Trong quá trình code thì có 1 cái bug nhỏ nhỏ, đây là kết quả trước khi fix bug (không cao bằng sau khi fix bug). Kết quả này chỉ để chứng minh sự ổn định của mô hình

Times: 1
Accuracy: 93.38%
F1 Score: 85.14%
Precision: 92.82%
Recall: 78.63%

{'learning_rate': 0.2915812030160753, 'max_depth': 14, 'subsample': 0.8358711439832384, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.9785353983381553, 'base_score': 0.75}
n_estimators: 90
Thời gian train: 720.760494 giây
Thời gian test: 96.793900 giây

Times: 2
Accuracy: 93.39%
F1 Score: 85.27%
Precision: 92.13%
Recall: 79.36%

{'learning_rate': 0.3742031465619321, 'max_depth': 20, 'subsample': 0.7901172682430067, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.037493509078348, 'base_score': 0.75}
n_estimators: 86
Thời gian train: 769.559253 giây
Thời gian test: 98.455912 giây

Times: 3
Accuracy: 93.31%
F1 Score: 84.82%
Precision: 93.54%
Recall: 77.59%

{'learning_rate': 0.20294642170109564, 'max_depth': 12, 'subsample': 0.726513427622264, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.2274334571686079, 'base_score': 0.75}
n_estimators: 82
Thời gian train: 588.061656 giây
Thời gian test: 79.418893 giây

Times: 4
Accuracy: 93.16%
F1 Score: 84.44%
Precision: 93.42%
Recall: 77.04%

{'learning_rate': 0.234093388497185, 'max_depth': 14, 'subsample': 0.7884665363546642, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.5031255169149849, 'base_score': 0.75}

n_estimators: 58
Thời gian train: 466.467558 giây
Thời gian test: 56.365968 giây

Times: 5
Accuracy: 93.18%
F1 Score: 84.73%
Precision: 92.05%
Recall: 78.49%

{'learning_rate': 0.3292101762822345, 'max_depth': 13, 'subsample': 0.7211109044602637, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.5764683017055452, 'base_score': 0.75}
n_estimators: 59
Thời gian train: 446.129905 giây
Thời gian test: 59.605972 giây

Times: 6
Accuracy: 93.39%
F1 Score: 85.26%
Precision: 92.20%
Recall: 79.29%

{'learning_rate': 0.32907274335743897, 'max_depth': 20, 'subsample': 0.8720637415462016, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.8644530821371883, 'base_score': 0.75}
n_estimators: 72
Thời gian train: 683.453436 giây
Thời gian test: 83.682319 giây

Times: 7
Accuracy: 93.38%
F1 Score: 85.18%
Precision: 92.57%
Recall: 78.87%

{'learning_rate': 0.30349723864263245, 'max_depth': 12, 'subsample': 0.8820213098184133, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.7380113546377567, 'base_score': 0.75}
n_estimators: 82
Thời gian train: 619.729235 giây
Thời gian test: 84.482719 giây

Times: 8
Accuracy: 93.38%
F1 Score: 84.99%
Precision: 93.60%
Recall: 77.84%

{'learning_rate': 0.21657674874427374, 'max_depth': 17, 'subsample': 0.7815216866147536, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.6583243972949084, 'base_score': 0.75}
n_estimators: 58
Thời gian train: 470.812317 giây

Thời gian test: 57.918499 giây

Times: 9
Accuracy: 93.47%
F1 Score: 85.38%
Precision: 92.64%
Recall: 79.18%

{'learning_rate': 0.36337366697986434, 'max_depth': 18, 'subsample': 0.8725066765598116, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.7348089857619753, 'base_score': 0.75}
n_estimators: 85
Thời gian train: 802.059144 giây
Thời gian test: 97.479431 giây

Times: 10
Accuracy: 93.38%
F1 Score: 85.08%
Precision: 93.02%
Recall: 78.39%

{'learning_rate': 0.26217246710237174, 'max_depth': 13, 'subsample': 0.7560779477361665, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.4933813298307215, 'base_score': 0.75}
n_estimators: 82
Thời gian train: 635.667851 giây
Thời gian test: 83.856061 giây

