Epoch 1/15

50000/50000 [==============================] - 483s 10ms/step - loss: 0.0900 - mean\_squared\_error: 0.0900 - acc: 0.1400 - val\_loss: 0.0899 - val\_mean\_squared\_error: 0.0899 - val\_acc: 0.1554

Epoch 2/15

50000/50000 [==============================] - 506s 10ms/step - loss: 0.0899 - mean\_squared\_error: 0.0899 - acc: 0.1492 - val\_loss: 0.0899 - val\_mean\_squared\_error: 0.0899 - val\_acc: 0.1646

Epoch 3/15

50000/50000 [==============================] - 467s 9ms/step - loss: 0.0899 - mean\_squared\_error: 0.0899 - acc: 0.1586 - val\_loss: 0.0898 - val\_mean\_squared\_error: 0.0898 - val\_acc: 0.1755

Epoch 4/15

50000/50000 [==============================] - 496s 10ms/step - loss: 0.0898 - mean\_squared\_error: 0.0898 - acc: 0.1682 - val\_loss: 0.0898 - val\_mean\_squared\_error: 0.0898 - val\_acc: 0.1854

Epoch 5/15

50000/50000 [==============================] - 523s 10ms/step - loss: 0.0898 - mean\_squared\_error: 0.0898 - acc: 0.1774 - val\_loss: 0.0897 - val\_mean\_squared\_error: 0.0897 - val\_acc: 0.1946

Epoch 6/15

50000/50000 [==============================] - 520s 10ms/step - loss: 0.0897 - mean\_squared\_error: 0.0897 - acc: 0.1869 - val\_loss: 0.0897 - val\_mean\_squared\_error: 0.0897 - val\_acc: 0.2028

Epoch 7/15

50000/50000 [==============================] - 486s 10ms/step - loss: 0.0897 - mean\_squared\_error: 0.0897 - acc: 0.1954 - val\_loss: 0.0896 - val\_mean\_squared\_error: 0.0896 - val\_acc: 0.2118

Epoch 8/15

50000/50000 [==============================] - 443s 9ms/step - loss: 0.0896 - mean\_squared\_error: 0.0896 - acc: 0.2041 - val\_loss: 0.0896 - val\_mean\_squared\_error: 0.0896 - val\_acc: 0.2201

Epoch 9/15

50000/50000 [==============================] - 462s 9ms/step - loss: 0.0896 - mean\_squared\_error: 0.0896 - acc: 0.2122 - val\_loss: 0.0895 - val\_mean\_squared\_error: 0.0895 - val\_acc: 0.2300

Epoch 10/15

50000/50000 [==============================] - 460s 9ms/step - loss: 0.0895 - mean\_squared\_error: 0.0895 - acc: 0.2201 - val\_loss: 0.0895 - val\_mean\_squared\_error: 0.0895 - val\_acc: 0.2367

Epoch 11/15

50000/50000 [==============================] - 456s 9ms/step - loss: 0.0895 - mean\_squared\_error: 0.0895 - acc: 0.2278 - val\_loss: 0.0894 - val\_mean\_squared\_error: 0.0894 - val\_acc: 0.2446

Epoch 12/15

50000/50000 [==============================] - 457s 9ms/step - loss: 0.0894 - mean\_squared\_error: 0.0894 - acc: 0.2353 - val\_loss: 0.0894 - val\_mean\_squared\_error: 0.0894 - val\_acc: 0.2515

Epoch 13/15

50000/50000 [==============================] - 457s 9ms/step - loss: 0.0894 - mean\_squared\_error: 0.0894 - acc: 0.2423 - val\_loss: 0.0893 - val\_mean\_squared\_error: 0.0893 - val\_acc: 0.2587

Epoch 14/15

50000/50000 [==============================] - 495s 10ms/step - loss: 0.0893 - mean\_squared\_error: 0.0893 - acc: 0.2487 - val\_loss: 0.0892 - val\_mean\_squared\_error: 0.0892 - val\_acc: 0.2650

