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## LAMPIRAN

### Lampiran 1. Hasil *running* per-epoch

#### A. CNN Dengan *Dataset* Original

Epoch 1/50

11210/11210 - 122s 11ms/step - loss: 1.7703 - accuracy: 0.6694 - precision\_1: 0.7147 - recall\_1: 0.4998 - F1Score: 0.6419 - val\_loss: 0.8469 - val\_accuracy: 0.7375 - val\_precision\_1: 0.8114 - val\_recall\_1: 0.6506 - val\_F1Score: 0.7215

Epoch 2/50

11210/11210 - 117s 10ms/step - loss: 0.7874 - accuracy: 0.7519 - precision\_1: 0.8078 - recall\_1: 0.6939 - F1Score: 0.7459 - val\_loss: 0.6659 - val\_accuracy: 0.7885 - val\_precision\_1: 0.8356 - val\_recall\_1: 0.7462 - val\_F1Score: 0.7880

Epoch 3/50

11210/11210 - 117s 10ms/step - loss: 0.6598 - accuracy: 0.7884 - precision\_1: 0.8330 - recall\_1: 0.7441 - F1Score: 0.7856 - val\_loss: 0.5904 - val\_accuracy: 0.8126 - val\_precision\_1: 0.8510 - val\_recall\_1: 0.7735 - val\_F1Score: 0.8101

Epoch 4/50

11210/11210 - 124s 11ms/step - loss: 0.6009 - accuracy: 0.8079 - precision\_1: 0.8458 - recall\_1: 0.7700 - F1Score: 0.8059 - val\_loss: 0.5505 - val\_accuracy: 0.8217 - val\_precision\_1: 0.8538 - val\_recall\_1: 0.7907 - val\_F1Score: 0.8208

Epoch 5/50

11210/11210 - 117s 10ms/step - loss: 0.5554 - accuracy: 0.8220 - precision\_1: 0.8553 - recall\_1: 0.7886 - F1Score: 0.8203 - val\_loss: 0.5203 - val\_accuracy: 0.8332 - val\_precision\_1: 0.8627 - val\_recall\_1: 0.8016 - val\_F1Score: 0.8308

Epoch 6/50

11210/11210 - 118s 10ms/step - loss: 0.5181 - accuracy: 0.8338 - precision\_1: 0.8642 - recall\_1: 0.8046 - F1Score: 0.8331 - val\_loss: 0.4948 - val\_accuracy: 0.8414 - val\_precision\_1: 0.8710 - val\_recall\_1: 0.8123 - val\_F1Score: 0.8404

Epoch 7/50

11210/11210 - 124s 11ms/step - loss: 0.5200 - accuracy: 0.8410 - precision\_1: 0.8691 - recall\_1: 0.8145 - F1Score: 0.8407 - val\_loss: 0.4485 - val\_accuracy: 0.8556 - val\_precision\_1: 0.8790 - val\_recall\_1: 0.8348 - val\_F1Score: 0.8562

Epoch 8/50

11210/11210 - 124s 11ms/step - loss: 0.4692 - accuracy: 0.8494 - precision\_1: 0.8755 - recall\_1: 0.8255 - F1Score: 0.8495 - val\_loss: 0.4460 - val\_accuracy: 0.8561 - val\_precision\_1: 0.8801 - val\_recall\_1: 0.8316 - val\_F1Score: 0.8550

Epoch 9/50

11210/11210 - 124s 11ms/step - loss: 0.5028 - accuracy: 0.8526 - precision\_1: 0.8777 - recall\_1: 0.8301 - F1Score: 0.8530 - val\_loss: 0.4398 - val\_accuracy: 0.8588 - val\_precision\_1: 0.8855 - val\_recall\_1: 0.8336 - val\_F1Score: 0.8586

Epoch 10/50

11210/11210 - 123s 11ms/step - loss: 0.4545 - accuracy: 0.8603 - precision\_1: 0.8841 - recall\_1: 0.8389 - F1Score: 0.8607 - val\_loss: 0.3848 - val\_accuracy: 0.8779 - val\_precision\_1: 0.9011 - val\_recall\_1: 0.8595 - val\_F1Score: 0.8796

Epoch 11/50

11210/11210 - 117s 10ms/step - loss: 0.4226 - accuracy: 0.8650 - precision\_1: 0.8881 - recall\_1: 0.8446 - F1Score: 0.8656 - val\_loss: 0.3849 - val\_accuracy: 0.8800 - val\_precision\_1: 0.9017 - val\_recall\_1: 0.8618 - val\_F1Score: 0.8811

Epoch 12/50

11210/11210 - 123s 11ms/step - loss: 0.4193 - accuracy: 0.8677 - precision\_1: 0.8898 - recall\_1: 0.8476 - F1Score: 0.8680 - val\_loss: 0.3813 - val\_accuracy: 0.8816 - val\_precision\_1: 0.9022 - val\_recall\_1: 0.8633 - val\_F1Score: 0.8822

Epoch 13/50  
11210/11210 - 116s 10ms/step - loss: 0.4078 - accuracy: 0.8707 - precision\_1: 0.8925 - recall\_1: 0.8516 - F1Score: 0.8714 - val\_loss: 0.3816 - val\_accuracy: 0.8776 - val\_precision\_1: 0.8976 - val\_recall\_1: 0.8602 - val\_F1Score: 0.8783

Epoch 14/50  
11210/11210 - 123s 11ms/step - loss: 0.3996 - accuracy: 0.8736 - precision\_1: 0.8944 - recall\_1: 0.8553 - F1Score: 0.8743 - val\_loss: 0.3643 - val\_accuracy: 0.8863 - val\_precision\_1: 0.9062 - val\_recall\_1: 0.8709 - val\_F1Score: 0.8881

Epoch 15/50  
11210/11210 - 117s 10ms/step - loss: 0.3962 - accuracy: 0.8745 - precision\_1: 0.8953 - recall\_1: 0.8564 - F1Score: 0.8752 - val\_loss: 0.3591 - val\_accuracy: 0.8896 - val\_precision\_1: 0.9078 - val\_recall\_1: 0.8727 - val\_F1Score: 0.8898

Epoch 16/50  
11210/11210 - 122s 11ms/step - loss: 0.3908 - accuracy: 0.8759 - precision\_1: 0.8968 - recall\_1: 0.8583 - F1Score: 0.8769 - val\_loss: 0.3853 - val\_accuracy: 0.8774 - val\_precision\_1: 0.8989 - val\_recall\_1: 0.8568 - val\_F1Score: 0.8772

Epoch 17/50  
11210/11210 - 124s 11ms/step - loss: 0.3880 - accuracy: 0.8771 - precision\_1: 0.8976 - recall\_1: 0.8594 - F1Score: 0.8779 - val\_loss: 0.3469 - val\_accuracy: 0.8916 - val\_precision\_1: 0.9077 - val\_recall\_1: 0.8783 - val\_F1Score: 0.8927

Epoch 18/50  
11210/11210 - 117s 10ms/step - loss: 0.3817 - accuracy: 0.8792 - precision\_1: 0.8990 - recall\_1: 0.8614 - F1Score: 0.8796 - val\_loss: 0.3345 - val\_accuracy: 0.8932 - val\_precision\_1: 0.9119 - val\_recall\_1: 0.8791 - val\_F1Score: 0.8951

Epoch 19/50  
11210/11210 - 122s 11ms/step - loss: 0.4153 - accuracy: 0.8759 - precision\_1: 0.8971 - recall\_1: 0.8574 - F1Score: 0.8766 - val\_loss: 0.3595 - val\_accuracy: 0.8867 - val\_precision\_1: 0.9076 - val\_recall\_1: 0.8693 - val\_F1Score: 0.8879

Epoch 20/50  
11210/11210 - 123s 11ms/step - loss: 0.4118 - accuracy: 0.8768 - precision\_1: 0.8974 - recall\_1: 0.8590 - F1Score: 0.8776 - val\_loss: 0.3800 - val\_accuracy: 0.8770 - val\_precision\_1: 0.8988 - val\_recall\_1: 0.8578 - val\_F1Score: 0.8777

Epoch 21/50  
11210/11210 - 123s 11ms/step - loss: 0.3755 - accuracy: 0.8807 - precision\_1: 0.9006 - recall\_1: 0.8638 - F1Score: 0.8816 - val\_loss: 0.3497 - val\_accuracy: 0.8868 - val\_precision\_1: 0.9070 - val\_recall\_1: 0.8709 - val\_F1Score: 0.8884

Epoch 22/50  
11210/11210 - 125s 11ms/step - loss: 0.4208 - accuracy: 0.8788 - precision\_1: 0.8992 - recall\_1: 0.8614 - F1Score: 0.8796 - val\_loss: 0.3324 - val\_accuracy: 0.8948 - val\_precision\_1: 0.9118 - val\_recall\_1: 0.8812 - val\_F1Score: 0.8961

Epoch 23/50  
11210/11210 - 124s 11ms/step - loss: 0.3740 - accuracy: 0.8833 - precision\_1: 0.9025 - recall\_1: 0.8670 - F1Score: 0.8842 - val\_loss: 0.3259 - val\_accuracy: 0.8975 - val\_precision\_1: 0.9143 - val\_recall\_1: 0.8852 - val\_F1Score: 0.8994

Epoch 24/50  
11210/11210 - 126s 11ms/step - loss: 0.3705 - accuracy: 0.8829 - precision\_1: 0.9023 - recall\_1: 0.8662 - F1Score: 0.8837 - val\_loss: 0.3421 - val\_accuracy: 0.8926 - val\_precision\_1: 0.9096 - val\_recall\_1: 0.8789 - val\_F1Score: 0.8939

Epoch 25/50  
11210/11210 - 117s 10ms/step - loss: 0.3769 - accuracy: 0.8816 - precision\_1: 0.9011 - recall\_1: 0.8648 - F1Score: 0.8824 - val\_loss: 0.3304 - val\_accuracy: 0.8965 - val\_precision\_1: 0.9126 - val\_recall\_1: 0.8820 - val\_F1Score: 0.8969

Epoch 26/50

11210/11210 - 118s 11ms/step - loss: 0.4400 - accuracy: 0.8775 - precision\_1: 0.8984 - recall\_1: 0.8593 - F1Score: 0.8781 - val\_loss: 0.3615 - val\_accuracy: 0.8856 - val\_precision\_1: 0.9038 - val\_recall\_1: 0.8707 - val\_F1Score: 0.8868

Epoch 27/50

11210/11210 - 125s 11ms/step - loss: 0.4008 - accuracy: 0.8784 - precision\_1: 0.8989 - recall\_1: 0.8602 - F1Score: 0.8789 - val\_loss: 0.5624 - val\_accuracy: 0.8249 - val\_precision\_1: 0.8627 - val\_recall\_1: 0.7911 - val\_F1Score: 0.8251

Epoch 28/50

11210/11210 - 125s 11ms/step - loss: 0.4081 - accuracy: 0.8711 - precision\_1: 0.8940 - recall\_1: 0.8509 - F1Score: 0.8716 - val\_loss: 0.3423 - val\_accuracy: 0.8934 - val\_precision\_1: 0.9134 - val\_recall\_1: 0.8757 - val\_F1Score: 0.8940

Epoch 29/50

11210/11210 - 119s 11ms/step - loss: 0.3826 - accuracy: 0.8792 - precision\_1: 0.9005 - recall\_1: 0.8608 - F1Score: 0.8800 - val\_loss: 0.3509 - val\_accuracy: 0.8910 - val\_precision\_1: 0.9107 - val\_recall\_1: 0.8734 - val\_F1Score: 0.8915

Epoch 30/50

11210/11210 - 124s 11ms/step - loss: 0.6928 - accuracy: 0.8338 - precision\_1: 0.8703 - recall\_1: 0.7998 - F1Score: 0.8329 - val\_loss: 0.5320 - val\_accuracy: 0.8276 - val\_precision\_1: 0.8707 - val\_recall\_1: 0.7864 - val\_F1Score: 0.8261

Epoch 31/50

11210/11210 - 124s 11ms/step - loss: 0.5442 - accuracy: 0.8239 - precision\_1: 0.8637 - recall\_1: 0.7859 - F1Score: 0.8226 - val\_loss: 0.5173 - val\_accuracy: 0.8318 - val\_precision\_1: 0.8665 - val\_recall\_1: 0.7990 - val\_F1Score: 0.8311

Epoch 32/50

11210/11210 - 118s 11ms/step - loss: 0.5277 - accuracy: 0.8384 - precision\_1: 0.8697 - recall\_1: 0.8095 - F1Score: 0.8382 - val\_loss: 0.4590 - val\_accuracy: 0.8548 - val\_precision\_1: 0.8830 - val\_recall\_1: 0.8295 - val\_F1Score: 0.8552

Epoch 33/50

11210/11210 - 125s 11ms/step - loss: 0.4879 - accuracy: 0.8482 - precision\_1: 0.8754 - recall\_1: 0.8222 - F1Score: 0.8477 - val\_loss: 0.4504 - val\_accuracy: 0.8590 - val\_precision\_1: 0.8833 - val\_recall\_1: 0.8367 - val\_F1Score: 0.8592

Epoch 34/50

11210/11210 - 125s 11ms/step - loss: 0.4714 - accuracy: 0.8553 - precision\_1: 0.8801 - recall\_1: 0.8325 - F1Score: 0.8554 - val\_loss: 0.4444 - val\_accuracy: 0.8608 - val\_precision\_1: 0.8881 - val\_recall\_1: 0.8324 - val\_F1Score: 0.8592

Epoch 35/50

11210/11210 - 125s 11ms/step - loss: 3.9930 - accuracy: 0.8422 - precision\_1: 0.8729 - recall\_1: 0.8133 - F1Score: 0.8403 - val\_loss: 0.4648 - val\_accuracy: 0.8541 - val\_precision\_1: 0.8795 - val\_recall\_1: 0.8306 - val\_F1Score: 0.8542

Epoch 36/50

11210/11210 - 125s 11ms/step - loss: 0.4573 - accuracy: 0.8551 - precision\_1: 0.8802 - recall\_1: 0.8314 - F1Score: 0.8549 - val\_loss: 0.4232 - val\_accuracy: 0.8673 - val\_precision\_1: 0.8914 - val\_recall\_1: 0.8448 - val\_F1Score: 0.8673

Epoch 37/50

11210/11210 - 118s 11ms/step - loss: 0.4397 - accuracy: 0.8614 - precision\_1: 0.8851 - recall\_1: 0.8397 - F1Score: 0.8616 - val\_loss: 0.4051 - val\_accuracy: 0.8740 - val\_precision\_1: 0.8964 - val\_recall\_1: 0.8535 - val\_F1Score: 0.8742

Epoch 38/50

11210/11210 - 117s 10ms/step - loss: 0.4425 - accuracy: 0.8606 - precision\_1: 0.8842 - recall\_1: 0.8388 - F1Score: 0.8607 - val\_loss: 0.4030 - val\_accuracy: 0.8724 - val\_precision\_1: 0.8952 - val\_recall\_1: 0.8518 - val\_F1Score: 0.8728

Epoch 39/50

11210/11210 - 125s 11ms/step - loss: 0.4329 - accuracy: 0.8641 - precision\_1: 0.8864 - recall\_1: 0.8437 - F1Score: 0.8643 - val\_loss: 0.3953 - val\_accuracy: 0.8754 - val\_precision\_1: 0.8958 - val\_recall\_1: 0.8570 - val\_F1Score: 0.8758



Epoch 40/50

11210/11210 - 118s 11ms/step - loss: 0.4313 - accuracy: 0.8653 - precision\_1: 0.8874 - recall\_1: 0.8452 - F1Score: 0.8656 - val\_loss: 0.4109 - val\_accuracy: 0.8707 - val\_precision\_1: 0.8903 - val\_recall\_1: 0.8487 - val\_F1Score: 0.8688

Epoch 41/50

11210/11210 - 119s 11ms/step - loss: 0.4652 - accuracy: 0.8595 - precision\_1: 0.8833 - recall\_1: 0.8378 - F1Score: 0.8596 - val\_loss: 0.3795 - val\_accuracy: 0.8805 - val\_precision\_1: 0.9003 - val\_recall\_1: 0.8623 - val\_F1Score: 0.8808

Epoch 42/50

11210/11210 - 126s 11ms/step - loss: 0.4162 - accuracy: 0.8677 - precision\_1: 0.8890 - recall\_1: 0.8481 - F1Score: 0.8679 - val\_loss: 0.3825 - val\_accuracy: 0.8781 - val\_precision\_1: 0.8973 - val\_recall\_1: 0.8609 - val\_F1Score: 0.8786

Epoch 43/50

11210/11210 - 127s 11ms/step - loss: 0.4997 - accuracy: 0.8553 - precision\_1: 0.8813 - recall\_1: 0.8318 - F1Score: 0.8550 - val\_loss: 0.3871 - val\_accuracy: 0.8775 - val\_precision\_1: 0.8997 - val\_recall\_1: 0.8570 - val\_F1Score: 0.8777

Epoch 44/50

11210/11210 - 126s 11ms/step - loss: 0.4487 - accuracy: 0.8647 - precision\_1: 0.8877 - recall\_1: 0.8436 - F1Score: 0.8648 - val\_loss: 0.3893 - val\_accuracy: 0.8783 - val\_precision\_1: 0.8967 - val\_recall\_1: 0.8613 - val\_F1Score: 0.8785

Epoch 45/50

11210/11210 - 121s 11ms/step - loss: 0.4119 - accuracy: 0.8690 - precision\_1: 0.8906 - recall\_1: 0.8496 - F1Score: 0.8694 - val\_loss: 0.3928 - val\_accuracy: 0.8735 - val\_precision\_1: 0.8964 - val\_recall\_1: 0.8526 - val\_F1Score: 0.8738

Epoch 46/50

11210/11210 - 126s 11ms/step - loss: 0.6949 - accuracy: 0.8657 - precision\_1: 0.8885 - recall\_1: 0.8452 - F1Score: 0.8659 - val\_loss: 0.3832 - val\_accuracy: 0.8791 - val\_precision\_1: 0.8978 - val\_recall\_1: 0.8604 - val\_F1Score: 0.8786

Epoch 47/50

11210/11210 - 127s 11ms/step - loss: 0.4060 - accuracy: 0.8711 - precision\_1: 0.8922 - recall\_1: 0.8519 - F1Score: 0.8714 - val\_loss: 0.4406 - val\_accuracy: 0.8618 - val\_precision\_1: 0.8849 - val\_recall\_1: 0.8388 - val\_F1Score: 0.8611

Epoch 48/50

11210/11210 - 121s 11ms/step - loss: 0.4060 - accuracy: 0.8719 - precision\_1: 0.8924 - recall\_1: 0.8532 - F1Score: 0.8722 - val\_loss: 0.3730 - val\_accuracy: 0.8815 - val\_precision\_1: 0.9040 - val\_recall\_1: 0.8616 - val\_F1Score: 0.8821

Epoch 49/50

11210/11210 - 127s 11ms/step - loss: 0.4128 - accuracy: 0.8724 - precision\_1: 0.8933 - recall\_1: 0.8538 - F1Score: 0.8729 - val\_loss: 0.3697 - val\_accuracy: 0.8831 - val\_precision\_1: 0.9036 - val\_recall\_1: 0.8649 - val\_F1Score: 0.8837

Epoch 50/50

11210/11210 - 127s 11ms/step - loss: 0.3979 - accuracy: 0.8734 - precision\_1: 0.8939 - recall\_1: 0.8547 - F1Score: 0.8737 - val\_loss: 0.3564 - val\_accuracy: 0.8890 - val\_precision\_1: 0.9095 - val\_recall\_1: 0.8705 - val\_F1Score: 0.8894

B. CNN Dengan *Dataset Undersampling*

Epoch 1/50

4119/4119 - 69s 13ms/step - loss: 3.0845 - accuracy: 0.4339 - precision: 0.7078 - recall: 0.2361  
 - F1Score: 0.3377 - val\_loss: 1.2728 - val\_accuracy: 0.5955 - val\_precision: 0.7467 - val\_recall:  
 0.3498 - val\_F1Score: 0.4748

Epoch 2/50

4119/4119 - 58s 14ms/step - loss: 1.2466 - accuracy: 0.5856 - precision: 0.7586 - recall: 0.4317  
 - F1Score: 0.5482 - val\_loss: 1.1623 - val\_accuracy: 0.6128 - val\_precision: 0.7341 - val\_recall:  
 0.3948 - val\_F1Score: 0.5119

Epoch 3/50

4119/4119 - 58s 14ms/step - loss: 1.0643 - accuracy: 0.6442 - precision: 0.7815 - recall: 0.5162  
 - F1Score: 0.6203 - val\_loss: 1.0106 - val\_accuracy: 0.6576 - val\_precision: 0.7943 - val\_recall:  
 0.4719 - val\_F1Score: 0.5906

Epoch 4/50

4119/4119 - 50s 12ms/step - loss: 0.9591 - accuracy: 0.6784 - precision: 0.7982 - recall: 0.5651  
 - F1Score: 0.6606 - val\_loss: 1.1176 - val\_accuracy: 0.6014 - val\_precision: 0.7128 - val\_recall:  
 0.4394 - val\_F1Score: 0.5424

Epoch 5/50

4119/4119 - 49s 12ms/step - loss: 0.8995 - accuracy: 0.6985 - precision: 0.8050 - recall: 0.5993  
 - F1Score: 0.6861 - val\_loss: 0.9554 - val\_accuracy: 0.6470 - val\_precision: 0.7422 - val\_recall:  
 0.5341 - val\_F1Score: 0.6203

Epoch 6/50

4119/4119 - 50s 12ms/step - loss: 0.9037 - accuracy: 0.7086 - precision: 0.8090 - recall: 0.6178  
 - F1Score: 0.6998 - val\_loss: 0.8511 - val\_accuracy: 0.7063 - val\_precision: 0.7918 - val\_recall:  
 0.5908 - val\_F1Score: 0.6759

Epoch 7/50

4119/4119 - 50s 12ms/step - loss: 0.8042 - accuracy: 0.7267 - precision: 0.8208 - recall: 0.6422  
 - F1Score: 0.7198 - val\_loss: 0.8627 - val\_accuracy: 0.6915 - val\_precision: 0.7791 - val\_recall:  
 0.5729 - val\_F1Score: 0.6594

