```
"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=46313

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_BDC.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 595616 rows, 58701 columns and 1673824 nonzeros
Model fingerprint: 0x9be0b769
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 343704 rows and 26015 columns (presolve time = 5s) ...
Presolve removed 473248 rows and 39092 columns
Presolve time: 9.64s
Presolved: 122368 rows, 19609 columns, 331758 nonzeros
Variable types: 0 continuous, 19609 integer (19579 binary)

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

Root relaxation presolved: 19609 rows, 141977 columns, 351367 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    7.4300000e+02   0.000000e+00   1.027000e+03     11s
Concurrent spin time: 0.02s

Solved with dual simplex (primal model)

Root relaxation: objective 7.430000e+02, 2874 iterations, 0.53 seconds (0.54 work units)

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

     0     0  743.00000    0   16          -  743.00000      -     -   11s
H    0     0                     823.0000000  743.00000  9.72%     -   12s
     0     0  743.00000    0   55  823.00000  743.00000  9.72%     -   12s
     0     0  743.00000    0    2  823.00000  743.00000  9.72%     -   16s
     0     0  743.00000    0   28  823.00000  743.00000  9.72%     -   17s
H    0     0                     743.0000000  743.00000  0.00%     -   17s
     0     0  743.00000    0   29  743.00000  743.00000  0.00%     -   17s

Cutting planes:
  Gomory: 1
  Cover: 44
  MIR: 29
  StrongCG: 24
  Relax-and-lift: 1

Explored 1 nodes (12824 simplex iterations) in 17.37 seconds (32.84 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 743 823

Optimal solution found (tolerance 1.00e-10)
Best objective 7.430000000000e+02, best bound 7.430000000000e+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 3035761 rows, 2395885 columns and 21185578 nonzeros
Model fingerprint: 0xd0db789e
Variable types: 1181973 continuous, 1213912 integer (1207162 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 3032478 rows and 2394685 columns (presolve time = 5s) ...
Presolve removed 3033528 rows and 2395035 columns
Presolve time: 6.70s
Presolved: 2233 rows, 850 columns, 6060 nonzeros
Variable types: 9 continuous, 841 integer (502 binary)
Found heuristic solution: objective 3482.4264926

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    8.2899365e+03   5.941813e+03   0.000000e+00      8s
     647    4.8614888e+03   0.000000e+00   0.000000e+00      8s

Root relaxation: objective 4.861489e+03, 647 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 4861.48879    0   45 3482.42649 4861.48879  39.6%     -    8s
H    0     0                4854.6166146 4861.48879  0.14%     -    8s
     0     0 4861.07693    0    7 4854.61661 4861.07693  0.13%     -    8s
     0     0 4861.07693    0    8 4854.61661 4861.07693  0.13%     -    8s
H    0     0                4860.4829105 4861.07693  0.01%     -    8s
H    0     0                4861.0769320 4861.07693  0.00%     -    8s

Explored 1 nodes (1204 simplex iterations) in 8.79 seconds (9.77 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 4861.08 4860.48 4854.62 3482.43

Optimal solution found (tolerance 1.00e-08)
Best objective 4.861076932024e+03, best bound 4.861076933877e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□4861

  Itr = 0
Collect_LB =   [743.0]
Collect_UB =   [10465.153864048996]
Collect_Hua =   [0.0]
Collect_SPObjVal =   [4861.076932024498]
Collect_MPObjValNHua =   [743.0]


Set parameter TimeLimit to value 12000
Set parameter MIPGap to value 0.0005
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 603390 rows, 344301 columns and 1681663 nonzeros
Model fingerprint: 0x6ffc1c11
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 413625 rows and 321128 columns (presolve time = 5s) ...
Presolve removed 413625 rows and 321128 columns (presolve time = 10s) ...
Presolve removed 535578 rows and 333380 columns
Presolve time: 11.59s
Presolved: 67812 rows, 10921 columns, 173175 nonzeros
Variable types: 0 continuous, 10921 integer (10891 binary)

