```
"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=2373

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 1e-10
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 557467 rows, 58701 columns and 1576383 nonzeros
Model fingerprint: 0xaf759b0a
Variable types: 1 continuous, 58700 integer (58660 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 342574 rows and 28008 columns (presolve time = 5s) ...
Presolve removed 342574 rows and 28008 columns (presolve time = 10s) ...
Presolve removed 444834 rows and 38927 columns
Presolve time: 11.60s
Presolved: 112633 rows, 19774 columns, 307906 nonzeros
Variable types: 0 continuous, 19774 integer (19744 binary)

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

Root relaxation presolved: 19774 rows, 132407 columns, 327680 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.4900000e+02   0.000000e+00   9.500000e+02     13s
Concurrent spin time: 0.00s

Solved with dual simplex (primal model)

Root relaxation: objective 6.490000e+02, 2260 iterations, 0.66 seconds (0.44 work units)

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

     0     0  649.00000    0   28          -  649.00000      -     -   13s
     0     0  649.00000    0   91          -  649.00000      -     -   14s
     0     0  649.00000    0   84          -  649.00000      -     -   15s
H    0     0                4029.0000000  649.00000  83.9%     -   15s
H    0     0                1789.0000000  649.00000  63.7%     -   15s
H    0     0                 709.0000000  649.00000  8.46%     -   15s
     0     0  649.00000    0  188  709.00000  649.00000  8.46%     -   16s
     0     0  649.00000    0   15  709.00000  649.00000  8.46%     -   21s
H    0     0                 649.0000000  649.00000  0.00%     -   21s

Cutting planes:
  Gomory: 3
  Cover: 75
  Implied bound: 1
  MIR: 49
  StrongCG: 50
  GUB cover: 1
  Zero half: 4
  Relax-and-lift: 3

Explored 1 nodes (10906 simplex iterations) in 21.79 seconds (29.16 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 649 709 1789 4029
```

```
Optimal solution found (tolerance 1.00e-10)
Best objective 6.490000000000e+02, best bound 6.490000000000e+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 654090 rows, 16030 columns and 1337378 nonzeros
Model fingerprint: 0xd5c55a0f
Variable types: 40 continuous, 15990 integer (9240 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 651769 rows and 15144 columns
Presolve time: 0.59s
Presolved: 2321 rows, 886 columns, 6181 nonzeros
Variable types: 10 continuous, 876 integer (524 binary)
Found heuristic solution: objective 3987.9062900

Root relaxation: objective 5.008444e+03, 732 iterations, 0.00 seconds (0.01 work units)

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

     0     0 5008.44444    0   26 3987.90629 5008.44444  25.6%     -    0s
H    0     0                    5008.3015873 5008.44444  0.00%     -    0s

Cutting planes:
  Learned: 4
  Gomory: 1
  Cover: 4
  Implied bound: 7
  MIR: 7

Explored 1 nodes (1165 simplex iterations) in 0.81 seconds (0.86 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 5008.3 3987.91

Optimal solution found (tolerance 1.00e-08)
Best objective 5.008301587302e+03, best bound 5.008301587302e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5008

 Itr = 0
Collect_LB =   [649.0]
Collect_UB =   [10665.603174603188]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [5008.301587301594]
Collect_MPObjValNHua =   [649.0]


Set parameter MIPGap to value 1e-10
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 566498 rows, 344301 columns and 1585459 nonzeros
Model fingerprint: 0xeb29b40a
Variable types: 1 continuous, 344300 integer (344260 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 414856 rows and 324178 columns (presolve time = 5s) ...
Presolve removed 414856 rows and 324178 columns (presolve time = 10s) ...
