課題：I235 2nd Report	**言語：C++(Console Application)**
氏名：GAO, Yuwei	
学生番号：s1910092	**提出日：2019/05/06**

① 学習データとして○と×をランダムに 7 個ずつ選んだ場合

Generalization Performance=0.89

Generalization Performance=0.9425

Generalization Performance=0.925

Generalization Performance=0.955

Generalization Performance=0.9225

Generalization Performance=0.8975

Generalization Performance=0.8175

Generalization Performance=0.955

Generalization Performance=0.9325

Generalization Performance=0.9175

----------Avg=0.9155----------

② 学習データとして○と×をランダムに 2 個ずつ選んだ場合

Generalization Performance=0.9125

Generalization Performance=0.87

Generalization Performance=0.9575

Generalization Performance=0.83

Generalization Performance=0.76

Generalization Performance=0.93

Generalization Performance=0.6125

Generalization Performance=0.725

Generalization Performance=0.845

Generalization Performance=0.82

----------Avg=0.82625----------

③ 汎化性能の平均値を比較

学習データが増える（10 個）と、汎化性能が 8.53%くらい上がった。

（図示は最後のところにある）

```cpp
#include <iostream>
#include <stdio.h>
#include <time.h>
#include <vector>
#include <map>
#define MAPSIZE 20
#define LOOP 10
std::map<short, short> nnMap;
std::map<short, bool> pointMap;
short MAPSIZE2 = MAPSIZE * MAPSIZE;
void run(short LEARNINGDATA)
{
    float avg = 0.0f;
    for (short l = 0; l < LOOP; l++)
    {
        nnMap.clear();
        pointMap.clear();
        for (short i = 0; i < LEARNINGDATA; i++)
        {
            short j;
            if (i < LEARNINGDATA / 2)
            {
                do {
                    j = rand() % MAPSIZE2;
                } while (pointMap.find(j) != pointMap.end()
                    || j % MAPSIZE >= MAPSIZE / 2);
                pointMap.insert({ j,true });
            }
            else
            {
                do {
                    j = rand() % MAPSIZE2;
                } while (pointMap.find(j) != pointMap.end()
                    || j % MAPSIZE < MAPSIZE / 2);
                pointMap.insert({ j,false });
            }
        }
        for (short i = 0; i < MAPSIZE2; i++)
        {
            short minPoint = -1, minDistance = MAPSIZE2 + MAPSIZE2;
            short x = i % MAPSIZE;
            short y = i / MAPSIZE;
            for (auto& j : pointMap)
            {
                short x_ = j.first % MAPSIZE;
                short y_ = j.first / MAPSIZE;
                short x_x = x_ - x; short y_y = y_ - y;
                short x_xy_y = x_x * x_x + y_y * y_y;
                if (x_xy_y <= minDistance)
                {
                    minDistance = x_xy_y;
                    minPoint = j.first;
                }
            }
            nnMap.insert({ i,pointMap[minPoint] });
        }
```

```
57          for (auto& i : pointMap)
58          {
59              nnMap[i.first] = i.second + 2;
60          }
61          short correctCount = 0;
62          for (short i = MAPSIZE - 1; i >= 0; i--)
63          {
64              for (short j = 0; j < MAPSIZE; j++)
65              {
66                  short k = nnMap[i * MAPSIZE + j];
67                  if (j < MAPSIZE / 2)
68                  {
69                      if (k % 2 == 1)correctCount++;
70                  }
71                  else
72                  {
73                      if (k % 2 == 0)correctCount++;
74                  }
75                  switch (k)
