```
"E:\1 □□□□\3 □□□□□\1 □□□□□□\1 □□□□□□□\1_□□□□□□_□□□□\1_LW _□□□□\4 □□□□\3 python_code\1 exzample\2 □□□□□□\9 Code for this paper\Scripts\python.exe" "D:\Python\Pycharm\setroute\PyCharm Community Edition 2021.2.3\plugins\python-ce\helpers\pydev\pydevconsole.py" --mode=client --port=7155

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['E:\\1 □□□□\\3 □□□□□□\\1 □□□□□□□\\1 □□□□□□□□□\\1_□□□□□□_□□□□\\1_LW _□□□□\\4 □□□□\\3 python_code\\9 Code for this paper', 'E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/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 _□□□□/4 □□□□/3 python_code/9 Code for this paper/main_DM.py', wdir='E:/1 □□□□/3 □□□□□/1 □□□□□□□/1 □□□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper')
Backend TkAgg is interactive backend. Turning interactive mode on.
Waiting 5s.....

Optimize the  ./R_13_1.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 430907 rows, 105716 columns and 1277679 nonzeros
Model fingerprint: 0x941fc439
Variable types: 0 continuous, 105716 integer (89245 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, 5e+06]
Presolve removed 379842 rows and 5255 columns
Presolve time: 0.33s
Presolved: 51065 rows, 100461 columns, 152682 nonzeros
Variable types: 0 continuous, 100461 integer (83990 binary)
Found heuristic solution: objective 1184.0000000
Root relaxation presolved: 40053 rows, 100517 columns, 117517 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 4.846555e+02, 3371 iterations, 1.72 seconds (0.37 work units)
Total elapsed time = 5.02s (DegenMoves)

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

     0     0  484.65546    0 2504 1184.00000  484.65546  59.1%     -    6s
H    0     0                814.0000000  484.65546  40.5%     -   10s
H    0     0                813.0000000  484.65546  40.4%     -   13s
     0     0  501.13851    0 2299  813.00000  501.13851  38.4%     -   15s
     0     0  513.92026    0 2418  813.00000  513.92026  36.8%     -   34s
     0     0  514.10424    0 2418  813.00000  514.10424  36.8%     -   34s
     0     0  516.31488    0 2027  813.00000  516.31488  36.5%     -   37s
     0     0  516.84695    0 2426  813.00000  516.84695  36.4%     -   45s
     0     0  516.87782    0 2425  813.00000  516.87782  36.4%     -   45s
     0     0  516.87824    0 2425  813.00000  516.87824  36.4%     -   46s
     0     0  519.77252    0 1918  813.00000  519.77252  36.1%     -   51s
     0     0  520.10890    0 2082  813.00000  520.10890  36.0%     -   58s
     0     0  520.14725    0 1942  813.00000  520.14725  36.0%     -   59s
     0     0  520.14853    0 2061  813.00000  520.14853  36.0%     -   59s
     0     0  521.26278    0 1865  813.00000  521.26278  35.9%     -   66s
     0     0  522.46701    0 1979  813.00000  522.46701  35.7%     -   75s
     0     0  522.86807    0 1919  813.00000  522.86807  35.7%     -   76s
     0     0  522.91212    0 1938  813.00000  522.91212  35.7%     -   77s
     0     0  522.91722    0 1973  813.00000  522.91722  35.7%     -   77s
     0     0  525.18383    0 1854  813.00000  525.18383  35.4%     -   80s
     0     0  526.29066    0 1924  813.00000  526.29066  35.3%     -   90s
     0     0  526.31891    0 1953  813.00000  526.31891  35.3%     -   90s
     0     0  526.33946    0 1996  813.00000  526.33946  35.3%     -   91s
     0     0  526.88482    0 1728  813.00000  526.88482  35.2%     -   93s
     0     0  526.95243    0 1880  813.00000  526.95243  35.2%     -  102s
     0     0  526.96100    0 1808  813.00000  526.96100  35.2%     -  102s
     0     0  527.23600    0 1823  813.00000  527.23600  35.1%     -  104s
```

```
     0     0  527.31716    0 1821  813.00000  527.31716  35.1%     -  113s
     0     0  527.32450    0 1830  813.00000  527.32450  35.1%     -  114s
     0     0  527.58896    0 1766  813.00000  527.58896  35.1%     -  115s
     0     0  527.61348    0 1794  813.00000  527.61348  35.1%     -  126s
     0     0  527.94777    0 1622  813.00000  527.94777  35.1%     -  127s
     0     0  527.97021    0 1587  813.00000  527.97021  35.1%     -  130s
     0     2  527.97021    0 1583  813.00000  527.97021  35.1%     -  138s
    85    88  530.02423   21 1603  813.00000  528.93558  34.9%  47.9  140s
   792   819  537.21784  186 1468  813.00000  528.93558  34.9%  11.3  145s
  1012  1007  543.17392  230 1425  813.00000  528.93558  34.9%  17.0  153s
  1286  1349  550.25104  257 1186  813.00000  528.93558  34.9%  27.4  155s