Epoch 8/50

4119/4119 - 50s 12ms/step - loss: 0.7677 - accuracy: 0.7385 - precision: 0.8262 - recall: 0.6611  
 - F1Score: 0.7337 - val\_loss: 0.8483 - val\_accuracy: 0.6901 - val\_precision: 0.7755 - val\_recall:  
 0.5834 - val\_F1Score: 0.6651

Epoch 9/50

4119/4119 - 51s 12ms/step - loss: 0.7339 - accuracy: 0.7488 - precision: 0.8317 - recall: 0.6765  
 - F1Score: 0.7454 - val\_loss: 0.7730 - val\_accuracy: 0.7247 - val\_precision: 0.8019 - val\_recall:  
 0.6305 - val\_F1Score: 0.7053

Epoch 10/50

4119/4119 - 50s 12ms/step - loss: 0.8313 - accuracy: 0.7527 - precision: 0.8312 - recall: 0.6836  
 - F1Score: 0.7495 - val\_loss: 0.7449 - val\_accuracy: 0.7490 - val\_precision: 0.8195 - val\_recall:  
 0.6477 - val\_F1Score: 0.7229

Epoch 11/50

4119/4119 - 57s 14ms/step - loss: 0.6838 - accuracy: 0.7664 - precision: 0.8410 - recall: 0.7006  
 - F1Score: 0.7638 - val\_loss: 0.7214 - val\_accuracy: 0.7447 - val\_precision: 0.8196 - val\_recall:  
 0.6511 - val\_F1Score: 0.7250

Epoch 12/50

4119/4119 - 57s 14ms/step - loss: 0.6820 - accuracy: 0.7710 - precision: 0.8431 - recall: 0.7084  
 - F1Score: 0.7694 - val\_loss: 0.7140 - val\_accuracy: 0.7429 - val\_precision: 0.8041 - val\_recall:  
 0.6633 - val\_F1Score: 0.7264

Epoch 13/50

4119/4119 - 57s 14ms/step - loss: 0.6584 - accuracy: 0.7773 - precision: 0.8459 - recall: 0.7180  
 - F1Score: 0.7762 - val\_loss: 0.7294 - val\_accuracy: 0.7383 - val\_precision: 0.8104 - val\_recall:  
 0.6422 - val\_F1Score: 0.7159

Epoch 14/50  
4119/4119 - 57s 14ms/step - loss: 0.6347 - accuracy: 0.7847 - precision: 0.8511 - recall: 0.7283  
- F1Score: 0.7844 - val\_loss: 0.7425 - val\_accuracy: 0.7313 - val\_precision: 0.7976 - val\_recall:  
0.6552 - val\_F1Score: 0.7188

Epoch 15/50  
4119/4119 - 57s 14ms/step - loss: 0.6130 - accuracy: 0.7907 - precision: 0.8537 - recall: 0.7361  
- F1Score: 0.7901 - val\_loss: 0.6464 - val\_accuracy: 0.7655 - val\_precision: 0.8183 - val\_recall:  
0.7031 - val\_F1Score: 0.7559

Epoch 16/50  
4119/4119 - 57s 14ms/step - loss: 0.6098 - accuracy: 0.7925 - precision: 0.8544 - recall: 0.7385  
- F1Score: 0.7917 - val\_loss: 0.6492 - val\_accuracy: 0.7756 - val\_precision: 0.8369 - val\_recall:  
0.7005 - val\_F1Score: 0.7621

Epoch 17/50  
4119/4119 - 57s 14ms/step - loss: 1.3850 - accuracy: 0.6944 - precision: 0.8147 - recall: 0.6147  
- F1Score: 0.6885 - val\_loss: 0.7370 - val\_accuracy: 0.7461 - val\_precision: 0.8174 - val\_recall:  
0.6635 - val\_F1Score: 0.7318

Epoch 18/50  
4119/4119 - 57s 14ms/step - loss: 0.6195 - accuracy: 0.7898 - precision: 0.8519 - recall: 0.7357  
- F1Score: 0.7890 - val\_loss: 0.6963 - val\_accuracy: 0.7466 - val\_precision: 0.7951 - val\_recall:  
0.6689 - val\_F1Score: 0.7261

Epoch 19/50  
4119/4119 - 50s 12ms/step - loss: 0.5856 - accuracy: 0.8001 - precision: 0.8589 - recall: 0.7503  
- F1Score: 0.8004 - val\_loss: 0.6314 - val\_accuracy: 0.7790 - val\_precision: 0.8371 - val\_recall:  
0.7031 - val\_F1Score: 0.7638

Epoch 20/50  
4119/4119 - 57s 14ms/step - loss: 0.5763 - accuracy: 0.8023 - precision: 0.8604 - recall: 0.7542  
- F1Score: 0.8033 - val\_loss: 0.6041 - val\_accuracy: 0.7913 - val\_precision: 0.8417 - val\_recall:  
0.7272 - val\_F1Score: 0.7798

Epoch 21/50  
4119/4119 - 57s 14ms/step - loss: 0.5662 - accuracy: 0.8096 - precision: 0.8653 - recall: 0.7631  
- F1Score: 0.8105 - val\_loss: 0.7450 - val\_accuracy: 0.7347 - val\_precision: 0.8002 - val\_recall:  
0.6696 - val\_F1Score: 0.7286

Epoch 22/50  
4119/4119 - 49s 12ms/step - loss: 0.5470 - accuracy: 0.8129 - precision: 0.8675 - recall: 0.7676  
- F1Score: 0.8141 - val\_loss: 0.6300 - val\_accuracy: 0.7726 - val\_precision: 0.8286 - val\_recall:  
0.7114 - val\_F1Score: 0.7651

Epoch 23/50  
4119/4119 - 49s 12ms/step - loss: 0.5377 - accuracy: 0.8166 - precision: 0.8696 - recall: 0.7724  
- F1Score: 0.8177 - val\_loss: 0.6374 - val\_accuracy: 0.7697 - val\_precision: 0.8222 - val\_recall:  
0.7048 - val\_F1Score: 0.7585

Epoch 24/50  
4119/4119 - 57s 14ms/step - loss: 1.2054 - accuracy: 0.8106 - precision: 0.8648 - recall: 0.7652  
- F1Score: 0.8111 - val\_loss: 0.6530 - val\_accuracy: 0.7679 - val\_precision: 0.8246 - val\_recall:  
0.7171 - val\_F1Score: 0.7667

Epoch 25/50  
4119/4119 - 57s 14ms/step - loss: 1.0853 - accuracy: 0.7993 - precision: 0.8607 - recall: 0.7511  
- F1Score: 0.8001 - val\_loss: 0.6420 - val\_accuracy: 0.7819 - val\_precision: 0.8369 - val\_recall:  
0.7174 - val\_F1Score: 0.7721

Epoch 26/50  
4119/4119 - 57s 14ms/step - loss: 0.5183 - accuracy: 0.8236 - precision: 0.8727 - recall: 0.7819  
- F1Score: 0.8244 - val\_loss: 0.5930 - val\_accuracy: 0.7878 - val\_precision: 0.8444 - val\_recall:  
0.7266 - val\_F1Score: 0.7806

Epoch 27/50

4119/4119 - 57s 14ms/step - loss: 0.5100 - accuracy: 0.8255 - precision: 0.8750 - recall: 0.7849  
 - F1Score: 0.8271 - val\_loss: 0.6202 - val\_accuracy: 0.7794 - val\_precision: 0.8323 - val\_recall:  
 0.7184 - val\_F1Score: 0.7707

Epoch 28/50

4119/4119 - 57s 14ms/step - loss: 0.5019 - accuracy: 0.8291 - precision: 0.8772 - recall: 0.7886  
 - F1Score: 0.8301 - val\_loss: 0.6130 - val\_accuracy: 0.7784 - val\_precision: 0.8231 - val\_recall:  
 0.7183 - val\_F1Score: 0.7667

Epoch 29/50

4119/4119 - 50s 12ms/step - loss: 0.4982 - accuracy: 0.8299 - precision: 0.8778 - recall: 0.7908  
 - F1Score: 0.8317 - val\_loss: 0.5816 - val\_accuracy: 0.8000 - val\_precision: 0.8444 - val\_recall:  
 0.7390 - val\_F1Score: 0.7878

Epoch 30/50

4119/4119 - 49s 12ms/step - loss: 1.5085 - accuracy: 0.8209 - precision: 0.8725 - recall: 0.7794  
 - F1Score: 0.8224 - val\_loss: 0.6059 - val\_accuracy: 0.7859 - val\_precision: 0.8372 - val\_recall:  
 0.7191 - val\_F1Score: 0.7732

Epoch 31/50

4119/4119 - 49s 12ms/step - loss: 0.5828 - accuracy: 0.8296 - precision: 0.8770 - recall: 0.7911  
 - F1Score: 0.8314 - val\_loss: 0.6260 - val\_accuracy: 0.7808 - val\_precision: 0.8301 - val\_recall:  
 0.7264 - val\_F1Score: 0.7744

Epoch 32/50

4119/4119 - 57s 14ms/step - loss: 0.5080 - accuracy: 0.8350 - precision: 0.8804 - recall: 0.7974  
 - F1Score: 0.8365 - val\_loss: 0.5891 - val\_accuracy: 0.7830 - val\_precision: 0.8315 - val\_recall:  
 0.7331 - val\_F1Score: 0.7789

Epoch 33/50

4119/4119 - 57s 14ms/step - loss: 0.4803 - accuracy: 0.8372 - precision: 0.8816 - recall: 0.8011  
 - F1Score: 0.8391 - val\_loss: 0.6071 - val\_accuracy: 0.7875 - val\_precision: 0.8379 - val\_recall:  
 0.7293 - val\_F1Score: 0.7794

Epoch 34/50

4119/4119 - 57s 14ms/step - loss: 0.4705 - accuracy: 0.8392 - precision: 0.8833 - recall: 0.8037  
 - F1Score: 0.8413 - val\_loss: 0.6395 - val\_accuracy: 0.7657 - val\_precision: 0.8234 - val\_recall:  
 0.7016 - val\_F1Score: 0.7572

Epoch 35/50

4119/4119 - 57s 14ms/step - loss: 0.7104 - accuracy: 0.8315 - precision: 0.8784 - recall: 0.7942  
 - F1Score: 0.8334 - val\_loss: 0.5913 - val\_accuracy: 0.7964 - val\_precision: 0.8460 - val\_recall:  
 0.7460 - val\_F1Score: 0.7925

Epoch 36/50

4119/4119 - 57s 14ms/step - loss: 0.4565 - accuracy: 0.8439 - precision: 0.8864 - recall: 0.8091  
 - F1Score: 0.8457 - val\_loss: 0.6273 - val\_accuracy: 0.7714 - val\_precision: 0.8255 - val\_recall:  
 0.7182 - val\_F1Score: 0.7677

Epoch 37/50

4119/4119 - 58s 14ms/step - loss: 0.4676 - accuracy: 0.8420 - precision: 0.8839 - recall: 0.8074  
 - F1Score: 0.8436 - val\_loss: 0.5697 - val\_accuracy: 0.8008 - val\_precision: 0.8443 - val\_recall:  
 0.7552 - val\_F1Score: 0.7969

Epoch 38/50

4119/4119 - 58s 14ms/step - loss: 0.4522 - accuracy: 0.8456 - precision: 0.8867 - recall: 0.8116  
 - F1Score: 0.8471 - val\_loss: 0.5597 - val\_accuracy: 0.8068 - val\_precision: 0.8499 - val\_recall:  
 0.7585 - val\_F1Score: 0.8012

Epoch 39/50

4119/4119 - 57s 14ms/step - loss: 0.4482 - accuracy: 0.8460 - precision: 0.8873 - recall: 0.8121  
 - F1Score: 0.8477 - val\_loss: 0.5904 - val\_accuracy: 0.7934 - val\_precision: 0.8406 - val\_recall:  
 0.7398 - val\_F1Score: 0.7866

Epoch 40/50

4119/4119 - 49s 12ms/step - loss: 0.4503 - accuracy: 0.8478 - precision: 0.8880 - recall: 0.8144  
 - F1Score: 0.8493 - val\_loss: 0.5484 - val\_accuracy: 0.8061 - val\_precision: 0.8490 - val\_recall:  
 0.7570 - val\_F1Score: 0.8000

Epoch 41/50  
4119/4119 - 57s 14ms/step - loss: 0.4453 - accuracy: 0.8475 - precision: 0.8881 - recall: 0.8146  
- F1Score: 0.8495 - val\_loss: 0.5859 - val\_accuracy: 0.7898 - val\_precision: 0.8312 - val\_recall:  
0.7398 - val\_F1Score: 0.7825

Epoch 42/50  
4119/4119 - 57s 14ms/step - loss: 0.4349 - accuracy: 0.8512 - precision: 0.8904 - recall: 0.8188  
- F1Score: 0.8528 - val\_loss: 0.6020 - val\_accuracy: 0.7903 - val\_precision: 0.8364 - val\_recall:  
0.7426 - val\_F1Score: 0.7864

Epoch 43/50  
4119/4119 - 50s 12ms/step - loss: 0.4354 - accuracy: 0.8514 - precision: 0.8906 - recall: 0.8190  
- F1Score: 0.8530 - val\_loss: 0.5935 - val\_accuracy: 0.7959 - val\_precision: 0.8386 - val\_recall:  
0.7471 - val\_F1Score: 0.7899

Epoch 44/50  
4119/4119 - 49s 12ms/step - loss: 0.4823 - accuracy: 0.8462 - precision: 0.8867 - recall: 0.8137  
- F1Score: 0.8482 - val\_loss: 0.5839 - val\_accuracy: 0.7980 - val\_precision: 0.8403 - val\_recall:  
0.7534 - val\_F1Score: 0.7941

Epoch 45/50  
4119/4119 - 57s 14ms/step - loss: 0.4222 - accuracy: 0.8550 - precision: 0.8928 - recall: 0.8242  
- F1Score: 0.8568 - val\_loss: 0.5749 - val\_accuracy: 0.7939 - val\_precision: 0.8370 - val\_recall:  
0.7477 - val\_F1Score: 0.7895

Epoch 46/50  
4119/4119 - 57s 14ms/step - loss: 0.4304 - accuracy: 0.8534 - precision: 0.8912 - recall: 0.8219  
- F1Score: 0.8548 - val\_loss: 0.5522 - val\_accuracy: 0.8088 - val\_precision: 0.8497 - val\_recall:  
0.7611 - val\_F1Score: 0.8026

Epoch 47/50  
4119/4119 - 50s 12ms/step - loss: 0.4402 - accuracy: 0.8535 - precision: 0.8908 - recall: 0.8227  
- F1Score: 0.8551 - val\_loss: 0.5253 - val\_accuracy: 0.8221 - val\_precision: 0.8608 - val\_recall:  
0.7799 - val\_F1Score: 0.8181

Epoch 48/50  
4119/4119 - 50s 12ms/step - loss: 0.4195 - accuracy: 0.8578 - precision: 0.8942 - recall: 0.8277  
- F1Score: 0.8594 - val\_loss: 0.5222 - val\_accuracy: 0.8245 - val\_precision: 0.8599 - val\_recall:  
0.7825 - val\_F1Score: 0.8191

Epoch 49/50  
4119/4119 - 57s 14ms/step - loss: 0.4177 - accuracy: 0.8564 - precision: 0.8933 - recall: 0.8255  
- F1Score: 0.8578 - val\_loss: 0.5328 - val\_accuracy: 0.8155 - val\_precision: 0.8517 - val\_recall:  
0.7726 - val\_F1Score: 0.8099

Epoch 50/50  
4119/4119 - 49s 12ms/step - loss: 0.4137 - accuracy: 0.8585 - precision: 0.8947 - recall: 0.8286  
- F1Score: 0.8601 - val\_loss: 0.5746 - val\_accuracy: 0.8023 - val\_precision: 0.8452 - val\_recall:  
0.7541 - val\_F1Score: 0.7967

C. CNN Dengan *Dataset* Oversampling

Epoch 1/50

12435/12435 - 140s 10ms/step - loss: 1.7044 - accuracy: 0.6401 - precision\_1: 0.7399 - recall\_1: 0.5156 - F1Score: 0.6000 - val\_loss: 0.7820 - val\_accuracy: 0.7482 - val\_precision\_1: 0.8117 - val\_recall\_1: 0.6802 - val\_F1Score: 0.7396

Epoch 2/50

12435/12435 - 135s 11ms/step - loss: 0.8176 - accuracy: 0.7352 - precision\_1: 0.8043 - recall\_1: 0.6657 - F1Score: 0.7278 - val\_loss: 0.6412 - val\_accuracy: 0.7955 - val\_precision\_1: 0.8547 - val\_recall\_1: 0.7286 - val\_F1Score: 0.7861

Epoch 3/50

12435/12435 - 135s 11ms/step - loss: 0.7155 - accuracy: 0.7676 - precision\_1: 0.8262 - recall\_1: 0.7118 - F1Score: 0.7642 - val\_loss: 0.5767 - val\_accuracy: 0.8127 - val\_precision\_1: 0.8608 - val\_recall\_1: 0.7657 - val\_F1Score: 0.8101

Epoch 4/50

12435/12435 - 128s 10ms/step - loss: 0.6405 - accuracy: 0.7881 - precision\_1: 0.8399 - recall\_1: 0.7396 - F1Score: 0.7862 - val\_loss: 0.5435 - val\_accuracy: 0.8219 - val\_precision\_1: 0.8582 - val\_recall\_1: 0.7855 - val\_F1Score: 0.8200

Epoch 5/50

12435/12435 - 134s 11ms/step - loss: 0.6023 - accuracy: 0.8039 - precision\_1: 0.8500 - recall\_1: 0.7603 - F1Score: 0.8022 - val\_loss: 0.4822 - val\_accuracy: 0.8432 - val\_precision\_1: 0.8767 - val\_recall\_1: 0.8118 - val\_F1Score: 0.8427

Epoch 6/50

12435/12435 - 135s 11ms/step - loss: 0.6272 - accuracy: 0.8132 - precision\_1: 0.8550 - recall\_1: 0.7732 - F1Score: 0.8116 - val\_loss: 0.4613 - val\_accuracy: 0.8505 - val\_precision\_1: 0.8845 - val\_recall\_1: 0.8166 - val\_F1Score: 0.8489

Epoch 7/50

12435/12435 - 136s 11ms/step - loss: 0.5274 - accuracy: 0.8269 - precision\_1: 0.8639 - recall\_1: 0.7915 - F1Score: 0.8258 - val\_loss: 0.4303 - val\_accuracy: 0.8601 - val\_precision\_1: 0.8880 - val\_recall\_1: 0.8346 - val\_F1Score: 0.8603

Epoch 8/50

12435/12435 - 136s 11ms/step - loss: 0.5029 - accuracy: 0.8353 - precision\_1: 0.8697 - recall\_1: 0.8033 - F1Score: 0.8349 - val\_loss: 0.4160 - val\_accuracy: 0.8667 - val\_precision\_1: 0.8949 - val\_recall\_1: 0.8391 - val\_F1Score: 0.8659

Epoch 9/50

12435/12435 - 128s 10ms/step - loss: 0.6422 - accuracy: 0.8283 - precision\_1: 0.8660 - recall\_1: 0.7942 - F1Score: 0.8274 - val\_loss: 0.4929 - val\_accuracy: 0.8343 - val\_precision\_1: 0.8669 - val\_recall\_1: 0.8086 - val\_F1Score: 0.8365

Epoch 10/50

12435/12435 - 129s 10ms/step - loss: 0.4794 - accuracy: 0.8437 - precision\_1: 0.8758 - recall\_1: 0.8139 - F1Score: 0.8434 - val\_loss: 0.4210 - val\_accuracy: 0.8694 - val\_precision\_1: 0.8947 - val\_recall\_1: 0.8451 - val\_F1Score: 0.8690

Epoch 11/50

12435/12435 - 127s 10ms/step - loss: 0.5177 - accuracy: 0.8445 - precision\_1: 0.8764 - recall\_1: 0.8157 - F1Score: 0.8442 - val\_loss: 0.4390 - val\_accuracy: 0.8551 - val\_precision\_1: 0.8870 - val\_recall\_1: 0.8238 - val\_F1Score: 0.8540

Epoch 12/50

12435/12435 - 135s 11ms/step - loss: 0.4455 - accuracy: 0.8555 - precision\_1: 0.8835 - recall\_1: 0.8302 - F1Score: 0.8558 - val\_loss: 0.3666 - val\_accuracy: 0.8831 - val\_precision\_1: 0.9053 - val\_recall\_1: 0.8623 - val\_F1Score: 0.8831

Epoch 13/50

12435/12435 - 127s 10ms/step - loss: 0.4346 - accuracy: 0.8590 - precision\_1: 0.8857 - recall\_1: 0.8350 - F1Score: 0.8594 - val\_loss: 0.3863 - val\_accuracy: 0.8749 - val\_precision\_1: 0.8954 - val\_recall\_1: 0.8584 - val\_F1Score: 0.8764

Epoch 14/50

12435/12435 - 134s 11ms/step - loss: 0.5129 - accuracy: 0.8576 - precision\_1: 0.8844 - recall\_1: 0.8334 - F1Score: 0.8578 - val\_loss: 0.4364 - val\_accuracy: 0.8579 - val\_precision\_1: 0.8900 - val\_recall\_1: 0.8263 - val\_F1Score: 0.8567

Epoch 15/50

12435/12435 - 134s 11ms/step - loss: 0.5215 - accuracy: 0.8540 - precision\_1: 0.8822 - recall\_1: 0.8288 - F1Score: 0.8538 - val\_loss: 0.3888 - val\_accuracy: 0.8735 - val\_precision\_1: 0.8988 - val\_recall\_1: 0.8525 - val\_F1Score: 0.8749

Epoch 16/50

12435/12435 - 135s 11ms/step - loss: 0.4297 - accuracy: 0.8660 - precision\_1: 0.8901 - recall\_1: 0.8444 - F1Score: 0.8664 - val\_loss: 0.3452 - val\_accuracy: 0.8903 - val\_precision\_1: 0.9118 - val\_recall\_1: 0.8695 - val\_F1Score: 0.8900

