```
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=52424

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_9_5.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 213639 rows, 72324 columns and 629811 nonzeros
Model fingerprint: 0x357ad604
Variable types: 0 continuous, 72324 integer (60921 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, 6e+06]
Presolve removed 175889 rows and 3088 columns
Presolve time: 0.33s
Presolved: 37750 rows, 69236 columns, 110804 nonzeros
Variable types: 0 continuous, 69236 integer (57842 binary)
Root relaxation presolved: 37715 rows, 69271 columns, 110734 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 3.631970e+02, 3227 iterations, 0.31 seconds (0.46 work units)

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

     0     0  363.19699    0 2288          -  363.19699      -     -    1s
H    0     0                581.0000000  363.19699  37.5%     -    2s
H    0     0                577.0000000  363.19699  37.1%     -    2s
H    0     0                574.0000000  363.19699  36.7%     -    3s
     0     0  382.96436    0 2069  574.00000  382.96436  33.3%     -    3s
     0     0  390.00000    0 2183  574.00000  390.00000  32.1%     -   14s
     0     0  390.00000    0 2292  574.00000  390.00000  32.1%     -   14s
     0     0  393.04891    0 1850  574.00000  393.04891  31.5%     -   15s
     0     0  393.41023    0 2238  574.00000  393.41023  31.5%     -   18s
     0     0  393.41733    0 2234  574.00000  393.41733  31.5%     -   18s
     0     0  395.42595    0 1551  574.00000  395.42595  31.1%     -   19s
     0     0  395.63420    0 1765  574.00000  395.63420  31.1%     -   21s
     0     0  395.72968    0 1762  574.00000  395.72968  31.1%     -   21s
     0     0  395.73141    0 1711  574.00000  395.73141  31.1%     -   21s
     0     0  396.08797    0 1402  574.00000  396.08797  31.0%     -   22s
     0     0  396.14893    0 1568  574.00000  396.14893  31.0%     -   25s
     0     0  396.15504    0 1507  574.00000  396.15504  31.0%     -   25s
     0     0  396.40156    0 1610  574.00000  396.40156  30.9%     -   26s
     0     0  396.42632    0 1664  574.00000  396.42632  30.9%     -   28s
     0     0  396.42632    0 1664  574.00000  396.42632  30.9%     -   28s
     0     0  396.63285    0 1336  574.00000  396.63285  30.9%     -   28s
     0     0  396.70604    0 1461  574.00000  396.70604  30.9%     -   32s
     0     0  396.73512    0 1428  574.00000  396.73512  30.9%     -   32s
     0     0  396.75281    0 1461  574.00000  396.75281  30.9%     -   32s
     0     0  396.87694    0 1412  574.00000  396.87694  30.9%     -   33s
     0     0  396.89431    0 1306  574.00000  396.89431  30.9%     -   33s
     0     2  410.00000    0 1283  574.00000  410.00000  28.6%     -   36s
   558   583  414.97168  133 1250  574.00000  410.00000  28.6%   7.9   40s
  1641  1648  411.11460  272 1107  574.00000  410.00000  28.6%  19.0   45s
  2186  2270  446.66751  378  987  574.00000  410.00000  28.6%  44.6   50s
```

```
 81    3516  3554  528.44178  699  734  574.00000  410.00000  28.6%  35.5   55s
 82    4365  4332  539.80047  837  730  574.00000  410.00000  28.6%  39.6   60s
 83    4551  3910  440.26721  300 1306  574.00000  410.00000  28.6%  39.3   66s
 84    4553  3911  544.00000  372 1366  574.00000  544.00000  5.23%  39.2   71s
 85    4554  3716  544.00000  221 1670  574.00000  544.00000  5.23%  39.2   82s
 86    4559  3719  546.93167  321 1727  574.00000  546.93167  4.72%  39.2   89s
 87    4560  3720  551.00000   39 1637  574.00000  551.00000  4.01%  39.2   90s
 88    4563  3722  551.00000   45 1870  574.00000  551.00000  4.01%  39.2   98s
