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nearest_neighbor_analysis.txt

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```

1 Analysis of K-Nearest Neighbor project
2
3 Algorithm 1: Forward Selection
4 Algorithm 2: Backwards Elimination
5 Algorithm 3: Exhaustive Search
6
7 Algorithm 3 (My own algorithm) is proven to produce better results
8 than both Forward Selection and Backwards Elimination.
9 The reason for this is because since both those algorithms use a bias to
10 guide a search towards a possible optimal selection, it's not guaranteed
11 to find the optimal solution. Exhaustive search is guaranteed
12 to find the optimal solution since all possible nodes and their children
13 are pushed onto the queue for processing. The drawback of this algorithm is
14 that it extremely costly. The time to complete the program's runtime
15 increases nearly exponentially as datasets become larger. To give an example,
16 I have posted the completion times for all three searches on both the
17 small and medium data sets.
18
19 =====BEGIN SMALL TEST=====
20
21 Forward Selection
22
23 real    0m43.893s
24 user    0m42.623s
25 sys     0m0.252s
26
27 Backwards Elimination
28
29 real    0m53.650s
30 user    0m53.155s
31 sys     0m0.004s
32
33 Brute Force
34
35 real    2m12.418s
36 user    2m11.332s
37 sys     0m0.532s
38
39
40 =====END SMALL TEST=====
41
42 =====BEGIN MEDIUM TEST=====
43
44 Forward Selection
45
46 real    3m3.177s
47 user    3m1.939s
48 sys     0m0.108s
49
50 Backwards Elimination
51
52 real    5m49.626s
53 user    5m48.386s
54 sys     0m0.488s
55
56 Brute Force
57
58 real    149m14.069s
59 user    148m45.458s
60 sys     0m4.912s
61
62 =====END MEDIUM TEST=====
63
64 We can see that a brute force search takes substantially longer
65 to finish even for a data set with 10 features over that of 5.
66 Having the additional branching factor makes it extremely
67 difficult to search every possible node. K-Nearest Neighbor
68 is in itself a relatively to implement algorithm, but it is naive
69 in nature. By using an exhaustive search, we can guarantee an optimal
70 solution but the cost is so high it simply isn't practical. Generally,
71 Forward Selection and Backwards Elimination will produce relatively optimal
72 solutions at an efficient cost.
73

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74 I have attached traces of the following:
75 1) All 3 searches run on a Small data set
76 2) Exhaustive Search run on a Medium data set
77 3) Forward Selection run on a Large data set
78
79 I will also attach graphs of the data involving the accuracies
80 correlating to features used and analyze that as well.
81

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Small_Trace.txt

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```

1 =====BEGIN ALGORITHM 1=====
2
3 Type the number of the algorithm you want to run.
4
5     1) Forward Selection
6     2) Backward Elimination
7     3) Hans' Special Algorithm
8
9 1
10 Using Forward Selection
11
12 68.5 % using features: { 1 }
13
14 Accuracy has increased to: 68.5 %
15
16 83.9 % using features: { 2 }
17
18 Accuracy has increased to: 83.9 %
19
20 68.2 % using features: { 3 }
21 73.3 % using features: { 4 }
22 66.8 % using features: { 5 }
23 83.5 % using features: { 1 2 }
24 86.4 % using features: { 2 3 }
25
26 Accuracy has increased to: 86.4 %
27
28 96.5 % using features: { 2 4 }
29
30 Accuracy has increased to: 96.5 %
31
32 83.6 % using features: { 2 5 }
33 91.6 % using features: { 1 2 4 }
34 95.4 % using features: { 2 3 4 }
35 94.0 % using features: { 2 4 5 }
36 Accuracy has decreased for all options, exiting
37 Highest accuracy was 96.5 % using features: { 2 4 }
38
39 =====BEGIN ALGORITHM 2=====
40
41 Type the number of the algorithm you want to run.
42
43     1) Forward Selection
44     2) Backward Elimination
45     3) Hans' Special Algorithm
46
47 2
48 Using Backwards Elimination
49
50 87.8 % using features: { 1 2 3 4 5 }
51 92.3 % using features: { 2 3 4 5 }
52
53 Accuracy has increased to: 92.3 %
54
55 73.6 % using features: { 1 3 4 5 }
56 89.8 % using features: { 1 2 4 5 }
57 80.0 % using features: { 1 2 3 5 }
58 91.7 % using features: { 1 2 3 4 }
59 73.2 % using features: { 3 4 5 }
60 94.0 % using features: { 2 4 5 }
61
62 Accuracy has increased to: 94.0 %
63
64 82.8 % using features: { 2 3 5 }
65 95.4 % using features: { 2 3 4 }
66
67 Accuracy has increased to: 95.4 %
68
69 73.8 % using features: { 3 4 }
70 96.5 % using features: { 2 4 }
71
72
73 Accuracy has increased to: 96.5 %

