```
D:\Python\Python\setroute\python.exe "D:\Python\Pycharm\setroute\PyCharm Community Edition 2021.2.3\plugins\python-ce\helpers\pydev\pydevconsole.py" --mode=client --port=27478

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['E:\\1 □□□□\\3 □□□□□\\1 □□□□□□□\\1 □□□□□□□□□\\1_□□□□□□_□□□□\\1_LW _□□□□1\\4 □□□□\\3 python_code\\9 Code for this paper', 'E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□1/4 □□□□/3 python_code/9 Code for this paper'])

PyDev console: starting.

Python 3.9.7 (tags/v3.9.7:1016ef3, Aug 30 2021, 20:19:38) [MSC v.1929 64 bit (AMD64)] on win32
>>> runfile('E:/1 □□□□/3 □□□□□/1 □□□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□1/4 □□□□/3 python_code/9 Code for this paper/main_DM.py', wdir='E:/1 □□□□/3 □□□□□/1 □□□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□1/4 □□□□/3 python_code/9 Code for this paper')
Backend TkAgg is interactive backend. Turning interactive mode on.
Waiting 5s.....

Optimize the  ./R_10_2.xlsx  instance

Set parameter TimeLimit to value 1200

Set parameter PoolSolutions to value 3
Set parameter PoolGap to value 0.05
Set parameter PoolSearchMode to value 2
Gurobi Optimizer version 11.0.0 build v11.0.0rc2 (win64 - Windows 10.0 (19045.2))

CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

Optimize a model with 260882 rows, 80570 columns and 770550 nonzeros
Model fingerprint: 0x5e5aba9d
Variable types: 0 continuous, 80570 integer (67900 binary)
Coefficient statistics:
  Matrix range     [1e+00, 5e+05]
  Objective range  [1e+00, 1e+00]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 7e+06]
Presolve removed 218468 rows and 3260 columns
Presolve time: 0.42s
Presolved: 42414 rows, 77310 columns, 126453 nonzeros
Variable types: 0 continuous, 77310 integer (64650 binary)
Found heuristic solution: objective 1224.0000000
Root relaxation presolved: 42370 rows, 77354 columns, 126364 nonzeros

Deterministic concurrent LP optimizer: primal and dual simplex
Showing primal log only...

Concurrent spin time: 0.00s

Solved with dual simplex

Root relaxation: objective 5.330165e+02, 3677 iterations, 0.34 seconds (0.47 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0  533.01652    0 2709 1224.00000  533.01652  56.5%     -    1s
H    0     0                       849.0000000  533.01652  37.2%     -    3s
     0     0  559.47394    0 2574  849.00000  559.47394  34.1%     -    5s
H    0     0                       848.0000000  559.47504  34.0%     -   17s
     0     0  568.96367    0 2717  848.00000  568.96367  32.9%     -   21s
     0     0  569.00398    0 2717  848.00000  569.00398  32.9%     -   21s
     0     0  572.61048    0 2124  848.00000  572.61048  32.5%     -   21s
     0     0  572.99846    0 2636  848.00000  572.99846  32.4%     -   29s
     0     0  573.03415    0 2636  848.00000  573.03415  32.4%     -   29s
     0     0  575.15180    0 1948  848.00000  575.15180  32.2%     -   30s
     0     0  576.06824    0 2393  848.00000  576.06824  32.1%     -   39s
     0     0  576.22353    0 2320  848.00000  576.22353  32.0%     -   39s
     0     0  576.30804    0 2365  848.00000  576.30804  32.0%     -   39s
     0     0  576.33428    0 2314  848.00000  576.33428  32.0%     -   40s
     0     0  576.35711    0 2403  848.00000  576.35711  32.0%     -   40s
     0     0  576.41199    0 2403  848.00000  576.41199  32.0%     -   40s
     0     0  576.41448    0 2403  848.00000  576.41448  32.0%     -   40s
     0     0  578.78872    0 2146  848.00000  578.78872  31.7%     -   41s
     0     0  579.04895    0 2187  848.00000  579.04895  31.7%     -   51s
     0     0  579.14192    0 2199  848.00000  579.14192  31.7%     -   51s
     0     0  579.16022    0 2286  848.00000  579.16022  31.7%     -   51s
     0     0  579.42333    0 2007  848.00000  579.42333  31.7%     -   52s
     0     0  579.48184    0 2241  848.00000  579.48184  31.7%     -   61s
     0     0  579.60290    0 2269  848.00000  579.60290  31.7%     -   62s
     0     0  579.61688    0 2249  848.00000  579.61688  31.6%     -   62s