Presolve removed 512796 rows and 334811 columns
Presolve time: 11.76s
Presolved: 53702 rows, 9490 columns, 140676 nonzeros
Variable types: 0 continuous, 9490 integer (9460 binary)
```

```
Root relaxation presolved: 9490 rows, 63192 columns, 150166 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0      handle free variables                         12s
    6928    5.6644444e+03   0.000000e+00   0.000000e+00     14s
    6928    5.6644444e+03   0.000000e+00   0.000000e+00     14s

Root relaxation: objective 5.664444e+03, 6928 iterations, 1.74 seconds (2.54 work units)

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

     0     0 5664.44444    0   11          - 5664.44444      -     -   14s
H    0     0                6324.4444444 5664.44444  10.4%     -   15s
     0     0 5664.44444    0  120 6324.44444 5664.44444  10.4%     -   15s
H    0     0                6044.4444444 5664.44444  6.29%     -   16s
     0     0 5664.44444    0   34 6044.44444 5664.44444  6.29%     -   17s
     0     0 5664.44444    0   33 6044.44444 5664.44444  6.29%     -   17s
     0     0 5664.44444    0   56 6044.44444 5664.44444  6.29%     -   17s
H    0     0                5864.4444444 5664.44444  3.41%     -   18s
     0     0 5664.44444    0   61 5864.44444 5664.44444  3.41%     -   18s
     0     0 5664.44444    0  174 5864.44444 5664.44444  3.41%     -   18s
     0     0 5664.44444    0   25 5864.44444 5664.44444  3.41%     -   19s
     0     0 5664.44444    0  164 5864.44444 5664.44444  3.41%     -   20s
     0     0 5664.44444    0  160 5864.44444 5664.44444  3.41%     -   20s
     0     0 5664.44444    0  160 5864.44444 5664.44444  3.41%     -   20s
     0     0 5664.44444    0   75 5864.44444 5664.44444  3.41%     -   20s
     0     0 5664.44444    0   72 5864.44444 5664.44444  3.41%     -   21s
     0     0 5664.44444    0  119 5864.44444 5664.44444  3.41%     -   21s
     0     0 5664.44444    0  118 5864.44444 5664.44444  3.41%     -   21s
H    0     0                5664.4444444 5664.44444  0.00%     -   22s
     0     0 5664.44444    0   69 5664.44444 5664.44444  0.00%     -   22s

Cutting planes:
  Learned: 2
  Gomory: 3
  Cover: 120
  Implied bound: 1200
  Clique: 285
  MIR: 71
  StrongCG: 45
  GUB cover: 8
  Zero half: 11
  RLT: 42
  Relax-and-lift: 8
  BQP: 6
  PSD: 2

Explored 1 nodes (40964 simplex iterations) in 22.08 seconds (24.12 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 5664.44 5864.44 6044.44 6324.44

Optimal solution found (tolerance 1.00e-10)
Best objective 5.664444444444e+03, best bound 5.664444444444e+03, 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 654090 rows, 16030 columns and 1337378 nonzeros
Model fingerprint: 0x998347ad
Variable types: 40 continuous, 15990 integer (9240 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 649496 rows and 14518 columns
Presolve time: 0.55s
Presolved: 4594 rows, 1512 columns, 12213 nonzeros
Variable types: 10 continuous, 1502 integer (875 binary)
Found heuristic solution: objective 4059.8240692

Root relaxation: objective 5.617444e+03, 1387 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 5617.44444    0   40 4059.82407 5617.44444  38.4%     -    0s
H    0     0                       4579.6044479 5617.44444  22.7%     -    0s
H    0     0                       5081.6470308 5617.44444  10.5%     -    0s
     0     0 5617.44444    0   39 5081.64703 5617.44444  10.5%     -    0s
H    0     0                       5299.6470308 5617.44444  6.00%     -    0s
H    0     0                       5614.0544382 5617.44444  0.06%     -    0s
     0     0 5617.17864    0   20 5614.05444 5617.17864  0.06%     -    0s

Cutting planes:
  Cover: 3
  Clique: 12
  MIR: 3
  Flow cover: 2
  Zero half: 3
  RLT: 2

Explored 1 nodes (2390 simplex iterations) in 0.95 seconds (0.97 work units)
Thread count was 8 (of 8 available processors)

Solution count 5: 5614.05 5299.65 5081.65 ... 4059.82

Optimal solution found (tolerance 1.00e-08)
Best objective 5.614054438168e+03, best bound 5.614054438168e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5614

 Itr = 1
Collect_LB =   [649.0, 5664.444444444451]
Collect_UB =   [10665.603174603188, 6270.197295310603]
Collect_Hua =   [0.0, 5008.301587301594]
Collect_SPObjVal =   [5008.301587301594, 5614.054438167746]
Collect_MPObjValNHua =   [649.0, 656.1428571428569]


Set parameter MIPGap to value 1e-10
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 566498 rows, 344301 columns and 1585459 nonzeros
Model fingerprint: 0x163d5724
Variable types: 1 continuous, 344300 integer (344260 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 415071 rows and 324162 columns (presolve time = 5s) ...