Epoch 15/15

50000/50000 [==============================] - 469s 9ms/step - loss: 0.0893 - mean\_squared\_error: 0.0893 - acc: 0.2554 - val\_loss: 0.0892 - val\_mean\_squared\_error: 0.0892 - val\_acc: 0.2707

10000/10000 [==============================] - 27s 3ms/step

The testing accuracy metric for 1 no. of cnn layers and lr : 0.001 is [0.08920712442398071, 0.08920712442398071, 0.2673]

---------------------------------------------------

Train on 50000 samples, validate on 10000 samples

Epoch 1/15

50000/50000 [==============================] - 466s 9ms/step - loss: 0.0897 - mean\_squared\_error: 0.0897 - acc: 0.1433 - val\_loss: 0.0894 - val\_mean\_squared\_error: 0.0894 - val\_acc: 0.2490

Epoch 2/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0890 - mean\_squared\_error: 0.0890 - acc: 0.3810 - val\_loss: 0.0886 - val\_mean\_squared\_error: 0.0886 - val\_acc: 0.5071

Epoch 3/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0883 - mean\_squared\_error: 0.0883 - acc: 0.5474 - val\_loss: 0.0878 - val\_mean\_squared\_error: 0.0878 - val\_acc: 0.6229

Epoch 4/15

50000/50000 [==============================] - 453s 9ms/step - loss: 0.0873 - mean\_squared\_error: 0.0873 - acc: 0.6288 - val\_loss: 0.0867 - val\_mean\_squared\_error: 0.0867 - val\_acc: 0.6723

Epoch 5/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0861 - mean\_squared\_error: 0.0861 - acc: 0.6568 - val\_loss: 0.0852 - val\_mean\_squared\_error: 0.0852 - val\_acc: 0.6917

Epoch 6/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0845 - mean\_squared\_error: 0.0845 - acc: 0.6627 - val\_loss: 0.0832 - val\_mean\_squared\_error: 0.0832 - val\_acc: 0.6900

Epoch 7/15

50000/50000 [==============================] - 450s 9ms/step - loss: 0.0820 - mean\_squared\_error: 0.0820 - acc: 0.6560 - val\_loss: 0.0801 - val\_mean\_squared\_error: 0.0801 - val\_acc: 0.6789

Epoch 8/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0784 - mean\_squared\_error: 0.0784 - acc: 0.6506 - val\_loss: 0.0755 - val\_mean\_squared\_error: 0.0755 - val\_acc: 0.6786

Epoch 9/15

50000/50000 [==============================] - 453s 9ms/step - loss: 0.0729 - mean\_squared\_error: 0.0729 - acc: 0.6610 - val\_loss: 0.0688 - val\_mean\_squared\_error: 0.0688 - val\_acc: 0.6920

Epoch 10/15

50000/50000 [==============================] - 455s 9ms/step - loss: 0.0654 - mean\_squared\_error: 0.0654 - acc: 0.6845 - val\_loss: 0.0600 - val\_mean\_squared\_error: 0.0600 - val\_acc: 0.7197

Epoch 11/15

50000/50000 [==============================] - 452s 9ms/step - loss: 0.0566 - mean\_squared\_error: 0.0566 - acc: 0.7170 - val\_loss: 0.0507 - val\_mean\_squared\_error: 0.0507 - val\_acc: 0.7568

Epoch 12/15

50000/50000 [==============================] - 451s 9ms/step - loss: 0.0482 - mean\_squared\_error: 0.0482 - acc: 0.7538 - val\_loss: 0.0425 - val\_mean\_squared\_error: 0.0425 - val\_acc: 0.7926

Epoch 13/15

50000/50000 [==============================] - 458s 9ms/step - loss: 0.0412 - mean\_squared\_error: 0.0412 - acc: 0.7932 - val\_loss: 0.0358 - val\_mean\_squared\_error: 0.0358 - val\_acc: 0.8339

