DarioNet

Improve Tiny Images Classification Through Super Resolution (and vice versa)

The DarioNet team 🏰🍝🐟:
Dario Ruggeri, Simone Ercolino,
Riccardo Ceccaroni, Romeo Lanzino

DATA SOURCE

Train

15% of ImageNet
Training set
(~195K images
~500x400, ~21Gb)

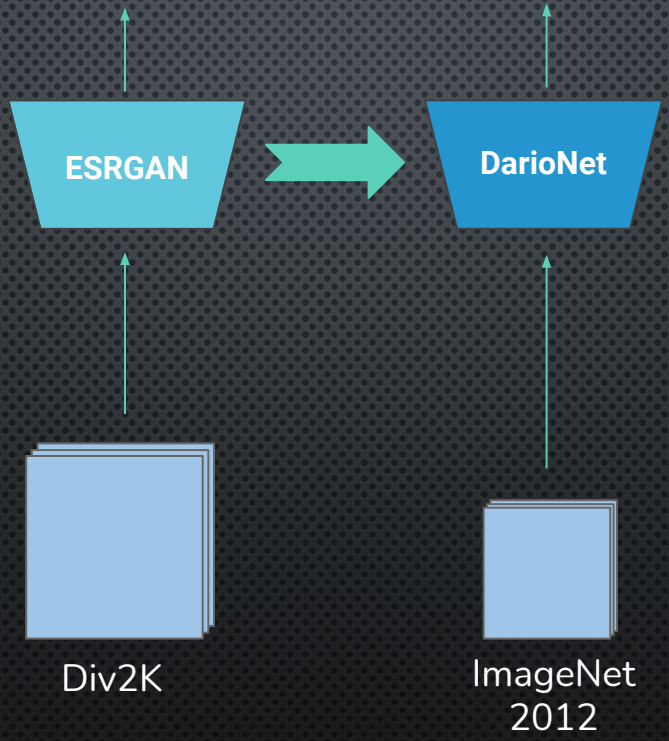
Validation

50% of ImageNet
Validation set
(~25K images ~500x400,
~3.5Gb)

Test

50% of ImageNet
Validation set
(~25K images ~500x400,
~3.5Gb)

