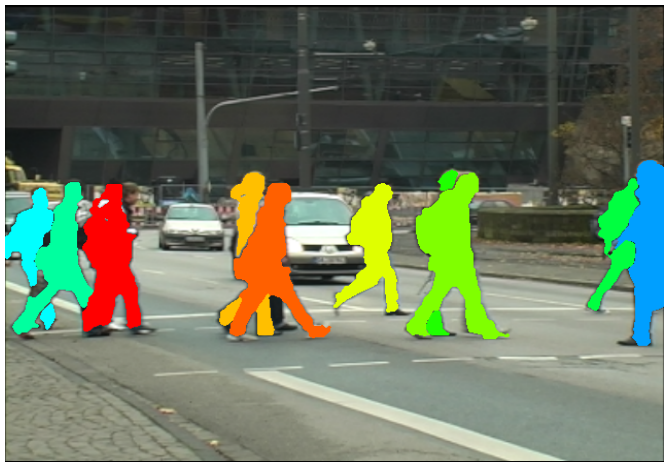
Network Graphs in Image Processing

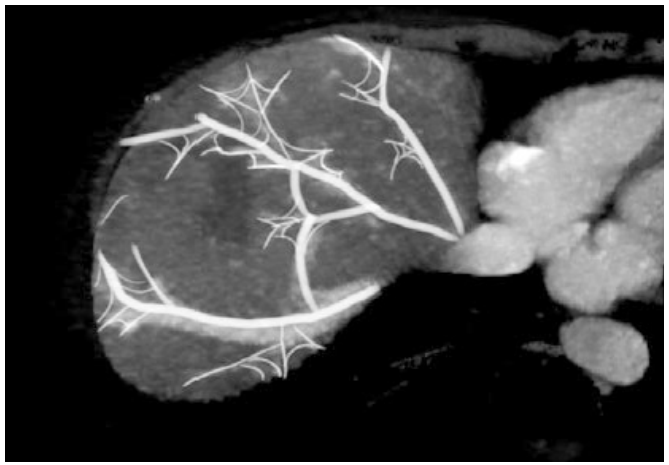
Presentation #3

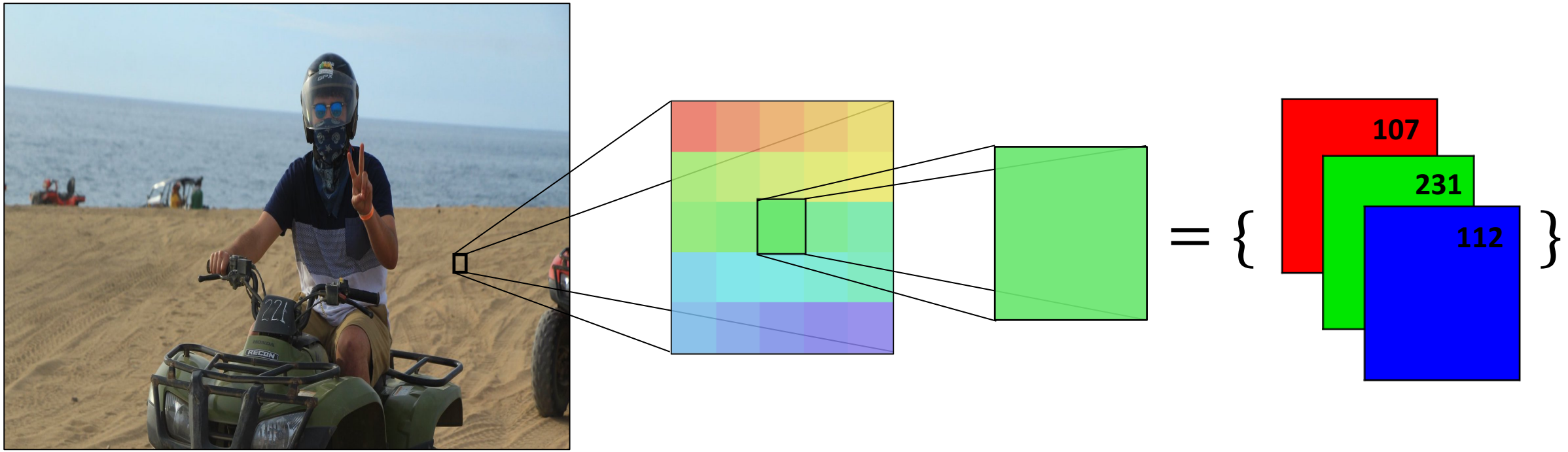
Anthony DeNiro & Rastko Stojsin

Goal : Develop a robust methodology to predict unknown areas of an image

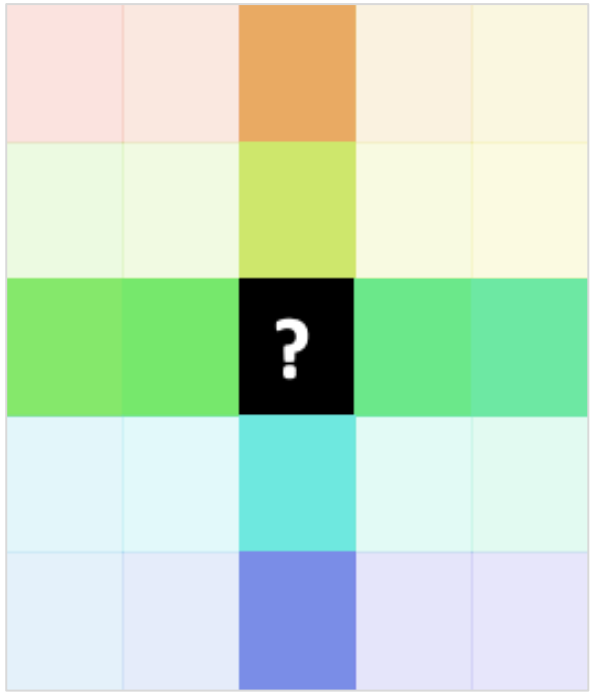
- photo restoration and editing
- computer vision (object continuity behind obstructions)
- medical image imputation

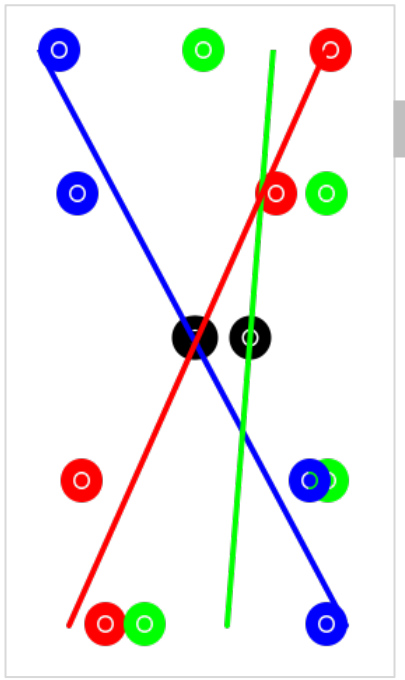





107
231
112

Linear Regression Approach





Vertical Predictions

R 167.75

G 193.50

B 165.25

avg

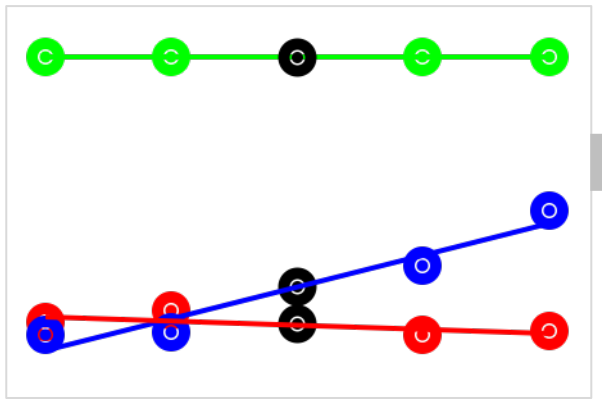
Unknown Pixel Pred.