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74
75 86.4 % using features: { 2 3 }
76 73.3 % using features: { 4 }
77 83.9 % using features: { 2 }
78 Accuracy has decreased for all options, exiting
79 Highest accuracy was 96.5 % using features: { 2 4 }
80
81
82 =====BEGIN ALGORITHM 3=====
83
84 Type the number of the algorithm you want to run.
85
86     1) Forward Selection
87     2) Backward Elimination
88     3) Hans' Special Algorithm
89
90 3
91 Using Special Algorithm
92
93 68.5 % using features: { 1 }
94
95 Accuracy has increased to: 68.5 %
96
97 83.9 % using features: { 2 }
98
99 Accuracy has increased to: 83.9 %
100
101 68.2 % using features: { 3 }
102 73.3 % using features: { 4 }
103 66.8 % using features: { 5 }
104 83.5 % using features: { 1 2 }
105 86.4 % using features: { 2 3 }
106
107 Accuracy has increased to: 86.4 %
108
109 96.5 % using features: { 2 4 }
110
111 Accuracy has increased to: 96.5 %
112
113 83.6 % using features: { 2 5 }
114 91.6 % using features: { 1 2 4 }
115 95.4 % using features: { 2 3 4 }
116 94.0 % using features: { 2 4 5 }
117 91.7 % using features: { 1 2 3 4 }
118 92.3 % using features: { 2 3 4 5 }
119 89.8 % using features: { 1 2 4 5 }
120 87.8 % using features: { 1 2 3 4 5 }
121 83.2 % using features: { 1 2 3 }
122 82.8 % using features: { 2 3 5 }
123 82.1 % using features: { 1 2 5 }
124 80.0 % using features: { 1 2 3 5 }
125 71.0 % using features: { 1 4 }
126 73.8 % using features: { 3 4 }
127 72.6 % using features: { 4 5 }
128 72.3 % using features: { 1 3 4 }
129 73.2 % using features: { 3 4 5 }
130 73.6 % using features: { 1 3 4 5 }
131 71.4 % using features: { 1 4 5 }
132 68.9 % using features: { 1 3 }
133 67.3 % using features: { 1 5 }
134 69.7 % using features: { 1 3 5 }
135 70.0 % using features: { 3 5 }
136
137 1
138 Special Algorithm finished running.
139 Highest accuracy was 96.5 % using features: { 2 5 }

