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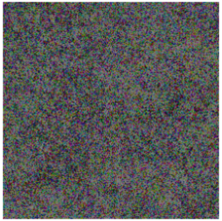
Adversarial Label Flips

Matthias Dellago & Maximilian Samsinger

A short recap

Fast gradient sign method

 $+ \ \epsilon$  $=$ 

Husky
(42.82% confidence)

Noise (PGD-40)
50x amplified

Handkerchief
(99.999988% confidence)

Source: `ctf.codes`, circa 2021

What we want to do

Confusion Matrix

		Categorised as		
		Dog	Cat	Plane
Adversarial Example of a	Dog	0.0	?	?
	Cat	?	0.0	?
	Plane	?	?	0.0

How many modified dogs get classified as cats vs as planes? etc.

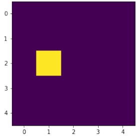
Some simple theory

We want similar images that are classified differently.
But what is "similar"?

Quantifying Changes

L^0-Norm

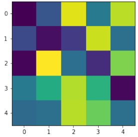
Number of pixels changed



Perturb one pixel maximally

L^1-Norm

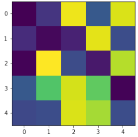
Sum of all changes



Minimise sum

L^2-Norm

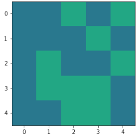
Sum of the *square* of all changes



Minimise sum of squares

L^∞-Norm

Maximum of all changes



Perturb all pixels equally

Two Different Approaches

small displacement and
big misclassification

maximise misclassification

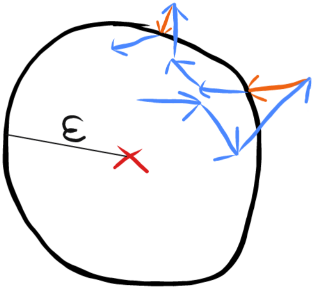
minimise displacement

small displacement

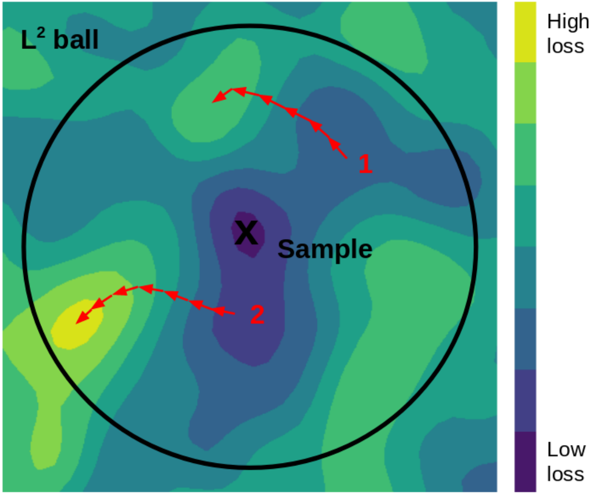
big misclassification

Projected Gradient Decent

1. Pick spot in epsilon ball
2. Iterate gradient decent
3. If leaving ball, project back onto surface.



Projected Gradient Decent



Know your enemy, Oscar Knagg, towardsdatascience.com, 2019

Carlini-Wagner-Attack

Original idea: minimise disance while always staying in "misclassification territory".
Problem: Nonlinearity of constraint makes for bad optimisation

Carlini-Wagner-Attack

Solution: Pack constraint into the function that is optimised.
=> minimise: distance + "how misclassified is x?"*
equiv. minimise distance while maximising misclassification.

*loss function

References I