ΑΡΙΣΤΟΤΕΛΕΙΟ
ΠΑΝΕΠΙΣΤΗΜΙΟ
ΘΕΣΣΑΛΟΝΙΚΗΣ

Νευρωνικά Δίκτυα - Βαθιά Μάθηση

Εργασία 3

ΜΙΧΟΥ ΓΕΩΡΓΙΑ 3828

Η εργασία εκπονήθηκε από την άνωθεν φοιτήτρια του τμήματος Πληροφορικής του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης, στα πλαίσια του μαθήματος «Νευρωνικά Δίκτυα - Βαθιά Μάθηση» κατά τη διάρκεια του ακαδημαϊκού έτους 2023-2024.

1. Γενικά

Η παρακάτω εργασία αφορά την υλοποίηση ενός συνελικτικού αυτόματου κωδικοποιητή (convolutional autoencoder) χρησιμοποιώντας τα keras και tensorflow, με σκοπό την ανακατασκευή δειγμάτων, δηλαδή των εικόνων που περιέχονται στη βάση δεδομένων cifar-10 (η ίδια βάση που χρησιμοποιήθηκε και στις 2 προηγούμενες εργασίες). Ο κώδικας αναπτύχτηκε στο Kaggle.

2. Κώδικας - Υλοποίηση

Α) Βάση δεδομένων και επεξεργασία αυτών: Στην αρχή, φορτώνεται το σύνολο δεδομένων CIFAR-10, το οποίο περιέχει 60.000 έγχρωμες εικόνες 32x32 σε 10 διαφορετικές κλάσεις. Οι τιμές των pixels κανονικοποιούνται ώστε να κυμαίνονται μεταξύ 0 και 1. Έπειτα, οι εικόνες μετατρέπονται σε κλίμακα του γκρι με τη χρήση του tf.image.rgb_to_grayscale επειδή ο αυτόματος κωδικοποιητής έχει σχεδιαστεί για εικόνες ενός καναλιού (κλίμακα του γκρι).

Β) Υλοποίηση του auto-encoder: Αρχικά, ορίζεται το στρώμα εισόδου που αντιπροσωπεύει τις εικόνες σε κλίμακα του γκρι με σχήμα (32, 32, 1). Έπειτα, ο κωδικοποιητής αποτελείται από συνελικτικά στρώματα για την εξαγωγή χαρακτηριστικών από τις εικόνες εισόδου. Το πρώτο επίπεδο Conv2D με 16 φίλτρα και πυρήνα (3, 3) εφαρμόζει ενεργοποίηση ReLU και διατηρεί τις χωρικές διαστάσεις με "ίδιο" γέμισμα. Επιλέχθηκαν οι συγκεκριμένες παράμετροι καθώς τα στρώματα συνελικτικής ανάλυσης έχουν μικρό μέγεθος πυρήνα (3x3), το οποίο βοηθά στη σύλληψη τοπικών μοτίβων και λεπτομερειών. Η συνάρτηση ενεργοποίησης ReLU, η οποία εισάγει μη γραμμικότητα στο μοντέλο, του επιτρέπει να μαθαίνει σύνθετες σχέσεις στα δεδομένα. Η παράμετρος "padding" έχει οριστεί σε "same", πράγμα που σημαίνει ότι προστίθεται μηδενικό padding στην είσοδο για να εξασφαλιστεί ότι η έξοδος έχει τις ίδιες χωρικές διαστάσεις. Όσον αφορά το κομμάτι του αποκωδικοποιητή, εκείνος αντικατοπτρίζει τον κωδικοποιητή όσον αφορά τα επίπεδα συνελίξεων, αλλά χρησιμοποιεί επίπεδα αναδειγματοληψίας αντί για επίπεδα μέγιστης συγκέντρωσης. Η αναδειγματοληψία βοηθά στην αύξηση της χωρικής ανάλυσης των χαρτών χαρακτηριστικών. Το τελευταίο στρώμα αποκωδικοποιητή χρησιμοποιεί τη σιγμοειδή συνάρτηση ενεργοποίησης. Δεδομένου ότι οι εικόνες είναι κλίμακες του γκρι, η σιγμοειδής συνάρτηση συμπιέζει τις τιμές εξόδου μεταξύ 0 και 1, γεγονός που είναι κατάλληλο για τις τιμές έντασης των εικονοστοιχείων. Τα στρώματα MaxPooling2D με μέγεθος συγκέντρωσης (2, 2) χρησιμοποιούνται για την υποδειγματοληψία. Αυτό μειώνει τις χωρικές διαστάσεις κατά το ήμισυ. Τα στρώματα

αναδειγματοληψίας (unsampling layers) χρησιμοποιούνται για την αύξηση των χωρικών διαστάσεων των χαρτών χαρακτηριστικών κατά τη διαδικασία αποκωδικοποίησης. Το μοντέλο ακολουθεί μια συμμετρική αρχιτεκτονική κωδικοποιητή-αποκωδικοποιητή, η οποία είναι ένας κοινός σχεδιασμός για τους αυτόματους κωδικοποιητές. Το στρώμα συμφόρησης (bottleneck layer κωδικοποιημένο) χρησιμεύει ως συμπιεσμένη αναπαράσταση της εισόδου. Αυτό το στρώμα είναι ζωτικής σημασίας για τη σύλληψη των πιο σημαντικών χαρακτηριστικών, ενώ απορρίπτονται οι περιττές λεπτομέρειες. Ως συνάρτηση χρησιμοποιείται η δυαδική συνάρτηση απώλειας crossentropy, η οποία στο πλαίσιο των αυτοκωδικοποιητών, μετρά την ομοιότητα μεταξύ των εικόνων εισόδου και εξόδου. Ο βελτιστοποιητής Adam επιλέγεται για την αποτελεσματικότητά του στην εκπαίδευση βαθιών νευρωνικών δικτύων. Βρόχος εκπαίδευσης: Το μοντέλο εκπαιδεύεται χρησιμοποιώντας τη μέθοδο train_on_batch σε έναν βρόχο για έναν καθορισμένο αριθμό εποχών. Αυτό επιτρέπει στο μοντέλο να ενημερώνει τα βάρη του με βάση μίνι παρτίδες δεδομένων εκπαίδευσης.

Στη συνέχεια, δοκιμάζονται διαφορετικοί αριθμοί νευρώνων στα παραπάνω layers, εκπαίδευση με διαφορετικό πλήθος εποχών, η sgd ως βελτιστοποιητής και έπειτα σύγκριση αποτελεσμάτων με την ανακατασκευή μέσω PCA. Δυστυχώς, στις παρακάτω εκτελέσεις δεν δοκιμάστηκε μεγάλος αριθμός εποχών λόγω ενδείξεων της RAM και αυτόματου τερματισμού του προγράμματος.

Γ) Αξιολόγηση του μοντέλου: Μέσω της εντολής summary, κάθε φορά εκτυπώνονται οι τιμές των παραμέτρων του μοντέλου και ύστερα εμφανίζεται η συμπεριφορά του δικτύου σε κάθε εποχή. Για να αξιολογηθεί, σε κάθε τέτοια επανάληψη υπολογίζεται και εκτυπώνεται η απώλεια στα δεδομένα εκπαίδευσης και επικύρωσης ξεχωριστά. Για να εξετάσουμε την περίπτωση της υπερεκπαίδευσης με βάση τα losses, μπορούμε να διακρίνουμε τις εξής περιπτώσεις:

- Αν και τα 2 ποσοστά μειώνονται, το μοντέλο αρχίζει να βελτιώνεται
- Αν το train loss μειώνεται και το val loss αυξάνεται είτε σταδιακά είτε απότομα, πιθανόν έχει γίνει overfitting στα δεδομένα.

Ακολουθούν οι μετρικές pixel_accuracy_train και pixel_accuracy_test που υπολογίζουν την ακρίβεια των τιμών των εικονοστοιχείων μεταξύ της αρχικής και της ανακατασκευασμένης εικόνας. Είναι ο λόγος των σωστά προβλεπόμενων εικονοστοιχείων προς τον συνολικό αριθμό των εικονοστοιχείων. Έπειτα και στα δεδομένα εκπαίδευσης αλλά και ελέγχου μετριούνται η μέση τετραγωνική διαφορά μεταξύ των αρχικών και των

ανακατασκευασμένων τιμών εικονοστοιχείων στις παραμέτρους mse_train, mse_test. Οι χαμηλότερες τιμές εδώ υποδηλώνουν καλύτερη ποιότητα ανακατασκευής. Η τελευταία μετρική που χρησιμοποιείται είναι ο μέγιστος λόγος σήματος προς θόρυβο (PSNR) ο οποίος μετρά την ποιότητα της ανακατασκευασμένης εικόνας, λαμβάνοντας υπόψη τόσο το MSE όσο και τη μέγιστη δυνατή τιμή εικονοστοιχείου. Υψηλότερες τιμές PSNR υποδηλώνουν καλύτερη ποιότητα εικόνας.

Μετά την εκπαίδευση, παρατίθενται 10 αρχικές εικόνες από το σύνολο δεδομένων, έπειτα σε μορφή grayscale και τέλος η ανατασκευασμένη μορφή τους.

Δ) Έκθεση αποτελεσμάτων: Παρατίθενται σε μορφή κειμένου οι εκτελέσεις του Autoencoder με διαφορετικές τιμές στις παραμέτρους όπως προαναφέρθηκαν.

1η εκτέλεση:

```
Layer Name: encoder_conv1
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv2
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv3
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv1
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv2
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv3
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: output_layer
Filters: 1, Kernel Size: (3, 3)
=================================================
Model: "autoencoder_model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (InputLayer)    [(None, 32, 32, 1)]       0

 encoder_conv1 (Conv2D)      (None, 32, 32, 16)        160

 encoder_pool1 (MaxPooling2  (None, 16, 16, 16)        0
 D)

 encoder_conv2 (Conv2D)      (None, 16, 16, 8)         1160

 encoder_pool2 (MaxPooling2  (None, 8, 8, 8)           0
 D)

 encoder_conv3 (Conv2D)      (None, 8, 8, 8)           584

 encoder_pool3 (MaxPooling2  (None, 4, 4, 8)           0
 D)

 decoder_conv1 (Conv2D)      (None, 4, 4, 8)           584

 decoder_upsample1 (UpSampl  (None, 8, 8, 8)           0
 ing2D)

 decoder_conv2 (Conv2D)      (None, 8, 8, 8)           584

 decoder_upsample2 (UpSampl  (None, 16, 16, 8)         0
 ing2D)

 decoder_conv3 (Conv2D)      (None, 16, 16, 16)        1168
```

```
 decoder_upsample3 (UpSampl  (None, 32, 32, 16)        0
 ing2D)

 output_layer (Conv2D)       (None, 32, 32, 1)         145

=================================================================
Total params: 4385 (17.13 KB)
Trainable params: 4385 (17.13 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 1/50 - Loss: 0.6930 - Val Loss: 0.6929 - Train Pixel Accuracy: 55.00% - Test Pixel Accuracy:
54.71% - Train MSE: 0.0574 - Test MSE: 0.0571 - Train PSNR: 12.4105 - Test PSNR: 12.4338
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 2/50 - Loss: 0.6928 - Val Loss: 0.6927 - Train Pixel Accuracy: 55.48% - Test Pixel Accuracy:
55.16% - Train MSE: 0.0573 - Test MSE: 0.0570 - Train PSNR: 12.4166 - Test PSNR: 12.4395
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 3/50 - Loss: 0.6927 - Val Loss: 0.6925 - Train Pixel Accuracy: 55.71% - Test Pixel Accuracy:
55.39% - Train MSE: 0.0572 - Test MSE: 0.0569 - Train PSNR: 12.4233 - Test PSNR: 12.4458
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 4/50 - Loss: 0.6925 - Val Loss: 0.6924 - Train Pixel Accuracy: 55.74% - Test Pixel Accuracy:
55.42% - Train MSE: 0.0571 - Test MSE: 0.0569 - Train PSNR: 12.4306 - Test PSNR: 12.4527
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 5/50 - Loss: 0.6923 - Val Loss: 0.6922 - Train Pixel Accuracy: 55.73% - Test Pixel Accuracy:
55.41% - Train MSE: 0.0570 - Test MSE: 0.0568 - Train PSNR: 12.4387 - Test PSNR: 12.4602
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 6/50 - Loss: 0.6921 - Val Loss: 0.6919 - Train Pixel Accuracy: 55.77% - Test Pixel Accuracy:
55.45% - Train MSE: 0.0569 - Test MSE: 0.0566 - Train PSNR: 12.4477 - Test PSNR: 12.4687
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 7/50 - Loss: 0.6918 - Val Loss: 0.6917 - Train Pixel Accuracy: 55.90% - Test Pixel Accuracy:
55.58% - Train MSE: 0.0568 - Test MSE: 0.0565 - Train PSNR: 12.4578 - Test PSNR: 12.4783
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 8/50 - Loss: 0.6916 - Val Loss: 0.6914 - Train Pixel Accuracy: 56.11% - Test Pixel Accuracy:
55.80% - Train MSE: 0.0566 - Test MSE: 0.0564 - Train PSNR: 12.4692 - Test PSNR: 12.4893
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 9/50 - Loss: 0.6913 - Val Loss: 0.6911 - Train Pixel Accuracy: 56.41% - Test Pixel Accuracy:
56.12% - Train MSE: 0.0565 - Test MSE: 0.0562 - Train PSNR: 12.4822 - Test PSNR: 12.5019
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 10/50 - Loss: 0.6909 - Val Loss: 0.6907 - Train Pixel Accuracy: 56.81% - Test Pixel
Accuracy: 56.54% - Train MSE: 0.0563 - Test MSE: 0.0560 - Train PSNR: 12.4972 - Test PSNR: 12.5165
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 11/50 - Loss: 0.6906 - Val Loss: 0.6903 - Train Pixel Accuracy: 57.29% - Test Pixel
Accuracy: 57.05% - Train MSE: 0.0560 - Test MSE: 0.0558 - Train PSNR: 12.5145 - Test PSNR: 12.5336
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 12/50 - Loss: 0.6901 - Val Loss: 0.6897 - Train Pixel Accuracy: 57.83% - Test Pixel
Accuracy: 57.61% - Train MSE: 0.0558 - Test MSE: 0.0555 - Train PSNR: 12.5347 - Test PSNR: 12.5536
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 13/50 - Loss: 0.6896 - Val Loss: 0.6891 - Train Pixel Accuracy: 58.44% - Test Pixel
Accuracy: 58.26% - Train MSE: 0.0555 - Test MSE: 0.0552 - Train PSNR: 12.5585 - Test PSNR: 12.5773
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 14/50 - Loss: 0.6890 - Val Loss: 0.6884 - Train Pixel Accuracy: 59.16% - Test Pixel
Accuracy: 59.02% - Train MSE: 0.0551 - Test MSE: 0.0549 - Train PSNR: 12.5865 - Test PSNR: 12.6054
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 15/50 - Loss: 0.6882 - Val Loss: 0.6876 - Train Pixel Accuracy: 59.85% - Test Pixel
Accuracy: 59.74% - Train MSE: 0.0547 - Test MSE: 0.0545 - Train PSNR: 12.6193 - Test PSNR: 12.6383
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 16/50 - Loss: 0.6874 - Val Loss: 0.6866 - Train Pixel Accuracy: 60.41% - Test Pixel
Accuracy: 60.32% - Train MSE: 0.0542 - Test MSE: 0.0540 - Train PSNR: 12.6574 - Test PSNR: 12.6766
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 17/50 - Loss: 0.6865 - Val Loss: 0.6855 - Train Pixel Accuracy: 60.99% - Test Pixel
Accuracy: 60.93% - Train MSE: 0.0537 - Test MSE: 0.0535 - Train PSNR: 12.7009 - Test PSNR: 12.7203
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 18/50 - Loss: 0.6854 - Val Loss: 0.6843 - Train Pixel Accuracy: 61.52% - Test Pixel
Accuracy: 61.48% - Train MSE: 0.0531 - Test MSE: 0.0528 - Train PSNR: 12.7503 - Test PSNR: 12.7701
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 19/50 - Loss: 0.6841 - Val Loss: 0.6829 - Train Pixel Accuracy: 62.00% - Test Pixel
Accuracy: 61.98% - Train MSE: 0.0524 - Test MSE: 0.0522 - Train PSNR: 12.8066 - Test PSNR: 12.8266
```

