```
"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=56726

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_RO_TWS.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.....
Set parameter MIPGap to value 0.001
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 398368 rows, 34789 columns and 1098502 nonzeros
Model fingerprint: 0x917db14a
Variable types: 1 continuous, 34788 integer (34764 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 191256 rows and 12027 columns (presolve time = 5s) ...
Presolve removed 348926 rows and 21902 columns
Presolve time: 8.09s
Presolved: 49442 rows, 12887 columns, 199039 nonzeros
Variable types: 0 continuous, 12887 integer (12869 binary)

Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
Showing first log only...

Root relaxation presolved: 49438 rows, 12891 columns, 199027 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    8.9700000e+02   7.187500e+01   1.412650e+08      9s
Concurrent spin time: 0.03s

Solved with dual simplex (primal model)

Root relaxation: objective 8.970000e+02, 1913 iterations, 0.31 seconds (0.25 work units)

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

     0     0  897.00000    0    2          -  897.00000      -     -    9s
H    0     0                1737.0000000  897.00000  48.4%     -    9s
     0     0  897.00000    0    8 1737.00000  897.00000  48.4%     -   10s
H    0     0                1057.0000000  897.00000  15.1%     -   10s
H    0     0                 957.0000000  897.00000  6.27%     -   10s

Explored 1 nodes (11312 simplex iterations) in 15.63 seconds (25.36 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 957 1057 1737

Optimal solution found (tolerance 1.00e-03)
Best objective 9.570000000000e+02, best bound 9.570000000000e+02, gap 0.0000%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 252611 rows, 9618 columns and 522175 nonzeros
Model fingerprint: 0x1a234adb
Variable types: 24 continuous, 9594 integer (5544 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
```

```
  Bounds range     [1e+00, 1e+00]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 247826 rows and 8144 columns
Presolve time: 0.83s
Presolved: 4785 rows, 1474 columns, 12785 nonzeros
Variable types: 4 continuous, 1470 integer (840 binary)
Found heuristic solution: objective 3668.6666667
Found heuristic solution: objective 3808.6666667

Root relaxation: objective 5.138792e+03, 1365 iterations, 0.08 seconds (0.03 work units)

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

     0     0 5138.79167    0   33 3808.66667 5138.79167  34.9%     -    1s
H    0     0                    4760.1666667 5136.16667  7.90%     -    1s
     0     0 5136.16667    0   12 4760.16667 5136.16667  7.90%     -    1s
H    0     0                    5136.1666667 5136.16667  0.00%     -    1s
     0     0 5136.16667    0   12 5136.16667 5136.16667  0.00%     -    1s

Cutting planes:
  Gomory: 3
  Implied bound: 3
  Clique: 26
  MIR: 4
  Flow cover: 1
  Zero half: 1
  RLT: 1
  Relax-and-lift: 2

Explored 1 nodes (2790 simplex iterations) in 1.38 seconds (0.66 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 5136.17 4760.17 3808.67 3668.67

Optimal solution found (tolerance 1.00e-08)
Best objective 5.136166666667e+03, best bound 5.136166666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5136

 Itr = 0
Collect_LB =   [957.0]
Collect_UB =   [11229.333333333343]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [5136.1666666666715]
Collect_MPObjValNHua =   [957.0]


Set parameter MIPGap to value 0.05
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 403795 rows, 137605 columns and 1103944 nonzeros
Model fingerprint: 0x14abc000
Variable types: 1 continuous, 137604 integer (137580 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 238372 rows and 120798 columns (presolve time = 5s) ...
Presolve removed 384612 rows and 130917 columns
Presolve time: 8.57s
Presolved: 19183 rows, 6688 columns, 85979 nonzeros
Variable types: 0 continuous, 6688 integer (6670 binary)

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.0406667e+03   9.430000e+02   0.000000e+00      9s
    4654    6.0406667e+03   0.000000e+00   0.000000e+00      9s

Root relaxation: objective 6.040667e+03, 4654 iterations, 0.09 seconds (0.13 work units)

```

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

     0     0 6040.66667    0   16          - 6040.66667      -     -    8s
     0     0 6040.66667    0   67          - 6040.66667      -     -   10s
     0     0 6040.66667    0  169          - 6040.66667      -     -   10s
     0     0 6040.66667    0  115          - 6040.66667      -     -   14s
     0     0 6040.66667    0  494          - 6040.66667      -     -   15s
     0     0 6040.66667    0  489          - 6040.66667      -     -   15s
     0     0 6040.66667    0  154          - 6040.66667      -     -   19s
     0     0 6040.66667    0  396          - 6040.66667      -     -   21s
     0     0 6040.66667    0  123          - 6040.66667      -     -   23s
     0     0 6040.66667    0  123          - 6040.66667      -     -   24s
     0     2 6040.66667    0  117          - 6040.66667      -     -   26s
    16    11 6040.66667    6  376          - 6040.66667      -  2591   30s
    43    32 6040.66667   13  275          - 6040.66667      -  2381   35s
   197   204 6040.66667   30  248          - 6040.66667      -   736   40s
*  235   204              67    6740.6666667 6040.66667  10.4%   620   40s
   396   230 6060.66667   54  382 6740.66667 6040.66667  10.4%   457   45s
   881   575 6060.66667  245  230 6740.66667 6040.66667  10.4%   233   50s
*  938   523             113    6540.6666667 6040.66667  7.64%   221   50s
H  969   390                  6380.6666667 6040.66667  5.33%   233   51s
H  996   279                  6300.6666667 6040.66667  4.13%   231   52s
H  996   227                  6260.6666667 6040.66667  3.51%   231   52s

