



BROWN

# Restoring B+W Photos: Image Colorization with Hybrid U-Net

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## Motivation

### Image recolorization benefits:

- Restoring old art and/or historic artifacts
- Highlighting different features in images (think medical imaging)
- Applications in photo editing, data augmentation
- Finally... **it's cool!**



## Datasets

Due to the fact that we used a number of pre-trained networks in our model architecture, parts of our CNN were trained on the following datasets:

### Training:

- VGG: Pretrained on ImageNet
- ResNet: Pretrained on ImageNet
- Custom head: MIT Places2 test dataset\* [1]

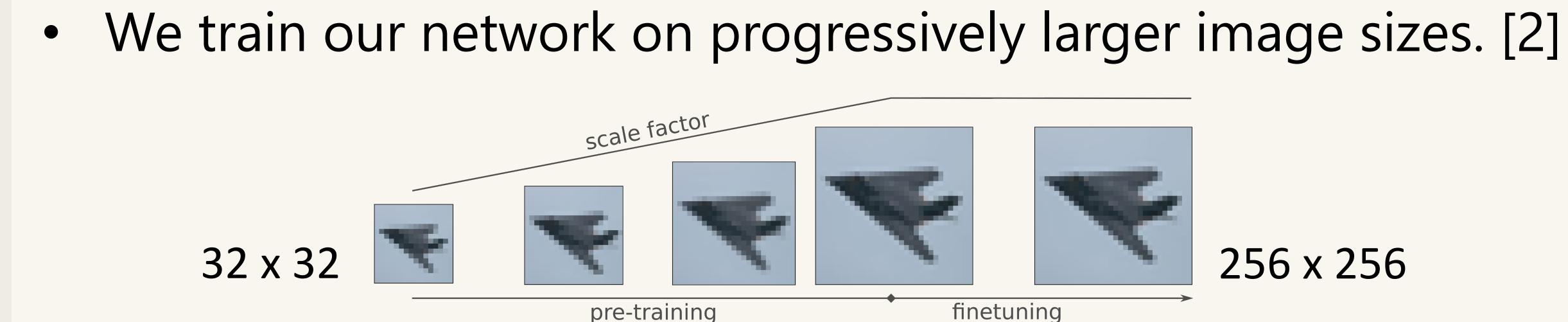
### Testing:

- MIT Places2 validation dataset\* [1]

\* Note: we used the test dataset for our training because the training dataset was too large to feasibly run on our resources