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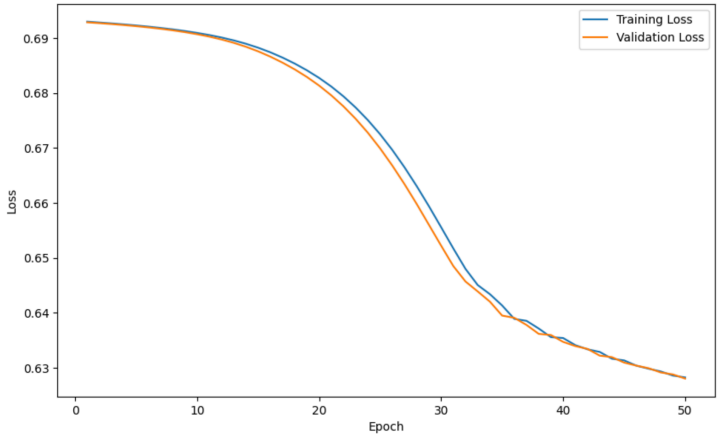
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 20/50 - Loss: 0.6827 - Val Loss: 0.6814 - Train Pixel Accuracy: 62.60% - Test Pixel
Accuracy: 62.59% - Train MSE: 0.0516 - Test MSE: 0.0514 - Train PSNR: 12.8712 - Test PSNR: 12.8913
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 21/50 - Loss: 0.6812 - Val Loss: 0.6796 - Train Pixel Accuracy: 63.33% - Test Pixel
Accuracy: 63.34% - Train MSE: 0.0507 - Test MSE: 0.0505 - Train PSNR: 12.9458 - Test PSNR: 12.9657
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 22/50 - Loss: 0.6794 - Val Loss: 0.6776 - Train Pixel Accuracy: 64.16% - Test Pixel
Accuracy: 64.16% - Train MSE: 0.0498 - Test MSE: 0.0495 - Train PSNR: 13.0319 - Test PSNR: 13.0513
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 23/50 - Loss: 0.6773 - Val Loss: 0.6753 - Train Pixel Accuracy: 65.08% - Test Pixel
Accuracy: 65.07% - Train MSE: 0.0486 - Test MSE: 0.0484 - Train PSNR: 13.1305 - Test PSNR: 13.1493
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 24/50 - Loss: 0.6751 - Val Loss: 0.6728 - Train Pixel Accuracy: 66.09% - Test Pixel
Accuracy: 66.08% - Train MSE: 0.0474 - Test MSE: 0.0472 - Train PSNR: 13.2431 - Test PSNR: 13.2614
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 25/50 - Loss: 0.6725 - Val Loss: 0.6699 - Train Pixel Accuracy: 67.23% - Test Pixel
Accuracy: 67.22% - Train MSE: 0.0460 - Test MSE: 0.0458 - Train PSNR: 13.3722 - Test PSNR: 13.3901
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 26/50 - Loss: 0.6696 - Val Loss: 0.6668 - Train Pixel Accuracy: 68.48% - Test Pixel
Accuracy: 68.48% - Train MSE: 0.0445 - Test MSE: 0.0443 - Train PSNR: 13.5187 - Test PSNR: 13.5359
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 27/50 - Loss: 0.6665 - Val Loss: 0.6634 - Train Pixel Accuracy: 69.80% - Test Pixel
Accuracy: 69.78% - Train MSE: 0.0428 - Test MSE: 0.0427 - Train PSNR: 13.6825 - Test PSNR: 13.6982
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 28/50 - Loss: 0.6631 - Val Loss: 0.6598 - Train Pixel Accuracy: 71.05% - Test Pixel
Accuracy: 71.02% - Train MSE: 0.0411 - Test MSE: 0.0410 - Train PSNR: 13.8627 - Test PSNR: 13.8771
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 4s 14ms/step
Epoch 29/50 - Loss: 0.6594 - Val Loss: 0.6560 - Train Pixel Accuracy: 72.15% - Test Pixel
Accuracy: 72.10% - Train MSE: 0.0393 - Test MSE: 0.0392 - Train PSNR: 14.0577 - Test PSNR: 14.0711
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 30/50 - Loss: 0.6556 - Val Loss: 0.6522 - Train Pixel Accuracy: 73.13% - Test Pixel
Accuracy: 73.07% - Train MSE: 0.0375 - Test MSE: 0.0374 - Train PSNR: 14.2631 - Test PSNR: 14.2735
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 31/50 - Loss: 0.6517 - Val Loss: 0.6485 - Train Pixel Accuracy: 73.89% - Test Pixel
Accuracy: 73.82% - Train MSE: 0.0358 - Test MSE: 0.0357 - Train PSNR: 14.4663 - Test PSNR: 14.4772
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 32/50 - Loss: 0.6480 - Val Loss: 0.6457 - Train Pixel Accuracy: 74.73% - Test Pixel
Accuracy: 74.65% - Train MSE: 0.0343 - Test MSE: 0.0343 - Train PSNR: 14.6436 - Test PSNR: 14.6480
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 33/50 - Loss: 0.6450 - Val Loss: 0.6439 - Train Pixel Accuracy: 74.72% - Test Pixel
Accuracy: 74.68% - Train MSE: 0.0337 - Test MSE: 0.0336 - Train PSNR: 14.7263 - Test PSNR: 14.7393
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 34/50 - Loss: 0.6434 - Val Loss: 0.6420 - Train Pixel Accuracy: 75.99% - Test Pixel
Accuracy: 75.91% - Train MSE: 0.0325 - Test MSE: 0.0325 - Train PSNR: 14.8850 - Test PSNR: 14.8868
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 35/50 - Loss: 0.6413 - Val Loss: 0.6395 - Train Pixel Accuracy: 76.59% - Test Pixel
Accuracy: 76.54% - Train MSE: 0.0314 - Test MSE: 0.0314 - Train PSNR: 15.0262 - Test PSNR: 15.0332
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 36/50 - Loss: 0.6389 - Val Loss: 0.6391 - Train Pixel Accuracy: 76.57% - Test Pixel
Accuracy: 76.50% - Train MSE: 0.0313 - Test MSE: 0.0313 - Train PSNR: 15.0404 - Test PSNR: 15.0508
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 37/50 - Loss: 0.6385 - Val Loss: 0.6378 - Train Pixel Accuracy: 77.59% - Test Pixel
Accuracy: 77.52% - Train MSE: 0.0305 - Test MSE: 0.0304 - Train PSNR: 15.1631 - Test PSNR: 15.1674
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 38/50 - Loss: 0.6371 - Val Loss: 0.6362 - Train Pixel Accuracy: 77.91% - Test Pixel
Accuracy: 77.84% - Train MSE: 0.0298 - Test MSE: 0.0298 - Train PSNR: 15.2536 - Test PSNR: 15.2610
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 39/50 - Loss: 0.6356 - Val Loss: 0.6359 - Train Pixel Accuracy: 77.69% - Test Pixel
Accuracy: 77.61% - Train MSE: 0.0299 - Test MSE: 0.0298 - Train PSNR: 15.2486 - Test PSNR: 15.2593
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 40/50 - Loss: 0.6354 - Val Loss: 0.6347 - Train Pixel Accuracy: 78.50% - Test Pixel
Accuracy: 78.43% - Train MSE: 0.0291 - Test MSE: 0.0291 - Train PSNR: 15.3541 - Test PSNR: 15.3619
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
```

```
Epoch 41/50 - Loss: 0.6341 - Val Loss: 0.6339 - Train Pixel Accuracy: 78.70% - Test Pixel
Accuracy: 78.64% - Train MSE: 0.0288 - Test MSE: 0.0288 - Train PSNR: 15.4019 - Test PSNR: 15.4103
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 42/50 - Loss: 0.6333 - Val Loss: 0.6334 - Train Pixel Accuracy: 78.40% - Test Pixel
Accuracy: 78.33% - Train MSE: 0.0288 - Test MSE: 0.0287 - Train PSNR: 15.4117 - Test PSNR: 15.4230
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 43/50 - Loss: 0.6329 - Val Loss: 0.6322 - Train Pixel Accuracy: 78.93% - Test Pixel
Accuracy: 78.87% - Train MSE: 0.0282 - Test MSE: 0.0281 - Train PSNR: 15.5026 - Test PSNR: 15.5126
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 44/50 - Loss: 0.6316 - Val Loss: 0.6319 - Train Pixel Accuracy: 79.18% - Test Pixel
Accuracy: 79.14% - Train MSE: 0.0280 - Test MSE: 0.0279 - Train PSNR: 15.5307 - Test PSNR: 15.5389
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 45/50 - Loss: 0.6313 - Val Loss: 0.6309 - Train Pixel Accuracy: 79.02% - Test Pixel
Accuracy: 78.97% - Train MSE: 0.0277 - Test MSE: 0.0276 - Train PSNR: 15.5768 - Test PSNR: 15.5879
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 46/50 - Loss: 0.6304 - Val Loss: 0.6304 - Train Pixel Accuracy: 79.09% - Test Pixel
Accuracy: 79.04% - Train MSE: 0.0275 - Test MSE: 0.0274 - Train PSNR: 15.6120 - Test PSNR: 15.6234
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 47/50 - Loss: 0.6298 - Val Loss: 0.6299 - Train Pixel Accuracy: 79.44% - Test Pixel
Accuracy: 79.42% - Train MSE: 0.0272 - Test MSE: 0.0271 - Train PSNR: 15.6580 - Test PSNR: 15.6673
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 48/50 - Loss: 0.6293 - Val Loss: 0.6291 - Train Pixel Accuracy: 79.49% - Test Pixel
Accuracy: 79.48% - Train MSE: 0.0269 - Test MSE: 0.0268 - Train PSNR: 15.7052 - Test PSNR: 15.7158
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 49/50 - Loss: 0.6286 - Val Loss: 0.6288 - Train Pixel Accuracy: 79.34% - Test Pixel
Accuracy: 79.31% - Train MSE: 0.0268 - Test MSE: 0.0267 - Train PSNR: 15.7187 - Test PSNR: 15.7312
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 50/50 - Loss: 0.6282 - Val Loss: 0.6280 - Train Pixel Accuracy: 79.65% - Test Pixel
Accuracy: 79.65% - Train MSE: 0.0264 - Test MSE: 0.0263 - Train PSNR: 15.7814 - Test PSNR: 15.7928
Training time: 2936.398024559021 seconds
```



:

2η εκτέλεση:

```
Layer Name: encoder_conv1
Filters: 16, Kernel Size: (3, 3)
==================================================
Layer Name: encoder_conv2
Filters: 8, Kernel Size: (3, 3)
==================================================
Layer Name: encoder_conv3
Filters: 8, Kernel Size: (3, 3)
==================================================
Layer Name: decoder_conv1
Filters: 8, Kernel Size: (3, 3)
==================================================
Layer Name: decoder_conv2
Filters: 8, Kernel Size: (3, 3)
==================================================
Layer Name: decoder_conv3
Filters: 16, Kernel Size: (3, 3)
```

```
==================================================
Layer Name: output_layer
Filters: 1, Kernel Size: (3, 3)
==================================================
Model: "autoencoder_model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (InputLayer)    [(None, 32, 32, 1)]       0

 encoder_conv1 (Conv2D)      (None, 32, 32, 16)        160

 encoder_pool1 (MaxPooling2  (None, 16, 16, 16)        0
 D)

 encoder_conv2 (Conv2D)      (None, 16, 16, 8)         1160

 encoder_pool2 (MaxPooling2  (None, 8, 8, 8)           0
 D)

 encoder_conv3 (Conv2D)      (None, 8, 8, 8)           584

 encoder_pool3 (MaxPooling2  (None, 4, 4, 8)           0
 D)

 decoder_conv1 (Conv2D)      (None, 4, 4, 8)           584

 decoder_upsample1 (UpSampl  (None, 8, 8, 8)           0
 ing2D)

 decoder_conv2 (Conv2D)      (None, 8, 8, 8)           584

 decoder_upsample2 (UpSampl  (None, 16, 16, 8)         0
 ing2D)

 decoder_conv3 (Conv2D)      (None, 16, 16, 16)        1168

 decoder_upsample3 (UpSampl  (None, 32, 32, 16)        0
 ing2D)

 output_layer (Conv2D)       (None, 32, 32, 1)         145

=================================================================
Total params: 4385 (17.13 KB)
Trainable params: 4385 (17.13 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 5s 15ms/step
Epoch 1/200 - Loss: 0.6930 - Val Loss: 0.6927 - Train Pixel Accuracy: 55.22% - Test Pixel
Accuracy: 54.86% - Train MSE: 0.0573 - Test MSE: 0.0570 - Train PSNR: 12.4169 - Test PSNR: 12.4385
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 2/200 - Loss: 0.6927 - Val Loss: 0.6924 - Train Pixel Accuracy: 54.99% - Test Pixel
Accuracy: 54.62% - Train MSE: 0.0572 - Test MSE: 0.0569 - Train PSNR: 12.4281 - Test PSNR: 12.4495
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 3/200 - Loss: 0.6924 - Val Loss: 0.6921 - Train Pixel Accuracy: 54.78% - Test Pixel
Accuracy: 54.40% - Train MSE: 0.0570 - Test MSE: 0.0567 - Train PSNR: 12.4408 - Test PSNR: 12.4615
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 4/200 - Loss: 0.6920 - Val Loss: 0.6918 - Train Pixel Accuracy: 54.72% - Test Pixel
Accuracy: 54.35% - Train MSE: 0.0568 - Test MSE: 0.0566 - Train PSNR: 12.4554 - Test PSNR: 12.4750
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 5/200 - Loss: 0.6916 - Val Loss: 0.6914 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.34% - Train MSE: 0.0566 - Test MSE: 0.0564 - Train PSNR: 12.4702 - Test PSNR: 12.4884
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 6/200 - Loss: 0.6913 - Val Loss: 0.6910 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0564 - Test MSE: 0.0562 - Train PSNR: 12.4872 - Test PSNR: 12.5043
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 7/200 - Loss: 0.6908 - Val Loss: 0.6905 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0562 - Test MSE: 0.0559 - Train PSNR: 12.5063 - Test PSNR: 12.5224
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 8/200 - Loss: 0.6903 - Val Loss: 0.6901 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0559 - Test MSE: 0.0557 - Train PSNR: 12.5265 - Test PSNR: 12.5415
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 9/200 - Loss: 0.6898 - Val Loss: 0.6895 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0556 - Test MSE: 0.0554 - Train PSNR: 12.5500 - Test PSNR: 12.5635
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 10/200 - Loss: 0.6892 - Val Loss: 0.6889 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0553 - Test MSE: 0.0551 - Train PSNR: 12.5761 - Test PSNR: 12.5877
```

