```
"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=5243

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 375969 rows, 34789 columns and 1042007 nonzeros
Model fingerprint: 0x36dd4b10
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 326897 rows and 23704 columns
Presolve time: 4.77s
Presolved: 49072 rows, 11085 columns, 174856 nonzeros
Variable types: 0 continuous, 11085 integer (11070 binary)

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

Root relaxation presolved: 49072 rows, 11085 columns, 174856 nonzeros

Concurrent spin time: 0.02s

Solved with dual simplex (primal model)

Root relaxation: objective 6.660000e+02, 1309 iterations, 0.16 seconds (0.16 work units)

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

     0     0  666.00000    0    3          -  666.00000      -     -    5s
H    0     0                1106.0000000  666.00000  39.8%     -    5s
H    0     0                 666.0000000  666.00000  0.00%     -    5s

Cutting planes:
  Gomory: 1
  Cover: 1
  StrongCG: 1
  GUB cover: 1
  RLT: 2

Explored 1 nodes (2694 simplex iterations) in 5.72 seconds (10.09 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 666 1106

Optimal solution found (tolerance 1.00e-10)
Best objective 6.660000000000e+02, best bound 6.660000000000e+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 1153692 rows, 901813 columns and 7829319 nonzeros
Model fingerprint: 0x8c49f5d5
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 1152265 rows and 901330 columns
Presolve time: 2.66s
Presolved: 1427 rows, 483 columns, 3802 nonzeros
Variable types: 0 continuous, 483 integer (274 binary)
Found heuristic solution: objective 2803.6666667

Root relaxation: objective 3.220667e+03, 293 iterations, 0.00 seconds (0.00 work units)

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

H    0     0                    3220.6666667 6180.66667  91.9%     -    3s
     0     0        -    0      3220.66667 3220.66667  0.00%     -    3s

Explored 1 nodes (445 simplex iterations) in 3.39 seconds (3.65 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 3220.67 2803.67

Optimal solution found (tolerance 1.00e-08)
Best objective 3.220666666667e+03, best bound 3.220666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□3220

  Itr = 0
Collect_LB =   [666.0]
Collect_UB =   [7107.3333333333285]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [3220.6666666666642]
Collect_MPObjValNHua =   [666.0]


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 634702 rows, 150727 columns and 1865101 nonzeros
Model fingerprint: 0xda7a6469
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 547726 rows and 138921 columns (presolve time = 5s) ...
Presolve removed 591872 rows and 143227 columns
Presolve time: 6.19s
Presolved: 42830 rows, 7500 columns, 132585 nonzeros
Variable types: 0 continuous, 7500 integer (6236 binary)
Root relaxation presolved: 7500 rows, 50330 columns, 140085 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0      handle free variables                       7s
    7587    4.0666667e+03   0.000000e+00   0.000000e+00      7s
    7587    4.0666667e+03   0.000000e+00   0.000000e+00      7s

Root relaxation: objective 4.066667e+03, 7587 iterations, 0.81 seconds (1.22 work units)

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

     0     0 4066.66667    0   74          - 4066.66667      -     -    7s
     0     0 4066.66667    0  102          - 4066.66667      -     -    8s
     0     0 4066.66667    0   63          - 4066.66667      -     -    8s
H    0     0                    4686.6666667 4066.66667  13.2%     -    9s
     0     0 4066.66667    0    4 4686.66667 4066.66667  13.2%     -    9s
*    0     0               0    4066.6666667 4066.66667  0.00%     -   10s

Cutting planes:
  Learned: 15
```

```
  Gomory: 14
  Cover: 250
  Implied bound: 108
  Clique: 1026
  MIR: 201
  StrongCG: 56
  Flow cover: 2
  GUB cover: 294
  Zero half: 18