R 142.25

G 212.75

B 147.13

=

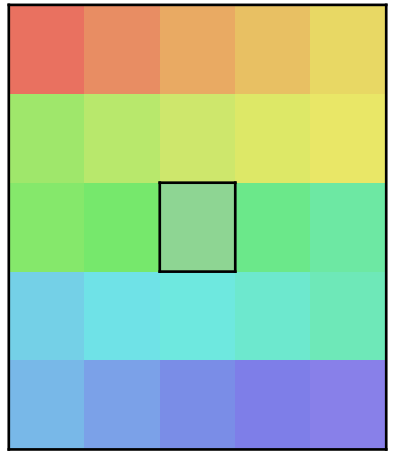


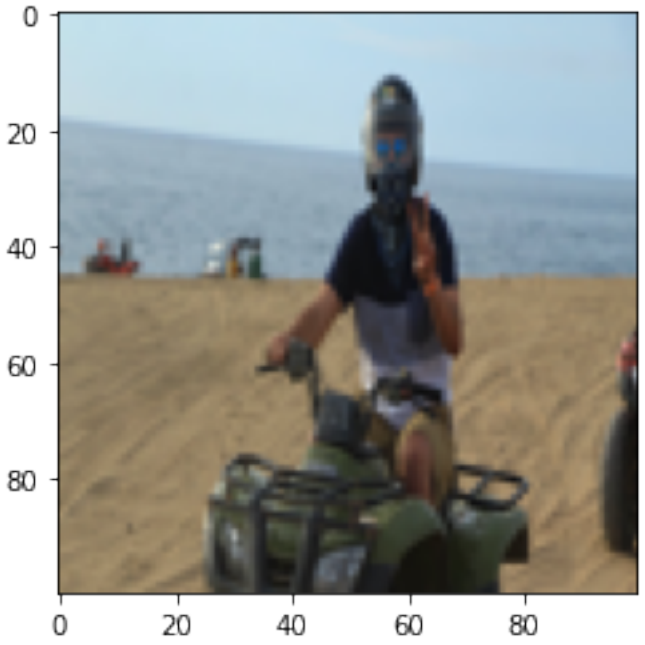
Horizontal Predictions

R 116.75

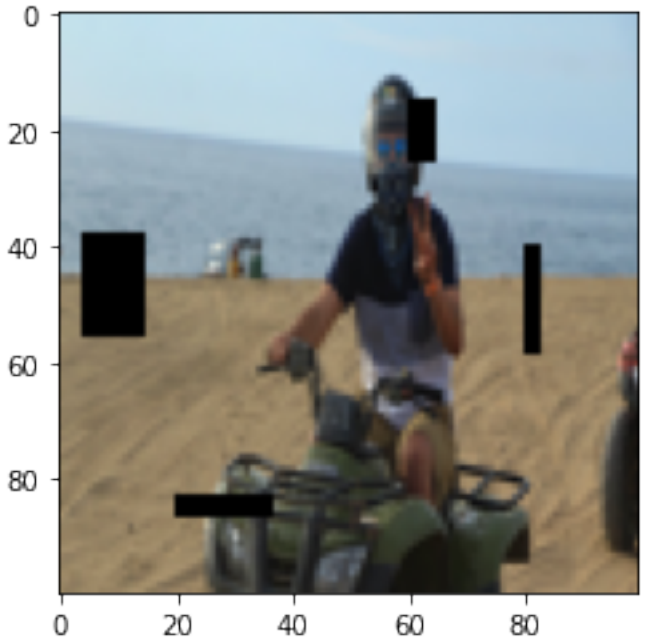
G 232.00

B 129.00



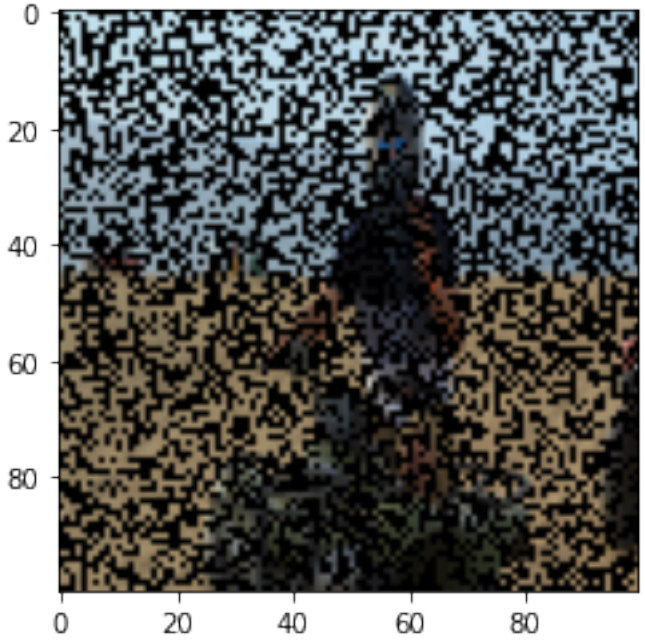


Problem 1



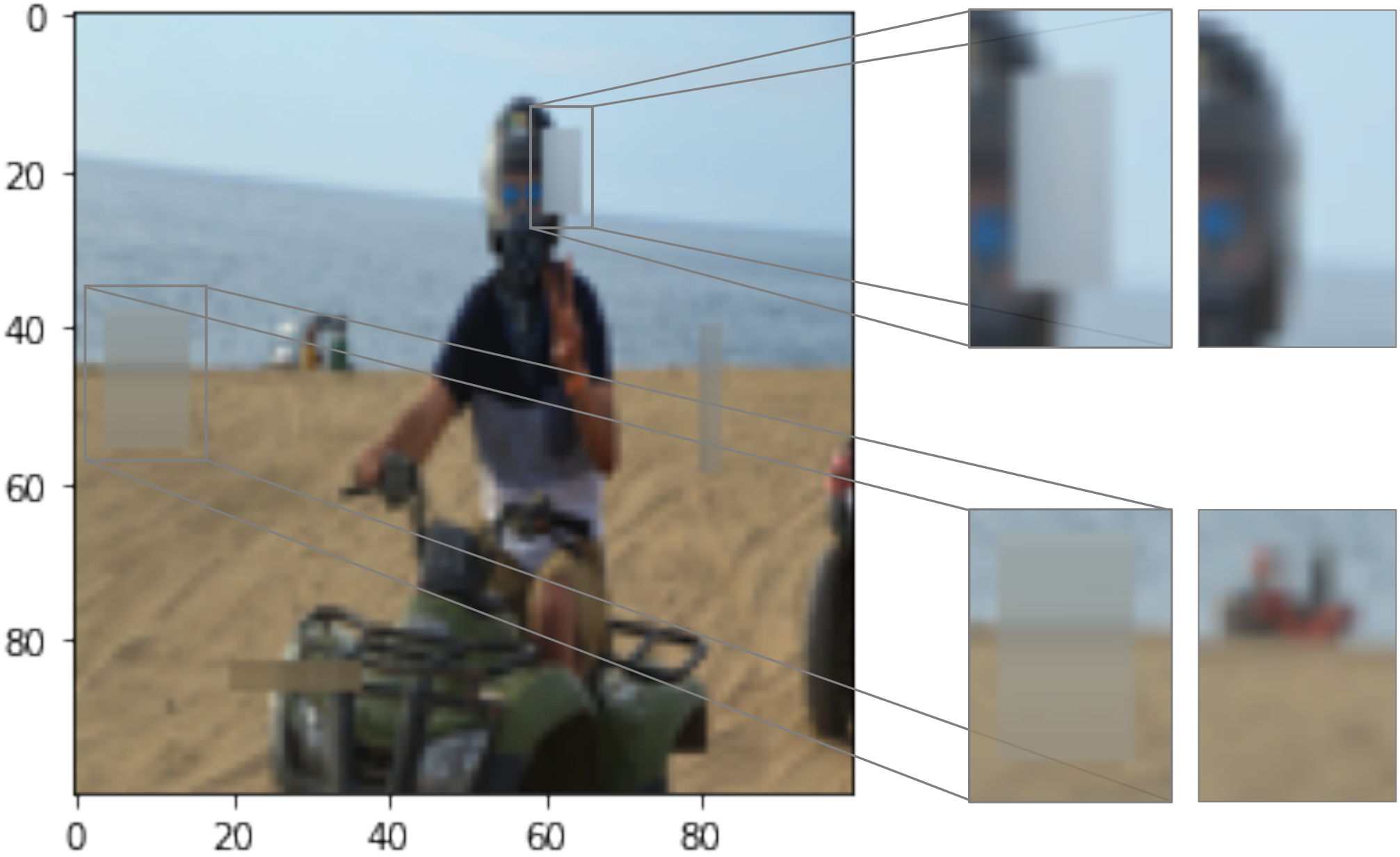
how well can this methodology predict specific areas?

