```
 1 C:\Users\Alex\Anaconda3\python.exe "C:/Users/Zihang
   Guan/Desktop/Deep-Reinforcement-Learning-for-
   Automated-Stock-Trading-Ensemble-Strategy-ICAIF-2020-
   master/run_DRL.py"
 2 2022-04-19 02:09:57.993112: W tensorflow/
   stream_executor/platform/default/dso_loader.cc:59]
   Could not load dynamic library 'cudart64_101.dll';
   dlerror: cudart64_101.dll not found
 3 2022-04-19 02:09:58.000608: I tensorflow/
   stream_executor/cuda/cudart_stub.cc:29] Ignore above
   cudart dlerror if you do not have a GPU set up on
   your machine.
 4 C:\Users\Alex\Anaconda3\lib\site-packages\
   stable_baselines\__init__.py:33: UserWarning: stable-
   baselines is in maintenance mode, please use [Stable-
   Baselines3 (SB3)](https://github.com/DLR-RM/stable-
   baselines3) for an up-to-date version. You can find a
   [migration guide](https://stable-baselines3.
   readthedocs.io/en/master/guide/migration.html) in SB3
   documentation.
 5   warnings.warn(
 6     datadate    tic      adjcp        open  ...      rsi
         cci      adx   turbulence
 7 0  20090102   AAPL   12.964286   12.268571  ...    100.0
   66.666667  100.0         0.0
 8 1  20090102    AXP   19.330000   18.570000  ...    100.0
   66.666667  100.0         0.0
 9 2  20090102     BA   45.250000   42.800000  ...    100.0
   66.666667  100.0         0.0
10 3  20090102    CAT   46.910000   44.910000  ...      0.0
   66.666667  100.0         0.0
11 4  20090102   CSCO   16.960000   16.410000  ...    100.0
   66.666667  100.0         0.0
12
13 [5 rows x 12 columns]
14 1053360
15 [20151002 20151005 20151006 ... 20200702 20200706
   20200707]
16 ============Start Ensemble Strategy============
17 ================================================
18 turbulence_threshold:  171.0940715631016
```

```
19 ======Model training from:  20090000 to  20151002
20 ======A2C Training========
21 2022-04-19 02:10:32.362010: I tensorflow/core/
   platform/cpu_feature_guard.cc:142] This TensorFlow
   binary is optimized with oneAPI Deep Neural Network
   Library (oneDNN)to use the following CPU instructions
    in performance-critical operations:  AVX2
22 To enable them in other operations, rebuild
   TensorFlow with the appropriate compiler flags.
23 2022-04-19 02:10:32.408759: I tensorflow/compiler/xla
   /service/service.cc:168] XLA service 0x1a4090060f0
   initialized for platform Host (this does not
   guarantee that XLA will be used). Devices:
24 2022-04-19 02:10:32.409687: I tensorflow/compiler/xla
   /service/service.cc:176]   StreamExecutor device (0
   ): Host, Default Version
25 2022-04-19 02:10:32.417156: W tensorflow/
   stream_executor/platform/default/dso_loader.cc:59]
   Could not load dynamic library 'nvcuda.dll'; dlerror
   : nvcuda.dll not found
26 2022-04-19 02:10:32.417422: W tensorflow/
   stream_executor/cuda/cuda_driver.cc:312] failed call
   to cuInit: UNKNOWN ERROR (303)
27 2022-04-19 02:10:32.418118: I tensorflow/
   stream_executor/cuda/cuda_diagnostics.cc:169]
   retrieving CUDA diagnostic information for host:
   LAPTOP-FJQ3PEHG
28 2022-04-19 02:10:32.418483: I tensorflow/
   stream_executor/cuda/cuda_diagnostics.cc:176]
   hostname: LAPTOP-FJQ3PEHG
29 WARNING:tensorflow:From C:\Users\Alex\Anaconda3\lib\
   site-packages\tensorflow\python\training\rmsprop.py:
   123: calling Ones.__init__ (from tensorflow.python.
   ops.init_ops) with dtype is deprecated and will be
   removed in a future version.
