


```

80     second level: [1. 0.]
81     third level: [2. 7.] ]
82     The No. 5 iteration is finished!
83
84 Beging the No. 6 iteration:
85     obj[gen-1] = 9.15    temp_best_value_gen = 7.99
86     Yes, update solution and obj[gen] = 7.99
87     solution chromosome =
88         first level: [ 2.03 4.43]
89         second level: [0. 3.]
90         third level: [3. 6.] ]
91     The No. 6 iteration is finished!
92
93 Beging the No. 7 iteration:
94     obj[gen-1] = 7.99    temp_best_value_gen = 7.95
95     Yes, update solution and obj[gen] = 7.95
96     solution chromosome =
97         first level: [ 2.25 4.42]
98         second level: [0. 3.]
99         third level: [3. 7.] ]
100    The No. 7 iteration is finished!
101
102 Beging the No. 8 iteration:
103     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
104     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 1
105     solution chromosome =
106         first level: [ 2.25 4.42]
107         second level: [0. 3.]
108         third level: [3. 7.] ]
109     The No. 8 iteration is finished!
110
111 Beging the No. 9 iteration:
112     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
113     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 2
114     solution chromosome =
115         first level: [ 2.25 4.42]
116         second level: [0. 3.]
117         third level: [3. 7.] ]
118     The No. 9 iteration is finished!
119
120 Beging the No. 10 iteration:
121     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
122     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 3
123     solution chromosome =
124         first level: [ 2.25 4.42]
125         second level: [0. 3.]
126         third level: [3. 7.] ]
127     The No. 10 iteration is finished!
128
129 Beging the No. 11 iteration:
130     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
131     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 4
132     solution chromosome =
133         first level: [ 2.25 4.42]
134         second level: [0. 3.]
135         third level: [3. 7.] ]
136     The No. 11 iteration is finished!
137
138 Beging the No. 12 iteration:
139     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
140     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 5
141     solution chromosome =
142         first level: [ 2.25 4.42]
143         second level: [0. 3.]
144         third level: [3. 7.] ]
145     The No. 12 iteration is finished!
146
147 Beging the No. 13 iteration:
148     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
149     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 6
150     solution chromosome =
151         first level: [ 2.25 4.42]
152         second level: [0. 3.]
153         third level: [3. 7.] ]
154     The No. 13 iteration is finished!
155
156 Beging the No. 14 iteration:
157     obj[gen-1] = 7.95    temp_best_value_gen = 7.95
158     No, maintain solution and obj[gen] = 7.95 , and the tolerance_counter = 7
159     solution chromosome =
160         first level: [ 2.25 4.42]
161         second level: [0. 3.]
162         third level: [3. 7.] ]
163     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
```

```
248 No, maintain solution and obj[gen] = 5.33 , and the tolerance_counter = 3
249 solution chromosome =
250   first level: [ [2.29 4.19]
251   second level: [0. 2.]
252   third level: [4. 7.] ]
253 The No. 24 iteration is finished!
254
255 Beging the No. 25 iteration:
256 obj[gen-1] = 5.33   temp_best_value_gen = 5.33
257 No, maintain solution and obj[gen] = 5.33 , and the tolerance_counter = 4
258 solution chromosome =
259   first level: [ [2.29 4.19]
260   second level: [0. 2.]
261   third level: [4. 7.] ]
262 The No. 25 iteration is finished!
263
264 Beging the No. 26 iteration:
265 obj[gen-1] = 5.33   temp_best_value_gen = 5.33
266 No, maintain solution and obj[gen] = 5.33 , and the tolerance_counter = 5
267 solution chromosome =
268   first level: [ [2.29 4.19]
269   second level: [0. 2.]
270   third level: [4. 7.] ]
271 The No. 26 iteration is finished!
272
273 Beging the No. 27 iteration:
274 obj[gen-1] = 5.33   temp_best_value_gen = 5.33
275 No, maintain solution and obj[gen] = 5.33 , and the tolerance_counter = 6
276 solution chromosome =
277   first level: [ [2.29 4.19]
278   second level: [0. 2.]
279   third level: [4. 7.] ]
280 The No. 27 iteration is finished!
281
282 Beging the No. 28 iteration:
283 obj[gen-1] = 5.33   temp_best_value_gen = 5.33
284 No, maintain solution and obj[gen] = 5.33 , and the tolerance_counter = 7
285 solution chromosome =
286   first level: [ [2.29 4.19]
287   second level: [0. 2.]