```

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

Root relaxation presolved: 10921 rows, 78733 columns, 184096 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    5.6040769e+03   0.000000e+00   5.338000e+03     12s
Concurrent spin time: 0.03s

Solved with dual simplex (primal model)

Root relaxation: objective 5.604077e+03, 4299 iterations, 0.48 seconds (0.62 work units)

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

     0     0 5604.07693    0   10          - 5604.07693      -     -   12s
     0     0 5604.07693    0   75          - 5604.07693      -     -   13s
     0     0 5604.07693    0   68          - 5604.07693      -     -   14s
     0     0 5604.07693    0   24          - 5604.07693      -     -   15s
     0     0 5604.07693    0   35          - 5604.07693      -     -   15s
     0     0 5604.07693    0   78          - 5604.07693      -     -   16s
     0     0 5604.07693    0   75          - 5604.07693      -     -   16s
     0     0 5604.07693    0   68          - 5604.07693      -     -   19s
     0     0 5604.07693    0   68          - 5604.07693      -     -   20s
H    0     0                    5604.0769320 5604.07693  0.00%     -   20s
     0     0 5604.07693    0   68 5604.07693 5604.07693  0.00%     -   20s

Cutting planes:
  Learned: 2
  Gomory: 2
  Cover: 217
  Implied bound: 18
  Clique: 678
  MIR: 158
  StrongCG: 167
  GUB cover: 11
  RLT: 2
  Relax-and-lift: 9
  BQP: 2

Explored 1 nodes (29914 simplex iterations) in 20.62 seconds (28.74 work units)
Thread count was 8 (of 8 available processors)

Solution count 1: 5604.08

Optimal solution found (tolerance 5.00e-04)
Best objective 5.604076932024e+03, best bound 5.604076932024e+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 3035761 rows, 2395885 columns and 21185578 nonzeros
Model fingerprint: 0xfa611190
Variable types: 1181973 continuous, 1213912 integer (1207162 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 3029879 rows and 2393977 columns (presolve time = 5s) ...
Presolve removed 3029927 rows and 2393995 columns
Presolve time: 5.76s
Presolved: 5834 rows, 1890 columns, 15471 nonzeros
Variable types: 10 continuous, 1880 integer (1090 binary)
Found heuristic solution: objective 4133.9680293

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    1.2304000e+04   5.034479e+03   0.000000e+00      7s
    1816    5.9878730e+03   0.000000e+00   0.000000e+00      7s

Root relaxation: objective 5.987873e+03, 1816 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 5987.87302    0   89 4133.96803 5987.87302  44.8%     -    7s
H    0     0                       5607.1254678 5987.87302  6.79%     -    7s
H    0     0                       5980.5533893 5986.94444  0.11%     -    7s
     0     0 5986.94444    0   54 5980.55339 5986.94444  0.11%     -    7s
     0     0 5986.94444    0   40 5980.55339 5986.94444  0.11%     -    7s
     0     0 5986.94444    0   26 5980.55339 5986.94444  0.11%     -    7s
H    0     0                       5986.9444444 5986.94444  0.00%     -    7s
     0     0 5986.94444    0   26 5986.94444 5986.94444  0.00%     -    7s

Cutting planes:
  Learned: 2
  Gomory: 4
  Cover: 2
  Implied bound: 5
  Clique: 7
  MIR: 4
  Flow cover: 1
  Zero half: 2
  RLT: 4
  Relax-and-lift: 1

Explored 1 nodes (3762 simplex iterations) in 7.83 seconds (8.49 work units)
Thread count was 8 (of 8 available processors)

Solution count 4: 5986.94 5980.55 5607.13 4133.97

Optimal solution found (tolerance 1.00e-08)
Best objective 5.986944444444e+03, best bound 5.986944444444e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□5986