30 Instructions for updating:
31 Call initializer instance with the dtype argument
   instead of passing it to the constructor
32 save intrinsic loss: Tensor("add_35:0", shape=(),
   dtype=float32)
33 timesteps: 30000
```

```
34 total_timesteps: 30000
35 Training time (A2C):  7.122615341345469  minutes
36 ======A2C Validation from:  20151002 to  20160104
37 A2C Sharpe Ratio:  -0.11460332145602341
38 ======Trading from:  20160104 to  20160405
39 Used Model:  <stable_baselines.a2c.a2c.A2C object at
   0x000001A40A34F1F0>
40 previous_total_asset:1000000
41 end_total_asset:1041968.4203497207
42 total_reward:41968.42034972075
43 total_cost:  3643.8658430597366
44 total trades:  1286
45 Sharpe:  0.14238807038148144
46 ============Trading Done============
47 ==========================================
48 turbulence_threshold:  96.08032158358223
49 ======Model training from:  20090000 to  20160104
50 ======A2C Training========
51 save intrinsic loss: Tensor("add_35:0", shape=(),
   dtype=float32)
52 timesteps: 30000
53 total_timesteps: 30000
54 Training time (A2C):  6.417601378758748  minutes
55 ======A2C Validation from:  20160104 to  20160405
56 A2C Sharpe Ratio:  0.1488679781620725
57 ======Trading from:  20160405 to  20160705
58 Used Model:  <stable_baselines.a2c.a2c.A2C object at
   0x000001A414161E50>
59 previous_total_asset:1041968.4203497207
60 end_total_asset:1036056.3183060036
61 total_reward:-5912.102043717168
62 total_cost:  5114.276714391691
63 total trades:  1480
64 Sharpe:  -0.01086567703227835
65 ============Trading Done============
66 ==========================================
67 turbulence_threshold:  171.0940715631016
68 ======Model training from:  20090000 to  20160405
69 ======A2C Training========
70 save intrinsic loss: Tensor("add_35:0", shape=(),
   dtype=float32)
```

```
 71 timesteps: 30000
 72 total_timesteps: 30000
 73 Training time (A2C):  8.056982946395873  minutes
 74 ======A2C Validation from:  20160405 to  20160705
 75 A2C Sharpe Ratio:  -0.027227223009651767
 76 ======Trading from:  20160705 to  20161003
 77 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A411ECF8B0>
 78 previous_total_asset:1036056.3183060036
 79 end_total_asset:1062837.5942480166
 80 total_reward:26781.275942013017
 81 total_cost:  4471.376011996594
 82 total trades:  1509
 83 Sharpe:  0.11799203261015659
 84 ============Trading Done============
 85 ================================================
 86 turbulence_threshold:  171.0940715631016
 87 ======Model training from:  20090000 to  20160705
 88 ======A2C Training========
 89 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
 90 timesteps: 30000
 91 total_timesteps: 30000
 92 Training time (A2C):  6.323322514692943  minutes
 93 ======A2C Validation from:  20160705 to  20161003
 94 A2C Sharpe Ratio:  -0.006677333692629373
 95 ======Trading from:  20161003 to  20170103
 96 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A416D33E80>
 97 previous_total_asset:1062837.5942480166
 98 end_total_asset:1271697.6795409769
 99 total_reward:208860.08529296028
100 total_cost:  3654.2045174032323
101 total trades:  1235
102 Sharpe:  0.7506026225885255
103 ============Trading Done============
104 =================================================
105 turbulence_threshold:  171.0940715631016
106 ======Model training from:  20090000 to  20161003
107 ======A2C Training========
108 save intrinsic loss: Tensor("add_35:0", shape=(),
```

```
108 dtype=float32)
109 timesteps: 30000
110 total_timesteps: 30000
111 Training time (A2C):  7.511975808938344  minutes
112 ======A2C Validation from:  20161003 to  20170103
113 A2C Sharpe Ratio:  0.6993311634438326
114 ======Trading from:  20170103 to  20170404
115 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x000001A413CC9880>
116 previous_total_asset:1271697.6795409769
117 end_total_asset:1278099.9157565106
118 total_reward:6402.236215533689
119 total_cost:  4086.280104074242
120 total trades:  1445
121 Sharpe:  0.031116806032709055
122 ============Trading Done============
123 ================================================
124 turbulence_threshold:  96.08032158358223
125 ======Model training from:  20090000 to  20170103
126 ======A2C Training========
127 save intrinsic loss: Tensor("add_35:0", shape=(),
     dtype=float32)
128 timesteps: 30000
129 total_timesteps: 30000
130 Training time (A2C):  8.572242693106334  minutes
131 ======A2C Validation from:  20170103 to  20170404
132 A2C Sharpe Ratio:  0.27113839753437213
133 ======Trading from:  20170404 to  20170705
134 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x000001A416C91FD0>
135 previous_total_asset:1278099.9157565106
136 end_total_asset:1288952.1283152564
137 total_reward:10852.212558745872
138 total_cost:  6243.4828984174255
139 total trades:  1346
140 Sharpe:  0.062195716947866006
141 ============Trading Done============
142 ================================================