Epoch 14/15

50000/50000 [==============================] - 454s 9ms/step - loss: 0.0356 - mean\_squared\_error: 0.0356 - acc: 0.8231 - val\_loss: 0.0308 - val\_mean\_squared\_error: 0.0308 - val\_acc: 0.8536

Epoch 15/15

50000/50000 [==============================] - 451s 9ms/step - loss: 0.0314 - mean\_squared\_error: 0.0314 - acc: 0.8412 - val\_loss: 0.0271 - val\_mean\_squared\_error: 0.0271 - val\_acc: 0.8640

10000/10000 [==============================] - 25s 3ms/step

The testing accuracy metric for 1 no. of cnn layers and lr : 0.01is [0.028068843910098076, 0.028068843910098076, 0.8604]

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Train on 50000 samples, validate on 10000 samples

Epoch 1/15

50000/50000 [==============================] - 452s 9ms/step - loss: 0.0877 - mean\_squared\_error: 0.0877 - acc: 0.3283 - val\_loss: 0.0840 - val\_mean\_squared\_error: 0.0840 - val\_acc: 0.5938

Epoch 2/15

50000/50000 [==============================] - 431s 9ms/step - loss: 0.0732 - mean\_squared\_error: 0.0732 - acc: 0.6379 - val\_loss: 0.0543 - val\_mean\_squared\_error: 0.0543 - val\_acc: 0.7236

Epoch 3/15

50000/50000 [==============================] - 423s 8ms/step - loss: 0.0395 - mean\_squared\_error: 0.0395 - acc: 0.7964 - val\_loss: 0.0257 - val\_mean\_squared\_error: 0.0257 - val\_acc: 0.8739

Epoch 4/15

50000/50000 [==============================] - 425s 8ms/step - loss: 0.0238 - mean\_squared\_error: 0.0238 - acc: 0.8696 - val\_loss: 0.0184 - val\_mean\_squared\_error: 0.0184 - val\_acc: 0.8953

Epoch 5/15

50000/50000 [==============================] - 458s 9ms/step - loss: 0.0193 - mean\_squared\_error: 0.0193 - acc: 0.8862 - val\_loss: 0.0160 - val\_mean\_squared\_error: 0.0160 - val\_acc: 0.9054

Epoch 6/15

50000/50000 [==============================] - 480s 10ms/step - loss: 0.0173 - mean\_squared\_error: 0.0173 - acc: 0.8944 - val\_loss: 0.0146 - val\_mean\_squared\_error: 0.0146 - val\_acc: 0.9104

Epoch 7/15

50000/50000 [==============================] - 456s 9ms/step - loss: 0.0160 - mean\_squared\_error: 0.0160 - acc: 0.9007 - val\_loss: 0.0138 - val\_mean\_squared\_error: 0.0138 - val\_acc: 0.9137

Epoch 8/15

50000/50000 [==============================] - 426s 9ms/step - loss: 0.0152 - mean\_squared\_error: 0.0152 - acc: 0.9051 - val\_loss: 0.0132 - val\_mean\_squared\_error: 0.0132 - val\_acc: 0.9165

Epoch 9/15

50000/50000 [==============================] - 424s 8ms/step - loss: 0.0145 - mean\_squared\_error: 0.0145 - acc: 0.9081 - val\_loss: 0.0126 - val\_mean\_squared\_error: 0.0126 - val\_acc: 0.9207

Epoch 10/15

50000/50000 [==============================] - 463s 9ms/step - loss: 0.0140 - mean\_squared\_error: 0.0140 - acc: 0.9115 - val\_loss: 0.0123 - val\_mean\_squared\_error: 0.0123 - val\_acc: 0.9229

Epoch 11/15

50000/50000 [==============================] - 471s 9ms/step - loss: 0.0135 - mean\_squared\_error: 0.0135 - acc: 0.9143 - val\_loss: 0.0119 - val\_mean\_squared\_error: 0.0119 - val\_acc: 0.9256

Epoch 12/15

50000/50000 [==============================] - 439s 9ms/step - loss: 0.0131 - mean\_squared\_error: 0.0131 - acc: 0.9160 - val\_loss: 0.0116 - val\_mean\_squared\_error: 0.0116 - val\_acc: 0.9274