```
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 11/200 - Loss: 0.6885 - Val Loss: 0.6882 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0549 - Test MSE: 0.0548 - Train PSNR: 12.6054 - Test PSNR: 12.6151
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 12/200 - Loss: 0.6878 - Val Loss: 0.6873 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0545 - Test MSE: 0.0544 - Train PSNR: 12.6394 - Test PSNR: 12.6476
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 13/200 - Loss: 0.6869 - Val Loss: 0.6864 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0540 - Test MSE: 0.0539 - Train PSNR: 12.6770 - Test PSNR: 12.6836
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 14/200 - Loss: 0.6859 - Val Loss: 0.6854 - Train Pixel Accuracy: 54.71% - Test Pixel
Accuracy: 54.33% - Train MSE: 0.0535 - Test MSE: 0.0534 - Train PSNR: 12.7194 - Test PSNR: 12.7240
1563/1563 [==============================] - 28s 18ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 15/200 - Loss: 0.6849 - Val Loss: 0.6843 - Train Pixel Accuracy: 54.72% - Test Pixel
Accuracy: 54.34% - Train MSE: 0.0529 - Test MSE: 0.0529 - Train PSNR: 12.7658 - Test PSNR: 12.7679
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 16/200 - Loss: 0.6837 - Val Loss: 0.6831 - Train Pixel Accuracy: 54.73% - Test Pixel
Accuracy: 54.35% - Train MSE: 0.0523 - Test MSE: 0.0523 - Train PSNR: 12.8179 - Test PSNR: 12.8179
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 17/200 - Loss: 0.6824 - Val Loss: 0.6817 - Train Pixel Accuracy: 54.79% - Test Pixel
Accuracy: 54.42% - Train MSE: 0.0516 - Test MSE: 0.0516 - Train PSNR: 12.8752 - Test PSNR: 12.8734
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 18/200 - Loss: 0.6810 - Val Loss: 0.6802 - Train Pixel Accuracy: 55.02% - Test Pixel
Accuracy: 54.65% - Train MSE: 0.0508 - Test MSE: 0.0509 - Train PSNR: 12.9372 - Test PSNR: 12.9329
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 19/200 - Loss: 0.6795 - Val Loss: 0.6787 - Train Pixel Accuracy: 55.63% - Test Pixel
Accuracy: 55.27% - Train MSE: 0.0501 - Test MSE: 0.0502 - Train PSNR: 13.0029 - Test PSNR: 12.9958
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 20/200 - Loss: 0.6779 - Val Loss: 0.6770 - Train Pixel Accuracy: 56.98% - Test Pixel
Accuracy: 56.64% - Train MSE: 0.0493 - Test MSE: 0.0494 - Train PSNR: 13.0743 - Test PSNR: 13.0653
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 21/200 - Loss: 0.6762 - Val Loss: 0.6753 - Train Pixel Accuracy: 58.82% - Test Pixel
Accuracy: 58.52% - Train MSE: 0.0484 - Test MSE: 0.0485 - Train PSNR: 13.1489 - Test PSNR: 13.1382
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 22/200 - Loss: 0.6744 - Val Loss: 0.6736 - Train Pixel Accuracy: 61.07% - Test Pixel
Accuracy: 60.82% - Train MSE: 0.0476 - Test MSE: 0.0477 - Train PSNR: 13.2256 - Test PSNR: 13.2123
1563/1563 [==============================] - 20s 13ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 23/200 - Loss: 0.6726 - Val Loss: 0.6717 - Train Pixel Accuracy: 63.79% - Test Pixel
Accuracy: 63.57% - Train MSE: 0.0467 - Test MSE: 0.0469 - Train PSNR: 13.3063 - Test PSNR: 13.2918
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 24/200 - Loss: 0.6707 - Val Loss: 0.6699 - Train Pixel Accuracy: 66.54% - Test Pixel
Accuracy: 66.34% - Train MSE: 0.0458 - Test MSE: 0.0460 - Train PSNR: 13.3881 - Test PSNR: 13.3726
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 25/200 - Loss: 0.6689 - Val Loss: 0.6681 - Train Pixel Accuracy: 68.84% - Test Pixel
Accuracy: 68.66% - Train MSE: 0.0450 - Test MSE: 0.0452 - Train PSNR: 13.4703 - Test PSNR: 13.4533
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 26/200 - Loss: 0.6670 - Val Loss: 0.6663 - Train Pixel Accuracy: 71.07% - Test Pixel
Accuracy: 70.89% - Train MSE: 0.0441 - Test MSE: 0.0443 - Train PSNR: 13.5543 - Test PSNR: 13.5379
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 27/200 - Loss: 0.6652 - Val Loss: 0.6645 - Train Pixel Accuracy: 72.54% - Test Pixel
Accuracy: 72.36% - Train MSE: 0.0432 - Test MSE: 0.0434 - Train PSNR: 13.6401 - Test PSNR: 13.6234
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 28/200 - Loss: 0.6634 - Val Loss: 0.6627 - Train Pixel Accuracy: 73.33% - Test Pixel
Accuracy: 73.17% - Train MSE: 0.0424 - Test MSE: 0.0426 - Train PSNR: 13.7258 - Test PSNR: 13.7100
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 29/200 - Loss: 0.6617 - Val Loss: 0.6610 - Train Pixel Accuracy: 73.81% - Test Pixel
Accuracy: 73.65% - Train MSE: 0.0416 - Test MSE: 0.0417 - Train PSNR: 13.8134 - Test PSNR: 13.7984
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 30/200 - Loss: 0.6600 - Val Loss: 0.6593 - Train Pixel Accuracy: 74.03% - Test Pixel
Accuracy: 73.90% - Train MSE: 0.0407 - Test MSE: 0.0409 - Train PSNR: 13.9012 - Test PSNR: 13.8874
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 31/200 - Loss: 0.6583 - Val Loss: 0.6576 - Train Pixel Accuracy: 74.14% - Test Pixel
Accuracy: 74.02% - Train MSE: 0.0399 - Test MSE: 0.0400 - Train PSNR: 13.9906 - Test PSNR: 13.9783
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
```

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Epoch 32/200 - Loss: 0.6567 - Val Loss: 0.6559 - Train Pixel Accuracy: 74.35% - Test Pixel
Accuracy: 74.24% - Train MSE: 0.0390 - Test MSE: 0.0391 - Train PSNR: 14.0845 - Test PSNR: 14.0739
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 33/200 - Loss: 0.6550 - Val Loss: 0.6542 - Train Pixel Accuracy: 74.16% - Test Pixel
Accuracy: 74.05% - Train MSE: 0.0383 - Test MSE: 0.0383 - Train PSNR: 14.1732 - Test PSNR: 14.1642
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 34/200 - Loss: 0.6534 - Val Loss: 0.6526 - Train Pixel Accuracy: 75.16% - Test Pixel
Accuracy: 75.07% - Train MSE: 0.0373 - Test MSE: 0.0374 - Train PSNR: 14.2831 - Test PSNR: 14.2761
1563/1563 [==============================] - 12s 7ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 35/200 - Loss: 0.6518 - Val Loss: 0.6515 - Train Pixel Accuracy: 73.23% - Test Pixel
Accuracy: 73.11% - Train MSE: 0.0371 - Test MSE: 0.0371 - Train PSNR: 14.3100 - Test PSNR: 14.3047
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 36/200 - Loss: 0.6507 - Val Loss: 0.6492 - Train Pixel Accuracy: 75.44% - Test Pixel
Accuracy: 75.35% - Train MSE: 0.0357 - Test MSE: 0.0357 - Train PSNR: 14.4765 - Test PSNR: 14.4733
1563/1563 [==============================] - 11s 7ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 37/200 - Loss: 0.6485 - Val Loss: 0.6478 - Train Pixel Accuracy: 76.18% - Test Pixel
Accuracy: 76.11% - Train MSE: 0.0349 - Test MSE: 0.0349 - Train PSNR: 14.5768 - Test PSNR: 14.5754
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 38/200 - Loss: 0.6471 - Val Loss: 0.6464 - Train Pixel Accuracy: 74.63% - Test Pixel
Accuracy: 74.52% - Train MSE: 0.0346 - Test MSE: 0.0346 - Train PSNR: 14.6059 - Test PSNR: 14.6069
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 39/200 - Loss: 0.6457 - Val Loss: 0.6442 - Train Pixel Accuracy: 75.94% - Test Pixel
Accuracy: 75.87% - Train MSE: 0.0335 - Test MSE: 0.0335 - Train PSNR: 14.7488 - Test PSNR: 14.7512
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 40/200 - Loss: 0.6436 - Val Loss: 0.6432 - Train Pixel Accuracy: 77.54% - Test Pixel
Accuracy: 77.47% - Train MSE: 0.0327 - Test MSE: 0.0327 - Train PSNR: 14.8541 - Test PSNR: 14.8569
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 41/200 - Loss: 0.6426 - Val Loss: 0.6411 - Train Pixel Accuracy: 76.86% - Test Pixel
Accuracy: 76.79% - Train MSE: 0.0321 - Test MSE: 0.0321 - Train PSNR: 14.9343 - Test PSNR: 14.9402
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 42/200 - Loss: 0.6405 - Val Loss: 0.6399 - Train Pixel Accuracy: 77.01% - Test Pixel
Accuracy: 76.93% - Train MSE: 0.0316 - Test MSE: 0.0316 - Train PSNR: 14.9980 - Test PSNR: 15.0059
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 43/200 - Loss: 0.6393 - Val Loss: 0.6382 - Train Pixel Accuracy: 78.19% - Test Pixel
Accuracy: 78.14% - Train MSE: 0.0307 - Test MSE: 0.0307 - Train PSNR: 15.1257 - Test PSNR: 15.1343
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 44/200 - Loss: 0.6376 - Val Loss: 0.6368 - Train Pixel Accuracy: 78.35% - Test Pixel
Accuracy: 78.31% - Train MSE: 0.0301 - Test MSE: 0.0301 - Train PSNR: 15.2073 - Test PSNR: 15.2180
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 45/200 - Loss: 0.6362 - Val Loss: 0.6358 - Train Pixel Accuracy: 78.17% - Test Pixel
Accuracy: 78.13% - Train MSE: 0.0299 - Test MSE: 0.0298 - Train PSNR: 15.2485 - Test PSNR: 15.2624
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 46/200 - Loss: 0.6353 - Val Loss: 0.6343 - Train Pixel Accuracy: 78.63% - Test Pixel
Accuracy: 78.60% - Train MSE: 0.0292 - Test MSE: 0.0291 - Train PSNR: 15.3527 - Test PSNR: 15.3668
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 47/200 - Loss: 0.6338 - Val Loss: 0.6336 - Train Pixel Accuracy: 78.71% - Test Pixel
Accuracy: 78.71% - Train MSE: 0.0289 - Test MSE: 0.0288 - Train PSNR: 15.3975 - Test PSNR: 15.4109
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 48/200 - Loss: 0.6331 - Val Loss: 0.6323 - Train Pixel Accuracy: 78.96% - Test Pixel
Accuracy: 78.94% - Train MSE: 0.0283 - Test MSE: 0.0282 - Train PSNR: 15.4763 - Test PSNR: 15.4924
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 49/200 - Loss: 0.6319 - Val Loss: 0.6314 - Train Pixel Accuracy: 79.16% - Test Pixel
Accuracy: 79.15% - Train MSE: 0.0279 - Test MSE: 0.0278 - Train PSNR: 15.5429 - Test PSNR: 15.5588
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 50/200 - Loss: 0.6309 - Val Loss: 0.6307 - Train Pixel Accuracy: 79.20% - Test Pixel
Accuracy: 79.21% - Train MSE: 0.0276 - Test MSE: 0.0275 - Train PSNR: 15.5937 - Test PSNR: 15.6072
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 51/200 - Loss: 0.6301 - Val Loss: 0.6295 - Train Pixel Accuracy: 79.53% - Test Pixel
Accuracy: 79.53% - Train MSE: 0.0271 - Test MSE: 0.0270 - Train PSNR: 15.6733 - Test PSNR: 15.6878
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 52/200 - Loss: 0.6290 - Val Loss: 0.6290 - Train Pixel Accuracy: 79.64% - Test Pixel
Accuracy: 79.63% - Train MSE: 0.0269 - Test MSE: 0.0268 - Train PSNR: 15.7105 - Test PSNR: 15.7252
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 53/200 - Loss: 0.6284 - Val Loss: 0.6283 - Train Pixel Accuracy: 79.60% - Test Pixel
Accuracy: 79.60% - Train MSE: 0.0266 - Test MSE: 0.0265 - Train PSNR: 15.7566 - Test PSNR: 15.7699
1563/1563 [==============================] - 12s 8ms/step
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313/313 [==============================] - 2s 8ms/step
Epoch 54/200 - Loss: 0.6278 - Val Loss: 0.6275 - Train Pixel Accuracy: 79.78% - Test Pixel
Accuracy: 79.78% - Train MSE: 0.0262 - Test MSE: 0.0261 - Train PSNR: 15.8145 - Test PSNR: 15.8282
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 55/200 - Loss: 0.6269 - Val Loss: 0.6271 - Train Pixel Accuracy: 79.86% - Test Pixel
Accuracy: 79.86% - Train MSE: 0.0260 - Test MSE: 0.0260 - Train PSNR: 15.8441 - Test PSNR: 15.8583
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 56/200 - Loss: 0.6265 - Val Loss: 0.6265 - Train Pixel Accuracy: 79.77% - Test Pixel
Accuracy: 79.76% - Train MSE: 0.0258 - Test MSE: 0.0257 - Train PSNR: 15.8843 - Test PSNR: 15.8970
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 57/200 - Loss: 0.6259 - Val Loss: 0.6258 - Train Pixel Accuracy: 79.94% - Test Pixel
Accuracy: 79.95% - Train MSE: 0.0255 - Test MSE: 0.0254 - Train PSNR: 15.9367 - Test PSNR: 15.9499
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 58/200 - Loss: 0.6252 - Val Loss: 0.6253 - Train Pixel Accuracy: 80.06% - Test Pixel
Accuracy: 80.07% - Train MSE: 0.0253 - Test MSE: 0.0252 - Train PSNR: 15.9711 - Test PSNR: 15.9846
1563/1563 [==============================] - 11s 7ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 59/200 - Loss: 0.6248 - Val Loss: 0.6248 - Train Pixel Accuracy: 80.01% - Test Pixel
Accuracy: 80.00% - Train MSE: 0.0251 - Test MSE: 0.0250 - Train PSNR: 16.0062 - Test PSNR: 16.0177
1563/1563 [==============================] - 12s 7ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 60/200 - Loss: 0.6243 - Val Loss: 0.6242 - Train Pixel Accuracy: 80.25% - Test Pixel
Accuracy: 80.25% - Train MSE: 0.0248 - Test MSE: 0.0247 - Train PSNR: 16.0598 - Test PSNR: 16.0722
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 61/200 - Loss: 0.6236 - Val Loss: 0.6237 - Train Pixel Accuracy: 80.36% - Test Pixel
Accuracy: 80.35% - Train MSE: 0.0246 - Test MSE: 0.0245 - Train PSNR: 16.0993 - Test PSNR: 16.1116
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 62/200 - Loss: 0.6231 - Val Loss: 0.6233 - Train Pixel Accuracy: 80.34% - Test Pixel
Accuracy: 80.32% - Train MSE: 0.0244 - Test MSE: 0.0243 - Train PSNR: 16.1267 - Test PSNR: 16.1379
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 63/200 - Loss: 0.6227 - Val Loss: 0.6228 - Train Pixel Accuracy: 80.51% - Test Pixel
Accuracy: 80.49% - Train MSE: 0.0242 - Test MSE: 0.0241 - Train PSNR: 16.1638 - Test PSNR: 16.1762
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 64/200 - Loss: 0.6223 - Val Loss: 0.6223 - Train Pixel Accuracy: 80.53% - Test Pixel
Accuracy: 80.50% - Train MSE: 0.0240 - Test MSE: 0.0239 - Train PSNR: 16.2052 - Test PSNR: 16.2159
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 65/200 - Loss: 0.6217 - Val Loss: 0.6217 - Train Pixel Accuracy: 80.68% - Test Pixel
Accuracy: 80.65% - Train MSE: 0.0237 - Test MSE: 0.0237 - Train PSNR: 16.2494 - Test PSNR: 16.2606
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 66/200 - Loss: 0.6211 - Val Loss: 0.6213 - Train Pixel Accuracy: 80.78% - Test Pixel
Accuracy: 80.75% - Train MSE: 0.0235 - Test MSE: 0.0235 - Train PSNR: 16.2850 - Test PSNR: 16.2962
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 67/200 - Loss: 0.6207 - Val Loss: 0.6209 - Train Pixel Accuracy: 80.81% - Test Pixel
Accuracy: 80.78% - Train MSE: 0.0234 - Test MSE: 0.0233 - Train PSNR: 16.3139 - Test PSNR: 16.3238
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 68/200 - Loss: 0.6203 - Val Loss: 0.6205 - Train Pixel Accuracy: 80.98% - Test Pixel
Accuracy: 80.96% - Train MSE: 0.0232 - Test MSE: 0.0231 - Train PSNR: 16.3482 - Test PSNR: 16.3596
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 69/200 - Loss: 0.6199 - Val Loss: 0.6201 - Train Pixel Accuracy: 80.98% - Test Pixel
Accuracy: 80.95% - Train MSE: 0.0230 - Test MSE: 0.0230 - Train PSNR: 16.3795 - Test PSNR: 16.3891
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 70/200 - Loss: 0.6195 - Val Loss: 0.6196 - Train Pixel Accuracy: 81.15% - Test Pixel
Accuracy: 81.13% - Train MSE: 0.0228 - Test MSE: 0.0228 - Train PSNR: 16.4193 - Test PSNR: 16.4301
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 71/200 - Loss: 0.6190 - Val Loss: 0.6192 - Train Pixel Accuracy: 81.16% - Test Pixel
Accuracy: 81.14% - Train MSE: 0.0226 - Test MSE: 0.0226 - Train PSNR: 16.4535 - Test PSNR: 16.4631
1563/1563 [==============================] - 17s 11ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 72/200 - Loss: 0.6186 - Val Loss: 0.6187 - Train Pixel Accuracy: 81.25% - Test Pixel
Accuracy: 81.22% - Train MSE: 0.0224 - Test MSE: 0.0224 - Train PSNR: 16.4891 - Test PSNR: 16.4990
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 73/200 - Loss: 0.6181 - Val Loss: 0.6183 - Train Pixel Accuracy: 81.29% - Test Pixel
Accuracy: 81.25% - Train MSE: 0.0223 - Test MSE: 0.0222 - Train PSNR: 16.5211 - Test PSNR: 16.5308