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Medium_Trace.txt

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1 Type the number of the algorithm you want to run.
2
3 1) Forward Selection
4 2) Backward Elimination
5 3) Hans' Special Algorithm
6
7 3
8 Using Special Algorithm
9
10 64.7 % using features: { 1 }
11
12 Accuracy has increased to: 64.7 %
13
14 66.4 % using features: { 2 }
15
16 Accuracy has increased to: 66.4 %
17
18 65.7 % using features: { 3 }
19 68.5 % using features: { 4 }
20
21 Accuracy has increased to: 68.5 %
22
23 65.1 % using features: { 5 }
24 67.3 % using features: { 6 }
25 70.0 % using features: { 7 }
26
27 Accuracy has increased to: 70.0 %
28
29 83.2 % using features: { 8 }
30
31 Accuracy has increased to: 83.2 %
32
33 69.4 % using features: { 9 }
34 69.1 % using features: { 10 }
35 80.9 % using features: { 1 8 }
36 82.8 % using features: { 2 8 }
37 82.0 % using features: { 3 8 }
38 80.6 % using features: { 4 8 }
39 82.8 % using features: { 5 8 }
40 82.6 % using features: { 6 8 }
41 82.7 % using features: { 7 8 }
42 97.5 % using features: { 8 9 }
43
44 Accuracy has increased to: 97.5 %
45
46 83.9 % using features: { 8 10 }
47 93.8 % using features: { 1 8 9 }
48 93.7 % using features: { 2 8 9 }
49 93.8 % using features: { 3 8 9 }
50 93.6 % using features: { 4 8 9 }
51
52 .
53 .
54 .
55
56 66.7 % using features: { 1 3 4 5 6 7 }
57 67.9 % using features: { 1 3 4 5 6 10 }
58 65.8 % using features: { 2 3 4 5 7 9 10 }
59 67.8 % using features: { 2 4 5 6 7 9 10 }
60 65.4 % using features: { 1 2 3 4 5 10 }
61 65.9 % using features: { 1 3 4 5 7 10 }
62 66.1 % using features: { 2 3 4 5 6 7 9 }
63 67.1 % using features: { 1 3 4 6 10 }
64 68.0 % using features: { 1 3 5 6 10 }
65 65.7 % using features: { 1 3 6 7 10 }
66 65.4 % using features: { 1 3 5 6 7 10 }
67 68.6 % using features: { 2 3 6 10 }
68 64.8 % using features: { 2 4 6 10 }
69 66.6 % using features: { 2 5 6 10 }
70 65.4 % using features: { 2 6 7 10 }
71 66.3 % using features: { 2 3 4 6 10 }
72 67.0 % using features: { 2 3 5 6 10 }
73 65.5 % using features: { 1 2 3 4 5 6 10 }