Presolve removed 415071 rows and 324162 columns (presolve time = 10s) ...
Presolve removed 512999 rows and 334836 columns
Presolve time: 12.13s
Presolved: 53499 rows, 9465 columns, 140196 nonzeros
Variable types: 0 continuous, 9465 integer (9435 binary)
Root relaxation presolved: 9465 rows, 62964 columns, 149661 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0     handle free variables                      13s
    6991    6.2790544e+03   0.000000e+00   0.000000e+00     15s
    6991    6.2790544e+03   0.000000e+00   0.000000e+00     15s

Root relaxation: objective 6.279054e+03, 6991 iterations, 1.95 seconds (2.34 work units)

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

     0     0 6279.05444    0   29          - 6279.05444      -     -   15s
     0     0 6279.05444    0   29          - 6279.05444      -     -   15s
     0     0 6279.05444    0   96          - 6279.05444      -     -   15s
     0     0 6279.05444    0   91          - 6279.05444      -     -   15s
     0     0 6279.05444    0   68          - 6279.05444      -     -   17s
     0     0 6279.05444    0  102          - 6279.05444      -     -   18s
H    0     0                       6299.0544382 6279.05444  0.32%     -   20s
     0     0 6279.05444    0   26 6299.05444 6279.05444  0.32%     -   21s
```

```
H    0     0                6279.0544382 6279.05444  0.00%     -   21s
     0     0 6279.05444    0   26 6279.05444 6279.05444  0.00%     -   21s

Cutting planes:
  Learned: 1
  Gomory: 5
  Cover: 68
  Implied bound: 1057
  Clique: 224
  MIR: 22
  StrongCG: 13
  GUB cover: 2
  Zero half: 8
  RLT: 2
  Relax-and-lift: 201

Explored 1 nodes (25706 simplex iterations) in 21.46 seconds (21.83 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 6279.05 6299.05

Optimal solution found (tolerance 1.00e-10)
Best objective 6.279054438168e+03, best bound 6.279054438168e+03, 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 654090 rows, 16030 columns and 1337378 nonzeros
Model fingerprint: 0x4c1a75f9
Variable types: 40 continuous, 15990 integer (9240 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 649351 rows and 14432 columns
Presolve time: 0.63s
Presolved: 4739 rows, 1598 columns, 12573 nonzeros
Variable types: 10 continuous, 1588 integer (927 binary)
Found heuristic solution: objective 4046.4907358

Root relaxation: objective 5.713444e+03, 1368 iterations, 0.02 seconds (0.01 work units)

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

     0     0 5713.44444    0   22 4046.49074 5713.44444  41.2%     -    0s
H    0     0                5155.0187770 5713.44444  10.8%     -    0s
H    0     0                5558.9076659 5713.44444  2.78%     -    0s
H    0     0                5578.9076659 5713.44444  2.41%     -    0s
     0     0 5713.44444    0   16 5578.90767 5713.44444  2.41%     -    0s
     0     0 5713.44444    0   18 5578.90767 5713.44444  2.41%     -    0s
H    0     0                5678.3928106 5713.44444  0.62%     -    0s
H    0     0                5708.3928106 5713.44444  0.09%     -    0s
     0     0 5708.39281    0   16 5708.39281 5708.39281  0.00%     -    0s