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 74/200 - Loss: 0.6177 - Val Loss: 0.6180 - Train Pixel Accuracy: 81.33% - Test Pixel
Accuracy: 81.29% - Train MSE: 0.0221 - Test MSE: 0.0221 - Train PSNR: 16.5520 - Test PSNR: 16.5614
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 75/200 - Loss: 0.6173 - Val Loss: 0.6176 - Train Pixel Accuracy: 81.41% - Test Pixel
Accuracy: 81.36% - Train MSE: 0.0220 - Test MSE: 0.0219 - Train PSNR: 16.5813 - Test PSNR: 16.5912
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 76/200 - Loss: 0.6170 - Val Loss: 0.6174 - Train Pixel Accuracy: 81.38% - Test Pixel
Accuracy: 81.33% - Train MSE: 0.0219 - Test MSE: 0.0218 - Train PSNR: 16.6012 - Test PSNR: 16.6099
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 77/200 - Loss: 0.6167 - Val Loss: 0.6174 - Train Pixel Accuracy: 81.39% - Test Pixel
Accuracy: 81.33% - Train MSE: 0.0219 - Test MSE: 0.0219 - Train PSNR: 16.5936 - Test PSNR: 16.6040
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 78/200 - Loss: 0.6169 - Val Loss: 0.6183 - Train Pixel Accuracy: 80.89% - Test Pixel
Accuracy: 80.84% - Train MSE: 0.0223 - Test MSE: 0.0223 - Train PSNR: 16.5189 - Test PSNR: 16.5258
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 79/200 - Loss: 0.6177 - Val Loss: 0.6191 - Train Pixel Accuracy: 80.83% - Test Pixel
Accuracy: 80.78% - Train MSE: 0.0226 - Test MSE: 0.0226 - Train PSNR: 16.4554 - Test PSNR: 16.4662
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 80/200 - Loss: 0.6185 - Val Loss: 0.6165 - Train Pixel Accuracy: 81.38% - Test Pixel
Accuracy: 81.32% - Train MSE: 0.0215 - Test MSE: 0.0215 - Train PSNR: 16.6681 - Test PSNR: 16.6758
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 81/200 - Loss: 0.6159 - Val Loss: 0.6165 - Train Pixel Accuracy: 81.35% - Test Pixel
Accuracy: 81.29% - Train MSE: 0.0215 - Test MSE: 0.0215 - Train PSNR: 16.6717 - Test PSNR: 16.6790
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 82/200 - Loss: 0.6159 - Val Loss: 0.6174 - Train Pixel Accuracy: 81.26% - Test Pixel
Accuracy: 81.21% - Train MSE: 0.0219 - Test MSE: 0.0218 - Train PSNR: 16.5977 - Test PSNR: 16.6080
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 83/200 - Loss: 0.6168 - Val Loss: 0.6154 - Train Pixel Accuracy: 81.75% - Test Pixel
Accuracy: 81.69% - Train MSE: 0.0210 - Test MSE: 0.0210 - Train PSNR: 16.7684 - Test PSNR: 16.7767
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 84/200 - Loss: 0.6148 - Val Loss: 0.6165 - Train Pixel Accuracy: 81.27% - Test Pixel
Accuracy: 81.22% - Train MSE: 0.0215 - Test MSE: 0.0215 - Train PSNR: 16.6729 - Test PSNR: 16.6794
1563/1563 [==============================] - 11s 7ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 85/200 - Loss: 0.6159 - Val Loss: 0.6157 - Train Pixel Accuracy: 81.74% - Test Pixel
Accuracy: 81.69% - Train MSE: 0.0212 - Test MSE: 0.0211 - Train PSNR: 16.7427 - Test PSNR: 16.7521
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 86/200 - Loss: 0.6151 - Val Loss: 0.6151 - Train Pixel Accuracy: 81.89% - Test Pixel
Accuracy: 81.83% - Train MSE: 0.0209 - Test MSE: 0.0209 - Train PSNR: 16.7945 - Test PSNR: 16.8035
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 87/200 - Loss: 0.6145 - Val Loss: 0.6158 - Train Pixel Accuracy: 81.45% - Test Pixel
Accuracy: 81.40% - Train MSE: 0.0212 - Test MSE: 0.0212 - Train PSNR: 16.7350 - Test PSNR: 16.7416
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 88/200 - Loss: 0.6151 - Val Loss: 0.6145 - Train Pixel Accuracy: 81.98% - Test Pixel
Accuracy: 81.92% - Train MSE: 0.0206 - Test MSE: 0.0206 - Train PSNR: 16.8531 - Test PSNR: 16.8613
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 89/200 - Loss: 0.6138 - Val Loss: 0.6152 - Train Pixel Accuracy: 81.79% - Test Pixel
Accuracy: 81.73% - Train MSE: 0.0209 - Test MSE: 0.0209 - Train PSNR: 16.7907 - Test PSNR: 16.7996
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 90/200 - Loss: 0.6145 - Val Loss: 0.6143 - Train Pixel Accuracy: 81.90% - Test Pixel
Accuracy: 81.84% - Train MSE: 0.0206 - Test MSE: 0.0205 - Train PSNR: 16.8669 - Test PSNR: 16.8742
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 91/200 - Loss: 0.6136 - Val Loss: 0.6144 - Train Pixel Accuracy: 81.79% - Test Pixel
Accuracy: 81.72% - Train MSE: 0.0206 - Test MSE: 0.0206 - Train PSNR: 16.8529 - Test PSNR: 16.8598
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 92/200 - Loss: 0.6138 - Val Loss: 0.6142 - Train Pixel Accuracy: 81.94% - Test Pixel
Accuracy: 81.89% - Train MSE: 0.0206 - Test MSE: 0.0205 - Train PSNR: 16.8706 - Test PSNR: 16.8787
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 93/200 - Loss: 0.6136 - Val Loss: 0.6138 - Train Pixel Accuracy: 82.04% - Test Pixel
Accuracy: 81.98% - Train MSE: 0.0204 - Test MSE: 0.0203 - Train PSNR: 16.9128 - Test PSNR: 16.9205
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 94/200 - Loss: 0.6131 - Val Loss: 0.6141 - Train Pixel Accuracy: 81.82% - Test Pixel
Accuracy: 81.76% - Train MSE: 0.0205 - Test MSE: 0.0205 - Train PSNR: 16.8855 - Test PSNR: 16.8923
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 95/200 - Loss: 0.6134 - Val Loss: 0.6134 - Train Pixel Accuracy: 82.10% - Test Pixel
Accuracy: 82.04% - Train MSE: 0.0202 - Test MSE: 0.0201 - Train PSNR: 16.9512 - Test PSNR: 16.9585
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 96/200 - Loss: 0.6127 - Val Loss: 0.6137 - Train Pixel Accuracy: 82.03% - Test Pixel
Accuracy: 81.98% - Train MSE: 0.0203 - Test MSE: 0.0203 - Train PSNR: 16.9247 - Test PSNR: 16.9320
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
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Epoch 97/200 - Loss: 0.6130 - Val Loss: 0.6132 - Train Pixel Accuracy: 82.06% - Test Pixel
Accuracy: 82.00% - Train MSE: 0.0201 - Test MSE: 0.0201 - Train PSNR: 16.9646 - Test PSNR: 16.9715
1563/1563 [==============================] - 12s 7ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 98/200 - Loss: 0.6125 - Val Loss: 0.6131 - Train Pixel Accuracy: 82.05% - Test Pixel
Accuracy: 81.99% - Train MSE: 0.0201 - Test MSE: 0.0200 - Train PSNR: 16.9725 - Test PSNR: 16.9791
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 99/200 - Loss: 0.6124 - Val Loss: 0.6131 - Train Pixel Accuracy: 82.11% - Test Pixel
Accuracy: 82.05% - Train MSE: 0.0201 - Test MSE: 0.0200 - Train PSNR: 16.9731 - Test PSNR: 16.9799
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 100/200 - Loss: 0.6124 - Val Loss: 0.6127 - Train Pixel Accuracy: 82.18% - Test Pixel
Accuracy: 82.13% - Train MSE: 0.0199 - Test MSE: 0.0199 - Train PSNR: 17.0113 - Test PSNR: 17.0177
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 101/200 - Loss: 0.6120 - Val Loss: 0.6128 - Train Pixel Accuracy: 82.04% - Test Pixel
Accuracy: 81.99% - Train MSE: 0.0200 - Test MSE: 0.0199 - Train PSNR: 16.9954 - Test PSNR: 17.0011
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 102/200 - Loss: 0.6122 - Val Loss: 0.6124 - Train Pixel Accuracy: 82.23% - Test Pixel
Accuracy: 82.18% - Train MSE: 0.0198 - Test MSE: 0.0198 - Train PSNR: 17.0313 - Test PSNR: 17.0373
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 103/200 - Loss: 0.6118 - Val Loss: 0.6124 - Train Pixel Accuracy: 82.25% - Test Pixel
Accuracy: 82.19% - Train MSE: 0.0198 - Test MSE: 0.0198 - Train PSNR: 17.0359 - Test PSNR: 17.0417
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 104/200 - Loss: 0.6117 - Val Loss: 0.6123 - Train Pixel Accuracy: 82.18% - Test Pixel
Accuracy: 82.12% - Train MSE: 0.0198 - Test MSE: 0.0197 - Train PSNR: 17.0426 - Test PSNR: 17.0478
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 105/200 - Loss: 0.6117 - Val Loss: 0.6120 - Train Pixel Accuracy: 82.30% - Test Pixel
Accuracy: 82.25% - Train MSE: 0.0196 - Test MSE: 0.0196 - Train PSNR: 17.0713 - Test PSNR: 17.0765
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 106/200 - Loss: 0.6113 - Val Loss: 0.6121 - Train Pixel Accuracy: 82.32% - Test Pixel
Accuracy: 82.27% - Train MSE: 0.0196 - Test MSE: 0.0196 - Train PSNR: 17.0667 - Test PSNR: 17.0720
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 107/200 - Loss: 0.6114 - Val Loss: 0.6118 - Train Pixel Accuracy: 82.30% - Test Pixel
Accuracy: 82.25% - Train MSE: 0.0195 - Test MSE: 0.0195 - Train PSNR: 17.0896 - Test PSNR: 17.0944
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 108/200 - Loss: 0.6111 - Val Loss: 0.6117 - Train Pixel Accuracy: 82.31% - Test Pixel
Accuracy: 82.26% - Train MSE: 0.0195 - Test MSE: 0.0195 - Train PSNR: 17.0998 - Test PSNR: 17.1044
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 109/200 - Loss: 0.6110 - Val Loss: 0.6117 - Train Pixel Accuracy: 82.37% - Test Pixel
Accuracy: 82.32% - Train MSE: 0.0195 - Test MSE: 0.0195 - Train PSNR: 17.1041 - Test PSNR: 17.1087
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 110/200 - Loss: 0.6110 - Val Loss: 0.6114 - Train Pixel Accuracy: 82.38% - Test Pixel
Accuracy: 82.34% - Train MSE: 0.0194 - Test MSE: 0.0194 - Train PSNR: 17.1278 - Test PSNR: 17.1321
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 111/200 - Loss: 0.6107 - Val Loss: 0.6113 - Train Pixel Accuracy: 82.35% - Test Pixel
Accuracy: 82.30% - Train MSE: 0.0194 - Test MSE: 0.0193 - Train PSNR: 17.1315 - Test PSNR: 17.1354
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 112/200 - Loss: 0.6107 - Val Loss: 0.6112 - Train Pixel Accuracy: 82.44% - Test Pixel
Accuracy: 82.40% - Train MSE: 0.0193 - Test MSE: 0.0193 - Train PSNR: 17.1439 - Test PSNR: 17.1478
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 113/200 - Loss: 0.6105 - Val Loss: 0.6110 - Train Pixel Accuracy: 82.46% - Test Pixel
Accuracy: 82.42% - Train MSE: 0.0192 - Test MSE: 0.0192 - Train PSNR: 17.1640 - Test PSNR: 17.1677
1563/1563 [==============================] - 12s 7ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 114/200 - Loss: 0.6103 - Val Loss: 0.6110 - Train Pixel Accuracy: 82.42% - Test Pixel
Accuracy: 82.38% - Train MSE: 0.0192 - Test MSE: 0.0192 - Train PSNR: 17.1683 - Test PSNR: 17.1718
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 115/200 - Loss: 0.6103 - Val Loss: 0.6108 - Train Pixel Accuracy: 82.51% - Test Pixel
Accuracy: 82.47% - Train MSE: 0.0191 - Test MSE: 0.0191 - Train PSNR: 17.1793 - Test PSNR: 17.1827
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 116/200 - Loss: 0.6101 - Val Loss: 0.6106 - Train Pixel Accuracy: 82.50% - Test Pixel
Accuracy: 82.46% - Train MSE: 0.0191 - Test MSE: 0.0191 - Train PSNR: 17.1965 - Test PSNR: 17.1999
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 117/200 - Loss: 0.6100 - Val Loss: 0.6106 - Train Pixel Accuracy: 82.50% - Test Pixel
Accuracy: 82.46% - Train MSE: 0.0190 - Test MSE: 0.0190 - Train PSNR: 17.2054 - Test PSNR: 17.2086
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 118/200 - Loss: 0.6099 - Val Loss: 0.6105 - Train Pixel Accuracy: 82.56% - Test Pixel
Accuracy: 82.52% - Train MSE: 0.0190 - Test MSE: 0.0190 - Train PSNR: 17.2091 - Test PSNR: 17.2122
1563/1563 [==============================] - 13s 8ms/step
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313/313 [==============================] - 3s 8ms/step
Epoch 119/200 - Loss: 0.6098 - Val Loss: 0.6104 - Train Pixel Accuracy: 82.48% - Test Pixel
Accuracy: 82.44% - Train MSE: 0.0190 - Test MSE: 0.0190 - Train PSNR: 17.2160 - Test PSNR: 17.2189
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 120/200 - Loss: 0.6097 - Val Loss: 0.6103 - Train Pixel Accuracy: 82.58% - Test Pixel
Accuracy: 82.55% - Train MSE: 0.0189 - Test MSE: 0.0189 - Train PSNR: 17.2321 - Test PSNR: 17.2351
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 121/200 - Loss: 0.6096 - Val Loss: 0.6101 - Train Pixel Accuracy: 82.59% - Test Pixel
Accuracy: 82.55% - Train MSE: 0.0189 - Test MSE: 0.0188 - Train PSNR: 17.2453 - Test PSNR: 17.2483
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 122/200 - Loss: 0.6094 - Val Loss: 0.6101 - Train Pixel Accuracy: 82.57% - Test Pixel
Accuracy: 82.54% - Train MSE: 0.0188 - Test MSE: 0.0188 - Train PSNR: 17.2512 - Test PSNR: 17.2540
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 123/200 - Loss: 0.6094 - Val Loss: 0.6100 - Train Pixel Accuracy: 82.64% - Test Pixel
Accuracy: 82.60% - Train MSE: 0.0188 - Test MSE: 0.0188 - Train PSNR: 17.2569 - Test PSNR: 17.2596
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 124/200 - Loss: 0.6093 - Val Loss: 0.6099 - Train Pixel Accuracy: 82.60% - Test Pixel
Accuracy: 82.56% - Train MSE: 0.0188 - Test MSE: 0.0187 - Train PSNR: 17.2684 - Test PSNR: 17.2710
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 125/200 - Loss: 0.6092 - Val Loss: 0.6097 - Train Pixel Accuracy: 82.68% - Test Pixel
Accuracy: 82.64% - Train MSE: 0.0187 - Test MSE: 0.0187 - Train PSNR: 17.2826 - Test PSNR: 17.2851
1563/1563 [==============================] - 20s 13ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 126/200 - Loss: 0.6090 - Val Loss: 0.6096 - Train Pixel Accuracy: 82.70% - Test Pixel
Accuracy: 82.66% - Train MSE: 0.0187 - Test MSE: 0.0186 - Train PSNR: 17.2922 - Test PSNR: 17.2945
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 127/200 - Loss: 0.6089 - Val Loss: 0.6096 - Train Pixel Accuracy: 82.67% - Test Pixel
Accuracy: 82.63% - Train MSE: 0.0186 - Test MSE: 0.0186 - Train PSNR: 17.2977 - Test PSNR: 17.2998
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 128/200 - Loss: 0.6089 - Val Loss: 0.6095 - Train Pixel Accuracy: 82.73% - Test Pixel
Accuracy: 82.70% - Train MSE: 0.0186 - Test MSE: 0.0186 - Train PSNR: 17.3055 - Test PSNR: 17.3076
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 129/200 - Loss: 0.6088 - Val Loss: 0.6094 - Train Pixel Accuracy: 82.72% - Test Pixel
Accuracy: 82.68% - Train MSE: 0.0185 - Test MSE: 0.0185 - Train PSNR: 17.3167 - Test PSNR: 17.3188
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 130/200 - Loss: 0.6086 - Val Loss: 0.6092 - Train Pixel Accuracy: 82.76% - Test Pixel
Accuracy: 82.72% - Train MSE: 0.0185 - Test MSE: 0.0185 - Train PSNR: 17.3280 - Test PSNR: 17.3300
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 131/200 - Loss: 0.6085 - Val Loss: 0.6092 - Train Pixel Accuracy: 82.78% - Test Pixel
Accuracy: 82.75% - Train MSE: 0.0185 - Test MSE: 0.0185 - Train PSNR: 17.3362 - Test PSNR: 17.3381
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 132/200 - Loss: 0.6084 - Val Loss: 0.6091 - Train Pixel Accuracy: 82.77% - Test Pixel
Accuracy: 82.73% - Train MSE: 0.0184 - Test MSE: 0.0184 - Train PSNR: 17.3429 - Test PSNR: 17.3447
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 133/200 - Loss: 0.6084 - Val Loss: 0.6090 - Train Pixel Accuracy: 82.83% - Test Pixel
Accuracy: 82.79% - Train MSE: 0.0184 - Test MSE: 0.0184 - Train PSNR: 17.3514 - Test PSNR: 17.3533
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 134/200 - Loss: 0.6083 - Val Loss: 0.6089 - Train Pixel Accuracy: 82.81% - Test Pixel
Accuracy: 82.78% - Train MSE: 0.0184 - Test MSE: 0.0184 - Train PSNR: 17.3617 - Test PSNR: 17.3634
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 135/200 - Loss: 0.6082 - Val Loss: 0.6088 - Train Pixel Accuracy: 82.86% - Test Pixel
Accuracy: 82.83% - Train MSE: 0.0183 - Test MSE: 0.0183 - Train PSNR: 17.3724 - Test PSNR: 17.3741
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 136/200 - Loss: 0.6081 - Val Loss: 0.6087 - Train Pixel Accuracy: 82.88% - Test Pixel
Accuracy: 82.85% - Train MSE: 0.0183 - Test MSE: 0.0183 - Train PSNR: 17.3817 - Test PSNR: 17.3835
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 137/200 - Loss: 0.6080 - Val Loss: 0.6086 - Train Pixel Accuracy: 82.89% - Test Pixel