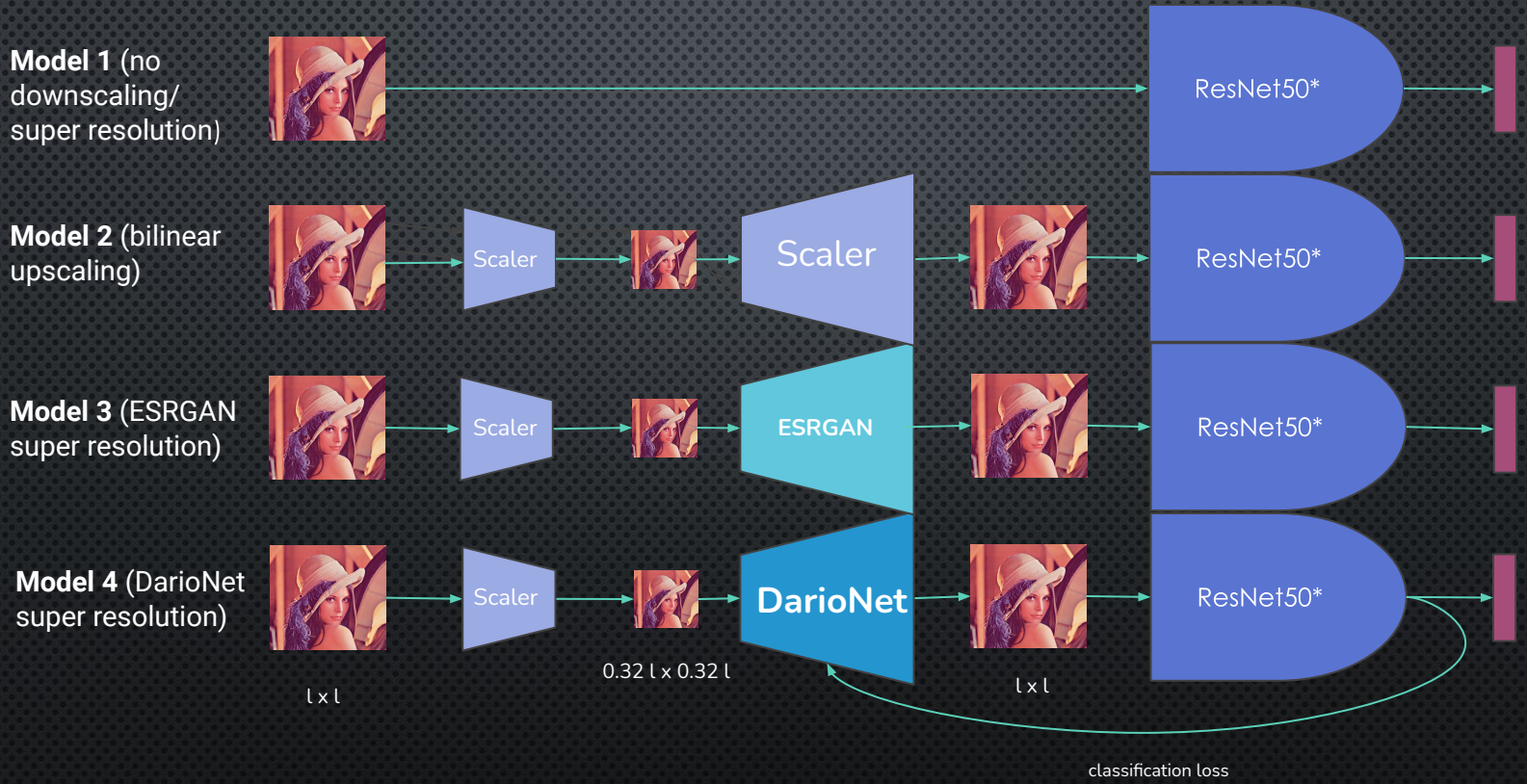
ESRGAN vs DarioNet



Images preprocessing

- **Data augmentation** seems to worsen the results and is not so needed since we have a very large dataset of images
- Previously we had random horizontal flip, random vertical flip and random crop at the end

End-to-end models pipelines

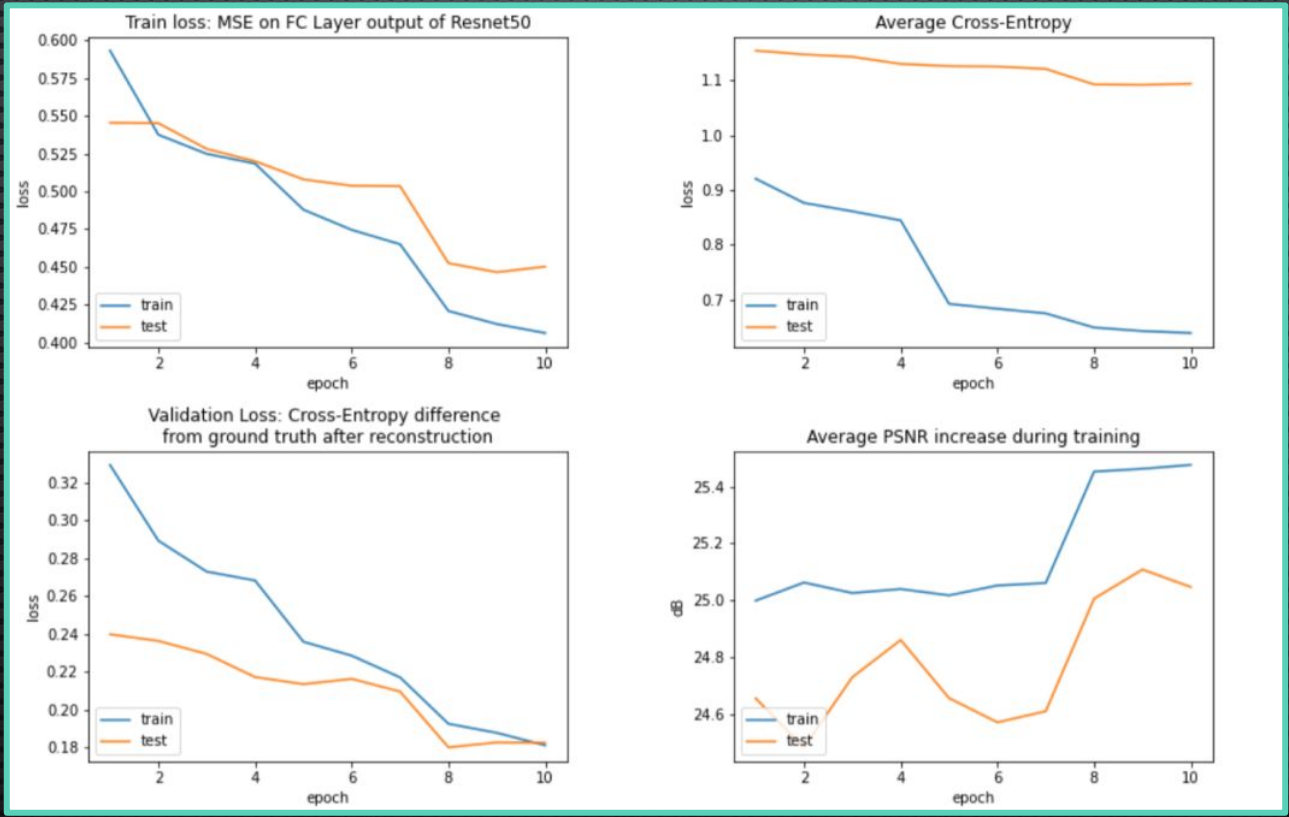


*previously ResNet18

Losses (1/2)

