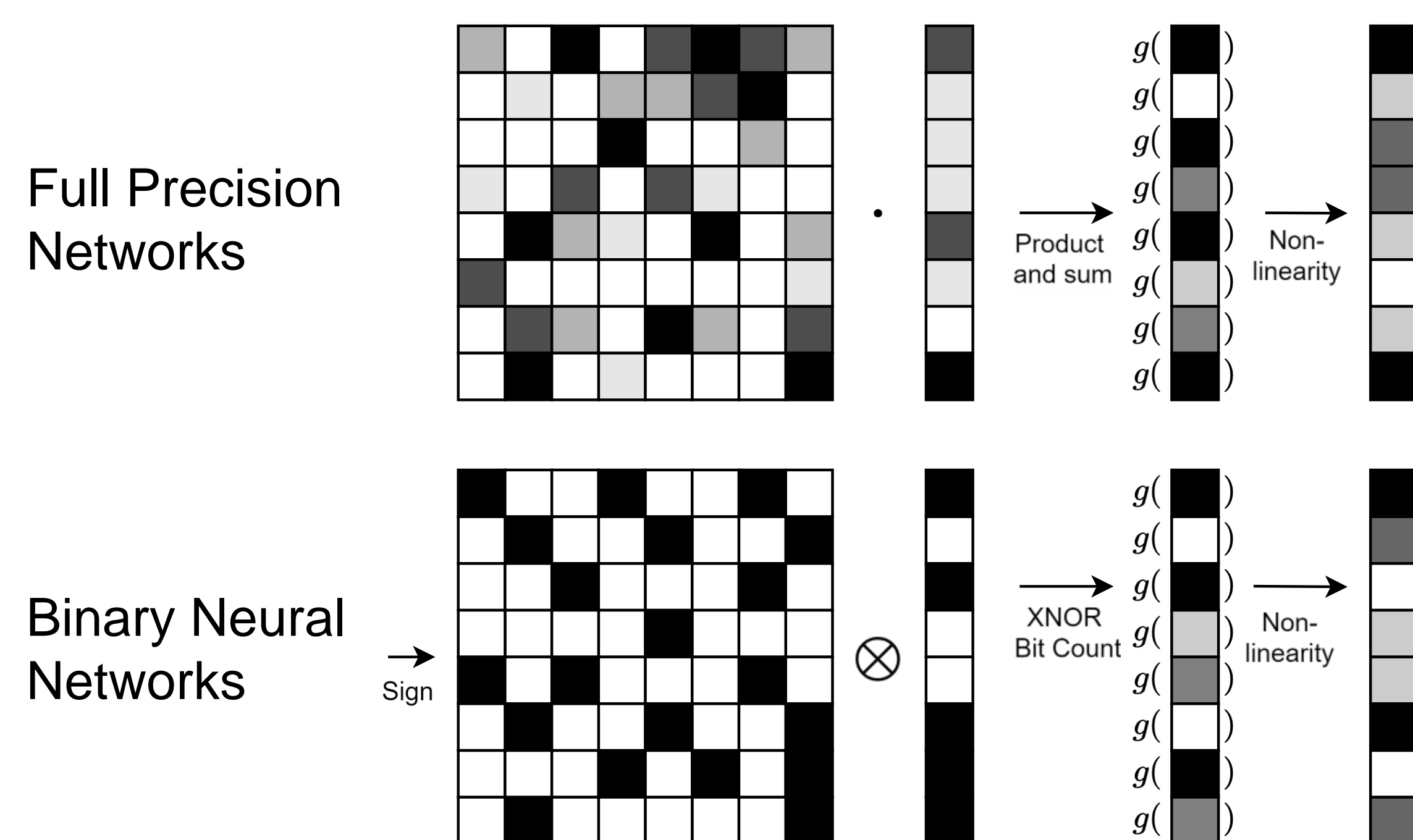


Our Contributions

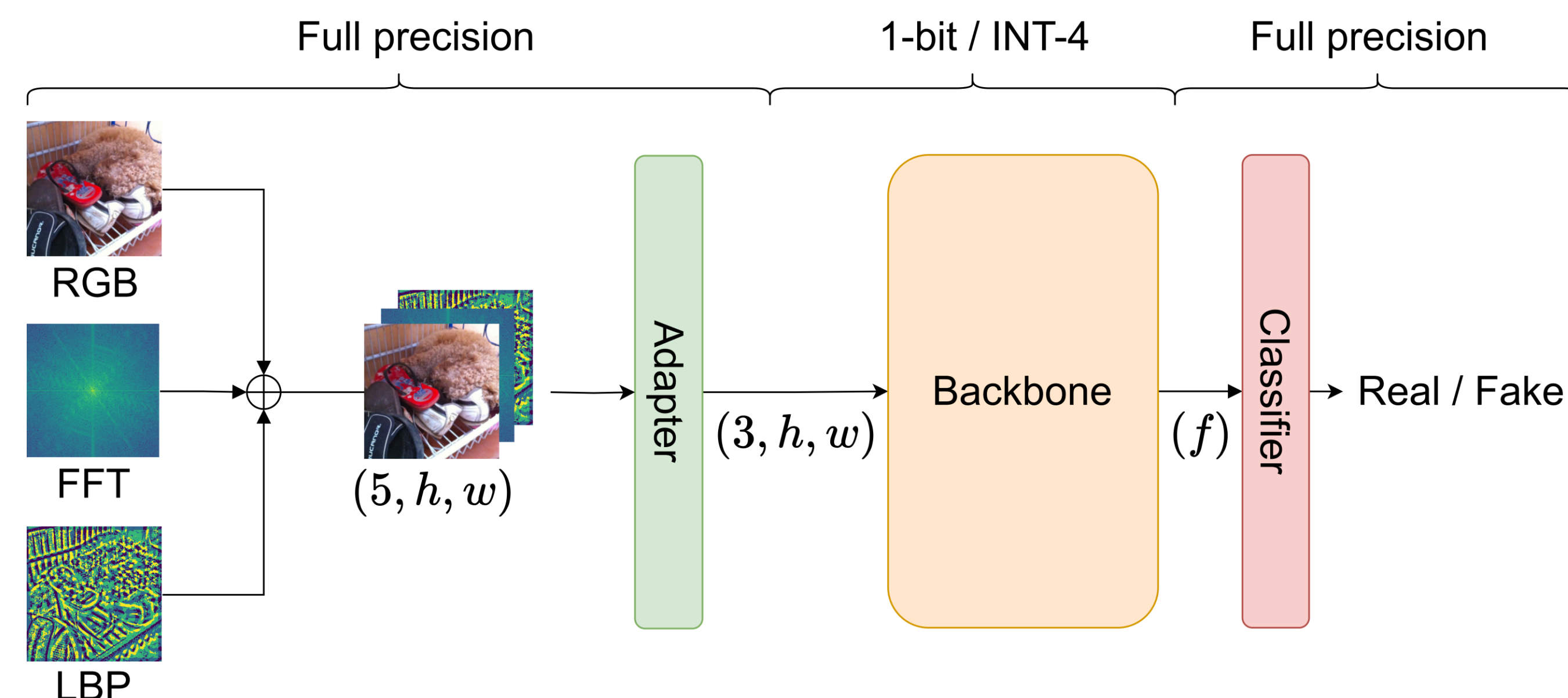
- We propose the **first-ever implementation of a Binary Neural Network (BNN)¹ for Deepfake Detection**, enabling efficient detection on low-resource devices.
- Our method showcases **robust performance** through extensive experimentation on three benchmark datasets: COCOFake², DFFD³, and CIFAKE⁴.