Accuracy: 82.86% - Train MSE: 0.0182 - Test MSE: 0.0182 - Train PSNR: 17.3897 - Test PSNR: 17.3914
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 138/200 - Loss: 0.6079 - Val Loss: 0.6085 - Train Pixel Accuracy: 82.93% - Test Pixel
Accuracy: 82.89% - Train MSE: 0.0182 - Test MSE: 0.0182 - Train PSNR: 17.3971 - Test PSNR: 17.3989
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 139/200 - Loss: 0.6078 - Val Loss: 0.6084 - Train Pixel Accuracy: 82.91% - Test Pixel
Accuracy: 82.89% - Train MSE: 0.0182 - Test MSE: 0.0182 - Train PSNR: 17.4050 - Test PSNR: 17.4068
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 140/200 - Loss: 0.6077 - Val Loss: 0.6084 - Train Pixel Accuracy: 82.97% - Test Pixel
Accuracy: 82.94% - Train MSE: 0.0181 - Test MSE: 0.0181 - Train PSNR: 17.4131 - Test PSNR: 17.4150
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1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 141/200 - Loss: 0.6076 - Val Loss: 0.6083 - Train Pixel Accuracy: 82.96% - Test Pixel
Accuracy: 82.93% - Train MSE: 0.0181 - Test MSE: 0.0181 - Train PSNR: 17.4219 - Test PSNR: 17.4238
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 142/200 - Loss: 0.6076 - Val Loss: 0.6082 - Train Pixel Accuracy: 83.01% - Test Pixel
Accuracy: 82.98% - Train MSE: 0.0181 - Test MSE: 0.0181 - Train PSNR: 17.4303 - Test PSNR: 17.4323
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 143/200 - Loss: 0.6075 - Val Loss: 0.6081 - Train Pixel Accuracy: 83.00% - Test Pixel
Accuracy: 82.97% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4390 - Test PSNR: 17.4410
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 144/200 - Loss: 0.6074 - Val Loss: 0.6080 - Train Pixel Accuracy: 83.06% - Test Pixel
Accuracy: 83.02% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4465 - Test PSNR: 17.4487
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 145/200 - Loss: 0.6073 - Val Loss: 0.6079 - Train Pixel Accuracy: 83.04% - Test Pixel
Accuracy: 83.00% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4536 - Test PSNR: 17.4556
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 146/200 - Loss: 0.6072 - Val Loss: 0.6079 - Train Pixel Accuracy: 83.08% - Test Pixel
Accuracy: 83.05% - Train MSE: 0.0180 - Test MSE: 0.0179 - Train PSNR: 17.4574 - Test PSNR: 17.4595
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 147/200 - Loss: 0.6072 - Val Loss: 0.6079 - Train Pixel Accuracy: 83.03% - Test Pixel
Accuracy: 83.00% - Train MSE: 0.0180 - Test MSE: 0.0179 - Train PSNR: 17.4587 - Test PSNR: 17.4606
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 148/200 - Loss: 0.6072 - Val Loss: 0.6080 - Train Pixel Accuracy: 83.06% - Test Pixel
Accuracy: 83.02% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4509 - Test PSNR: 17.4529
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 149/200 - Loss: 0.6072 - Val Loss: 0.6081 - Train Pixel Accuracy: 82.94% - Test Pixel
Accuracy: 82.91% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4381 - Test PSNR: 17.4397
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 150/200 - Loss: 0.6074 - Val Loss: 0.6083 - Train Pixel Accuracy: 82.95% - Test Pixel
Accuracy: 82.91% - Train MSE: 0.0181 - Test MSE: 0.0181 - Train PSNR: 17.4162 - Test PSNR: 17.4182
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 151/200 - Loss: 0.6076 - Val Loss: 0.6083 - Train Pixel Accuracy: 82.86% - Test Pixel
Accuracy: 82.84% - Train MSE: 0.0181 - Test MSE: 0.0181 - Train PSNR: 17.4187 - Test PSNR: 17.4201
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 152/200 - Loss: 0.6076 - Val Loss: 0.6080 - Train Pixel Accuracy: 83.04% - Test Pixel
Accuracy: 83.00% - Train MSE: 0.0180 - Test MSE: 0.0180 - Train PSNR: 17.4494 - Test PSNR: 17.4514
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 153/200 - Loss: 0.6072 - Val Loss: 0.6074 - Train Pixel Accuracy: 83.18% - Test Pixel
Accuracy: 83.15% - Train MSE: 0.0177 - Test MSE: 0.0177 - Train PSNR: 17.5089 - Test PSNR: 17.5107
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 154/200 - Loss: 0.6067 - Val Loss: 0.6071 - Train Pixel Accuracy: 83.28% - Test Pixel
Accuracy: 83.25% - Train MSE: 0.0176 - Test MSE: 0.0176 - Train PSNR: 17.5345 - Test PSNR: 17.5366
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 155/200 - Loss: 0.6064 - Val Loss: 0.6073 - Train Pixel Accuracy: 83.25% - Test Pixel
Accuracy: 83.22% - Train MSE: 0.0177 - Test MSE: 0.0177 - Train PSNR: 17.5175 - Test PSNR: 17.5198
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 156/200 - Loss: 0.6066 - Val Loss: 0.6075 - Train Pixel Accuracy: 83.14% - Test Pixel
Accuracy: 83.12% - Train MSE: 0.0178 - Test MSE: 0.0178 - Train PSNR: 17.4991 - Test PSNR: 17.5010
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 157/200 - Loss: 0.6068 - Val Loss: 0.6074 - Train Pixel Accuracy: 83.23% - Test Pixel
Accuracy: 83.20% - Train MSE: 0.0177 - Test MSE: 0.0177 - Train PSNR: 17.5098 - Test PSNR: 17.5122
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 158/200 - Loss: 0.6067 - Val Loss: 0.6070 - Train Pixel Accuracy: 83.30% - Test Pixel
Accuracy: 83.28% - Train MSE: 0.0176 - Test MSE: 0.0176 - Train PSNR: 17.5492 - Test PSNR: 17.5515
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 159/200 - Loss: 0.6063 - Val Loss: 0.6068 - Train Pixel Accuracy: 83.38% - Test Pixel
Accuracy: 83.36% - Train MSE: 0.0175 - Test MSE: 0.0175 - Train PSNR: 17.5712 - Test PSNR: 17.5737
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 160/200 - Loss: 0.6061 - Val Loss: 0.6068 - Train Pixel Accuracy: 83.37% - Test Pixel
Accuracy: 83.34% - Train MSE: 0.0175 - Test MSE: 0.0175 - Train PSNR: 17.5629 - Test PSNR: 17.5656
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 161/200 - Loss: 0.6061 - Val Loss: 0.6070 - Train Pixel Accuracy: 83.29% - Test Pixel
Accuracy: 83.27% - Train MSE: 0.0176 - Test MSE: 0.0176 - Train PSNR: 17.5532 - Test PSNR: 17.5556
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
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Epoch 162/200 - Loss: 0.6062 - Val Loss: 0.6069 - Train Pixel Accuracy: 83.37% - Test Pixel
Accuracy: 83.34% - Train MSE: 0.0175 - Test MSE: 0.0175 - Train PSNR: 17.5615 - Test PSNR: 17.5645
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 163/200 - Loss: 0.6061 - Val Loss: 0.6066 - Train Pixel Accuracy: 83.40% - Test Pixel
Accuracy: 83.40% - Train MSE: 0.0174 - Test MSE: 0.0174 - Train PSNR: 17.5892 - Test PSNR: 17.5920
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 164/200 - Loss: 0.6059 - Val Loss: 0.6064 - Train Pixel Accuracy: 83.47% - Test Pixel
Accuracy: 83.46% - Train MSE: 0.0173 - Test MSE: 0.0173 - Train PSNR: 17.6074 - Test PSNR: 17.6103
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 165/200 - Loss: 0.6057 - Val Loss: 0.6064 - Train Pixel Accuracy: 83.48% - Test Pixel
Accuracy: 83.47% - Train MSE: 0.0173 - Test MSE: 0.0173 - Train PSNR: 17.6075 - Test PSNR: 17.6105
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 166/200 - Loss: 0.6057 - Val Loss: 0.6065 - Train Pixel Accuracy: 83.40% - Test Pixel
Accuracy: 83.40% - Train MSE: 0.0174 - Test MSE: 0.0174 - Train PSNR: 17.6021 - Test PSNR: 17.6049
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 167/200 - Loss: 0.6057 - Val Loss: 0.6064 - Train Pixel Accuracy: 83.47% - Test Pixel
Accuracy: 83.46% - Train MSE: 0.0174 - Test MSE: 0.0173 - Train PSNR: 17.6047 - Test PSNR: 17.6078
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 168/200 - Loss: 0.6057 - Val Loss: 0.6063 - Train Pixel Accuracy: 83.44% - Test Pixel
Accuracy: 83.44% - Train MSE: 0.0173 - Test MSE: 0.0173 - Train PSNR: 17.6213 - Test PSNR: 17.6239
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 169/200 - Loss: 0.6056 - Val Loss: 0.6061 - Train Pixel Accuracy: 83.54% - Test Pixel
Accuracy: 83.54% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6393 - Test PSNR: 17.6422
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 170/200 - Loss: 0.6054 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.55% - Test Pixel
Accuracy: 83.55% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6506 - Test PSNR: 17.6534
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 171/200 - Loss: 0.6053 - Val Loss: 0.6059 - Train Pixel Accuracy: 83.53% - Test Pixel
Accuracy: 83.53% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6538 - Test PSNR: 17.6564
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 172/200 - Loss: 0.6052 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.57% - Test Pixel
Accuracy: 83.56% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6517 - Test PSNR: 17.6544
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 173/200 - Loss: 0.6052 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.45% - Test Pixel
Accuracy: 83.45% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6467 - Test PSNR: 17.6491
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 174/200 - Loss: 0.6053 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.55% - Test Pixel
Accuracy: 83.54% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6435 - Test PSNR: 17.6464
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 2s 7ms/step
Epoch 175/200 - Loss: 0.6053 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.42% - Test Pixel
Accuracy: 83.42% - Train MSE: 0.0172 - Test MSE: 0.0172 - Train PSNR: 17.6495 - Test PSNR: 17.6519
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 176/200 - Loss: 0.6053 - Val Loss: 0.6058 - Train Pixel Accuracy: 83.58% - Test Pixel
Accuracy: 83.57% - Train MSE: 0.0171 - Test MSE: 0.0171 - Train PSNR: 17.6629 - Test PSNR: 17.6659
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 177/200 - Loss: 0.6051 - Val Loss: 0.6056 - Train Pixel Accuracy: 83.53% - Test Pixel
Accuracy: 83.53% - Train MSE: 0.0170 - Test MSE: 0.0170 - Train PSNR: 17.6840 - Test PSNR: 17.6867
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 178/200 - Loss: 0.6049 - Val Loss: 0.6055 - Train Pixel Accuracy: 83.64% - Test Pixel
Accuracy: 83.64% - Train MSE: 0.0170 - Test MSE: 0.0170 - Train PSNR: 17.7015 - Test PSNR: 17.7045
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 179/200 - Loss: 0.6048 - Val Loss: 0.6054 - Train Pixel Accuracy: 83.65% - Test Pixel
Accuracy: 83.65% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7117 - Test PSNR: 17.7147
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 180/200 - Loss: 0.6047 - Val Loss: 0.6053 - Train Pixel Accuracy: 83.62% - Test Pixel
Accuracy: 83.62% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7141 - Test PSNR: 17.7170
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 181/200 - Loss: 0.6046 - Val Loss: 0.6054 - Train Pixel Accuracy: 83.67% - Test Pixel
Accuracy: 83.67% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7121 - Test PSNR: 17.7153
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 182/200 - Loss: 0.6046 - Val Loss: 0.6054 - Train Pixel Accuracy: 83.55% - Test Pixel
Accuracy: 83.56% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7095 - Test PSNR: 17.7122
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 183/200 - Loss: 0.6047 - Val Loss: 0.6054 - Train Pixel Accuracy: 83.65% - Test Pixel
Accuracy: 83.65% - Train MSE: 0.0170 - Test MSE: 0.0169 - Train PSNR: 17.7065 - Test PSNR: 17.7097
1563/1563 [==============================] - 13s 9ms/step
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313/313 [==============================] - 3s 9ms/step
Epoch 184/200 - Loss: 0.6047 - Val Loss: 0.6054 - Train Pixel Accuracy: 83.52% - Test Pixel
Accuracy: 83.52% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7105 - Test PSNR: 17.7129
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 185/200 - Loss: 0.6047 - Val Loss: 0.6053 - Train Pixel Accuracy: 83.67% - Test Pixel
Accuracy: 83.66% - Train MSE: 0.0169 - Test MSE: 0.0169 - Train PSNR: 17.7169 - Test PSNR: 17.7200
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 186/200 - Loss: 0.6046 - Val Loss: 0.6052 - Train Pixel Accuracy: 83.58% - Test Pixel
Accuracy: 83.58% - Train MSE: 0.0169 - Test MSE: 0.0168 - Train PSNR: 17.7337 - Test PSNR: 17.7361
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 187/200 - Loss: 0.6044 - Val Loss: 0.6050 - Train Pixel Accuracy: 83.74% - Test Pixel
Accuracy: 83.74% - Train MSE: 0.0168 - Test MSE: 0.0168 - Train PSNR: 17.7510 - Test PSNR: 17.7538
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 188/200 - Loss: 0.6043 - Val Loss: 0.6048 - Train Pixel Accuracy: 83.71% - Test Pixel
Accuracy: 83.71% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7675 - Test PSNR: 17.7700
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 189/200 - Loss: 0.6041 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.78% - Test Pixel
Accuracy: 83.78% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7789 - Test PSNR: 17.7815
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 190/200 - Loss: 0.6040 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.78% - Test Pixel
Accuracy: 83.78% - Train MSE: 0.0167 - Test MSE: 0.0166 - Train PSNR: 17.7858 - Test PSNR: 17.7884
1563/1563 [==============================] - 12s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 191/200 - Loss: 0.6039 - Val Loss: 0.6046 - Train Pixel Accuracy: 83.75% - Test Pixel
Accuracy: 83.75% - Train MSE: 0.0166 - Test MSE: 0.0166 - Train PSNR: 17.7891 - Test PSNR: 17.7918
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 192/200 - Loss: 0.6039 - Val Loss: 0.6046 - Train Pixel Accuracy: 83.80% - Test Pixel
Accuracy: 83.80% - Train MSE: 0.0166 - Test MSE: 0.0166 - Train PSNR: 17.7890 - Test PSNR: 17.7919
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 193/200 - Loss: 0.6039 - Val Loss: 0.6046 - Train Pixel Accuracy: 83.69% - Test Pixel
Accuracy: 83.70% - Train MSE: 0.0166 - Test MSE: 0.0166 - Train PSNR: 17.7883 - Test PSNR: 17.7912
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 194/200 - Loss: 0.6039 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.78% - Test Pixel
Accuracy: 83.78% - Train MSE: 0.0167 - Test MSE: 0.0166 - Train PSNR: 17.7831 - Test PSNR: 17.7863
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 195/200 - Loss: 0.6039 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.61% - Test Pixel
Accuracy: 83.63% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7798 - Test PSNR: 17.7827
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 196/200 - Loss: 0.6040 - Val Loss: 0.6048 - Train Pixel Accuracy: 83.75% - Test Pixel
Accuracy: 83.75% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7712 - Test PSNR: 17.7743
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 197/200 - Loss: 0.6040 - Val Loss: 0.6048 - Train Pixel Accuracy: 83.55% - Test Pixel
Accuracy: 83.56% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7703 - Test PSNR: 17.7730
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 198/200 - Loss: 0.6041 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.74% - Test Pixel
Accuracy: 83.74% - Train MSE: 0.0167 - Test MSE: 0.0167 - Train PSNR: 17.7726 - Test PSNR: 17.7754
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 199/200 - Loss: 0.6040 - Val Loss: 0.6046 - Train Pixel Accuracy: 83.62% - Test Pixel
Accuracy: 83.63% - Train MSE: 0.0166 - Test MSE: 0.0166 - Train PSNR: 17.7946 - Test PSNR: 17.7971
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
Epoch 200/200 - Loss: 0.6038 - Val Loss: 0.6043 - Train Pixel Accuracy: 83.84% - Test Pixel
Accuracy: 83.85% - Train MSE: 0.0165 - Test MSE: 0.0165 - Train PSNR: 17.8213 - Test PSNR: 17.8240
Training time: 11261.44893860817 seconds
```