Epoch 17/50

12435/12435 - 128s 10ms/step - loss: 0.4063 - accuracy: 0.8682 - precision\_1: 0.8917 - recall\_1: 0.8473 - F1Score: 0.8688 - val\_loss: 0.3498 - val\_accuracy: 0.8888 - val\_precision\_1: 0.9077 - val\_recall\_1: 0.8705 - val\_F1Score: 0.8886

Epoch 18/50

12435/12435 - 135s 11ms/step - loss: 0.4041 - accuracy: 0.8696 - precision\_1: 0.8924 - recall\_1: 0.8494 - F1Score: 0.8702 - val\_loss: 0.3279 - val\_accuracy: 0.8957 - val\_precision\_1: 0.9121 - val\_recall\_1: 0.8814 - val\_F1Score: 0.8964

Epoch 19/50

12435/12435 - 128s 10ms/step - loss: 0.5491 - accuracy: 0.8648 - precision\_1: 0.8891 - recall\_1: 0.8437 - F1Score: 0.8654 - val\_loss: 0.3733 - val\_accuracy: 0.8824 - val\_precision\_1: 0.9076 - val\_recall\_1: 0.8602 - val\_F1Score: 0.8831

Epoch 20/50

12435/12435 - 128s 10ms/step - loss: 0.4092 - accuracy: 0.8677 - precision\_1: 0.8915 - recall\_1: 0.8468 - F1Score: 0.8683 - val\_loss: 0.3402 - val\_accuracy: 0.8907 - val\_precision\_1: 0.9083 - val\_recall\_1: 0.8756 - val\_F1Score: 0.8915

Epoch 21/50

12435/12435 - 128s 10ms/step - loss: 0.5610 - accuracy: 0.8401 - precision\_1: 0.8747 - recall\_1: 0.8080 - F1Score: 0.8379 - val\_loss: 0.3818 - val\_accuracy: 0.8788 - val\_precision\_1: 0.9018 - val\_recall\_1: 0.8581 - val\_F1Score: 0.8792

Epoch 22/50

12435/12435 - 135s 11ms/step - loss: 0.4022 - accuracy: 0.8722 - precision\_1: 0.8943 - recall\_1: 0.8525 - F1Score: 0.8727 - val\_loss: 0.3211 - val\_accuracy: 0.8985 - val\_precision\_1: 0.9157 - val\_recall\_1: 0.8841 - val\_F1Score: 0.8995

Epoch 23/50

12435/12435 - 128s 10ms/step - loss: 0.4034 - accuracy: 0.8722 - precision\_1: 0.8940 - recall\_1: 0.8530 - F1Score: 0.8728 - val\_loss: 0.3256 - val\_accuracy: 0.8963 - val\_precision\_1: 0.9144 - val\_recall\_1: 0.8808 - val\_F1Score: 0.8971

Epoch 24/50

12435/12435 - 136s 11ms/step - loss: 0.3796 - accuracy: 0.8764 - precision\_1: 0.8974 - recall\_1: 0.8581 - F1Score: 0.8771 - val\_loss: 0.3132 - val\_accuracy: 0.9015 - val\_precision\_1: 0.9186 - val\_recall\_1: 0.8858 - val\_F1Score: 0.9017

Epoch 25/50

12435/12435 - 134s 11ms/step - loss: 0.3835 - accuracy: 0.8784 - precision\_1: 0.8985 - recall\_1: 0.8608 - F1Score: 0.8790 - val\_loss: 0.3357 - val\_accuracy: 0.8942 - val\_precision\_1: 0.9112 - val\_recall\_1: 0.8791 - val\_F1Score: 0.8947

Epoch 26/50

12435/12435 - 127s 10ms/step - loss: 0.3735 - accuracy: 0.8790 - precision\_1: 0.8990 - recall\_1: 0.8614 - F1Score: 0.8796 - val\_loss: 0.3223 - val\_accuracy: 0.8975 - val\_precision\_1: 0.9147 - val\_recall\_1: 0.8828 - val\_F1Score: 0.8983

Epoch 27/50

12435/12435 - 134s 11ms/step - loss: 0.4132 - accuracy: 0.8774 - precision\_1: 0.8982 - recall\_1: 0.8591 - F1Score: 0.8781 - val\_loss: 0.3435 - val\_accuracy: 0.8923 - val\_precision\_1: 0.9107 - val\_recall\_1: 0.8767 - val\_F1Score: 0.8933

Epoch 28/50

12435/12435 - 134s 11ms/step - loss: 0.3824 - accuracy: 0.8784 - precision\_1: 0.8984 - recall\_1: 0.8608 - F1Score: 0.8790 - val\_loss: 0.3284 - val\_accuracy: 0.8963 - val\_precision\_1: 0.9160 - val\_recall\_1: 0.8784 - val\_F1Score: 0.8967

Epoch 29/50

12435/12435 - 134s 11ms/step - loss: 0.3632 - accuracy: 0.8812 - precision\_1: 0.9006 - recall\_1: 0.8645 - F1Score: 0.8820 - val\_loss: 0.3548 - val\_accuracy: 0.8873 - val\_precision\_1: 0.9033 - val\_recall\_1: 0.8736 - val\_F1Score: 0.8881

Epoch 30/50

12435/12435 - 127s 10ms/step - loss: 0.3597 - accuracy: 0.8827 - precision\_1: 0.9016 - recall\_1: 0.8663 - F1Score: 0.8835 - val\_loss: 0.4157 - val\_accuracy: 0.8669 - val\_precision\_1: 0.8886 - val\_recall\_1: 0.8484 - val\_F1Score: 0.8679

Epoch 31/50

12435/12435 - 128s 10ms/step - loss: 0.3824 - accuracy: 0.8816 - precision\_1: 0.9008 - recall\_1: 0.8651 - F1Score: 0.8823 - val\_loss: 0.2946 - val\_accuracy: 0.9066 - val\_precision\_1: 0.9221 - val\_recall\_1: 0.8935 - val\_F1Score: 0.9075

Epoch 32/50

12435/12435 - 134s 11ms/step - loss: 0.3543 - accuracy: 0.8844 - precision\_1: 0.9031 - recall\_1: 0.8685 - F1Score: 0.8853 - val\_loss: 0.3263 - val\_accuracy: 0.8987 - val\_precision\_1: 0.9163 - val\_recall\_1: 0.8827 - val\_F1Score: 0.8991

Epoch 33/50

12435/12435 - 136s 11ms/step - loss: 0.3568 - accuracy: 0.8839 - precision\_1: 0.9025 - recall\_1: 0.8676 - F1Score: 0.8845 - val\_loss: 0.3111 - val\_accuracy: 0.9014 - val\_precision\_1: 0.9170 - val\_recall\_1: 0.8880 - val\_F1Score: 0.9021

Epoch 34/50

12435/12435 - 136s 11ms/step - loss: 0.3488 - accuracy: 0.8864 - precision\_1: 0.9043 - recall\_1: 0.8708 - F1Score: 0.8871 - val\_loss: 0.3176 - val\_accuracy: 0.8983 - val\_precision\_1: 0.9137 - val\_recall\_1: 0.8851 - val\_F1Score: 0.8991

Epoch 35/50

12435/12435 - 136s 11ms/step - loss: 0.3484 - accuracy: 0.8858 - precision\_1: 0.9041 - recall\_1: 0.8703 - F1Score: 0.8867 - val\_loss: 0.2998 - val\_accuracy: 0.9050 - val\_precision\_1: 0.9193 - val\_recall\_1: 0.8930 - val\_F1Score: 0.9059

Epoch 36/50

12435/12435 - 128s 10ms/step - loss: 0.3677 - accuracy: 0.8846 - precision\_1: 0.9028 - recall\_1: 0.8688 - F1Score: 0.8852 - val\_loss: 0.3123 - val\_accuracy: 0.9018 - val\_precision\_1: 0.9171 - val\_recall\_1: 0.8871 - val\_F1Score: 0.9017

Epoch 37/50

12435/12435 - 129s 10ms/step - loss: 0.3463 - accuracy: 0.8872 - precision\_1: 0.9049 - recall\_1: 0.8716 - F1Score: 0.8878 - val\_loss: 0.3338 - val\_accuracy: 0.8938 - val\_precision\_1: 0.9079 - val\_recall\_1: 0.8820 - val\_F1Score: 0.8947

Epoch 38/50

12435/12435 - 128s 10ms/step - loss: 0.3820 - accuracy: 0.8863 - precision\_1: 0.9042 - recall\_1: 0.8713 - F1Score: 0.8872 - val\_loss: 0.3604 - val\_accuracy: 0.8825 - val\_precision\_1: 0.9032 - val\_recall\_1: 0.8627 - val\_F1Score: 0.8823

Epoch 39/50

12435/12435 - 134s 11ms/step - loss: 0.3530 - accuracy: 0.8865 - precision\_1: 0.9047 - recall\_1: 0.8710 - F1Score: 0.8874 - val\_loss: 0.4703 - val\_accuracy: 0.8586 - val\_precision\_1: 0.8799 - val\_recall\_1: 0.8406 - val\_F1Score: 0.8597

Epoch 40/50

12435/12435 - 135s 11ms/step - loss: 0.3483 - accuracy: 0.8868 - precision\_1: 0.9052 - recall\_1: 0.8712 - F1Score: 0.8877 - val\_loss: 0.3217 - val\_accuracy: 0.8978 - val\_precision\_1: 0.9153 - val\_recall\_1: 0.8825 - val\_F1Score: 0.8985



Epoch 41/50

12435/12435 - 135s 11ms/step - loss: 0.3556 - accuracy: 0.8868 - precision\_1: 0.9049 - recall\_1: 0.8714 - F1Score: 0.8877 - val\_loss: 0.2964 - val\_accuracy: 0.9063 - val\_precision\_1: 0.9220 - val\_recall\_1: 0.8928 - val\_F1Score: 0.9071

Epoch 42/50

12435/12435 - 128s 10ms/step - loss: 0.5999 - accuracy: 0.8855 - precision\_1: 0.9036 - recall\_1: 0.8703 - F1Score: 0.8864 - val\_loss: 0.3011 - val\_accuracy: 0.9048 - val\_precision\_1: 0.9211 - val\_recall\_1: 0.8917 - val\_F1Score: 0.9060

Epoch 43/50

12435/12435 - 128s 10ms/step - loss: 0.3438 - accuracy: 0.8880 - precision\_1: 0.9059 - recall\_1: 0.8730 - F1Score: 0.8890 - val\_loss: 0.3022 - val\_accuracy: 0.9042 - val\_precision\_1: 0.9185 - val\_recall\_1: 0.8921 - val\_F1Score: 0.9050

Epoch 44/50

12435/12435 - 135s 11ms/step - loss: 0.3652 - accuracy: 0.8881 - precision\_1: 0.9055 - recall\_1: 0.8733 - F1Score: 0.8889 - val\_loss: 0.3172 - val\_accuracy: 0.9012 - val\_precision\_1: 0.9163 - val\_recall\_1: 0.8884 - val\_F1Score: 0.9020

Epoch 45/50

12435/12435 - 128s 10ms/step - loss: 0.3434 - accuracy: 0.8882 - precision\_1: 0.9059 - recall\_1: 0.8732 - F1Score: 0.8891 - val\_loss: 0.3176 - val\_accuracy: 0.8996 - val\_precision\_1: 0.9159 - val\_recall\_1: 0.8860 - val\_F1Score: 0.9006

Epoch 46/50

12435/12435 - 128s 10ms/step - loss: 0.3400 - accuracy: 0.8892 - precision\_1: 0.9065 - recall\_1: 0.8744 - F1Score: 0.8900 - val\_loss: 0.3782 - val\_accuracy: 0.8779 - val\_precision\_1: 0.8971 - val\_recall\_1: 0.8620 - val\_F1Score: 0.8791

Epoch 47/50

12435/12435 - 135s 11ms/step - loss: 0.3982 - accuracy: 0.8835 - precision\_1: 0.9017 - recall\_1: 0.8680 - F1Score: 0.8843 - val\_loss: 0.3009 - val\_accuracy: 0.9045 - val\_precision\_1: 0.9196 - val\_recall\_1: 0.8918 - val\_F1Score: 0.9054

Epoch 48/50

12435/12435 - 128s 10ms/step - loss: 0.3374 - accuracy: 0.8899 - precision\_1: 0.9072 - recall\_1: 0.8753 - F1Score: 0.8908 - val\_loss: 0.3168 - val\_accuracy: 0.8984 - val\_precision\_1: 0.9145 - val\_recall\_1: 0.8846 - val\_F1Score: 0.8992

Epoch 49/50

12435/12435 - 136s 11ms/step - loss: 0.3374 - accuracy: 0.8904 - precision\_1: 0.9075 - recall\_1: 0.8759 - F1Score: 0.8912 - val\_loss: 0.3082 - val\_accuracy: 0.9087 - val\_precision\_1: 0.9234 - val\_recall\_1: 0.8957 - val\_F1Score: 0.9093

Epoch 50/50

12435/12435 - 135s 11ms/step - loss: 0.3519 - accuracy: 0.8876 - precision\_1: 0.9050 - recall\_1: 0.8725 - F1Score: 0.8883 - val\_loss: 0.3556 - val\_accuracy: 0.8883 - val\_precision\_1: 0.9060 - val\_recall\_1: 0.8735 - val\_F1Score: 0.8894

D. LSTM Dengan *Dataset Original*

Epoch 1/50

561/561 - 42s 58ms/step - loss: 0.5218 - accuracy: 0.8510 - precision: 0.8854 - recall: 0.8179 - F1Score: 0.8453 - val\_loss: 0.6999 - val\_accuracy: 0.8150 - val\_precision: 0.8341 - val\_recall: 0.7866 - val\_F1Score: 0.8043

Epoch 2/50

561/561 - 31s 56ms/step - loss: 0.2954 - accuracy: 0.9132 - precision: 0.9229 - recall: 0.9040 - F1Score: 0.9132 - val\_loss: 0.2646 - val\_accuracy: 0.9180 - val\_precision: 0.9267 - val\_recall: 0.9094 - val\_F1Score: 0.9152

Epoch 3/50

561/561 - 33s 59ms/step - loss: 0.2334 - accuracy: 0.9305 - precision: 0.9365 - recall: 0.9244 - F1Score: 0.9303 - val\_loss: 0.2336 - val\_accuracy: 0.9245 - val\_precision: 0.9283 - val\_recall: 0.9193 - val\_F1Score: 0.9223

Epoch 4/50

561/561 - 34s 60ms/step - loss: 0.2270 - accuracy: 0.9300 - precision: 0.9368 - recall: 0.9236 - F1Score: 0.9301 - val\_loss: 0.2165 - val\_accuracy: 0.9339 - val\_precision: 0.9420 - val\_recall: 0.9268 - val\_F1Score: 0.9311

Epoch 5/50

561/561 - 32s 57ms/step - loss: 0.2083 - accuracy: 0.9359 - precision: 0.9414 - recall: 0.9301 - F1Score: 0.9357 - val\_loss: 0.1979 - val\_accuracy: 0.9348 - val\_precision: 0.9406 - val\_recall: 0.9290 - val\_F1Score: 0.9327

Epoch 6/50

561/561 - 34s 61ms/step - loss: 0.1931 - accuracy: 0.9392 - precision: 0.9447 - recall: 0.9343 - F1Score: 0.9394 - val\_loss: 0.1979 - val\_accuracy: 0.9357 - val\_precision: 0.9377 - val\_recall: 0.9342 - val\_F1Score: 0.9355

Epoch 7/50

561/561 - 33s 60ms/step - loss: 0.1815 - accuracy: 0.9421 - precision: 0.9458 - recall: 0.9381 - F1Score: 0.9419 - val\_loss: 0.1844 - val\_accuracy: 0.9444 - val\_precision: 0.9467 - val\_recall: 0.9424 - val\_F1Score: 0.9441

Epoch 8/50

561/561 - 33s 58ms/step - loss: 0.1725 - accuracy: 0.9454 - precision: 0.9490 - recall: 0.9416 - F1Score: 0.9453 - val\_loss: 0.1830 - val\_accuracy: 0.9394 - val\_precision: 0.9414 - val\_recall: 0.9383 - val\_F1Score: 0.9395

Epoch 9/50

561/561 - 33s 58ms/step - loss: 0.1779 - accuracy: 0.9417 - precision: 0.9459 - recall: 0.9378 - F1Score: 0.9419 - val\_loss: 0.1856 - val\_accuracy: 0.9391 - val\_precision: 0.9424 - val\_recall: 0.9367 - val\_F1Score: 0.9389

Epoch 10/50

561/561 - 33s 60ms/step - loss: 0.1739 - accuracy: 0.9445 - precision: 0.9478 - recall: 0.9401 - F1Score: 0.9439 - val\_loss: 0.2079 - val\_accuracy: 0.9362 - val\_precision: 0.9409 - val\_recall: 0.9320 - val\_F1Score: 0.9355

Epoch 11/50

561/561 - 34s 61ms/step - loss: 0.1602 - accuracy: 0.9478 - precision: 0.9514 - recall: 0.9444 - F1Score: 0.9479 - val\_loss: 0.1716 - val\_accuracy: 0.9458 - val\_precision: 0.9493 - val\_recall: 0.9429 - val\_F1Score: 0.9452

Epoch 12/50

561/561 - 34s 60ms/step - loss: 0.1645 - accuracy: 0.9465 - precision: 0.9499 - recall: 0.9432 - F1Score: 0.9466 - val\_loss: 0.1659 - val\_accuracy: 0.9466 - val\_precision: 0.9501 - val\_recall: 0.9435 - val\_F1Score: 0.9458

Epoch 13/50

561/561 - 31s 55ms/step - loss: 0.1750 - accuracy: 0.9440 - precision: 0.9476 - recall: 0.9406 - F1Score: 0.9441 - val\_loss: 0.1939 - val\_accuracy: 0.9393 - val\_precision: 0.9424 - val\_recall: 0.9362 - val\_F1Score: 0.9385

Epoch 14/50  
561/561 - 32s 56ms/step - loss: 0.1702 - accuracy: 0.9445 - precision: 0.9477 - recall: 0.9414 - F1Score: 0.9444 - val\_loss: 0.1802 - val\_accuracy: 0.9424 - val\_precision: 0.9462 - val\_recall: 0.9388 - val\_F1Score: 0.9416

Epoch 15/50  
561/561 - 32s 57ms/step - loss: 0.1558 - accuracy: 0.9499 - precision: 0.9529 - recall: 0.9468 - F1Score: 0.9498 - val\_loss: 0.1973 - val\_accuracy: 0.9406 - val\_precision: 0.9447 - val\_recall: 0.9383 - val\_F1Score: 0.9403

Epoch 16/50  
561/561 - 32s 58ms/step - loss: 0.1557 - accuracy: 0.9492 - precision: 0.9524 - recall: 0.9460 - F1Score: 0.9492 - val\_loss: 0.1975 - val\_accuracy: 0.9383 - val\_precision: 0.9417 - val\_recall: 0.9357 - val\_F1Score: 0.9379

Epoch 17/50  
561/561 - 31s 55ms/step - loss: 0.1576 - accuracy: 0.9490 - precision: 0.9518 - recall: 0.9459 - F1Score: 0.9488 - val\_loss: 0.1894 - val\_accuracy: 0.9402 - val\_precision: 0.9436 - val\_recall: 0.9371 - val\_F1Score: 0.9395

Epoch 18/50  
561/561 - 31s 55ms/step - loss: 0.1617 - accuracy: 0.9474 - precision: 0.9508 - recall: 0.9437 - F1Score: 0.9472 - val\_loss: 0.1888 - val\_accuracy: 0.9413 - val\_precision: 0.9470 - val\_recall: 0.9367 - val\_F1Score: 0.9406

Epoch 19/50  
561/561 - 32s 58ms/step - loss: 0.1584 - accuracy: 0.9475 - precision: 0.9508 - recall: 0.9448 - F1Score: 0.9477 - val\_loss: 0.2163 - val\_accuracy: 0.9384 - val\_precision: 0.9426 - val\_recall: 0.9347 - val\_F1Score: 0.9377

Epoch 20/50  
561/561 - 32s 57ms/step - loss: 0.1536 - accuracy: 0.9497 - precision: 0.9531 - recall: 0.9468 - F1Score: 0.9499 - val\_loss: 0.1884 - val\_accuracy: 0.9403 - val\_precision: 0.9427 - val\_recall: 0.9392 - val\_F1Score: 0.9405

Epoch 21/50  
561/561 - 31s 55ms/step - loss: 0.1496 - accuracy: 0.9519 - precision: 0.9549 - recall: 0.9495 - F1Score: 0.9522 - val\_loss: 0.1912 - val\_accuracy: 0.9372 - val\_precision: 0.9410 - val\_recall: 0.9352 - val\_F1Score: 0.9370

Epoch 22/50  
561/561 - 31s 55ms/step - loss: 0.1504 - accuracy: 0.9510 - precision: 0.9535 - recall: 0.9485 - F1Score: 0.9510 - val\_loss: 0.2417 - val\_accuracy: 0.9274 - val\_precision: 0.9310 - val\_recall: 0.9239 - val\_F1Score: 0.9263

Epoch 23/50  
561/561 - 32s 58ms/step - loss: 0.1560 - accuracy: 0.9486 - precision: 0.9518 - recall: 0.9463 - F1Score: 0.9490 - val\_loss: 0.1599 - val\_accuracy: 0.9465 - val\_precision: 0.9488 - val\_recall: 0.9452 - val\_F1Score: 0.9465

Epoch 24/50  
561/561 - 32s 57ms/step - loss: 0.1382 - accuracy: 0.9548 - precision: 0.9572 - recall: 0.9529 - F1Score: 0.9550 - val\_loss: 0.1652 - val\_accuracy: 0.9453 - val\_precision: 0.9480 - val\_recall: 0.9434 - val\_F1Score: 0.9453

Epoch 25/50  
561/561 - 31s 55ms/step - loss: 0.1351 - accuracy: 0.9554 - precision: 0.9576 - recall: 0.9534 - F1Score: 0.9555 - val\_loss: 0.1633 - val\_accuracy: 0.9464 - val\_precision: 0.9485 - val\_recall: 0.9440 - val\_F1Score: 0.9459

