```
"E:\1 □□□□\3 □□□□□\1 □□□□□□\1 □□□□□□□\1_□□□□□□_□□□□\1_LW_□□□□2\6 □□□□\2 python code\01_My_Python_Code\Scripts\python.exe" "D:\Python\Pycharm\setroute\PyCharm Community Edition 2021.2.3\plugins\python-ce\helpers\pydev\pydevconsole.py" --mode=client --port=5504

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['E:\\1 □□□□\\3 □□□□□\\1 □□□□□□□\\1 □□□□□□□□□\\1_□□□□□□_□□□□\\1_LW_□□□□2\\6 □□□□\\2 python code\\01_My_Python_Code', 'E:/1 □□□□/3 □□□□□/1 □□□□□□□/1 □□□□□□□□□/1_□□□□□□_□□□□/1_LW_□□□□2/6 □□□□/2 python code/01_My_Python_Code'])

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_□□□□2/6 □□□□/2 python code/01_My_Python_Code/main_BACASP_official_ENSGA-II.py', wdir='E:/1 □□□□/3 □□□□□/1 □□□□□□□/1 □□□□□□□□□/1_□□□□□□_□□□□/1_LW_□□□□2/6 □□□□/2 python code/01_My_Python_Code')
Backend TkAgg is interactive backend. Turning interactive mode on.
Waiting 1s.....

This is the  R_2_1 _standerd_test.xlsx  optimization process solved by ENSGA-II algorithm.

Start

Before iteration:
    Read basic data
    Parameter setting:
        trail =  57
        Pop_size =  10
        Tolerance_iteration_unchanged_number =  10
        Chrom_size =  6
        Iter_num_GA =  300
        Select_rate =  0.8
        Crossover_rate =  0.9
        Mutation rate =  0.9
        Mu_oper_type =  2
        vessel_move_way =  2
        coefficient for Obj1=  1.9
        coefficient for Obj2=  0.10000000000000009
        gen =  0

Iteration begin:
Beging the No. 0  iteration:
    obj[0] = 11.36      temp_best_value_gen = 11.36
    The No. 0  iteration is finished!

Beging the No. 1  iteration:
    obj[gen-1] = 11.36   temp_best_value_gen = 11.36
    No, maintain solution  and obj[gen] = 11.36 , and the tolerance_counter = 1
    solution chromosome =
        first level: [ [2.13 5.76]
        second level:  [1. 3.]
        third level:  [4. 5.] ]
    The No. 1  iteration is finished!

Beging the No. 2  iteration:
    obj[gen-1] = 11.36   temp_best_value_gen = 9.15
    Yes, update solution and obj[gen] = 9.15
    solution chromosome =
        first level: [ [2.5 4.3]
        second level:  [1. 0.]
        third level:  [2. 7.] ]
    The No. 2  iteration is finished!

Beging the No. 3  iteration:
    obj[gen-1] = 9.15     temp_best_value_gen = 9.15
    No, maintain solution  and obj[gen] = 9.15 , and the tolerance_counter = 1
    solution chromosome =
        first level: [ [2.5 4.3]
        second level:  [1. 0.]
        third level:  [2. 7.] ]
    The No. 3  iteration is finished!

Beging the No. 4  iteration:
    obj[gen-1] = 9.15     temp_best_value_gen = 9.15
    No, maintain solution  and obj[gen] = 9.15 , and the tolerance_counter = 2
    solution chromosome =
        first level: [ [2.5 4.3]
        second level:  [1. 0.]
        third level:  [2. 7.] ]
    The No. 4  iteration is finished!

Beging the No. 5  iteration:
    obj[gen-1] = 9.15     temp_best_value_gen = 9.15
    No, maintain solution  and obj[gen] = 9.15 , and the tolerance_counter = 3
    solution chromosome =
        first level: [ [2.5 4.3]
```

```
      second level:  [1. 0.]
      third level:  [2. 7.] ]
   The No. 5  iteration is finished!

