Depth Prediction and RGBD Images for Recognition

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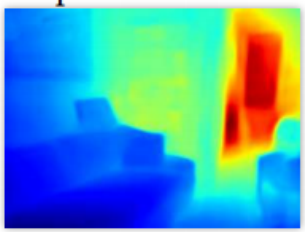
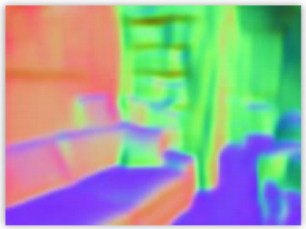
May 25, 2016

Related work and motivation

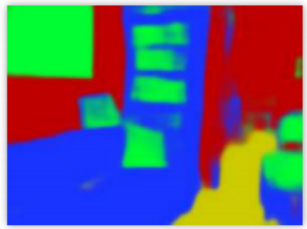
Depth

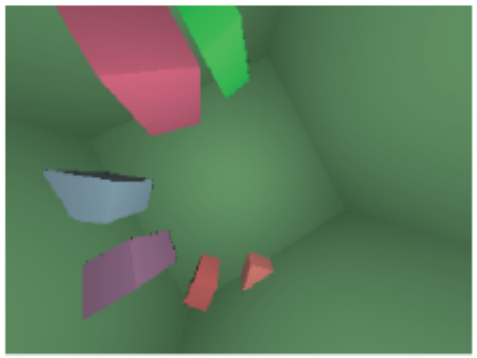


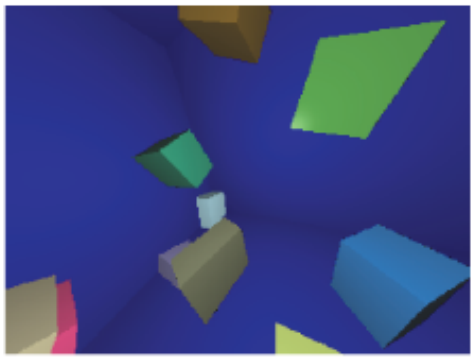
Normals

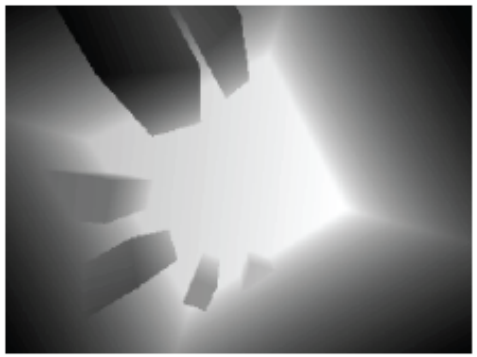


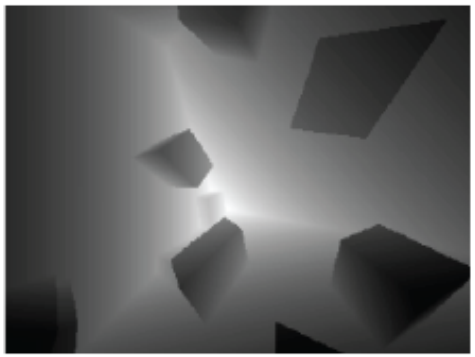
Labels







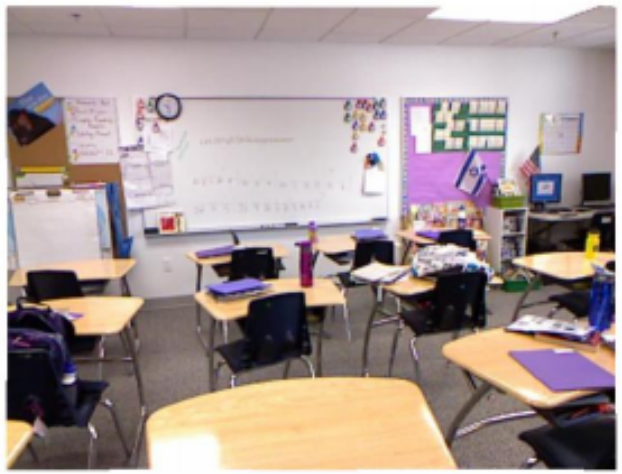




overview

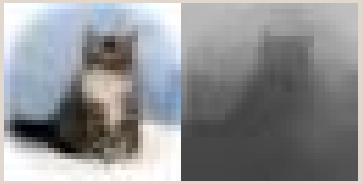
our project: depth estimation & Classification on RGBD images

