TRAINING DL MODEL ON REAL DATASET

==================================================

Loading training data from: Train.csv

Training data shape: (639999, 2)

Loading testing data from: Test.csv

Testing data shape: (159997, 2)

Using training columns: URL='url', Label='label'

Using testing columns: URL='url', Label='label'

Training set: 639,999 URLs

Test set: 159,997 URLs

Training label distribution: [320002 319997]

Test label distribution: [79999 79998]

Tokenized sequences - Train: (639999, 200), Test: (159997, 200)

2025-09-27 21:14:26.331559: I tensorflow/core/platform/cpu\_feature\_guard.cc:210] This TensorFlow binary is optimized to use available CPU instructions in performance-critical operations.

To enable the following instructions: SSE3 SSE4.1 SSE4.2 AVX AVX2 AVX512F AVX512\_VNNI FMA, in other operations, rebuild TensorFlow with the appropriate compiler flags.

CNN Model Architecture:

Model: "sequential"

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┃ Layer (type) ┃ Output Shape ┃ Param # ┃

┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━┩

│ embedding (Embedding) │ ? │ 0 (unbuilt) │

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│ conv1d (Conv1D) │ ? │ 0 (unbuilt) │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ max\_pooling1d (MaxPooling1D) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ dropout (Dropout) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ conv1d\_1 (Conv1D) │ ? │ 0 (unbuilt) │

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│ max\_pooling1d\_1 (MaxPooling1D) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ dropout\_1 (Dropout) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ conv1d\_2 (Conv1D) │ ? │ 0 (unbuilt) │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ max\_pooling1d\_2 (MaxPooling1D) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ dropout\_2 (Dropout) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ flatten (Flatten) │ ? │ 0 (unbuilt) │

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│ dense (Dense) │ ? │ 0 (unbuilt) │

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│ dropout\_3 (Dropout) │ ? │ 0 │

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│ dense\_1 (Dense) │ ? │ 0 (unbuilt) │

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│ dropout\_4 (Dropout) │ ? │ 0 │

├──────────────────────────────────────┼─────────────────────────────┼─────────────────┤

│ dense\_2 (Dense) │ ? │ 0 (unbuilt) │

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Total params: 0 (0.00 B)

Trainable params: 0 (0.00 B)

Non-trainable params: 0 (0.00 B)

Training CNN model on real dataset...

Epoch 1/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 241s 30ms/step - accuracy: 0.9299 - loss: 0.1785 - precision: 0.9403 - recall: 0.9182 - val\_accuracy: 0.9606 - val\_loss: 0.1075 - val\_precision: 0.9753 - val\_recall: 0.9450 - learning\_rate: 0.0010

Epoch 2/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 234s 29ms/step - accuracy: 0.9537 - loss: 0.1258 - precision: 0.9611 - recall: 0.9458 - val\_accuracy: 0.9608 - val\_loss: 0.1009 - val\_precision: 0.9866 - val\_recall: 0.9340 - learning\_rate: 0.0010

Epoch 3/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 234s 29ms/step - accuracy: 0.9585 - loss: 0.1144 - precision: 0.9668 - recall: 0.9496 - val\_accuracy: 0.9675 - val\_loss: 0.0885 - val\_precision: 0.9713 - val\_recall: 0.9632 - learning\_rate: 0.0010

Epoch 4/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 234s 29ms/step - accuracy: 0.9607 - loss: 0.1093 - precision: 0.9687 - recall: 0.9523 - val\_accuracy: 0.9691 - val\_loss: 0.0858 - val\_precision: 0.9780 - val\_recall: 0.9597 - learning\_rate: 0.0010

Epoch 5/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 237s 30ms/step - accuracy: 0.9624 - loss: 0.1045 - precision: 0.9703 - recall: 0.9541 - val\_accuracy: 0.9698 - val\_loss: 0.0833 - val\_precision: 0.9733 - val\_recall: 0.9660 - learning\_rate: 0.0010