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Medium_Trace.txt

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```

74 65.1 % using features: { 1 3 4 5 6 7 10 }
75 65.4 % using features: { 3 4 6 10 }
76 66.9 % using features: { 3 5 6 10 }
77 66.1 % using features: { 2 3 4 5 6 7 9 10 }
78 66.7 % using features: { 1 3 4 10 }
79 66.0 % using features: { 2 3 4 10 }
80 64.9 % using features: { 3 4 7 10 }
81 67.2 % using features: { 2 3 4 5 6 }
82 64.2 % using features: { 3 4 5 6 7 }
83 67.1 % using features: { 3 4 5 6 10 }
84 65.7 % using features: { 1 2 7 10 }
85 67.4 % using features: { 2 3 7 10 }
86 65.7 % using features: { 2 4 7 10 }
87 67.1 % using features: { 2 5 7 10 }
88 67.3 % using features: { 1 2 4 6 7 10 }
89 65.4 % using features: { 1 2 3 4 5 7 }
90 65.1 % using features: { 1 2 3 4 6 10 }
91 68.3 % using features: { 3 5 10 }
92 67.0 % using features: { 1 3 5 10 }
93 67.3 % using features: { 2 3 5 10 }
94 68.7 % using features: { 3 5 7 10 }
95 66.9 % using features: { 1 3 5 7 10 }
96 66.3 % using features: { 2 3 5 7 10 }
97 64.9 % using features: { 3 4 5 7 10 }
98 66.8 % using features: { 3 5 6 7 10 }
99 65.6 % using features: { 1 2 3 7 }
100 65.0 % using features: { 2 3 4 7 }
101 66.2 % using features: { 2 3 5 7 }
102 65.1 % using features: { 1 2 3 7 10 }
103 64.5 % using features: { 2 3 4 7 10 }
104 63.5 % using features: { 4 5 6 10 }
105 65.6 % using features: { 5 6 7 10 }
106 67.6 % using features: { 1 6 7 }
107 65.6 % using features: { 2 6 7 }
108 64.7 % using features: { 4 6 7 }
109 64.8 % using features: { 5 6 7 }
110 66.6 % using features: { 1 2 6 7 }
111 66.8 % using features: { 1 4 6 7 }
112 66.6 % using features: { 1 5 6 7 }
113 67.4 % using features: { 1 6 }
114 66.9 % using features: { 2 6 }
115 64.4 % using features: { 3 6 }
116 64.8 % using features: { 5 6 }
117 68.8 % using features: { 1 2 6 }
118 68.4 % using features: { 1 3 6 }
119 65.3 % using features: { 1 4 6 }
120 66.0 % using features: { 1 5 6 }
121 67.4 % using features: { 1 2 3 6 }
122 70.4 % using features: { 1 2 4 6 }
123 65.5 % using features: { 1 2 5 6 }
124 64.9 % using features: { 1 2 3 4 6 }
125 67.1 % using features: { 1 2 4 5 6 }
126 69.4 % using features: { 1 2 4 6 7 }
127 66.2 % using features: { 1 2 4 5 6 7 }
128 66.8 % using features: { 1 3 4 6 }
129 70.7 % using features: { 1 3 5 6 }
130 65.3 % using features: { 1 2 3 5 6 }
131 66.3 % using features: { 1 3 5 6 7 }
132 66.0 % using features: { 1 2 3 5 10 }
133 66.4 % using features: { 2 3 4 5 10 }
134 65.6 % using features: { 1 2 3 4 6 7 10 }
135 66.4 % using features: { 1 2 4 5 6 7 10 }
136 64.5 % using features: { 3 4 6 7 10 }
137 70.0 % using features: { 1 4 5 6 10 }
138 65.3 % using features: { 1 5 6 7 10 }
139 65.7 % using features: { 1 4 5 6 7 10 }
140 66.0 % using features: { 1 4 6 7 10 }
141 64.9 % using features: { 2 3 4 5 6 7 }
142 65.2 % using features: { 2 3 4 5 6 10 }
143 64.7 % using features: { 1 2 3 4 5 6 7 }
144 65.4 % using features: { 3 4 5 6 7 10 }
145 64.9 % using features: { 1 3 7 10 }
146 65.9 % using features: { 1 3 4 6 7 10 }