Cutting planes:
  Learned: 922
  Gomory: 1
  Cover: 588
  Implied bound: 289
  Clique: 173
  MIR: 204
  StrongCG: 94
  GUB cover: 6
  Zero half: 16
  RLT: 13
  Relax-and-lift: 64
  BQP: 4

Explored 1013 nodes (326652 simplex iterations) in 52.26 seconds (93.03 work units)
Thread count was 8 (of 8 available processors)

Solution count 5: 6260.67 6300.67 6380.67 ... 6740.67

Optimal solution found (tolerance 5.00e-02)
Best objective 6.260666666667e+03, best bound 6.040666666667e+03, gap 3.5140%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 252611 rows, 9618 columns and 522175 nonzeros
Model fingerprint: 0x07d1d5c2
Variable types: 24 continuous, 9594 integer (5544 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 246863 rows and 7848 columns
Presolve time: 0.23s
Presolved: 5748 rows, 1770 columns, 15223 nonzeros
Variable types: 4 continuous, 1766 integer (1017 binary)
Found heuristic solution: objective 3714.7551108

Root relaxation: objective 5.283667e+03, 1862 iterations, 0.02 seconds (0.02 work units)

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

*    0     0               0    5283.6666667 5283.66667  0.00%     -    0s

Explored 1 nodes (2851 simplex iterations) in 0.36 seconds (0.59 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 5283.67 3714.76

Optimal solution found (tolerance 1.00e-08)
Best objective 5.283666666667e+03, best bound 5.283666666667e+03, gap 0.0000%
```

```
SP is solved
SP's optimal solution is'□5283

 Itr = 1
Collect_LB =   [957.0, 6260.6666666666715]
Collect_UB =   [11229.333333333343, 6408.166666666668]
Collect_Hua =   [0.0, 5136.1666666666715]
Collect_SPObjVal =   [5136.1666666666715, 5283.666666666668]
Collect_MPObjValNHua =   [957.0, 1124.5]


Set parameter MIPGap to value 0.05
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 403795 rows, 137605 columns and 1103944 nonzeros
Model fingerprint: 0x3730fd1c
Variable types: 1 continuous, 137604 integer (137580 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 238307 rows and 120806 columns (presolve time = 5s) ...
Presolve removed 384613 rows and 130917 columns
Presolve time: 8.33s
Presolved: 19182 rows, 6688 columns, 85971 nonzeros
Variable types: 0 continuous, 6688 integer (6670 binary)

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.1806667e+03   9.430000e+02   0.000000e+00      9s
    4622    6.1806667e+03   0.000000e+00   0.000000e+00      9s

Root relaxation: objective 6.180667e+03, 4622 iterations, 0.11 seconds (0.13 work units)

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

     0     0 6180.66667    0   16          - 6180.66667      -     -    8s
     0     0 6180.66667    0  167          - 6180.66667      -     -    9s
     0     0 6180.66667    0  183          - 6180.66667      -     -   10s
     0     0 6180.66667    0  191          - 6180.66667      -     -   10s
     0     0 6180.66667    0  125          - 6180.66667      -     -   10s
     0     0 6180.66667    0  191          - 6180.66667      -     -   16s
     0     0 6180.66667    0  170          - 6180.66667      -     -   16s
     0     0 6180.66667    0  488          - 6180.66667      -     -   18s
     0     0 6180.66667    0  185          - 6180.66667      -     -   21s
     0     0 6180.66667    0  564          - 6180.66667      -     -   22s
     0     0 6180.66667    0  419          - 6180.66667      -     -   26s
     0     0 6180.66667    0  402          - 6180.66667      -     -   27s
     0     2 6180.66667    0  374          - 6180.66667      -     -   29s
     5     6 6630.66667    3  177          - 6180.66667      -  2930   31s
    31    23 6756.83688    8  382          - 6180.66667      -  2279   35s
H   46    33                6920.6666667 6180.66667  10.7%  1809   37s
*   76    35              19    6900.6666667 6180.66667  10.4%  1764   39s
    77    41     cutoff   14      6900.66667 6180.66667  10.4%  1741   40s
H  165   124                  6860.6666667 6180.66667  9.91%   921   41s
H  220   158                  6780.6666667 6180.66667  8.85%   705   42s
H  262   196                  6700.6666667 6180.72116  7.76%   628   43s
H  277   196                  6660.6666667 6180.72116  7.21%   598   43s
H  284   196                  6620.6666667 6180.72116  6.65%   584   43s
H  326   247                  6580.6666667 6180.72116  6.08%   525   45s
H  354   247                  6500.6666667 6180.72116  4.92%   485   45s