implement previous work



Go further

(2) Build a RGBD CIFAR10 based on indoor depth knowledge



(3) Compare RGBD and RGB

$label = f(RGBD)$

$label = f(RGB)$

infer depth from RGB image

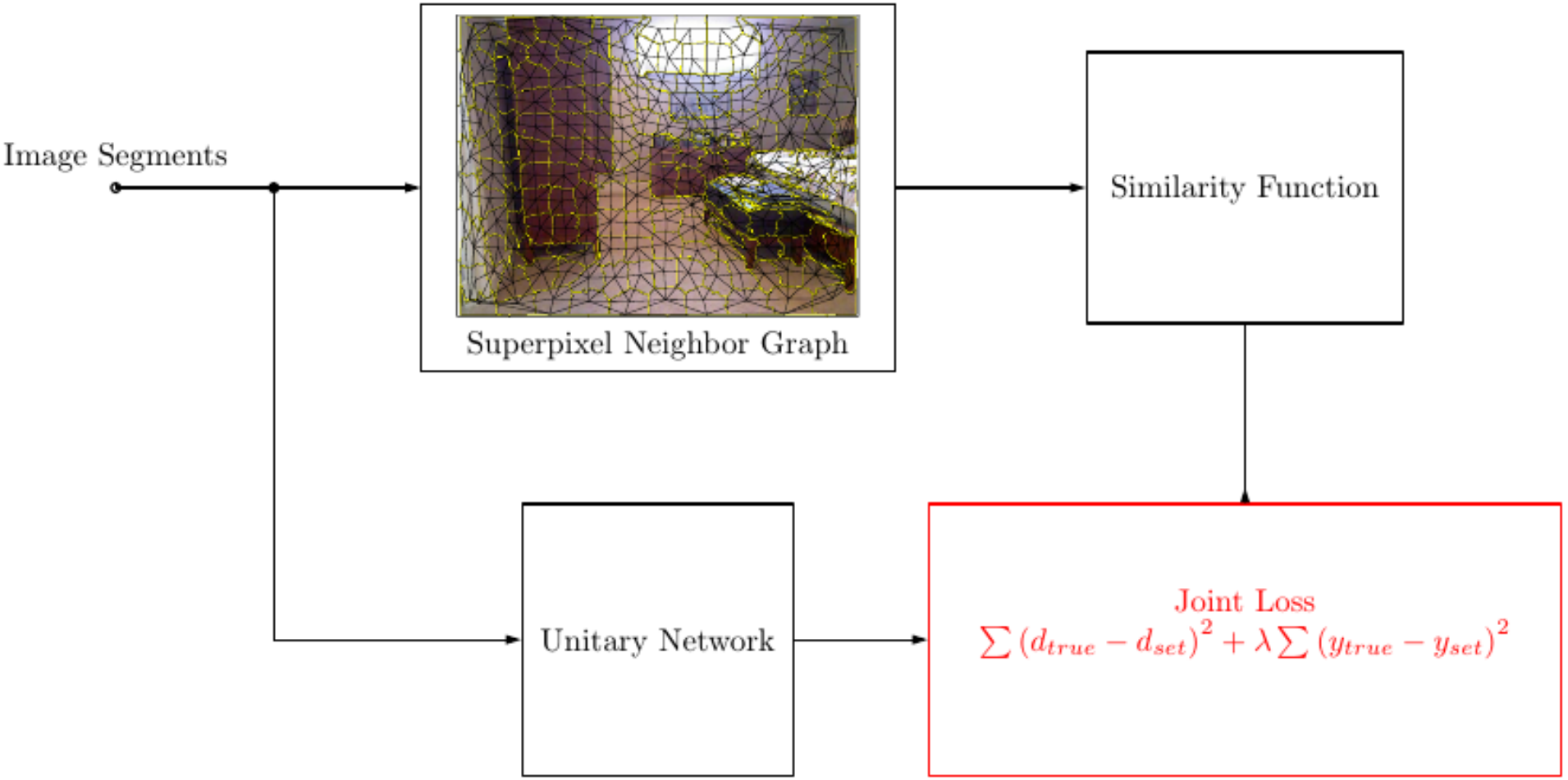
Infer depth from RGB image: Loss defination

At training time, we combine two objective function[1]

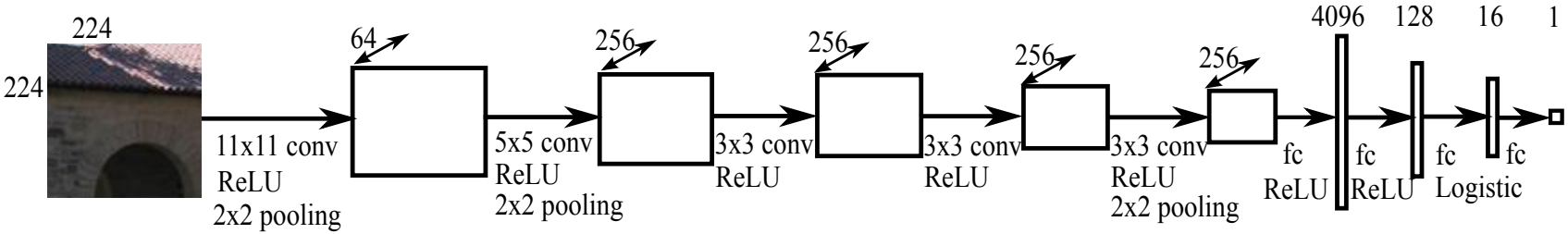
1. regress to groud truth depth image(Kinect, PrimeSense) $\Sigma_p(y_p - \hat{y}_p)^2$, p stands for pixel.
2. Similarity between superpixels. $R_{pq} = \sum_{k=1}^{K} \beta_k S_{pq}^{(k)}$ β is trainable weight. S is similarity function.

[1] Fayao Liu, Chunhua Shen, and Guosheng Lin. "Deep convolutional neural fields for depth estimation from a single image". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2015, pp. 5162–5170.