Times: 11
Accuracy: 93.39%
F1 Score: 85.22%
Precision: 92.44%
Recall: 79.05%

{'learning_rate': 0.3403595529281148, 'max_depth': 13, 'subsample': 0.775723200723048, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.3743575317403185, 'base_score': 0.75}
n_estimators: 62
Thời gian train: 493.516645 giây
Thời gian test: 63.732815 giây

Lần chạy thứ 2:

Times: 1
Accuracy: 93.21%
F1 Score: 84.81%
Precision: 91.99%
Recall: 78.67%

{'learning_rate': 0.3625723006143446, 'max_depth': 13, 'subsample': 0.7511843134516374, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.177287653420585, 'base_score': 0.75}
n_estimators: 75
Thời gian train: 614.344625 giây
Thời gian test: 80.604118 giây

Times: 2
Accuracy: 93.33%
F1 Score: 85.02%
Precision: 92.69%
Recall: 78.53%

{'learning_rate': 0.36939891383235013, 'max_depth': 16, 'subsample': 0.8494097414155424, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.8457030720572136, 'base_score': 0.75}
n_estimators: 53
Thời gian train: 499.314307 giây
Thời gian test: 59.271863 giây

Times: 3
Accuracy: 93.29%
F1 Score: 85.01%
Precision: 92.09%
Recall: 78.94%

{'learning_rate': 0.31991069441040043, 'max_depth': 19, 'subsample': 0.8800658736190863, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.700123103588676, 'base_score': 0.75}
n_estimators: 73
Thời gian train: 722.696660 giây
Thời gian test: 88.105352 giây

Times: 4
Accuracy: 93.21%
F1 Score: 84.90%
Precision: 91.46%
Recall: 79.22%

{'learning_rate': 0.370965759885013, 'max_depth': 15, 'subsample': 0.7377909468679633, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.377305023680371, 'base_score': 0.75}
n_estimators: 99
Thời gian train: 795.781571 giây
Thời gian test: 111.932804 giây

Times: 5
Accuracy: 93.33%
F1 Score: 85.08%
Precision: 92.24%
Recall: 78.94%

{'learning_rate': 0.23772938658789428, 'max_depth': 19, 'subsample': 0.8257471885844647, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.195592008465077, 'base_score': 0.75}

n_estimators: 83
Thời gian train: 802.496509 giây
Thời gian test: 99.332890 giây

Times: 6
Accuracy: 93.28%
F1 Score: 84.86%
Precision: 92.89%
Recall: 78.11%

{'learning_rate': 0.23846103589228893, 'max_depth': 20, 'subsample': 0.7672171108315351,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.2585511813225128, 'base_score': 0.75}
n_estimators: 56
Thời gian train: 524.931128 giây
Thời gian test: 61.385501 giây

Times: 7
Accuracy: 93.24%
F1 Score: 84.84%
Precision: 92.35%
Recall: 78.46%

{'learning_rate': 0.2716195576031786, 'max_depth': 15, 'subsample': 0.7905949394684113,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.5146645215288679, 'base_score': 0.75}
n_estimators: 71
Thời gian train: 639.499361 giây
Thời gian test: 78.043470 giây

Times: 8
Accuracy: 93.16%
F1 Score: 84.66%
Precision: 92.08%
Recall: 78.35%

{'learning_rate': 0.34457813210703786, 'max_depth': 13, 'subsample': 0.7150884871033325,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.0185067941967008, 'base_score': 0.75}
n_estimators: 73
Thời gian train: 555.882150 giây
Thời gian test: 77.864838 giây

Times: 9
Accuracy: 93.28%
F1 Score: 84.92%
Precision: 92.54%
Recall: 78.46%

{'learning_rate': 0.2206078223938139, 'max_depth': 14, 'subsample': 0.7553623387095134,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.9651579660283938, 'base_score': 0.75}
n_estimators: 99
Thời gian train: 772.960175 giây