143 turbulence_threshold:  171.0940715631016
144 ======Model training from:  20090000 to  20170404
145 ======A2C Training========
```

```
146 save intrinsic loss: Tensor("add_35:0", shape=(),
      dtype=float32)
147 timesteps: 30000
148 total_timesteps: 30000
149 Training time (A2C):  6.074416486422221  minutes
150 ======A2C Validation from:  20170404 to  20170705
151 A2C Sharpe Ratio:  0.3071532757523224
152 ======Trading from:  20170705 to  20171003
153 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x000001A413AFDA30>
154 previous_total_asset:1288952.1283152564
155 end_total_asset:1357824.652627641
156 total_reward:68872.52431238466
157 total_cost:  9341.623194965308
158 total trades:  1626
159 Sharpe:  0.5537238984387243
160 ============Trading Done============
161 ==========================================
162 turbulence_threshold:  171.0940715631016
163 ======Model training from:  20090000 to  20170705
164 ======A2C Training========
165 save intrinsic loss: Tensor("add_35:0", shape=(),
      dtype=float32)
166 timesteps: 30000
167 total_timesteps: 30000
168 Training time (A2C):  6.043405544757843  minutes
169 ======A2C Validation from:  20170705 to  20171003
170 A2C Sharpe Ratio:  0.18171418552332774
171 ======Trading from:  20171003 to  20180103
172 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x000001A40A3609A0>
173 previous_total_asset:1357824.652627641
174 end_total_asset:1493062.7591288853
175 total_reward:135238.10650124424
176 total_cost:  8022.526656616029
177 total trades:  1537
178 Sharpe:  0.7433855275516166
179 ============Trading Done============
180 ==========================================
181 turbulence_threshold:  96.08032158358223
182 ======Model training from:  20090000 to  20171003
```

```
183 ======A2C Training========
184 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
185 timesteps: 30000
186 total_timesteps: 30000
187 Training time (A2C):  5.561907343069712  minutes
188 ======A2C Validation from:  20171003 to  20180103
189 A2C Sharpe Ratio:  0.411249888395323
190 ======Trading from:  20180103 to  20180405
191 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A413D022E0>
192 previous_total_asset:1493062.7591288853
193 end_total_asset:1508397.4371320833
194 total_reward:15334.678003198002
195 total_cost:  2201.329592052235
196 total trades:  359
197 Sharpe:  0.11105544194180364
198 ============Trading Done============
199 ================================================
200 turbulence_threshold:  96.08032158358223
201 ======Model training from:  20090000 to  20180103
202 ======A2C Training========
203 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
204 timesteps: 30000
205 total_timesteps: 30000
206 Training time (A2C):  5.316114576657613  minutes
207 ======A2C Validation from:  20180103 to  20180405
208 A2C Sharpe Ratio:  0.007141159381971283
209 ======Trading from:  20180405 to  20180705
210 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A414537250>
211 previous_total_asset:1508397.4371320833
212 end_total_asset:1481594.3795186037
213 total_reward:-26803.057613479672
214 total_cost:  6097.906777793213
215 total trades:  1000
216 Sharpe:  -0.14581454396663546
217 ============Trading Done============
218 ================================================
219 turbulence_threshold:  96.08032158358223
```

```
220 ======Model training from:  20090000 to  20180405
221 =====A2C Training========
222 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
223 timesteps: 30000
224 total_timesteps: 30000
225 Training time (A2C):  5.1240455389022825  minutes
226 =====A2C Validation from:  20180405 to  20180705
227 A2C Sharpe Ratio:  -0.15585537954084708
228 ======Trading from:  20180705 to  20181003
229 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A413EFEA90>
230 previous_total_asset:1481594.3795186037
231 end_total_asset:1485021.964054189
232 total_reward:3427.5845355852507
233 total_cost:  6694.1086812729745
234 total trades:  939
235 Sharpe:  0.02736926132886187
236 ============Trading Done============
237 ==============================================
238 turbulence_threshold:  96.08032158358223
239 =====Model training from:  20090000 to  20180705
240 =====A2C Training========
241 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
242 timesteps: 30000
243 total_timesteps: 30000
244 Training time (A2C):  5.229494472344716  minutes
245 =====A2C Validation from:  20180705 to  20181003
246 A2C Sharpe Ratio:  0.1896425959902672
247 ======Trading from:  20181003 to  20190104
248 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A413EFE550>
249 previous_total_asset:1485021.964054189
250 end_total_asset:1494583.6577054362
251 total_reward:9561.693651247304
252 total_cost:  934.0002194830034
253 total trades:  181
254 Sharpe:  0.24774522407084068
255 ============Trading Done============
256 ==============================================
```

```