76                  {
77                  case 0:std::cout << "x "; break;
78                  case 1:std::cout << ". "; break;
79                  case 2:std::cout << "X "; break;
80                  case 3:std::cout << "o "; break;
81                  default:break;
82
83                  }
84              }
85              std::cout << "\n";
86          }
87          std::cout << "Generalization Performance="
88              << (float)correctCount / MAPSIZE2 << "\n\n";
89          avg += (float)correctCount / MAPSIZE2 / LOOP;
90      }
91      std::cout << "-------------Avg=" << avg
92          << "---------------\n\n";
93  }
94  int main()
95  {
96      srand((unsigned int)time(NULL));
97      run(7 * 2);//〇と×をランダムに7個ずつ選んだ場合
98      run(2 * 2);//〇と×をランダムに2個ずつ選んだ場合
99      return 0;
100 }
101 /*/////////////実行結果///////////////
102
103 . . . . . . . . x x x x x x x x x x x x
104 . . . . . o . . x x x x x x X x x x x x
105 . . . . . . . . x x X x x x x x x x x x
106 . . . . . . . . x x x x x x x x x x x x
107 . . . . . . . . x x x x x x x x x x x x
108 . . . . . . . . . x x x x x x x x x x x
109 . . . . . . . . . . . . x x x x x x x x
110 . . . . . . . . . . . . . . x x x x x x
111 . . . . . . . . o . . . . x x x x x x x
112 . . . . . . . . . . . . . x x x x x x x
```

```
113 . . . . . x x x x x x x x
114 . . . . . x x x x x x x x x
115 . . . . . x x x x x x x X x x x x
116 . o . . . . x x x x x x x x x x x x x
117 . . . . . x x x X X x x x x x x x x
118 . . . . . x x x x x X x X x x x x
119 o . . . . . x x x x x x x x x
120 . . . . . o . o . . x x x x x x x x
121 . . . . . x x x x x x x x
122 . . . . o . . . . . x x x x x x x
123 Generalization Performance=0.89
124
125 . . . . . x x x x x x x x x
126 . . . . . x x x x x x x x x
127 . o . . . . . x x x x X x x x x
128 . . . . . x x x x x x x x x
129 . . . . . o . . x x x x x x x x x
130 o . . . . . x x X x x X x x x x
131 . . o . . o . . . x x X x x x x x x x
132 . . . . . x x x x x x x x x
133 . . . . . x x x x x x x x x x
134 . . . . . x x x x x x x x x x
135 . . . . . x x x x x x x x x x
136 . . . . . x x x x x x x x x x
137 . . . . . x x x x x x x x x x
138 o . . . . . x x x x x x x X x x x x
139 . . . . . x x x x x x x x x x
140 . . . . . x x x x x x x x x x
141 . . . . . x x x X x x x x x
142 . . . . . x x x x x x x x
143 . . . . . x x x x x x x X x
144 . . . . . o . . . x x x x x x x x
145 Generalization Performance=0.9425
146
147 . . . . . o . . . . . x x x x x x
148 . . . . . x x x x x x x
149 . . . . . x x x x x x x
150 . . . . . x x x x x x x x x
151 . . . . . x x x x x x x x x x
152 . . . . . x x x x x x x x X x x x
153 . . o . . . . x x x x X x x x x x x x
154 . . . . . x x x x x x x x x x x x
155 . . . . . x x x x x x x x x x x x
156 . . o o . . . . . x x x x x x x x X x x
157 . . . . o . . . . x x x x x x x x x x x
158 . . . . . x x x x x x x x x x
159 . . . . . x x x x x x x x x x
160 . . . . . x x x x x x x x x x
161 . . . . . x x x x x x x x x x
162 . . . o . . . . . x x x x x x x x X x x
163 . . . . . x x x x x X x x x x
164 . . . . . x x x x x x x x x x X
165 . . . . . x x x x x x x x x x x
166 . . . . . o x X x x x x x x x x x
167 Generalization Performance=0.925
168
```

```
169 . . . . . x x x x x x x x x x
170 . . . . . x x x x x x x X x x
171 . . . . . o . . . . x x x x x x x x x x