- **PSNR** ❌
  - indeed one of the most used loss for this application
  - considered unstable for training and seems to lead to blurred images
- **L1** ❌
  - Manhattan distance
  - lead to blurred images
- **Distillation with scores** ✅
  - in our case, MSE between ResNet's scores
  - focussing on the classification
  - highest scores
- **Combination of various losses** ❌
  - tradeoff between aesthetics and performances
  - problem: different losses have different order of magnitude

Losses (2/2)


Train loss: MSE on FC Layer output of Resnet50
loss
epoch
train
test
Average Cross-Entropy
loss
epoch
train
test
Validation Loss: Cross-Entropy difference
from ground truth after reconstruction
loss
epoch
train
test
Average PSNR increase during training
dB
epoch
train
test

Results (1/4)

Is it possible to play just right now with DarioNet:

- Apply Super Resolution to an image via Google Colab
- Take a look at test.py and try_darionet.py in our GitHub repo

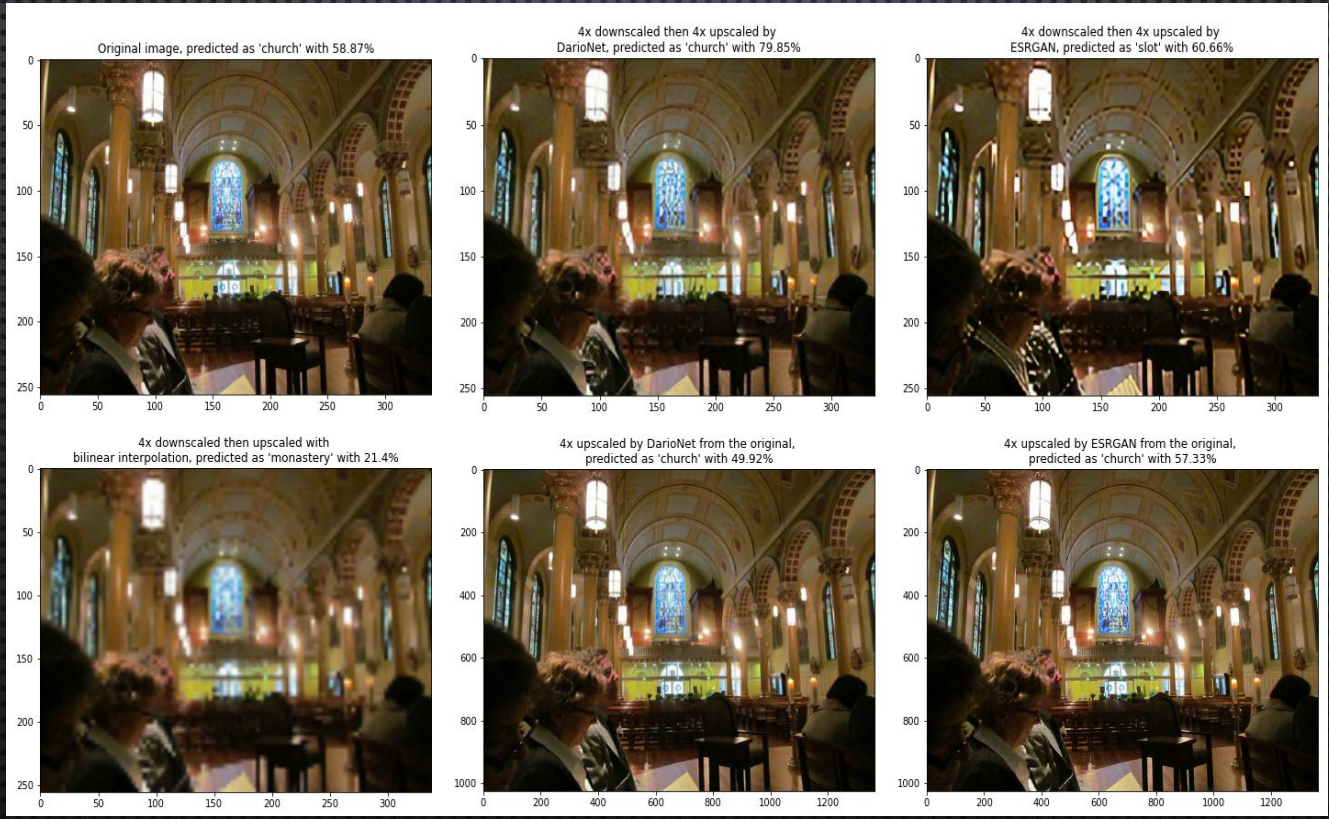
Model 1 (no downscaling/ super resolution)