Cutting planes:
  Gomory: 5
  Cover: 5
  Implied bound: 1
  Clique: 24
  MIR: 1
  Flow cover: 1
  Zero half: 2
  RLT: 1

Explored 1 nodes (2593 simplex iterations) in 0.99 seconds (0.96 work units)
Thread count was 8 (of 8 available processors)

Solution count 6: 5708.39 5678.39 5578.91 ... 4046.49

Optimal solution found (tolerance 1.00e-08)
Best objective 5.708392810563e+03, best bound 5.708392810563e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5708

 Itr = 2
Collect_LB =   [649.0, 5664.444444444451, 6279.054438167746]
```

```
Collect_UB =   [10665.603174603188, 6270.197295310603, 6270.197295310603]
Collect_Hua =   [0.0, 5008.301587301594, 5614.054438167746]
Collect_SPObjVal =   [5008.301587301594, 5614.054438167746, 5708.392810563295]
Collect_MPObjValNHua =   [649.0, 656.1428571428569, 665.0]


 No, it is wrong, stop iteration
 Values adopted from the Itr-1' th iteration, and Itr = {2}, judgeCount = {1}

~~~~~~~~~~judgeCount = 1, SPObj_SPF = 5614.054438167746
Vessel i: 0:    pi: 0-5,    ai-di: 9-20,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 9-20,    taoi-deltai: 9-18,    taoPi_SP-deltaPi_SP: 9-18,    betaNi: 9,    bi: 9
Vessel i: 1:    pi: 0-5,    ai-di: 33-51,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 33-51,    taoi-deltai: 33-49,    taoPi_SP-deltaPi_SP: 33-49,    betaNi: 16,    bi: 16
Vessel i: 2:    pi: 0-5,    ai-di: 57-67,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 57-67,    taoi-deltai: 57-65,    taoPi_SP-deltaPi_SP: 57-65,    betaNi: 8,    bi: 8
Vessel i: 3:    pi: 5-10,    ai-di: 15-27,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 15-27,    taoi-deltai: 15-25,    taoPi_SP-deltaPi_SP: 15-25,    betaNi: 10,    bi: 10
Vessel i: 4:    pi: 5-10,    ai-di: 42-62,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 42-62,    taoi-deltai: 42-60,    taoPi_SP-deltaPi_SP: 42-56,    betaNi: 18,    bi: 18
Vessel i: 5:    pi: 12-18,    ai-di: 17-40,    gi_SP-gpi_SP: 0.000000-0.891036,    ai_SP-di: 17-40,    taoi-deltai: 18-28,    taoPi_SP-deltaPi_SP: 18-28,    betaNi: 10,    bi: 10
Vessel i: 6:    pi: 10-15,    ai-di: 21-48,    gi_SP-gpi_SP: 1.000000-0.214615,    ai_SP-di: 29-48,    taoi-deltai: 29-42,    taoPi_SP-deltaPi_SP: 29-42,    betaNi: 13,    bi: 13
Vessel i: 7:    pi: 28-34,    ai-di: 37-57,    gi_SP-gpi_SP: 0.400000-0.894350,    ai_SP-di: 41-57,    taoi-deltai: 40-44,    taoPi_SP-deltaPi_SP: 41-44,    betaNi: 4,    bi: 4
Vessel i: 8:    pi: 21-26,    ai-di: 8-41,    gi_SP-gpi_SP: 0.600000-1.000000,    ai_SP-di: 12-41,    taoi-deltai: 12-29,    taoPi_SP-deltaPi_SP: 13-29,    betaNi: 17,    bi: 17
Vessel i: 9:    pi: 16-21,    ai-di: 25-58,    gi_SP-gpi_SP: 1.000000-0.000000,    ai_SP-di: 32-58,    taoi-deltai: 32-54,    taoPi_SP-deltaPi_SP: 32-54,    betaNi: 22,    bi: 22

round LB =   [649, 5664, 6279]
round UB =   [10666, 6270, 6270]
round Hua =   [0, 5008, 5614]
round SPObjVal =   [5008, 5614, 5708]
round MPObjValNHua =   [649, 656, 665]

OptimalObj = 6279.054438167746
Time: 168.000000



libpng warning: iCCP: known incorrect sRGB profile
libpng warning: iCCP: known incorrect sRGB profile
```