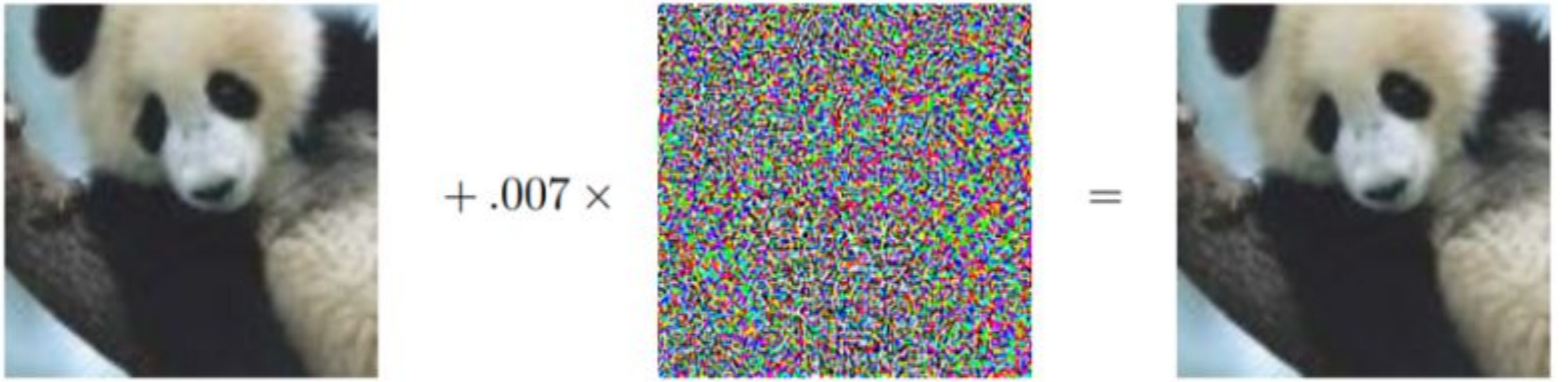
Analyse Layer-wise feature of adversarial examples and their Texture bias to build defense

- Adversarial attak
- CNN is shape biased or texture biased
- Transferbility of adversarial example
- Analyse Layer-wise feature of adversarial examples

Rated work : adversarial attack

- What is adversarial attack?
  The simplest method——FGSM

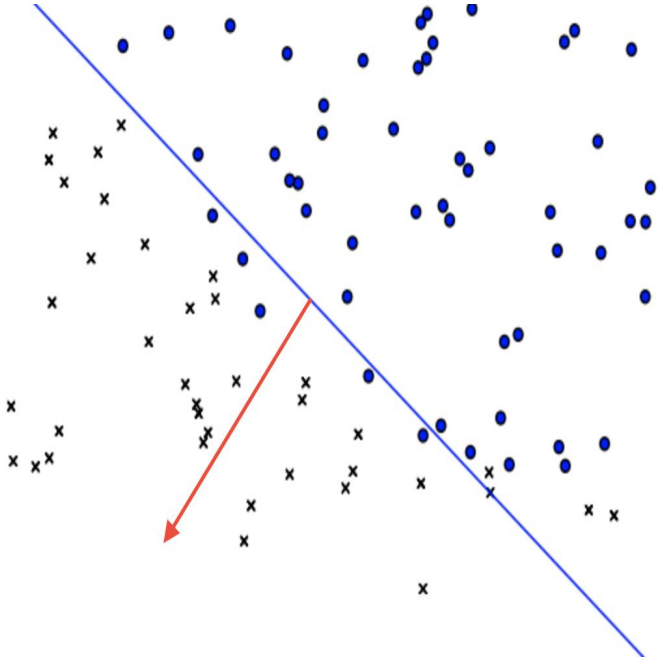


Picture 1[1]

Rated work : adversarial attack

- Why lead prediction to a wrong class?

1. Getting parameter through SGD= minimize the loss, fit prediction to label
2. Then parameter of Neural network is fixed.
3. Add dericvative to input,update input to maximize loss
4. loss increase = prediction mismatches labels



picture 3

Rated work : adversarial attack

- Target and Untarget attack

Untarget:

$$x^{adv} = x + \varepsilon \cdot \mathtt{sign}(\nabla_x J(x, y_{true})),$$

where

x is the input (clean) image,

x^{adv} is the perturbed adversarial image,

J is the classification loss function,

y_{true} is true label for the input x.