Thời gian test: 107.722911 giây

Times: 10
Accuracy: 93.47%
F1 Score: 85.33%
Precision: 92.95%
Recall: 78.87%

{'learning_rate': 0.2625037890324058, 'max_depth': 15, 'subsample': 0.7726965302168614, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.9212415676485357, 'base_score': 0.75}
n_estimators: 77
Thời gian train: 648.581345 giây
Thời gian test: 84.651981 giây

Times: 11
Accuracy: 93.29%
F1 Score: 85.08%
Precision: 91.66%
Recall: 79.39%

{'learning_rate': 0.3450572537823793, 'max_depth': 19, 'subsample': 0.7749759922392756, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.6030720307967803, 'base_score': 0.75}
n_estimators: 100
Thời gian train: 869.213324 giây
Thời gian test: 115.226130 giây

Times: 12
Accuracy: 93.29%
F1 Score: 84.97%
Precision: 92.33%
Recall: 78.70%

{'learning_rate': 0.31164231224367667, 'max_depth': 16, 'subsample': 0.7639804708282407, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.6011818079897364, 'base_score': 0.75}
n_estimators: 77
Thời gian train: 689.921214 giây
Thời gian test: 87.395312 giây

Times: 13
Accuracy: 93.13%
F1 Score: 84.51%
Precision: 92.62%
Recall: 77.70%

{'learning_rate': 0.20201956118103181, 'max_depth': 18, 'subsample': 0.8033708542246375, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.8946632429323536, 'base_score': 0.75}
n_estimators: 99
Thời gian train: 945.395405 giây
Thời gian test: 111.504982 giây

Times: 14
Accuracy: 93.53%
F1 Score: 85.54%
Precision: 92.62%
Recall: 79.46%

{'learning_rate': 0.3191038613937676, 'max_depth': 16, 'subsample': 0.7150331132898761, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.3178148509068706, 'base_score': 0.75}
n_estimators: 98
Thời gian train: 851.016990 giây
Thời gian test: 112.311276 giây

Times: 15
Accuracy: 93.17%
F1 Score: 84.63%
Precision: 92.57%
Recall: 77.94%

{'learning_rate': 0.2122689162176367, 'max_depth': 16, 'subsample': 0.899907259158363, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.123220609205938, 'base_score': 0.75}
n_estimators: 72
Thời gian train: 689.444825 giây
Thời gian test: 78.101461 giây

Times: 16
Accuracy: 93.27%
F1 Score: 84.86%
Precision: 92.78%
Recall: 78.18%

{'learning_rate': 0.21945126340940918, 'max_depth': 16, 'subsample': 0.793540583338285, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.9743693720817173, 'base_score': 0.75}
n_estimators: 78
Thời gian train: 660.757728 giây
Thời gian test: 84.226503 giây

Times: 17
Accuracy: 93.36%
F1 Score: 85.17%
Precision: 92.19%
Recall: 79.15%

{'learning_rate': 0.3291512528811621, 'max_depth': 16, 'subsample': 0.890177379978124, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.8964576956320567, 'base_score': 0.75}
n_estimators: 86
Thời gian train: 781.827168 giây
Thời gian test: 99.815987 giây

Times: 18

Accuracy: 93.13%
F1 Score: 84.54%
Precision: 92.41%
Recall: 77.90%

{'learning_rate': 0.25582715046299254, 'max_depth': 16, 'subsample': 0.8793526886562827, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.079738939780703, 'base_score': 0.75}
n_estimators: 68
Thời gian train: 629.640470 giây
Thời gian test: 74.993124 giây

Times: 1
Accuracy: 93.39%
F1 Score: 85.16%
Precision: 92.82%
Recall: 78.67%

{'learning_rate': 0.3319946164176514, 'max_depth': 14, 'subsample': 0.7675054771817555, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.0139484065507958, 'base_score': 0.75}
n_estimators: 53
Thời gian train: 443.427894 giây
Thời gian test: 58.313629 giây