Problem 2



how well does this methodology understand the image as a whole?

Problem 1



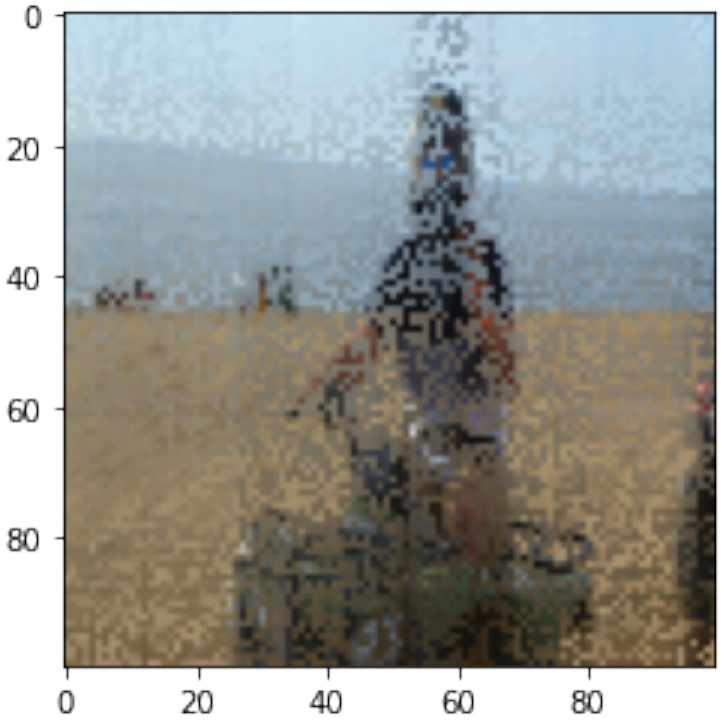
original

captures too much blueness from sky (horizontal calculation)

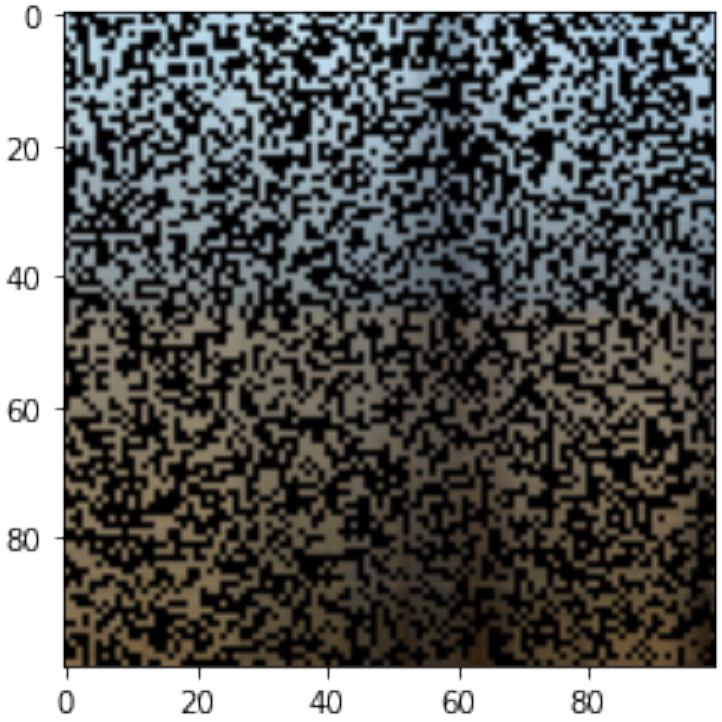
not sensitive enough to neighborhood

okay performance on horizon

Problem 2



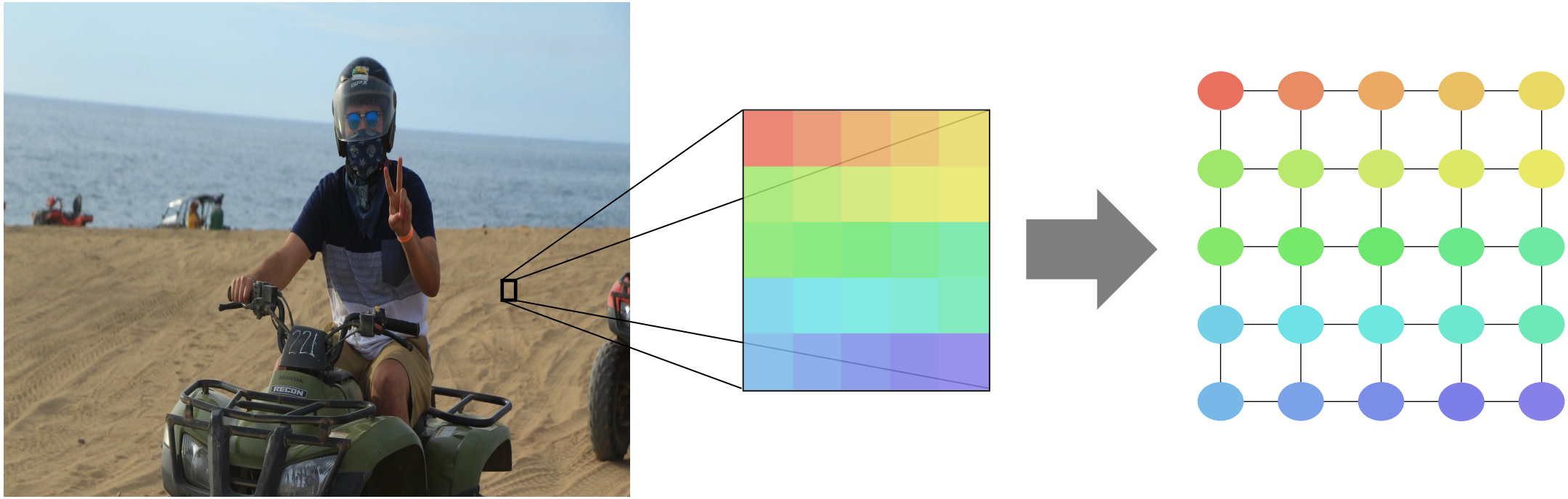
predicted pixels only



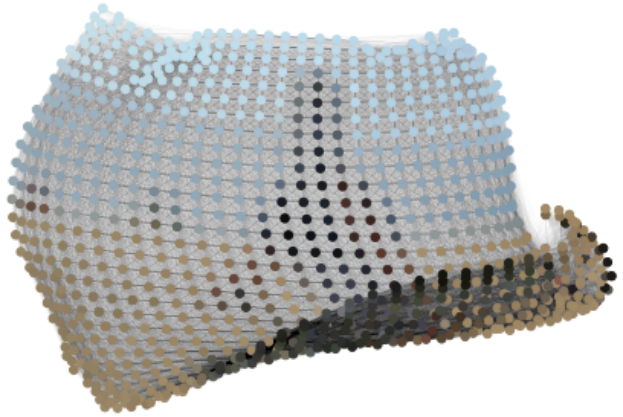
- Too insensitive
- Only captures large exactly vertical & horizontal features
- Does not consider any diagonal pixels