Target:

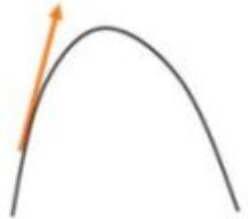
$$x^{adv} = x - \varepsilon \cdot \mathtt{sign}(\nabla_x J(x, y_{target})),$$

where

y_{target} is the target label for the adversarial attack.

Rated work : adversarial attack

- State-of-Art Attack Method :
  - FGSM(Fast Gradient Sign Mehthod



  - Iterative FGSM

$$x_0^{adv} = x, \quad x_{t+1}^{adv} = x_t^{adv} + \alpha \cdot \mathrm{sign}\left(\nabla_x J(x_t^{adv}, y)\right).$$

  - other optimization method to find the maxima of loss

picture2

Related work: CNN is base on texture or shape?

(a) Texture image

81.4%	**Indian elephant**
10.3%	indri
8.2%	black swan

(b) Content image

71.1%	**tabby cat**
17.3%	grey fox
3.3%	Siamese cat

(c) Texture-shape cue conflict

63.9%	**Indian elephant**
26.4%	indri
9.6%	black swan

picture 4[2]

Related work: CNN is base on texture or shape?

- Image trained CNN,but not human,exhibit a strong texture

human observers (red circles)

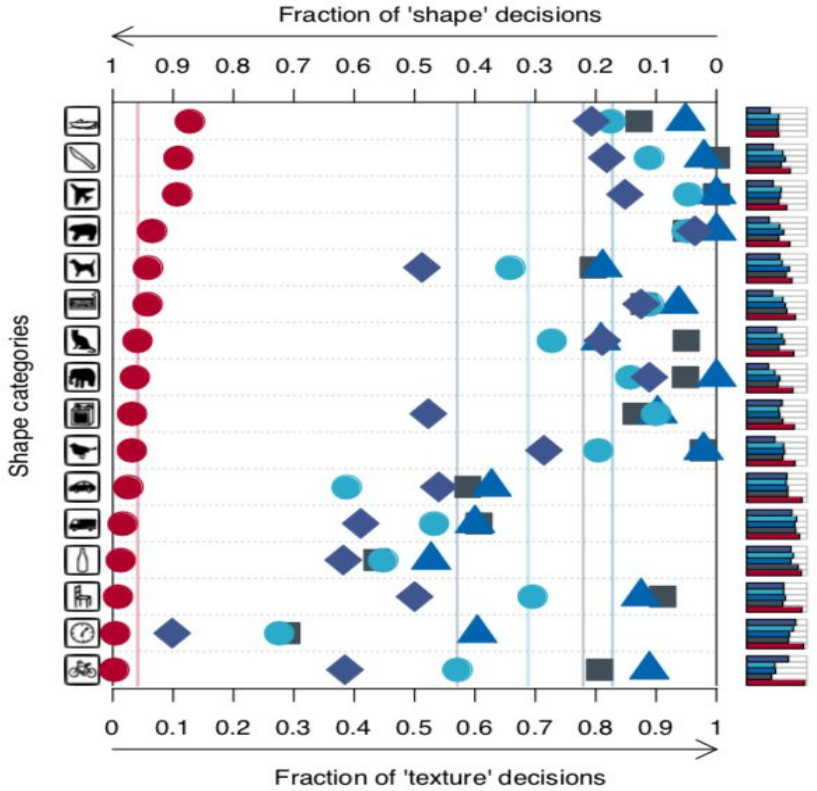
AlexNet (purple diamonds),

VGG-16 (blue triangles),

GoogLeNet(turquoise circles)

ResNet-50(grey squares)