 Itr = 1
Collect_LB =   [743.0, 5604.076932024498]
Collect_UB =   [10465.153864048996, 6729.944444444442]
Collect_Hua =   [0.0, 4861.076932024498]
Collect_SPObjVal =   [4861.076932024498, 5986.944444444442]
Collect_MPObjValNHua =   [743.0, 743.0]


Set parameter TimeLimit to value 12000
Set parameter MIPGap to value 0.0005
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 603391 rows, 344301 columns and 1681684 nonzeros
Model fingerprint: 0x4b281349
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 417667 rows and 321479 columns (presolve time = 5s) ...
Presolve removed 417667 rows and 321479 columns (presolve time = 10s) ...
Presolve removed 536165 rows and 333455 columns
Presolve time: 11.42s
Presolved: 67226 rows, 10846 columns, 170827 nonzeros
Variable types: 0 continuous, 10846 integer (10816 binary)

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

Root relaxation presolved: 10846 rows, 78072 columns, 181673 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.7324444e+03   0.000000e+00   5.338000e+03     12s
Concurrent spin time: 0.09s

Solved with dual simplex (primal model)

Root relaxation: objective 6.732444e+03, 4502 iterations, 0.44 seconds (0.67 work units)

```

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

     0     0 6732.44444    0   23          - 6732.44444      -     -   12s
     0     0 6732.44444    0  353          - 6732.44444      -     -   14s
     0     0 6732.44444    0  296          - 6732.44444      -     -   14s
     0     0 6732.44444    0  201          - 6732.44444      -     -   14s
     0     0 6732.44444    0   93          - 6732.44444      -     -   17s
     0     0 6732.44444    0  101          - 6732.44444      -     -   17s
     0     0 6732.44444    0   47          - 6732.44444      -     -   18s
     0     0 6732.44444    0  101          - 6732.44444      -     -   18s
     0     0 6732.44444    0   64          - 6732.44444      -     -   19s
H    0     0                 6832.4444444 6732.44444  1.46%     -   19s
H    0     0                 6812.4444444 6732.44444  1.17%     -   19s
H    0     0                 6732.4444444 6732.44444  0.00%     -   21s
     0     0 6732.44444    0   64 6732.44444 6732.44444  0.00%     -   21s

Cutting planes:
  Learned: 1
  Gomory: 1
  Cover: 89
  Implied bound: 394
  Clique: 1070
  MIR: 26
  StrongCG: 19
  GUB cover: 8
  Zero half: 2
  RLT: 2
  Relax-and-lift: 20
  BQP: 9

Explored 1 nodes (29232 simplex iterations) in 21.37 seconds (32.16 work units)
Thread count was 8 (of 8 available processors)

Solution count 3: 6732.44 6812.44 6832.44

Optimal solution found (tolerance 5.00e-04)
Best objective 6.732444444444e+03, best bound 6.732444444444e+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 3035761 rows, 2395885 columns and 21185578 nonzeros
Model fingerprint: 0x4b39522e
Variable types: 1181973 continuous, 1213912 integer (1207162 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 3030796 rows and 2394227 columns (presolve time = 5s) ...
Presolve removed 3031116 rows and 2394327 columns
Presolve time: 6.12s
Presolved: 4645 rows, 1558 columns, 12363 nonzeros
Variable types: 10 continuous, 1548 integer (906 binary)

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    1.1149000e+04   5.079458e+03   0.000000e+00      8s
    1283    5.8269444e+03   0.000000e+00   0.000000e+00      8s

Root relaxation: objective 5.826944e+03, 1283 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

H    0     0                 5826.9444444 14682.7778   152%     -    7s
     0     0        -    0      5826.94444 5826.94444  0.00%     -    7s

Explored 1 nodes (1978 simplex iterations) in 8.04 seconds (8.97 work units)
Thread count was 8 (of 8 available processors)

Solution count 1: 5826.94

Optimal solution found (tolerance 1.00e-08)
Best objective 5.826944444444e+03, best bound 5.826944444444e+03, gap 0.0000%
SP is solved
```

```
SP's optimal solution is'□5826

 Itr = 2
Collect_LB =  [743.0, 5604.076932024498, 6732.444444444442]
Collect_UB =  [10465.153864048996, 6729.944444444442, 6572.444444444442]
Collect_Hua =  [0.0, 4861.076932024498, 5986.944444444442]
Collect_SPObjVal =  [4861.076932024498, 5986.944444444442, 5826.944444444442]
Collect_MPObjValNHua =  [743.0, 743.0, 745.5]


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