172 . . . . . x x x x X x x x x x x
173 . . . . . x x x x x x x x x x x
174 . . . . . x x x x x x x x x x
175 . . . . . o . . . . . x x x x x x x x x
176 . . . . . x x x X x x x x x
177 . . . . . o . . . . x x x x x x x x x
178 . . . . . o . . . x x x x x x x X
179 . . . o . . . . . . x x x x x x x x x
180 . . . . . x x x x x x x x x
181 . . . . . o . . . . x x x x x x x x x
182 . . . . . x x x x x x x x x
183 . . . . . x x x x X x x x
184 . . . . . x x x x x x x x x
185 . . . . . x x x x x x x x x x
186 . . . . . x x x x x x x x x x
187 . . . . . x x x x X x x x x x
188 . . . . . o . . . . x x x x x x X x x x
189 Generalization Performance=0.955
190
191 . . . . . x x x x x x x x
192 . . . . o o . . . . . x x x X x x x
193 . . . . . x x x x x x x x
194 . . . . . o . . x x x x x x x x
195 . . . . . x x X x x x x X
196 . . . . . o . . . x x x x x X x x
197 . . o . . . . . . x x x x x x x x
198 . . . . . o . . . x x x x x x x x
199 . . . . . x x x x x x X x
200 . . . . . o . x x x x x x x x x
201 . . . . . x X x x x x x x x
202 . . . . . x x X x x x x x x
203 . . . . . x x x x x x x x x x
204 . . . . . x x x x x x x x x x
205 . . . . . x x x x x x x x x x
206 . . . . . x x x x x x x x x x x
207 . . . . . x x x x x x x x x x x
208 . . . . . x x x x x x x x x x x x
209 . . . . . x x x x x x x x x x x x
210 . . . . . x x x x x x x x x x x x
211 Generalization Performance=0.9225
212
213 . . . . . x x x x x x x x x x x x x x
214 . . . . . x x x x x x x x x x x x x
215 . . . . . x x x x x x x x x X x x
216 . . . . . x X x x x x x x x x x
217 . . . . . o x x x x x x x x X x
218 . . . o . . . . . . x x x x x x x x x
219 . . o . . . o . . . x x X x x X x x x x
220 . o . . . . . x x X x x x x x x x
221 . . . . . x x x x x x x x x x
222 . . . . . x x x x x x x x x x
223 . . . . . x x x x x x x x x x
224 . . . . . x x x x x x x x x
```

```
225 . . . . . o . . . . . x x x x x x x
226 . . . . . x x x x x x x
227 . . . . . x x x x X x x
228 . . . . . x x x x x x x
229 . . . . . o . . . . x x x x x x x
230 . . . . . x x x x x x x
231 . . . . . . x x x x x x
232 . . . . . x x x x x x
233 Generalization Performance=0.8975
234
235 . . . o . . . . . . x x x x x x X
236 . . . . . o . . . . x x x x x x x
237 . o . . . . . x x x x x X x x
238 . . . . . x x x x x x x x x
239 . . . . . x x x x x x x x x x
240 . . o . . . x x x x X x x x x x x x
241 . . . . . x x x x x x x x x x x x
242 o . . . . . x x x x x x x x x x x x
243 . . o . . . . x x x x x x x x x x x
244 . . . . . x x x x x x x x X X x x x
245 . . o . . . . . x x x x x x x x x x
246 . . . . . x x x x x x x x x x x
247 . . . . . x x x x x x x x x x x x
248 . . . . . x x x x x x x x x x X x
249 . . . . . x x x x x x x x x x x x
250 . . . . . x x x x x x x x x x x x x
251 . . . . x x x x x x X x x x x x x x x
252 . . . . x x x x x x x x x x x x x x
253 . . . x x x x x x x x x x x x x x x
254 . . x x x x x x x x x x x x x x x x
255 Generalization Performance=0.8175
256
257 . . . o . . . . . x x x x x x x x X x x
258 . . . . . x x x x x x x x x x x
259 . . . . . x x x x x x x x x x
260 . . . . . x x x x x x x x x x
261 . . . . . x x X x x x x x x
262 . . . o . . . . . x x x x x x x x x
263 . . . . . o . . x x x x x x x x x
264 . . . . . x x x x x x x x x
265 . . . . . x x x x x x x x x
266 . . . . . x x x x x x x x x x
