```
"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=27281

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_CCG.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 360923 rows, 34789 columns and 1002717 nonzeros
Model fingerprint: 0xa61a2c1f
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 176910 rows and 12747 columns (presolve time = 5s) ...
Presolve removed 307571 rows and 21407 columns
Presolve time: 8.96s
Presolved: 53352 rows, 13382 columns, 204541 nonzeros
Variable types: 0 continuous, 13382 integer (13364 binary)

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

Root relaxation presolved: 53351 rows, 13383 columns, 204538 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    1.1240000e+03   9.687500e+01   1.931714e+08     10s
Concurrent spin time: 0.03s

Solved with dual simplex (primal model)

Root relaxation: objective 8.040000e+02, 1859 iterations, 0.38 seconds (0.23 work units)
Total elapsed time = 10.01s

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

     0     0  804.00000    0    2          -  804.00000      -     -   11s
H    0     0                2244.0000000  804.00000  64.2%     -   11s
H    0     0                1364.0000000  804.00000  41.1%     -   11s
     0     0  804.00000    0   19 1364.00000  804.00000  41.1%     -   12s
H    0     0                 804.0000000  804.00000  0.00%     -   14s
     0     0  804.00000    0    7  804.00000  804.00000  0.00%     -   14s

Cutting planes:
  Cover: 122
  Implied bound: 610
  Clique: 3
  MIR: 4
  StrongCG: 3
  GUB cover: 1
  Zero half: 2
  Relax-and-lift: 19

Explored 1 nodes (13323 simplex iterations) in 14.85 seconds (15.78 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 804 1364 2244

Optimal solution found (tolerance 1.00e-10)
Best objective 8.040000000000e+02, best bound 8.040000000000e+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 1153684 rows, 901813 columns and 7829291 nonzeros
Model fingerprint: 0x84063345
Variable types: 441325 continuous, 460488 integer (456438 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  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 1151313 rows and 900957 columns
Presolve time: 2.74s
Presolved: 2371 rows, 856 columns, 6316 nonzeros
Variable types: 0 continuous, 856 integer (503 binary)
Found heuristic solution: objective 4207.6666667

Root relaxation: objective 5.149667e+03, 652 iterations, 0.01 seconds (0.01 work units)

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

*    0     0               0    5149.6666667 5149.66667  0.00%     -    3s

Explored 1 nodes (652 simplex iterations) in 3.58 seconds (3.48 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 5149.67 4207.67

Optimal solution found (tolerance 1.00e-08)
Best objective 5.149666666667e+03, best bound 5.149666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5149

  Itr = 0
Collect_LB =   [804.0]
Collect_UB =   [11103.333333333336]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [5149.666666666668]
Collect_MPObjValNHua =   [804.0]


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 619788 rows, 150727 columns and 1825935 nonzeros
Model fingerprint: 0x6b305609
Variable types: 1 continuous, 150726 integer (143124 binary)
Coefficient statistics:
  Matrix range     [1e-01, 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 457892 rows and 131808 columns (presolve time = 5s) ...
Presolve removed 457892 rows and 131808 columns (presolve time = 10s) ...
Presolve removed 457892 rows and 131808 columns (presolve time = 15s) ...
Presolve removed 540701 rows and 140038 columns (presolve time = 20s) ...
Presolve removed 568819 rows and 140043 columns
Presolve time: 20.78s
Presolved: 50969 rows, 10684 columns, 198392 nonzeros
Variable types: 0 continuous, 10684 integer (8834 binary)

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

Root relaxation presolved: 50969 rows, 10684 columns, 198392 nonzeros


Root simplex log...