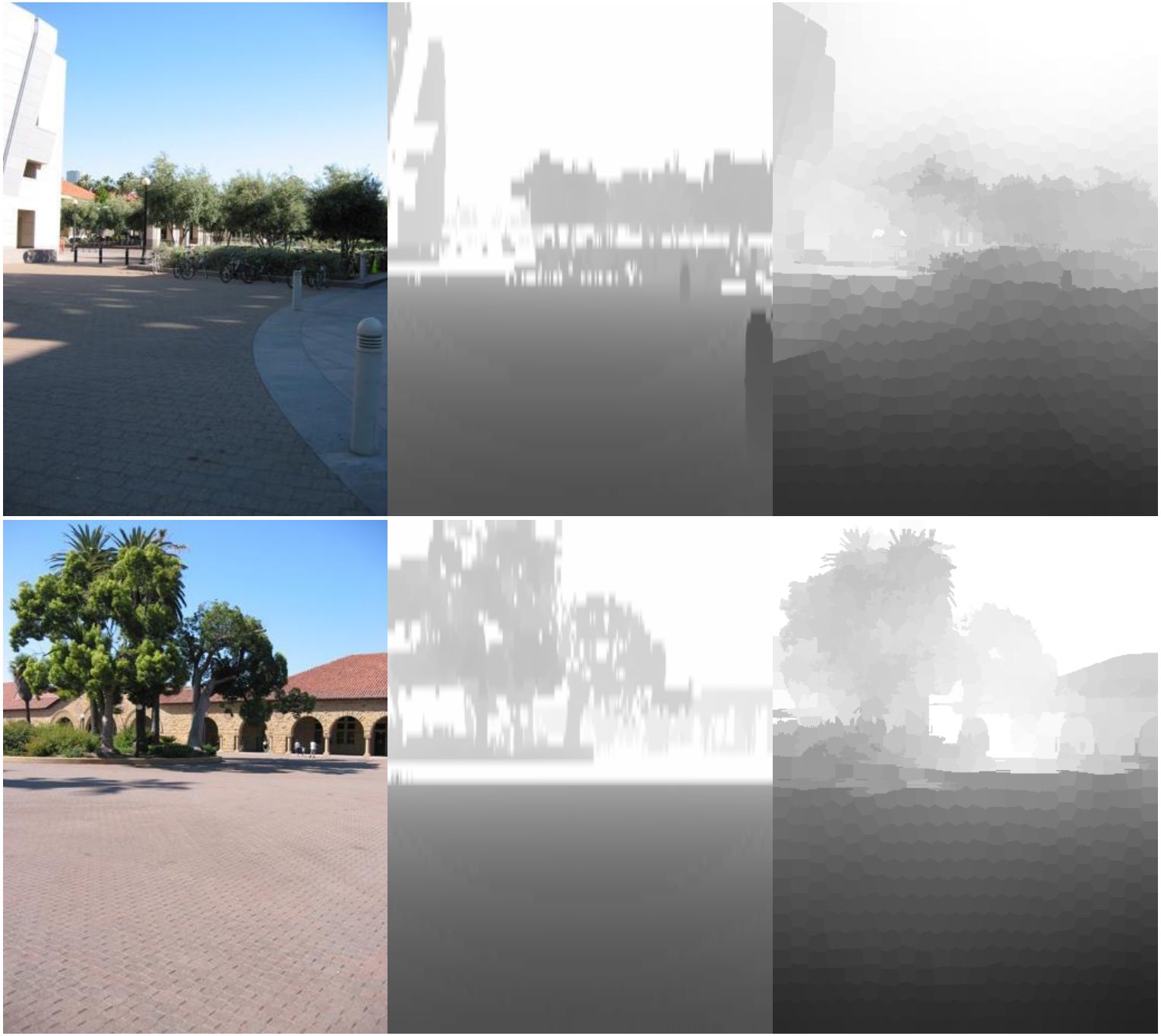
Architecture: Deep convolutional Neural Field



Infer depth from RGB image: Supervised part



using traditional CNN.



Compare performance with original paper

Method	Error (lower is better)			Accuracy (higher is better)		
	rel	log10	rms	$\delta < 1.25$	$\delta < 1.25^2$	$\delta < 1.25^3$
Our implementation	**0.252**	0.103	0.860	0.544	**0.861**	0.943
Original paper	0.230	**0.095**	**0.824**	**0.614**	0.883	**0.971**

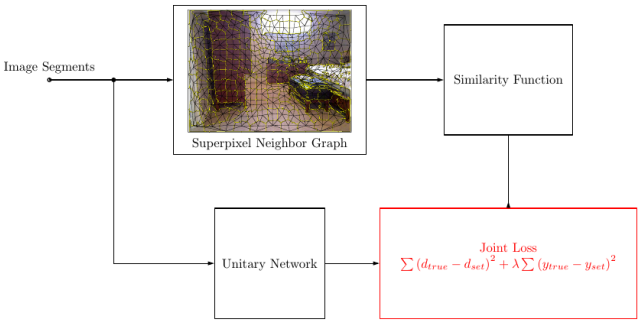
Table: Sanity check (**Bold** is better)

