C:\Users\Robai\Desktop\CsProjects\StockTraderV3\Deep-Reinforcement-Learning-for-Automated-Stock-Trading-Ensemble-Strategy-ICAIF-2020>python run\_DRL.py

datadate tic adjcp open high low volume macd rsi cci adx turbulence

0 20090102 AAPL 12.964286 12.268571 13.005714 12.165714 26641980.0 0.0 100.0 66.666667 100.0 0.0

1 20090102 AXP 19.330000 18.570000 19.520000 18.400000 10955620.0 0.0 100.0 66.666667 100.0 0.0

2 20090102 BA 45.250000 42.800000 45.560000 42.780000 7010171.0 0.0 100.0 66.666667 100.0 0.0

3 20090102 CAT 46.910000 44.910000 46.980000 44.710000 7116726.0 0.0 0.0 66.666667 100.0 0.0

4 20090102 CSCO 16.960000 16.410000 17.000000 16.250000 40977480.0 0.0 100.0 66.666667 100.0 0.0

1053360

[20151002 20151005 20151006 ... 20200702 20200706 20200707]

============Start Ensemble Strategy============

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20151002

======A2C Training========

Training time (A2C): 2.0102113087972007 minutes

======A2C Validation from: 20151002 to 20160104

A2C Sharpe Ratio: -0.028729550678645216

======PPO Training========

Training time (PPO): 7.24202633301417 minutes

======PPO Validation from: 20151002 to 20160104

PPO Sharpe Ratio: -0.005389146775433365

======DDPG Training========

Training time (DDPG): 1.2334364175796508 minutes

======DDPG Validation from: 20151002 to 20160104

======Trading from: 20160104 to 20160405

previous\_total\_asset:1000000

end\_total\_asset:1058835.4941962215

total\_reward:58835.494196221465

total\_cost: 1464.0755616076683

total trades: 1249

Sharpe: 0.18286140166121384

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20160104

======A2C Training========

Training time (A2C): 2.467221148808797 minutes

======A2C Validation from: 20160104 to 20160405

A2C Sharpe Ratio: 0.09009195009292005

======PPO Training========

Training time (PPO): 7.790709761778514 minutes

======PPO Validation from: 20160104 to 20160405

PPO Sharpe Ratio: 0.22112933381553274

======DDPG Training========

Training time (DDPG): 1.390673045317332 minutes

======DDPG Validation from: 20160104 to 20160405

======Trading from: 20160405 to 20160705

previous\_total\_asset:1058835.4941962215

end\_total\_asset:1067521.3722468459

total\_reward:8685.878050624393

total\_cost: 4520.202738206032

total trades: 1495

Sharpe: 0.037652997891755656

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20160405

======A2C Training========

Training time (A2C): 2.0334933002789817 minutes

======A2C Validation from: 20160405 to 20160705

A2C Sharpe Ratio: 0.06395146867957373

======PPO Training========

Training time (PPO): 7.311526052157084 minutes

======PPO Validation from: 20160405 to 20160705

PPO Sharpe Ratio: 0.03981300724306997

======DDPG Training========

Training time (DDPG): 1.2892975409825642 minutes

======DDPG Validation from: 20160405 to 20160705

======Trading from: 20160705 to 20161003

previous\_total\_asset:1067521.3722468459

end\_total\_asset:1092451.2820891899

total\_reward:24929.909842344

total\_cost: 2724.7284891900463

total trades: 1329

Sharpe: 0.1175670389491662

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20160705

======A2C Training========

Training time (A2C): 2.1070903460184733 minutes

======A2C Validation from: 20160705 to 20161003

A2C Sharpe Ratio: 0.1446817375260123

======PPO Training========

Training time (PPO): 7.426472906271616 minutes

======PPO Validation from: 20160705 to 20161003

PPO Sharpe Ratio: -0.08079419692885331

======DDPG Training========

Training time (DDPG): 1.3526938160260518 minutes

======DDPG Validation from: 20160705 to 20161003

======Trading from: 20161003 to 20170103

previous\_total\_asset:1092451.2820891899

end\_total\_asset:1172110.1904086727

total\_reward:79658.90831948281

total\_cost: 1528.4187319321372

total trades: 1001

Sharpe: 0.42116930435394206

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20161003

======A2C Training========

Training time (A2C): 2.2791646122932434 minutes

======A2C Validation from: 20161003 to 20170103

A2C Sharpe Ratio: 0.4972116472632053

======PPO Training========

Training time (PPO): 7.965102700392405 minutes

======PPO Validation from: 20161003 to 20170103

PPO Sharpe Ratio: 0.34391203103200707

======DDPG Training========

Training time (DDPG): 1.3343050479888916 minutes

======DDPG Validation from: 20161003 to 20170103

======Trading from: 20170103 to 20170404

previous\_total\_asset:1172110.1904086727

end\_total\_asset:1209492.251442472

total\_reward:37382.06103379931

total\_cost: 1482.702086245127

total trades: 1110

Sharpe: 0.20119166006934858

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20170103

======A2C Training========

Training time (A2C): 1.818022855122884 minutes

======A2C Validation from: 20170103 to 20170404

A2C Sharpe Ratio: 0.3970208813165948

======PPO Training========

Training time (PPO): 7.143004858493805 minutes

======PPO Validation from: 20170103 to 20170404

PPO Sharpe Ratio: 0.35035398067949813