267 . . . . o . . . x x x X x x x x X x x x
268 . . . . . x x x x x x x x x x
269 . . . . . x X x x x x x x x
270 . . . . . o . x x x x x x x x X x
271 . . . . . x x x x x x x x x
272 . . . . . x x x x x x x x x
273 . . . . . x x x x x x x x x
274 . . . . . x x x x x x x x x x
275 o . o . . . . x x x x x X x x x x x x
276 . . . . . x x x x x x x x x x x x
277 Generalization Performance=0.955
278
279 . . . . . x x x x X x x
280 . . . . . o . . . . x x x x x x x
```

```
281 . . . o . . . . . . . . x x x x x x x
282 . . . . . . . . . . . . x x x x x x x
283 . . . . . . . . . . . . x x x x x x x
284 . . . . . . . . . . x x x x x x x x x
285 . . . . . . . . . . x x x x x x x x X
286 . . . . . . . . . . x x x x x x x x x
287 . . . . . . . . . . x x x X x x x x x
288 . . . . . . . . . . x x x x x x x x x
289 . . . . . . . . . . . x x x x X x x x
290 . . . . . . . . . . o . . x x x x x x x
291 . o . . . . . . . . . . x x X x x x x x
292 . . . . . . . . . . . . x x x x x x x x
293 . . . . . . . o . o . x X x x x x x x
294 . . . . . . . . . . . . x X x x x x x x
295 . . . . . . . . . . . . x x x x x x x x
296 . . . . . . . . . . . x x x x x x x x x
297 . . . . . . . o . . . x x x x x x x x x
298 . . . . . . . . . . . . x x x x x x x x
299 Generalization Performance=0.9325
300
301 . . . . . . . . . . . . . x x x x X x x x
302 . . . . . . . . o . . . . x x x x x x x x
303 . . . . . . . o . . . . . x x x x x x x x
304 . . . o . . . . . . . . . x x x x x x x x
305 . . . . . . . . . . . x x x x X x x x x
306 . . . . . . . . . . x x x x X x x x x x
307 . . . . . . . . x x x x x x x x x x x x
308 . . . . . . . . x x x x X x x x x x x X
309 . . . . . . . . x x x x x x x x x x x x
310 . . . o . . . . x x x x x x x x x x x x
311 . . . . . . . . x x x x x x x x x x x x
312 . . . . . . . . . x x x x x x x x x X x
313 . . . . . . . . . . . . x x x x x x x x
314 . . . o . . . . . . . . x x x x x x x x
315 . . . . . . . . . . . . . x x x x x x x
316 . . . . . . . . . . . . . x x x x x x x
317 o . . . . . . o . . . . x x x x x X x x
318 . . . . . . . . . . . . . x x x x x x x
319 . . . . . . . . . . . . . x x x x x x x
320 . . . . . . . . . . . . . x x x x x x x
321 Generalization Performance=0.9175
322
323 -------------Avg=0.9155---------------
324
325 . . . . . o . . . . . . . x x x x x x x
326 . . . . . . . . . . . . . x x x x x x x
327 . . . . . . . . . . . . . x x x x x x x
328 . . . . . . . . . . . . . x x x x x x x
329 . . . . . . . . . . . . . x x x x x x x
330 . . . . . . . . . . . . . x x x x x x X
331 . . . . . o . . . . . . . x x x x x x x
332 . . . . . . . . . . . . . x x x x x x x
333 . . . . . . . . . . . . . x x x x x x x
334 . . . . . . . . . . . . . x x x x x x X
335 . . . . . . . . . . . . . x x x x x x x
336 . . . . . . . . . . . . . x x x x x x x
```

```
337 . . . . . x x x x x x x x
338 . . . . . x x x x x x x x x
339 . . . . . x x x x x x x x x
340 . . . . . x x x x x x x x x
341 . . . . . x x x x x x x x x
342 . . . . . x x x x x x x x x
343 . . . . . x x x x x x x x x
344 . . . . . x x x x x x x x x
345 Generalization Performance=0.9125
346
347 . . . . x x x x x x x x x x x x x x x
348 . . . . x x x x x x x x x x x x x x x
349 . . . . . x x x x x x x x x x x x x x
350 . . . . . x x x x x x x x x x x x x x
351 . . . . . x x x x x x x x x x x x x x
352 . . . . . x x x x x x x x x x x x x x