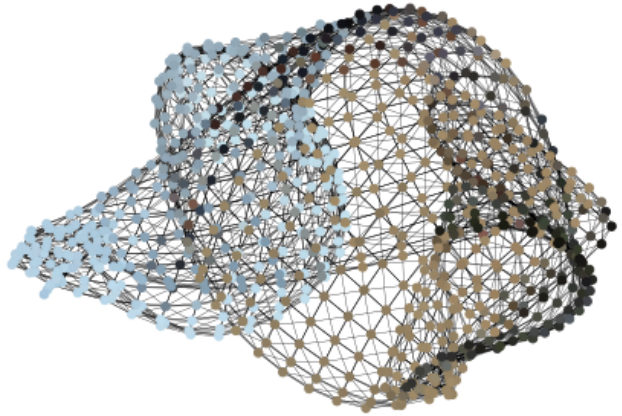
- Solution: A Graph Network Approach?

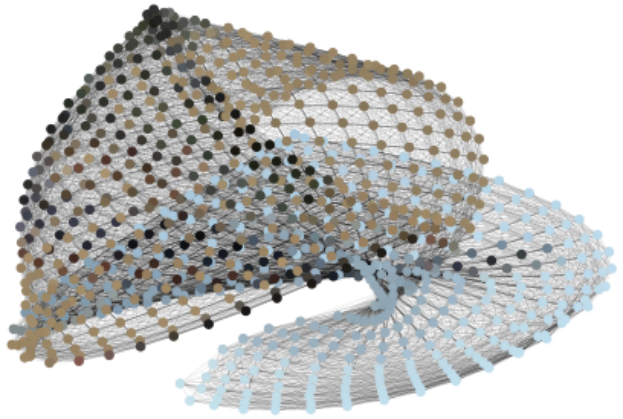
Graph Network Approach

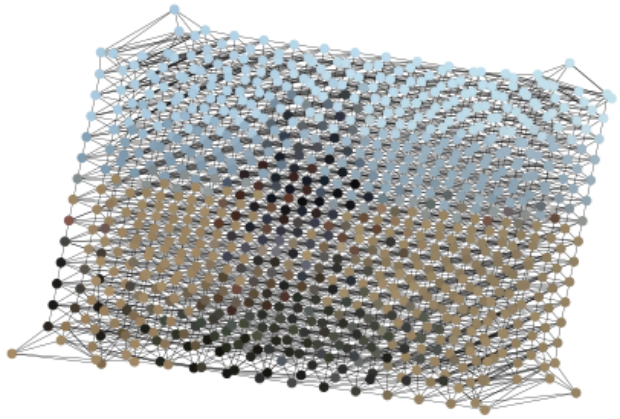


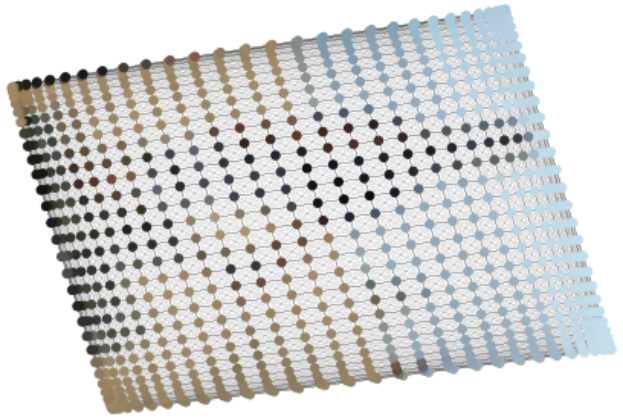

221
RECON