```

```
Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    9.2400000e+02   2.328407e+03   1.517823e+09     22s
Concurrent spin time: 0.17s

Solved with dual simplex (primal model)

Root relaxation: objective 6.073667e+03, 4608 iterations, 0.87 seconds (0.64 work units)

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

     0     0 6073.66667    0  151          - 6073.66667      -     -   23s
     0     0 6073.66667    0  427          - 6073.66667      -     -   27s
     0     0 6073.66667    0  570          - 6073.66667      -     -   27s
     0     0 6073.66667    0  493          - 6073.66667      -     -   28s
     0     0 6073.66667    0  491          - 6073.66667      -     -   28s
     0     0 6073.66667    0  402          - 6073.66667      -     -   29s
     0     0 6073.66667    0  133          - 6073.66667      -     -   33s
     0     0 6073.66667    0  133          - 6073.66667      -     -   33s
     0     0 6073.66667    0  244          - 6073.66667      -     -   34s
     0     0 6073.66667    0  117          - 6073.66667      -     -   43s
     0     0 6073.66667    0   97          - 6073.66667      -     -   43s
     0     0 6073.66667    0  152          - 6073.66667      -     -   45s
     0     0 6073.66667    0  148          - 6073.66667      -     -   45s
H    0     0                    6073.6666667 6073.66667  0.00%     -   53s
     0     0 6073.66667    0  202 6073.66667 6073.66667  0.00%     -   53s

Cutting planes:
  Gomory: 10
  Cover: 407
  Implied bound: 825
  Clique: 1465
  MIR: 194
  StrongCG: 15
  Flow cover: 2
  GUB cover: 41
  Zero half: 30
  RLT: 35
  Relax-and-lift: 890
  BQP: 18
  PSD: 1

Explored 1 nodes (48234 simplex iterations) in 53.14 seconds (37.31 work units)
Thread count was 8 (of 8 available processors)

Solution count 1: 6073.67

Optimal solution found (tolerance 5.00e-02)
Best objective 6.073666666667e+03, best bound 6.073666666667e+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 1153684 rows, 901813 columns and 7829291 nonzeros
Model fingerprint: 0x03399a85
Variable types: 441325 continuous, 460488 integer (456438 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  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 1148884 rows and 900158 columns
Presolve time: 2.71s
Presolved: 4800 rows, 1655 columns, 12735 nonzeros
Variable types: 4 continuous, 1651 integer (960 binary)
Found heuristic solution: objective 3772.8300722

Root relaxation: objective 5.402667e+03, 1384 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

H    0     0                    5402.6666667 14440.0000   167%     -    3s
     0     0        -    0     5402.66667 5402.66667  0.00%     -    3s

Explored 1 nodes (1986 simplex iterations) in 3.60 seconds (3.30 work units)
Thread count was 8 (of 8 available processors)
```

```
Solution count 2: 5402.67 3772.83

Optimal solution found (tolerance 1.00e-08)
Best objective 5.402666666667e+03, best bound 5.402666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5402

  Itr = 1
Collect_LB =   [804.0, 6073.666666666666]
Collect_UB =   [11103.333333333336, 6326.666666666668]
Collect_Hua =   [0.0, 5149.666666666666]
Collect_SPObjVal =   [5149.666666666668, 5402.666666666668]
Collect_MPObjValNHua =   [804.0, 924.0]


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 872342 rows, 163849 columns and 2642827 nonzeros
Model fingerprint: 0x2336ce8c
Variable types: 1 continuous, 163848 integer (148668 binary)
Coefficient statistics:
  Matrix range     [1e-01, 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 670594 rows and 139786 columns (presolve time = 5s) ...
Presolve removed 681093 rows and 140834 columns (presolve time = 10s) ...
Presolve removed 681093 rows and 140834 columns (presolve time = 15s) ...
Presolve removed 768112 rows and 148889 columns
Presolve time: 17.62s
Presolved: 104230 rows, 14960 columns, 337457 nonzeros
Variable types: 0 continuous, 14960 integer (11278 binary)

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

Root relaxation presolved: 14960 rows, 119190 columns, 352417 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.3266667e+03   0.000000e+00   6.277989e+04     19s
Concurrent spin time: 0.50s

Solved with dual simplex (primal model)

Root relaxation: objective 6.326667e+03, 6079 iterations, 2.04 seconds (1.63 work units)

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

     0     0 6326.66667    0  115          - 6326.66667      -     -   23s
     0     0 6326.66667    0  607          - 6326.66667      -     -   27s
     0     0 6326.66667    0  521          - 6326.66667      -     -   28s
     0     0 6326.66667    0  699          - 6326.66667      -     -   30s
     0     0 6326.66667    0  688          - 6326.66667      -     -   30s
     0     0 6326.66667    0  106          - 6326.66667      -     -   34s
     0     0 6326.66667    0  105          - 6326.66667      -     -   34s