Epoch 6/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 236s 30ms/step - accuracy: 0.9635 - loss: 0.1022 - precision: 0.9709 - recall: 0.9557 - val\_accuracy: 0.9702 - val\_loss: 0.0848 - val\_precision: 0.9798 - val\_recall: 0.9601 - learning\_rate: 0.0010

Epoch 7/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 238s 30ms/step - accuracy: 0.9645 - loss: 0.0998 - precision: 0.9720 - recall: 0.9566 - val\_accuracy: 0.9704 - val\_loss: 0.0836 - val\_precision: 0.9853 - val\_recall: 0.9549 - learning\_rate: 0.0010

Epoch 8/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 236s 29ms/step - accuracy: 0.9652 - loss: 0.0988 - precision: 0.9728 - recall: 0.9571 - val\_accuracy: 0.9703 - val\_loss: 0.0819 - val\_precision: 0.9877 - val\_recall: 0.9522 - learning\_rate: 0.0010

Epoch 9/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 244s 30ms/step - accuracy: 0.9660 - loss: 0.0968 - precision: 0.9731 - recall: 0.9586 - val\_accuracy: 0.9686 - val\_loss: 0.0854 - val\_precision: 0.9892 - val\_recall: 0.9473 - learning\_rate: 0.0010

Epoch 10/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 246s 31ms/step - accuracy: 0.9662 - loss: 0.0960 - precision: 0.9736 - recall: 0.9584 - val\_accuracy: 0.9722 - val\_loss: 0.0791 - val\_precision: 0.9797 - val\_recall: 0.9642 - learning\_rate: 0.0010

Epoch 11/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 262s 33ms/step - accuracy: 0.9668 - loss: 0.0948 - precision: 0.9739 - recall: 0.9594 - val\_accuracy: 0.9702 - val\_loss: 0.0824 - val\_precision: 0.9882 - val\_recall: 0.9517 - learning\_rate: 0.0010

Epoch 12/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 265s 33ms/step - accuracy: 0.9672 - loss: 0.0936 - precision: 0.9743 - recall: 0.9598 - val\_accuracy: 0.9726 - val\_loss: 0.0760 - val\_precision: 0.9832 - val\_recall: 0.9615 - learning\_rate: 0.0010

Epoch 13/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 269s 34ms/step - accuracy: 0.9672 - loss: 0.0935 - precision: 0.9744 - recall: 0.9596 - val\_accuracy: 0.9729 - val\_loss: 0.0760 - val\_precision: 0.9780 - val\_recall: 0.9674 - learning\_rate: 0.0010

Epoch 14/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 277s 35ms/step - accuracy: 0.9677 - loss: 0.0925 - precision: 0.9747 - recall: 0.9604 - val\_accuracy: 0.9727 - val\_loss: 0.0747 - val\_precision: 0.9761 - val\_recall: 0.9690 - learning\_rate: 0.0010

Epoch 15/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 246s 31ms/step - accuracy: 0.9677 - loss: 0.0931 - precision: 0.9745 - recall: 0.9606 - val\_accuracy: 0.9732 - val\_loss: 0.0747 - val\_precision: 0.9807 - val\_recall: 0.9653 - learning\_rate: 0.0010

Epoch 16/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 220s 28ms/step - accuracy: 0.9678 - loss: 0.0914 - precision: 0.9742 - recall: 0.9612 - val\_accuracy: 0.9732 - val\_loss: 0.0756 - val\_precision: 0.9819 - val\_recall: 0.9640 - learning\_rate: 0.0010

Epoch 17/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 223s 28ms/step - accuracy: 0.9681 - loss: 0.0918 - precision: 0.9751 - recall: 0.9607 - val\_accuracy: 0.9736 - val\_loss: 0.0777 - val\_precision: 0.9807 - val\_recall: 0.9662 - learning\_rate: 0.0010