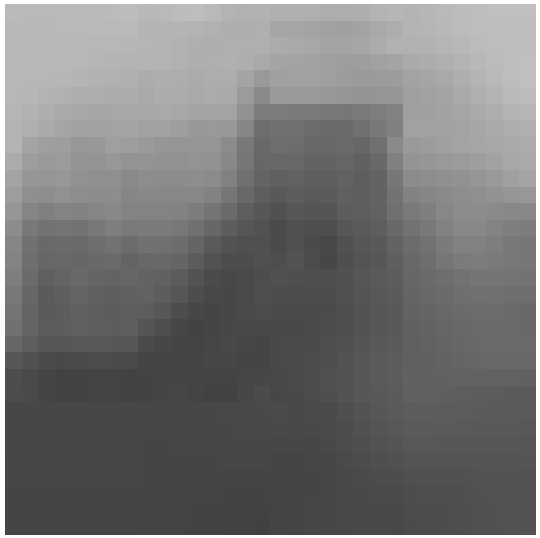
Classification on RGBD images

build RGBD CIFAR dataset

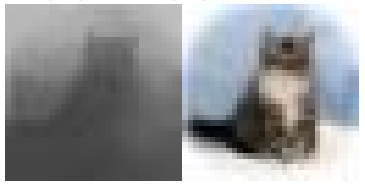
32x32x3

400x400x3

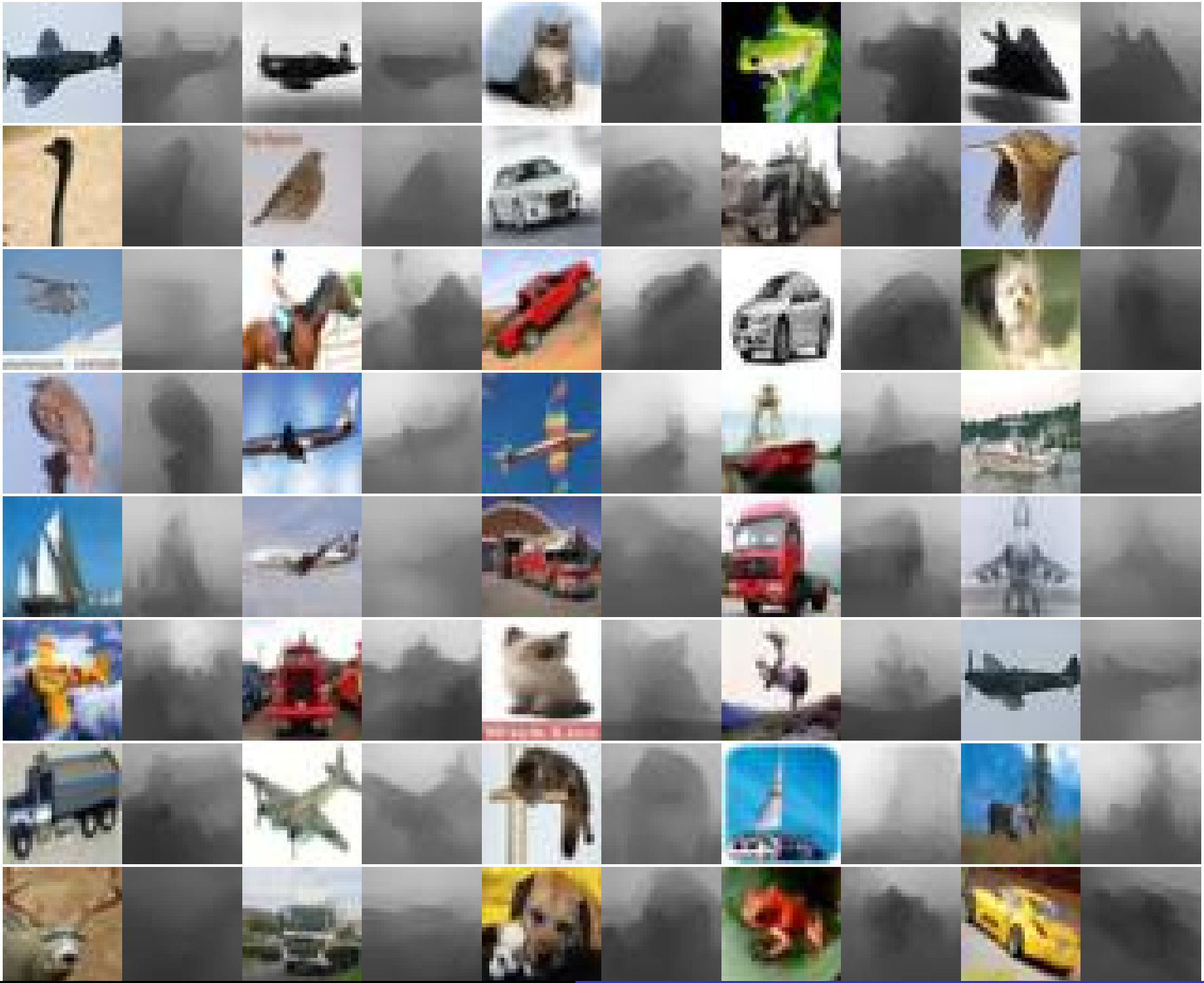




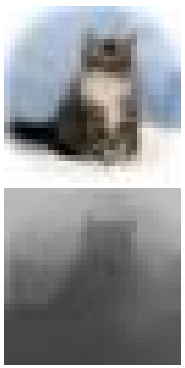
400x400x1