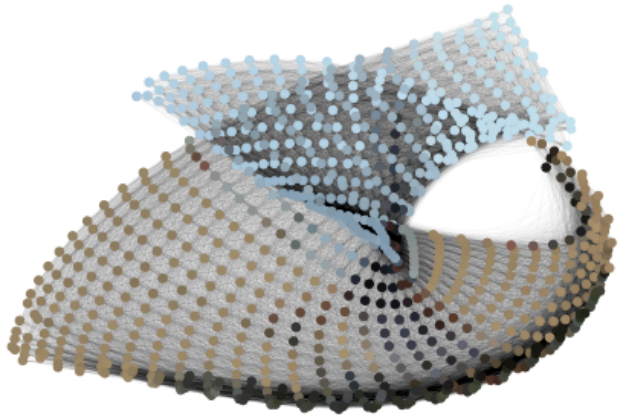


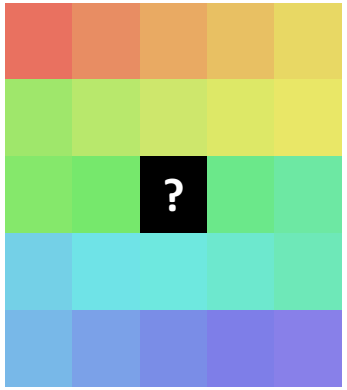


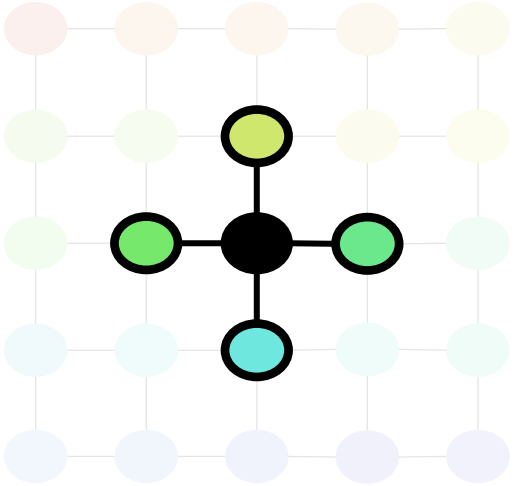


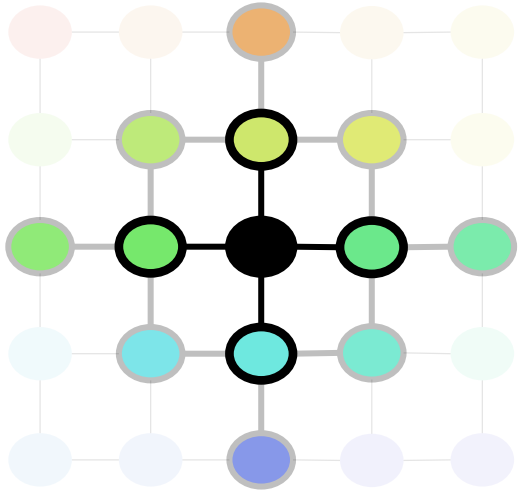






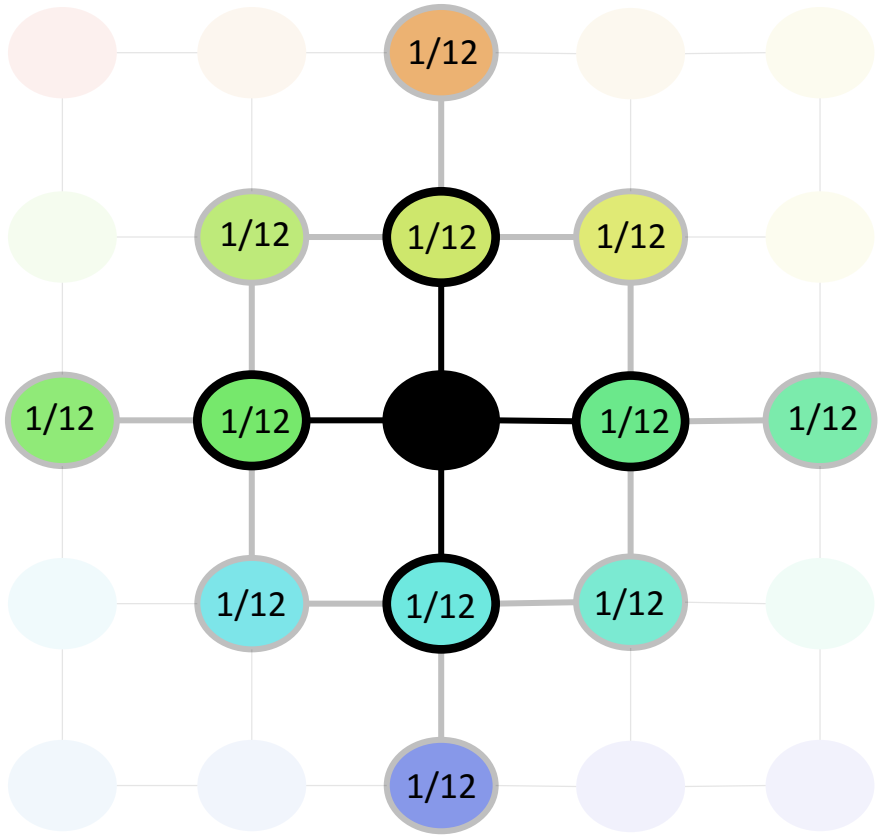




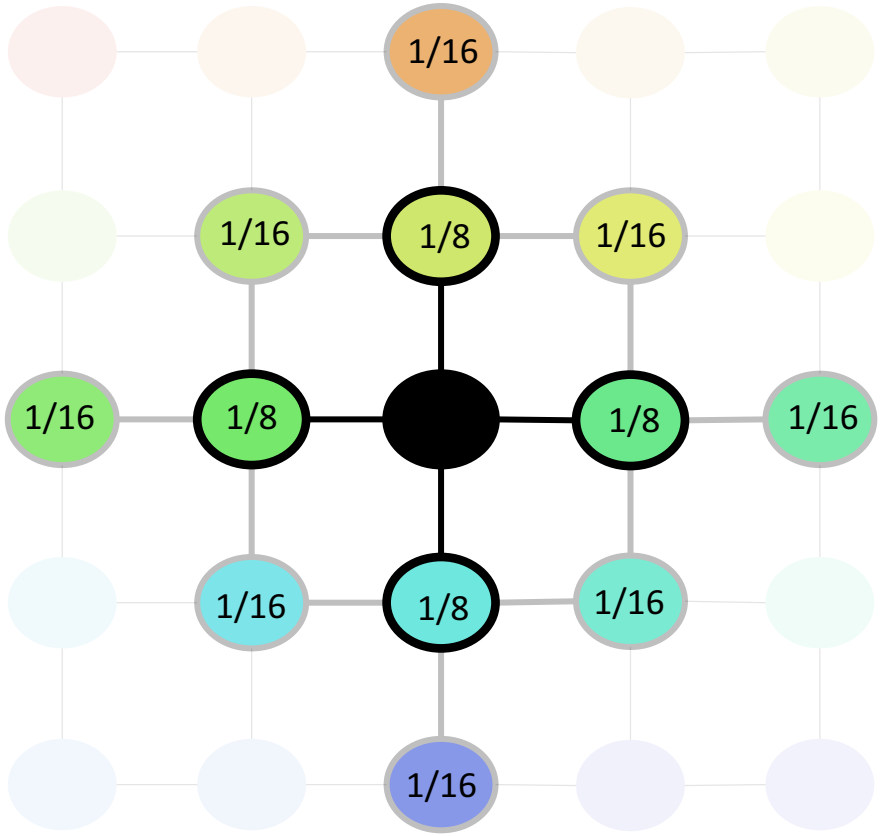


. . .