Epoch 13/15

50000/50000 [==============================] - 432s 9ms/step - loss: 0.0128 - mean\_squared\_error: 0.0128 - acc: 0.9182 - val\_loss: 0.0113 - val\_mean\_squared\_error: 0.0113 - val\_acc: 0.9303

Epoch 14/15

50000/50000 [==============================] - 437s 9ms/step - loss: 0.0124 - mean\_squared\_error: 0.0124 - acc: 0.9209 - val\_loss: 0.0111 - val\_mean\_squared\_error: 0.0111 - val\_acc: 0.9294

Epoch 15/15

50000/50000 [==============================] - 441s 9ms/step - loss: 0.0121 - mean\_squared\_error: 0.0121 - acc: 0.9228 - val\_loss: 0.0108 - val\_mean\_squared\_error: 0.0108 - val\_acc: 0.9326

10000/10000 [==============================] - 28s 3ms/step8/10000 [=============>................] - ETA: 14s

The testing accuracy metric for 1 no. of cnn layers and lr : 0.05 is [0.011191880146600306, 0.011191880146600306, 0.9284]

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Train on 50000 samples, validate on 10000 samples

Epoch 1/15

50000/50000 [==============================] - 446s 9ms/step - loss: 0.0825 - mean\_squared\_error: 0.0825 - acc: 0.5190 - val\_loss: 0.0608 - val\_mean\_squared\_error: 0.0608 - val\_acc: 0.6638

Epoch 2/15

50000/50000 [==============================] - 422s 8ms/step - loss: 0.0352 - mean\_squared\_error: 0.0352 - acc: 0.8056 - val\_loss: 0.0196 - val\_mean\_squared\_error: 0.0196 - val\_acc: 0.8920

Epoch 3/15

50000/50000 [==============================] - 406s 8ms/step - loss: 0.0189 - mean\_squared\_error: 0.0189 - acc: 0.8872 - val\_loss: 0.0150 - val\_mean\_squared\_error: 0.0150 - val\_acc: 0.9067

Epoch 4/15

50000/50000 [==============================] - 409s 8ms/step - loss: 0.0158 - mean\_squared\_error: 0.0158 - acc: 0.9014 - val\_loss: 0.0132 - val\_mean\_squared\_error: 0.0132 - val\_acc: 0.9164

Epoch 5/15

50000/50000 [==============================] - 409s 8ms/step - loss: 0.0144 - mean\_squared\_error: 0.0144 - acc: 0.9090 - val\_loss: 0.0122 - val\_mean\_squared\_error: 0.0122 - val\_acc: 0.9227

Epoch 6/15

50000/50000 [==============================] - 407s 8ms/step - loss: 0.0134 - mean\_squared\_error: 0.0134 - acc: 0.9152 - val\_loss: 0.0116 - val\_mean\_squared\_error: 0.0116 - val\_acc: 0.9253

Epoch 7/15

50000/50000 [==============================] - 411s 8ms/step - loss: 0.0126 - mean\_squared\_error: 0.0126 - acc: 0.9198 - val\_loss: 0.0112 - val\_mean\_squared\_error: 0.0112 - val\_acc: 0.9275

Epoch 8/15

50000/50000 [==============================] - 412s 8ms/step - loss: 0.0120 - mean\_squared\_error: 0.0120 - acc: 0.9233 - val\_loss: 0.0106 - val\_mean\_squared\_error: 0.0106 - val\_acc: 0.9323

Epoch 9/15

50000/50000 [==============================] - 407s 8ms/step - loss: 0.0115 - mean\_squared\_error: 0.0115 - acc: 0.9271 - val\_loss: 0.0101 - val\_mean\_squared\_error: 0.0101 - val\_acc: 0.9366

Epoch 10/15

50000/50000 [==============================] - 406s 8ms/step - loss: 0.0109 - mean\_squared\_error: 0.0109 - acc: 0.9300 - val\_loss: 0.0097 - val\_mean\_squared\_error: 0.0097 - val\_acc: 0.9390