Model 2 (bilinear super resolution)

Model 3 (ESRGAN super resolution)

Model 4 (DarioNet super resolution)

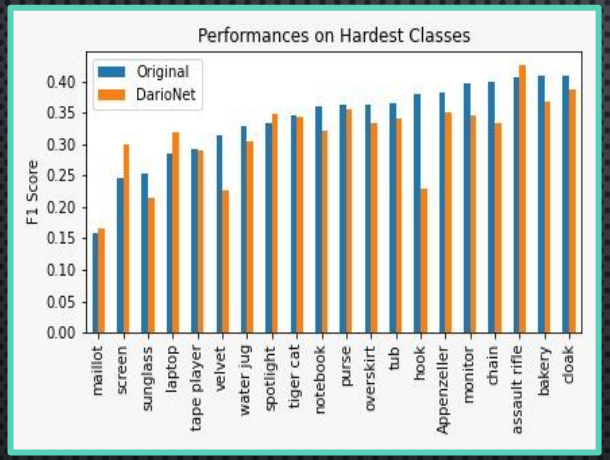
Results (2/4)


Original image, predicted as 'church' with 58.87%
4x downscaled then 4x upscaled by DarioNet, predicted as 'church' with 79.85%
4x downscaled then 4x upscaled by ESRGAN, predicted as 'slot' with 60.66%
4x downscaled then upscaled with bilinear interpolation, predicted as 'monastery' with 21.4%
4x upscaled by DarioNet from the original, predicted as 'church' with 49.92%
4x upscaled by ESRGAN from the original, predicted as 'church' with 57.33%

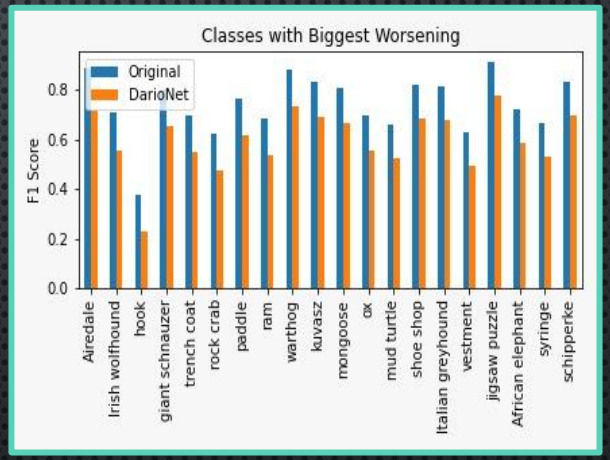
Results (3/4)

Name of the model	Average cross entropy loss	Average PSNR (dB)	Accuracy	Total time on test (minutes)
Model 1 (Original images)	0.9112	inf	0.7676	1
Model 2 (bilinear upscaling)	1.9864	25.2466	0.5446	1
Model 3 (ESRGAN super resolution)	1.6946	22.5088	0.6063	14
Model 4 (DarioNet super resolution)	1.0931	25.2211	0.7275	14

Results (4/4)


Performances on Hardest Classes
Original
DarioNet
F1 Score
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
maillot
screen
sunglass
laptop
tape player
velvet
water jug
spotlight
tiger cat
notebook
purse
overskirt
tub
hook
Appenzeller
monitor
chain
assault rifle
bakery
cloak


Classes with Biggest Improvements
Original
DarioNet
F1 Score
0.0
0.2
0.4
0.6
0.8
clog
scabbard
iPod
potpie
mortarboard
lampshade
table lamp
beer glass
screen
bulletproof vest
electric locomotive
ashcan
dragonfly
breastplate
swab
digital watch
bib
reflex camera
fire screen
backpack


Classes with Biggest Worsening
Original
DarioNet
F1 Score
0.0
0.2
0.4
0.6
0.8
Airedale
Irish wolfhound
hook
giant schnauzer
trench coat
rock crab
paddle
ram
warthog
kuvasz
mongoose
ox
mud turtle
shoe shop
Italian greyhound
vestment
jigsaw puzzle
African elephant
syringe
schipperke

Conclusions and Future work

- **Starting idea**: evaluate the performances of super-resolution on different task.

- **Primary interest of our work**: improve the results on the classification task starting from low resolution inputs

- A step towards **image compression**

- **Train also ResNet50** (testing on tiny ImageNet dataset)

- train DarioNet on **new tasks** like semantic segmentation or object detection

- See the results when classification has **less classes to predict**

Thank you for the attention!!
Questions?

- *THE DARIONET TEAM*