

# CS342 - Section 6

- Homework 5
  - Due 10/4, can still turn it in until Sunday
  - Survey
    - Weight decay? Dropout?
    - Augmentation (flipping, cropping, color jittering)? Ensemble?
- Homework 6
  - Posted on webpage
  - Train deeper networks using resnet
- Homework 4
  - Grade Posted

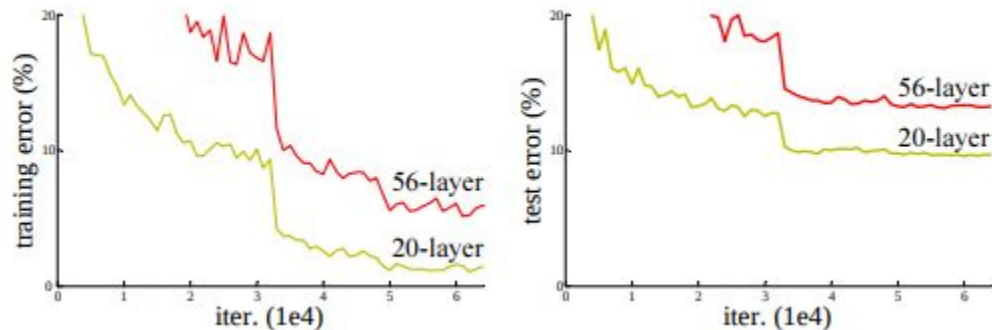
Questions?

# Agenda

- Recap of ResNet
- Exercise: how to upgrade a regular convnet to a resnet
- PyTorch walk through

# Recap of ResNet

- Proposed in 2015 by He et al. (10000+ citations as of now)
- Problems of plain stacking of layers
  - Network degradation: even training errors are higher



Credit: He et al.

# Recap of ResNet

- Proposed in 2015 by He et al. (10000+ citations as of now)
- Problems of plain stacking of layers
  - Network degradation: even training errors are higher
    - Error := error in model assumption + error in optimization + error in data. Not all networks are equally easy to train.
  - Vanishing gradients
    - When networks are too deep, gradient gradually goes to 0 by chain rule
    - Nonlinearities (e.g. ReLU) “cuts-off” your gradient
  - Dilemma: want model to be deeper, but still trainable

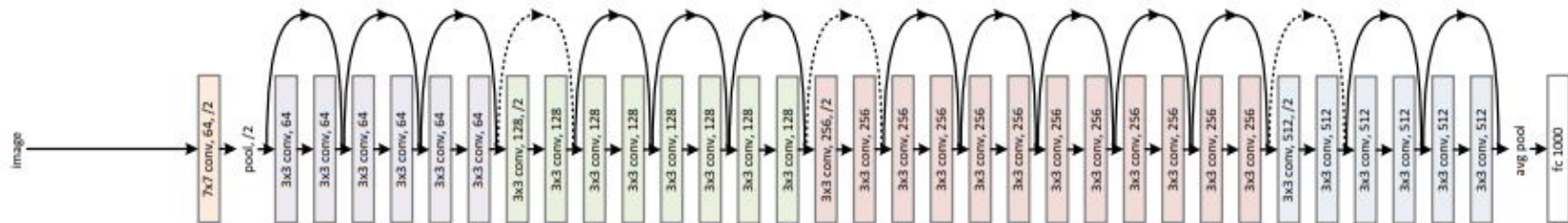
# Recap of ResNet

- Recall from lecture: ResNet bypass the problem by using skip connections



# Recap of ResNet

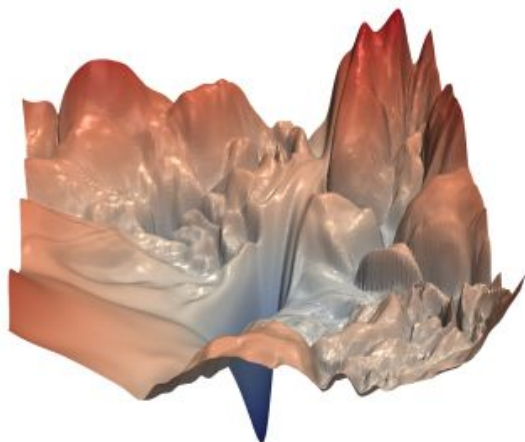
- ResNet bypass the problem by using skip connections
  - Gradients can now always flow through the skip connections.