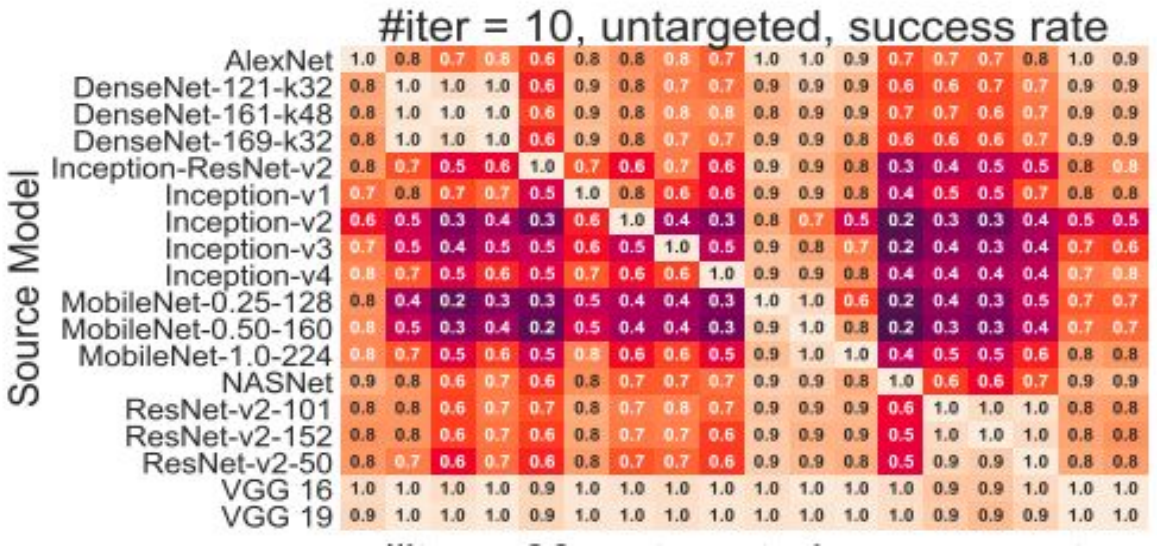
Notice that VGG-16(blue triangles) is almost the most texture biased one!



picture 5

Related work: the transferbility of adversarial example

VGG get the best attack success rate



picture 6[3]

Hypothesis: adversarial example is texture biased

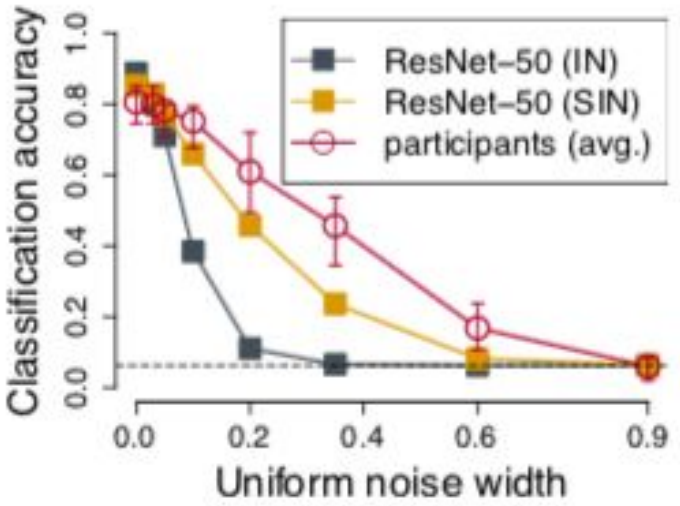
- How to prove?

1. shape biased CNN is more robust to noisy input
2. visionlizing CNN last conv layer feature

How to prove: 1.shape biased CNN is more robust to noisy input (previous others work)

SIN: texture transfered Imagenet

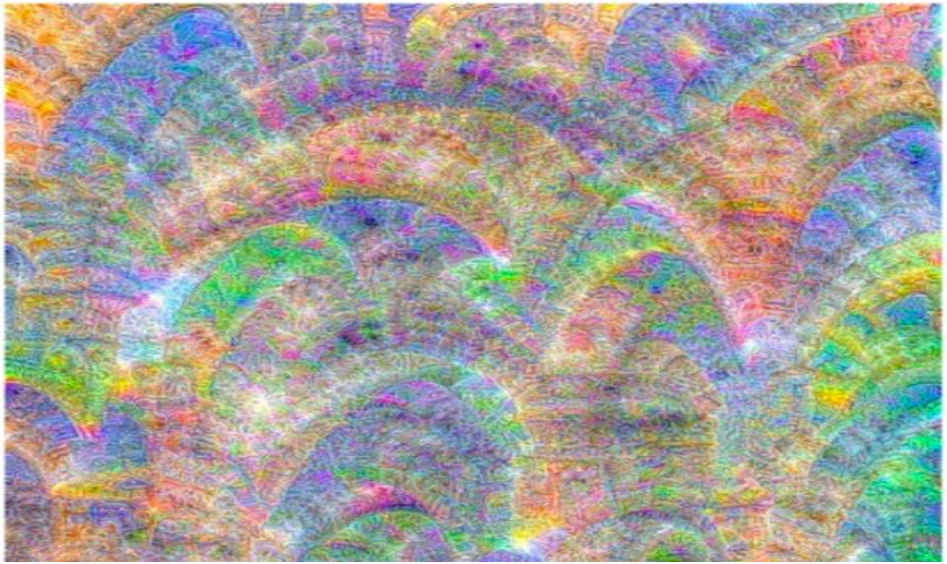
(each class with diverse texture)



