```
 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 2022-03-30 14:55:54.671236: 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 2022-03-30 14:55:54.673926: 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 calling calc_entropy..
22 2022-03-30 14:56:31.859294: 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
23 To enable them in other operations, rebuild
   TensorFlow with the appropriate compiler flags.
24 2022-03-30 14:56:31.979861: I tensorflow/compiler/xla
   /service/service.cc:168] XLA service 0x22a886e5150
   initialized for platform Host (this does not
   guarantee that XLA will be used). Devices:
25 2022-03-30 14:56:31.982782: I tensorflow/compiler/xla
   /service/service.cc:176]   StreamExecutor device (0
   ): Host, Default Version
26 2022-03-30 14:56:32.003357: W tensorflow/
   stream_executor/platform/default/dso_loader.cc:59]
   Could not load dynamic library 'nvcuda.dll'; dlerror
   : nvcuda.dll not found
27 2022-03-30 14:56:32.005780: W tensorflow/
   stream_executor/cuda/cuda_driver.cc:312] failed call
   to cuInit: UNKNOWN ERROR (303)
28 2022-03-30 14:56:32.008317: I tensorflow/
   stream_executor/cuda/cuda_diagnostics.cc:169]
   retrieving CUDA diagnostic information for host:
   LAPTOP-FJQ3PEHG
29 2022-03-30 14:56:32.012882: I tensorflow/
   stream_executor/cuda/cuda_diagnostics.cc:176]
   hostname: LAPTOP-FJQ3PEHG
30 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.
31 Instructions for updating:
32 Call initializer instance with the dtype argument
   instead of passing it to the constructor
33 Training time (A2C):  5.010890805721283  minutes
34 ======A2C Validation from:  20151002 to  20160104
```

```
35 A2C Sharpe Ratio:  0.030416382064989884
36 ======Trading from:  20160104 to  20160405
37 Used Model:  <stable_baselines.a2c.a2c.A2C object at
   0x0000022A89F6B370>
38 previous_total_asset:1000000
39 end_total_asset:1073414.804247225
40 total_reward:73414.80424722494
41 total_cost:  6085.744077356763
42 total trades:  1493
43 Sharpe:  0.276615357385207
44 ===========Trading Done===========
45 ==========================================
46 turbulence_threshold:  96.08032158358223
47 ======Model training from:  20090000 to  20160104
48 ======A2C Training========
49 calling calc_entropy..
50 Training time (A2C):  2.972819904486338  minutes
51 ======A2C Validation from:  20160104 to  20160405
52 A2C Sharpe Ratio:  0.1392409191584235
53 ======Trading from:  20160405 to  20160705
54 Used Model:  <stable_baselines.a2c.a2c.A2C object at
   0x0000022A93C21A90>
55 previous_total_asset:1073414.804247225
56 end_total_asset:1072303.3102328924
57 total_reward:-1111.4940143325366
58 total_cost:  4617.679688573079
59 total trades:  1517
60 Sharpe:  0.004334728216301486
61 ===========Trading Done===========
62 ==========================================
63 turbulence_threshold:  171.0940715631016
64 ======Model training from:  20090000 to  20160405
65 ======A2C Training========
66 calling calc_entropy..
67 Training time (A2C):  3.317957897981008  minutes
68 ======A2C Validation from:  20160405 to  20160705
69 A2C Sharpe Ratio:  -0.06891952058578202
70 ======Trading from:  20160705 to  20161003
71 Used Model:  <stable_baselines.a2c.a2c.A2C object at
   0x0000022A92747940>
72 previous_total_asset:1072303.3102328924
```

```
 73 end_total_asset:1157498.5702353397
 74 total_reward:85195.26000244729
 75 total_cost:  2306.30153275198
 76 total trades:  1211
 77 Sharpe:  0.33012187361769013
 78 ============Trading Done============
 79 ==========================================
 80 turbulence_threshold:  171.0940715631016
 81 ======Model training from:  20090000 to  20160705
 82 ======A2C Training========
 83 calling calc_entropy..
 84 Training time (A2C):  2.8720102508862815  minutes
 85 ======A2C Validation from:  20160705 to  20161003
 86 A2C Sharpe Ratio:  -0.07275938759494209
 87 ======Trading from:  20161003 to  20170103
 88 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x0000022A910419D0>
 89 previous_total_asset:1157498.5702353397
 90 end_total_asset:1347788.014647132
 91 total_reward:190289.44441179233
 92 total_cost:  5805.91753450873
 93 total trades:  1547
 94 Sharpe:  0.7014968639606767
 95 ============Trading Done============
 96 ==========================================
 97 turbulence_threshold:  171.0940715631016
 98 ======Model training from:  20090000 to  20161003
 99 ======A2C Training========
100 calling calc_entropy..