Epoch 26/50  
561/561 - 31s 55ms/step - loss: 0.1352 - accuracy: 0.9568 - precision: 0.9592 - recall: 0.9549 - F1Score: 0.9570 - val\_loss: 0.1601 - val\_accuracy: 0.9465 - val\_precision: 0.9499 - val\_recall: 0.9449 - val\_F1Score: 0.9467

Epoch 27/50

561/561 - 32s 57ms/step - loss: 0.1396 - accuracy: 0.9546 - precision: 0.9567 - recall: 0.9518 - F1Score: 0.9542 - val\_loss: 0.1638 - val\_accuracy: 0.9456 - val\_precision: 0.9488 - val\_recall: 0.9434 - val\_F1Score: 0.9457

Epoch 28/50

561/561 - 31s 55ms/step - loss: 0.1418 - accuracy: 0.9548 - precision: 0.9563 - recall: 0.9527 - F1Score: 0.9545 - val\_loss: 0.2212 - val\_accuracy: 0.9363 - val\_precision: 0.9382 - val\_recall: 0.9351 - val\_F1Score: 0.9358

Epoch 29/50

561/561 - 33s 58ms/step - loss: 0.1286 - accuracy: 0.9587 - precision: 0.9607 - recall: 0.9568 - F1Score: 0.9588 - val\_loss: 0.1666 - val\_accuracy: 0.9508 - val\_precision: 0.9532 - val\_recall: 0.9495 - val\_F1Score: 0.9510

Epoch 30/50

561/561 - 33s 58ms/step - loss: 0.1293 - accuracy: 0.9589 - precision: 0.9606 - recall: 0.9573 - F1Score: 0.9589 - val\_loss: 0.1632 - val\_accuracy: 0.9515 - val\_precision: 0.9529 - val\_recall: 0.9508 - val\_F1Score: 0.9516

Epoch 31/50

561/561 - 32s 57ms/step - loss: 0.1253 - accuracy: 0.9591 - precision: 0.9611 - recall: 0.9577 - F1Score: 0.9594 - val\_loss: 0.1595 - val\_accuracy: 0.9486 - val\_precision: 0.9518 - val\_recall: 0.9455 - val\_F1Score: 0.9481

Epoch 32/50

561/561 - 32s 57ms/step - loss: 0.1191 - accuracy: 0.9616 - precision: 0.9631 - recall: 0.9599 - F1Score: 0.9615 - val\_loss: 0.1511 - val\_accuracy: 0.9515 - val\_precision: 0.9537 - val\_recall: 0.9500 - val\_F1Score: 0.9515

Epoch 33/50

561/561 - 32s 57ms/step - loss: 0.1253 - accuracy: 0.9594 - precision: 0.9608 - recall: 0.9575 - F1Score: 0.9591 - val\_loss: 0.1642 - val\_accuracy: 0.9487 - val\_precision: 0.9507 - val\_recall: 0.9478 - val\_F1Score: 0.9491

Epoch 34/50

561/561 - 32s 57ms/step - loss: 0.1288 - accuracy: 0.9568 - precision: 0.9581 - recall: 0.9553 - F1Score: 0.9566 - val\_loss: 0.1740 - val\_accuracy: 0.9443 - val\_precision: 0.9475 - val\_recall: 0.9430 - val\_F1Score: 0.9448

Epoch 35/50

561/561 - 33s 58ms/step - loss: 0.1222 - accuracy: 0.9593 - precision: 0.9613 - recall: 0.9580 - F1Score: 0.9596 - val\_loss: 0.1419 - val\_accuracy: 0.9547 - val\_precision: 0.9569 - val\_recall: 0.9536 - val\_F1Score: 0.9549

Epoch 36/50

561/561 - 31s 55ms/step - loss: 0.1075 - accuracy: 0.9643 - precision: 0.9653 - recall: 0.9631 - F1Score: 0.9642 - val\_loss: 0.1732 - val\_accuracy: 0.9446 - val\_precision: 0.9469 - val\_recall: 0.9433 - val\_F1Score: 0.9446

Epoch 37/50

561/561 - 31s 55ms/step - loss: 0.1124 - accuracy: 0.9626 - precision: 0.9639 - recall: 0.9616 - F1Score: 0.9626 - val\_loss: 0.1590 - val\_accuracy: 0.9522 - val\_precision: 0.9541 - val\_recall: 0.9509 - val\_F1Score: 0.9521

Epoch 38/50

561/561 - 31s 55ms/step - loss: 0.1050 - accuracy: 0.9638 - precision: 0.9649 - recall: 0.9627 - F1Score: 0.9638 - val\_loss: 0.1506 - val\_accuracy: 0.9541 - val\_precision: 0.9564 - val\_recall: 0.9524 - val\_F1Score: 0.9538

Epoch 39/50

561/561 - 32s 57ms/step - loss: 0.1085 - accuracy: 0.9646 - precision: 0.9658 - recall: 0.9635 - F1Score: 0.9646 - val\_loss: 0.1659 - val\_accuracy: 0.9448 - val\_precision: 0.9470 - val\_recall: 0.9431 - val\_F1Score: 0.9446

Epoch 40/50

561/561 - 31s 55ms/step - loss: 0.1161 - accuracy: 0.9609 - precision: 0.9622 - recall: 0.9596 - F1Score: 0.9609 - val\_loss: 0.1684 - val\_accuracy: 0.9484 - val\_precision: 0.9501 - val\_recall: 0.9465 - val\_F1Score: 0.9479

Epoch 41/50  
561/561 - 32s 57ms/step - loss: 0.1122 - accuracy: 0.9629 - precision: 0.9646 - recall: 0.9616 - F1Score: 0.9631 - val\_loss: 0.1746 - val\_accuracy: 0.9447 - val\_precision: 0.9463 - val\_recall: 0.9437 - val\_F1Score: 0.9447

Epoch 42/50  
561/561 - 31s 55ms/step - loss: 0.1205 - accuracy: 0.9602 - precision: 0.9617 - recall: 0.9588 - F1Score: 0.9603 - val\_loss: 0.1632 - val\_accuracy: 0.9485 - val\_precision: 0.9509 - val\_recall: 0.9473 - val\_F1Score: 0.9488

Epoch 43/50  
561/561 - 31s 55ms/step - loss: 0.1186 - accuracy: 0.9605 - precision: 0.9621 - recall: 0.9591 - F1Score: 0.9606 - val\_loss: 0.1656 - val\_accuracy: 0.9485 - val\_precision: 0.9505 - val\_recall: 0.9475 - val\_F1Score: 0.9484

Epoch 44/50  
561/561 - 32s 57ms/step - loss: 0.1079 - accuracy: 0.9636 - precision: 0.9648 - recall: 0.9624 - F1Score: 0.9636 - val\_loss: 0.1959 - val\_accuracy: 0.9427 - val\_precision: 0.9436 - val\_recall: 0.9420 - val\_F1Score: 0.9426

Epoch 45/50  
561/561 - 31s 55ms/step - loss: 0.1300 - accuracy: 0.9555 - precision: 0.9577 - recall: 0.9538 - F1Score: 0.9557 - val\_loss: 0.1930 - val\_accuracy: 0.9380 - val\_precision: 0.9402 - val\_recall: 0.9356 - val\_F1Score: 0.9372

Epoch 46/50  
561/561 - 31s 55ms/step - loss: 0.1127 - accuracy: 0.9599 - precision: 0.9618 - recall: 0.9586 - F1Score: 0.9602 - val\_loss: 0.1903 - val\_accuracy: 0.9446 - val\_precision: 0.9457 - val\_recall: 0.9435 - val\_F1Score: 0.9441

Epoch 47/50  
561/561 - 32s 57ms/step - loss: 0.1095 - accuracy: 0.9638 - precision: 0.9653 - recall: 0.9622 - F1Score: 0.9638 - val\_loss: 0.1550 - val\_accuracy: 0.9500 - val\_precision: 0.9524 - val\_recall: 0.9485 - val\_F1Score: 0.9500

Epoch 48/50  
561/561 - 32s 57ms/step - loss: 0.1156 - accuracy: 0.9600 - precision: 0.9613 - recall: 0.9589 - F1Score: 0.9601 - val\_loss: 0.1517 - val\_accuracy: 0.9485 - val\_precision: 0.9500 - val\_recall: 0.9475 - val\_F1Score: 0.9484

Epoch 49/50  
561/561 - 32s 57ms/step - loss: 0.1147 - accuracy: 0.9617 - precision: 0.9633 - recall: 0.9604 - F1Score: 0.9618 - val\_loss: 0.1737 - val\_accuracy: 0.9454 - val\_precision: 0.9466 - val\_recall: 0.9450 - val\_F1Score: 0.9456

Epoch 50/50  
561/561 - 32s 57ms/step - loss: 0.1159 - accuracy: 0.9608 - precision: 0.9621 - recall: 0.9593 - F1Score: 0.9608 - val\_loss: 0.2207 - val\_accuracy: 0.9384 - val\_precision: 0.9411 - val\_recall: 0.9360 - val\_F1Score: 0.9375

E. LSTM Dengan *Dataset Undersampling*

Epoch 1/50

206/206 - 19s 74ms/step - loss: 1.5057 - accuracy: 0.4657 - precision: 0.8666 - recall: 0.5734 - F1Score: 0.3499 - val\_loss: 1.4894 - val\_accuracy: 0.4501 - val\_precision: 0.7517 - val\_recall: 0.2574 - val\_F1Score: 0.2985

Epoch 2/50

206/206 - 16s 77ms/step - loss: 1.2611 - accuracy: 0.5388 - precision: 0.7019 - recall: 0.3471 - F1Score: 0.4598 - val\_loss: 1.2081 - val\_accuracy: 0.4633 - val\_precision: 0.9142 - val\_recall: 0.3460 - val\_F1Score: 0.3651

Epoch 3/50

206/206 - 14s 69ms/step - loss: 1.1029 - accuracy: 0.5903 - precision: 0.7363 - recall: 0.4244 - F1Score: 0.5354 - val\_loss: 0.6574 - val\_accuracy: 0.8366 - val\_precision: 0.9403 - val\_recall: 0.6579 - val\_F1Score: 0.7367

Epoch 4/50

206/206 - 14s 66ms/step - loss: 0.8874 - accuracy: 0.6614 - precision: 0.7793 - recall: 0.5307 - F1Score: 0.6299 - val\_loss: 0.7166 - val\_accuracy: 0.7205 - val\_precision: 0.8109 - val\_recall: 0.4762 - val\_F1Score: 0.5455

Epoch 5/50

206/206 - 15s 73ms/step - loss: 0.8153 - accuracy: 0.6868 - precision: 0.7918 - recall: 0.5699 - F1Score: 0.6618 - val\_loss: 0.5780 - val\_accuracy: 0.8250 - val\_precision: 0.9155 - val\_recall: 0.6385 - val\_F1Score: 0.7158

Epoch 6/50

206/206 - 15s 71ms/step - loss: 0.7688 - accuracy: 0.7012 - precision: 0.7969 - recall: 0.5945 - F1Score: 0.6800 - val\_loss: 0.5441 - val\_accuracy: 0.8712 - val\_precision: 0.9242 - val\_recall: 0.7731 - val\_F1Score: 0.8222

Epoch 7/50

206/206 - 15s 73ms/step - loss: 0.7606 - accuracy: 0.7060 - precision: 0.8028 - recall: 0.6060 - F1Score: 0.6898 - val\_loss: 0.9073 - val\_accuracy: 0.4948 - val\_precision: 0.5247 - val\_recall: 0.4102 - val\_F1Score: 0.4245

Epoch 8/50

206/206 - 15s 73ms/step - loss: 0.6971 - accuracy: 0.7278 - precision: 0.8124 - recall: 0.6342 - F1Score: 0.7115 - val\_loss: 0.5894 - val\_accuracy: 0.8343 - val\_precision: 0.9005 - val\_recall: 0.6995 - val\_F1Score: 0.7671

Epoch 9/50

206/206 - 15s 73ms/step - loss: 0.6539 - accuracy: 0.7409 - precision: 0.8176 - recall: 0.6606 - F1Score: 0.7299 - val\_loss: 0.9293 - val\_accuracy: 0.5562 - val\_precision: 0.5725 - val\_recall: 0.4283 - val\_F1Score: 0.4594

Epoch 10/50

206/206 - 15s 73ms/step - loss: 0.6360 - accuracy: 0.7508 - precision: 0.8212 - recall: 0.6750 - F1Score: 0.7404 - val\_loss: 0.7606 - val\_accuracy: 0.6380 - val\_precision: 0.6780 - val\_recall: 0.5115 - val\_F1Score: 0.5493

Epoch 11/50

206/206 - 15s 73ms/step - loss: 0.6236 - accuracy: 0.7579 - precision: 0.8270 - recall: 0.6855 - F1Score: 0.7489 - val\_loss: 0.7824 - val\_accuracy: 0.6351 - val\_precision: 0.6798 - val\_recall: 0.5086 - val\_F1Score: 0.5457

Epoch 12/50

206/206 - 14s 66ms/step - loss: 0.6176 - accuracy: 0.7545 - precision: 0.8244 - recall: 0.6847 - F1Score: 0.7474 - val\_loss: 1.1734 - val\_accuracy: 0.5177 - val\_precision: 0.5293 - val\_recall: 0.4599 - val\_F1Score: 0.4722

Epoch 13/50

206/206 - 14s 66ms/step - loss: 0.6122 - accuracy: 0.7595 - precision: 0.8272 - recall: 0.6889 - F1Score: 0.7510 - val\_loss: 0.9678 - val\_accuracy: 0.5045 - val\_precision: 0.5764 - val\_recall: 0.4152 - val\_F1Score: 0.4474

Epoch 14/50

206/206 - 14s 68ms/step - loss: 0.5916 - accuracy: 0.7684 - precision: 0.8318 - recall: 0.7035 - F1Score: 0.7617 - val\_loss: 1.1372 - val\_accuracy: 0.4912 - val\_precision: 0.5132 - val\_recall: 0.4299 - val\_F1Score: 0.4427

Epoch 15/50

206/206 - 15s 73ms/step - loss: 0.6118 - accuracy: 0.7622 - precision: 0.8275 - recall: 0.6968 - F1Score: 0.7557 - val\_loss: 0.7272 - val\_accuracy: 0.7127 - val\_precision: 0.7637 - val\_recall: 0.5962 - val\_F1Score: 0.6467

Epoch 16/50

206/206 - 14s 66ms/step - loss: 0.5737 - accuracy: 0.7731 - precision: 0.8372 - recall: 0.7078 - F1Score: 0.7666 - val\_loss: 1.3181 - val\_accuracy: 0.4545 - val\_precision: 0.4955 - val\_recall: 0.4060 - val\_F1Score: 0.4264

Epoch 17/50

206/206 - 14s 66ms/step - loss: 0.5525 - accuracy: 0.7829 - precision: 0.8400 - recall: 0.7257 - F1Score: 0.7782 - val\_loss: 1.1157 - val\_accuracy: 0.5141 - val\_precision: 0.5176 - val\_recall: 0.4623 - val\_F1Score: 0.4782

Epoch 18/50

206/206 - 15s 73ms/step - loss: 0.5285 - accuracy: 0.7894 - precision: 0.8428 - recall: 0.7336 - F1Score: 0.7839 - val\_loss: 1.4378 - val\_accuracy: 0.4680 - val\_precision: 0.4883 - val\_recall: 0.4294 - val\_F1Score: 0.4449

Epoch 19/50

206/206 - 15s 73ms/step - loss: 0.5231 - accuracy: 0.7969 - precision: 0.8448 - recall: 0.7473 - F1Score: 0.7927 - val\_loss: 1.4199 - val\_accuracy: 0.4827 - val\_precision: 0.5036 - val\_recall: 0.4374 - val\_F1Score: 0.4503

Epoch 20/50

206/206 - 14s 66ms/step - loss: 0.5191 - accuracy: 0.8001 - precision: 0.8456 - recall: 0.7484 - F1Score: 0.7936 - val\_loss: 0.7748 - val\_accuracy: 0.6979 - val\_precision: 0.7366 - val\_recall: 0.5881 - val\_F1Score: 0.6317

Epoch 21/50

206/206 - 14s 69ms/step - loss: 0.5114 - accuracy: 0.8007 - precision: 0.8475 - recall: 0.7514 - F1Score: 0.7961 - val\_loss: 0.8567 - val\_accuracy: 0.7096 - val\_precision: 0.7362 - val\_recall: 0.6283 - val\_F1Score: 0.6663

Epoch 22/50

206/206 - 15s 73ms/step - loss: 0.4859 - accuracy: 0.8117 - precision: 0.8558 - recall: 0.7663 - F1Score: 0.8082 - val\_loss: 0.8020 - val\_accuracy: 0.7159 - val\_precision: 0.7642 - val\_recall: 0.5793 - val\_F1Score: 0.6407

Epoch 23/50

206/206 - 15s 74ms/step - loss: 0.5089 - accuracy: 0.8060 - precision: 0.8544 - recall: 0.7551 - F1Score: 0.8009 - val\_loss: 0.8345 - val\_accuracy: 0.6678 - val\_precision: 0.6910 - val\_recall: 0.5994 - val\_F1Score: 0.6287

Epoch 24/50

206/206 - 14s 66ms/step - loss: 0.5031 - accuracy: 0.8095 - precision: 0.8528 - recall: 0.7654 - F1Score: 0.8062 - val\_loss: 0.6584 - val\_accuracy: 0.7728 - val\_precision: 0.7939 - val\_recall: 0.7172 - val\_F1Score: 0.7483

Epoch 25/50

206/206 - 14s 66ms/step - loss: 0.4820 - accuracy: 0.8142 - precision: 0.8571 - recall: 0.7737 - F1Score: 0.8128 - val\_loss: 1.6700 - val\_accuracy: 0.4511 - val\_precision: 0.4544 - val\_recall: 0.4315 - val\_F1Score: 0.4365

Epoch 26/50

206/206 - 14s 66ms/step - loss: 0.4517 - accuracy: 0.8285 - precision: 0.8654 - recall: 0.7849 - F1Score: 0.8229 - val\_loss: 1.1926 - val\_accuracy: 0.5921 - val\_precision: 0.5986 - val\_recall: 0.5459 - val\_F1Score: 0.5622

Epoch 27/50

206/206 - 15s 73ms/step - loss: 0.4622 - accuracy: 0.8218 - precision: 0.8644 - recall: 0.7807 - F1Score: 0.8200 - val\_loss: 1.4100 - val\_accuracy: 0.5138 - val\_precision: 0.5188 - val\_recall: 0.4829 - val\_F1Score: 0.4946

Epoch 28/50

206/206 - 14s 67ms/step - loss: 0.4582 - accuracy: 0.8237 - precision: 0.8648 - recall: 0.7844 - F1Score: 0.8222 - val\_loss: 1.6064 - val\_accuracy: 0.5240 - val\_precision: 0.5277 - val\_recall: 0.4957 - val\_F1Score: 0.5043

Epoch 29/50

206/206 - 15s 73ms/step - loss: 0.4346 - accuracy: 0.8307 - precision: 0.8707 - recall: 0.7939 - F1Score: 0.8300 - val\_loss: 1.0291 - val\_accuracy: 0.6119 - val\_precision: 0.6318 - val\_recall: 0.5684 - val\_F1Score: 0.5905

Epoch 30/50

206/206 - 14s 67ms/step - loss: 0.4214 - accuracy: 0.8373 - precision: 0.8740 - recall: 0.8032 - F1Score: 0.8368 - val\_loss: 0.9768 - val\_accuracy: 0.6730 - val\_precision: 0.6891 - val\_recall: 0.6340 - val\_F1Score: 0.6522

Epoch 31/50

206/206 - 14s 67ms/step - loss: 0.4426 - accuracy: 0.8282 - precision: 0.8663 - recall: 0.7900 - F1Score: 0.8259 - val\_loss: 1.4947 - val\_accuracy: 0.5390 - val\_precision: 0.5428 - val\_recall: 0.5139 - val\_F1Score: 0.5217

Epoch 32/50

206/206 - 14s 66ms/step - loss: 0.4248 - accuracy: 0.8380 - precision: 0.8737 - recall: 0.8016 - F1Score: 0.8356 - val\_loss: 1.1114 - val\_accuracy: 0.6403 - val\_precision: 0.6536 - val\_recall: 0.6099 - val\_F1Score: 0.6262

Epoch 33/50

206/206 - 15s 73ms/step - loss: 0.5009 - accuracy: 0.8107 - precision: 0.8554 - recall: 0.7662 - F1Score: 0.8077 - val\_loss: 1.1888 - val\_accuracy: 0.6126 - val\_precision: 0.6243 - val\_recall: 0.5702 - val\_F1Score: 0.5906

Epoch 34/50

206/206 - 14s 66ms/step - loss: 0.4351 - accuracy: 0.8299 - precision: 0.8679 - recall: 0.7943 - F1Score: 0.8290 - val\_loss: 0.9417 - val\_accuracy: 0.6888 - val\_precision: 0.7006 - val\_recall: 0.6642 - val\_F1Score: 0.6786

Epoch 35/50

206/206 - 15s 73ms/step - loss: 0.4052 - accuracy: 0.8422 - precision: 0.8763 - recall: 0.8095 - F1Score: 0.8412 - val\_loss: 0.9517 - val\_accuracy: 0.6684 - val\_precision: 0.6865 - val\_recall: 0.6209 - val\_F1Score: 0.6454

Epoch 36/50

206/206 - 15s 73ms/step - loss: 0.3967 - accuracy: 0.8479 - precision: 0.8811 - recall: 0.8160 - F1Score: 0.8470 - val\_loss: 1.1447 - val\_accuracy: 0.5857 - val\_precision: 0.6008 - val\_recall: 0.5537 - val\_F1Score: 0.5704

Epoch 37/50

206/206 - 15s 73ms/step - loss: 0.4057 - accuracy: 0.8409 - precision: 0.8794 - recall: 0.8086 - F1Score: 0.8422 - val\_loss: 2.1775 - val\_accuracy: 0.4331 - val\_precision: 0.4344 - val\_recall: 0.4240 - val\_F1Score: 0.4272