  RLT: 9
  Relax-and-lift: 188
  BQP: 7

Explored 1 nodes (20003 simplex iterations) in 10.10 seconds (17.19 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 4066.67 4686.67

Optimal solution found (tolerance 5.00e-02)
Best objective 4.066666666667e+03, best bound 4.066666666667e+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 1153692 rows, 901813 columns and 7829319 nonzeros
Model fingerprint: 0x5e3e0d87
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 1151411 rows and 901028 columns
Presolve time: 2.58s
Presolved: 2281 rows, 785 columns, 6036 nonzeros
Variable types: 4 continuous, 781 integer (448 binary)
Found heuristic solution: objective 2808.3818887

Root relaxation: objective 3.722667e+03, 644 iterations, 0.00 seconds (0.00 work units)

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

     0     0 3722.66667    0   14 2808.38189 3722.66667  32.6%     -    3s
H    0     0                2918.6666667 3722.66667  27.5%     -    3s
H    0     0                3252.6666667 3722.66667  14.4%     -    3s
     0     0 3722.66667    0    4 3252.66667 3722.66667  14.4%     -    3s
H    0     0                3722.6666667 3722.66667  0.00%     -    3s
     0     0 3722.66667    0    4 3722.66667 3722.66667  0.00%     -    3s

Cutting planes:
  Gomory: 1
  Clique: 4
  RLT: 1

Explored 1 nodes (939 simplex iterations) in 3.48 seconds (3.21 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 3722.67 3252.67 2918.67 2808.38

Optimal solution found (tolerance 1.00e-08)
Best objective 3.722666666667e+03, best bound 3.722666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□3722

  Itr = 1
Collect_LB =   [666.0, 4066.6666666666642]
Collect_UB =   [7107.3333333333285, 4568.666666666664]
Collect_Hua =   [0.0, 3220.6666666666642]
Collect_SPObjVal =   [3220.6666666666642, 3722.6666666666642]
Collect_MPObjValNHua =   [666.0, 846.0]


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
```

```
248
249  Optimize a model with 887260 rows, 163849 columns and 2682005 nonzeros
250  Model fingerprint: 0x928f4c29
251  Variable types: 1 continuous, 163848 integer (148668 binary)
252  Coefficient statistics:
253    Matrix range     [1e-01, 1e+10]
254    Objective range  [1e+00, 2e+01]
255    Bounds range     [1e+00, 1e+00]
256    RHS range        [1e+00, 2e+10]
257  Warning: Model contains large matrix coefficients
258  Warning: Model contains large rhs
259           Consider reformulating model or setting NumericFocus parameter
260           to avoid numerical issues.
261  Presolve removed 791336 rows and 149706 columns (presolve time = 5s) ...
262  Presolve removed 829808 rows and 153437 columns
263  Presolve time: 9.15s
264  Presolved: 57452 rows, 10412 columns, 193926 nonzeros
265  Variable types: 0 continuous, 10412 integer (7900 binary)
266
267  Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
268  Showing first log only...
269
270  Root relaxation presolved: 10412 rows, 67864 columns, 204338 nonzeros
271
272
273  Root simplex log...
274
275  Iteration    Objective       Primal Inf.    Dual Inf.      Time
276         0    4.5686667e+03   0.000000e+00   2.884902e+04     10s
277  Concurrent spin time: 0.04s
278
279  Solved with dual simplex (primal model)
280
281  Root relaxation: objective 4.568667e+03, 4742 iterations, 0.51 seconds (0.47 work units)
282
283      Nodes    |    Current Node    |     Objective Bounds      |     Work
284   Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time
285
286       0     0 4568.66667    0   71          - 4568.66667      -     -   10s
287       0     0 4568.66667    0  421          - 4568.66667      -     -   13s
288       0     0 4568.66667    0  405          - 4568.66667      -     -   13s
289       0     0 4568.66667    0   19          - 4568.66667      -     -   15s
290       0     0 4568.66667    0  206          - 4568.66667      -     -   16s
291  H    0     0                    4648.6666667 4568.66667  1.72%     -   17s