~~~~~~~~~~judgeCount = 1, SPObj_SPF = 5986.944444444442
Vessel i: 0:  pi: 0-5,  ai-di: 5-15,  gi_SP-gpi_SP: 0.000000-0.000000,  ai_SP-di: 5-15,  taoi-deltai: 5-10,  taoPi_SP-deltaPi_SP: 5-10,  betaNi: 5,  bi: 5
Vessel i: 1:  pi: 0-7,  ai-di: 22-44,  gi_SP-gpi_SP: 0.000000-0.000000,  ai_SP-di: 22-44,  taoi-deltai: 22-34,  taoPi_SP-deltaPi_SP: 22-34,  betaNi: 12,  bi: 12
Vessel i: 2:  pi: 5-10,  ai-di: 8-26,  gi_SP-gpi_SP: 0.000000-0.000000,  ai_SP-di: 8-26,  taoi-deltai: 8-19,  taoPi_SP-deltaPi_SP: 8-19,  betaNi: 11,  bi: 11
Vessel i: 3:  pi: 3-8,  ai-di: 41-62,  gi_SP-gpi_SP: 0.000000-0.000000,  ai_SP-di: 41-62,  taoi-deltai: 41-53,  taoPi_SP-deltaPi_SP: 41-53,  betaNi: 12,  bi: 12
Vessel i: 4:  pi: 3-10,  ai-di: 55-82,  gi_SP-gpi_SP: 0.000000-0.000000,  ai_SP-di: 55-82,  taoi-deltai: 55-75,  taoPi_SP-deltaPi_SP: 55-75,  betaNi: 20,  bi: 20
Vessel i: 5:  pi: 17-22,  ai-di: 18-61,  gi_SP-gpi_SP: 0.000000-1.000000,  ai_SP-di: 18-61,  taoi-deltai: 21-46,  taoPi_SP-deltaPi_SP: 21-46,  betaNi: 25,  bi: 25
Vessel i: 6:  pi: 15-20,  ai-di: 9-39,  gi_SP-gpi_SP: 0.875000-0.400000,  ai_SP-di: 15-39,  taoi-deltai: 11-20,  taoPi_SP-deltaPi_SP: 16-20,  betaNi: 9,  bi: 9
Vessel i: 7:  pi: 10-16,  ai-di: 35-77,  gi_SP-gpi_SP: 1.000000-0.600000,  ai_SP-di: 45-77,  taoi-deltai: 40-59,  taoPi_SP-deltaPi_SP: 45-59,  betaNi: 19,  bi: 19
Vessel i: 8:  pi: 10-15,  ai-di: 5-41,  gi_SP-gpi_SP: 0.553571-1.000000,  ai_SP-di: 8-41,  taoi-deltai: 12-25,  taoPi_SP-deltaPi_SP: 12-25,  betaNi: 13,  bi: 13
Vessel i: 9:  pi: 10-15,  ai-di: 29-55,  gi_SP-gpi_SP: 0.571429-0.000000,  ai_SP-di: 33-55,  taoi-deltai: 33-39,  taoPi_SP-deltaPi_SP: 33-39,  betaNi: 6,  bi: 6

round LB =  [743, 5604, 6732]
round UB =  [10465, 6730, 6572]
round Hua =  [0, 4861, 5987]
round SPObjVal =  [4861, 5987, 5827]
round MPObjValNHua =  [743, 743, 746]

OptimalObj = 6732.444444444442
Time: 591.000000
```