- An ablation study highlights the impact of our design choices and opens avenues for fine-tuning BNNs across different domains.

Binary Neural Networks

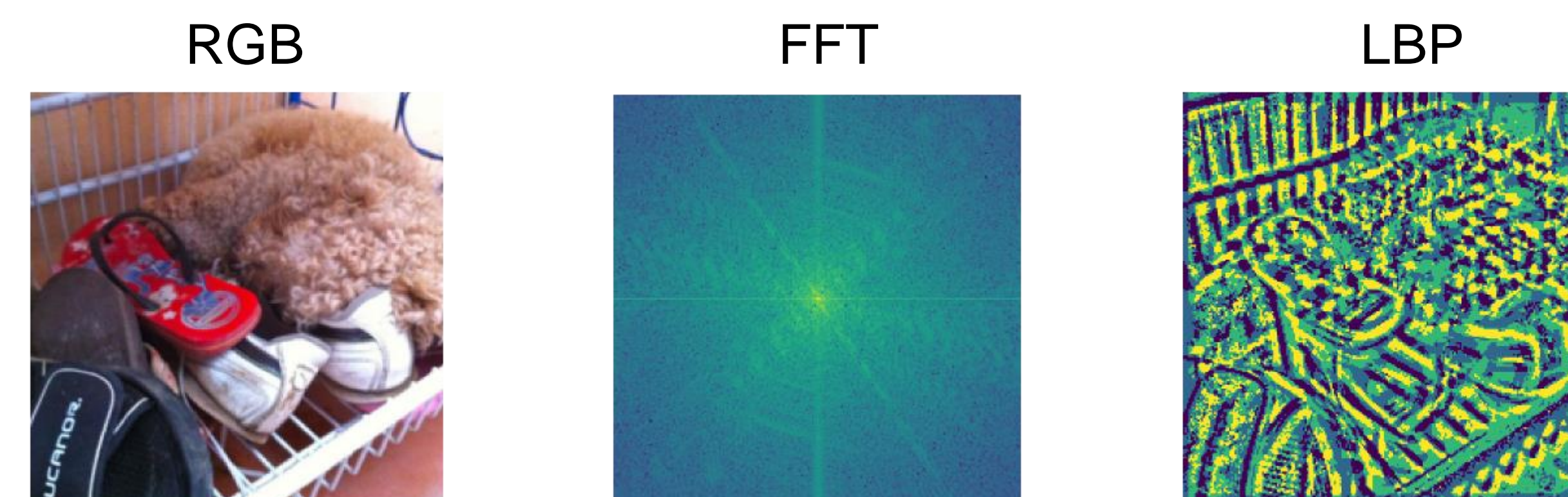


Precision	Operations	Memory saving	Computational saving	Input domain	Output domain
32 bits	+, -, ×	×1	×1	\mathbb{R}	\mathbb{R}
1 bit	XNOR, bitcount	×32	×58	$\{-1, 1\}$	\mathbb{Z}

Architecture



Features



Can RGB, FFT, and LBP help to reveal micropatterns?