101 Training time (A2C):  2.829496661822001  minutes
102 ======A2C Validation from:  20161003 to  20170103
103 A2C Sharpe Ratio:  0.6624340054322264
104 ======Trading from:  20170103 to  20170404
105 Used Model:  <stable_baselines.a2c.a2c.A2C object at
    0x0000022A93A0A730>
106 previous_total_asset:1347788.014647132
107 end_total_asset:1405815.395804145
108 total_reward:58027.38115701289
109 total_cost:  5080.074033618012
110 total trades:  1383
111 Sharpe:  0.2335706112625035
```

```
112 ============Trading Done============
113 ==============================================
114 turbulence_threshold:  96.08032158358223
115 ======Model training from:  20090000 to  20170103
116 ======A2C Training========
117 calling calc_entropy..
118 Training time (A2C):  3.009485431512197  minutes
119 ======A2C Validation from:  20170103 to  20170404
120 A2C Sharpe Ratio:  0.34254115586368344
121 ======Trading from:  20170404 to  20170705
122 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x0000022A915FFDF0>
123 previous_total_asset:1405815.395804145
124 end_total_asset:1427781.5903547574
125 total_reward:21966.194550612476
126 total_cost:  6102.267633740811
127 total trades:  1139
128 Sharpe:  0.1331380462362274
129 ============Trading Done============
130 ==============================================
131 turbulence_threshold:  171.0940715631016
132 ======Model training from:  20090000 to  20170404
133 ======A2C Training========
134 calling calc_entropy..
135 Training time (A2C):  3.056315048535665  minutes
136 ======A2C Validation from:  20170404 to  20170705
137 A2C Sharpe Ratio:  0.30319862616353377
138 ======Trading from:  20170705 to  20171003
139 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x0000022A8ED34040>
140 previous_total_asset:1427781.5903547574
141 end_total_asset:1504188.970315704
142 total_reward:76407.3799609465
143 total_cost:  7089.1909833756945
144 total trades:  1533
145 Sharpe:  0.34539429363621427
146 ============Trading Done============
147 ==============================================
148 turbulence_threshold:  171.0940715631016
149 ======Model training from:  20090000 to  20170705
150 ======A2C Training========
```

```
151 calling calc_entropy..
152 Training time (A2C):  3.26300505797070826  minutes
153 ======A2C Validation from:  20170705 to  20171003
154 A2C Sharpe Ratio:  0.30802650866905523
155 ======Trading from:  20171003 to  20180103
156 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x0000022A92622C70>
157 previous_total_asset:1504188.970315704
158 end_total_asset:1666182.3691328291
159 total_reward:161993.39881712524
160 total_cost:  3945.9183535852367
161 total trades:  1389
162 Sharpe:  0.5976421536024762
163 ============Trading Done============
164 ==========================================
165 turbulence_threshold:  96.08032158358223
166 ======Model training from:  20090000 to  20171003
167 ======A2C Training========
168 calling calc_entropy..
169 Training time (A2C):  4.84157741467158  minutes
170 ======A2C Validation from:  20171003 to  20180103
171 A2C Sharpe Ratio:  0.5552783624397133
172 ======Trading from:  20180103 to  20180405
173 Used Model:  <stable_baselines.a2c.a2c.A2C object at
     0x0000022A93F73070>
174 previous_total_asset:1666182.3691328291
175 end_total_asset:1685339.8153778806
176 total_reward:19157.446245051455
177 total_cost:  2640.3259135845674
178 total trades:  359
179 Sharpe:  0.10219218332297451
180 ============Trading Done============
181 ==========================================
182 turbulence_threshold:  96.08032158358223
183 ======Model training from:  20090000 to  20180103
184 ======A2C Training========
185 calling calc_entropy..
186 Training time (A2C):  4.226594030857086  minutes
187 ======A2C Validation from:  20180103 to  20180405
188 A2C Sharpe Ratio:  -0.030764132848115893
189 ======Trading from:  20180405 to  20180705
```

```
190 Used Model:  <stable_baselines.a2c.a2c.A2C object at
       0x0000022A947EC040>
191 previous_total_asset:1685339.8153778806
192 end_total_asset:1642582.5810403244
193 total_reward:-42757.234337556176
194 total_cost:  6345.848161718608
195 total trades:  1002
196 Sharpe:  -0.15630724085764866
197 ============Trading Done============
198 ================================================
199 turbulence_threshold:  96.08032158358223
200 ======Model training from:  20090000 to  20180405
201 ======A2C Training========
202 calling calc_entropy..
203 Training time (A2C):  3.864098083972931  minutes
204 ======A2C Validation from:  20180405 to  20180705
205 A2C Sharpe Ratio:  0.1171178622783187
206 ======Trading from:  20180705 to  20181003
207 Used Model:  <stable_baselines.a2c.a2c.A2C object at
       0x0000022A910417F0>
208 previous_total_asset:1642582.5810403244
209 end_total_asset:1647741.892164361
210 total_reward:5159.311124036554
211 total_cost:  6195.07051194225
212 total trades:  919
213 Sharpe:  0.07459337487610782
214 ============Trading Done============
215 ================================================
216 turbulence_threshold:  96.08032158358223
217 ======Model training from:  20090000 to  20180705
218 ======A2C Training========
219 calling calc_entropy..