288   third level: [4. 7.] ]
289 The No. 28 iteration is finished!
290
291 Beging the No. 29 iteration:
292 obj[gen-1] = 5.33   temp_best_value_gen = 4.11
293 Yes, update solution and obj[gen] = 4.11
294 solution chromosome =
295   first level: [ [2. 4.02]
296   second level: [0. 2.]
297   third level: [4. 7.] ]
298 The No. 29 iteration is finished!
299
300 Beging the No. 30 iteration:
301 obj[gen-1] = 4.11   temp_best_value_gen = 4.11
302 No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 1
303 solution chromosome =
304   first level: [ [2. 4.02]
305   second level: [0. 2.]
306   third level: [4. 7.] ]
307 The No. 30 iteration is finished!
308
309 Beging the No. 31 iteration:
310 obj[gen-1] = 4.11   temp_best_value_gen = 4.11
311 No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 2
312 solution chromosome =
313   first level: [ [2. 4.02]
314   second level: [0. 2.]
315   third level: [4. 7.] ]
316 The No. 31 iteration is finished!
317
318 Beging the No. 32 iteration:
319 obj[gen-1] = 4.11   temp_best_value_gen = 4.11
320 No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 3
321 solution chromosome =
322   first level: [ [2. 4.02]
323   second level: [0. 2.]
324   third level: [4. 7.] ]
325 The No. 32 iteration is finished!
326
327 Beging the No. 33 iteration:
328 obj[gen-1] = 4.11   temp_best_value_gen = 4.11
329 No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 4
330 solution chromosome =
331   first level: [ [2. 4.02]
```

```

332     second level: [0. 2.]
333     third level: [4. 7.] ]
334     The No. 33 iteration is finished!
335
336 Beging the No. 34 iteration:
337     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
338     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 5
339     solution chromosome =
340     first level: [ [2. 4.02]
341     second level: [0. 2.]
342     third level: [4. 7.] ]
343     The No. 34 iteration is finished!
344
345 Beging the No. 35 iteration:
346     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
347     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 6
348     solution chromosome =
349     first level: [ [2. 4.02]
350     second level: [0. 2.]
351     third level: [4. 7.] ]
352     The No. 35 iteration is finished!
353
354 Beging the No. 36 iteration:
355     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
356     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 7
357     solution chromosome =
358     first level: [ [2. 4.02]
359     second level: [0. 2.]
360     third level: [4. 7.] ]
361     The No. 36 iteration is finished!
362
363 Beging the No. 37 iteration:
364     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
365     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 8
366     solution chromosome =
367     first level: [ [2. 4.02]
368     second level: [0. 2.]
369     third level: [4. 7.] ]
370     The No. 37 iteration is finished!
371
372 Beging the No. 38 iteration:
373     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
374     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 9
375     solution chromosome =
376     first level: [ [2. 4.02]
377     second level: [0. 2.]
378     third level: [4. 7.] ]
379     The No. 38 iteration is finished!
380
381 Beging the No. 39 iteration:
382     obj[gen-1] = 4.11     temp_best_value_gen = 4.11
383     No, maintain solution and obj[gen] = 4.11 , and the tolerance_counter = 10
384     solution chromosome =
385     first level: [ [2. 4.02]
386     second level: [0. 2.]
387     third level: [4. 7.] ]
388     The No. 39 iteration is finished!
389
390
391 -----
392 The iteration is terminated and then visulize the solution:
393     solution chromosome =
394     first level: [ [2. 4.02]
395     second level: [0. 2.]
396     third level: [4. 7.] ]
397 Objective function values and some other indicators:
398     Obj0 = 2.00         Obj1 = 3.12         Obj0 + Obj1 = 5.12
399     Total movement of crane: 1.12
400     Total waiting time in berth position: 2.00
401     Total index of q during berthing: 27.00
402 Specific arrangement for each vessel:
403     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
404             duration_time_i: 2.0             demand_i: 160.0             work load_i: 160.0             work load gap_i: 0
405     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
406             duration_time_i: 1.0             demand_i: 120.0             work load_i: 120.0             work load gap_i: 0
407
408 Algorithm finished and the total CPU time: 333 s
409 End
410

```