Epoch 38/50

206/206 - 14s 67ms/step - loss: 0.3779 - accuracy: 0.8576 - precision: 0.8850 - recall: 0.8299 - F1Score: 0.8563 - val\_loss: 1.4504 - val\_accuracy: 0.5465 - val\_precision: 0.5532 - val\_recall: 0.5115 - val\_F1Score: 0.5273

Epoch 39/50

206/206 - 14s 67ms/step - loss: 0.3591 - accuracy: 0.8604 - precision: 0.8889 - recall: 0.8308 - F1Score: 0.8587 - val\_loss: 1.3281 - val\_accuracy: 0.5761 - val\_precision: 0.5831 - val\_recall: 0.5471 - val\_F1Score: 0.5583

Epoch 40/50

206/206 - 14s 66ms/step - loss: 0.3755 - accuracy: 0.8537 - precision: 0.8801 - recall: 0.8281 - F1Score: 0.8530 - val\_loss: 1.2356 - val\_accuracy: 0.5029 - val\_precision: 0.5071 - val\_recall: 0.4834 - val\_F1Score: 0.4893



Epoch 41/50  
206/206 - 14s 67ms/step - loss: 0.3821 - accuracy: 0.8542 - precision: 0.8856 - recall: 0.8253 - F1Score: 0.8541 - val\_loss: 0.9757 - val\_accuracy: 0.6886 - val\_precision: 0.7012 - val\_recall: 0.6691 - val\_F1Score: 0.6805

Epoch 42/50  
206/206 - 14s 66ms/step - loss: 0.3672 - accuracy: 0.8588 - precision: 0.8893 - recall: 0.8334 - F1Score: 0.8602 - val\_loss: 1.1368 - val\_accuracy: 0.6177 - val\_precision: 0.6338 - val\_recall: 0.5403 - val\_F1Score: 0.5677

Epoch 43/50  
206/206 - 15s 73ms/step - loss: 0.3632 - accuracy: 0.8617 - precision: 0.8905 - recall: 0.8346 - F1Score: 0.8613 - val\_loss: 1.2575 - val\_accuracy: 0.5427 - val\_precision: 0.5514 - val\_recall: 0.5101 - val\_F1Score: 0.5223

Epoch 44/50  
206/206 - 15s 74ms/step - loss: 0.3411 - accuracy: 0.8706 - precision: 0.8952 - recall: 0.8459 - F1Score: 0.8698 - val\_loss: 1.1133 - val\_accuracy: 0.6055 - val\_precision: 0.6238 - val\_recall: 0.5638 - val\_F1Score: 0.5833

Epoch 45/50  
206/206 - 15s 73ms/step - loss: 0.3452 - accuracy: 0.8671 - precision: 0.8944 - recall: 0.8434 - F1Score: 0.8677 - val\_loss: 1.1466 - val\_accuracy: 0.5657 - val\_precision: 0.5825 - val\_recall: 0.5099 - val\_F1Score: 0.5305

Epoch 46/50  
206/206 - 14s 66ms/step - loss: 0.3372 - accuracy: 0.8704 - precision: 0.8948 - recall: 0.8473 - F1Score: 0.8702 - val\_loss: 1.8481 - val\_accuracy: 0.4400 - val\_precision: 0.4422 - val\_recall: 0.4270 - val\_F1Score: 0.4309

Epoch 47/50  
206/206 - 14s 66ms/step - loss: 0.3147 - accuracy: 0.8801 - precision: 0.9022 - recall: 0.8578 - F1Score: 0.8792 - val\_loss: 0.8623 - val\_accuracy: 0.7810 - val\_precision: 0.7910 - val\_recall: 0.7696 - val\_F1Score: 0.7776

Epoch 48/50  
206/206 - 15s 73ms/step - loss: 0.3177 - accuracy: 0.8825 - precision: 0.9038 - recall: 0.8620 - F1Score: 0.8821 - val\_loss: 1.0927 - val\_accuracy: 0.6338 - val\_precision: 0.6474 - val\_recall: 0.6061 - val\_F1Score: 0.6210

Epoch 49/50  
206/206 - 15s 73ms/step - loss: 0.2809 - accuracy: 0.8914 - precision: 0.9130 - recall: 0.8737 - F1Score: 0.8927 - val\_loss: 1.3408 - val\_accuracy: 0.5799 - val\_precision: 0.5860 - val\_recall: 0.5471 - val\_F1Score: 0.5592

Epoch 50/50  
206/206 - 15s 73ms/step - loss: 0.2669 - accuracy: 0.8975 - precision: 0.9158 - recall: 0.8816 - F1Score: 0.8982 - val\_loss: 1.4058 - val\_accuracy: 0.5772 - val\_precision: 0.5950 - val\_recall: 0.5472 - val\_F1Score: 0.5628

F. LSTM Dengan *Dataset Oversampling*

Epoch 1/50  
622/622 - 47s 59ms/step - loss: 1.1484 - accuracy: 0.6313 - precision: 0.7423 - recall: 0.5144 - F1Score: 0.5993 - val\_loss: 0.6118 - val\_accuracy: 0.8583 - val\_precision: 0.8993 - val\_recall: 0.8047 - val\_F1Score: 0.8219

Epoch 2/50  
622/622 - 33s 53ms/step - loss: 0.7959 - accuracy: 0.7357 - precision: 0.7918 - recall: 0.6758 - F1Score: 0.7285 - val\_loss: 1.1031 - val\_accuracy: 0.4689 - val\_precision: 0.4745 - val\_recall: 0.3704 - val\_F1Score: 0.3936

Epoch 3/50  
622/622 - 34s 55ms/step - loss: 0.7711 - accuracy: 0.7430 - precision: 0.8009 - recall: 0.6839 - F1Score: 0.7370 - val\_loss: 0.9055 - val\_accuracy: 0.4951 - val\_precision: 0.5621 - val\_recall: 0.3910 - val\_F1Score: 0.4216

Epoch 4/50  
622/622 - 36s 58ms/step - loss: 0.6743 - accuracy: 0.7712 - precision: 0.8144 - recall: 0.7254 - F1Score: 0.7669 - val\_loss: 1.0988 - val\_accuracy: 0.4820 - val\_precision: 0.5040 - val\_recall: 0.4080 - val\_F1Score: 0.4193

Epoch 5/50  
622/622 - 35s 57ms/step - loss: 0.6322 - accuracy: 0.7816 - precision: 0.8208 - recall: 0.7414 - F1Score: 0.7787 - val\_loss: 1.1703 - val\_accuracy: 0.4306 - val\_precision: 0.4481 - val\_recall: 0.3601 - val\_F1Score: 0.3869

Epoch 6/50  
622/622 - 36s 57ms/step - loss: 0.6133 - accuracy: 0.7885 - precision: 0.8269 - recall: 0.7492 - F1Score: 0.7857 - val\_loss: 1.3698 - val\_accuracy: 0.4490 - val\_precision: 0.4431 - val\_recall: 0.3994 - val\_F1Score: 0.4149

Epoch 7/50  
622/622 - 36s 58ms/step - loss: 0.6184 - accuracy: 0.7871 - precision: 0.8235 - recall: 0.7468 - F1Score: 0.7828 - val\_loss: 1.5934 - val\_accuracy: 0.4271 - val\_precision: 0.4355 - val\_recall: 0.3969 - val\_F1Score: 0.4076

Epoch 8/50  
622/622 - 35s 57ms/step - loss: 0.6276 - accuracy: 0.7828 - precision: 0.8226 - recall: 0.7405 - F1Score: 0.7790 - val\_loss: 1.0231 - val\_accuracy: 0.5484 - val\_precision: 0.5933 - val\_recall: 0.4504 - val\_F1Score: 0.4738

Epoch 9/50  
622/622 - 34s 55ms/step - loss: 0.5819 - accuracy: 0.7974 - precision: 0.8333 - recall: 0.7611 - F1Score: 0.7952 - val\_loss: 0.8416 - val\_accuracy: 0.6476 - val\_precision: 0.6767 - val\_recall: 0.5402 - val\_F1Score: 0.5780

Epoch 10/50  
622/622 - 34s 55ms/step - loss: 0.5663 - accuracy: 0.8004 - precision: 0.8343 - recall: 0.7653 - F1Score: 0.7980 - val\_loss: 1.0450 - val\_accuracy: 0.5441 - val\_precision: 0.5894 - val\_recall: 0.4391 - val\_F1Score: 0.4599

Epoch 11/50  
622/622 - 36s 57ms/step - loss: 0.5613 - accuracy: 0.8025 - precision: 0.8357 - recall: 0.7673 - F1Score: 0.7998 - val\_loss: 1.0906 - val\_accuracy: 0.5556 - val\_precision: 0.5767 - val\_recall: 0.4588 - val\_F1Score: 0.4827

Epoch 12/50  
622/622 - 34s 55ms/step - loss: 0.5521 - accuracy: 0.8058 - precision: 0.8381 - recall: 0.7723 - F1Score: 0.8036 - val\_loss: 1.1581 - val\_accuracy: 0.4749 - val\_precision: 0.4956 - val\_recall: 0.4231 - val\_F1Score: 0.4395

Epoch 13/50  
622/622 - 35s 57ms/step - loss: 0.5266 - accuracy: 0.8122 - precision: 0.8418 - recall: 0.7801 - F1Score: 0.8095 - val\_loss: 1.3146 - val\_accuracy: 0.5302 - val\_precision: 0.5519 - val\_recall: 0.4724 - val\_F1Score: 0.4909

Epoch 14/50  
622/622 - 34s 55ms/step - loss: 0.5268 - accuracy: 0.8137 - precision: 0.8449 - recall: 0.7809 - F1Score: 0.8113 - val\_loss: 0.6707 - val\_accuracy: 0.7338 - val\_precision: 0.7950 - val\_recall: 0.6362 - val\_F1Score: 0.6812

Epoch 15/50  
622/622 - 35s 57ms/step - loss: 0.5199 - accuracy: 0.8170 - precision: 0.8461 - recall: 0.7864 - F1Score: 0.8148 - val\_loss: 1.6553 - val\_accuracy: 0.4485 - val\_precision: 0.4548 - val\_recall: 0.4228 - val\_F1Score: 0.4331

Epoch 16/50  
622/622 - 35s 57ms/step - loss: 0.5171 - accuracy: 0.8151 - precision: 0.8470 - recall: 0.7832 - F1Score: 0.8137 - val\_loss: 0.7524 - val\_accuracy: 0.7416 - val\_precision: 0.7998 - val\_recall: 0.6381 - val\_F1Score: 0.6892

Epoch 17/50  
622/622 - 35s 57ms/step - loss: 0.4897 - accuracy: 0.8238 - precision: 0.8531 - recall: 0.7952 - F1Score: 0.8228 - val\_loss: 1.3587 - val\_accuracy: 0.5220 - val\_precision: 0.5396 - val\_recall: 0.4657 - val\_F1Score: 0.4818

Epoch 18/50  
622/622 - 34s 55ms/step - loss: 0.4853 - accuracy: 0.8256 - precision: 0.8542 - recall: 0.7960 - F1Score: 0.8238 - val\_loss: 1.2011 - val\_accuracy: 0.5515 - val\_precision: 0.5934 - val\_recall: 0.5038 - val\_F1Score: 0.5221

Epoch 19/50  
622/622 - 38s 61ms/step - loss: 0.4929 - accuracy: 0.8230 - precision: 0.8533 - recall: 0.7912 - F1Score: 0.8208 - val\_loss: 1.4516 - val\_accuracy: 0.5349 - val\_precision: 0.5457 - val\_recall: 0.5011 - val\_F1Score: 0.5112

Epoch 20/50  
622/622 - 35s 57ms/step - loss: 0.4626 - accuracy: 0.8325 - precision: 0.8576 - recall: 0.8045 - F1Score: 0.8300 - val\_loss: 1.0517 - val\_accuracy: 0.5944 - val\_precision: 0.6208 - val\_recall: 0.5086 - val\_F1Score: 0.5311

Epoch 21/50  
622/622 - 35s 57ms/step - loss: 0.4543 - accuracy: 0.8347 - precision: 0.8606 - recall: 0.8070 - F1Score: 0.8327 - val\_loss: 1.7549 - val\_accuracy: 0.4722 - val\_precision: 0.4760 - val\_recall: 0.4532 - val\_F1Score: 0.4585

Epoch 22/50  
622/622 - 35s 56ms/step - loss: 0.4476 - accuracy: 0.8376 - precision: 0.8621 - recall: 0.8126 - F1Score: 0.8364 - val\_loss: 1.1790 - val\_accuracy: 0.6184 - val\_precision: 0.6406 - val\_recall: 0.5826 - val\_F1Score: 0.5986

Epoch 23/50  
622/622 - 35s 57ms/step - loss: 0.4518 - accuracy: 0.8350 - precision: 0.8610 - recall: 0.8098 - F1Score: 0.8344 - val\_loss: 1.0093 - val\_accuracy: 0.6884 - val\_precision: 0.7275 - val\_recall: 0.6316 - val\_F1Score: 0.6612

Epoch 24/50  
622/622 - 34s 55ms/step - loss: 0.4437 - accuracy: 0.8387 - precision: 0.8635 - recall: 0.8133 - F1Score: 0.8375 - val\_loss: 1.0442 - val\_accuracy: 0.6366 - val\_precision: 0.6813 - val\_recall: 0.5966 - val\_F1Score: 0.6213

Epoch 25/50  
622/622 - 35s 57ms/step - loss: 0.4370 - accuracy: 0.8422 - precision: 0.8666 - recall: 0.8177 - F1Score: 0.8412 - val\_loss: 1.0595 - val\_accuracy: 0.6331 - val\_precision: 0.6979 - val\_recall: 0.5499 - val\_F1Score: 0.5879

Epoch 26/50  
622/622 - 34s 54ms/step - loss: 0.4456 - accuracy: 0.8394 - precision: 0.8647 - recall: 0.8139 - F1Score: 0.8383 - val\_loss: 1.3079 - val\_accuracy: 0.5939 - val\_precision: 0.6584 - val\_recall: 0.5454 - val\_F1Score: 0.5754

Epoch 27/50

622/622 - 34s 55ms/step - loss: 0.4396 - accuracy: 0.8406 - precision: 0.8645 - recall: 0.8155 - F1Score: 0.8391 - val\_loss: 0.5457 - val\_accuracy: 0.8323 - val\_precision: 0.8929 - val\_recall: 0.7339 - val\_F1Score: 0.7880

Epoch 28/50

622/622 - 36s 57ms/step - loss: 0.4339 - accuracy: 0.8405 - precision: 0.8645 - recall: 0.8156 - F1Score: 0.8391 - val\_loss: 1.2659 - val\_accuracy: 0.5932 - val\_precision: 0.6124 - val\_recall: 0.5224 - val\_F1Score: 0.5454

Epoch 29/50

622/622 - 34s 55ms/step - loss: 0.4271 - accuracy: 0.8426 - precision: 0.8652 - recall: 0.8213 - F1Score: 0.8425 - val\_loss: 1.2391 - val\_accuracy: 0.6155 - val\_precision: 0.6496 - val\_recall: 0.5749 - val\_F1Score: 0.5964

Epoch 30/50

622/622 - 34s 55ms/step - loss: 0.4137 - accuracy: 0.8473 - precision: 0.8693 - recall: 0.8271 - F1Score: 0.8475 - val\_loss: 1.1739 - val\_accuracy: 0.5971 - val\_precision: 0.6191 - val\_recall: 0.5611 - val\_F1Score: 0.5786

Epoch 31/50

622/622 - 34s 55ms/step - loss: 0.3903 - accuracy: 0.8577 - precision: 0.8767 - recall: 0.8383 - F1Score: 0.8569 - val\_loss: 1.3973 - val\_accuracy: 0.5876 - val\_precision: 0.6379 - val\_recall: 0.5507 - val\_F1Score: 0.5736

Epoch 32/50

622/622 - 34s 55ms/step - loss: 0.4066 - accuracy: 0.8521 - precision: 0.8738 - recall: 0.8305 - F1Score: 0.8515 - val\_loss: 0.9512 - val\_accuracy: 0.6872 - val\_precision: 0.7092 - val\_recall: 0.6630 - val\_F1Score: 0.6754

Epoch 33/50

622/622 - 34s 55ms/step - loss: 0.3872 - accuracy: 0.8579 - precision: 0.8783 - recall: 0.8366 - F1Score: 0.8568 - val\_loss: 1.4150 - val\_accuracy: 0.6211 - val\_precision: 0.6310 - val\_recall: 0.6086 - val\_F1Score: 0.6153

Epoch 34/50

622/622 - 35s 57ms/step - loss: 0.3723 - accuracy: 0.8616 - precision: 0.8792 - recall: 0.8426 - F1Score: 0.8604 - val\_loss: 0.9787 - val\_accuracy: 0.6855 - val\_precision: 0.7499 - val\_recall: 0.6369 - val\_F1Score: 0.6711

Epoch 35/50

622/622 - 34s 55ms/step - loss: 0.3810 - accuracy: 0.8588 - precision: 0.8787 - recall: 0.8404 - F1Score: 0.8590 - val\_loss: 0.8402 - val\_accuracy: 0.7403 - val\_precision: 0.7652 - val\_recall: 0.7052 - val\_F1Score: 0.7248

Epoch 36/50

622/622 - 34s 55ms/step - loss: 0.3760 - accuracy: 0.8613 - precision: 0.8791 - recall: 0.8423 - F1Score: 0.8602 - val\_loss: 0.8017 - val\_accuracy: 0.7373 - val\_precision: 0.7933 - val\_recall: 0.6941 - val\_F1Score: 0.7261

Epoch 37/50

622/622 - 34s 55ms/step - loss: 0.3755 - accuracy: 0.8606 - precision: 0.8797 - recall: 0.8424 - F1Score: 0.8606 - val\_loss: 0.6184 - val\_accuracy: 0.7851 - val\_precision: 0.8433 - val\_recall: 0.7142 - val\_F1Score: 0.7600

Epoch 38/50

622/622 - 34s 55ms/step - loss: 0.3779 - accuracy: 0.8597 - precision: 0.8785 - recall: 0.8417 - F1Score: 0.8595 - val\_loss: 1.2276 - val\_accuracy: 0.6821 - val\_precision: 0.7054 - val\_recall: 0.6566 - val\_F1Score: 0.6728

Epoch 39/50

622/622 - 35s 57ms/step - loss: 0.3848 - accuracy: 0.8595 - precision: 0.8784 - recall: 0.8420 - F1Score: 0.8597 - val\_loss: 0.8534 - val\_accuracy: 0.7040 - val\_precision: 0.7623 - val\_recall: 0.6408 - val\_F1Score: 0.6797

Epoch 40/50

622/622 - 35s 57ms/step - loss: 0.3491 - accuracy: 0.8698 - precision: 0.8878 - recall: 0.8520 - F1Score: 0.8693 - val\_loss: 0.8430 - val\_accuracy: 0.7244 - val\_precision: 0.7590 - val\_recall: 0.6801 - val\_F1Score: 0.7062

Epoch 41/50  
622/622 - 34s 55ms/step - loss: 0.3521 - accuracy: 0.8694 - precision: 0.8864 - recall: 0.8535 - F1Score: 0.8695 - val\_loss: 1.5338 - val\_accuracy: 0.5993 - val\_precision: 0.6189 - val\_recall: 0.5704 - val\_F1Score: 0.5839

Epoch 42/50  
622/622 - 34s 55ms/step - loss: 0.3549 - accuracy: 0.8672 - precision: 0.8844 - recall: 0.8507 - F1Score: 0.8671 - val\_loss: 0.8099 - val\_accuracy: 0.7206 - val\_precision: 0.7475 - val\_recall: 0.6821 - val\_F1Score: 0.7064

Epoch 43/50  
622/622 - 34s 55ms/step - loss: 0.3477 - accuracy: 0.8726 - precision: 0.8885 - recall: 0.8563 - F1Score: 0.8720 - val\_loss: 0.6622 - val\_accuracy: 0.7990 - val\_precision: 0.8336 - val\_recall: 0.7403 - val\_F1Score: 0.7752

Epoch 44/50  
622/622 - 36s 57ms/step - loss: 0.3614 - accuracy: 0.8664 - precision: 0.8844 - recall: 0.8494 - F1Score: 0.8663 - val\_loss: 0.9947 - val\_accuracy: 0.6841 - val\_precision: 0.7117 - val\_recall: 0.6508 - val\_F1Score: 0.6705

Epoch 45/50  
622/622 - 36s 57ms/step - loss: 0.3476 - accuracy: 0.8699 - precision: 0.8874 - recall: 0.8546 - F1Score: 0.8706 - val\_loss: 0.9607 - val\_accuracy: 0.7056 - val\_precision: 0.7446 - val\_recall: 0.6591 - val\_F1Score: 0.6881

Epoch 46/50  
622/622 - 36s 57ms/step - loss: 0.3490 - accuracy: 0.8708 - precision: 0.8867 - recall: 0.8559 - F1Score: 0.8709 - val\_loss: 0.5925 - val\_accuracy: 0.8028 - val\_precision: 0.8630 - val\_recall: 0.7436 - val\_F1Score: 0.7894

Epoch 47/50  
622/622 - 34s 55ms/step - loss: 0.3272 - accuracy: 0.8770 - precision: 0.8920 - recall: 0.8623 - F1Score: 0.8767 - val\_loss: 1.1124 - val\_accuracy: 0.7025 - val\_precision: 0.7287 - val\_recall: 0.6657 - val\_F1Score: 0.6866

Epoch 48/50  
622/622 - 34s 55ms/step - loss: 0.3216 - accuracy: 0.8813 - precision: 0.8958 - recall: 0.8670 - F1Score: 0.8811 - val\_loss: 1.1737 - val\_accuracy: 0.6931 - val\_precision: 0.7232 - val\_recall: 0.6605 - val\_F1Score: 0.6803

Epoch 49/50  
622/622 - 36s 58ms/step - loss: 0.3275 - accuracy: 0.8795 - precision: 0.8942 - recall: 0.8647 - F1Score: 0.8791 - val\_loss: 0.9926 - val\_accuracy: 0.6899 - val\_precision: 0.7295 - val\_recall: 0.6319 - val\_F1Score: 0.6631