Epoch 18/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 226s 28ms/step - accuracy: 0.9683 - loss: 0.0906 - precision: 0.9753 - recall: 0.9611 - val\_accuracy: 0.9728 - val\_loss: 0.0771 - val\_precision: 0.9868 - val\_recall: 0.9583 - learning\_rate: 0.0010

Epoch 19/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 228s 29ms/step - accuracy: 0.9680 - loss: 0.0912 - precision: 0.9744 - recall: 0.9614 - val\_accuracy: 0.9727 - val\_loss: 0.0740 - val\_precision: 0.9869 - val\_recall: 0.9581 - learning\_rate: 0.0010

Epoch 20/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 232s 29ms/step - accuracy: 0.9685 - loss: 0.0908 - precision: 0.9751 - recall: 0.9617 - val\_accuracy: 0.9719 - val\_loss: 0.0799 - val\_precision: 0.9866 - val\_recall: 0.9566 - learning\_rate: 0.0010

Epoch 21/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 237s 30ms/step - accuracy: 0.9687 - loss: 0.0905 - precision: 0.9756 - recall: 0.9616 - val\_accuracy: 0.9737 - val\_loss: 0.0771 - val\_precision: 0.9844 - val\_recall: 0.9625 - learning\_rate: 0.0010

Epoch 22/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 241s 30ms/step - accuracy: 0.9688 - loss: 0.0902 - precision: 0.9756 - recall: 0.9616 - val\_accuracy: 0.9737 - val\_loss: 0.0748 - val\_precision: 0.9813 - val\_recall: 0.9657 - learning\_rate: 0.0010

Epoch 23/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 246s 31ms/step - accuracy: 0.9687 - loss: 0.0897 - precision: 0.9754 - recall: 0.9616 - val\_accuracy: 0.9731 - val\_loss: 0.0763 - val\_precision: 0.9865 - val\_recall: 0.9593 - learning\_rate: 0.0010

Epoch 24/50

7999/8000 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.9683 - loss: 0.0903 - precision: 0.9749 - recall: 0.9615

Epoch 24: ReduceLROnPlateau reducing learning rate to 0.0005000000237487257.

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 250s 31ms/step - accuracy: 0.9685 - loss: 0.0912 - precision: 0.9752 - recall: 0.9615 - val\_accuracy: 0.9723 - val\_loss: 0.0785 - val\_precision: 0.9866 - val\_recall: 0.9575 - learning\_rate: 0.0010

Epoch 25/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 255s 32ms/step - accuracy: 0.9716 - loss: 0.0807 - precision: 0.9782 - recall: 0.9647 - val\_accuracy: 0.9749 - val\_loss: 0.0714 - val\_precision: 0.9832 - val\_recall: 0.9662 - learning\_rate: 5.0000e-04

Epoch 26/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 259s 32ms/step - accuracy: 0.9726 - loss: 0.0787 - precision: 0.9791 - recall: 0.9658 - val\_accuracy: 0.9748 - val\_loss: 0.0763 - val\_precision: 0.9882 - val\_recall: 0.9609 - learning\_rate: 5.0000e-04

Epoch 27/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 264s 33ms/step - accuracy: 0.9726 - loss: 0.0772 - precision: 0.9792 - recall: 0.9658 - val\_accuracy: 0.9757 - val\_loss: 0.0703 - val\_precision: 0.9853 - val\_recall: 0.9656 - learning\_rate: 5.0000e-04

Epoch 28/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 270s 34ms/step - accuracy: 0.9732 - loss: 0.0760 - precision: 0.9793 - recall: 0.9668 - val\_accuracy: 0.9749 - val\_loss: 0.0747 - val\_precision: 0.9892 - val\_recall: 0.9601 - learning\_rate: 5.0000e-04

Epoch 29/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 279s 35ms/step - accuracy: 0.9735 - loss: 0.0757 - precision: 0.9800 - recall: 0.9667 - val\_accuracy: 0.9764 - val\_loss: 0.0692 - val\_precision: 0.9837 - val\_recall: 0.9688 - learning\_rate: 5.0000e-04