257 turbulence_threshold:  171.0940715631016
258 ======Model training from:  20090000 to  20181003
259 ======A2C Training========
260 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
261 timesteps: 30000
262 total_timesteps: 30000
263 Training time (A2C):  6.024219171206156  minutes
264 ======A2C Validation from:  20181003 to  20190104
265 A2C Sharpe Ratio:  -0.3768090012239727
266 ======Trading from:  20190104 to  20190405
267 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A416EA80A0>
268 previous_total_asset:1494583.6577054362
269 end_total_asset:1602065.114334178
270 total_reward:107481.4566287417
271 total_cost:  5287.689380071166
272 total trades:  1020
273 Sharpe:  0.4767433411513363
274 ============Trading Done============
275 ================================================
276 turbulence_threshold:  96.08032158358223
277 ======Model training from:  20090000 to  20190104
278 ======A2C Training========
279 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
280 timesteps: 30000
281 total_timesteps: 30000
282 Training time (A2C):  5.694295231501261  minutes
283 ======A2C Validation from:  20190104 to  20190405
284 A2C Sharpe Ratio:  0.07341260203499606
285 ======Trading from:  20190405 to  20190708
286 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A416C2DF70>
287 previous_total_asset:1602065.114334178
288 end_total_asset:1604625.6173834498
289 total_reward:2560.5030492718797
290 total_cost:  889.9608779594405
291 total trades:  165
292 Sharpe:  0.1983381699602818
293 ============Trading Done============
```

```
294 ================================================
295 turbulence_threshold:  96.08032158358223
296 ======Model training from:  20090000 to  20190405
297 ======A2C Training========
298 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
299 timesteps: 30000
300 total_timesteps: 30000
301 Training time (A2C):  5.343256568908691  minutes
302 ======A2C Validation from:  20190405 to  20190708
303 A2C Sharpe Ratio:  0.0667202368355186
304 ======Trading from:  20190708 to  20191004
305 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A411B4EB50>
306 previous_total_asset:1604625.6173834498
307 end_total_asset:1595988.9646278035
308 total_reward:-8636.652755646268
309 total_cost:  2047.9204076388871
310 total trades:  368
311 Sharpe:  -0.24350016410871023
312 ============Trading Done============
313 ================================================
314 turbulence_threshold:  96.08032158358223
315 ======Model training from:  20090000 to  20190708
316 ======A2C Training========
317 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
318 timesteps: 30000
319 total_timesteps: 30000
320 Training time (A2C):  5.115283584594726  minutes
321 ======A2C Validation from:  20190708 to  20191004
322 A2C Sharpe Ratio:  -0.1188199542754505
323 ======Trading from:  20191004 to  20200106
324 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A41396BBE0>
325 previous_total_asset:1595988.9646278035
326 end_total_asset:1595537.2930052006
327 total_reward:-451.67162260296755
328 total_cost:  391.24794518383516
329 total trades:  66
330 Sharpe:  -0.08943867540954137
```

```
331 ============Trading Done============
332 =============================================
333 turbulence_threshold:  96.08032158358223
334 ======Model training from:  20090000 to  20191004
335 ======A2C Training========
336 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
337 timesteps: 30000
338 total_timesteps: 30000
339 Training time (A2C):  8.123391123612722  minutes
340 ======A2C Validation from:  20191004 to  20200106
341 A2C Sharpe Ratio:  -0.2880873459636514
342 ======Trading from:  20200106 to  20200406
343 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A416C6E9D0>
344 previous_total_asset:1595537.2930052006
345 end_total_asset:1581799.6115763618
346 total_reward:-13737.681428838754
347 total_cost:  861.0914530371521
348 total trades:  175
349 Sharpe:  -0.4645179220372516
350 ============Trading Done============
351 =============================================
352 turbulence_threshold:  96.08032158358223
353 ======Model training from:  20090000 to  20200106
354 ======A2C Training========
355 save intrinsic loss: Tensor("add_35:0", shape=(),
    dtype=float32)
356 timesteps: 30000
357 total_timesteps: 30000
358 Training time (A2C):  7.463866635163625  minutes
359 ======A2C Validation from:  20200106 to  20200406
360 A2C Sharpe Ratio:  -0.3857387562863904
361 ======Trading from:  20200406 to  20200707
362 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x000001A413B503D0>
363 previous_total_asset:1581799.6115763618
364 end_total_asset:1583578.6315164005
365 total_reward:1779.0199400386773
366 total_cost:  386.0172212752509
367 total trades:  105
```

```
368 Sharpe:  0.1751439856574254
369 ============Trading Done============
370 A2C Intrinsic Strategy took:  115.8262498776118
    minutes
371
372 Process finished with exit code 0
373
```