Epoch 50/50  
622/622 - 36s 57ms/step - loss: 0.3157 - accuracy: 0.8833 - precision: 0.8973 - recall: 0.8701 - F1Score: 0.8834 - val\_loss: 1.2124 - val\_accuracy: 0.6743 - val\_precision: 0.7052 - val\_recall: 0.6386 - val\_F1Score: 0.6595

G. Bi-LSTM Dengan *Dataset Original*

Epoch 1/50

561/561 - 81s 131ms/step - loss: 0.4732 - accuracy: 0.8635 - precision\_1: 0.8974 - recall\_1: 0.8351 - F1Score: 0.8602 - val\_loss: 0.2879 - val\_accuracy: 0.9102 - val\_precision\_1: 0.9253 - val\_recall\_1: 0.8991 - val\_F1Score: 0.9079

Epoch 2/50

561/561 - 72s 129ms/step - loss: 0.2860 - accuracy: 0.9142 - precision\_1: 0.9245 - recall\_1: 0.9038 - F1Score: 0.9141 - val\_loss: 0.2620 - val\_accuracy: 0.9203 - val\_precision\_1: 0.9302 - val\_recall\_1: 0.9098 - val\_F1Score: 0.9151

Epoch 3/50

561/561 - 73s 130ms/step - loss: 0.2639 - accuracy: 0.9180 - precision\_1: 0.9267 - recall\_1: 0.9084 - F1Score: 0.9174 - val\_loss: 0.2792 - val\_accuracy: 0.9155 - val\_precision\_1: 0.9232 - val\_recall\_1: 0.9075 - val\_F1Score: 0.9127

Epoch 4/50

561/561 - 72s 128ms/step - loss: 0.2331 - accuracy: 0.9261 - precision\_1: 0.9342 - recall\_1: 0.9186 - F1Score: 0.9263 - val\_loss: 0.2065 - val\_accuracy: 0.9376 - val\_precision\_1: 0.9407 - val\_recall\_1: 0.9336 - val\_F1Score: 0.9361

Epoch 5/50

561/561 - 73s 130ms/step - loss: 0.2158 - accuracy: 0.9304 - precision\_1: 0.9387 - recall\_1: 0.9236 - F1Score: 0.9309 - val\_loss: 0.2252 - val\_accuracy: 0.9306 - val\_precision\_1: 0.9330 - val\_recall\_1: 0.9288 - val\_F1Score: 0.9303

Epoch 6/50

561/561 - 71s 126ms/step - loss: 0.1965 - accuracy: 0.9372 - precision\_1: 0.9436 - recall\_1: 0.9312 - F1Score: 0.9373 - val\_loss: 0.1980 - val\_accuracy: 0.9369 - val\_precision\_1: 0.9410 - val\_recall\_1: 0.9336 - val\_F1Score: 0.9365

Epoch 7/50

561/561 - 72s 128ms/step - loss: 0.2201 - accuracy: 0.9302 - precision\_1: 0.9374 - recall\_1: 0.9235 - F1Score: 0.9303 - val\_loss: 0.2026 - val\_accuracy: 0.9393 - val\_precision\_1: 0.9440 - val\_recall\_1: 0.9336 - val\_F1Score: 0.9373

Epoch 8/50

561/561 - 74s 132ms/step - loss: 0.1999 - accuracy: 0.9355 - precision\_1: 0.9425 - recall\_1: 0.9289 - F1Score: 0.9356 - val\_loss: 0.1914 - val\_accuracy: 0.9396 - val\_precision\_1: 0.9427 - val\_recall\_1: 0.9368 - val\_F1Score: 0.9385

Epoch 9/50

561/561 - 71s 126ms/step - loss: 0.1855 - accuracy: 0.9394 - precision\_1: 0.9445 - recall\_1: 0.9347 - F1Score: 0.9395 - val\_loss: 0.2143 - val\_accuracy: 0.9336 - val\_precision\_1: 0.9405 - val\_recall\_1: 0.9262 - val\_F1Score: 0.9307

Epoch 10/50

561/561 - 72s 129ms/step - loss: 0.2033 - accuracy: 0.9347 - precision\_1: 0.9413 - recall\_1: 0.9294 - F1Score: 0.9353 - val\_loss: 0.2279 - val\_accuracy: 0.9263 - val\_precision\_1: 0.9313 - val\_recall\_1: 0.9226 - val\_F1Score: 0.9256

Epoch 11/50

561/561 - 74s 132ms/step - loss: 0.1876 - accuracy: 0.9391 - precision\_1: 0.9440 - recall\_1: 0.9350 - F1Score: 0.9395 - val\_loss: 0.1831 - val\_accuracy: 0.9438 - val\_precision\_1: 0.9480 - val\_recall\_1: 0.9402 - val\_F1Score: 0.9431

Epoch 12/50

561/561 - 71s 126ms/step - loss: 0.1813 - accuracy: 0.9408 - precision\_1: 0.9457 - recall\_1: 0.9362 - F1Score: 0.9409 - val\_loss: 0.1835 - val\_accuracy: 0.9436 - val\_precision\_1: 0.9491 - val\_recall\_1: 0.9385 - val\_F1Score: 0.9421

Epoch 13/50

561/561 - 71s 126ms/step - loss: 0.1938 - accuracy: 0.9385 - precision\_1: 0.9434 - recall\_1: 0.9331 - F1Score: 0.9382 - val\_loss: 0.2234 - val\_accuracy: 0.9314 - val\_precision\_1: 0.9346 - val\_recall\_1: 0.9278 - val\_F1Score: 0.9300

Epoch 14/50  
561/561 - 71s 126ms/step - loss: 0.1830 - accuracy: 0.9401 - precision\_1: 0.9444 - recall\_1: 0.9354 - F1Score: 0.9397 - val\_loss: 0.2276 - val\_accuracy: 0.9300 - val\_precision\_1: 0.9361 - val\_recall\_1: 0.9238 - val\_F1Score: 0.9279

Epoch 15/50  
561/561 - 71s 126ms/step - loss: 0.1755 - accuracy: 0.9427 - precision\_1: 0.9465 - recall\_1: 0.9388 - F1Score: 0.9426 - val\_loss: 0.1749 - val\_accuracy: 0.9426 - val\_precision\_1: 0.9456 - val\_recall\_1: 0.9390 - val\_F1Score: 0.9413

Epoch 16/50  
561/561 - 71s 126ms/step - loss: 0.1751 - accuracy: 0.9425 - precision\_1: 0.9466 - recall\_1: 0.9384 - F1Score: 0.9424 - val\_loss: 0.1857 - val\_accuracy: 0.9413 - val\_precision\_1: 0.9475 - val\_recall\_1: 0.9369 - val\_F1Score: 0.9411

Epoch 17/50  
561/561 - 72s 128ms/step - loss: 0.1711 - accuracy: 0.9462 - precision\_1: 0.9504 - recall\_1: 0.9427 - F1Score: 0.9465 - val\_loss: 0.1690 - val\_accuracy: 0.9456 - val\_precision\_1: 0.9487 - val\_recall\_1: 0.9424 - val\_F1Score: 0.9449

Epoch 18/50  
561/561 - 73s 130ms/step - loss: 0.1655 - accuracy: 0.9460 - precision\_1: 0.9493 - recall\_1: 0.9425 - F1Score: 0.9459 - val\_loss: 0.2049 - val\_accuracy: 0.9359 - val\_precision\_1: 0.9444 - val\_recall\_1: 0.9290 - val\_F1Score: 0.9346

Epoch 19/50  
561/561 - 71s 126ms/step - loss: 0.1585 - accuracy: 0.9492 - precision\_1: 0.9529 - recall\_1: 0.9459 - F1Score: 0.9494 - val\_loss: 0.1829 - val\_accuracy: 0.9409 - val\_precision\_1: 0.9429 - val\_recall\_1: 0.9392 - val\_F1Score: 0.9406

Epoch 20/50  
561/561 - 71s 126ms/step - loss: 0.1590 - accuracy: 0.9478 - precision\_1: 0.9515 - recall\_1: 0.9450 - F1Score: 0.9482 - val\_loss: 0.1883 - val\_accuracy: 0.9383 - val\_precision\_1: 0.9424 - val\_recall\_1: 0.9347 - val\_F1Score: 0.9372

Epoch 21/50  
561/561 - 72s 129ms/step - loss: 0.1692 - accuracy: 0.9462 - precision\_1: 0.9501 - recall\_1: 0.9428 - F1Score: 0.9464 - val\_loss: 0.1667 - val\_accuracy: 0.9485 - val\_precision\_1: 0.9528 - val\_recall\_1: 0.9458 - val\_F1Score: 0.9487

Epoch 22/50  
561/561 - 73s 130ms/step - loss: 0.1616 - accuracy: 0.9501 - precision\_1: 0.9528 - recall\_1: 0.9472 - F1Score: 0.9499 - val\_loss: 0.1624 - val\_accuracy: 0.9471 - val\_precision\_1: 0.9510 - val\_recall\_1: 0.9455 - val\_F1Score: 0.9476

Epoch 23/50  
561/561 - 73s 130ms/step - loss: 0.1653 - accuracy: 0.9469 - precision\_1: 0.9505 - recall\_1: 0.9441 - F1Score: 0.9473 - val\_loss: 0.1906 - val\_accuracy: 0.9419 - val\_precision\_1: 0.9455 - val\_recall\_1: 0.9390 - val\_F1Score: 0.9411

Epoch 24/50  
561/561 - 71s 126ms/step - loss: 0.1592 - accuracy: 0.9486 - precision\_1: 0.9524 - recall\_1: 0.9453 - F1Score: 0.9488 - val\_loss: 0.1992 - val\_accuracy: 0.9434 - val\_precision\_1: 0.9456 - val\_recall\_1: 0.9427 - val\_F1Score: 0.9438

Epoch 25/50  
561/561 - 71s 126ms/step - loss: 0.1644 - accuracy: 0.9461 - precision\_1: 0.9503 - recall\_1: 0.9433 - F1Score: 0.9468 - val\_loss: 0.1871 - val\_accuracy: 0.9449 - val\_precision\_1: 0.9465 - val\_recall\_1: 0.9435 - val\_F1Score: 0.9446

Epoch 26/50  
561/561 - 73s 130ms/step - loss: 0.1707 - accuracy: 0.9434 - precision\_1: 0.9474 - recall\_1: 0.9394 - F1Score: 0.9434 - val\_loss: 0.2145 - val\_accuracy: 0.9311 - val\_precision\_1: 0.9340 - val\_recall\_1: 0.9270 - val\_F1Score: 0.9295

Epoch 27/50

561/561 - 71s 126ms/step - loss: 0.1647 - accuracy: 0.9456 - precision\_1: 0.9493 - recall\_1: 0.9420 - F1Score: 0.9456 - val\_loss: 0.1755 - val\_accuracy: 0.9446 - val\_precision\_1: 0.9485 - val\_recall\_1: 0.9408 - val\_F1Score: 0.9432

Epoch 28/50

561/561 - 71s 126ms/step - loss: 0.1570 - accuracy: 0.9485 - precision\_1: 0.9524 - recall\_1: 0.9449 - F1Score: 0.9485 - val\_loss: 0.1937 - val\_accuracy: 0.9424 - val\_precision\_1: 0.9465 - val\_recall\_1: 0.9393 - val\_F1Score: 0.9419

Epoch 29/50

561/561 - 71s 126ms/step - loss: 0.1527 - accuracy: 0.9497 - precision\_1: 0.9530 - recall\_1: 0.9463 - F1Score: 0.9497 - val\_loss: 0.1793 - val\_accuracy: 0.9439 - val\_precision\_1: 0.9466 - val\_recall\_1: 0.9424 - val\_F1Score: 0.9440

Epoch 30/50

561/561 - 71s 126ms/step - loss: 0.1727 - accuracy: 0.9455 - precision\_1: 0.9498 - recall\_1: 0.9408 - F1Score: 0.9453 - val\_loss: 0.1771 - val\_accuracy: 0.9436 - val\_precision\_1: 0.9479 - val\_recall\_1: 0.9401 - val\_F1Score: 0.9429

Epoch 31/50

561/561 - 71s 126ms/step - loss: 0.1674 - accuracy: 0.9457 - precision\_1: 0.9512 - recall\_1: 0.9416 - F1Score: 0.9463 - val\_loss: 0.2202 - val\_accuracy: 0.9277 - val\_precision\_1: 0.9314 - val\_recall\_1: 0.9235 - val\_F1Score: 0.9265

Epoch 32/50

561/561 - 73s 130ms/step - loss: 0.1616 - accuracy: 0.9470 - precision\_1: 0.9510 - recall\_1: 0.9429 - F1Score: 0.9468 - val\_loss: 0.1861 - val\_accuracy: 0.9387 - val\_precision\_1: 0.9435 - val\_recall\_1: 0.9355 - val\_F1Score: 0.9384

Epoch 33/50

561/561 - 73s 130ms/step - loss: 0.1612 - accuracy: 0.9467 - precision\_1: 0.9506 - recall\_1: 0.9435 - F1Score: 0.9470 - val\_loss: 0.2046 - val\_accuracy: 0.9383 - val\_precision\_1: 0.9423 - val\_recall\_1: 0.9338 - val\_F1Score: 0.9371

Epoch 34/50

561/561 - 73s 130ms/step - loss: 0.1562 - accuracy: 0.9486 - precision\_1: 0.9520 - recall\_1: 0.9445 - F1Score: 0.9481 - val\_loss: 0.1819 - val\_accuracy: 0.9407 - val\_precision\_1: 0.9437 - val\_recall\_1: 0.9390 - val\_F1Score: 0.9408

Epoch 35/50

561/561 - 73s 130ms/step - loss: 0.1586 - accuracy: 0.9475 - precision\_1: 0.9512 - recall\_1: 0.9439 - F1Score: 0.9475 - val\_loss: 0.1789 - val\_accuracy: 0.9434 - val\_precision\_1: 0.9477 - val\_recall\_1: 0.9403 - val\_F1Score: 0.9430

Epoch 36/50

561/561 - 72s 128ms/step - loss: 0.1594 - accuracy: 0.9481 - precision\_1: 0.9516 - recall\_1: 0.9449 - F1Score: 0.9482 - val\_loss: 0.1530 - val\_accuracy: 0.9500 - val\_precision\_1: 0.9541 - val\_recall\_1: 0.9479 - val\_F1Score: 0.9502

Epoch 37/50

561/561 - 73s 130ms/step - loss: 0.1555 - accuracy: 0.9485 - precision\_1: 0.9520 - recall\_1: 0.9447 - F1Score: 0.9482 - val\_loss: 0.1793 - val\_accuracy: 0.9451 - val\_precision\_1: 0.9479 - val\_recall\_1: 0.9424 - val\_F1Score: 0.9447

Epoch 38/50

561/561 - 73s 130ms/step - loss: 0.1489 - accuracy: 0.9509 - precision\_1: 0.9545 - recall\_1: 0.9479 - F1Score: 0.9511 - val\_loss: 0.1874 - val\_accuracy: 0.9427 - val\_precision\_1: 0.9454 - val\_recall\_1: 0.9407 - val\_F1Score: 0.9422

Epoch 39/50

561/561 - 73s 130ms/step - loss: 0.1586 - accuracy: 0.9483 - precision\_1: 0.9520 - recall\_1: 0.9444 - F1Score: 0.9481 - val\_loss: 0.2934 - val\_accuracy: 0.9041 - val\_precision\_1: 0.9092 - val\_recall\_1: 0.8984 - val\_F1Score: 0.9027

Epoch 40/50

561/561 - 73s 130ms/step - loss: 0.1820 - accuracy: 0.9419 - precision\_1: 0.9464 - recall\_1: 0.9379 - F1Score: 0.9422 - val\_loss: 0.1876 - val\_accuracy: 0.9408 - val\_precision\_1: 0.9426 - val\_recall\_1: 0.9389 - val\_F1Score: 0.9403



Epoch 41/50

561/561 - 73s 130ms/step - loss: 0.1753 - accuracy: 0.9430 - precision\_1: 0.9476 - recall\_1: 0.9394 - F1Score: 0.9435 - val\_loss: 0.1746 - val\_accuracy: 0.9436 - val\_precision\_1: 0.9457 - val\_recall\_1: 0.9414 - val\_F1Score: 0.9428

Epoch 42/50

561/561 - 73s 130ms/step - loss: 0.1603 - accuracy: 0.9485 - precision\_1: 0.9520 - recall\_1: 0.9452 - F1Score: 0.9486 - val\_loss: 0.2148 - val\_accuracy: 0.9355 - val\_precision\_1: 0.9394 - val\_recall\_1: 0.9316 - val\_F1Score: 0.9345

Epoch 43/50

561/561 - 71s 126ms/step - loss: 0.1522 - accuracy: 0.9504 - precision\_1: 0.9538 - recall\_1: 0.9471 - F1Score: 0.9505 - val\_loss: 0.1799 - val\_accuracy: 0.9463 - val\_precision\_1: 0.9487 - val\_recall\_1: 0.9441 - val\_F1Score: 0.9456

Epoch 44/50

561/561 - 73s 130ms/step - loss: 0.1593 - accuracy: 0.9493 - precision\_1: 0.9525 - recall\_1: 0.9457 - F1Score: 0.9490 - val\_loss: 0.1775 - val\_accuracy: 0.9444 - val\_precision\_1: 0.9470 - val\_recall\_1: 0.9437 - val\_F1Score: 0.9451

Epoch 45/50

561/561 - 73s 130ms/step - loss: 0.1423 - accuracy: 0.9539 - precision\_1: 0.9566 - recall\_1: 0.9514 - F1Score: 0.9540 - val\_loss: 0.1781 - val\_accuracy: 0.9455 - val\_precision\_1: 0.9492 - val\_recall\_1: 0.9430 - val\_F1Score: 0.9449

Epoch 46/50

561/561 - 71s 126ms/step - loss: 0.1467 - accuracy: 0.9521 - precision\_1: 0.9551 - recall\_1: 0.9494 - F1Score: 0.9522 - val\_loss: 0.1906 - val\_accuracy: 0.9431 - val\_precision\_1: 0.9459 - val\_recall\_1: 0.9412 - val\_F1Score: 0.9428

Epoch 47/50

561/561 - 71s 126ms/step - loss: 0.1431 - accuracy: 0.9539 - precision\_1: 0.9562 - recall\_1: 0.9517 - F1Score: 0.9539 - val\_loss: 0.1837 - val\_accuracy: 0.9417 - val\_precision\_1: 0.9442 - val\_recall\_1: 0.9388 - val\_F1Score: 0.9409

Epoch 48/50

561/561 - 72s 128ms/step - loss: 0.1445 - accuracy: 0.9543 - precision\_1: 0.9569 - recall\_1: 0.9518 - F1Score: 0.9543 - val\_loss: 0.1615 - val\_accuracy: 0.9523 - val\_precision\_1: 0.9545 - val\_recall\_1: 0.9506 - val\_F1Score: 0.9519

Epoch 49/50

561/561 - 71s 126ms/step - loss: 0.1423 - accuracy: 0.9544 - precision\_1: 0.9569 - recall\_1: 0.9523 - F1Score: 0.9546 - val\_loss: 0.2041 - val\_accuracy: 0.9426 - val\_precision\_1: 0.9438 - val\_recall\_1: 0.9416 - val\_F1Score: 0.9424

Epoch 50/50

561/561 - 72s 128ms/step - loss: 0.1375 - accuracy: 0.9564 - precision\_1: 0.9586 - recall\_1: 0.9545 - F1Score: 0.9565 - val\_loss: 0.1590 - val\_accuracy: 0.9533 - val\_precision\_1: 0.9548 - val\_recall\_1: 0.9519 - val\_F1Score: 0.9531

H. Bi-LSTM Dengan *Dataset Undersampling*

Epoch 1/50

206/206 - 40s 165ms/step - loss: 1.3878 - accuracy: 0.4952 - precision\_1: 0.8781 - recall\_1: 0.5983 - F1Score: 0.3856 - val\_loss: 0.7653 - val\_accuracy: 0.8625 - val\_precision\_1: 0.9609 - val\_recall\_1: 0.3806 - val\_F1Score: 0.4133

Epoch 2/50

206/206 - 34s 165ms/step - loss: 1.1508 - accuracy: 0.5726 - precision\_1: 0.7173 - recall\_1: 0.3895 - F1Score: 0.5023 - val\_loss: 0.6218 - val\_accuracy: 0.8635 - val\_precision\_1: 0.8995 - val\_recall\_1: 0.8297 - val\_F1Score: 0.8424

Epoch 3/50

206/206 - 34s 166ms/step - loss: 0.9921 - accuracy: 0.6209 - precision\_1: 0.7435 - recall\_1: 0.4653 - F1Score: 0.5698 - val\_loss: 0.5772 - val\_accuracy: 0.8677 - val\_precision\_1: 0.9300 - val\_recall\_1: 0.7175 - val\_F1Score: 0.7830

Epoch 4/50

206/206 - 34s 167ms/step - loss: 0.8781 - accuracy: 0.6618 - precision\_1: 0.7721 - recall\_1: 0.5351 - F1Score: 0.6310 - val\_loss: 0.5617 - val\_accuracy: 0.8798 - val\_precision\_1: 0.9424 - val\_recall\_1: 0.7711 - val\_F1Score: 0.8222

Epoch 5/50

206/206 - 32s 156ms/step - loss: 0.8478 - accuracy: 0.6747 - precision\_1: 0.7788 - recall\_1: 0.5528 - F1Score: 0.6450 - val\_loss: 0.5090 - val\_accuracy: 0.8861 - val\_precision\_1: 0.9175 - val\_recall\_1: 0.8107 - val\_F1Score: 0.8461

Epoch 6/50

206/206 - 31s 151ms/step - loss: 0.7298 - accuracy: 0.7166 - precision\_1: 0.8007 - recall\_1: 0.6185 - F1Score: 0.6969 - val\_loss: 0.7522 - val\_accuracy: 0.6450 - val\_precision\_1: 0.7630 - val\_recall\_1: 0.4407 - val\_F1Score: 0.4761