Times: 2
Accuracy: 93.32%
F1 Score: 84.90%
Precision: 93.22%
Recall: 77.94%

{'learning_rate': 0.20207022545092276, 'max_depth': 14, 'subsample': 0.8401765904433116, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.206749197520117, 'base_score': 0.75}
n_estimators: 87
Thời gian train: 758.035904 giây
Thời gian test: 96.252326 giây

Times: 3
Accuracy: 93.03%
F1 Score: 84.49%
Precision: 91.15%
Recall: 78.73%

{'learning_rate': 0.385838278194556, 'max_depth': 16, 'subsample': 0.7927451702810461, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.9432486207870652, 'base_score': 0.75}
n_estimators: 78
Thời gian train: 697.093153 giây
Thời gian test: 89.201627 giây

Times: 4
Accuracy: 93.12%
F1 Score: 84.61%
Precision: 91.86%
Recall: 78.42%

{'learning_rate': 0.39172698852163107, 'max_depth': 18, 'subsample': 0.8471393322022952, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.4631758287737782, 'base_score': 0.75}
n_estimators: 52
Thời gian train: 523.581898 giây
Thời gian test: 58.353750 giây

Times: 5
Accuracy: 93.20%
F1 Score: 84.83%
Precision: 91.75%
Recall: 78.87%

{'learning_rate': 0.34034366260744514, 'max_depth': 19, 'subsample': 0.7822746622150664, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.412241859705304, 'base_score': 0.75}
n_estimators: 57
Thời gian train: 529.016929 giây
Thời gian test: 64.076355 giây

Times: 6
Accuracy: 93.25%
F1 Score: 84.87%
Precision: 92.28%
Recall: 78.56%

{'learning_rate': 0.2738874613104734, 'max_depth': 18, 'subsample': 0.7617291071954383, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.1872738612551594, 'base_score': 0.75}
n_estimators: 64
Thời gian train: 637.755174 giây
Thời gian test: 69.305220 giây

Times: 7
Accuracy: 93.36%
F1 Score: 85.16%
Precision: 92.29%
Recall: 79.05%

{'learning_rate': 0.3102783333564698, 'max_depth': 13, 'subsample': 0.7625777436559045, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.5965046299582408, 'base_score': 0.75}
n_estimators: 100
Thời gian train: 811.175982 giây
Thời gian test: 107.417660 giây

Times: 8

Accuracy: 93.42%
F1 Score: 85.15%
Precision: 93.43%
Recall: 78.22%

{'learning_rate': 0.22766537616958363, 'max_depth': 19, 'subsample': 0.8083573230257906, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.8188994720966731, 'base_score': 0.75}
n_estimators: 62
Thời gian train: 598.828727 giây
Thời gian test: 68.103280 giây

Times: 9
Accuracy: 93.37%
F1 Score: 85.24%
Precision: 91.92%
Recall: 79.46%

{'learning_rate': 0.37959612417586175, 'max_depth': 20, 'subsample': 0.7071190852972624, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.894274545917447, 'base_score': 0.75}
n_estimators: 96
Thời gian train: 791.583811 giây
Thời gian test: 109.608197 giây

Times: 10
Accuracy: 93.15%
F1 Score: 84.43%
Precision: 93.34%
Recall: 77.07%

{'learning_rate': 0.23170664608775093, 'max_depth': 15, 'subsample': 0.890395723366066, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.0497572340540025, 'base_score': 0.75}
n_estimators: 50
Thời gian train: 435.055952 giây
Thời gian test: 49.488590 giây

Times: 11
Accuracy: 93.08%
F1 Score: 84.36%
Precision: 92.67%
Recall: 77.42%

{'learning_rate': 0.3573459755936248, 'max_depth': 14, 'subsample': 0.7205320079136959, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.938355801554892, 'base_score': 0.75}
n_estimators: 50
Thời gian train: 381.081365 giây
Thời gian test: 52.364432 giây