Epoch 30/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 280s 35ms/step - accuracy: 0.9736 - loss: 0.0750 - precision: 0.9794 - recall: 0.9675 - val\_accuracy: 0.9763 - val\_loss: 0.0689 - val\_precision: 0.9848 - val\_recall: 0.9674 - learning\_rate: 5.0000e-04

Epoch 31/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 286s 36ms/step - accuracy: 0.9739 - loss: 0.0749 - precision: 0.9796 - recall: 0.9681 - val\_accuracy: 0.9764 - val\_loss: 0.0676 - val\_precision: 0.9842 - val\_recall: 0.9682 - learning\_rate: 5.0000e-04

Epoch 32/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 292s 36ms/step - accuracy: 0.9738 - loss: 0.0746 - precision: 0.9803 - recall: 0.9670 - val\_accuracy: 0.9750 - val\_loss: 0.0699 - val\_precision: 0.9890 - val\_recall: 0.9606 - learning\_rate: 5.0000e-04

Epoch 33/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 299s 37ms/step - accuracy: 0.9742 - loss: 0.0735 - precision: 0.9805 - recall: 0.9677 - val\_accuracy: 0.9764 - val\_loss: 0.0706 - val\_precision: 0.9845 - val\_recall: 0.9679 - learning\_rate: 5.0000e-04

Epoch 34/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 307s 38ms/step - accuracy: 0.9742 - loss: 0.0735 - precision: 0.9807 - recall: 0.9675 - val\_accuracy: 0.9766 - val\_loss: 0.0680 - val\_precision: 0.9829 - val\_recall: 0.9700 - learning\_rate: 5.0000e-04

Epoch 35/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 313s 39ms/step - accuracy: 0.9741 - loss: 0.0738 - precision: 0.9806 - recall: 0.9674 - val\_accuracy: 0.9765 - val\_loss: 0.0690 - val\_precision: 0.9814 - val\_recall: 0.9713 - learning\_rate: 5.0000e-04

Epoch 36/50

7999/8000 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.9750 - loss: 0.0717 - precision: 0.9807 - recall: 0.9690

Epoch 36: ReduceLROnPlateau reducing learning rate to 0.0002500000118743628.

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 319s 40ms/step - accuracy: 0.9745 - loss: 0.0729 - precision: 0.9808 - recall: 0.9680 - val\_accuracy: 0.9766 - val\_loss: 0.0686 - val\_precision: 0.9837 - val\_recall: 0.9692 - learning\_rate: 5.0000e-04

Epoch 37/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 321s 40ms/step - accuracy: 0.9755 - loss: 0.0689 - precision: 0.9811 - recall: 0.9697 - val\_accuracy: 0.9774 - val\_loss: 0.0666 - val\_precision: 0.9847 - val\_recall: 0.9697 - learning\_rate: 2.5000e-04

Epoch 38/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 329s 41ms/step - accuracy: 0.9762 - loss: 0.0671 - precision: 0.9823 - recall: 0.9698 - val\_accuracy: 0.9770 - val\_loss: 0.0662 - val\_precision: 0.9852 - val\_recall: 0.9685 - learning\_rate: 2.5000e-04

Epoch 39/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 337s 42ms/step - accuracy: 0.9760 - loss: 0.0674 - precision: 0.9820 - recall: 0.9698 - val\_accuracy: 0.9774 - val\_loss: 0.0654 - val\_precision: 0.9840 - val\_recall: 0.9704 - learning\_rate: 2.5000e-04

Epoch 40/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 337s 42ms/step - accuracy: 0.9764 - loss: 0.0669 - precision: 0.9821 - recall: 0.9705 - val\_accuracy: 0.9772 - val\_loss: 0.0652 - val\_precision: 0.9830 - val\_recall: 0.9712 - learning\_rate: 2.5000e-04