Epoch 11/15

50000/50000 [==============================] - 405s 8ms/step - loss: 0.0105 - mean\_squared\_error: 0.0105 - acc: 0.9328 - val\_loss: 0.0093 - val\_mean\_squared\_error: 0.0093 - val\_acc: 0.9411

Epoch 12/15

50000/50000 [==============================] - 412s 8ms/step - loss: 0.0101 - mean\_squared\_error: 0.0101 - acc: 0.9362 - val\_loss: 0.0089 - val\_mean\_squared\_error: 0.0089 - val\_acc: 0.9437

Epoch 13/15

50000/50000 [==============================] - 410s 8ms/step - loss: 0.0097 - mean\_squared\_error: 0.0097 - acc: 0.9384 - val\_loss: 0.0086 - val\_mean\_squared\_error: 0.0086 - val\_acc: 0.9459

Epoch 14/15

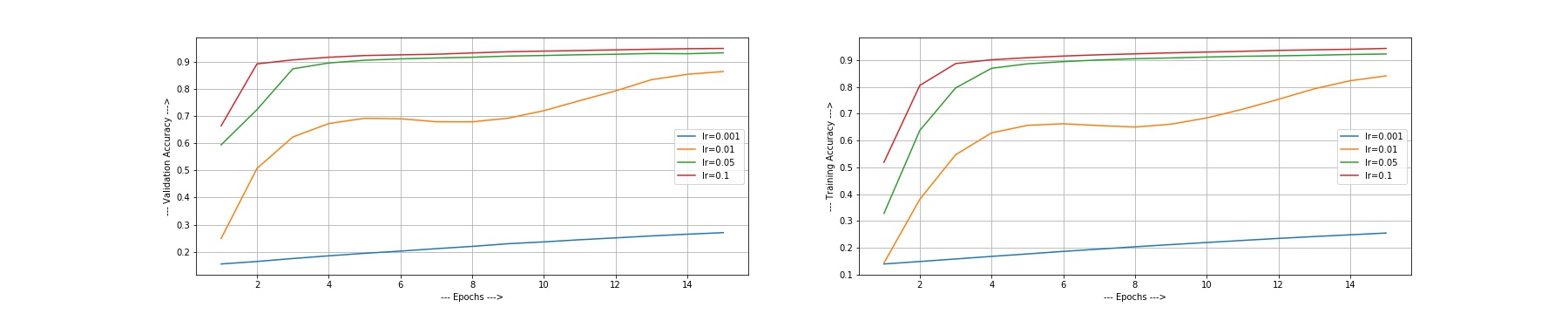
50000/50000 [==============================] - 400s 8ms/step - loss: 0.0094 - mean\_squared\_error: 0.0094 - acc: 0.9405 - val\_loss: 0.0084 - val\_mean\_squared\_error: 0.0084 - val\_acc: 0.9478

Epoch 15/15

50000/50000 [==============================] - 413s 8ms/step - loss: 0.0090 - mean\_squared\_error: 0.0090 - acc: 0.9435 - val\_loss: 0.0081 - val\_mean\_squared\_error: 0.0081 - val\_acc: 0.9488

10000/10000 [==============================] - 21s 2ms/step

The testing accuracy metric for 1 no. of cnn layers and lr : 0.1 is [0.008340230064152274, 0.008340230064152274, 0.947]



**OBSERVATIONS:**  
**Learning Rate vs Accuracy**:

1. N=0.01: When the learning rate was this small, it took time to gain significant accuracy. That’s why we see that training and validation accuracy is bit low in this case as compared to others. Its not saturated till 15 epochs. Both training and validation accuracy only reached 30% after 15 epoch.
2. N= 0.1: Being the greatest among all other, the model learned very quickly. We can also see that , the validation accuracy reached around 65% after one epoch only for lr=0.1, while the one with learning rate 0.01 is at 25% and the one with 0.001 is around 15%.