Times: 12
Accuracy: 93.32%
F1 Score: 85.03%

Precision: 92.41%
Recall: 78.73%

{'learning_rate': 0.3238877815154922, 'max_depth': 16, 'subsample': 0.822219878417335,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.161969604122616, 'base_score': 0.75}
n_estimators: 73
Thời gian train: 658.856289 giây
Thời gian test: 83.315574 giây

Times: 13
Accuracy: 93.08%
F1 Score: 84.57%
Precision: 91.34%
Recall: 78.73%

{'learning_rate': 0.3629537756483528, 'max_depth': 14, 'subsample': 0.7041019074058619,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 1.3482605565924537, 'base_score': 0.75}
n_estimators: 98
Thời gian train: 779.858172 giây
Thời gian test: 106.597212 giây

Times: 1
Accuracy: 93.28%
F1 Score: 84.72%
Precision: 93.79%
Recall: 77.25%

{'learning_rate': 0.10320077869533933, 'max_depth': 20, 'subsample': 0.6097547627177247,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 3.0375756256637763, 'base_score': 0.5}
n_estimators: 89
Thời gian train: 618.142679 giây
Thời gian test: 81.948707 giây

Times: 2
Accuracy: 93.21%
F1 Score: 84.51%
Precision: 93.80%
Recall: 76.90%

{'learning_rate': 0.12076543034587278, 'max_depth': 16, 'subsample': 0.7181970485190858,
'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 3.3883652646882836, 'base_score': 0.5}
n_estimators: 98
Thời gian train: 704.817550 giây
Thời gian test: 94.923040 giây

Times: 3

Accuracy: 93.21%
F1 Score: 84.63%
Precision: 93.11%
Recall: 77.56%

{'learning_rate': 0.1760024710235429, 'max_depth': 18, 'subsample': 0.8254926711181025, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 3.784397321721968, 'base_score': 0.5}
n_estimators: 86
Thời gian train: 708.583973 giây
Thời gian test: 91.682189 giây

Times: 4
Accuracy: 93.18%
F1 Score: 84.50%
Precision: 93.50%
Recall: 77.07%

{'learning_rate': 0.1107753262877994, 'max_depth': 19, 'subsample': 0.6397014994923381, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.231790122897828, 'base_score': 0.5}
n_estimators: 87
Thời gian train: 648.604391 giây
Thời gian test: 80.473542 giây

Times: 5
Accuracy: 93.26%
F1 Score: 84.69%
Precision: 93.56%
Recall: 77.35%

{'learning_rate': 0.1336598815114524, 'max_depth': 20, 'subsample': 0.8954928610800057, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 3.158172295367523, 'base_score': 0.5}
n_estimators: 78
Thời gian train: 696.316714 giây
Thời gian test: 78.182401 giây

Times: 6
Accuracy: 93.31%
F1 Score: 84.85%
Precision: 93.36%
Recall: 77.77%

{'learning_rate': 0.17575409417322496, 'max_depth': 19, 'subsample': 0.7954153250054333, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.838995209465158, 'base_score': 0.5}
n_estimators: 90
Thời gian train: 787.918282 giây
Thời gian test: 98.321584 giây

Times: 7
Accuracy: 92.97%
F1 Score: 83.96%

Precision: 93.36%
Recall: 76.28%

{'learning_rate': 0.13850008950018963, 'max_depth': 17, 'subsample': 0.5270990361995134, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 3.4020593643960675, 'base_score': 0.5}
n_estimators: 75
Thời gian train: 455.869723 giây
Thời gian test: 69.102875 giây

Times: 8
Accuracy: 93.22%
F1 Score: 84.61%
Precision: 93.33%
Recall: 77.39%

{'learning_rate': 0.1578933750929088, 'max_depth': 19, 'subsample': 0.9670593006602863, 'reg_lambda': 1.0, 'gamma': 0.0, 'min_child_weight': 2.950605556696705, 'base_score': 0.5}
n_estimators: 89
Thời gian train: 854.242097 giây
Thời gian test: 95.758486 giây