$n = 1$ $n = 2$ $n = x$


1/12
1/12
1/12
1/12
1/12
1/12
1/12
1/12
1/12
1/12

$n = 2 : d = 1$


1/16
1/16
1/8
1/16
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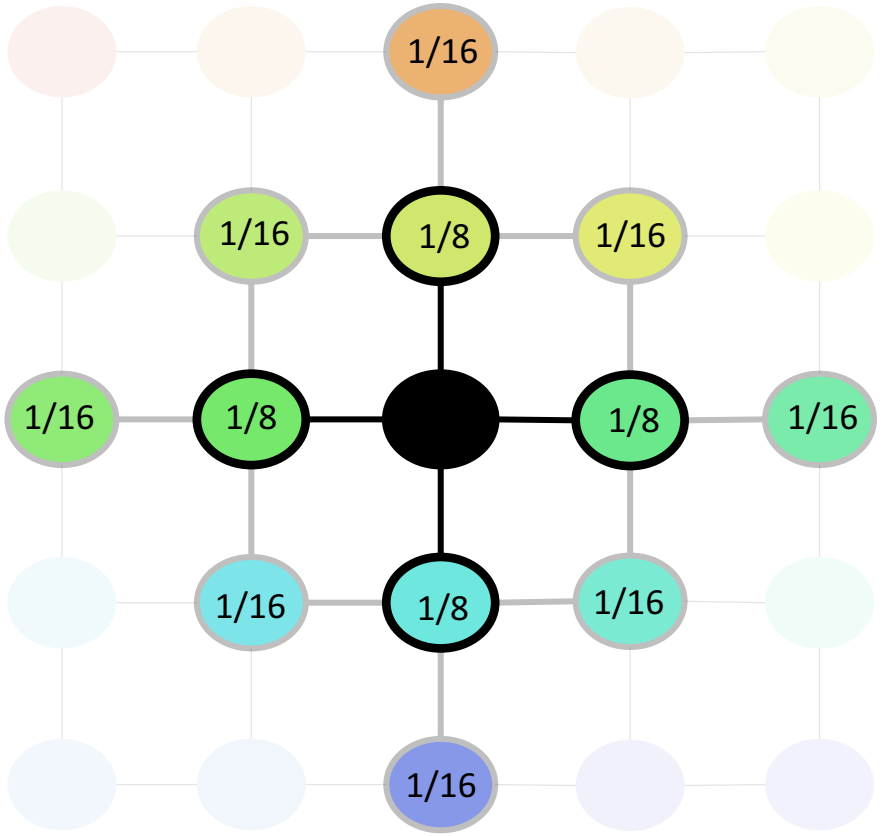
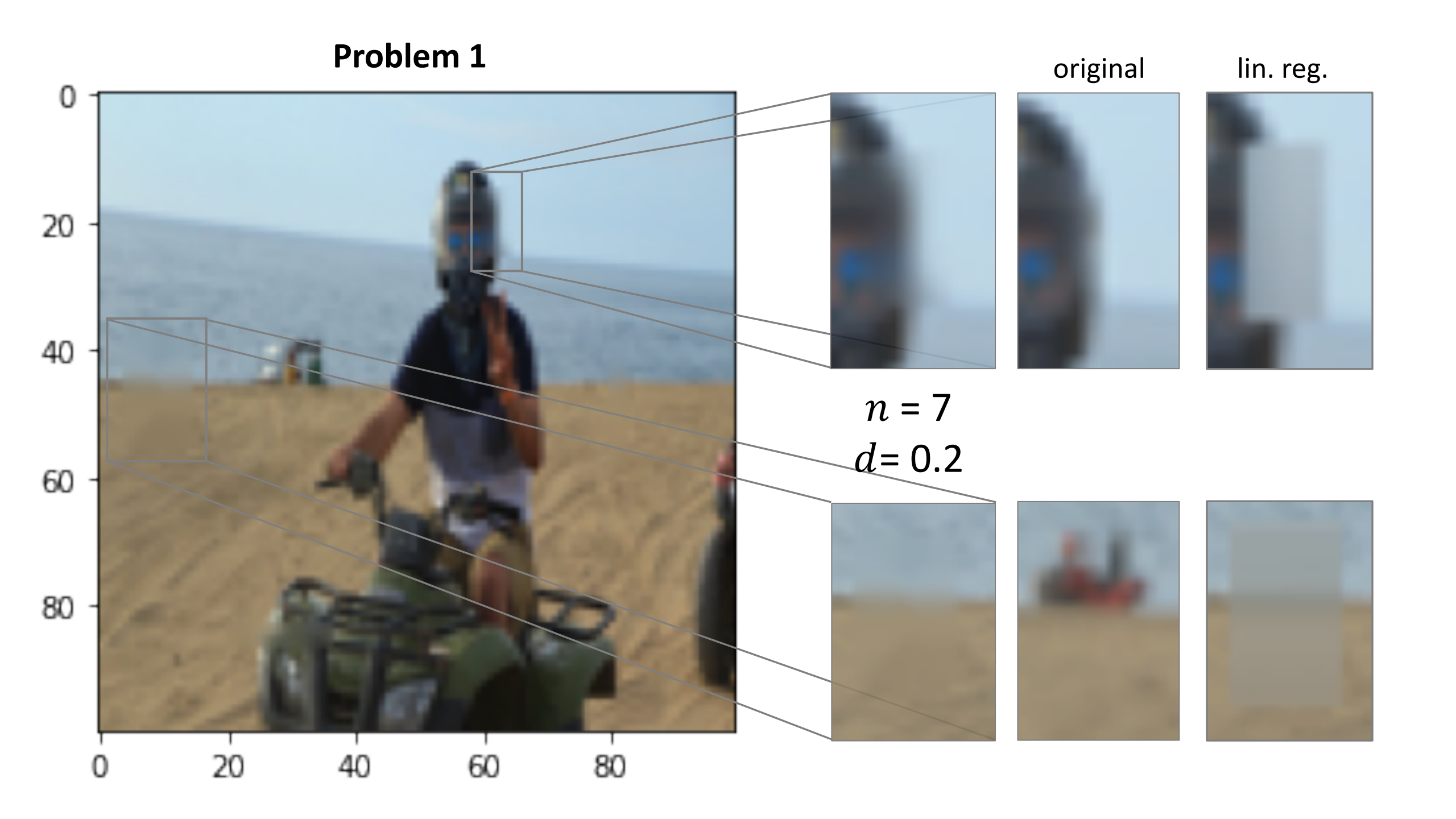
$n = 2 : d = 0.5$

$$w_i =$$

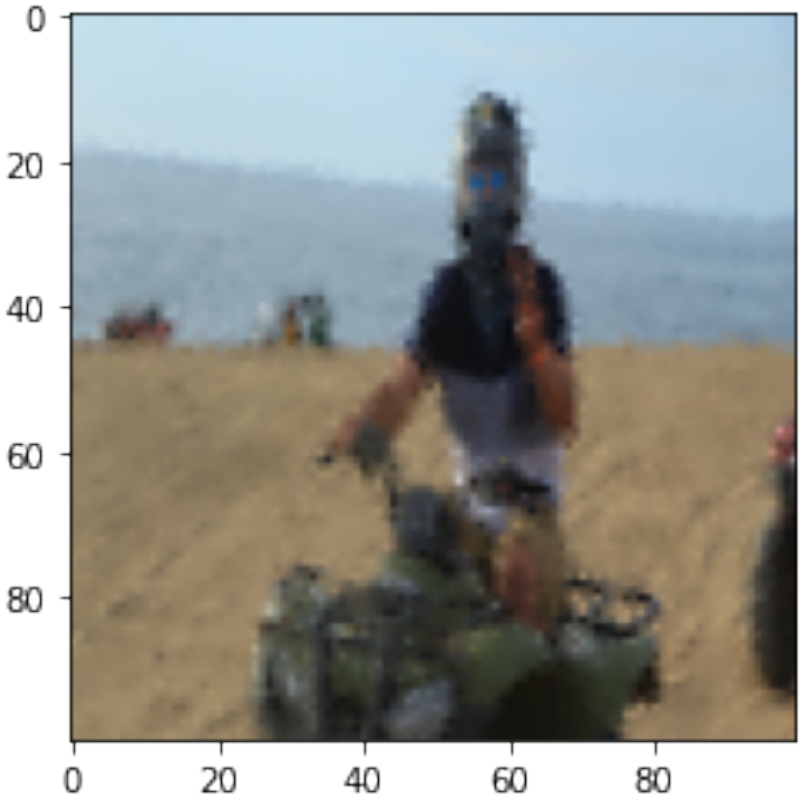


$$\begin{bmatrix} R_p \\ G_p \\ B_p \end{bmatrix} = \sum_{i=1}^{m} \begin{bmatrix} R_i \\ G_i \\ B_i \end{bmatrix} w_i$$