Epoch 41/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 342s 43ms/step - accuracy: 0.9765 - loss: 0.0660 - precision: 0.9820 - recall: 0.9708 - val\_accuracy: 0.9774 - val\_loss: 0.0662 - val\_precision: 0.9851 - val\_recall: 0.9692 - learning\_rate: 2.5000e-04

Epoch 42/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 346s 43ms/step - accuracy: 0.9766 - loss: 0.0658 - precision: 0.9819 - recall: 0.9711 - val\_accuracy: 0.9771 - val\_loss: 0.0670 - val\_precision: 0.9856 - val\_recall: 0.9683 - learning\_rate: 2.5000e-04

Epoch 43/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 347s 43ms/step - accuracy: 0.9769 - loss: 0.0650 - precision: 0.9823 - recall: 0.9713 - val\_accuracy: 0.9772 - val\_loss: 0.0649 - val\_precision: 0.9806 - val\_recall: 0.9736 - learning\_rate: 2.5000e-04

Epoch 44/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 357s 45ms/step - accuracy: 0.9770 - loss: 0.0654 - precision: 0.9820 - recall: 0.9718 - val\_accuracy: 0.9771 - val\_loss: 0.0655 - val\_precision: 0.9814 - val\_recall: 0.9725 - learning\_rate: 2.5000e-04

Epoch 45/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 361s 45ms/step - accuracy: 0.9771 - loss: 0.0647 - precision: 0.9824 - recall: 0.9717 - val\_accuracy: 0.9775 - val\_loss: 0.0666 - val\_precision: 0.9856 - val\_recall: 0.9690 - learning\_rate: 2.5000e-04

Epoch 46/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 369s 46ms/step - accuracy: 0.9767 - loss: 0.0655 - precision: 0.9818 - recall: 0.9714 - val\_accuracy: 0.9778 - val\_loss: 0.0643 - val\_precision: 0.9847 - val\_recall: 0.9706 - learning\_rate: 2.5000e-04

Epoch 47/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 373s 47ms/step - accuracy: 0.9770 - loss: 0.0647 - precision: 0.9826 - recall: 0.9711 - val\_accuracy: 0.9779 - val\_loss: 0.0658 - val\_precision: 0.9853 - val\_recall: 0.9702 - learning\_rate: 2.5000e-04

Epoch 48/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 377s 47ms/step - accuracy: 0.9772 - loss: 0.0644 - precision: 0.9825 - recall: 0.9717 - val\_accuracy: 0.9774 - val\_loss: 0.0653 - val\_precision: 0.9812 - val\_recall: 0.9733 - learning\_rate: 2.5000e-04

Epoch 49/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 382s 48ms/step - accuracy: 0.9771 - loss: 0.0641 - precision: 0.9821 - recall: 0.9720 - val\_accuracy: 0.9778 - val\_loss: 0.0660 - val\_precision: 0.9845 - val\_recall: 0.9708 - learning\_rate: 2.5000e-04

Epoch 50/50

8000/8000 ━━━━━━━━━━━━━━━━━━━━ 389s 49ms/step - accuracy: 0.9773 - loss: 0.0642 - precision: 0.9825 - recall: 0.9720 - val\_accuracy: 0.9776 - val\_loss: 0.0681 - val\_precision: 0.9863 - val\_recall: 0.9685 - learning\_rate: 2.5000e-04

Restoring model weights from the end of the best epoch: 46.

Evaluating on test set...

5000/5000 ━━━━━━━━━━━━━━━━━━━━ 26s 5ms/step

DL MODEL PERFORMANCE (Real Dataset):

Training time: 14193.2s

Training samples: 639,999

Test samples: 159,997

Test Accuracy: 0.9765

Test F1 Score: 0.9764

Test Precision: 0.9823

Test Recall: 0.9705

Detailed Classification Report:

precision recall f1-score support

0 0.97 0.98 0.98 79999

1 0.98 0.97 0.98 79998

accuracy 0.98 159997

macro avg 0.98 0.98 0.98 159997

weighted avg 0.98 0.98 0.98 159997

Files created:

- real\_dataset\_dl\_model.h5