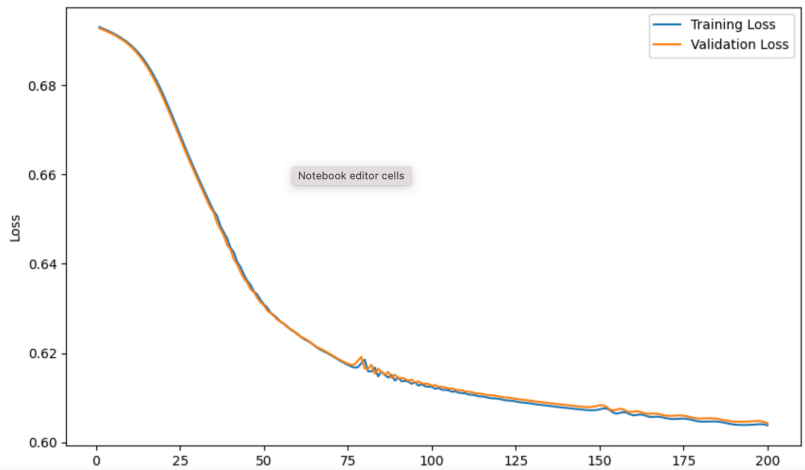

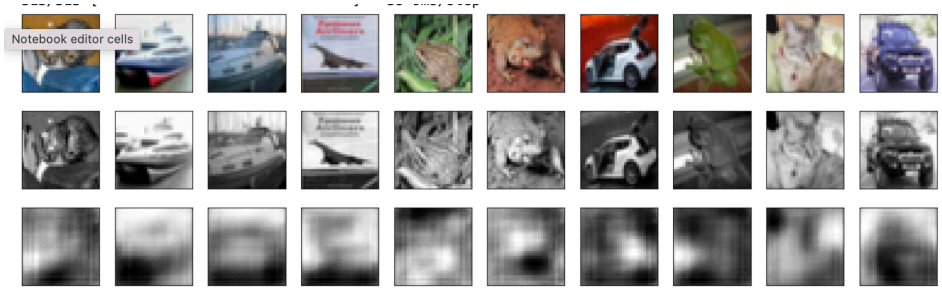

3η εκτέλεση:

```
Layer
Name: encoder_conv1
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv2
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv3
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv1
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv2
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv3
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: output_layer
Filters: 1, Kernel Size: (3, 3)
=================================================
Model: "autoencoder_model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (InputLayer)    [(None, 32, 32, 1)]       0

 encoder_conv1 (Conv2D)      (None, 32, 32, 16)        160

 encoder_pool1 (MaxPooling2  (None, 16, 16, 16)        0
 D)

 encoder_conv2 (Conv2D)      (None, 16, 16, 8)         1160

 encoder_pool2 (MaxPooling2  (None, 8, 8, 8)           0
 D)

 encoder_conv3 (Conv2D)      (None, 8, 8, 8)           584

 encoder_pool3 (MaxPooling2  (None, 4, 4, 8)           0
 D)

 decoder_conv1 (Conv2D)      (None, 4, 4, 8)           584

 decoder_upsample1 (UpSampl  (None, 8, 8, 8)           0
 ing2D)

 decoder_conv2 (Conv2D)      (None, 8, 8, 8)           584

 decoder_upsample2 (UpSampl  (None, 16, 16, 8)         0
 ing2D)

 decoder_conv3 (Conv2D)      (None, 16, 16, 16)        1168

 decoder_upsample3 (UpSampl  (None, 32, 32, 16)        0
```

```
 ing2D)

 output_layer (Conv2D)       (None, 32, 32, 1)         145

=================================================================
Total params: 4385 (17.13 KB)
Trainable params: 4385 (17.13 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 1/500 - Loss: 0.6934 - Val Loss: 0.6929 - Train Pixel Accuracy: 49.43% - Test Pixel
Accuracy: 49.72% - Train MSE: 0.0575 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
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313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 10/500 - Loss: 0.6893 - Val Loss: 0.6884 - Train Pixel Accuracy: 56.48% - Test Pixel
Accuracy: 56.63% - Train MSE: 0.0553 - Test MSE: 0.0549
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
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313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 20/500 - Loss: 0.6775 - Val Loss: 0.6751 - Train Pixel Accuracy: 62.60% - Test Pixel
Accuracy: 62.73% - Train MSE: 0.0488 - Test MSE: 0.0484
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
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1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 30/500 - Loss: 0.6453 - Val Loss: 0.6437 - Train Pixel Accuracy: 75.72% - Test Pixel
Accuracy: 75.66% - Train MSE: 0.0337 - Test MSE: 0.0335
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 8s 25ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 40/500 - Loss: 0.6377 - Val Loss: 0.6371 - Train Pixel Accuracy: 77.76% - Test Pixel
Accuracy: 77.71% - Train MSE: 0.0306 - Test MSE: 0.0305
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
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313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 50/500 - Loss: 0.6323 - Val Loss: 0.6320 - Train Pixel Accuracy: 78.68% - Test Pixel
Accuracy: 78.64% - Train MSE: 0.0284 - Test MSE: 0.0282
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 60/500 - Loss: 0.6276 - Val Loss: 0.6276 - Train Pixel Accuracy: 79.41% - Test Pixel
Accuracy: 79.38% - Train MSE: 0.0264 - Test MSE: 0.0263
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
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313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 70/500 - Loss: 0.6235 - Val Loss: 0.6235 - Train Pixel Accuracy: 80.06% - Test Pixel
Accuracy: 80.04% - Train MSE: 0.0246 - Test MSE: 0.0246
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 27s 17ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
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313/313 [==============================] - 3s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 80/500 - Loss: 0.6198 - Val Loss: 0.6200 - Train Pixel Accuracy: 80.67% - Test Pixel
Accuracy: 80.66% - Train MSE: 0.0231 - Test MSE: 0.0230
1563/1563 [==============================] - 20s 13ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 13s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 90/500 - Loss: 0.6167 - Val Loss: 0.6169 - Train Pixel Accuracy: 81.26% - Test Pixel
Accuracy: 81.25% - Train MSE: 0.0218 - Test MSE: 0.0218
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 2s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
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1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 100/500 - Loss: 0.6142 - Val Loss: 0.6146 - Train Pixel Accuracy: 81.79% - Test Pixel
Accuracy: 81.76% - Train MSE: 0.0208 - Test MSE: 0.0208
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
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313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 110/500 - Loss: 0.6123 - Val Loss: 0.6127 - Train Pixel Accuracy: 82.24% - Test Pixel
Accuracy: 82.19% - Train MSE: 0.0200 - Test MSE: 0.0200
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 27s 18ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 27s 17ms/step
313/313 [==============================] - 3s 9ms/step
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1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 120/500 - Loss: 0.6107 - Val Loss: 0.6111 - Train Pixel Accuracy: 82.55% - Test Pixel
Accuracy: 82.51% - Train MSE: 0.0194 - Test MSE: 0.0193
1563/1563 [==============================] - 30s 19ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
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313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 130/500 - Loss: 0.6093 - Val Loss: 0.6098 - Train Pixel Accuracy: 82.81% - Test Pixel
Accuracy: 82.78% - Train MSE: 0.0188 - Test MSE: 0.0188
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
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1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
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1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 140/500 - Loss: 0.6081 - Val Loss: 0.6086 - Train Pixel Accuracy: 83.04% - Test Pixel
Accuracy: 83.02% - Train MSE: 0.0183 - Test MSE: 0.0183
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 150/500 - Loss: 0.6070 - Val Loss: 0.6080 - Train Pixel Accuracy: 83.05% - Test Pixel
Accuracy: 83.04% - Train MSE: 0.0181 - Test MSE: 0.0180
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
```

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313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 160/500 - Loss: 0.6064 - Val Loss: 0.6069 - Train Pixel Accuracy: 83.30% - Test Pixel
Accuracy: 83.31% - Train MSE: 0.0177 - Test MSE: 0.0176
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 18s 11ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
Epoch 170/500 - Loss: 0.6055 - Val Loss: 0.6060 - Train Pixel Accuracy: 83.48% - Test Pixel
Accuracy: 83.48% - Train MSE: 0.0173 - Test MSE: 0.0172
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 4s 11ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 17s 11ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 24s 15ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 17s 11ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 180/500 - Loss: 0.6048 - Val Loss: 0.6053 - Train Pixel Accuracy: 83.61% - Test Pixel
Accuracy: 83.61% - Train MSE: 0.0170 - Test MSE: 0.0170
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 30s 19ms/step
313/313 [==============================] - 4s 13ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
Epoch 190/500 - Loss: 0.6041 - Val Loss: 0.6047 - Train Pixel Accuracy: 83.76% - Test Pixel
Accuracy: 83.76% - Train MSE: 0.0167 - Test MSE: 0.0167
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 26s 17ms/step
313/313 [==============================] - 9s 28ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
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1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 17s 11ms/step
313/313 [==============================] - 4s 11ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 200/500 - Loss: 0.6035 - Val Loss: 0.6041 - Train Pixel Accuracy: 83.92% - Test Pixel
Accuracy: 83.92% - Train MSE: 0.0165 - Test MSE: 0.0164
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 210/500 - Loss: 0.6028 - Val Loss: 0.6034 - Train Pixel Accuracy: 84.06% - Test Pixel
Accuracy: 84.06% - Train MSE: 0.0162 - Test MSE: 0.0162
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 17s 11ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 220/500 - Loss: 0.6022 - Val Loss: 0.6028 - Train Pixel Accuracy: 84.17% - Test Pixel
Accuracy: 84.17% - Train MSE: 0.0160 - Test MSE: 0.0159
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 230/500 - Loss: 0.6018 - Val Loss: 0.6032 - Train Pixel Accuracy: 83.86% - Test Pixel
Accuracy: 83.85% - Train MSE: 0.0161 - Test MSE: 0.0161
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
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313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 240/500 - Loss: 0.6012 - Val Loss: 0.6021 - Train Pixel Accuracy: 84.29% - Test Pixel
Accuracy: 84.30% - Train MSE: 0.0157 - Test MSE: 0.0157
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 250/500 - Loss: 0.6008 - Val Loss: 0.6016 - Train Pixel Accuracy: 84.31% - Test Pixel
Accuracy: 84.31% - Train MSE: 0.0154 - Test MSE: 0.0154
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 260/500 - Loss: 0.6004 - Val Loss: 0.6011 - Train Pixel Accuracy: 84.46% - Test Pixel
Accuracy: 84.46% - Train MSE: 0.0153 - Test MSE: 0.0152
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 7s 22ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 23s 15ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 28s 18ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 270/500 - Loss: 0.6001 - Val Loss: 0.6008 - Train Pixel Accuracy: 84.54% - Test Pixel
Accuracy: 84.54% - Train MSE: 0.0151 - Test MSE: 0.0151
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
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1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 22s 14ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 280/500 - Loss: 0.5998 - Val Loss: 0.6005 - Train Pixel Accuracy: 84.58% - Test Pixel
Accuracy: 84.59% - Train MSE: 0.0150 - Test MSE: 0.0150
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 8ms/step
Epoch 290/500 - Loss: 0.5995 - Val Loss: 0.6002 - Train Pixel Accuracy: 84.66% - Test Pixel
Accuracy: 84.65% - Train MSE: 0.0149 - Test MSE: 0.0149
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 8ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 300/500 - Loss: 0.5993 - Val Loss: 0.6001 - Train Pixel Accuracy: 84.69% - Test Pixel
Accuracy: 84.69% - Train MSE: 0.0149 - Test MSE: 0.0149
1563/1563 [==============================] - 13s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 4s 12ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 310/500 - Loss: 0.5994 - Val Loss: 0.6001 - Train Pixel Accuracy: 84.54% - Test Pixel
Accuracy: 84.55% - Train MSE: 0.0148 - Test MSE: 0.0148
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
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313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 320/500 - Loss: 0.5989 - Val Loss: 0.5996 - Train Pixel Accuracy: 84.75% - Test Pixel
Accuracy: 84.75% - Train MSE: 0.0146 - Test MSE: 0.0146
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 21s 14ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 330/500 - Loss: 0.5986 - Val Loss: 0.5994 - Train Pixel Accuracy: 84.79% - Test Pixel
Accuracy: 84.80% - Train MSE: 0.0146 - Test MSE: 0.0146
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 4s 11ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 340/500 - Loss: 0.5984 - Val Loss: 0.5992 - Train Pixel Accuracy: 84.85% - Test Pixel
Accuracy: 84.86% - Train MSE: 0.0145 - Test MSE: 0.0145
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 4s 12ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 350/500 - Loss: 0.5982 - Val Loss: 0.5990 - Train Pixel Accuracy: 84.93% - Test Pixel
Accuracy: 84.93% - Train MSE: 0.0144 - Test MSE: 0.0144
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
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1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 8s 25ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 360/500 - Loss: 0.5980 - Val Loss: 0.5988 - Train Pixel Accuracy: 84.96% - Test Pixel
Accuracy: 84.96% - Train MSE: 0.0144 - Test MSE: 0.0144
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 370/500 - Loss: 0.5985 - Val Loss: 0.5995 - Train Pixel Accuracy: 84.81% - Test Pixel
Accuracy: 84.80% - Train MSE: 0.0146 - Test MSE: 0.0146
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 380/500 - Loss: 0.5977 - Val Loss: 0.5986 - Train Pixel Accuracy: 85.03% - Test Pixel
Accuracy: 85.02% - Train MSE: 0.0143 - Test MSE: 0.0143
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 29s 19ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 29s 18ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 390/500 - Loss: 0.5976 - Val Loss: 0.5984 - Train Pixel Accuracy: 85.07% - Test Pixel
Accuracy: 85.06% - Train MSE: 0.0142 - Test MSE: 0.0142
1563/1563 [==============================] - 15s 9ms/step
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313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
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313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 400/500 - Loss: 0.5975 - Val Loss: 0.5982 - Train Pixel Accuracy: 85.09% - Test Pixel
Accuracy: 85.09% - Train MSE: 0.0141 - Test MSE: 0.0141
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 18s 11ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 21s 13ms/step
313/313 [==============================] - 7s 22ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 410/500 - Loss: 0.5973 - Val Loss: 0.5981 - Train Pixel Accuracy: 85.08% - Test Pixel
Accuracy: 85.08% - Train MSE: 0.0141 - Test MSE: 0.0141
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 30s 19ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 24s 15ms/step
313/313 [==============================] - 5s 15ms/step
Epoch 420/500 - Loss: 0.5972 - Val Loss: 0.5980 - Train Pixel Accuracy: 85.16% - Test Pixel
Accuracy: 85.15% - Train MSE: 0.0140 - Test MSE: 0.0140
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 430/500 - Loss: 0.5971 - Val Loss: 0.5980 - Train Pixel Accuracy: 85.17% - Test Pixel
Accuracy: 85.17% - Train MSE: 0.0140 - Test MSE: 0.0140
```

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1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 440/500 - Loss: 0.5970 - Val Loss: 0.5977 - Train Pixel Accuracy: 85.20% - Test Pixel
Accuracy: 85.20% - Train MSE: 0.0139 - Test MSE: 0.0139
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
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313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 8s 24ms/step
Epoch 450/500 - Loss: 0.5969 - Val Loss: 0.5977 - Train Pixel Accuracy: 85.23% - Test Pixel
Accuracy: 85.23% - Train MSE: 0.0139 - Test MSE: 0.0139
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 29s 18ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 460/500 - Loss: 0.5968 - Val Loss: 0.5976 - Train Pixel Accuracy: 85.19% - Test Pixel
Accuracy: 85.18% - Train MSE: 0.0138 - Test MSE: 0.0139
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
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1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
```
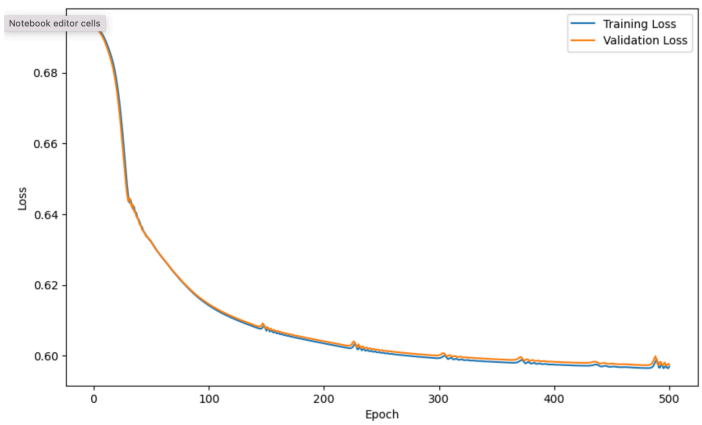
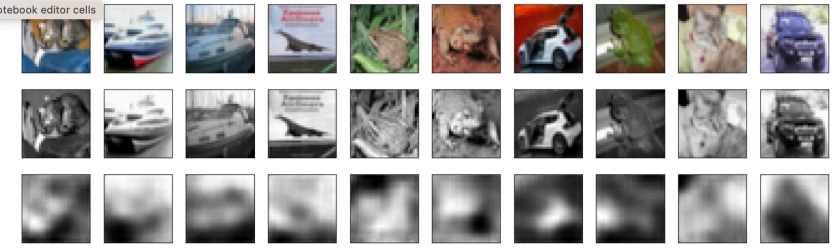

```
Epoch 470/500 - Loss: 0.5966 - Val Loss: 0.5974 - Train Pixel Accuracy: 85.26% - Test Pixel
Accuracy: 85.26% - Train MSE: 0.0138 - Test MSE: 0.0138
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 22s 14ms/step
313/313 [==============================] - 4s 12ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 480/500 - Loss: 0.5965 - Val Loss: 0.5973 - Train Pixel Accuracy: 85.28% - Test Pixel
Accuracy: 85.28% - Train MSE: 0.0137 - Test MSE: 0.0137
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 28s 18ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 490/500 - Loss: 0.5980 - Val Loss: 0.5975 - Train Pixel Accuracy: 85.18% - Test Pixel
Accuracy: 85.17% - Train MSE: 0.0138 - Test MSE: 0.0138
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/ste1563/1563 [==============================] -
14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 26s 16ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 500/500 - Loss: 0.5969 - Val Loss: 0.5975 - Train Pixel Accuracy: 85.29% - Test Pixel
Accuracy: 85.28% - Train MSE: 0.0138 - Test MSE: 0.0138
Training time: 39806.62816953659 seconds
```



```
313/313 [==============================] - 3s 9ms/step
```