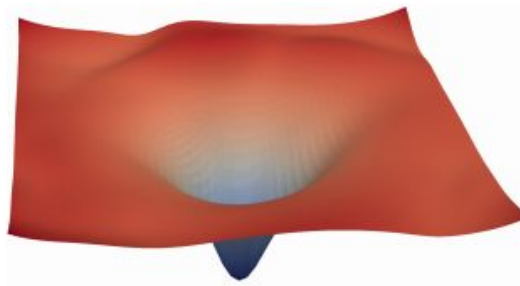
Credit: He et al.

# Recap of ResNet

- ResNet bypass the problem by using skip connections
  - Better loss surface



(a) without skip connections



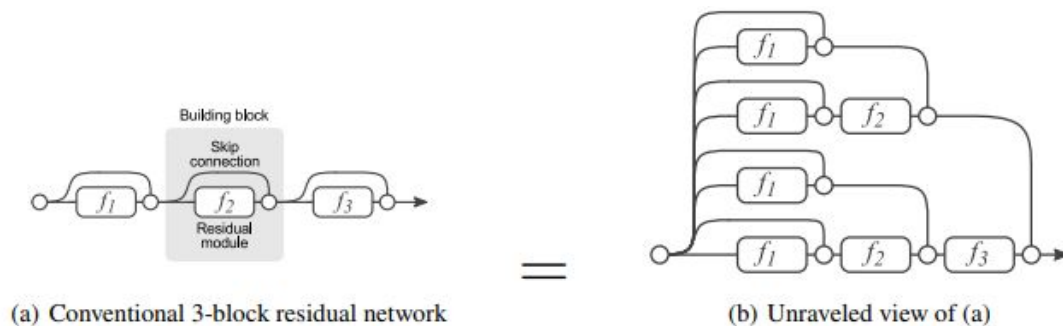
(b) with skip connections

Credit: Li et al. Visualizing the loss landscape of neural nets



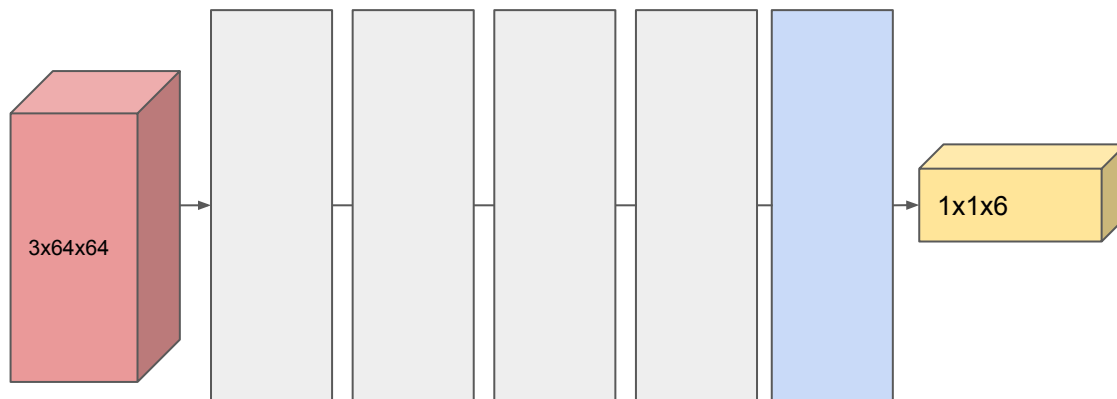
# Recap of ResNet

- ResNet bypass the problem by using skip connections
  - Multiple paths in networks
    - behaves like an ensemble of models of various depths
    - More robust features