Ablation	Variations	Accuracy (%)
Baseline	-	90.35
Features added to the learned ones	Magnitude	82.36
	FFT	88.18
	LBP	88.42
	Magnitude and FFT	81.20
	Magnitude and LBP	81.67
	FFT and LBP	91.60
	Magnitude, FFT and LBP	81.56

Code

github.com/fedeloper/binary_deepfake_detection



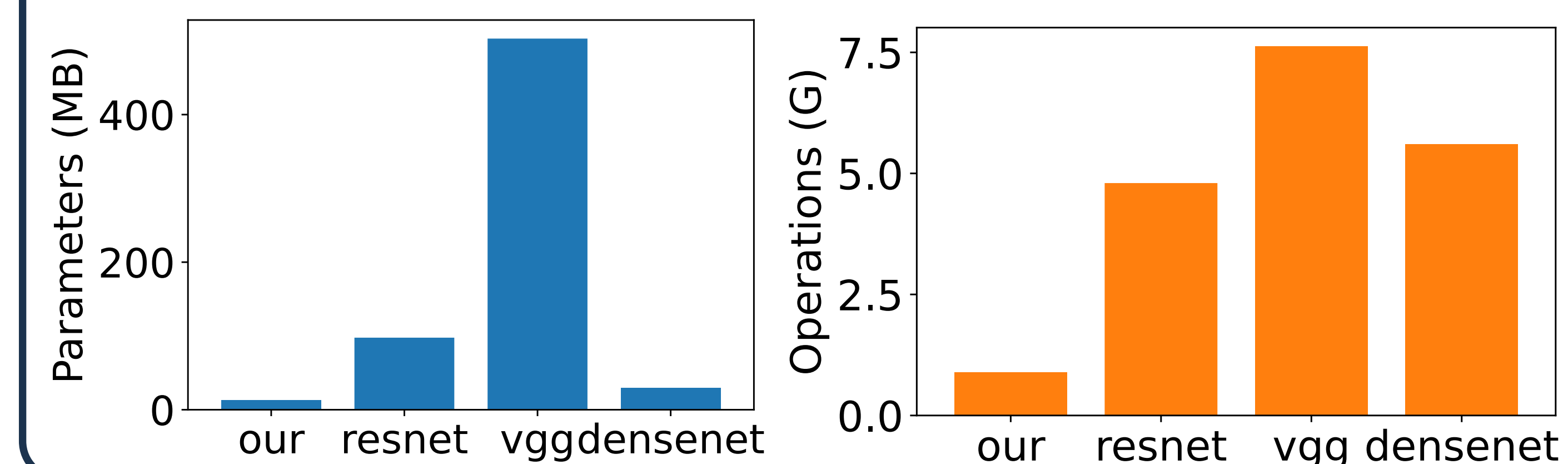
Results



Method	Model	Pre-training dataset	Accuracy	AUC	Parameters (M)	FLOPs (G)
[2]	ResNet50	ImageNet	90.31	-	25.6	4.8
	ViT-B/32	ImageNet	87.64	-	88.3	8.56
	CLIP-ResNet50	OpenAI WIT	99.07	-	25.6	4.8
	CLIP-ViT-B/32	OpenAI WIT	99.11	-	88.3	8.56
	OpenCLIP-ViT-B/32	LAION-400M	97.88	-	88.3	8.56
	OpenCLIP-ViT-B/32	LAION-2B	99.68	-	88.3	8.56
Ours	BNext-T with frozen backbone	ImageNet	83.65	81.98	29.8	0.89
	BNext-S with frozen backbone	ImageNet	93.15	95.19	67.1	1.91
	BNext-M with frozen backbone	ImageNet	84.59	82.11	133	3.39
	BNext-T	ImageNet	99.25	99.86	29.8	0.89
	BNext-S	ImageNet	99.28	99.89	67.1	1.91
	BNext-M	ImageNet	99.18	99.91	133	3.39

Efficiency

We measured the efficiency using number of operations in inference and space need for storage



¹ Hubara, I., et al, "Binarized Neural Networks," NIPS 2016

² Amoroso, R., et al, "Parents and children: Distinguishing multimodal deepfakes from natural images." arXiv preprint 2023

³ Dang, H., et al, "On the detection of digital face manipulation" CVPR 2020

⁴ Bird, J., et al, "Cifake: Image classification and explainable identification of AI-generated synthetic images" IEEE Access 2024