Epoch 7/50

206/206 - 34s 166ms/step - loss: 0.7178 - accuracy: 0.7194 - precision\_1: 0.8050 - recall\_1: 0.6267 - F1Score: 0.7040 - val\_loss: 0.4475 - val\_accuracy: 0.8988 - val\_precision\_1: 0.9156 - val\_recall\_1: 0.8738 - val\_F1Score: 0.8850

Epoch 8/50

206/206 - 33s 160ms/step - loss: 0.7304 - accuracy: 0.7143 - precision\_1: 0.8015 - recall\_1: 0.6211 - F1Score: 0.6990 - val\_loss: 0.6242 - val\_accuracy: 0.7713 - val\_precision\_1: 0.8353 - val\_recall\_1: 0.6432 - val\_F1Score: 0.7045

Epoch 9/50

206/206 - 33s 161ms/step - loss: 0.6878 - accuracy: 0.7309 - precision\_1: 0.8102 - recall\_1: 0.6437 - F1Score: 0.7166 - val\_loss: 0.5530 - val\_accuracy: 0.8729 - val\_precision\_1: 0.9360 - val\_recall\_1: 0.6803 - val\_F1Score: 0.7573

Epoch 10/50

206/206 - 31s 150ms/step - loss: 0.6658 - accuracy: 0.7410 - precision\_1: 0.8129 - recall\_1: 0.6606 - F1Score: 0.7283 - val\_loss: 0.5368 - val\_accuracy: 0.8434 - val\_precision\_1: 0.8986 - val\_recall\_1: 0.7616 - val\_F1Score: 0.8117

Epoch 11/50

206/206 - 33s 160ms/step - loss: 0.6810 - accuracy: 0.7329 - precision\_1: 0.8105 - recall\_1: 0.6490 - F1Score: 0.7198 - val\_loss: 0.7066 - val\_accuracy: 0.6632 - val\_precision\_1: 0.7137 - val\_recall\_1: 0.5563 - val\_F1Score: 0.5968

Epoch 12/50

206/206 - 33s 160ms/step - loss: 0.6423 - accuracy: 0.7479 - precision\_1: 0.8198 - recall\_1: 0.6745 - F1Score: 0.7392 - val\_loss: 0.6619 - val\_accuracy: 0.7458 - val\_precision\_1: 0.8211 - val\_recall\_1: 0.5610 - val\_F1Score: 0.6253

Epoch 13/50

206/206 - 33s 160ms/step - loss: 0.6437 - accuracy: 0.7461 - precision\_1: 0.8183 - recall\_1: 0.6694 - F1Score: 0.7357 - val\_loss: 0.8918 - val\_accuracy: 0.5556 - val\_precision\_1: 0.5840 - val\_recall\_1: 0.4376 - val\_F1Score: 0.4545

Epoch 14/50  
206/206 - 33s 160ms/step - loss: 0.6633 - accuracy: 0.7400 - precision\_1: 0.8088 - recall\_1: 0.6637 - F1Score: 0.7282 - val\_loss: 0.6041 - val\_accuracy: 0.8014 - val\_precision\_1: 0.8606 - val\_recall\_1: 0.6907 - val\_F1Score: 0.7491

Epoch 15/50  
206/206 - 33s 160ms/step - loss: 0.6121 - accuracy: 0.7633 - precision\_1: 0.8246 - recall\_1: 0.6949 - F1Score: 0.7538 - val\_loss: 0.8980 - val\_accuracy: 0.5178 - val\_precision\_1: 0.5489 - val\_recall\_1: 0.4316 - val\_F1Score: 0.4468

Epoch 16/50  
206/206 - 31s 150ms/step - loss: 0.6056 - accuracy: 0.7585 - precision\_1: 0.8204 - recall\_1: 0.6883 - F1Score: 0.7480 - val\_loss: 0.7482 - val\_accuracy: 0.6381 - val\_precision\_1: 0.6621 - val\_recall\_1: 0.5744 - val\_F1Score: 0.6011

Epoch 17/50  
206/206 - 33s 160ms/step - loss: 0.5748 - accuracy: 0.7748 - precision\_1: 0.8328 - recall\_1: 0.7163 - F1Score: 0.7697 - val\_loss: 0.6531 - val\_accuracy: 0.7191 - val\_precision\_1: 0.7732 - val\_recall\_1: 0.5646 - val\_F1Score: 0.6189

Epoch 18/50  
206/206 - 33s 160ms/step - loss: 0.5906 - accuracy: 0.7709 - precision\_1: 0.8283 - recall\_1: 0.7072 - F1Score: 0.7621 - val\_loss: 0.8257 - val\_accuracy: 0.5835 - val\_precision\_1: 0.6662 - val\_recall\_1: 0.4341 - val\_F1Score: 0.4590

Epoch 19/50  
206/206 - 31s 150ms/step - loss: 0.5808 - accuracy: 0.7742 - precision\_1: 0.8334 - recall\_1: 0.7127 - F1Score: 0.7677 - val\_loss: 1.0947 - val\_accuracy: 0.4430 - val\_precision\_1: 0.5314 - val\_recall\_1: 0.3382 - val\_F1Score: 0.3759

Epoch 20/50  
206/206 - 31s 150ms/step - loss: 0.5656 - accuracy: 0.7747 - precision\_1: 0.8338 - recall\_1: 0.7182 - F1Score: 0.7712 - val\_loss: 0.5808 - val\_accuracy: 0.7951 - val\_precision\_1: 0.8351 - val\_recall\_1: 0.7217 - val\_F1Score: 0.7612

Epoch 21/50  
206/206 - 31s 151ms/step - loss: 0.5453 - accuracy: 0.7878 - precision\_1: 0.8404 - recall\_1: 0.7277 - F1Score: 0.7794 - val\_loss: 1.0044 - val\_accuracy: 0.5200 - val\_precision\_1: 0.5363 - val\_recall\_1: 0.4595 - val\_F1Score: 0.4729

Epoch 22/50  
206/206 - 33s 161ms/step - loss: 0.5612 - accuracy: 0.7831 - precision\_1: 0.8339 - recall\_1: 0.7270 - F1Score: 0.7763 - val\_loss: 0.4656 - val\_accuracy: 0.8667 - val\_precision\_1: 0.8949 - val\_recall\_1: 0.8404 - val\_F1Score: 0.8558

Epoch 23/50  
206/206 - 33s 161ms/step - loss: 0.5347 - accuracy: 0.7934 - precision\_1: 0.8421 - recall\_1: 0.7399 - F1Score: 0.7872 - val\_loss: 0.9130 - val\_accuracy: 0.5693 - val\_precision\_1: 0.5797 - val\_recall\_1: 0.4944 - val\_F1Score: 0.5200

Epoch 24/50  
206/206 - 33s 161ms/step - loss: 0.5479 - accuracy: 0.7885 - precision\_1: 0.8379 - recall\_1: 0.7346 - F1Score: 0.7825 - val\_loss: 0.8257 - val\_accuracy: 0.6079 - val\_precision\_1: 0.6488 - val\_recall\_1: 0.4840 - val\_F1Score: 0.5175

Epoch 25/50  
206/206 - 33s 161ms/step - loss: 0.5412 - accuracy: 0.7887 - precision\_1: 0.8410 - recall\_1: 0.7362 - F1Score: 0.7845 - val\_loss: 0.8423 - val\_accuracy: 0.6024 - val\_precision\_1: 0.6149 - val\_recall\_1: 0.5361 - val\_F1Score: 0.5599

Epoch 26/50  
206/206 - 33s 161ms/step - loss: 0.5411 - accuracy: 0.7889 - precision\_1: 0.8364 - recall\_1: 0.7370 - F1Score: 0.7831 - val\_loss: 1.1705 - val\_accuracy: 0.4710 - val\_precision\_1: 0.4747 - val\_recall\_1: 0.4411 - val\_F1Score: 0.4484

Epoch 27/50

206/206 - 33s 161ms/step - loss: 0.5043 - accuracy: 0.8029 - precision\_1: 0.8476 - recall\_1: 0.7549 - F1Score: 0.7981 - val\_loss: 1.4251 - val\_accuracy: 0.4614 - val\_precision\_1: 0.4697 - val\_recall\_1: 0.4277 - val\_F1Score: 0.4416

Epoch 28/50

206/206 - 31s 150ms/step - loss: 0.4885 - accuracy: 0.8111 - precision\_1: 0.8536 - recall\_1: 0.7649 - F1Score: 0.8064 - val\_loss: 0.8089 - val\_accuracy: 0.6272 - val\_precision\_1: 0.6588 - val\_recall\_1: 0.5438 - val\_F1Score: 0.5769

Epoch 29/50

206/206 - 33s 160ms/step - loss: 0.4840 - accuracy: 0.8108 - precision\_1: 0.8566 - recall\_1: 0.7676 - F1Score: 0.8092 - val\_loss: 0.8924 - val\_accuracy: 0.6166 - val\_precision\_1: 0.6306 - val\_recall\_1: 0.5831 - val\_F1Score: 0.5980

Epoch 30/50

206/206 - 33s 161ms/step - loss: 0.4881 - accuracy: 0.8088 - precision\_1: 0.8520 - recall\_1: 0.7640 - F1Score: 0.8052 - val\_loss: 1.1440 - val\_accuracy: 0.5474 - val\_precision\_1: 0.5554 - val\_recall\_1: 0.5074 - val\_F1Score: 0.5201

Epoch 31/50

206/206 - 33s 161ms/step - loss: 0.4711 - accuracy: 0.8168 - precision\_1: 0.8558 - recall\_1: 0.7749 - F1Score: 0.8129 - val\_loss: 0.5900 - val\_accuracy: 0.7983 - val\_precision\_1: 0.8206 - val\_recall\_1: 0.7567 - val\_F1Score: 0.7824

Epoch 32/50

206/206 - 31s 150ms/step - loss: 0.4663 - accuracy: 0.8183 - precision\_1: 0.8567 - recall\_1: 0.7765 - F1Score: 0.8143 - val\_loss: 0.4533 - val\_accuracy: 0.8578 - val\_precision\_1: 0.8835 - val\_recall\_1: 0.8294 - val\_F1Score: 0.8449

Epoch 33/50

206/206 - 33s 161ms/step - loss: 0.4771 - accuracy: 0.8159 - precision\_1: 0.8562 - recall\_1: 0.7729 - F1Score: 0.8121 - val\_loss: 0.9290 - val\_accuracy: 0.5996 - val\_precision\_1: 0.6456 - val\_recall\_1: 0.5355 - val\_F1Score: 0.5636

Epoch 34/50

206/206 - 33s 161ms/step - loss: 0.4678 - accuracy: 0.8199 - precision\_1: 0.8584 - recall\_1: 0.7791 - F1Score: 0.8164 - val\_loss: 1.5026 - val\_accuracy: 0.4569 - val\_precision\_1: 0.4580 - val\_recall\_1: 0.4270 - val\_F1Score: 0.4369

Epoch 35/50

206/206 - 31s 151ms/step - loss: 0.4551 - accuracy: 0.8190 - precision\_1: 0.8572 - recall\_1: 0.7795 - F1Score: 0.8161 - val\_loss: 0.7301 - val\_accuracy: 0.7120 - val\_precision\_1: 0.7377 - val\_recall\_1: 0.6524 - val\_F1Score: 0.6821

Epoch 36/50

206/206 - 31s 151ms/step - loss: 0.4630 - accuracy: 0.8199 - precision\_1: 0.8609 - recall\_1: 0.7769 - F1Score: 0.8163 - val\_loss: 0.6096 - val\_accuracy: 0.7606 - val\_precision\_1: 0.8003 - val\_recall\_1: 0.6855 - val\_F1Score: 0.7244

Epoch 37/50

206/206 - 31s 150ms/step - loss: 0.4425 - accuracy: 0.8265 - precision\_1: 0.8623 - recall\_1: 0.7874 - F1Score: 0.8227 - val\_loss: 0.5184 - val\_accuracy: 0.8333 - val\_precision\_1: 0.8893 - val\_recall\_1: 0.7074 - val\_F1Score: 0.7710

Epoch 38/50

206/206 - 33s 160ms/step - loss: 0.4900 - accuracy: 0.8108 - precision\_1: 0.8508 - recall\_1: 0.7649 - F1Score: 0.8051 - val\_loss: 1.3232 - val\_accuracy: 0.5182 - val\_precision\_1: 0.5280 - val\_recall\_1: 0.4901 - val\_F1Score: 0.4996

Epoch 39/50

206/206 - 33s 161ms/step - loss: 0.4456 - accuracy: 0.8255 - precision\_1: 0.8660 - recall\_1: 0.7850 - F1Score: 0.8230 - val\_loss: 0.7197 - val\_accuracy: 0.7498 - val\_precision\_1: 0.7743 - val\_recall\_1: 0.7077 - val\_F1Score: 0.7343

Epoch 40/50

206/206 - 31s 151ms/step - loss: 0.4358 - accuracy: 0.8318 - precision\_1: 0.8691 - recall\_1: 0.7938 - F1Score: 0.8295 - val\_loss: 0.8672 - val\_accuracy: 0.6217 - val\_precision\_1: 0.6689 - val\_recall\_1: 0.5706 - val\_F1Score: 0.5966

Epoch 41/50  
 206/206 - 33s 160ms/step - loss: 0.4622 - accuracy: 0.8186 - precision\_1: 0.8563 - recall\_1: 0.7797 - F1Score: 0.8160 - val\_loss: 0.7167 - val\_accuracy: 0.6999 - val\_precision\_1: 0.7459 - val\_recall\_1: 0.6103 - val\_F1Score: 0.6535

Epoch 42/50  
 206/206 - 31s 150ms/step - loss: 0.4187 - accuracy: 0.8392 - precision\_1: 0.8741 - recall\_1: 0.8017 - F1Score: 0.8360 - val\_loss: 0.7600 - val\_accuracy: 0.6623 - val\_precision\_1: 0.7151 - val\_recall\_1: 0.6236 - val\_F1Score: 0.6531

Epoch 43/50  
 206/206 - 33s 161ms/step - loss: 0.4112 - accuracy: 0.8406 - precision\_1: 0.8745 - recall\_1: 0.8075 - F1Score: 0.8394 - val\_loss: 1.4682 - val\_accuracy: 0.5038 - val\_precision\_1: 0.5077 - val\_recall\_1: 0.4836 - val\_F1Score: 0.4899

Epoch 44/50  
 206/206 - 33s 160ms/step - loss: 0.4154 - accuracy: 0.8353 - precision\_1: 0.8697 - recall\_1: 0.8032 - F1Score: 0.8348 - val\_loss: 0.7006 - val\_accuracy: 0.7521 - val\_precision\_1: 0.7744 - val\_recall\_1: 0.7108 - val\_F1Score: 0.7349

Epoch 45/50  
 206/206 - 33s 160ms/step - loss: 0.4033 - accuracy: 0.8414 - precision\_1: 0.8753 - recall\_1: 0.8074 - F1Score: 0.8397 - val\_loss: 0.8004 - val\_accuracy: 0.6631 - val\_precision\_1: 0.7097 - val\_recall\_1: 0.6268 - val\_F1Score: 0.6536

Epoch 46/50  
 206/206 - 31s 150ms/step - loss: 0.4245 - accuracy: 0.8341 - precision\_1: 0.8688 - recall\_1: 0.7988 - F1Score: 0.8321 - val\_loss: 0.8906 - val\_accuracy: 0.6215 - val\_precision\_1: 0.6689 - val\_recall\_1: 0.5847 - val\_F1Score: 0.6102

Epoch 47/50  
 206/206 - 33s 161ms/step - loss: 0.3868 - accuracy: 0.8490 - precision\_1: 0.8798 - recall\_1: 0.8170 - F1Score: 0.8469 - val\_loss: 0.8326 - val\_accuracy: 0.6633 - val\_precision\_1: 0.6794 - val\_recall\_1: 0.6217 - val\_F1Score: 0.6410

Epoch 48/50  
 206/206 - 31s 150ms/step - loss: 0.4093 - accuracy: 0.8390 - precision\_1: 0.8741 - recall\_1: 0.8079 - F1Score: 0.8394 - val\_loss: 0.9555 - val\_accuracy: 0.6548 - val\_precision\_1: 0.6771 - val\_recall\_1: 0.6381 - val\_F1Score: 0.6517

Epoch 49/50  
 206/206 - 31s 150ms/step - loss: 0.3783 - accuracy: 0.8520 - precision\_1: 0.8824 - recall\_1: 0.8224 - F1Score: 0.8511 - val\_loss: 0.7258 - val\_accuracy: 0.7472 - val\_precision\_1: 0.7627 - val\_recall\_1: 0.7225 - val\_F1Score: 0.7363

Epoch 50/50  
 206/206 - 31s 150ms/step - loss: 0.4098 - accuracy: 0.8415 - precision\_1: 0.8713 - recall\_1: 0.8089 - F1Score: 0.8388 - val\_loss: 0.9016 - val\_accuracy: 0.6752 - val\_precision\_1: 0.6961 - val\_recall\_1: 0.6484 - val\_F1Score: 0.6645

I. Bi-LSTM Dengan *Dataset Oversampling*

Epoch 1/50

622/622 - 91s 134ms/step - loss: 1.0521 - accuracy: 0.6649 - precision: 0.7553 - recall: 0.5638 - F1Score: 0.6370 - val\_loss: 0.7137 - val\_accuracy: 0.8452 - val\_precision: 0.9151 - val\_recall: 0.5354 - val\_F1Score: 0.6243

Epoch 2/50

622/622 - 78s 125ms/step - loss: 0.7840 - accuracy: 0.7391 - precision: 0.7958 - recall: 0.6759 - F1Score: 0.7301 - val\_loss: 1.4179 - val\_accuracy: 0.4099 - val\_precision: 0.4182 - val\_recall: 0.3660 - val\_F1Score: 0.3825

Epoch 3/50

622/622 - 80s 128ms/step - loss: 0.7335 - accuracy: 0.7529 - precision: 0.8036 - recall: 0.6999 - F1Score: 0.7474 - val\_loss: 0.5724 - val\_accuracy: 0.8388 - val\_precision: 0.8861 - val\_recall: 0.7313 - val\_F1Score: 0.7874

Epoch 4/50

622/622 - 77s 124ms/step - loss: 0.6939 - accuracy: 0.7647 - precision: 0.8090 - recall: 0.7161 - F1Score: 0.7591 - val\_loss: 0.7956 - val\_accuracy: 0.6360 - val\_precision: 0.7313 - val\_recall: 0.4880 - val\_F1Score: 0.5390

Epoch 5/50

622/622 - 81s 130ms/step - loss: 0.6686 - accuracy: 0.7739 - precision: 0.8160 - recall: 0.7266 - F1Score: 0.7684 - val\_loss: 0.5794 - val\_accuracy: 0.8590 - val\_precision: 0.9026 - val\_recall: 0.7426 - val\_F1Score: 0.7958

Epoch 6/50

622/622 - 79s 126ms/step - loss: 0.6413 - accuracy: 0.7795 - precision: 0.8205 - recall: 0.7347 - F1Score: 0.7748 - val\_loss: 0.5553 - val\_accuracy: 0.8624 - val\_precision: 0.8967 - val\_recall: 0.8069 - val\_F1Score: 0.8330

Epoch 7/50

622/622 - 77s 124ms/step - loss: 0.6592 - accuracy: 0.7725 - precision: 0.8175 - recall: 0.7269 - F1Score: 0.7688 - val\_loss: 0.7339 - val\_accuracy: 0.7440 - val\_precision: 0.8576 - val\_recall: 0.5053 - val\_F1Score: 0.5702

Epoch 8/50

622/622 - 79s 127ms/step - loss: 0.6065 - accuracy: 0.7880 - precision: 0.8284 - recall: 0.7464 - F1Score: 0.7848 - val\_loss: 0.7374 - val\_accuracy: 0.7473 - val\_precision: 0.8038 - val\_recall: 0.6402 - val\_F1Score: 0.6919

Epoch 9/50

622/622 - 77s 124ms/step - loss: 0.5960 - accuracy: 0.7911 - precision: 0.8267 - recall: 0.7513 - F1Score: 0.7869 - val\_loss: 0.8799 - val\_accuracy: 0.6944 - val\_precision: 0.7583 - val\_recall: 0.5179 - val\_F1Score: 0.5628

Epoch 10/50

622/622 - 77s 124ms/step - loss: 0.5828 - accuracy: 0.7944 - precision: 0.8294 - recall: 0.7569 - F1Score: 0.7910 - val\_loss: 1.1479 - val\_accuracy: 0.5736 - val\_precision: 0.6149 - val\_recall: 0.4470 - val\_F1Score: 0.4705

Epoch 11/50

622/622 - 77s 124ms/step - loss: 0.5611 - accuracy: 0.8015 - precision: 0.8345 - recall: 0.7653 - F1Score: 0.7982 - val\_loss: 1.0621 - val\_accuracy: 0.5841 - val\_precision: 0.6070 - val\_recall: 0.4832 - val\_F1Score: 0.5076

Epoch 12/50

622/622 - 77s 124ms/step - loss: 0.5465 - accuracy: 0.8058 - precision: 0.8385 - recall: 0.7726 - F1Score: 0.8039 - val\_loss: 1.3065 - val\_accuracy: 0.5365 - val\_precision: 0.5669 - val\_recall: 0.4378 - val\_F1Score: 0.4569

Epoch 13/50

622/622 - 79s 127ms/step - loss: 0.5748 - accuracy: 0.7976 - precision: 0.8319 - recall: 0.7605 - F1Score: 0.7942 - val\_loss: 1.1682 - val\_accuracy: 0.5049 - val\_precision: 0.5256 - val\_recall: 0.4464 - val\_F1Score: 0.4614

Epoch 14/50  
622/622 - 79s 127ms/step - loss: 0.5580 - accuracy: 0.8005 - precision: 0.8319 - recall: 0.7675 - F1Score: 0.7981 - val\_loss: 1.6032 - val\_accuracy: 0.4363 - val\_precision: 0.4481 - val\_recall: 0.3856 - val\_F1Score: 0.3934