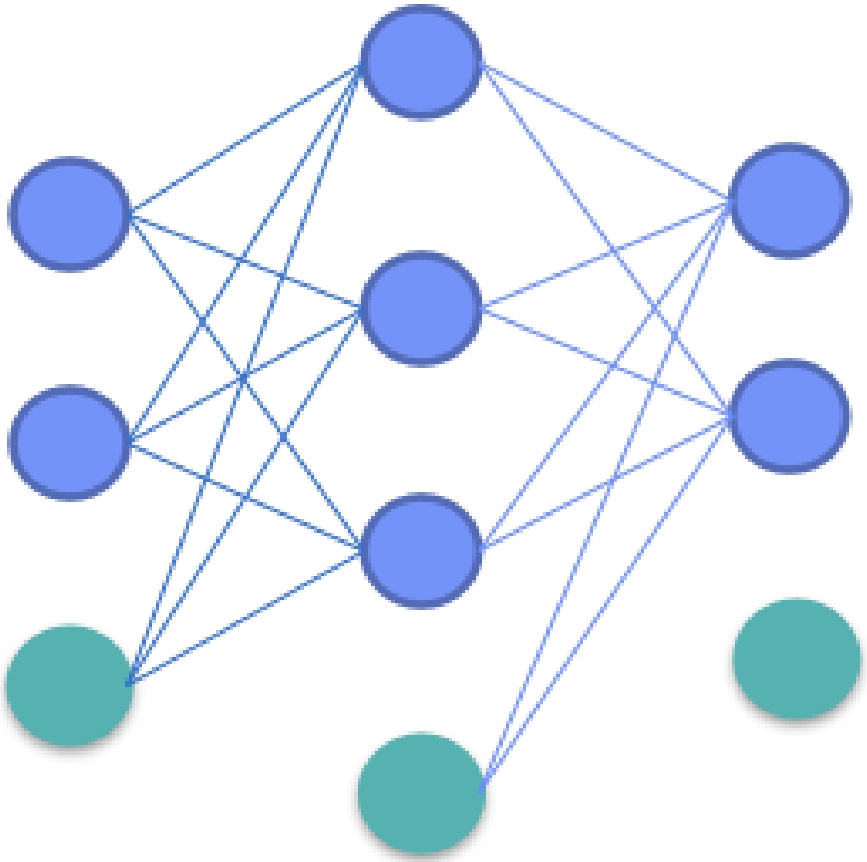
32x32x4



architecture



32x32x4



airplane

automobile

bird

cat

deer

dog

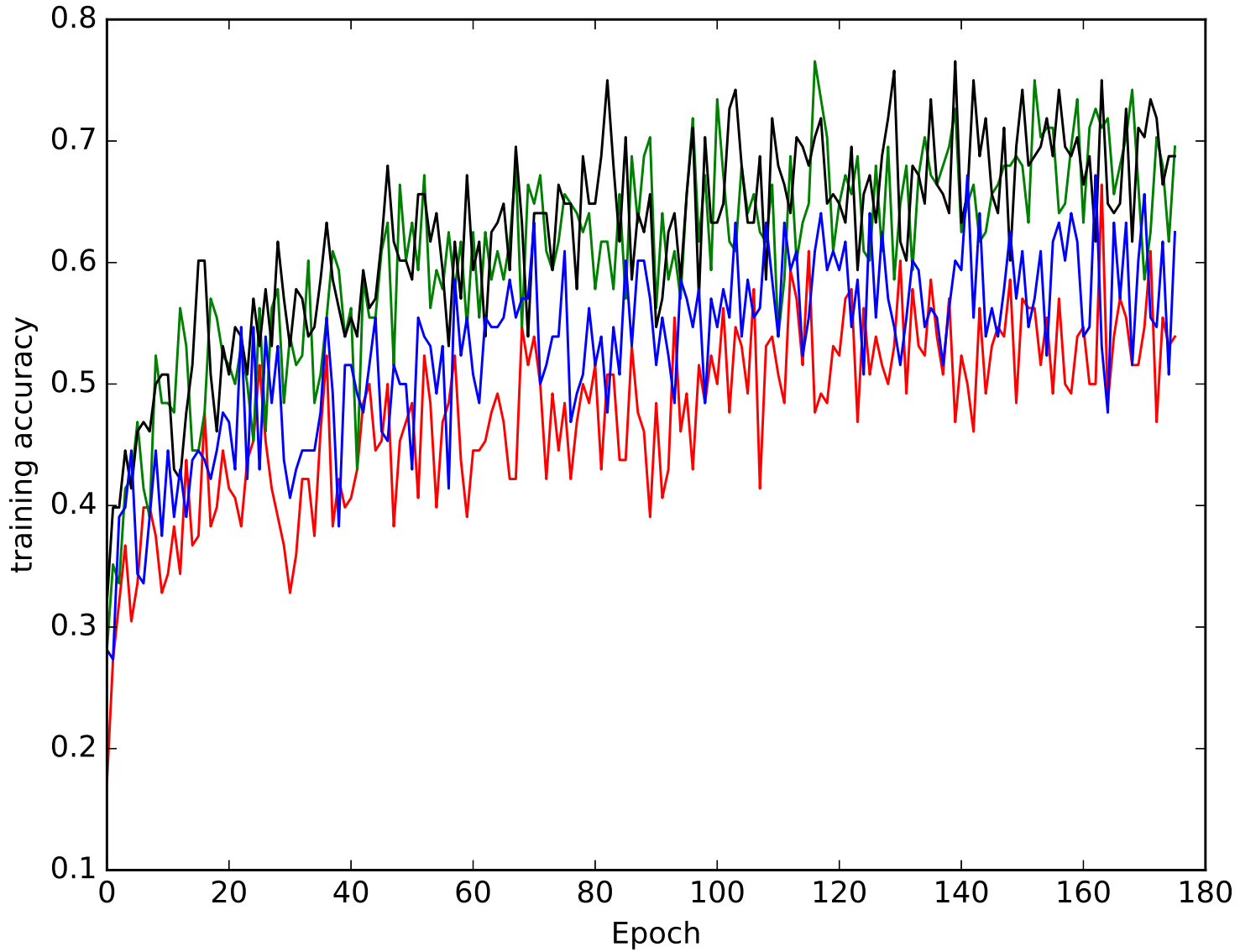
frog

horse

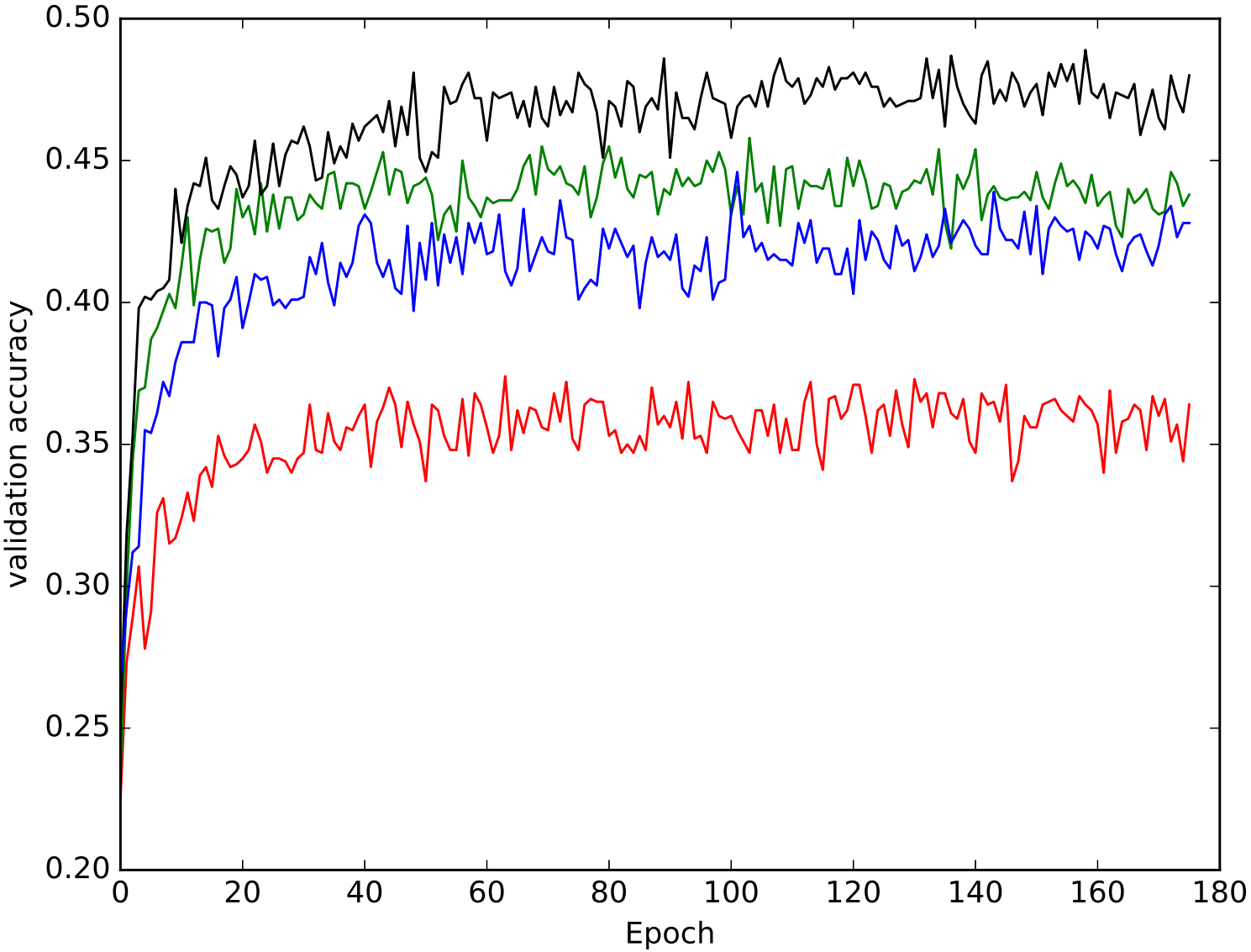
ship

truck

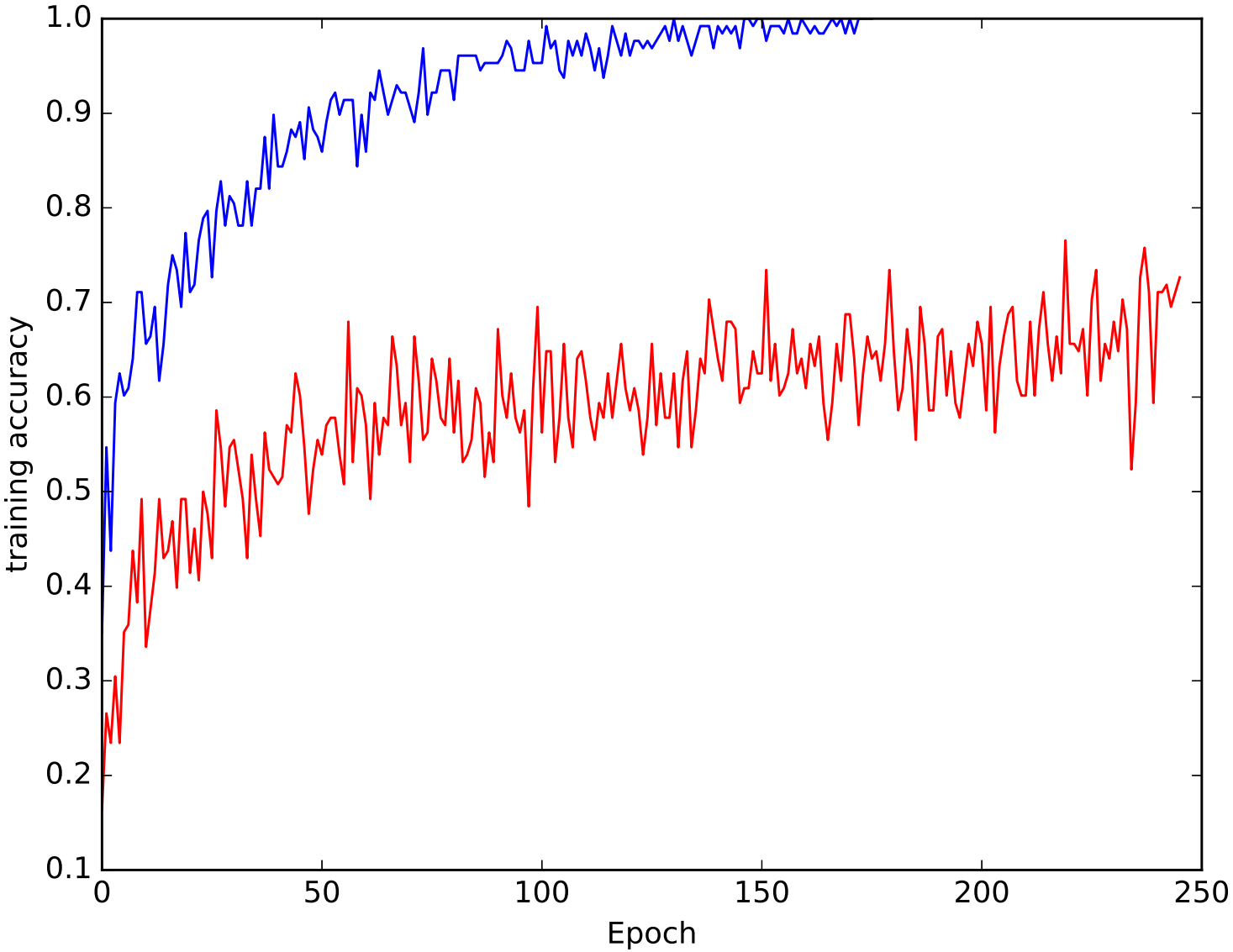
R vs G vs B vs D: training time