# Exercise: How to upgrade a ConvNet

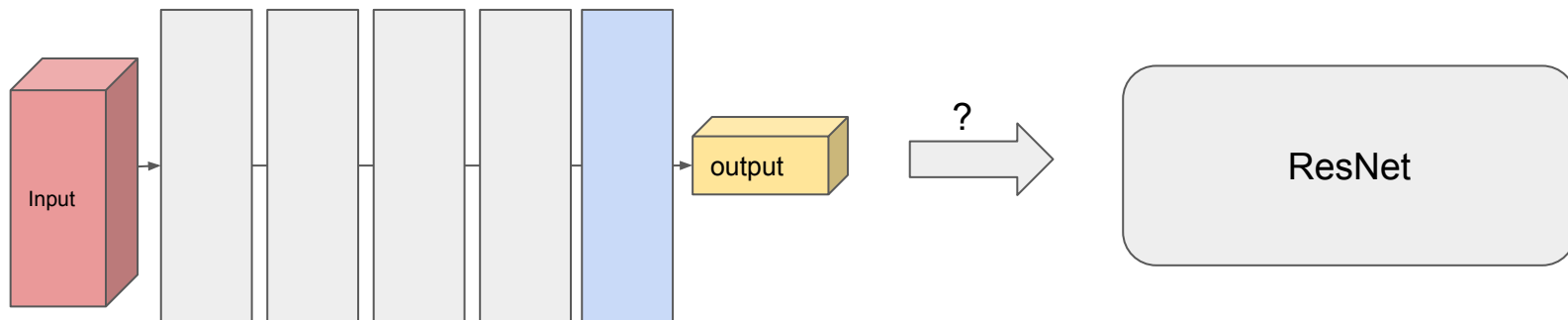
- Our master solution to hw4



Note: nonlinearities not shown

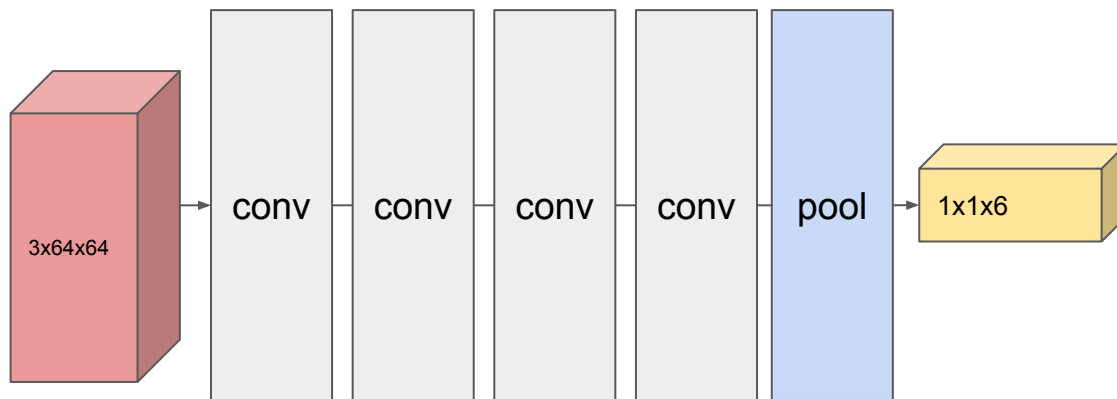
# Exercise: How to upgrade a ConvNet

- How to make this a ResNet ?



# Exercise: How to upgrade a ConvNet

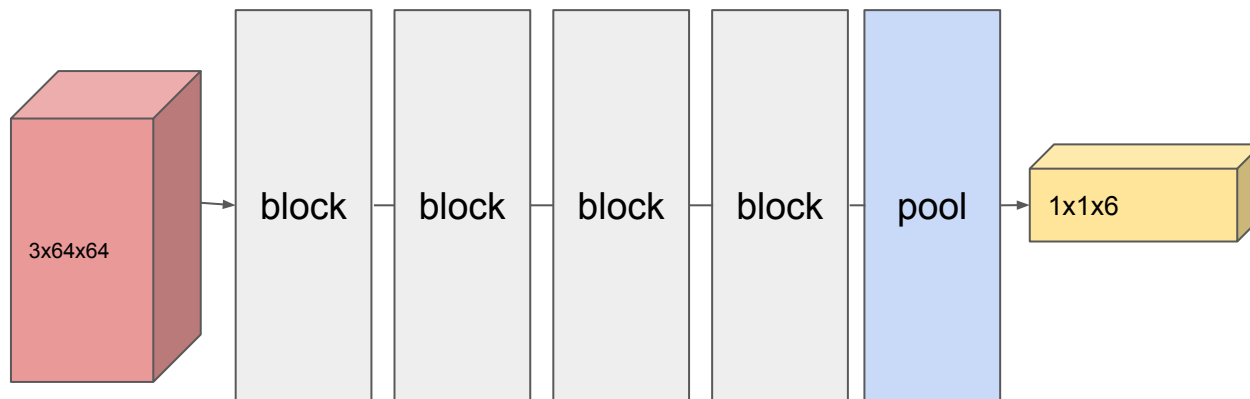
- Our master solution to hw4



Note: nonlinearities not shown

# Exercise: How to upgrade a ConvNet

- Change conv layers to resnet blocks



Note: nonlinearities not shown

# PyTorch Code Walkthrough