     0     0  580.08953    0 1935  848.00000  580.08953  31.6%     -   63s
     0     0  580.25953    0 2185  848.00000  580.25953  31.6%     -   72s
     0     0  580.27441    0 2197  848.00000  580.27441  31.6%     -   72s
     0     0  580.82649    0 1978  848.00000  580.82649  31.5%     -   73s
```

```
  81     0    0  580.95814    0 2083  848.00000  580.95814  31.5%    -   84s
  82     0    0  580.96961    0 2046  848.00000  580.96961  31.5%    -   85s
  83     0    0  581.39964    0 2066  848.00000  581.39964  31.4%    -   85s
  84     0    0  581.49452    0 2167  848.00000  581.49452  31.4%    -  107s
  85     0    0  581.50674    0 2171  848.00000  581.50674  31.4%    -  107s
  86     0    0  581.87686    0 2022  848.00000  581.87686  31.4%    -  108s
  87     0    0  581.88301    0 2017  848.00000  581.88301  31.4%    -  109s
  88     0    2  581.90633    0 2015  848.00000  581.90633  31.4%    -  145s
  89   474  488  587.33499  115 1905  848.00000  582.69974  31.3%   7.2  150s
  90  1119 1257  604.24290  244 1807  848.00000  582.69974  31.3%  10.7  155s
  91  1773 1858  667.81831  365 1610  848.00000  582.69974  31.3%  14.5  160s
  92  2852 2814  676.95853  677 1411  848.00000  582.69974  31.3%  19.7  178s
  93  3017 3053  680.31119  723 1383  848.00000  582.69974  31.3%  25.2  180s
  94  3518 3544  689.83549  843 1178  848.00000  582.69974  31.3%  41.6  185s
  95  3791 3795  696.00000  928 1060  848.00000  582.69974  31.3%  60.7  190s
  96  4071 4075  704.00000 1045  970  848.00000  582.69974  31.3%  80.7  195s
  97  4413 4413  741.13035 1216  823  848.00000  582.69974  31.3%   100  201s
  98  4632 4631  751.00000 1278  779  848.00000  582.69974  31.3%   117  205s
  99  4883 4894  620.40906   15 1665  848.00000  583.90388  31.1%   132  211s
 100  5172 5060  610.83568  256 2017  848.00000  583.90388  31.1%   137  231s
 101  5174 5061  819.00000  325 1732  848.00000  819.00000  3.42%   137  238s
 102  5175 5062  819.00000   93  113  848.00000  819.00000  3.42%   137  241s
 103  5177 5063  819.00000  449  139  848.00000  819.00000  3.42%   137  245s
 104  5186 5069  826.05340   63  656  848.00000  826.05340  2.59%   137  253s
 105  5187 5070  826.28123  500  737  848.00000  826.28123  2.56%   136  255s
 106  5193 5074  828.14028  556  636  848.00000  828.14028  2.34%   136  263s
 107  5197 5077  832.66809  517  358  848.00000  832.66809  1.81%   136  268s
 108  5202 5080  834.00000  941  356  848.00000  834.00000  1.65%   136  271s
 109  5205 5082  835.74708  995  439  848.00000  835.74708  1.44%   136  276s
 110  5209 5085  836.00540 1207  562  848.00000  836.00540  1.41%   136  283s
 111  5212 5087  836.39513  402  573  848.00000  836.39513  1.37%   136  286s
 112  5213 5087  836.66232  724  523  848.00000  836.66232  1.34%   136  294s
 113  5216 5089  836.79544   32  522  848.00000  836.79544  1.32%   136  295s
 114  5220 5092  837.07280  733  534  848.00000  837.07280  1.29%   136  314s
 115  5222 5093  837.08334 1083  569  848.00000  837.08334  1.29%   136  319s
 116  5223 5094  837.26873  612  526  848.00000  837.26873  1.27%   136  348s
 117  5225 5095  837.27248  714  543  848.00000  837.27248  1.27%   135  356s
 118  5226 5096  837.43814   63  489  848.00000  837.43814  1.25%   135  364s
 119  5227 5097  837.45520  669  483  848.00000  837.45520  1.24%   135  365s
 120  5229 5098  837.47638  654  502  848.00000  837.47638  1.24%   135  370s
 121  5230 5099  837.61830  828  528  848.00000  837.61830  1.22%   135  378s
 122  5232 5100  837.64626  502  484  848.00000  837.64626  1.22%   135  385s
 123  5233 5101  837.78027 1021  470  848.00000  837.78027  1.21%   135  394s
 124  5234 5101  837.81051  236  439  848.00000  837.81051  1.20%   135  395s
 125  5235 5102  837.81995  600  546  848.00000  837.81995  1.20%   135  400s
 126  5236 5103  837.94963  478  433  848.00000  837.94963  1.19%   135  410s
 127  5239 5105  837.97954  317  464  848.00000  837.97954  1.18%   135  416s
 128  5240 5105  838.20197  633  481  848.00000  838.20197  1.16%   135  429s
