Table 1: **CIFAR and Tiny ImageNet Base Architecture.** Reference architecture used for experiments on CIFAR-10, CIFAR-100 and Tiny ImageNet. This architecture is based off the VGG[1] architecture. C is a hyperparameter that controls the network width, we use $C = 64$ for our initial tests. The activation size rows are offset from the layer description rows to convey the input and output shapes.

(a) Reference

Layer	Act. Size
	$3 \times 32 \times 32$
convA, $w \in \mathbb{R}^{21\times3\times3\times3}$	$21 \times 32 \times 32$
pool1, max pool 2×2	$21 \times 16 \times 16$
convB, $w \in \mathbb{R}^{147\times21\times3\times3}$	$147 \times 16 \times 16$
pool2, max pool 2×2	$147 \times 8 \times 8$

(b) Reference 2

Layer	Act. Size
	$3 \times 32 \times 32$
conv0, $w \in \mathbb{R}^{16\times3\times3\times3}$	$16 \times 32 \times 32$
convA, $w \in \mathbb{R}^{50\times16\times3\times3}$	$50 \times 32 \times 32$
pool1, max pooling 2×2	$50 \times 16 \times 16$
convB, $w \in \mathbb{R}^{147\times50\times3\times3}$	$147 \times 16 \times 16$
pool2, max pooling 2×2	$147 \times 8 \times 8$

(c) Original ScatterNet

Layer	Act. Size
	$3 \times 32 \times 32$
scat1, no w	$21 \times 16 \times 16$
scat2, no w	$147 \times 8 \times 8$

(d) Learnable ScatterNet

Layer	Act. Size
	$3 \times 32 \times 32$
inv1, $A \in \mathbb{R}^{21\times21}$	$21 \times 16 \times 16$
inv2, $A \in \mathbb{R}^{147\times147}$	$147 \times 8 \times 8$

(e) Learnable ScatterNet with conv0

Layer	Act. Size
	$3 \times 32 \times 32$
conv0, $w \in \mathbb{R}^{16\times3\times3\times3}$	$16 \times 32 \times 32$
inv1, $A \in \mathbb{R}^{50\times112}$	$50 \times 16 \times 16$
inv2, $A \in \mathbb{R}^{147\times350}$	$147 \times 8 \times 8$