Notebook editor cells



4η εκτέλεση:

```
Layer Name: encoder_conv1
Filters: 32, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv2
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: encoder_conv3
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv1
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv2
Filters: 8, Kernel Size: (3, 3)
=================================================
Layer Name: decoder_conv3
Filters: 16, Kernel Size: (3, 3)
=================================================
Layer Name: output_layer
Filters: 1, Kernel Size: (3, 3)
=================================================
Model: "autoencoder_model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_layer (InputLayer)    [(None, 32, 32, 1)]       0

 encoder_conv1 (Conv2D)      (None, 32, 32, 32)        320

 encoder_pool1 (MaxPooling2  (None, 16, 16, 32)        0
 D)

 encoder_conv2 (Conv2D)      (None, 16, 16, 16)        4624

 encoder_pool2 (MaxPooling2  (None, 8, 8, 16)          0
 D)

 encoder_conv3 (Conv2D)      (None, 8, 8, 8)           1160

 encoder_pool3 (MaxPooling2  (None, 4, 4, 8)           0
 D)

 decoder_conv1 (Conv2D)      (None, 4, 4, 8)           584

 decoder_upsample1 (UpSampl  (None, 8, 8, 8)           0
 ing2D)

 decoder_conv2 (Conv2D)      (None, 8, 8, 8)           584

 decoder_upsample2 (UpSampl  (None, 16, 16, 8)         0
 ing2D)

 decoder_conv3 (Conv2D)      (None, 16, 16, 16)        1168
```

```
 decoder_upsample3 (UpSampl  (None, 32, 32, 16)        0
 ing2D)

 output_layer (Conv2D)       (None, 32, 32, 1)         145

=================================================================
Total params: 8585 (33.54 KB)
Trainable params: 8585 (33.54 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 1/50 - Loss: 0.6932 - Val Loss: 0.6930 - Train Pixel Accuracy: 55.37% - Test Pixel Accuracy: 55.10% - Train
MSE: 0.0575 - Test MSE: 0.0572 - Train PSNR: 12.4041 - Test PSNR: 12.4279
1563/1563 [==============================] - 18s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 2/50 - Loss: 0.6930 - Val Loss: 0.6929 - Train Pixel Accuracy: 55.59% - Test Pixel Accuracy: 55.23% - Train
MSE: 0.0574 - Test MSE: 0.0571 - Train PSNR: 12.4106 - Test PSNR: 12.4338
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 3/50 - Loss: 0.6928 - Val Loss: 0.6927 - Train Pixel Accuracy: 55.59% - Test Pixel Accuracy: 55.23% - Train
MSE: 0.0573 - Test MSE: 0.0570 - Train PSNR: 12.4174 - Test PSNR: 12.4400
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 4/50 - Loss: 0.6926 - Val Loss: 0.6925 - Train Pixel Accuracy: 55.93% - Test Pixel Accuracy: 55.56% - Train
MSE: 0.0572 - Test MSE: 0.0569 - Train PSNR: 12.4245 - Test PSNR: 12.4465
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 5/50 - Loss: 0.6925 - Val Loss: 0.6923 - Train Pixel Accuracy: 56.59% - Test Pixel Accuracy: 56.21% - Train
MSE: 0.0571 - Test MSE: 0.0568 - Train PSNR: 12.4344 - Test PSNR: 12.4561
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 6/50 - Loss: 0.6922 - Val Loss: 0.6919 - Train Pixel Accuracy: 57.81% - Test Pixel Accuracy: 57.43% - Train
MSE: 0.0569 - Test MSE: 0.0566 - Train PSNR: 12.4482 - Test PSNR: 12.4695
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 7/50 - Loss: 0.6918 - Val Loss: 0.6915 - Train Pixel Accuracy: 59.69% - Test Pixel Accuracy: 59.36% - Train
MSE: 0.0567 - Test MSE: 0.0564 - Train PSNR: 12.4664 - Test PSNR: 12.4876
1563/1563 [==============================] - 24s 15ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 8/50 - Loss: 0.6914 - Val Loss: 0.6908 - Train Pixel Accuracy: 61.83% - Test Pixel Accuracy: 61.55% - Train
MSE: 0.0564 - Test MSE: 0.0561 - Train PSNR: 12.4897 - Test PSNR: 12.5109
1563/1563 [==============================] - 18s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 9/50 - Loss: 0.6907 - Val Loss: 0.6901 - Train Pixel Accuracy: 63.53% - Test Pixel Accuracy: 63.31% - Train
MSE: 0.0560 - Test MSE: 0.0557 - Train PSNR: 12.5198 - Test PSNR: 12.5411
1563/1563 [==============================] - 18s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 10/50 - Loss: 0.6900 - Val Loss: 0.6891 - Train Pixel Accuracy: 64.79% - Test Pixel Accuracy: 64.62% - Train
MSE: 0.0555 - Test MSE: 0.0552 - Train PSNR: 12.5589 - Test PSNR: 12.5802
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 11/50 - Loss: 0.6890 - Val Loss: 0.6878 - Train Pixel Accuracy: 65.80% - Test Pixel Accuracy: 65.66% - Train
MSE: 0.0549 - Test MSE: 0.0546 - Train PSNR: 12.6072 - Test PSNR: 12.6286
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 12/50 - Loss: 0.6877 - Val Loss: 0.6864 - Train Pixel Accuracy: 66.44% - Test Pixel Accuracy: 66.38% - Train
MSE: 0.0542 - Test MSE: 0.0539 - Train PSNR: 12.6631 - Test PSNR: 12.6846
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 13/50 - Loss: 0.6863 - Val Loss: 0.6847 - Train Pixel Accuracy: 66.92% - Test Pixel Accuracy: 66.90% - Train
MSE: 0.0533 - Test MSE: 0.0530 - Train PSNR: 12.7313 - Test PSNR: 12.7536
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 14/50 - Loss: 0.6846 - Val Loss: 0.6827 - Train Pixel Accuracy: 67.46% - Test Pixel Accuracy: 67.44% - Train
MSE: 0.0523 - Test MSE: 0.0520 - Train PSNR: 12.8140 - Test PSNR: 12.8378
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
```

Epoch 15/50 - Loss: 0.6826 - Val Loss: 0.6803 - Train Pixel Accuracy: 68.11% - Test Pixel Accuracy: 68.09% - Train MSE: 0.0511 - Test MSE: 0.0509 - Train PSNR: 12.9117 - Test PSNR: 12.9368
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 16/50 - Loss: 0.6803 - Val Loss: 0.6775 - Train Pixel Accuracy: 69.22% - Test Pixel Accuracy: 69.19% - Train MSE: 0.0497 - Test MSE: 0.0495 - Train PSNR: 13.0322 - Test PSNR: 13.0574
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 17/50 - Loss: 0.6774 - Val Loss: 0.6743 - Train Pixel Accuracy: 69.95% - Test Pixel Accuracy: 69.95% - Train MSE: 0.0481 - Test MSE: 0.0479 - Train PSNR: 13.1745 - Test PSNR: 13.1990
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 18/50 - Loss: 0.6742 - Val Loss: 0.6705 - Train Pixel Accuracy: 70.47% - Test Pixel Accuracy: 70.44% - Train MSE: 0.0463 - Test MSE: 0.0460 - Train PSNR: 13.3446 - Test PSNR: 13.3698
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 19/50 - Loss: 0.6704 - Val Loss: 0.6661 - Train Pixel Accuracy: 71.03% - Test Pixel Accuracy: 70.97% - Train MSE: 0.0442 - Test MSE: 0.0439 - Train PSNR: 13.5453 - Test PSNR: 13.5711
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 20/50 - Loss: 0.6660 - Val Loss: 0.6615 - Train Pixel Accuracy: 72.17% - Test Pixel Accuracy: 72.14% - Train MSE: 0.0419 - Test MSE: 0.0417 - Train PSNR: 13.7753 - Test PSNR: 13.7989
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 21/50 - Loss: 0.6613 - Val Loss: 0.6567 - Train Pixel Accuracy: 72.59% - Test Pixel Accuracy: 72.52% - Train MSE: 0.0397 - Test MSE: 0.0395 - Train PSNR: 14.0128 - Test PSNR: 14.0377
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 22/50 - Loss: 0.6565 - Val Loss: 0.6530 - Train Pixel Accuracy: 73.37% - Test Pixel Accuracy: 73.35% - Train MSE: 0.0379 - Test MSE: 0.0377 - Train PSNR: 14.2087 - Test PSNR: 14.2311
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 23/50 - Loss: 0.6527 - Val Loss: 0.6511 - Train Pixel Accuracy: 72.58% - Test Pixel Accuracy: 72.45% - Train MSE: 0.0372 - Test MSE: 0.0370 - Train PSNR: 14.2937 - Test PSNR: 14.3164
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 24/50 - Loss: 0.6508 - Val Loss: 0.6494 - Train Pixel Accuracy: 73.71% - Test Pixel Accuracy: 73.69% - Train MSE: 0.0363 - Test MSE: 0.0361 - Train PSNR: 14.4030 - Test PSNR: 14.4230
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 25/50 - Loss: 0.6491 - Val Loss: 0.6448 - Train Pixel Accuracy: 74.72% - Test Pixel Accuracy: 74.67% - Train MSE: 0.0342 - Test MSE: 0.0340 - Train PSNR: 14.6576 - Test PSNR: 14.6800
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 26/50 - Loss: 0.6445 - Val Loss: 0.6455 - Train Pixel Accuracy: 74.08% - Test Pixel Accuracy: 73.95% - Train MSE: 0.0346 - Test MSE: 0.0344 - Train PSNR: 14.6108 - Test PSNR: 14.6284
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 27/50 - Loss: 0.6451 - Val Loss: 0.6431 - Train Pixel Accuracy: 75.32% - Test Pixel Accuracy: 75.32% - Train MSE: 0.0334 - Test MSE: 0.0332 - Train PSNR: 14.7682 - Test PSNR: 14.7900
1563/1563 [==============================] - 18s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 28/50 - Loss: 0.6428 - Val Loss: 0.6407 - Train Pixel Accuracy: 75.91% - Test Pixel Accuracy: 75.89% - Train MSE: 0.0323 - Test MSE: 0.0321 - Train PSNR: 14.9118 - Test PSNR: 14.9334
1563/1563 [==============================] - 18s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 29/50 - Loss: 0.6404 - Val Loss: 0.6417 - Train Pixel Accuracy: 75.26% - Test Pixel Accuracy: 75.12% - Train MSE: 0.0328 - Test MSE: 0.0327 - Train PSNR: 14.8466 - Test PSNR: 14.8603
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 30/50 - Loss: 0.6412 - Val Loss: 0.6382 - Train Pixel Accuracy: 76.60% - Test Pixel Accuracy: 76.57% - Train MSE: 0.0311 - Test MSE: 0.0310 - Train PSNR: 15.0670 - Test PSNR: 15.0876
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 31/50 - Loss: 0.6379 - Val Loss: 0.6387 - Train Pixel Accuracy: 76.74% - Test Pixel Accuracy: 76.74% - Train MSE: 0.0313 - Test MSE: 0.0311 - Train PSNR: 15.0490 - Test PSNR: 15.0706
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step

Epoch 32/50 - Loss: 0.6384 - Val Loss: 0.6374 - Train Pixel Accuracy: 76.69% - Test Pixel Accuracy: 76.57% - Train MSE: 0.0308 - Test MSE: 0.0307 - Train PSNR: 15.1203 - Test PSNR: 15.1343
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 33/50 - Loss: 0.6369 - Val Loss: 0.6359 - Train Pixel Accuracy: 77.18% - Test Pixel Accuracy: 77.06% - Train MSE: 0.0301 - Test MSE: 0.0300 - Train PSNR: 15.2143 - Test PSNR: 15.2295
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 34/50 - Loss: 0.6355 - Val Loss: 0.6361 - Train Pixel Accuracy: 77.47% - Test Pixel Accuracy: 77.46% - Train MSE: 0.0301 - Test MSE: 0.0299 - Train PSNR: 15.2198 - Test PSNR: 15.2400
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 35/50 - Loss: 0.6357 - Val Loss: 0.6341 - Train Pixel Accuracy: 77.83% - Test Pixel Accuracy: 77.76% - Train MSE: 0.0292 - Test MSE: 0.0291 - Train PSNR: 15.3431 - Test PSNR: 15.3601
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 36/50 - Loss: 0.6336 - Val Loss: 0.6347 - Train Pixel Accuracy: 77.52% - Test Pixel Accuracy: 77.38% - Train MSE: 0.0295 - Test MSE: 0.0294 - Train PSNR: 15.2986 - Test PSNR: 15.3092
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 37/50 - Loss: 0.6342 - Val Loss: 0.6329 - Train Pixel Accuracy: 78.13% - Test Pixel Accuracy: 78.06% - Train MSE: 0.0287 - Test MSE: 0.0286 - Train PSNR: 15.4220 - Test PSNR: 15.4381
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 38/50 - Loss: 0.6325 - Val Loss: 0.6332 - Train Pixel Accuracy: 78.12% - Test Pixel Accuracy: 78.08% - Train MSE: 0.0288 - Test MSE: 0.0286 - Train PSNR: 15.4124 - Test PSNR: 15.4299
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 39/50 - Loss: 0.6327 - Val Loss: 0.6320 - Train Pixel Accuracy: 78.24% - Test Pixel Accuracy: 78.13% - Train MSE: 0.0283 - Test MSE: 0.0282 - Train PSNR: 15.4801 - Test PSNR: 15.4929
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 40/50 - Loss: 0.6315 - Val Loss: 0.6320 - Train Pixel Accuracy: 78.15% - Test Pixel Accuracy: 78.03% - Train MSE: 0.0283 - Test MSE: 0.0283 - Train PSNR: 15.4786 - Test PSNR: 15.4892
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 41/50 - Loss: 0.6314 - Val Loss: 0.6310 - Train Pixel Accuracy: 78.52% - Test Pixel Accuracy: 78.45% - Train MSE: 0.0278 - Test MSE: 0.0277 - Train PSNR: 15.5531 - Test PSNR: 15.5684
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 42/50 - Loss: 0.6305 - Val Loss: 0.6308 - Train Pixel Accuracy: 78.58% - Test Pixel Accuracy: 78.51% - Train MSE: 0.0277 - Test MSE: 0.0276 - Train PSNR: 15.5713 - Test PSNR: 15.5871
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 43/50 - Loss: 0.6303 - Val Loss: 0.6301 - Train Pixel Accuracy: 78.57% - Test Pixel Accuracy: 78.45% - Train MSE: 0.0275 - Test MSE: 0.0274 - Train PSNR: 15.6047 - Test PSNR: 15.6166
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 44/50 - Loss: 0.6296 - Val Loss: 0.6298 - Train Pixel Accuracy: 78.60% - Test Pixel Accuracy: 78.47% - Train MSE: 0.0274 - Test MSE: 0.0273 - Train PSNR: 15.6243 - Test PSNR: 15.6354
1563/1563 [==============================] - 20s 13ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 45/50 - Loss: 0.6293 - Val Loss: 0.6292 - Train Pixel Accuracy: 78.87% - Test Pixel Accuracy: 78.79% - Train MSE: 0.0271 - Test MSE: 0.0270 - Train PSNR: 15.6780 - Test PSNR: 15.6923
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 46/50 - Loss: 0.6287 - Val Loss: 0.6288 - Train Pixel Accuracy: 78.96% - Test Pixel Accuracy: 78.87% - Train MSE: 0.0269 - Test MSE: 0.0268 - Train PSNR: 15.7073 - Test PSNR: 15.7213
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 13ms/step
Epoch 47/50 - Loss: 0.6283 - Val Loss: 0.6284 - Train Pixel Accuracy: 78.91% - Test Pixel Accuracy: 78.79% - Train MSE: 0.0268 - Test MSE: 0.0267 - Train PSNR: 15.7237 - Test PSNR: 15.7340
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step
Epoch 48/50 - Loss: 0.6279 - Val Loss: 0.6279 - Train Pixel Accuracy: 79.05% - Test Pixel Accuracy: 78.92% - Train MSE: 0.0265 - Test MSE: 0.0265 - Train PSNR: 15.7610 - Test PSNR: 15.7712
1563/1563 [==============================] - 19s 12ms/step
313/313 [==============================] - 4s 12ms/step