Beging the No. 6  iteration:
   obj[gen-1] = 9.15     temp_best_value_gen = 7.99
   Yes, update solution and obj[gen] = 7.99
   solution chromosome =
      first level: [ [2.03 4.43]
      second level:  [0. 3.]
      third level:  [3. 6.] ]
   The No. 6  iteration is finished!

Beging the No. 7  iteration:
   obj[gen-1] = 7.99     temp_best_value_gen = 7.95
   Yes, update solution and obj[gen] = 7.95
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 7  iteration is finished!

Beging the No. 8  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 1
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 8  iteration is finished!

Beging the No. 9  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 2
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 9  iteration is finished!

Beging the No. 10  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 3
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 10  iteration is finished!

Beging the No. 11  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 4
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 11  iteration is finished!

Beging the No. 12  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 5
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 12  iteration is finished!

Beging the No. 13  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 6
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 13  iteration is finished!

Beging the No. 14  iteration:
   obj[gen-1] = 7.95     temp_best_value_gen = 7.95
   No, maintain solution  and obj[gen] = 7.95 , and the tolerance_counter = 7
   solution chromosome =
      first level: [ [2.25 4.42]
      second level:  [0. 3.]
      third level:  [3. 7.] ]
   The No. 14  iteration is finished!
```

```
164
165  Beging the No. 15  iteration:
166      obj[gen-1] = 7.95     temp_best_value_gen = 5.99
167      Yes, update solution and obj[gen] = 5.99
168      solution chromosome =
169          first level: [ [2.43 4.26]
170          second level:  [0. 2.]
171          third level:  [4. 8.] ]
172      The No. 15  iteration is finished!
173
174  Beging the No. 16  iteration:
175      obj[gen-1] = 5.99     temp_best_value_gen = 5.99
176      No, maintain solution  and obj[gen] = 5.99 , and the tolerance_counter = 1
177      solution chromosome =
178          first level: [ [2.43 4.26]
179          second level:  [0. 2.]
180          third level:  [4. 8.] ]
181      The No. 16  iteration is finished!
182
183  Beging the No. 17  iteration:
184      obj[gen-1] = 5.99     temp_best_value_gen = 5.99
185      No, maintain solution  and obj[gen] = 5.99 , and the tolerance_counter = 2
186      solution chromosome =
187          first level: [ [2.43 4.26]
188          second level:  [0. 2.]
189          third level:  [4. 8.] ]
190      The No. 17  iteration is finished!
191
192  Beging the No. 18  iteration:
193      obj[gen-1] = 5.99     temp_best_value_gen = 5.99
194      No, maintain solution  and obj[gen] = 5.99 , and the tolerance_counter = 3
195      solution chromosome =
196          first level: [ [2.43 4.26]
197          second level:  [0. 2.]
198          third level:  [4. 8.] ]
199      The No. 18  iteration is finished!
200
201  Beging the No. 19  iteration:
202      obj[gen-1] = 5.99     temp_best_value_gen = 5.99
203      No, maintain solution  and obj[gen] = 5.99 , and the tolerance_counter = 4
204      solution chromosome =
205          first level: [ [2.43 4.26]
206          second level:  [0. 2.]
207          third level:  [4. 8.] ]
208      The No. 19  iteration is finished!
209
210  Beging the No. 20  iteration:
211      obj[gen-1] = 5.99     temp_best_value_gen = 5.99
212      No, maintain solution  and obj[gen] = 5.99 , and the tolerance_counter = 5
213      solution chromosome =
214          first level: [ [2.43 4.26]
215          second level:  [0. 2.]
216          third level:  [4. 8.] ]
217      The No. 20  iteration is finished!
218
219  Beging the No. 21  iteration:
220      obj[gen-1] = 5.99     temp_best_value_gen = 5.33
221      Yes, update solution and obj[gen] = 5.33
222      solution chromosome =
223          first level: [ [2.29 4.19]
224          second level:  [0. 2.]
225          third level:  [4. 7.] ]
226      The No. 21  iteration is finished!
227
228  Beging the No. 22  iteration:
229      obj[gen-1] = 5.33     temp_best_value_gen = 5.33
230      No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 1
231      solution chromosome =
232          first level: [ [2.29 4.19]
233          second level:  [0. 2.]