======DDPG Training========

Training time (DDPG): 1.3974647959073385 minutes

======DDPG Validation from: 20170103 to 20170404

======Trading from: 20170404 to 20170705

previous\_total\_asset:1209492.251442472

end\_total\_asset:1238570.6518548816

total\_reward:29078.400412409566

total\_cost: 6570.460240219821

total trades: 1208

Sharpe: 0.19843194174227693

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20170404

======A2C Training========

Training time (A2C): 2.3912898818651835 minutes

======A2C Validation from: 20170404 to 20170705

A2C Sharpe Ratio: 0.29876568121656333

======PPO Training========

Training time (PPO): 7.6514373024304705 minutes

======PPO Validation from: 20170404 to 20170705

PPO Sharpe Ratio: 0.22553914336895345

======DDPG Training========

Training time (DDPG): 1.0882069746653238 minutes

======DDPG Validation from: 20170404 to 20170705

======Trading from: 20170705 to 20171003

previous\_total\_asset:1238570.6518548816

end\_total\_asset:1245747.999185052

total\_reward:7177.347330170451

total\_cost: 8019.911742614664

total trades: 1473

Sharpe: 0.051544615815011435

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20170705

======A2C Training========

Training time (A2C): 1.7696361978848776 minutes

======A2C Validation from: 20170705 to 20171003

A2C Sharpe Ratio: 0.5053552607233832

======PPO Training========

Training time (PPO): 7.239803604284922 minutes

======PPO Validation from: 20170705 to 20171003

PPO Sharpe Ratio: 0.2473113443707483

======DDPG Training========

Training time (DDPG): 134.5302638053894 minutes

======DDPG Validation from: 20170705 to 20171003

======Trading from: 20171003 to 20180103

previous\_total\_asset:1245747.999185052

end\_total\_asset:1395952.497980893

total\_reward:150204.4987958409

total\_cost: 7703.759084056999

total trades: 1450

Sharpe: 0.8476082560373751

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20171003

======A2C Training========

Training time (A2C): 3.0643120845158895 minutes

======A2C Validation from: 20171003 to 20180103

A2C Sharpe Ratio: 0.437296473795776

======PPO Training========

Training time (PPO): 9.979060264428457 minutes

======PPO Validation from: 20171003 to 20180103

PPO Sharpe Ratio: 0.13692269546819513

======DDPG Training========

Training time (DDPG): 1.322961111863454 minutes

======DDPG Validation from: 20171003 to 20180103

======Trading from: 20180103 to 20180405

previous\_total\_asset:1395952.497980893

end\_total\_asset:1411036.8039613536

total\_reward:15084.305980460718

total\_cost: 1845.7833738624643

total trades: 256

Sharpe: 0.06363340474688796

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20180103

======A2C Training========

Training time (A2C): 2.2677886207898457 minutes

======A2C Validation from: 20180103 to 20180405

A2C Sharpe Ratio: 0.0017547175507107262

======PPO Training========

Training time (PPO): 7.611203161875407 minutes

======PPO Validation from: 20180103 to 20180405

PPO Sharpe Ratio: -0.04406967233324395

======DDPG Training========

Training time (DDPG): 1.2462720314661662 minutes

======DDPG Validation from: 20180103 to 20180405

======Trading from: 20180405 to 20180705

previous\_total\_asset:1411036.8039613536

end\_total\_asset:1394988.6997355109

total\_reward:-16048.104225842748

total\_cost: 4610.06997012742

total trades: 951

Sharpe: -0.05236967349132693

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20180405

======A2C Training========

Training time (A2C): 2.5097499092419944 minutes

======A2C Validation from: 20180405 to 20180705

A2C Sharpe Ratio: -0.23947472932447283

======PPO Training========

Training time (PPO): 8.876463854312897 minutes

======PPO Validation from: 20180405 to 20180705

PPO Sharpe Ratio: -0.1875752819778485

======DDPG Training========

Training time (DDPG): 1.5319084962209066 minutes

======DDPG Validation from: 20180405 to 20180705

======Trading from: 20180705 to 20181003

previous\_total\_asset:1394988.6997355109

end\_total\_asset:1404569.6295485701

total\_reward:9580.92981305928

total\_cost: 5678.230363440367

total trades: 783

Sharpe: 0.08787489256570284

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20180705

======A2C Training========

Training time (A2C): 2.5193111379941304 minutes

======A2C Validation from: 20180705 to 20181003

A2C Sharpe Ratio: 0.15191145245341933

======PPO Training========

Training time (PPO): 8.71497275431951 minutes

======PPO Validation from: 20180705 to 20181003

PPO Sharpe Ratio: 0.1556097311165768

======DDPG Training========

Training time (DDPG): 1.3898229002952576 minutes

======DDPG Validation from: 20180705 to 20181003

======Trading from: 20181003 to 20190104

previous\_total\_asset:1404569.6295485701

end\_total\_asset:1422553.8030005542

total\_reward:17984.17345198407

total\_cost: 988.4590455102582

total trades: 179

Sharpe: 0.365494325785537

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turbulence\_threshold: 171.0940715631016