## Training Optimizations

### Progressive Resizing



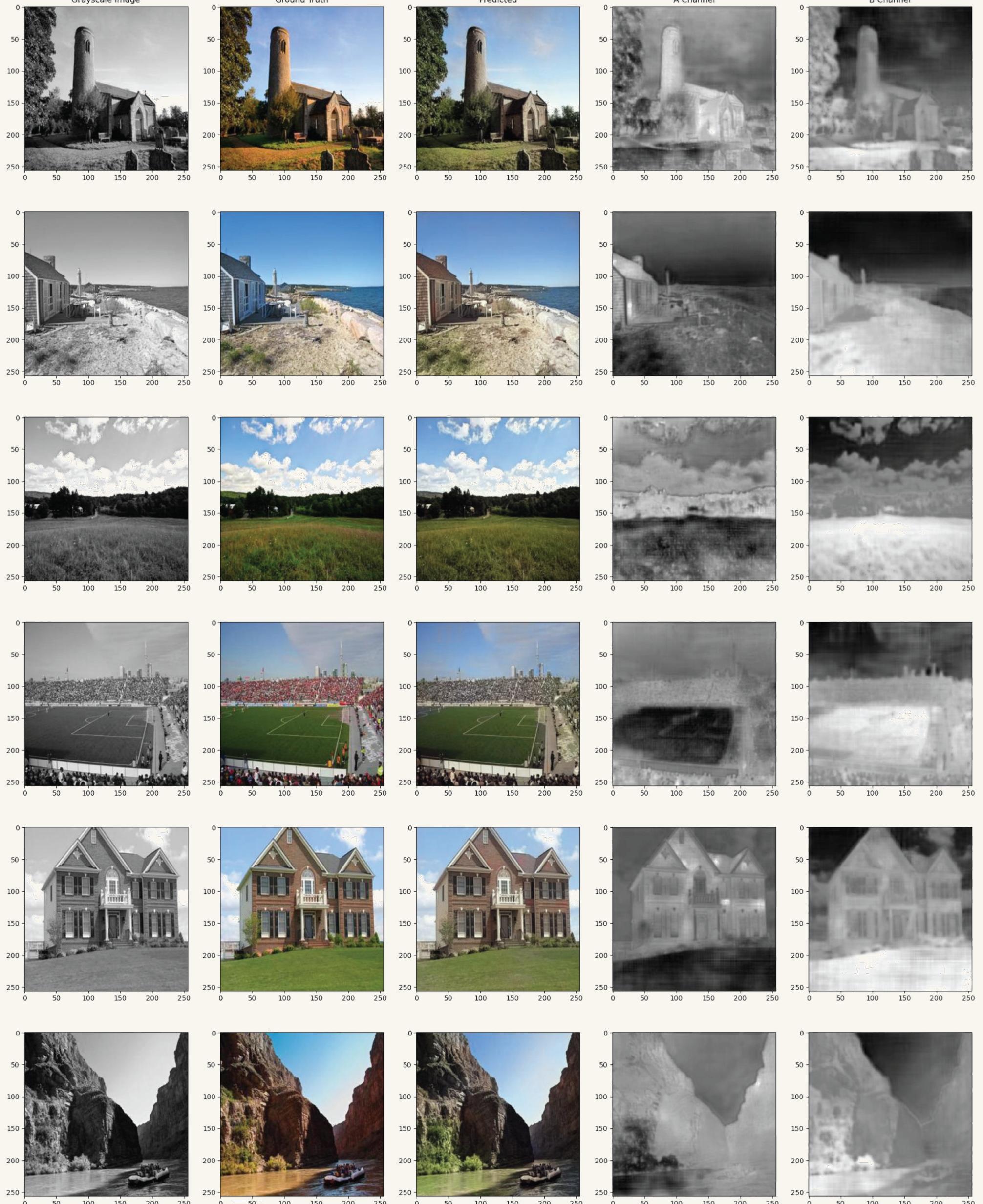
### Future Improvements

- Improve loss function by incentivizing confident guesses for rare colors [3] to decrease 'averaging' (sepia colors).
- Incorporate a GAN into our model to improve accuracy.