234          third level:  [4. 7.] ]
235      The No. 22  iteration is finished!
236
237  Beging the No. 23  iteration:
238      obj[gen-1] = 5.33     temp_best_value_gen = 5.33
239      No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 2
240      solution chromosome =
241          first level: [ [2.29 4.19]
242          second level:  [0. 2.]
243          third level:  [4. 7.] ]
244      The No. 23  iteration is finished!
245
246  Beging the No. 24  iteration:
247      obj[gen-1] = 5.33     temp_best_value_gen = 5.33
```

```
    No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 3
    solution chromosome =
       first level: [ [2.29 4.19]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 24  iteration is finished!

Beging the No. 25  iteration:
    obj[gen-1] = 5.33     temp_best_value_gen = 5.33
    No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 4
    solution chromosome =
       first level: [ [2.29 4.19]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 25  iteration is finished!

Beging the No. 26  iteration:
    obj[gen-1] = 5.33     temp_best_value_gen = 5.33
    No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 5
    solution chromosome =
       first level: [ [2.29 4.19]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 26  iteration is finished!

Beging the No. 27  iteration:
    obj[gen-1] = 5.33     temp_best_value_gen = 5.33
    No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 6
    solution chromosome =
       first level: [ [2.29 4.19]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 27  iteration is finished!

Beging the No. 28  iteration:
    obj[gen-1] = 5.33     temp_best_value_gen = 5.33
    No, maintain solution  and obj[gen] = 5.33 , and the tolerance_counter = 7
    solution chromosome =
       first level: [ [2.29 4.19]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 28  iteration is finished!

Beging the No. 29  iteration:
    obj[gen-1] = 5.33     temp_best_value_gen = 4.11
    Yes, update solution and obj[gen] = 4.11
    solution chromosome =
       first level: [ [2.   4.02]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 29  iteration is finished!

Beging the No. 30  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 1
    solution chromosome =
       first level: [ [2.   4.02]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 30  iteration is finished!

Beging the No. 31  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 2
    solution chromosome =
       first level: [ [2.   4.02]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 31  iteration is finished!

Beging the No. 32  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 3
    solution chromosome =
       first level: [ [2.   4.02]
       second level:  [0. 2.]
       third level:  [4. 7.] ]
    The No. 32  iteration is finished!

Beging the No. 33  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 4
    solution chromosome =
       first level: [ [2.   4.02]
```

```
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 33  iteration is finished!

Beging the No. 34  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 5
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 34  iteration is finished!

Beging the No. 35  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 6
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 35  iteration is finished!

Beging the No. 36  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 7
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 36  iteration is finished!

Beging the No. 37  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 8
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 37  iteration is finished!

Beging the No. 38  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 9
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 38  iteration is finished!

Beging the No. 39  iteration:
    obj[gen-1] = 4.11     temp_best_value_gen = 4.11
    No, maintain solution  and obj[gen] = 4.11 , and the tolerance_counter = 10
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    The No. 39  iteration is finished!


--------------------------------------------------------------------------------
The iteration is terminated and then visulize the solution:
    solution chromosome =
        first level: [ [2.   4.02]
        second level:  [0. 2.]
        third level:  [4. 7.] ]
    Objective function values and some other indicators:
        Obj0 = 2.00          Obj1 = 3.12          Obj0 + Obj1 = 5.12
        Total movement of crane: 1.12
        Total waiting time in berth position: 2.00
        Total index of q during berthing: 27.00
    Specific arrangement for each vessel:
        V_id:  0          li: 4.0          xi: 2.0          bow of i: 0.0          tail of i: 4.0          gama_i0: 0.0          gama_i1: 2.0
                    duration_time_i: 2.0          demand_i: 160.0          work load_i: 160.0          work load gap_i: 0
        V_id:  1          li: 8.0          xi: 4.0          bow of i: 0.0          tail of i: 8.0          gama_i0: 2.0          gama_i1: 3.0
                    duration_time_i: 1.0          demand_i: 120.0          work load_i: 120.0          work load gap_i: 0

Algorithm finished and the total CPU time: 333 s
End
```