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147	65.6 %	using features: { 1 2 5 7 10 }	
148	65.8 %	using features: { 2 4 5 7 10 }	
149	64.9 %	using features: { 2 5 6 7 10 }	
150	67.1 %	using features: { 1 2 3 10 }	
151	67.1 %	using features: { 1 2 4 10 }	
152	67.0 %	using features: { 1 2 5 10 }	
153	65.7 %	using features: { 1 2 3 4 10 }	
154	66.0 %	using features: { 1 2 4 5 10 }	
155	66.3 %	using features: { 1 2 4 7 10 }	
156	64.4 %	using features: { 2 3 5 6 7 10 }	
157	64.7 %	using features: { 1 3 4 6 7 }	
158	67.4 %	using features: { 1 5 7 }	
159	65.9 %	using features: { 2 5 7 }	
160	65.2 %	using features: { 4 5 7 }	
161	69.4 %	using features: { 5 7 10 }	
162	67.1 %	using features: { 1 5 7 10 }	
163	65.2 %	using features: { 4 5 7 10 }	
164	66.7 %	using features: { 1 2 5 7 }	
165	65.9 %	using features: { 1 3 5 7 }	
166	67.5 %	using features: { 1 4 5 7 }	
167	66.9 %	using features: { 1 2 4 5 7 }	
168	65.5 %	using features: { 1 4 5 6 7 }	
169	65.1 %	using features: { 1 4 5 7 10 }	
170	67.8 %	using features: { 1 4 5 10 }	
171	66.2 %	using features: { 1 2 4 5 7 10 }	
172	68.0 %	using features: { 4 5 10 }	
173	66.6 %	using features: { 4 7 10 }	
174	67.1 %	using features: { 2 4 5 10 }	
175	64.9 %	using features: { 2 4 5 6 10 }	
176	65.7 %	using features: { 2 3 6 }	
177	65.6 %	using features: { 2 4 6 }	
178	64.8 %	using features: { 2 5 6 }	
179	63.9 %	using features: { 2 3 4 6 7 10 }	
180	62.9 %	using features: { 1 2 3 5 7 10 }	
181	64.7 %	using features: { 2 3 4 6 }	
182	67.6 %	using features: { 1 3 4 7 10 }	
183	65.3 %	using features: { 1 2 3 4 7 10 }	
184	66.0 %	using features: { 1 2 3 5 7 }	
185	67.2 %	using features: { 1 2 5 6 7 }	
186	67.8 %	using features: { 1 2 4 }	
187	64.7 %	using features: { 2 4 5 }	
188	63.2 %	using features: { 2 4 7 }	
189	67.9 %	using features: { 1 2 3 4 }	
190	67.1 %	using features: { 1 2 4 5 }	
191	67.2 %	using features: { 1 2 4 7 }	
192	64.8 %	using features: { 1 2 3 4 7 }	
193	65.0 %	using features: { 1 3 4 7 }	
194	66.3 %	using features: { 1 4 7 10 }	
195	64.6 %	using features: { 4 6 7 10 }	
196	63.4 %	using features: { 2 3 4 5 7 10 }	
197	65.5 %	using features: { 1 2 3 4 5 6 7 10 }	
198	66.9 %	using features: { 1 2 }	
199	67.5 %	using features: { 2 3 }	
200	64.1 %	using features: { 2 5 }	
201	69.4 %	using features: { 1 2 3 }	
202	66.8 %	using features: { 2 3 5 }	
203	65.8 %	using features: { 1 2 3 5 }	
204	66.8 %	using features: { 1 2 5 }	
205	69.8 %	using features: { 1 2 7 }	
206	67.4 %	using features: { 2 3 5 6 }	
207	64.3 %	using features: { 1 2 3 5 6 7 10 }	
208	64.7 %	using features: { 1 2 3 4 5 7 10 }	
209	65.8 %	using features: { 1 4 5 }	
210	64.3 %	using features: { 4 5 6 }	
211	65.2 %	using features: { 2 3 4 5 7 }	
212	66.2 %	using features: { 1 4 7 }	
213	66.8 %	using features: { 1 4 5 6 }	
214	68.1 %	using features: { 2 4 5 7 }	
215	66.7 %	using features: { 2 5 6 7 }	
216	63.7 %	using features: { 2 4 5 6 7 }	
217	62.6 %	using features: { 2 4 5 6 7 10 }	
218	64.2 %	using features: { 1 3 }	
219	68.9 %	using features: { 3 5 }	

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220	67.4 %	using features: { 1 3 5 }	
221	68.6 %	using features: { 3 5 6 }	
222	64.7 %	using features: { 2 4 6 7 10 }	
223	64.6 %	using features: { 4 5 6 7 10 }	
224	62.6 %	using features: { 2 4 6 7 }	
225	65.3 %	using features: { 2 4 5 6 }	
226	62.9 %	using features: { 2 3 4 5 6 7 10 }	
227	63.8 %	using features: { 4 5 6 7 }	
228	66.3 %	using features: { 1 5 }	
229	1		
230	Special Algorithm finished running.		
231	Highest accuracy was 97.5 % using features: { 8 10 }		