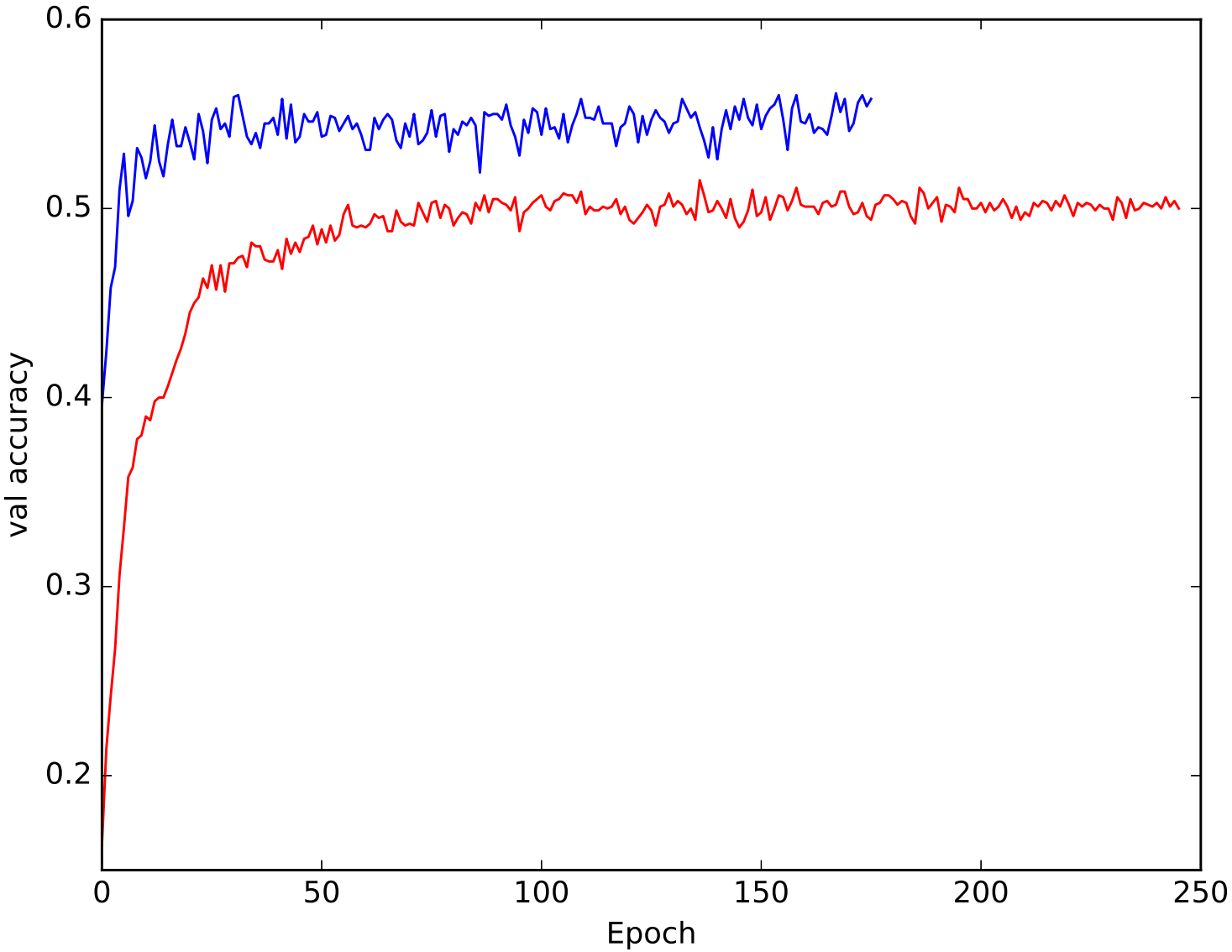
R vs G vs B vs D: testing time



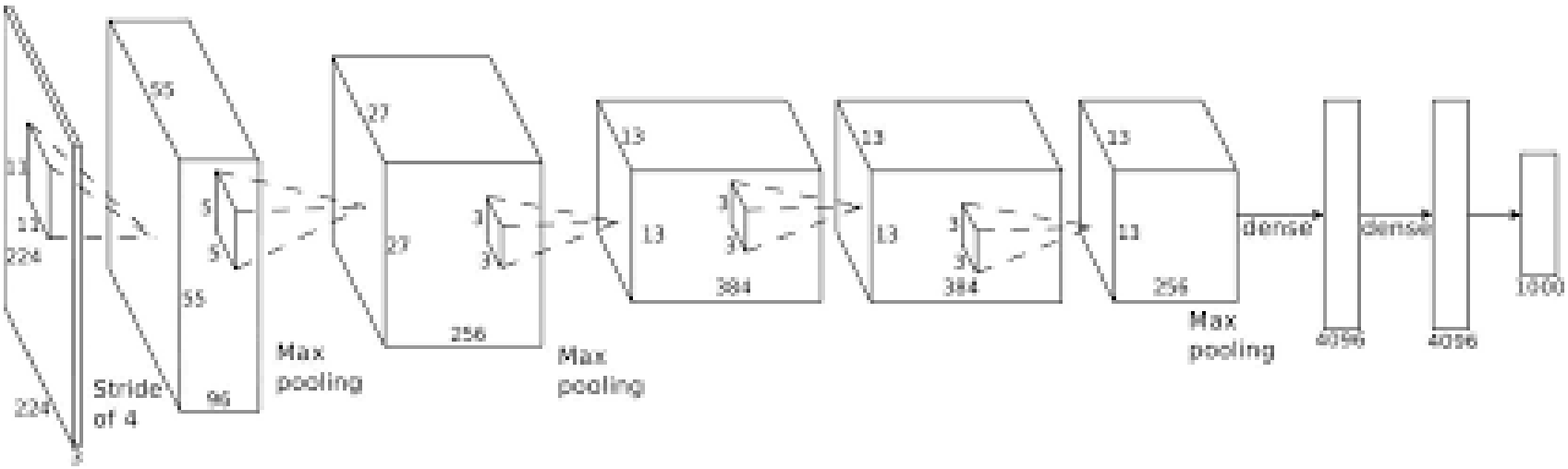
RGBD vs RGB: training time



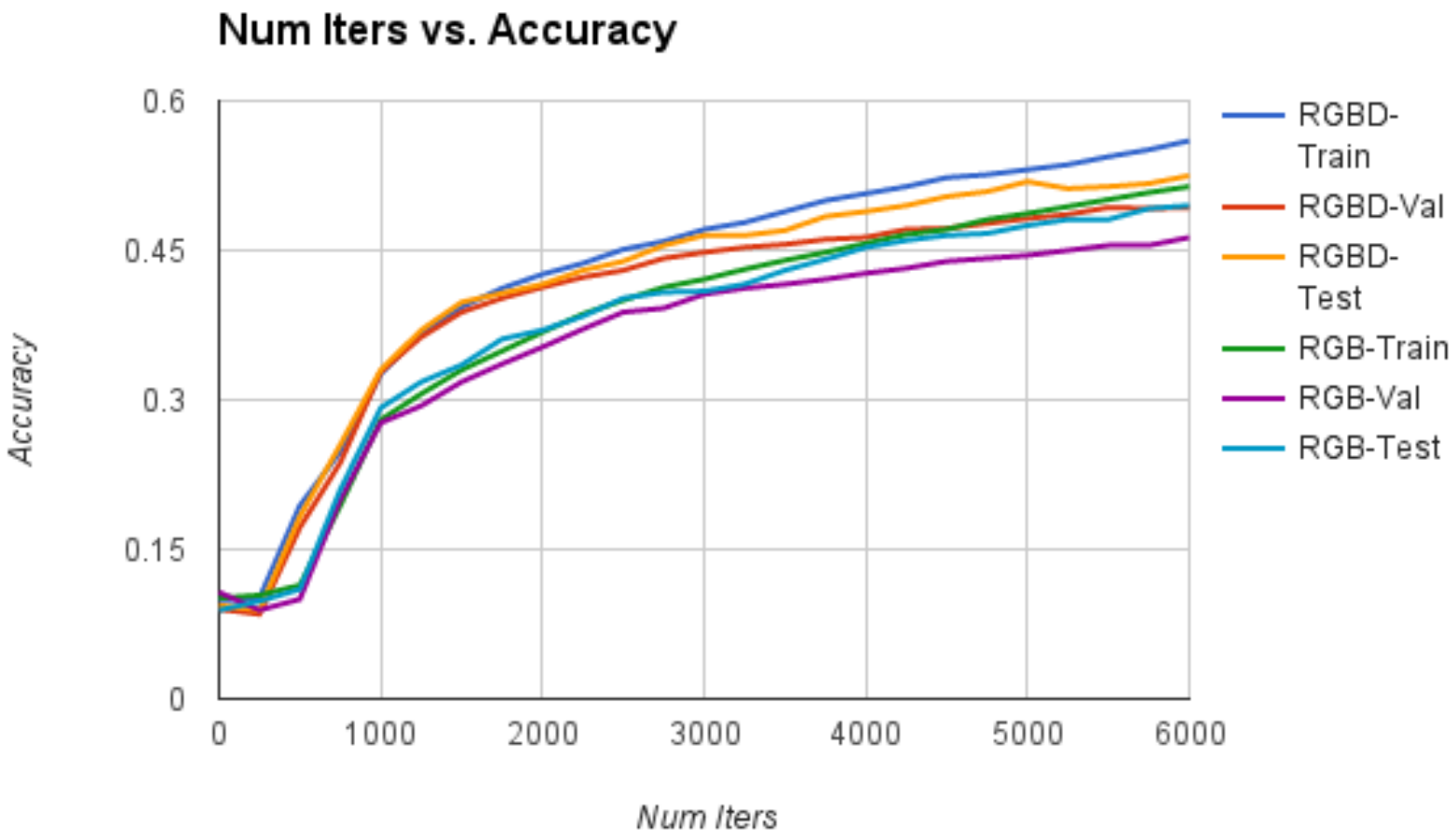
RGBD vs RGB: tges time



architecture



results


Num Iters vs. Accuracy
Accuracy
0.6
0.45
0.3
0.15
0
0
1000
2000
3000
4000
5000
6000
Num Iters
RGBD-Train
RGBD-Val
RGBD-Test
RGB-Train
RGB-Val
RGB-Test

our contribution

1. reproduce previous work on depth estimation
2. create the first RGBD CIFAR10 dataset
3. define a new metric for depth prediction problem
4. prove that depth channel has a better feature representation
5. show that training on RGBD images can somehow improve accuracy

questions?[2]

[2] code, references, report and slides can be access here: https://github.com/yihui-he/Depth-estimation-with-neural-network