## Results: Good and Bad

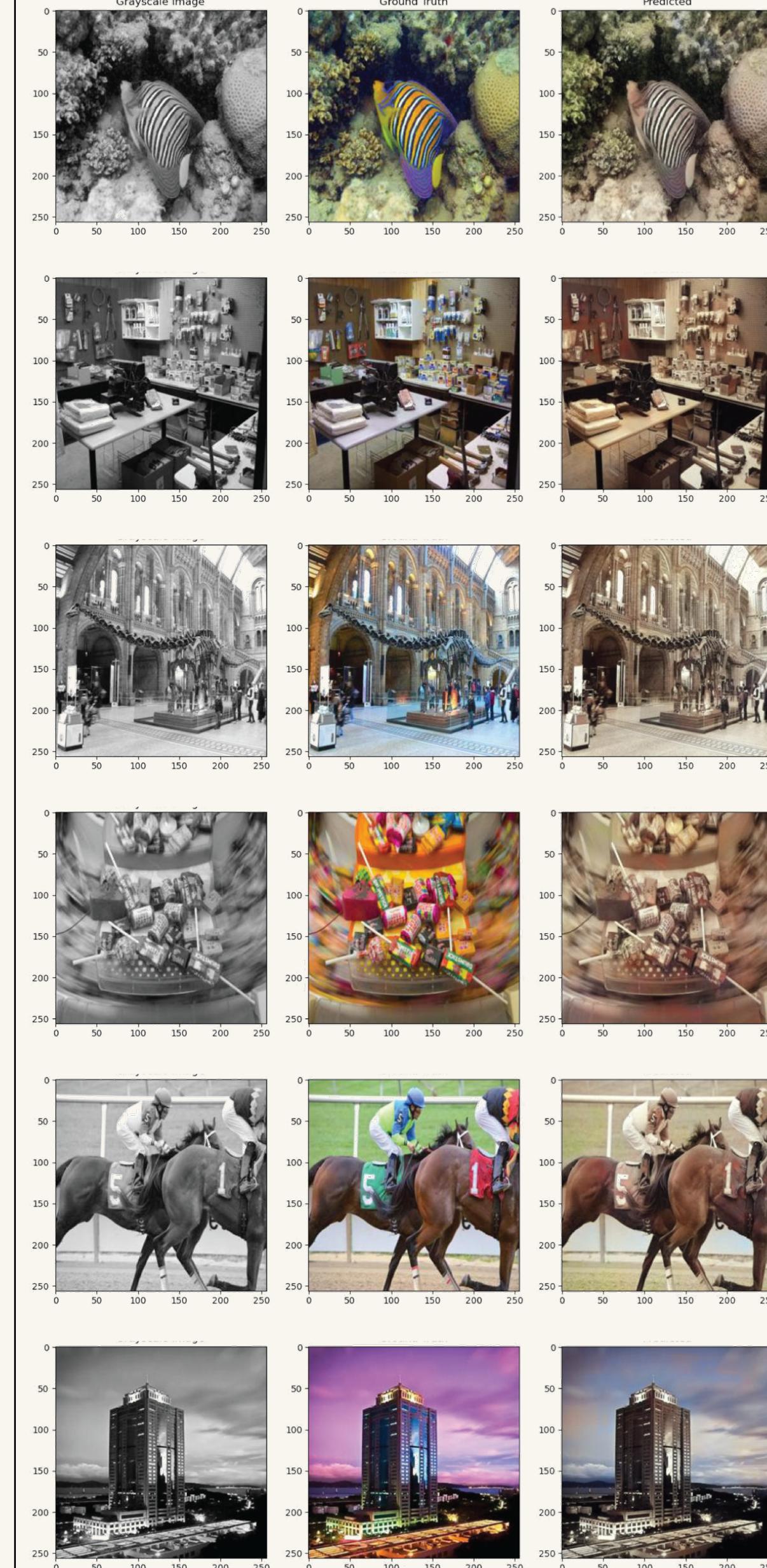
### Good:

Landscapes, Homes, Sky, Greenery

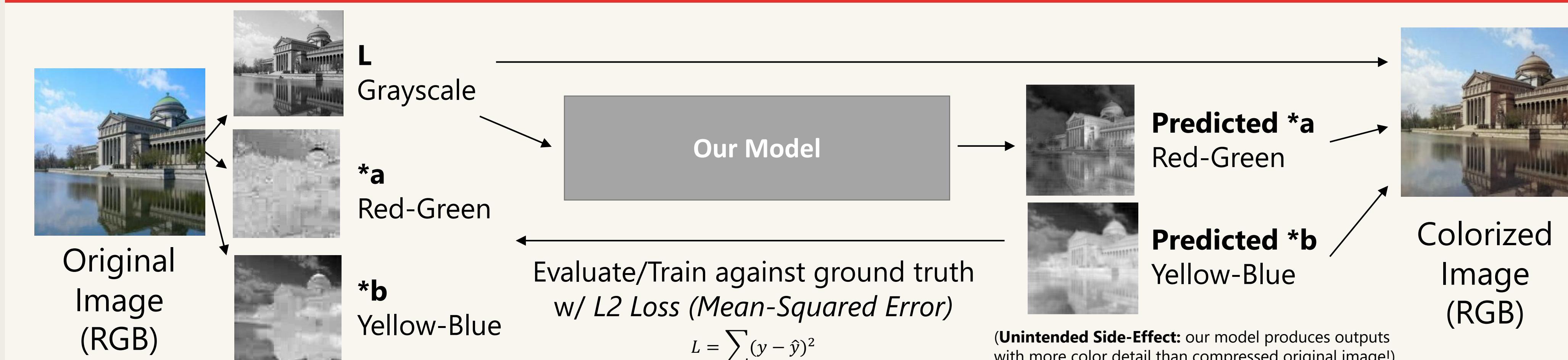


### Bad:

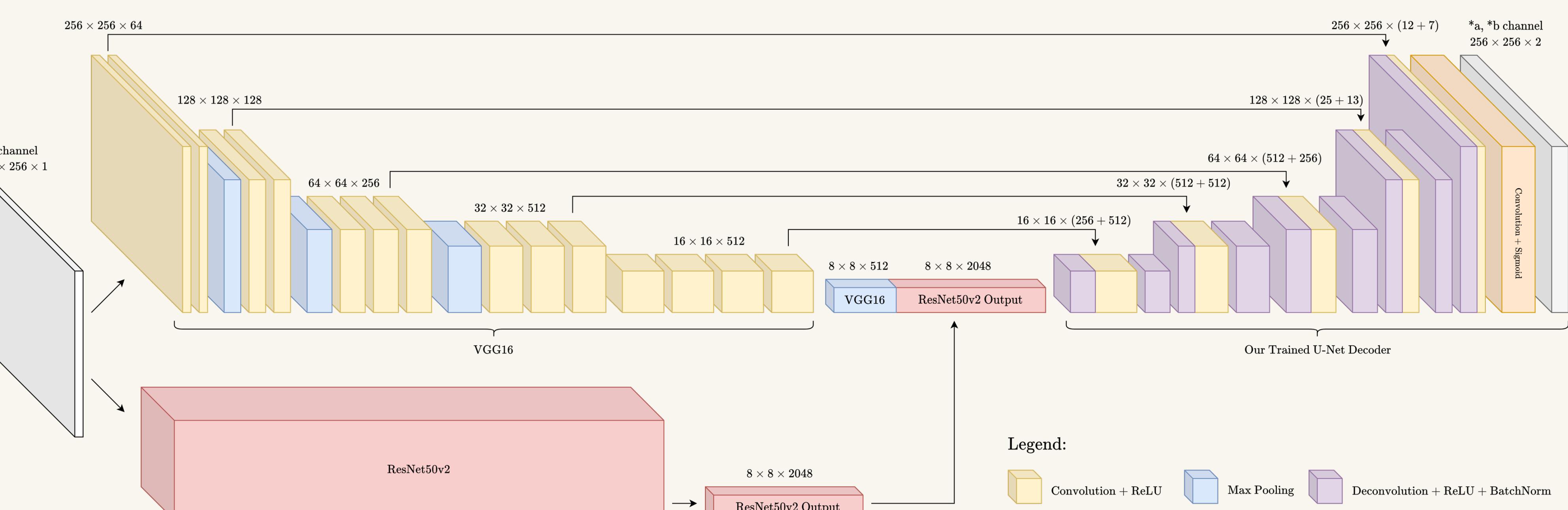
Patterns, Objects, Warm/Cool Colors, Artifacts



## How it works



## Model Architecture: U-Net with VGG16 & ResNet50v2 Backbone



- Pretrained VGG16 [4] **and** ResNet50v2 [5] encoders for rich (high-dimensional) feature tensor.
- Trained U-Net decoder: deconvolution + concatenation from appropriately-sized VGG16 convolution tensors.

## References

[1] Bolei Zhou, Agata Lapedriza, Aditya Khosla, Aude Oliva, and Antonio Torralba. Places: A 10 million image database for scene recognition. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 2017.

[2] MosaicML, Progressive Image Resizing

[3] Vincent Billaut, Matthieu de Rochemontex, and Marc Thibault. Colorunet: A convolutional classification approach to colorization. *CoRR*, abs/1811.03120, 2018.

[4] Karen Simonyan and Andrew Zisserman. Very deep convolutional networks for large-scale image recognition, 2014.

[5] Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. Deep residual learning for image recognition, 2015

## Acknowledgements

We would like to thank the CS1430 course staff (especially Miku) for their wonderful support; James for his wonderful teaching and instruction; CCV/GCP for compute; and a Stanford CS231n final project [3] for inspiration.