     0     0 6326.66667    0  155          - 6326.66667      -     -   35s
     0     0 6326.66667    0   77          - 6326.66667      -     -   38s
     0     0 6326.66667    0  112          - 6326.66667      -     -   38s
     0     0 6326.66667    0  228          - 6326.66667      -     -   40s
     0     0 6326.66667    0  258          - 6326.66667      -     -   40s
     0     0 6326.66667    0  130          - 6326.66667      -     -   43s
     0     0 6326.66667    0  133          - 6326.66667      -     -   44s
     0     0 6326.66667    0   72          - 6326.66667      -     -   46s
     0     2 6326.66667    0   70          - 6326.66667      -     -   53s
     1     4 6326.66667    1  136          - 6326.66667      -  5278   55s
     7    12 6326.66667    3  183          - 6326.66667      -  3235   60s
    15    20 6326.66667    4  369          - 6326.66667      -  2722   67s
    23    28 6326.66667    6  497          - 6326.66667      -  2714   70s
    33    38 6326.66667    7  518          - 6326.66667      -  2566   76s
    37    48 6326.66667    7  510          - 6326.66667      -  3102   81s
    47    83 6326.66667   11  125          - 6326.66667      -  3380   90s
   102   144 6326.66667   29   31          - 6326.66667      -  2174  102s
```

```
 *  148   144              72    6326.6666667 6326.66667  0.00%  1502  102s

Cutting planes:
  Learned: 1
  Gomory: 6
  Cover: 412
  Implied bound: 66
  Clique: 2611
  MIR: 94
  StrongCG: 26
  Flow cover: 4
  GUB cover: 41
  Zero half: 37
  RLT: 46
  Relax-and-lift: 623
  BQP: 22
  PSD: 4

Explored 201 nodes (325493 simplex iterations) in 102.36 seconds (153.47 work units)
Thread count was 8 (of 8 available processors)

Solution count 1: 6326.67

Optimal solution found (tolerance 5.00e-02)
Best objective 6.326666666667e+03, best bound 6.326666666667e+03, gap 0.0000%
Warning: linear constraint 367235 and linear constraint 619789 have the same name "ConSP25_1[0,0]"
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 1153684 rows, 901813 columns and 7829291 nonzeros
Model fingerprint: 0xc36b8a52
Variable types: 441325 continuous, 460488 integer (456438 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  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 1148165 rows and 899983 columns
Presolve time: 2.96s
Presolved: 5519 rows, 1830 columns, 14680 nonzeros
Variable types: 4 continuous, 1826 integer (1050 binary)
Found heuristic solution: objective 3825.2733636

Root relaxation: objective 5.402667e+03, 1469 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

H    0     0                    5402.6666667 16220.0000   200%     -    3s
     0     0         -    0     5402.66667 5402.66667  0.00%     -    3s

Explored 1 nodes (1867 simplex iterations) in 4.10 seconds (3.29 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 5402.67 3825.27

Optimal solution found (tolerance 1.00e-08)
Best objective 5.402666666667e+03, best bound 5.402666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5402

  Itr = 2
Collect_LB =   [804.0, 6073.666666666666, 6326.666666666666]
Collect_UB =   [11103.333333333336, 6326.666666666668, 6326.666666666668]
Collect_Hua =   [0.0, 5149.666666666666, 5402.666666666666]
Collect_SPObjVal =   [5149.666666666668, 5402.666666666668, 5402.666666666668]
Collect_MPObjValNHua =   [804.0, 924.0, 924.0]


  Reach the termination conditions, stop iteration
 Values adopted from the Itr' th iteration, and Itr = {2}, judgeCount = {2}

~~~~~~~~~~judge = 2, SPObj_SPF = 5402.666666666668
Vessel i: 0:     pi: 7-13,     ai-di: 3-37,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 3-37,     taoi-deltai: 3-35,     taoPi_SP-deltaPi_SP: 3-35,     betaNi: 32
,     bi: 32
Vessel i: 1:     pi: 13-20,     ai-di: 17-33,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 17-33,     taoi-deltai: 17-31,     taoPi_SP-deltaPi_SP: 17-31,
    betaNi: 14,     bi: 14
```

```
414  Vessel i: 2:    pi: 20-26,    ai-di: 23-49,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 23-49,    taoi-deltai: 23-47,    taoPi_SP-deltaPi_SP: 23-47,
     betaNi: 24,    bi: 24
415  Vessel i: 3:    pi: 11-17,    ai-di: 41-57,    gi_SP-gpi_SP: 0.000000-0.000000,    ai_SP-di: 41-57,    taoi-deltai: 41-55,    taoPi_SP-deltaPi_SP: 41-55,
     betaNi: 14,    bi: 14
416  Vessel i: 4:    pi: 17-23,    ai-di: 50-74,    gi_SP-gpi_SP: 0.200000-1.000000,    ai_SP-di: 51-74,    taoi-deltai: 51-73,    taoPi_SP-deltaPi_SP: 51-73,
     betaNi: 22,    bi: 22
417  Vessel i: 5:    pi: 10-17,    ai-di: 51-75,    gi_SP-gpi_SP: 1.000000-0.200000,    ai_SP-di: 58-75,    taoi-deltai: 59-81,    taoPi_SP-deltaPi_SP: 59-81,
     betaNi: 22,    bi: 22
418
419  round LB =   [804, 6074, 6327]
420  round UB =   [11103, 6327, 6327]
421  round Hua =   [0, 5150, 5403]
422  round SPObjVal =   [5150, 5403, 5403]
423  round MPObjValNHua =   [804, 924, 924]
424
425  Time: 495.000000
426
427
428
429
```