 129  5241 5106  838.21822  500  508  848.00000  838.21822  1.15%   135  430s
 130  5244 5108  838.40417  810  511  848.00000  838.40417  1.13%   135  436s
 131  5249 5111  838.59847  771  657  848.00000  838.59847  1.11%   135  441s
 132  5253 5114  838.77511  909  639  848.00000  838.77511  1.09%   135  449s
 133  5254 5115  838.81462  556  537  848.00000  838.81462  1.08%   135  450s
 134  5257 5117  838.93280   41  627  848.00000  838.93280  1.07%   135  455s
 135  5262 5120  839.08742  785  626  848.00000  839.08742  1.05%   135  472s
 136  5266 5123  839.18317   28  608  848.00000  839.18317  1.04%   134  476s
 137  5270 5125  839.28590 1067  608  848.00000  839.28590  1.03%   134  483s
 138  5273 5127  839.32436 1340  626  848.00000  839.32436  1.02%   134  485s
 139  5274 5128  839.35331  325  596  848.00000  839.35331  1.02%   134  490s
 140  5278 5131  839.53521  522  598  848.00000  839.53521  1.00%   134  499s
 141  5279 5131  839.84089 1157  584  848.00000  839.84089  0.96%   134  500s
 142  5284 5135  840.11821 1039  562  848.00000  840.11821  0.93%   134  505s
 143  5287 5137  840.48513  500  551  848.00000  840.48513  0.89%   134  510s
 144  5291 5139  840.54361 1052  584  848.00000  840.54361  0.88%   134  517s
 145  5294 5141  840.59192  617  587  848.00000  840.59192  0.87%   134  532s
 146  5296 5143  840.60494  243  603  848.00000  840.60494  0.87%   134  535s
 147  5309 5154  846.91204 1207   57  848.00000  846.91204  0.13%   156  540s
 148
 149  Explored 5312 nodes (845972 simplex iterations) in 540.24 seconds (500.38 work units)
 150  Thread count was 8 (of 8 available processors)
 151
 152  Solution count 3: 848 848 848
 153  No other solutions better than 848
 154
 155  Optimal solution found (tolerance 1.00e-04)
 156  Best objective 8.480000000000e+02, best bound 8.480000000000e+02, gap 0.0000%
 157
 158  Output optimal solution and the Optimal Obj:  848.0
 159
 160
 161  Obj = 848.0
 162
 163  Solutions:
 164     The total pi =  157.0
```

The total duration time in berth stage = 199.0
The total duration time in quay crane scheduling stage = 37.0
The total departure time in berth stage= 505.0
The total departure time in quay crane scheduling stage = 343.0
The total wasted crane work hour according QC0= 6.040755716041328
The last depature time in quay crane scheduling stage = 60.0

The specific solution are as follows:
Vessel i: 0 li: 6, pi: 13-19, ai-di: 56-75, taoi-deltai: 56-75, periodi: 19, taoPi_SP-deltaPi_SP: 56-60, periodPi: 4, c_i: 4877652, dowork: 5404702, fa_i: 4
Vessel i: 1 li: 7, pi: 27-34, ai-di: 18-32, taoi-deltai: 18-32, periodi: 14, taoPi_SP-deltaPi_SP: 18-20, periodPi: 2, c_i: 3690865, dowork: 3691016, fa_i: 6
Vessel i: 2 li: 7, pi: 0-7, ai-di: 51-71, taoi-deltai: 51-71, periodi: 20, taoPi_SP-deltaPi_SP: 51-54, periodPi: 3, c_i: 5078032, dowork: 5141058, fa_i: 7
Vessel i: 3 li: 6, pi: 21-27, ai-di: 11-32, taoi-deltai: 11-32, periodi: 21, taoPi_SP-deltaPi_SP: 11-14, periodPi: 3, c_i: 5446369, dowork: 5536524, fa_i: 6
Vessel i: 4 li: 6, pi: 28-34, ai-di: 40-60, taoi-deltai: 40-60, periodi: 20, taoPi_SP-deltaPi_SP: 40-43, periodPi: 3, c_i: 5202834, dowork: 5272880, fa_i: 6
Vessel i: 5 li: 4, pi: 17-21, ai-di: 22-44, taoi-deltai: 22-44, periodi: 22, taoPi_SP-deltaPi_SP: 22-26, periodPi: 4, c_i: 5709150, dowork: 6063812, fa_i: 4
Vessel i: 6 li: 5, pi: 8-13, ai-di: 2-21, taoi-deltai: 2-20, periodi: 18, taoPi_SP-deltaPi_SP: 2-5, periodPi: 3, c_i: 4706531, dowork: 4745592, fa_i: 5
Vessel i: 7 li: 6, pi: 7-13, ai-di: 47-66, taoi-deltai: 47-66, periodi: 19, taoPi_SP-deltaPi_SP: 47-51, periodPi: 4, c_i: 4994677, dowork: 5272880, fa_i: 4
Vessel i: 8 li: 5, pi: 23-28, ai-di: 43-65, taoi-deltai: 43-63, periodi: 20, taoPi_SP-deltaPi_SP: 43-47, periodPi: 4, c_i: 5174489, dowork: 5272880, fa_i: 3
Vessel i: 9 li: 4, pi: 13-17, ai-di: 16-45, taoi-deltai: 16-42, periodi: 26, taoPi_SP-deltaPi_SP: 16-23, periodPi: 7, c_i: 6782880, dowork: 6854744, fa_i: 3
TimeSolveModel: 550.000000

TimeAll: 554.000000