picture 7 [2]

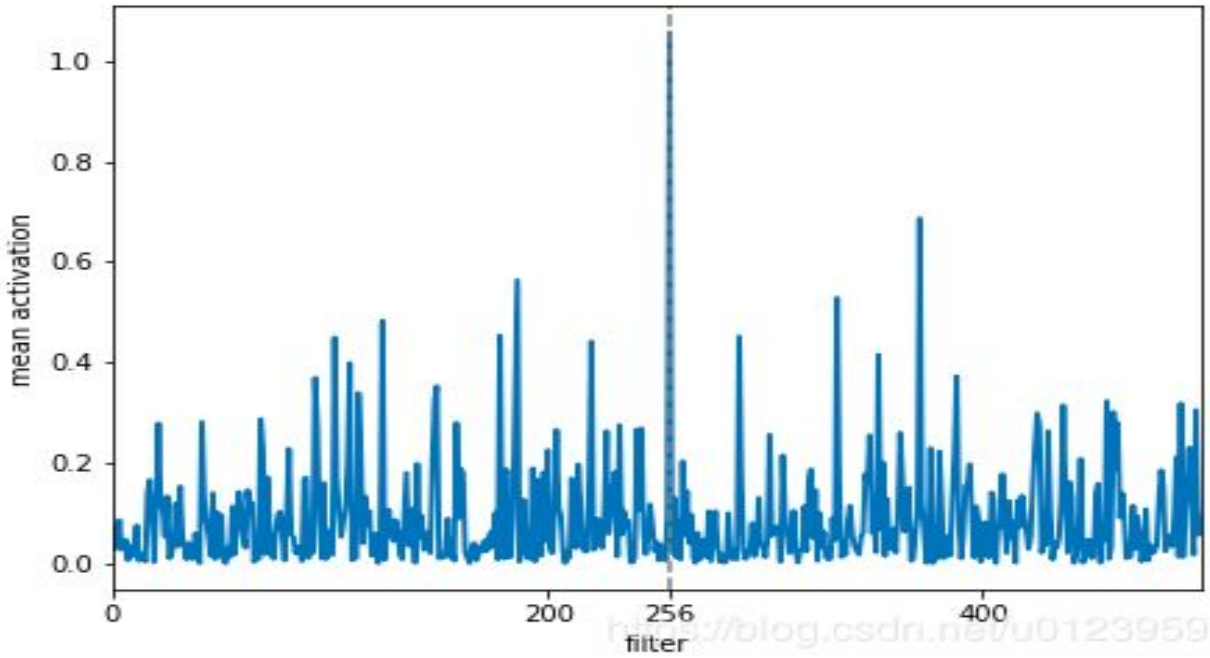
How to prove: 2.visionlizing CNN last conv layer feature (previous others work)

visualizing the feature of 286 filter guess class



How to prove: 2.visionlizing CNN last conv layer feature

Activation of filter



How to prove: 2.visionlizing CNN last conv layer feature

My Idea: (prospective experiment)

Visualizing the feature against adversarial examples

How does the misclassed high activation feature look like?

How to defende against adversarial example?

Idea:

1. Build more shape biased network.
2. detect and distinguish texture feature.
3. Election of the shape feature in inference

Citation

[1]Explaining and Harnessing Adversarial Examples

[2]ImageNet-trained CNNs are biased towards texture; increasing shape bias improves accuracy and robustness

[3] Is Robustness the Cost of Accuracy? – A Comprehensive Study on the Robustness of 18 Deep Image Classification Models