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Large_Trace.txt

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```

1 Type the number of the algorithm you want to run.
2
3   1) Forward Selection
4   2) Backward Elimination
5   3) Hans' Special Algorithm
6
7 1
8 Using Forward Selection
9
10 70.7 % using features: { 1 }
11
12 Accuracy has increased to: 70.7 %
13
14 71.1 % using features: { 2 }
15
16 Accuracy has increased to: 71.1 %
17
18 72.7 % using features: { 3 }
19
20 Accuracy has increased to: 72.7 %
21
22 70.7 % using features: { 4 }
23 76.0 % using features: { 5 }
24
25 Accuracy has increased to: 76.0 %
26
27 72.1 % using features: { 6 }
28 71.6 % using features: { 7 }
29 69.2 % using features: { 8 }
30 72.6 % using features: { 9 }
31 71.7 % using features: { 10 }
32 70.2 % using features: { 11 }
33
34 .
35 .
36 .
37
38 Accuracy has increased to: 96.7 %
39
40 85.2 % using features: { 6 32 }
41 87.1 % using features: { 7 32 }
42 85.2 % using features: { 8 32 }
43 84.3 % using features: { 9 32 }
44 84.3 % using features: { 10 32 }
45 85.7 % using features: { 11 32 }
46 86.3 % using features: { 12 32 }
47 85.6 % using features: { 13 32 }
48 85.3 % using features: { 14 32 }
49 83.9 % using features: { 15 32 }
50 85.3 % using features: { 16 32 }
51 84.5 % using features: { 17 32 }
52 83.3 % using features: { 18 32 }
53 84.5 % using features: { 19 32 }
54 84.4 % using features: { 20 32 }
55 84.9 % using features: { 21 32 }
56 84.4 % using features: { 22 32 }
57 85.2 % using features: { 23 32 }
58 83.3 % using features: { 24 32 }
59 82.2 % using features: { 25 32 }
60 85.0 % using features: { 26 32 }
61 83.5 % using features: { 27 32 }
62 86.2 % using features: { 28 32 }
63 85.0 % using features: { 29 32 }
64 85.6 % using features: { 30 32 }
65 83.7 % using features: { 31 32 }
66 86.0 % using features: { 32 33 }
67 85.9 % using features: { 32 34 }
68 84.2 % using features: { 32 35 }
69 84.9 % using features: { 32 36 }
70 82.6 % using features: { 32 37 }
71 84.7 % using features: { 32 38 }
72 86.9 % using features: { 32 39 }
73 84.8 % using features: { 32 40 }

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74 94.2 % using features: { 1 5 32 }
75 93.4 % using features: { 2 5 32 }
76 93.7 % using features: { 3 5 32 }
77 93.7 % using features: { 4 5 32 }
78 94.1 % using features: { 5 6 32 }
79 96.0 % using features: { 5 7 32 }
80 95.0 % using features: { 5 8 32 }
81 93.9 % using features: { 5 9 32 }
82 94.4 % using features: { 5 10 32 }
83 94.3 % using features: { 5 11 32 }
84 93.4 % using features: { 5 12 32 }
85 93.8 % using features: { 5 13 32 }
86 93.0 % using features: { 5 14 32 }
87 94.1 % using features: { 5 15 32 }
88 94.2 % using features: { 5 16 32 }
89 94.0 % using features: { 5 17 32 }
90 92.7 % using features: { 5 18 32 }
91 93.8 % using features: { 5 19 32 }
92 94.6 % using features: { 5 20 32 }
93 92.4 % using features: { 5 21 32 }
94 93.8 % using features: { 5 22 32 }
95 94.4 % using features: { 5 23 32 }
96 94.8 % using features: { 5 24 32 }
97 94.8 % using features: { 5 25 32 }
98 94.9 % using features: { 5 26 32 }
99 95.5 % using features: { 5 27 32 }
100 94.2 % using features: { 5 28 32 }
101 95.7 % using features: { 5 29 32 }
102 93.1 % using features: { 5 30 32 }
103 94.2 % using features: { 5 31 32 }
104 95.0 % using features: { 5 32 33 }
105 94.9 % using features: { 5 32 34 }
106 93.5 % using features: { 5 32 35 }
107 93.8 % using features: { 5 32 36 }
108 94.9 % using features: { 5 32 37 }
109 93.6 % using features: { 5 32 38 }
110 94.2 % using features: { 5 32 39 }
111 93.5 % using features: { 5 32 40 }
112 Accuracy has decreased for all options, exiting
113 Highest accuracy was 96.7 % using features: { 5 32 }
114

```