  2092  2137  636.04494  493  899  813.00000  528.93558  34.9%  41.6  160s
  2845  2841  714.00000  778  702  813.00000  528.93558  34.9%  54.4  165s
  3556  3604  580.56604   99 1447  813.00000  529.14010  34.9%  62.6  170s
  3750  3605  762.00000  630 20038  813.00000  529.14010  34.9%  61.8  179s
  3752  3606  786.00000   46 1475  813.00000  786.00000  3.32%  61.8  186s
H 3752  3425                     812.0000000  788.31553  2.92%  61.8  189s
  3753  3426  788.31553   23  302  812.00000  788.31553  2.92%  61.7  190s
H 3763  2944                     811.0000000  790.90308  2.48%  68.1  195s
  3775  2805  800.04649  571  440  811.00000  800.04649  1.35%  67.9  200s
  3797  2679  806.58362  174  145  811.00000  806.58362  0.54%  67.5  205s
  3818  2693  808.37227  957   90  811.00000  808.37227  0.32%  67.1  210s
  3836  2705  809.36846   77   38  811.00000  809.36846  0.20%  66.8  215s
  3849  2714  809.45939   72   77  811.00000  809.45939  0.19%  66.6  220s

Cutting planes:
  Learned: 21
  Gomory: 44
  Lift-and-project: 2
  Cover: 3
  Implied bound: 47
  Clique: 3
  MIR: 30
  StrongCG: 26
  Flow cover: 60
  Zero half: 31
  RLT: 32
  Relax-and-lift: 294

Explored 3863 nodes (307878 simplex iterations) in 224.14 seconds (135.84 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 811 811 811
No other solutions better than 811

Optimal solution found (tolerance 1.00e-04)
Best objective 8.110000000000e+02, best bound 8.110000000000e+02, gap 0.0000%

Output optimal solution and the Optimal Obj:  811.0


Obj = 811.0

Solutions:
    The total pi =  213.0
    The total duration time in berth stage =  149.0
    The total duration time in quay crane scheduling stage =  30.0
    The total departure time in berth stage=  465.0
    The total departure time in quay crane scheduling stage =  346.0
    The total wasted crane work hour according QC0=  8.544309751027901
    The last depature time in quay crane scheduling stage =  52.0

The specific solution are as follows:
    Vessel i: 0:    li: 5,    pi: 9-14,    ai-di: 1-14,    taoi-deltai: 1-17,    periodi: 16,    taoPi_SP-deltaPi_SP: 1-4,    periodPi: 3,    c_i: 4045894,    dowork: 4745592,    fa_i: 4
    Vessel i: 1:    li: 6,    pi: 14-20,    ai-di: 4-15,    taoi-deltai: 4-13,    periodi: 9,    taoPi_SP-deltaPi_SP: 4-6,    periodPi: 2,    c_i: 2245580,    dowork: 2504618,    fa_i: 4
    Vessel i: 2:    li: 5,    pi: 21-26,    ai-di: 9-16,    taoi-deltai: 9-15,    periodi: 6,    taoPi_SP-deltaPi_SP: 9-10,    periodPi: 1,    c_i: 1402489,    dowork: 1450042,    fa_i: 4
    Vessel i: 3:    li: 6,    pi: 28-34,    ai-di: 13-18,    taoi-deltai: 13-17,    periodi: 4,    taoPi_SP-deltaPi_SP: 13-14,    periodPi: 1,    c_i: 1000000,    dowork: 1318220,    fa_i: 3
    Vessel i: 4:    li: 7,    pi: 14-21,    ai-di: 15-35,    taoi-deltai: 15-36,    periodi: 21,    taoPi_SP-deltaPi_SP: 15-19,    periodPi: 4,    c_i: 5281421,    dowork: 5404702,    fa_i: 4
    Vessel i: 5:    li: 7,    pi: 7-14,    ai-di: 19-35,    taoi-deltai: 19-36,    periodi: 17,    taoPi_SP-deltaPi_SP: 19-22,    periodPi: 3,    c_i: 4386290,    dowork: 4481948,    fa_i: 4
    Vessel i: 6:    li: 7,    pi: 21-28,    ai-di: 23-39,    taoi-deltai: 23-39,    periodi: 16,    taoPi_SP-deltaPi_SP: 23-26,    periodPi: 3,    c_i: 3981008,    dowork: 4086482,    fa_i: 4
    Vessel i: 7:    li: 6,    pi: 28-34,    ai-di: 28-40,    taoi-deltai: 28-33,    periodi: 5,    taoPi_SP-deltaPi_SP: 28-29,    periodPi: 1,    c_i: 1080122,    dowork: 1318220,    fa_i: 3
    Vessel i: 8:    li: 5,    pi: 29-34,    ai-di: 34-59,    taoi-deltai: 34-52,    periodi: 18,    taoPi_SP-deltaPi_SP: 34-38,    periodPi: 4,    c_i: 4586182,    dowork: 4745592,    fa_i: 4
    Vessel i: 9:    li: 5,    pi: 0-5,    ai-di: 35-55,    taoi-deltai: 35-42,    periodi: 7,    taoPi_SP-deltaPi_SP: 35-37,    periodPi: 2,    c_i: 1843576,    dowork: 1845508,    fa_i: 4
    Vessel i: 10:    li: 5,    pi: 14-19,    ai-di: 42-63,    taoi-deltai: 42-54,    periodi: 12,    taoPi_SP-
```

```
deltaPi_SP: 42-45,  periodPi: 3,  c_i: 3159187,  dowork: 3163728,  fa_i: 4
    Vessel i: 11:  li: 5,  pi: 19-24,  ai-di: 43-62,  taoi-deltai: 43-49,  periodi: 6,  taoPi_SP-
deltaPi_SP: 43-44,  periodPi: 1,  c_i: 1570504,  dowork: 1581864,  fa_i: 4
    Vessel i: 12:  li: 5,  pi: 9-14,  ai-di: 50-70,  taoi-deltai: 50-62,  periodi: 12,  taoPi_SP-
deltaPi_SP: 50-52,  periodPi: 2,  c_i: 2975335,  dowork: 3163728,  fa_i: 4
TimeSolveModel: 246.000000

TimeAll: 249.000000
```