Epoch 49/50 - Loss: 0.6274 - Val Loss: 0.6276 - Train Pixel Accuracy: 79.25% - Test Pixel Accuracy: 79.14% - Train MSE: 0.0263 - Test MSE: 0.0262 - Train PSNR: 15.7988 - Test PSNR: 15.8118

5η εκτέλεση:

Layer Name: encoder_conv1
Filters: 16, Kernel Size: (3, 3)
==========
Layer Name: encoder_conv2
Filters: 8, Kernel Size: (3, 3)
==========
Layer Name: encoder_conv3
Filters: 8, Kernel Size: (3, 3)
==========
Layer Name: decoder_conv1
Filters: 8, Kernel Size: (3, 3)
==========
Layer Name: decoder_conv2
Filters: 8, Kernel Size: (3, 3)
==========
Layer Name: decoder_conv3
Filters: 16, Kernel Size: (3, 3)
==========
Layer Name: output_layer
Filters: 1, Kernel Size: (3, 3)
==========
Model: "autoencoder_model"

Layer (type)	Output Shape	Param #
input_layer (InputLayer)	[(None, 32, 32, 1)]	0
encoder_conv1 (Conv2D)	(None, 32, 32, 16)	160
encoder_pool1 (MaxPooling2D)	(None, 16, 16, 16)	0
encoder_conv2 (Conv2D)	(None, 16, 16, 8)	1160
encoder_pool2 (MaxPooling2D)	(None, 8, 8, 8)	0
encoder_conv3 (Conv2D)	(None, 8, 8, 8)	584
encoder_pool3 (MaxPooling2D)	(None, 4, 4, 8)	0
decoder_conv1 (Conv2D)	(None, 4, 4, 8)	584
decoder_upsample1 (UpSampling2D)	(None, 8, 8, 8)	0
decoder_conv2 (Conv2D)	(None, 8, 8, 8)	584
decoder_upsample2 (UpSampling2D)	(None, 16, 16, 8)	0
decoder_conv3 (Conv2D)	(None, 16, 16, 16)	1168
decoder_upsample3 (UpSampling2D)	(None, 32, 32, 16)	0
output_layer (Conv2D)	(None, 32, 32, 1)	145

==========
Total params: 4385 (17.13 KB)
Trainable params: 4385 (17.13 KB)
Non-trainable params: 0 (0.00 Byte)

1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 1/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.13% - Test Pixel Accuracy: 53.84% - Train MSE: 0.0576 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 2/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.25% - Test Pixel Accuracy: 53.95% - Train MSE: 0.0576 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 3/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.35% - Test Pixel Accuracy: 54.05% - Train MSE: 0.0576 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 4/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.45% - Test Pixel Accuracy: 54.14% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 5/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.52% - Test Pixel Accuracy: 54.21% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 6/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.59% - Test Pixel Accuracy: 54.27% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 7/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.65% - Test Pixel Accuracy: 54.33% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 8/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.70% - Test Pixel Accuracy: 54.37% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 9/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.75% - Test Pixel Accuracy: 54.42% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 10/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.79% - Test Pixel Accuracy: 54.45% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 11/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.82% - Test Pixel Accuracy: 54.48% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 12/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.85% - Test Pixel Accuracy: 54.51% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 13/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.87% - Test Pixel Accuracy: 54.53% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 14/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.90% - Test Pixel Accuracy: 54.55% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 15/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.91% - Test Pixel Accuracy: 54.57% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 16/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.93% - Test Pixel Accuracy: 54.58% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 17/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.94% - Test Pixel Accuracy: 54.60% - Train MSE: 0.0575 - Test MSE: 0.0572

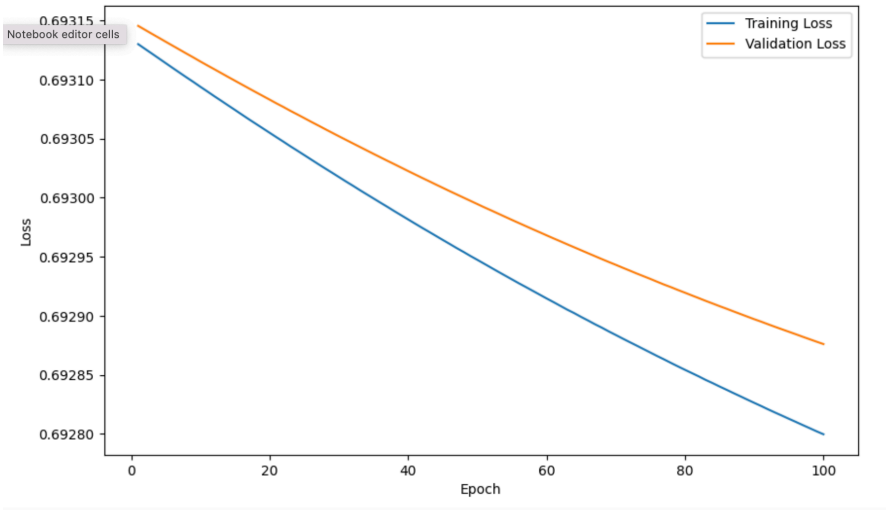
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 18/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.95% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 19/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.96% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 20/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 21/100 - Loss: 0.6931 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 22/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 23/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 24/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 25/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.98% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 26/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 27/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 28/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.62% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 29/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 30/100 - Loss: 0.6930 - Val Loss: 0.6931 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 31/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 32/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 30s 19ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 33/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.61% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 34/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.97% - Test Pixel Accuracy: 54.60% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step

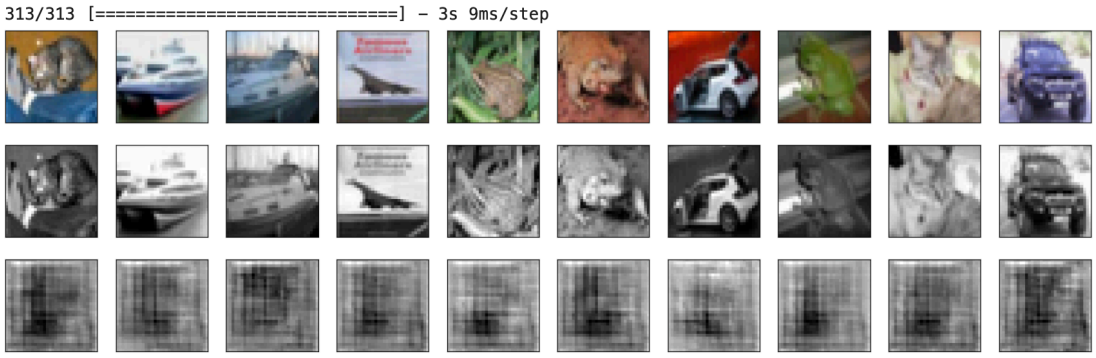
313/313 [==============================] - 3s 9ms/step
Epoch 35/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.96% - Test Pixel Accuracy: 54.60% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 36/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.96% - Test Pixel Accuracy: 54.60% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 37/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.96% - Test Pixel Accuracy: 54.60% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 38/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.96% - Test Pixel Accuracy: 54.59% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 39/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.95% - Test Pixel Accuracy: 54.59% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 40/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.95% - Test Pixel Accuracy: 54.58% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 41/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.95% - Test Pixel Accuracy: 54.58% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 42/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.94% - Test Pixel Accuracy: 54.58% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 20s 13ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 43/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.94% - Test Pixel Accuracy: 54.57% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 44/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.94% - Test Pixel Accuracy: 54.57% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 45/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.93% - Test Pixel Accuracy: 54.56% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 46/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.93% - Test Pixel Accuracy: 54.56% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 47/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.93% - Test Pixel Accuracy: 54.56% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 48/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.92% - Test Pixel Accuracy: 54.55% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 49/100 - Loss: 0.6930 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.92% - Test Pixel Accuracy: 54.55% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 50/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.91% - Test Pixel Accuracy: 54.54% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 51/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.91% - Test Pixel Accuracy: 54.54% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step

Epoch 52/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.91% - Test Pixel Accuracy: 54.53% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 53/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.90% - Test Pixel Accuracy: 54.53% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 54/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.90% - Test Pixel Accuracy: 54.53% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 15s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 55/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.90% - Test Pixel Accuracy: 54.52% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 56/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.89% - Test Pixel Accuracy: 54.52% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 57/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.89% - Test Pixel Accuracy: 54.51% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 58/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.88% - Test Pixel Accuracy: 54.51% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 59/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.88% - Test Pixel Accuracy: 54.51% - Train MSE: 0.0575 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 60/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.88% - Test Pixel Accuracy: 54.50% - Train MSE: 0.0574 - Test MSE: 0.0572
1563/1563 [==============================] - 16s 10ms/step
313/313 [==============================] - 3s 11ms/step
Epoch 61/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.87% - Test Pixel Accuracy: 54.50% - Train MSE: 0.0574 - Test MSE: 0.0572
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 62/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.87% - Test Pixel Accuracy: 54.49% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 63/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.86% - Test Pixel Accuracy: 54.49% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 64/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.86% - Test Pixel Accuracy: 54.49% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 65/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.86% - Test Pixel Accuracy: 54.48% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 66/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.85% - Test Pixel Accuracy: 54.48% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 67/100 - Loss: 0.6929 - Val Loss: 0.6930 - Train Pixel Accuracy: 54.85% - Test Pixel Accuracy: 54.47% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 68/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.84% - Test Pixel Accuracy: 54.47% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step

Epoch 69/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.84% - Test Pixel Accuracy: 54.46% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 70/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.84% - Test Pixel Accuracy: 54.46% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 71/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.83% - Test Pixel Accuracy: 54.46% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 72/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.83% - Test Pixel Accuracy: 54.45% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 73/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.82% - Test Pixel Accuracy: 54.45% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 74/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.82% - Test Pixel Accuracy: 54.44% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 75/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.82% - Test Pixel Accuracy: 54.44% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 76/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.81% - Test Pixel Accuracy: 54.44% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 77/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.81% - Test Pixel Accuracy: 54.43% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 78/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.81% - Test Pixel Accuracy: 54.43% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 79/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.80% - Test Pixel Accuracy: 54.43% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 80/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.80% - Test Pixel Accuracy: 54.42% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 81/100 - Loss: 0.6929 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.80% - Test Pixel Accuracy: 54.42% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 82/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.79% - Test Pixel Accuracy: 54.42% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 83/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.79% - Test Pixel Accuracy: 54.41% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 84/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.79% - Test Pixel Accuracy: 54.41% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 85/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.78% - Test Pixel Accuracy: 54.41% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step

Epoch 86/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.78% - Test Pixel Accuracy: 54.40% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 87/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.78% - Test Pixel Accuracy: 54.40% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 88/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.78% - Test Pixel Accuracy: 54.40% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 89/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.77% - Test Pixel Accuracy: 54.40% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 90/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.77% - Test Pixel Accuracy: 54.39% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 91/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.77% - Test Pixel Accuracy: 54.39% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 92/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.77% - Test Pixel Accuracy: 54.39% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 93/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.76% - Test Pixel Accuracy: 54.39% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 94/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.76% - Test Pixel Accuracy: 54.38% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 15s 10ms/step
313/313 [==============================] - 3s 10ms/step
Epoch 95/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.76% - Test Pixel Accuracy: 54.38% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 96/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.76% - Test Pixel Accuracy: 54.38% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 97/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.76% - Test Pixel Accuracy: 54.38% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 98/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.75% - Test Pixel Accuracy: 54.38% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 99/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.75% - Test Pixel Accuracy: 54.37% - Train MSE: 0.0574 - Test MSE: 0.0571
1563/1563 [==============================] - 14s 9ms/step
313/313 [==============================] - 3s 9ms/step
Epoch 100/100 - Loss: 0.6928 - Val Loss: 0.6929 - Train Pixel Accuracy: 54.75% - Test Pixel Accuracy: 54.37% - Train MSE: 0.0574 - Test MSE: 0.0571
Training time: 7755.882892847061 seconds





Ε) Σχόλια στις παραπάνω εκτελέσεις: Αξιολογώντας τις τιμές στις μετρικές που λαμβάνονται στα δεδομένα εκπαίδευσης και επικύρωσης, προκύπτουν ορισμένα συμπεράσματα σχετικά με την υπερκεκπαίδευση (overfitting). Βλέποντας τις εκτελέσεις με την σειρά,

- Losses: Στις 2 πρώτες εκτελέσεις και στην 4η, παρατηρείται σταδιακή μείωση, γεγονός που δείχνει πως το μοντέλο μαθαίνει και βελτιώνει την ικανότητα του να κάνει προβλέψεις. Στην 3η εκτέλεση, ανά 10 εποχές, τα losses αυξομειώνονται, δεν παρατηρείται σταθερή αύξηση ή μείωση μέχρι το τέλος της εκπαίδευσης. Η 5η εκτέλεση όπου χρησιμοποιείται sgd και όχι adam, δεν είναι επιτυχής καθώς τα losses έχουν σταθερή τιμή.
- Pixel accuracy: Στις 2 πρώτες εκτελέσεις και στην 4η, τόσο η ακρίβεια των pixels εκπαίδευσης όσο και η ακρίβεια των pixels δοκιμής αυξάνονται, υποδεικνύοντας ότι το μοντέλο ταξινομεί όλο και καλύτερα τα pixels. Στην 3η εκτέλεση, σε σχέση με τις 2 προηγούμενες, είναι πιο έντονη η αυξομείωση στις τιμές, με μικρή διαφορά (λιγότερο από 1%) αλλά το μοντέλο επιτυγχάνει εντέλει υψηλά ποσοστά. Η 5η εκτέλεση όπως προαναφέρθηκε, έχει τιμές που κυμαίνονται στο 54-55%.

- MSE, PSNR: Βλέποντας τις εκτελέσεις, το MSE τόσο για τα σύνολα εκπαίδευσης όσο και για τα σύνολα δοκιμής μειώνεται, υποδεικνύοντας ότι το μοντέλο βελτιώνεται όσον αφορά το σφάλμα ανακατασκευής. Η υπερβολική προσαρμογή θα οδηγούσε συνήθως σε χαμηλότερο MSE εκπαίδευσης σε σύγκριση με το MSE δοκιμής. Το PSNR τόσο για τα σύνολα εκπαίδευσης όσο και για τα σύνολα δοκιμής αυξάνεται, γεγονός που αποτελεί θετικό σημάδι. Και στις 2 μετρικές, η μικρή διαφορά ανάμεσα στις τιμές στα δεδομένα εκπαίδευσης και δοκιμής υποδηλώνει ότι το μοντέλο δεν προσαρμόζεται υπερβολικά. Στην 5η εκτέλεση οι τιμές παραμένουν σταθερές όπως και στα προηγούμενα, επιβεβαιώνοντας την δυσλειτουργία του autoencoder με τις συγκεκριμένες παραμέτρους.

ΣΤ) Ανακατασκευή μέσω PCA: Προκειμένου να αξιολογηθεί περαιτέρω η ανακατασκευή μέσω autoencoder, γράφτηκε επιπλέον κώδικας όπου εικόνες ανακατασκευάζονται μέσω PCA κρατώντας το 90% της πληροφορίας και ο αριθμός των στοιχείων επιλέγεται αναλόγως. Η PCA είναι μια τεχνική μείωσης διαστάσεων που χρησιμοποιείται συνήθως για την εξαγωγή χαρακτηριστικών και τη συμπίεση δεδομένων. Στο πλαίσιο της ανακατασκευής εικόνας, η PCA μπορεί να χρησιμοποιηθεί για τη μείωση της διαστατικότητας των δεδομένων με τη σύλληψη των πιο σημαντικών χαρακτηριστικών (κύριες συνιστώσες), ενώ απορρίπτονται λιγότερο σημαντικές πληροφορίες. Συγκριτικά με τον Autoencoder, με τις παραμέτρους που δοκιμάστηκε, με την μέθοδο pca επιτυγχάνονται καλύτερα ποσοστά στις μετρικές ενώ είναι εμφανής και η καλύτερη ανακατασκευή που γίνεται, στα προβαλλόμενα παραδείγματα.

```
MSE on training set: 0.7616
Pixel Accuracy on training set: 44.53%
PSNR on training set: 1.1829
MSE on test set: 0.7650
Pixel Accuracy on test set: 44.24%
PSNR on test set: 1.1636
```

+ Code + Markdown