Epoch 15/50  
622/622 - 79s 127ms/step - loss: 0.5439 - accuracy: 0.8050 - precision: 0.8368 - recall: 0.7724 - F1Score: 0.8029 - val\_loss: 0.8659 - val\_accuracy: 0.6855 - val\_precision: 0.7394 - val\_recall: 0.5853 - val\_F1Score: 0.6243

Epoch 16/50  
622/622 - 79s 127ms/step - loss: 0.5228 - accuracy: 0.8118 - precision: 0.8419 - recall: 0.7801 - F1Score: 0.8095 - val\_loss: 1.4090 - val\_accuracy: 0.5530 - val\_precision: 0.5640 - val\_recall: 0.4716 - val\_F1Score: 0.4933

Epoch 17/50  
622/622 - 79s 128ms/step - loss: 0.5151 - accuracy: 0.8144 - precision: 0.8454 - recall: 0.7827 - F1Score: 0.8127 - val\_loss: 0.6594 - val\_accuracy: 0.7693 - val\_precision: 0.8107 - val\_recall: 0.6970 - val\_F1Score: 0.7335

Epoch 18/50  
622/622 - 77s 124ms/step - loss: 0.5171 - accuracy: 0.8125 - precision: 0.8449 - recall: 0.7791 - F1Score: 0.8105 - val\_loss: 0.6653 - val\_accuracy: 0.8007 - val\_precision: 0.8456 - val\_recall: 0.7434 - val\_F1Score: 0.7768

Epoch 19/50  
622/622 - 77s 124ms/step - loss: 0.5302 - accuracy: 0.8098 - precision: 0.8408 - recall: 0.7780 - F1Score: 0.8079 - val\_loss: 1.2123 - val\_accuracy: 0.5653 - val\_precision: 0.5934 - val\_recall: 0.4858 - val\_F1Score: 0.5069

Epoch 20/50  
622/622 - 79s 127ms/step - loss: 0.5228 - accuracy: 0.8113 - precision: 0.8407 - recall: 0.7791 - F1Score: 0.8085 - val\_loss: 1.8799 - val\_accuracy: 0.4817 - val\_precision: 0.4830 - val\_recall: 0.4470 - val\_F1Score: 0.4548

Epoch 21/50  
622/622 - 77s 124ms/step - loss: 0.5141 - accuracy: 0.8167 - precision: 0.8448 - recall: 0.7861 - F1Score: 0.8141 - val\_loss: 0.7663 - val\_accuracy: 0.7078 - val\_precision: 0.7925 - val\_recall: 0.5967 - val\_F1Score: 0.6467

Epoch 22/50  
622/622 - 79s 127ms/step - loss: 0.4968 - accuracy: 0.8207 - precision: 0.8502 - recall: 0.7921 - F1Score: 0.8198 - val\_loss: 0.9657 - val\_accuracy: 0.6883 - val\_precision: 0.7416 - val\_recall: 0.5806 - val\_F1Score: 0.6258

Epoch 23/50  
622/622 - 79s 128ms/step - loss: 0.4923 - accuracy: 0.8208 - precision: 0.8490 - recall: 0.7943 - F1Score: 0.8204 - val\_loss: 0.7590 - val\_accuracy: 0.7573 - val\_precision: 0.8161 - val\_recall: 0.6514 - val\_F1Score: 0.7019

Epoch 24/50  
622/622 - 79s 127ms/step - loss: 0.4781 - accuracy: 0.8257 - precision: 0.8541 - recall: 0.7971 - F1Score: 0.8245 - val\_loss: 0.6354 - val\_accuracy: 0.8217 - val\_precision: 0.8580 - val\_recall: 0.7844 - val\_F1Score: 0.8077

Epoch 25/50  
622/622 - 79s 127ms/step - loss: 0.4945 - accuracy: 0.8207 - precision: 0.8485 - recall: 0.7907 - F1Score: 0.8183 - val\_loss: 1.3747 - val\_accuracy: 0.5668 - val\_precision: 0.5924 - val\_recall: 0.5020 - val\_F1Score: 0.5224

Epoch 26/50  
622/622 - 79s 127ms/step - loss: 0.4873 - accuracy: 0.8231 - precision: 0.8521 - recall: 0.7936 - F1Score: 0.8216 - val\_loss: 0.7323 - val\_accuracy: 0.7528 - val\_precision: 0.8119 - val\_recall: 0.6591 - val\_F1Score: 0.7045

Epoch 27/50

622/622 - 79s 127ms/step - loss: 0.4657 - accuracy: 0.8291 - precision: 0.8576 - recall: 0.8017 - F1Score: 0.8286 - val\_loss: 0.8981 - val\_accuracy: 0.6980 - val\_precision: 0.7667 - val\_recall: 0.6130 - val\_F1Score: 0.6545

Epoch 28/50

622/622 - 80s 128ms/step - loss: 0.4560 - accuracy: 0.8313 - precision: 0.8582 - recall: 0.8051 - F1Score: 0.8305 - val\_loss: 1.1451 - val\_accuracy: 0.6270 - val\_precision: 0.6455 - val\_recall: 0.5786 - val\_F1Score: 0.5985

Epoch 29/50

622/622 - 80s 128ms/step - loss: 0.4721 - accuracy: 0.8260 - precision: 0.8521 - recall: 0.7983 - F1Score: 0.8242 - val\_loss: 1.2702 - val\_accuracy: 0.6517 - val\_precision: 0.6710 - val\_recall: 0.6130 - val\_F1Score: 0.6301

Epoch 30/50

622/622 - 79s 128ms/step - loss: 0.4667 - accuracy: 0.8305 - precision: 0.8556 - recall: 0.8048 - F1Score: 0.8291 - val\_loss: 0.8343 - val\_accuracy: 0.7225 - val\_precision: 0.7545 - val\_recall: 0.6304 - val\_F1Score: 0.6699

Epoch 31/50

622/622 - 79s 128ms/step - loss: 0.4528 - accuracy: 0.8340 - precision: 0.8582 - recall: 0.8075 - F1Score: 0.8318 - val\_loss: 0.5789 - val\_accuracy: 0.8181 - val\_precision: 0.8722 - val\_recall: 0.7437 - val\_F1Score: 0.7861

Epoch 32/50

622/622 - 79s 128ms/step - loss: 0.4417 - accuracy: 0.8370 - precision: 0.8609 - recall: 0.8138 - F1Score: 0.8365 - val\_loss: 1.4454 - val\_accuracy: 0.6399 - val\_precision: 0.6557 - val\_recall: 0.5875 - val\_F1Score: 0.6081

Epoch 33/50

622/622 - 77s 124ms/step - loss: 0.4576 - accuracy: 0.8341 - precision: 0.8584 - recall: 0.8086 - F1Score: 0.8326 - val\_loss: 0.6948 - val\_accuracy: 0.7470 - val\_precision: 0.7976 - val\_recall: 0.6979 - val\_F1Score: 0.7286

Epoch 34/50

622/622 - 77s 124ms/step - loss: 0.4421 - accuracy: 0.8394 - precision: 0.8607 - recall: 0.8147 - F1Score: 0.8369 - val\_loss: 1.0036 - val\_accuracy: 0.6611 - val\_precision: 0.7464 - val\_recall: 0.6108 - val\_F1Score: 0.6489

Epoch 35/50

622/622 - 79s 128ms/step - loss: 0.4412 - accuracy: 0.8372 - precision: 0.8602 - recall: 0.8135 - F1Score: 0.8359 - val\_loss: 0.7872 - val\_accuracy: 0.7652 - val\_precision: 0.8081 - val\_recall: 0.7156 - val\_F1Score: 0.7467

Epoch 36/50

622/622 - 77s 124ms/step - loss: 0.4320 - accuracy: 0.8399 - precision: 0.8639 - recall: 0.8162 - F1Score: 0.8392 - val\_loss: 0.8501 - val\_accuracy: 0.7581 - val\_precision: 0.7984 - val\_recall: 0.6816 - val\_F1Score: 0.7202

Epoch 37/50

622/622 - 77s 123ms/step - loss: 0.4247 - accuracy: 0.8426 - precision: 0.8654 - recall: 0.8205 - F1Score: 0.8422 - val\_loss: 0.8963 - val\_accuracy: 0.6947 - val\_precision: 0.7182 - val\_recall: 0.6605 - val\_F1Score: 0.6785

Epoch 38/50

622/622 - 79s 127ms/step - loss: 0.4325 - accuracy: 0.8406 - precision: 0.8639 - recall: 0.8165 - F1Score: 0.8393 - val\_loss: 0.7858 - val\_accuracy: 0.7538 - val\_precision: 0.8306 - val\_recall: 0.6683 - val\_F1Score: 0.7206

Epoch 39/50

622/622 - 77s 124ms/step - loss: 0.4542 - accuracy: 0.8353 - precision: 0.8611 - recall: 0.8084 - F1Score: 0.8336 - val\_loss: 0.6487 - val\_accuracy: 0.8017 - val\_precision: 0.8376 - val\_recall: 0.7511 - val\_F1Score: 0.7801

Epoch 40/50

622/622 - 79s 127ms/step - loss: 0.4321 - accuracy: 0.8403 - precision: 0.8630 - recall: 0.8182 - F1Score: 0.8397 - val\_loss: 0.9898 - val\_accuracy: 0.6338 - val\_precision: 0.7123 - val\_recall: 0.5619 - val\_F1Score: 0.5976



Epoch 41/50  
622/622 - 77s 123ms/step - loss: 0.4395 - accuracy: 0.8387 - precision: 0.8635 - recall: 0.8141 - F1Score: 0.8378 - val\_loss: 1.2154 - val\_accuracy: 0.6011 - val\_precision: 0.6200 - val\_recall: 0.5370 - val\_F1Score: 0.5630

Epoch 42/50  
622/622 - 79s 127ms/step - loss: 0.4084 - accuracy: 0.8497 - precision: 0.8699 - recall: 0.8283 - F1Score: 0.8484 - val\_loss: 0.7391 - val\_accuracy: 0.7605 - val\_precision: 0.8046 - val\_recall: 0.7011 - val\_F1Score: 0.7360

Epoch 43/50  
622/622 - 79s 127ms/step - loss: 0.4264 - accuracy: 0.8410 - precision: 0.8658 - recall: 0.8172 - F1Score: 0.8406 - val\_loss: 0.6149 - val\_accuracy: 0.8092 - val\_precision: 0.8512 - val\_recall: 0.7422 - val\_F1Score: 0.7806

Epoch 44/50  
622/622 - 79s 127ms/step - loss: 0.4117 - accuracy: 0.8480 - precision: 0.8690 - recall: 0.8264 - F1Score: 0.8470 - val\_loss: 1.0727 - val\_accuracy: 0.6385 - val\_precision: 0.7154 - val\_recall: 0.5806 - val\_F1Score: 0.6167

Epoch 45/50  
622/622 - 77s 124ms/step - loss: 0.4092 - accuracy: 0.8476 - precision: 0.8693 - recall: 0.8270 - F1Score: 0.8474 - val\_loss: 0.9544 - val\_accuracy: 0.6727 - val\_precision: 0.7429 - val\_recall: 0.6374 - val\_F1Score: 0.6671

Epoch 46/50  
622/622 - 77s 124ms/step - loss: 0.4302 - accuracy: 0.8427 - precision: 0.8657 - recall: 0.8173 - F1Score: 0.8405 - val\_loss: 0.8621 - val\_accuracy: 0.6903 - val\_precision: 0.7209 - val\_recall: 0.6602 - val\_F1Score: 0.6768

Epoch 47/50  
622/622 - 77s 124ms/step - loss: 0.3975 - accuracy: 0.8540 - precision: 0.8752 - recall: 0.8339 - F1Score: 0.8539 - val\_loss: 1.1576 - val\_accuracy: 0.5792 - val\_precision: 0.6499 - val\_recall: 0.5194 - val\_F1Score: 0.5487

Epoch 48/50  
622/622 - 79s 127ms/step - loss: 0.3971 - accuracy: 0.8524 - precision: 0.8728 - recall: 0.8321 - F1Score: 0.8518 - val\_loss: 0.7655 - val\_accuracy: 0.7433 - val\_precision: 0.7748 - val\_recall: 0.7014 - val\_F1Score: 0.7260

Epoch 49/50  
622/622 - 79s 127ms/step - loss: 0.4030 - accuracy: 0.8514 - precision: 0.8718 - recall: 0.8310 - F1Score: 0.8508 - val\_loss: 0.9683 - val\_accuracy: 0.7026 - val\_precision: 0.7427 - val\_recall: 0.6500 - val\_F1Score: 0.6800

Epoch 50/50  
622/622 - 79s 127ms/step - loss: 0.3866 - accuracy: 0.8573 - precision: 0.8770 - recall: 0.8373 - F1Score: 0.8565 - val\_loss: 1.5050 - val\_accuracy: 0.5724 - val\_precision: 0.5972 - val\_recall: 0.5284 - val\_F1Score: 0.5452

Lampiran 2. *Source Code Deployment Model*

```

import streamlit as st
import pickle
import pandas as pd
import numpy as np
from sklearn.preprocessing import MinMaxScaler, LabelEncoder
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.models import load_model
from keras.utils import custom_object_scope
from metrics import F1Score
import base64
from tqdm import tqdm
from sklearn.metrics import accuracy_score, classification_report,
confusion_matrix, roc_curve, auc
import seaborn as sns
import matplotlib.pyplot as plt

def download_csv(df):
    csv = df.to_csv(index=False)
    b64 = base64.b64encode(csv.encode()).decode()
    href = f'<a href="data:file/csv;base64,{b64}"
download="predictions.csv">Download CSV file</a>'
    st.markdown(href, unsafe_allow_html=True)

def main():
    # st.title("OTT Traffic Network Identification")

    html_temp = """
    <div style="background-color:teal ;padding:10px">
    <h2 style="color:white;text-align:center;">OTT Traffic Network
Classification</h2>
    </div>
    """
    st.markdown(html_temp, unsafe_allow_html=True)

    activities=['CNN', 'LSTM', 'Bi-LSTM']
    option=st.sidebar.selectbox('Which model would you like to
use?',activities)
    markdown_text = f"<div style='text-align:center; font-
size:30px'><b>{option}</b></div>"
    st.markdown(markdown_text, unsafe_allow_html=True)
    upload_test = st.file_uploader("Upload your file here")

    if upload_test:
        data_test = pd.read_csv(upload_test)
        st.write(data_test.head(10))

    if upload_test:

```

```

        if st.button('Identify'):
            if option=='CNN':
                st.success(process_cnn(data_test))
            else:
                st.success(process_lstm(data_test,option))

def process_cnn(data_test):

    data = pd.read_csv("./data/data_train_norm.csv")
    # st.write(data.head())

    list_cols = [ "pktTotalCount", "octetTotalCount", "min_ps",
"max_ps", "avg_ps",
    "std_dev_ps", "flowStart", "flowEnd", "flowDuration",
    "min_piat", "max_piat", "avg_piat", "std_dev_piat",
"f_pktTotalCount",
    "f_octetTotalCount", "f_max_ps", "f_avg_ps", "f_std_dev_ps",
"f_min_piat",
    "f_max_piat", "f_avg_piat", "f_std_dev_piat", "b_pktTotalCount",
    "b_octetTotalCount", "b_max_ps", "b_avg_ps", "b_std_dev_ps",
"b_min_piat",
    "b_max_piat", "b_avg_piat", "b_std_dev_piat",]

    categorical = ["src_ip_numeric", "dst_ip_numeric", "src_port",
"dst_port", "proto", "flowEndReason" ]

    list_targets = [
        "Amazon", "Dropbox", "Facebook", "GMail", "Google", "IMO",
        "Instagram", "Messenger", "Microsoft",
        "Skype","Twitter", "UbuntuONE", "WhatsApp", "YouTube"
    ]

    # define feature and target
    train_feature = data.drop(['web_service'], axis=1)
    train_num = train_feature[list_cols].values.astype("float32")
    train_target = data["web_service"]

    scaler = MinMaxScaler()
    scaler.fit(train_num)

    encoder = LabelEncoder()
    y_train = encoder.fit(train_target.values)

    feature = data_test.drop(['flow_key', 'category',
'application_protocol'], axis=1)
    feature_num = feature[list_cols].values.astype("float32")
    feature_cat = feature[categorical].values.astype("float32")
    scaled_num = scaler.transform(feature_num)
    feature_scaled = np.hstack((scaled_num, feature_cat))

```

```

feature_scaled = feature_scaled.reshape(feature_scaled.shape[0],
feature_scaled.shape[1], 1)

with custom_object_scope({'F1Score': F1Score}):
    model = load_model("./model/cnn_over.h5")

y_preds = model.predict(feature_scaled).argmax(axis = 1)
y_preds = encoder.inverse_transform(y_preds)

y_preds_df = pd.DataFrame(y_preds, columns=["Identified OTT"])
df_with_preds = pd.concat([data_test, y_preds_df], axis=1)

st.subheader("Preview of Classification Results")
st.write(df_with_preds.sample(20))

data_as_csv = df_with_preds.to_csv(index=False).encode("utf-8")
st.download_button(
    "Download data as CSV",
    data_as_csv,
    "predicted-traffic.csv",
    "text/csv",
    key="download-tools-csv",
)
st.stop()

def process_lstm(data_test, option):

    def create_sequences(df, target_var, seq_length=150, step=20):

        def get_sequence_label(seq_df):
            return seq_df[target_var].mode()[0]

        sequences = []
        labels = []

        for i in tqdm(range(0, len(df) - seq_length + 1, step)):
            seq_df = df.iloc[i:i+seq_length]

            if len(seq_df) == seq_length:

sequences.append(seq_df.drop(columns=[target_var]).values)
                labels.append(get_sequence_label(seq_df))

        sequences = np.array(sequences)
        labels = np.array(labels)

        return sequences, labels

```

```

list_cols = [ "pktTotalCount", "octetTotalCount", "min_ps",
"max_ps", "avg_ps",
"std_dev_ps", "flowStart", "flowEnd", "flowDuration",
"min_piat", "max_piat", "avg_piat", "std_dev_piat",
"f_pktTotalCount",
"f_octetTotalCount", "f_max_ps", "f_avg_ps", "f_std_dev_ps",
"f_min_piat",
"f_max_piat", "f_avg_piat", "f_std_dev_piat", "b_pktTotalCount",
"b_octetTotalCount", "b_max_ps", "b_avg_ps", "b_std_dev_ps",
"b_min_piat",
"b_max_piat", "b_avg_piat", "b_std_dev_piat",]

categorical = ["src_ip_numeric", "dst_ip_numeric", "src_port",
"dst_port", "proto", "flowEndReason" ]

list_targets = [
"Amazon", "Dropbox", "Facebook", "GMail", "Google", "IMO",
"Instagram", "Messenger", "Microsoft",
"Skype", "Twitter", "UbuntuONE", "WhatsApp", "YouTube"
]

# define feature and target
# reduce rows based on defined targets
test_feature = data_test.drop(['web_service',
'application_protocol', 'category', 'flow_key'], axis=1)
test_target = data_test["web_service"]

scaler = MinMaxScaler()
test_feature[list_cols] =
scaler.fit_transform(test_feature[list_cols])
test_scaled = pd.concat([test_feature[list_cols],
test_feature[categorical], test_target], axis=1)

# Create the sequences and labels using the `create_sequences`
function
test_segment, test_label = create_sequences(test_scaled,
'web_service')

encoder = LabelEncoder()
# encode label
target_encode = encoder.fit_transform(test_label)
test_categorical = to_categorical(target_encode)

with custom_object_scope({'F1Score': F1Score}):
if option == 'LSTM':
model = load_model("./model/lstm_norm.h5")
else:
model = load_model("./model/bilstm_norm.h5")

```

```

y_preds = model.predict(test_segment).argmax(axis = 1)
y_true = test_categorical.argmax(axis = 1)

cm = confusion_matrix(y_true, y_preds)
report_dict = (classification_report(y_true, y_preds,
target_names = [list_targets[i] for i in np.unique(y_true)],
output_dict=True))
report = (classification_report(y_true, y_preds, target_names =
[list_targets[i] for i in np.unique(y_true)]))

accuracy = accuracy_score(y_true, y_preds)
f1_score = report_dict['macro avg']['f1-score']

st.divider()
col1, col2 = st.columns(2)
col1.metric("Accuracy", round(accuracy * 100, 2))
col2.metric("F1 Score", round(f1_score * 100, 2))

col1, col2 = st.columns(2)

with col1:
    # compute confusion matrix
    conf_mat = confusion_matrix(y_true, y_preds)
    # create heatmap
    cm_fig, ax = plt.subplots(figsize=(9,7))
    # Create the heatmap using seaborn with light theme
    sns.heatmap(conf_mat, annot=True, fmt="d", cbar=True,
ax=ax, square = True, annot_kws={"fontsize": 8})

    # Set labels, title, and ticks
    ax.set_xlabel("Predicted Classes")
    ax.set_ylabel("Actual Classes")
    ax.set_title("Confusion matrix")
    ax.set_xticklabels(list_targets, rotation=45, ha='right',
fontsize=8)
    ax.set_yticklabels(list_targets, rotation=0, fontsize=8)
    ax.tick_params(axis='x', colors='black')
    ax.tick_params(axis='y', colors='black')

    # adjust plot layout
    plt.tight_layout()
    st.pyplot(cm_fig)

with col2:
    # compute ROC curve and ROC area for each class
    n_classes = len(list_targets)
    y_onehot = np.eye(n_classes)[y_true]
    y_score = np.eye(n_classes)[y_preds]
    fpr = dict()

```

```

tpr = dict()
roc_auc = dict()
for i in range(n_classes):
    fpr[i], tpr[i], _ = roc_curve(y_onehot[:, i], y_score[:,
i])
    roc_auc[i] = auc(fpr[i], tpr[i])

# Plot ROC curves
roc_fig, ax = plt.subplots(figsize=(9, 7.7))
for i in range(n_classes):
    plt.plot(fpr[i], tpr[i], label='ROC Curve {} (area =
 {:.2f})'.format(list_targets[i], roc_auc[i]))

plt.plot([0, 1], [0, 1], 'k--')
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve')
plt.legend(loc="lower right")
st.pyplot(roc_fig)

st.header("Classification Report")
st.code(report)
st.stop()

if __name__ == '__main__':
    main()

```