353 . . . . . x x x x x x x x x x x x x x
354 . . . . . x x x x x x X x x x x x x
355 . . . . . x x x x x x x x x x x x x
356 . . . . . x x x x x x x x x x x x x
357 . . . . . x x x x x x x x x x x x x
358 . . . . . x x x x x x x x x x x x x
359 . . o . . . . . x x x x x x x x x x x
360 . . . . . x x x x x x x x x x x x x
361 . . . . . x x x x x x x x x x x x x
362 . . . . . x x x x x x x x x x x x x
363 . . . . . x x x x x x x x x x x x x
364 . . . . . x x x x x x x x x x x x x
365 . . . . . x x x x x x X x x x x
366 . . . o . . . . . x x x x x x x x x x
367 Generalization Performance=0.87
368
369 . . . . . x x x x x x x x x x x x x
370 . . . . . x x x x x x x x x x x x x
371 . . . . . x x x x x x x x x x x x X
372 . . . . . x x x x x x x x x x x x x
373 . . . . . x x x x x x x x x x x x x
374 . . . . . x x x x x x x x x x x x x
375 . . . . . x x x x x x x x x x x x x
376 . . . . . x x x x x x x x x x x x x
377 . . . . . x x x x x x x x x x x x x
378 . . . . . x x x x x x x x x x x x x
379 . . . . . x x x x x x x x x x x x x
380 . . . . o . . . . . x x x x x x x x x x
381 . . . . . x x x x x x x x x x x x x
382 . . . . . x x x x x x x x x x x x x
383 . . . . . x x x x x x x x x x x x x
384 . . . . . x x x x x X x x x x
385 . . . . . x x x x x x x x x x x x x
386 . . . . . x x x x x x x x x x x x x
387 . . . . . o . . . . . x x x x x x x x x x
388 . . . . . x x x x x x x x x x x x x
389 Generalization Performance=0.9575
390
391 . . . . x x x x x x x x x x x x x x x
392 . . . . . x x x x x x x x x x x x x x
```

```
393 . . . . . x x x x x x x x x x x x x x x x
394 . . . . . . x x x x x x x x x x x x X x
395 . . . . . . . x x x x x x x x x x x x x
396 . . . . . . . x x x x x x x x x x x x x
397 . . . . . . . x x x x x x x x x x x x x
398 . . . . . . . x x x x x x x x x x x x x
399 . . . . . . . x x x x x x x x x x x x x
400 . . . . . . . x x x x x x x x x x x x x
401 . . . . . . . x x x x x x x x x x x x x
402 . . . . . . . x x x x x x x x x x x x x
403 . . . . . . . x x x x x x x x x x x x x
404 . . . . . . . x x x x x x x x x x x x x
405 . . . . . . . x x x x x x x x x x x x x
406 . . . o . . . x x x X x x x x x x x x x
407 . . . . . . . x x x x x x x x x x x x x
408 . . . . . . . x x x x x x x x x x x x x
409 . . o . . . . x x x x x x x x x x x x x
410 . . . . . . . x x x x x x x x x x x x x
411 Generalization Performance=0.83
412
413 . . x x x x x x x x x x x x x x x x x x
414 . . . x x x x x x x x x x x x x x x x x
415 . . . . x x x x x x x x x x x x x x x x
416 . . . . . x x x x x x x x x x x x x x x
417 . . . . . x x x x x x x x x x x X x x x
418 . . . . . x x x x x x x x x x x x x x x
419 . . . . . x x X x x x x x x x x x x x
420 . . . . . x x x x x x x x x x x x x
421 . . . . . o . x x x x x x x x x x x
422 . . . . . x x x x x x x x x x
423 . . . . . x x x x x x x x x x
424 . . . . o . . . . . x x x x x x x x
425 . . . . . x x x x x x x
426 . . . . . x x x x x x
427 . . . . . x x x x
428 . . . . . x x x
429 . . . . . x x x
430 . . . . . x x
431 . . . . . x x
432 . . . . . x
433 Generalization Performance=0.76
434
435 . . . . . x x x x x x x x x x x
436 . . . . . x x x x x x x x x x x
437 . . . . . x x x x x x x x x x x
438 . . . . . x x x x x x x x x x x
439 . . . . . x x x x x x x x x x x
440 . . . . . x x x x x x x x x x