 89  H 4563  3536                       573.0000000  551.00000  3.84%  39.2   98s
 90    4566  3538  552.63053  324  112  573.00000  552.63053  3.55%  39.1  101s
 91    4570  3541  552.87885  120  262  573.00000  552.87885  3.51%  39.1  105s
 92    4580  3203  553.18494   93  518  573.00000  553.18494  3.46%  51.6  110s
 93    4588  2897  559.00000  251  795  573.00000  559.00000  2.44%  53.0  116s
 94  H 4592  2755                       570.0000000  561.00000  1.58%  52.9  121s
 95    4671  2768  561.42431   63  435  570.00000  561.00000  1.58%  62.3  125s
 96    4879  2492  561.44849   87  342  570.00000  561.00000  1.58%  77.6  130s
 97    5070  2504  561.50639  105  292  570.00000  561.00000  1.58%  95.1  135s
 98    5459  2529  564.00000  156  104  570.00000  561.00000  1.58%   110  140s
 99    5844  2612 infeasible  193       570.00000  561.00000  1.58%   118  145s
100    6354  2837 infeasible  245       570.00000  561.00000  1.58%   121  150s
101    7069  3314  563.00000  198  157  570.00000  561.00000  1.58%   117  155s
102    8742  4152  566.00000  292   73  570.00000  561.72253  1.45%   103  161s
103   10140  4477  567.00000  261   73  570.00000  562.00000  1.40%  93.7  165s
104   10434  4383  568.00000  169  278  570.00000  562.00000  1.40%  94.7  170s
105   10443  4389  568.00000  201  282  570.00000  562.73666  1.27%  94.6  175s
106   10448  4392  567.00000  115  261  570.00000  562.82545  1.26%  94.6  181s
107  H10450  4174                       569.0000000  563.00000  1.05%  94.6  184s
108   10453  4176  567.51544  104  221  569.00000  563.00372  1.05%  94.5  185s
109   10471  3969  563.00828   66  166  569.00000  563.00828  1.05%  97.5  190s
110   10757  3769  565.00000  100   76  569.00000  563.33333  1.00%   101  195s
111   11368  3971  565.00000   94   97  569.00000  563.83728  0.91%   102  200s
112   12476  4209  566.00000  117   47  569.00000  564.50000  0.79%   102  205s
113   13994  4833  567.00000  122   28  569.00000  565.00000  0.70%  94.6  211s
114   15605  4837  568.00000  137   31  569.00000  565.00000  0.70%  89.3  216s
115   16730  5019  566.00000  129   30  569.00000  565.00000  0.70%  86.1  220s
116   18543  5177  567.00000  141   38  569.00000  565.00000  0.70%  81.9  226s
117   19732  5219  567.00000  142   24  569.00000  565.00000  0.70%  80.4  230s
118   20857  5117  566.00000  113  110  569.00000  565.00000  0.70%  79.9  235s
119   20876  5131  567.00000  119   81  569.00000  565.00000  0.70%  80.2  240s
120  H20891  4883                       568.0000000  565.00000  0.53%  80.1  243s
121   20897  4887  567.00000  148   41  568.00000  565.00000  0.53%  80.1  245s
122   21182  4495  567.00000  107   70  568.00000  565.00000  0.53%  81.6  250s
123   21860  4661 infeasible  121       568.00000  565.00000  0.53%  82.0  255s
124   22931  4870  565.00000   99   66  568.00000  565.00000  0.53%  82.6  260s
125   23650  4901  566.00000  102   85  568.00000  565.00000  0.53%  82.8  265s
126  H24484  4869                       567.0000000  565.00000  0.35%  83.1  268s
127   24783  3384  566.00000  100  103  567.00000  565.00000  0.35%  82.9  270s
128   25945  3216  566.00000   97   80  567.00000  565.00000  0.35%  84.0  275s
129   27389  2932  565.01667  103   69  567.00000  565.00000  0.35%  85.9  281s
130   28650  2599     cutoff  103       567.00000  565.05556  0.34%  86.2  285s
131   30067  1967     cutoff  123       567.00000  566.00000  0.18%  86.8  291s
132   32166  1096  566.00000  113   64  567.00000  566.00000  0.18%  88.4  298s
133   33347  1000  566.00000  106   80  567.00000  566.00000  0.18%  89.2  301s
134   34624   901     cutoff  106       567.00000  566.00000  0.18%  89.3  305s