292
293  Cutting planes:
294    Learned: 8
295    Gomory: 14
296    Lift-and-project: 2
297    Cover: 296
298    Implied bound: 176
299    Clique: 1663
300    MIR: 185
301    StrongCG: 23
302    Flow cover: 247
303    GUB cover: 22
304    Zero half: 36
305    RLT: 57
306    Relax-and-lift: 331
307    BQP: 12
308    PSD: 2
309
310  Explored 1 nodes (26421 simplex iterations) in 17.40 seconds (26.25 work units)
311  Thread count was 8 (of 8 available processors)
312
313  Solution count 1: 4648.67
314
315  Optimal solution found (tolerance 5.00e-02)
316  Best objective 4.648666666667e+03, best bound 4.568666666667e+03, gap 1.7209%
317  Warning: linear constraint 382145 and linear constraint 634703 have the same name "ConSP25_1[0,0]"
318  Set parameter MIPGap to value 1e-08
319  Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
320
321  CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
322  Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
323
324  Optimize a model with 1153692 rows, 901813 columns and 7829319 nonzeros
325  Model fingerprint: 0x0eda2133
326  Variable types: 441325 continuous, 460488 integer (456438 binary)
327  Coefficient statistics:
328    Matrix range     [1e-01, 1e+10]
329    Objective range  [6e-05, 5e+01]
330    Bounds range     [1e+00, 8e+01]
331    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 1151297 rows and 901015 columns
Presolve time: 2.39s
Presolved: 2395 rows, 798 columns, 6324 nonzeros
Variable types: 4 continuous, 794 integer (449 binary)
Found heuristic solution: objective 2907.9278404

Root relaxation: objective 3.722667e+03, 524 iterations, 0.00 seconds (0.00 work units)

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

H    0     0                    3722.6666667 9040.00000   143%     -    3s
     0     0          -    0     3722.66667 3722.66667  0.00%     -    3s

Explored 1 nodes (722 simplex iterations) in 3.17 seconds (3.20 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 3722.67 2907.93

Optimal solution found (tolerance 1.00e-08)
Best objective 3.722666666667e+03, best bound 3.722666666667e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□3722

  Itr = 2
Collect_LB =   [666.0, 4066.6666666666642, 4648.666666666664]
Collect_UB =   [7107.3333333333285, 4568.666666666664, 4568.666666666664]
Collect_Hua =   [0.0, 3220.6666666666642, 3722.6666666666642]
Collect_SPObjVal =   [3220.6666666666642, 3722.6666666666642, 3722.6666666666642]
Collect_MPObjValNHua =   [666.0, 846.0, 926.0]


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

~~~~~~~~~~judgeCount = 1, SPObj_SPF = 3722.6666666666642
Vessel i: 0:     pi: 14-20,     ai-di: 2-23,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 2-23,     taoi-deltai: 2-25,     taoPi_SP-deltaPi_SP: 2-25,     betaNi: 23
,     bi: 23
Vessel i: 1:     pi: 7-14,     ai-di: 8-17,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 8-17,     taoi-deltai: 8-16,     taoPi_SP-deltaPi_SP: 8-16,     betaNi: 8
,     bi: 8
Vessel i: 2:     pi: 7-14,     ai-di: 34-42,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 34-42,     taoi-deltai: 34-41,     taoPi_SP-deltaPi_SP: 34-41,     betaNi
: 7,     bi: 7
Vessel i: 3:     pi: 16-23,     ai-di: 40-58,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 40-58,     taoi-deltai: 40-56,     taoPi_SP-deltaPi_SP: 40-56,
betaNi: 16,     bi: 16
Vessel i: 4:     pi: 8-14,     ai-di: 47-59,     gi_SP-gpi_SP: 0.200000-1.000000,     ai_SP-di: 48-59,     taoi-deltai: 48-61,     taoPi_SP-deltaPi_SP: 48-61,     betaNi
: 13,     bi: 13
Vessel i: 5:     pi: 14-21,     ai-di: 50-67,     gi_SP-gpi_SP: 1.000000-0.200000,     ai_SP-di: 58-67,     taoi-deltai: 58-77,     taoPi_SP-deltaPi_SP: 58-77,
betaNi: 19,     bi: 19

round LB =   [666, 4067, 4649]
round UB =   [7107, 4569, 4569]
round Hua =   [0, 3221, 3723]
round SPObjVal =   [3221, 3723, 3723]
round MPObjValNHua =   [666, 846, 926]

Time: 271.000000
```