441 . . . . . x x x x x x x x x x
442 . . . . . x x X x x x x x
443 . . . . . x x x x x x x x
444 . . . . . o . . x x x x x x x x
445 . . . . . x x x x x x x x
446 . . . . . x x x x x x x
447 . . . . . x x x x x x
448 . . . . . x x x x x x
```

```
. . . . . o . . . . . . x x x x x x x x
. . . . . . . . . . . x x x x x x x x x
. . . . . . . . . . . x x x x x x x x x
. . . . . . . . . . x x x x x x x x x x
. . . . . . . . . . x x x x x X x x x x
. . . . . . . . . x x x x x x x x x x x
Generalization Performance=0.93

. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . x
. . . . . . . . . o . . . . . . . . . x
. . . . . . . . . . . . . . . . . . x x
. . . . . . . . . . . . . . . . . x x x
. . . . . . . . . o . . . . . . x x x x
. . . . . . . . . . . . . . . . x x x x
. . . . . . . . . . . . . . x x x x x x
. . . . . . . . . . . x x x x x x x x x
. . . . . . . . x x x x x x x x x x x x
. . . . . x x x x x x x x x x x x x x x
. . x x x x x x x x x X x x x x x x x X
x x x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x x x x x
Generalization Performance=0.6125

. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . .
. . . . . . . . o . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . x x
. . . . . . . . . . . . . . . . . x x x
. . . . . . . . . . . . . . . x x x x x
. . . . . . . . . . . . . x x x x x x x
. . . o . . . . . . . . x x x x x x x x
. . . . . . . . . . x x x x x x x x x x
. . . . . . . . . x x x x x x x x x x x
. . . . . . . . . x x x x x x x x x x x
. . . . . . . . x x x x x x x x x x x x
. . . . . . . . x x x x x x X x x x x x
. . . . . . . x x x x x x x x x X x x x
. . . . . . . x x x x x x x x x x x x x
. . . . . . . x x x x x x x x x x x x x
Generalization Performance=0.725

. . . . . . . . . . . . . . . . . . x x
. . . . . . . . . . . . . . . . . x x x
. . . . . . . . . . . . . . . . x x x x
. . . . . . . . . o . . . . . x x x x x
```

```
505 . . . . . x x x x x x x
506 . . . . . x x x x x x x x
507 . . . . . x x x x x x x x x
508 . . . . . x x x x x x x x x x
509 . . . . . x x x x X x x x x x x
510 . . . . . x x x x x x x x x x x x
511 . . . . . x x x x x x x x x x x x
512 . . . . . x x x x x x x x x x x x
513 . . . . . x x x x x x x X x x
514 . . . . . x x x x x x x x x
515 . . . . . x x x x x x x x x
516 . . . . . x x x x x x x x
517 . . . . . o . . . . . x x x x x x x
518 . . . . . x x x x x x
519 . . . . . x x x x x x
520 . . . . . x x x x x x
521 Generalization Performance=0.845
522
523 . . . . . x x x x x x x
524 . . . . . x x x x x x x
525 . . . . . o . . . x x x x x x x x
526 . . . . . x x x x x x x x
527 . . . . . x x x x x x x x x
528 . . . . . x x x X x x x x x
529 . . . . o . . . . . x x x x x x x x x x
530 . . . . . x x x x x x x x x x
531 . . . . . x x x x x x x x x x
532 . . . . . x x x x x x x x x x
533 . . . . . x x x x x x x x x x
534 . . . . . x x x x x x x x x x x
535 . . . . . x x x x x x x x x x x x
536 . . . . . x x x x x x x x x x x x x
537 . . . . x x x x x x x x x x x x x x x
538 . . . x x x x x x x x x x x x x x x x
539 . x x x x x x x x x x x x x x x x x x
540 x x x x x x x x x x X x x x x x x x x
541 x x x x x x x x x x x x x x x x x x x
542 x x x x x x x x x x x x x x x x x x x
543 Generalization Performance=0.82
544
545 -------------Avg=0.82625---------------
546
547 *//////////////////////////////////////
```