$$n = 2 : d = 0.5$$


Problem 1
original
lin. reg.
0
20
40
60
80
0
20
40
60
80
n = 7
d= 0.2

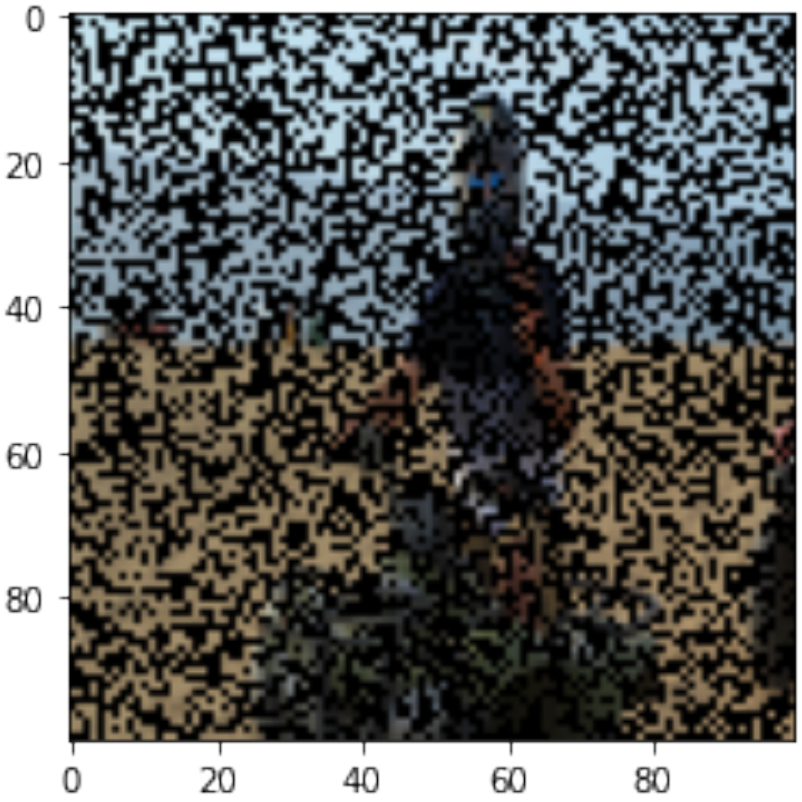
Problem 2



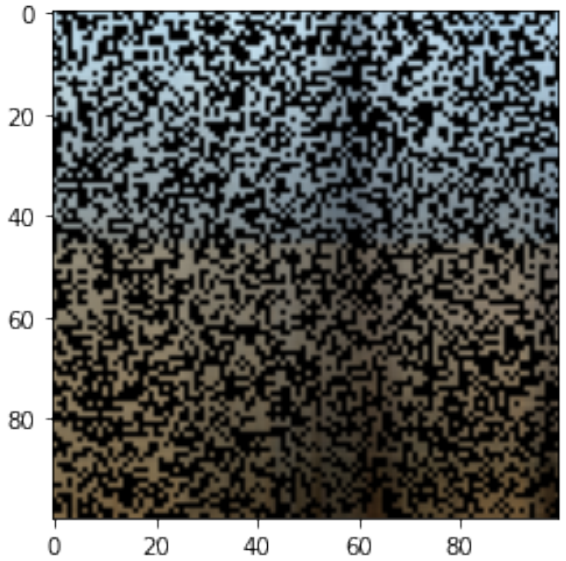
$n = 7$

$d = 0.2$

predicted pixels only



- Great performance!
- Clearly captures all elements of the original photo (large and small elements)



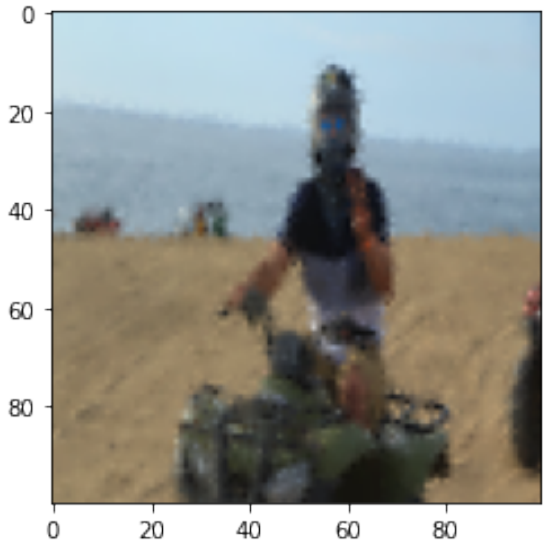
Graph Networks vs Linear Regression

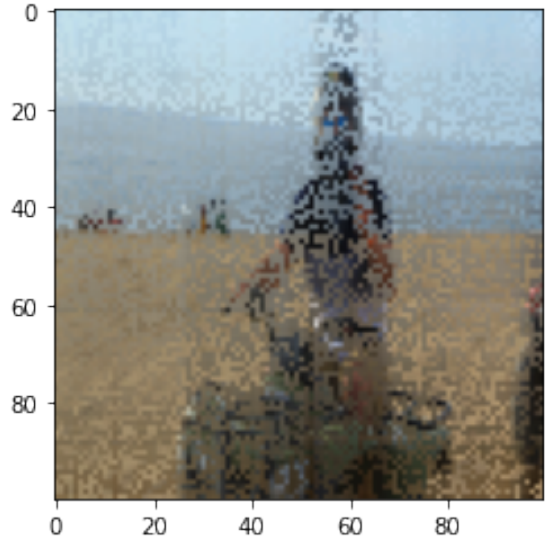
Advantages

- better performance
- flexibility
  - Can tune *n* & *w* for any image
  - Doesn't need any pixels directly on horizontal and/or vertical