135   37018   772     cutoff  114       567.00000  566.00000  0.18%  90.6  312s
136   38400   774     cutoff  103       567.00000  566.00000  0.18%  91.0  317s
137   38812   739  566.00000  114   43  567.00000  566.00000  0.18%  91.1  321s
138   40315   669  566.00000  110   63  567.00000  566.00000  0.18%  91.6  326s
139   41705   554  566.00000   98   63  567.00000  566.00000  0.18%  91.9  330s
140   44734   486     cutoff  111       567.00000  566.00000  0.18%  92.8  339s
141   46033   403     cutoff  107       567.00000  566.00000  0.18%  93.2  343s
142   47466   390  566.00000  116   53  567.00000  566.00000  0.18%  93.7  347s
143   48982   298  566.00000  106   79  567.00000  566.00000  0.18%  93.9  351s
144   50403   205  566.00000  104   15  567.00000  566.00000  0.18%  94.2  355s
145   52722    14     cutoff  101       567.00000  566.00000  0.18%  94.7  360s
146
147  Cutting planes:
148    Gomory: 11
149    Lift-and-project: 2
150    MIR: 8
151    StrongCG: 1
152    Flow cover: 33
153    Inf proof: 1
154    Zero half: 6
155    RLT: 5
156    Relax-and-lift: 23
157
158  Explored 53625 nodes (5084316 simplex iterations) in 362.34 seconds (399.95 work units)
159  Thread count was 8 (of 8 available processors)
160
161  Solution count 3: 567 567 567
162  No other solutions better than 567
163
164  Optimal solution found (tolerance 1.00e-04)
```

```
Best objective 5.670000000000e+02, best bound 5.670000000000e+02, gap 0.0000%

Output optimal solution and the Optimal Obj:  567.0


Obj = 567.0

Solutions:
    The total pi =  111.0
    The total duration time in berth stage =  160.0
    The total duration time in quay crane scheduling stage =  35.0
    The total departure time in berth stage=  346.0
    The total departure time in quay crane scheduling stage =  221.0
    The total wasted crane work hour according QC0=  5.194352991154739
    The last depature time in quay crane scheduling stage =  65.0

The specific solution are as follows:
    Vessel i: 0:    li: 7,    pi: 0-7,    ai-di: 29-41,    taoi-deltai: 29-41,    periodi: 12,    taoPi_SP-deltaPi_SP: 29-32,    periodPi: 3,    c_i: 2998254,    dowork: 3163728,    fa_i: 4
    Vessel i: 1:    li: 5,    pi: 9-14,    ai-di: 62-72,    taoi-deltai: 62-72,    periodi: 10,    taoPi_SP-deltaPi_SP: 62-65,    periodPi: 3,    c_i: 2572578,    dowork: 2636440,    fa_i: 2
    Vessel i: 2:    li: 4,    pi: 20-24,    ai-di: 12-29,    taoi-deltai: 12-29,    periodi: 17,    taoPi_SP-deltaPi_SP: 12-15,    periodPi: 3,    c_i: 4442483,    dowork: 4613770,    fa_i: 4
    Vessel i: 3:    li: 5,    pi: 29-34,    ai-di: 25-47,    taoi-deltai: 25-47,    periodi: 22,    taoPi_SP-deltaPi_SP: 25-30,    periodPi: 5,    c_i: 5592497,    dowork: 5800168,    fa_i: 3
    Vessel i: 4:    li: 7,    pi: 7-14,    ai-di: 20-41,    taoi-deltai: 20-41,    periodi: 21,    taoPi_SP-deltaPi_SP: 20-23,    periodPi: 3,    c_i: 5290648,    dowork: 5536524,    fa_i: 6
    Vessel i: 5:    li: 6,    pi: 8-14,    ai-di: 2-21,    taoi-deltai: 2-19,    periodi: 17,    taoPi_SP-deltaPi_SP: 2-5,    periodPi: 3,    c_i: 4218868,    dowork: 4350126,    fa_i: 6
    Vessel i: 6:    li: 5,    pi: 0-5,    ai-di: 7-27,    taoi-deltai: 7-27,    periodi: 20,    taoPi_SP-deltaPi_SP: 7-12,    periodPi: 5,    c_i: 5106454,    dowork: 5272880,    fa_i: 4
    Vessel i: 7:    li: 6,    pi: 14-20,    ai-di: 7-26,    taoi-deltai: 7-25,    periodi: 18,    taoPi_SP-deltaPi_SP: 7-13,    periodPi: 6,    c_i: 4675387,    dowork: 4877414,    fa_i: 2
    Vessel i: 8:    li: 5,    pi: 24-29,    ai-di: 22-46,    taoi-deltai: 22-45,    periodi: 23,    taoPi_SP-deltaPi_SP: 22-26,    periodPi: 4,    c_i: 5916411,    dowork: 5931990,    fa_i: 5
TimeSolveModel: 371.000000

TimeAll: 375.000000
```