Cutting planes:
  Learned: 3
  Gomory: 8
  Cover: 614
  Implied bound: 312
  Clique: 174
  MIR: 177
  StrongCG: 109
  GUB cover: 66
  Zero half: 51
  RLT: 14
  Relax-and-lift: 223
```

```
  BQP: 2

Explored 368 nodes (268675 simplex iterations) in 45.17 seconds (78.08 work units)
Thread count was 8 (of 8 available processors)

Solution count 9: 6500.67 6580.67 6620.67 ... 6920.67

Optimal solution found (tolerance 5.00e-02)
Best objective 6.500666666667e+03, best bound 6.200666666667e+03, gap 4.6149%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

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 252611 rows, 9618 columns and 522175 nonzeros
Model fingerprint: 0x8b05bbc5
Variable types: 24 continuous, 9594 integer (5544 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 246724 rows and 7818 columns
Presolve time: 0.22s
Presolved: 5887 rows, 1800 columns, 15681 nonzeros
Variable types: 4 continuous, 1796 integer (1036 binary)
Found heuristic solution: objective 971.8435550
Found heuristic solution: objective 3879.6666667

Root relaxation: objective 5.430667e+03, 1594 iterations, 0.02 seconds (0.03 work units)

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

H    0     0                    5430.6666667 16108.0000   197%     -    0s
     0     0          -    0     5430.66667 5430.66667  0.00%     -    0s

Explored 1 nodes (2365 simplex iterations) in 0.36 seconds (0.58 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 5430.67 3879.67 971.844

Optimal solution found (tolerance 1.00e-08)
Best objective 5.430666666667e+03, best bound 5.430666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5430

 Itr = 2
Collect_LB =   [957.0, 6260.6666666666715, 6500.666666666668]
Collect_UB =   [11229.333333333343, 6408.166666666668, 6408.166666666668]
Collect_Hua =   [0.0, 5136.1666666666715, 5283.666666666668]
Collect_SPObjVal =   [5136.1666666666715, 5283.666666666668, 5430.666666666668]
Collect_MPObjValNHua =   [957.0, 1124.5, 1217.0]


  Ops, stop iteration
 Values adopted from the Itr-1' th iteration, and Itr = {2}, judgeCount = {1}

~~~~~~~~~~judgeCount = 1, SPObj_SPF = 5283.666666666668
Vessel i: 0:      pi: 0-6,      ai-di: 4-12,      gi_SP-gpi_SP: 0.000000-0.000000,      ai_SP-di: 4-12,      taoi-deltai: 4-10,      taoPi_SP-deltaPi_SP: 4-7,      betaNi: 6,
bi: 6
Vessel i: 1:      pi: 0-7,      ai-di: 20-54,      gi_SP-gpi_SP: 0.000000-0.000000,      ai_SP-di: 20-54,      taoi-deltai: 20-52,      taoPi_SP-deltaPi_SP: 22-52,      betaNi:
32,      bi: 32
Vessel i: 2:      pi: 7-14,      ai-di: 24-60,      gi_SP-gpi_SP: 0.000000-0.000000,      ai_SP-di: 24-60,      taoi-deltai: 24-58,      taoPi_SP-deltaPi_SP: 24-58,      betaNi
: 34,      bi: 34
Vessel i: 3:      pi: 27-34,      ai-di: 31-55,      gi_SP-gpi_SP: 0.000000-0.000000,      ai_SP-di: 31-55,      taoi-deltai: 31-53,      taoPi_SP-deltaPi_SP: 31-53,
betaNi: 22,      bi: 22
Vessel i: 4:      pi: 14-21,      ai-di: 30-68,      gi_SP-gpi_SP: 0.200000-1.000000,      ai_SP-di: 31-68,      taoi-deltai: 42-69,      taoPi_SP-deltaPi_SP: 42-69,
betaNi: 27,      bi: 27
Vessel i: 5:      pi: 27-34,      ai-di: 50-68,      gi_SP-gpi_SP: 1.000000-0.200000,      ai_SP-di: 58-68,      taoi-deltai: 57-65,      taoPi_SP-deltaPi_SP: 58-65,
betaNi: 8,      bi: 8

round LB =   [957, 6261, 6501]
round UB =   [11229, 6408, 6408]
round Hua =   [0, 5136, 5284]
round SPObjVal =   [5136, 5284, 5431]
round MPObjValNHua =   [957, 1124, 1217]

OptimalObj = 6500.666666666668
```

410 Time: 169.000000
411
412
413
414