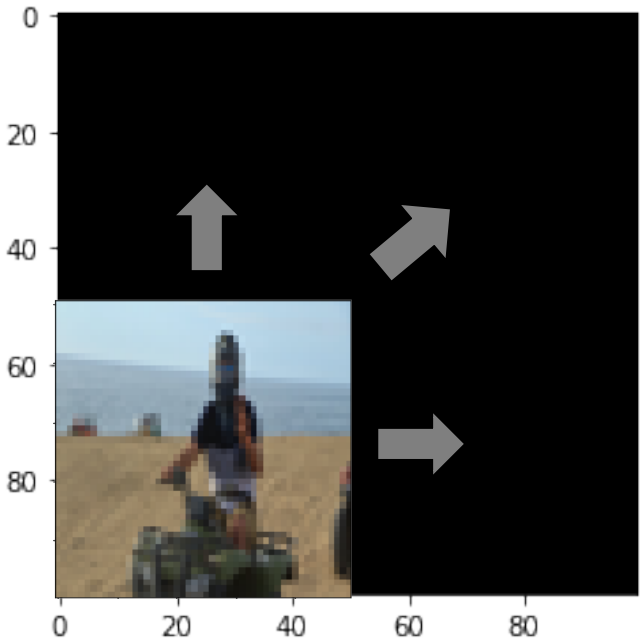
Disadvantage

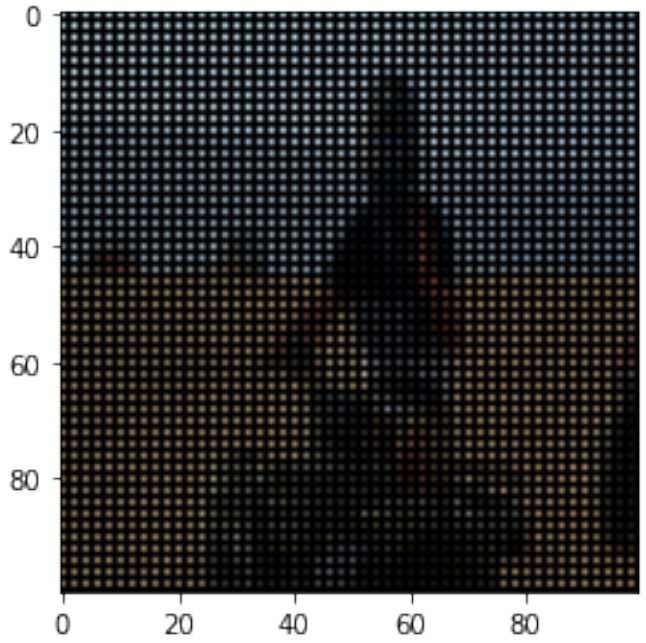
- computation time



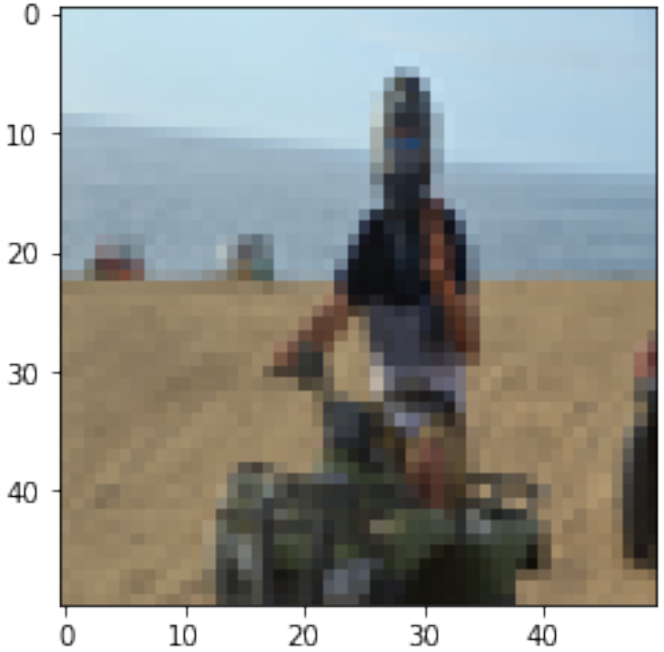


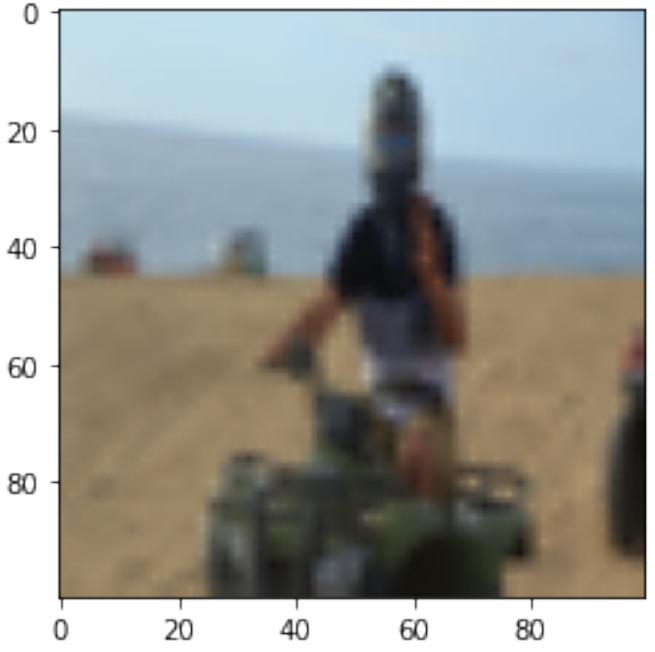

Questions?

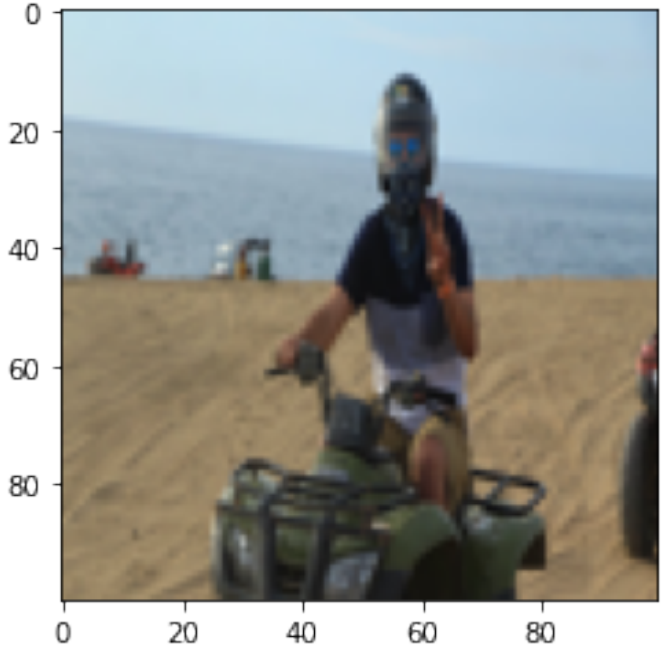


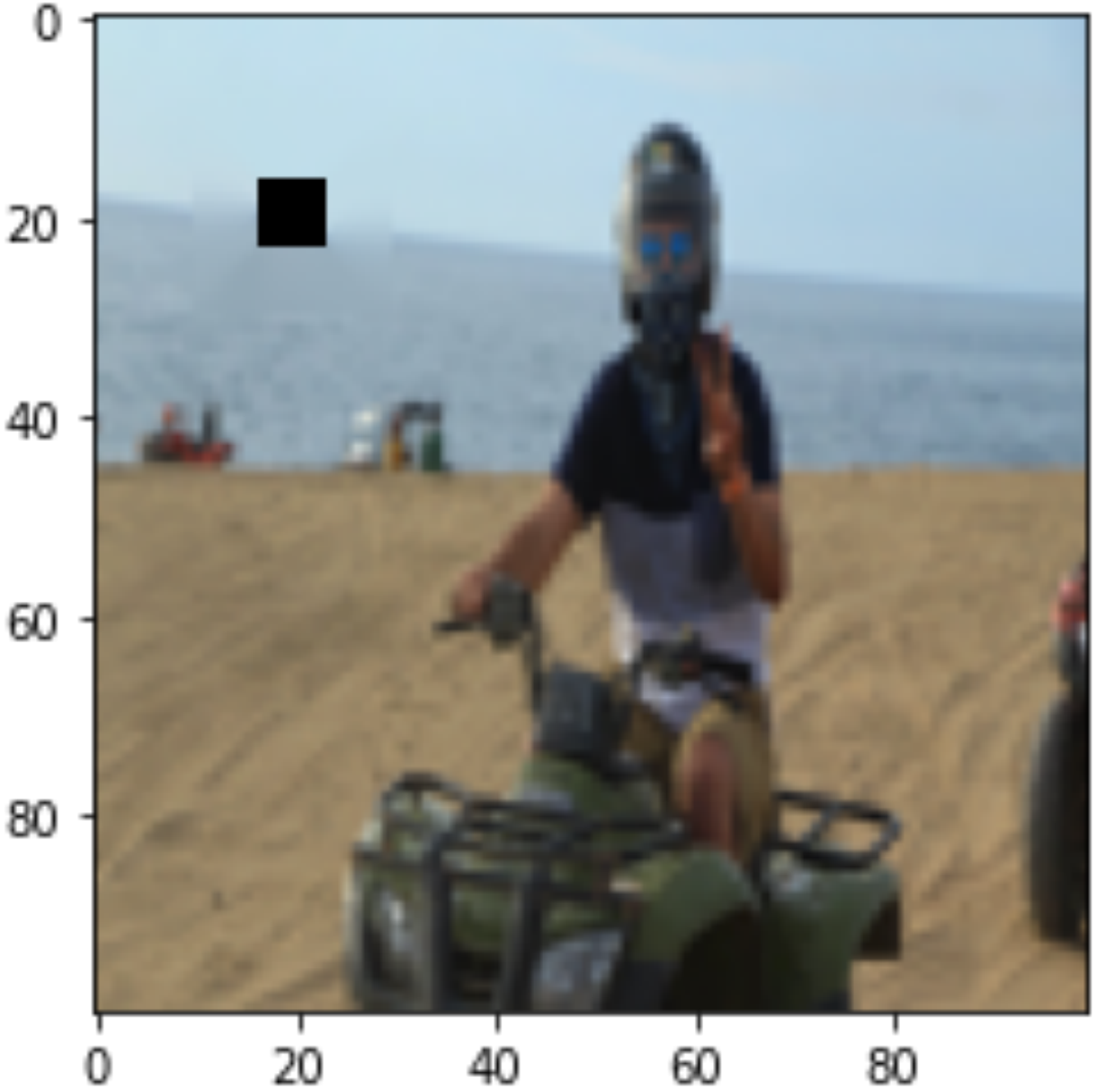


“Enhance that image!”
– every movie ever









- increase n and decrease w

-Rerun algorithm