220 Training time (A2C):  4.0548887848854065  minutes
221 ======A2C Validation from:  20180705 to  20181003
222 A2C Sharpe Ratio:  0.14852064369393894
223 ======Trading from:  20181003 to  20190104
224 Used Model:  <stable_baselines.a2c.a2c.A2C object at
       0x0000022A93BC0A00>
225 previous_total_asset:1647741.892164361
226 end_total_asset:1656625.537500731
227 total_reward:8883.645336369984
```

```
228 total_cost:  949.8365635946379
229 total trades:  182
230 Sharpe:  0.22538239894376472
231 ============Trading Done============
232 ===========================================
233 turbulence_threshold:  171.0940715631016
234 ======Model training from:  20090000 to  20181003
235 ======A2C Training========
236 calling calc_entropy..
237 Training time (A2C):  3.798892386754354  minutes
238 ======A2C Validation from:  20181003 to  20190104
239 A2C Sharpe Ratio:  -0.30726478002905294
240 ======Trading from:  20190104 to  20190405
241 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A947927F0>
242 previous_total_asset:1656625.537500731
243 end_total_asset:1723985.7446276757
244 total_reward:67360.20712694479
245 total_cost:  6280.944381198835
246 total trades:  1232
247 Sharpe:  0.20575428570598778
248 ============Trading Done============
249 ===========================================
250 turbulence_threshold:  96.08032158358223
251 ======Model training from:  20090000 to  20190104
252 ======A2C Training========
253 calling calc_entropy..
254 Training time (A2C):  3.607733138402303  minutes
255 ======A2C Validation from:  20190104 to  20190405
256 A2C Sharpe Ratio:  0.084083224985572
257 ======Trading from:  20190405 to  20190708
258 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A8EF835B0>
259 previous_total_asset:1723985.7446276757
260 end_total_asset:1729399.427408516
261 total_reward:5413.682780840201
262 total_cost:  1080.7573594065739
263 total trades:  153
264 Sharpe:  0.2650808932149074
265 ============Trading Done============
266 ===========================================
```

```
267 turbulence_threshold:  96.08032158358223
268 ======Model training from:  20090000 to  20190405
269 ======A2C Training========
270 calling calc_entropy..
271 Training time (A2C):  3.3759334683418274  minutes
272 ======A2C Validation from:  20190405 to  20190708
273 A2C Sharpe Ratio:  0.35537965028890395
274 ======Trading from:  20190708 to  20191004
275 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A8ECE4DF0>
276 previous_total_asset:1729399.427408516
277 end_total_asset:1731572.10165564
278 total_reward:2172.6742471239995
279 total_cost:  2330.803214060845
280 total trades:  366
281 Sharpe:  0.04962627150834497
282 ============Trading Done============
283 ===========================================
284 turbulence_threshold:  96.08032158358223
285 ======Model training from:  20090000 to  20190708
286 ======A2C Training========
287 calling calc_entropy..
288 Training time (A2C):  3.434118378162384  minutes
289 ======A2C Validation from:  20190708 to  20191004
290 A2C Sharpe Ratio:  -0.23159644018004905
291 ======Trading from:  20191004 to  20200106
292 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A8ECF89A0>
293 previous_total_asset:1731572.10165564
294 end_total_asset:1731110.5428905103
295 total_reward:-461.5587651296519
296 total_cost:  329.2364225281954
297 total trades:  64
298 Sharpe:  -0.0999185481569033
299 ============Trading Done============
300 ===========================================
301 turbulence_threshold:  96.08032158358223
302 ======Model training from:  20090000 to  20191004
303 ======A2C Training========
304 calling calc_entropy..
305 Training time (A2C):  3.398111720879873  minutes
```

```
306 ======A2C Validation from:  20191004 to   20200106
307 A2C Sharpe Ratio:  -0.12668130179908282
308 ======Trading from:  20200106 to   20200406
309 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A96CCA430>
310 previous_total_asset:1731110.5428905103
311 end_total_asset:1719532.5749016362
312 total_reward:-11577.967988874065
313 total_cost:  668.2959072886896
314 total trades:  141
315 Sharpe:  -0.4241320951270995
316 ============Trading Done===========
317 ===============================================
318 turbulence_threshold:  96.08032158358223
319 ======Model training from:  20090000 to   20200106
320 ======A2C Training=======
321 calling calc_entropy..
322 Training time (A2C):  3.456123948097229  minutes
323 ======A2C Validation from:  20200106 to   20200406
324 A2C Sharpe Ratio:  -0.38681843588868736
325 ======Trading from:  20200406 to   20200707
326 Used Model:  <stable_baselines.a2c.a2c.A2C object at
      0x0000022A9408C190>
327 previous_total_asset:1719532.5749016362
328 end_total_asset:1722511.472352077
329 total_reward:2978.897450440796
330 total_cost:  505.7182801517618
331 total trades:  115
332 Sharpe:  0.230556449928488
333 ============Trading Done===========
334 A2C Intrinsic Strategy took:  64.7903999487559
    minutes
335
336 Process finished with exit code 0
337
```