======Model training from: 20090000 to 20181003

======A2C Training========

Training time (A2C): 2.6693105896313987 minutes

======A2C Validation from: 20181003 to 20190104

A2C Sharpe Ratio: -0.3880372344045416

======PPO Training========

Training time (PPO): 9.193815835316975 minutes

======PPO Validation from: 20181003 to 20190104

PPO Sharpe Ratio: -0.3531495624767656

======DDPG Training========

Training time (DDPG): 1.3729496518770854 minutes

======DDPG Validation from: 20181003 to 20190104

======Trading from: 20190104 to 20190405

previous\_total\_asset:1422553.8030005542

end\_total\_asset:1483360.4626701134

total\_reward:60806.659669559216

total\_cost: 8618.50701540794

total trades: 1500

Sharpe: 0.2492049173343681

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20190104

======A2C Training========

Training time (A2C): 2.7543103019396464 minutes

======A2C Validation from: 20190104 to 20190405

A2C Sharpe Ratio: 0.10205910491659001

======PPO Training========

Training time (PPO): 8.99228138923645 minutes

======PPO Validation from: 20190104 to 20190405

PPO Sharpe Ratio: 0.1582163713135373

======DDPG Training========

Training time (DDPG): 1.4230705936749777 minutes

======DDPG Validation from: 20190104 to 20190405

======Trading from: 20190405 to 20190708

previous\_total\_asset:1483360.4626701134

end\_total\_asset:1486084.7000166504

total\_reward:2724.2373465369456

total\_cost: 1047.5917119500657

total trades: 155

Sharpe: 0.21954251250192866

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20190405

======A2C Training========

Training time (A2C): 2.7668197631835936 minutes

======A2C Validation from: 20190405 to 20190708

A2C Sharpe Ratio: 0.11695679655346651

======PPO Training========

Training time (PPO): 11.444523056348165 minutes

======PPO Validation from: 20190405 to 20190708

PPO Sharpe Ratio: 0.2270924596851665

======DDPG Training========

Training time (DDPG): 2.80308172305425 minutes

======DDPG Validation from: 20190405 to 20190708

======Trading from: 20190708 to 20191004

previous\_total\_asset:1486084.7000166504

end\_total\_asset:1484196.2729407027

total\_reward:-1888.4270759476349

total\_cost: 1839.7753472888066

total trades: 330

Sharpe: -0.06316560884529329

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20190708

======A2C Training========

Training time (A2C): 3.7324901978174845 minutes

======A2C Validation from: 20190708 to 20191004

A2C Sharpe Ratio: 0.09017455945847162

======PPO Training========

Training time (PPO): 10.935458866755168 minutes

======PPO Validation from: 20190708 to 20191004

PPO Sharpe Ratio: -0.14724931981036016

======DDPG Training========

Training time (DDPG): 1.9371007879575093 minutes

======DDPG Validation from: 20190708 to 20191004

======Trading from: 20191004 to 20200106

previous\_total\_asset:1484196.2729407027

end\_total\_asset:1482955.2618032391

total\_reward:-1241.011137463618

total\_cost: 277.35193485852244

total trades: 46

Sharpe: -0.3393992285672833

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20191004

======A2C Training========

Training time (A2C): 4.023934344450633 minutes

======A2C Validation from: 20191004 to 20200106

A2C Sharpe Ratio: -0.19449820818817615

======PPO Training========

Training time (PPO): 11.06712996562322 minutes

======PPO Validation from: 20191004 to 20200106

PPO Sharpe Ratio: -0.3504228141636595

======DDPG Training========

Training time (DDPG): 1.8208934505780539 minutes

======DDPG Validation from: 20191004 to 20200106

======Trading from: 20200106 to 20200406

previous\_total\_asset:1482955.2618032391

end\_total\_asset:1472773.9077518638

total\_reward:-10181.354051375296

total\_cost: 847.8044996999168

total trades: 150

Sharpe: -0.38413223288290477

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turbulence\_threshold: 96.08032158358223

======Model training from: 20090000 to 20200106

======A2C Training========

Training time (A2C): 3.5502064704895018 minutes

======A2C Validation from: 20200106 to 20200406

A2C Sharpe Ratio: -0.44348867501795786

======PPO Training========

Training time (PPO): 10.96697035630544 minutes

======PPO Validation from: 20200106 to 20200406

PPO Sharpe Ratio: -0.44021163078036785

======DDPG Training========

Training time (DDPG): 1.3809613029162089 minutes

======DDPG Validation from: 20200106 to 20200406

======Trading from: 20200406 to 20200707

previous\_total\_asset:1472773.9077518638

end\_total\_asset:1476635.9032912592

total\_reward:3861.9955393953715

total\_cost: 525.7463236042283

total trades: 107

Sharpe: 0.2669069177218868

Ensemble Strategy took: 367.3660026629766 minutes