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1 #!/usr/bin/env python3 -B
2 # vim: ts=2:sw=2:sts=2:et
3 """
4 binr.py : build rules via stochastic incremental XAI
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6
7 Options:
8   -h      Show help.
9   -b bins? Number of bins for discretization (int).
10  -B Budget? Max rows to eval (int).
11  -eras10 Number of rows in an era (int)
12  -p p=2 Distance coefficient.
13  -r repeats=20 Number of experimental repeats (int).
14  -s seed=42 Random number seed (int).
15  -f file=~/data/auto93.csv File to load (str).
16 """
17 from types import SimpleNamespace as o
18 from math import floor,sqrt,cos,log,exp,pi
19 from typing import Any,Iterable
20 import fileinput,random,sys,re
21 rand = random.random
22
23 the = o(bins=7, Budget=30, era=10, p=2, repeats=20, seed=42,
24         file=~/data/auto93.csv")
25
26 QTY = float | int
27 ATOM = QTY | str
28 ROW = list[ATOM]
29 ROWS = list[ROW]
30 NUM,SYM,COLS = o,o,o # redefined below
31 COL = NUM | SYM # redefined below
32 DATA = tuple[ROWS, COLS] # redefined below
33
34 #
35 def SYM() -> SYM:
36     return o(it=SYM, n=0, has={}, bins={})
37
38 def NUM() -> NUM:
39     return o(it=NUM, n=0, mu=0, sd=0, m2=0, bins={})
40
41 def COL(at=0, of=""") -> COL:
42     it = NUM if of[0].isupper() else SYM()
43     it.at = at
44     it.of = of
45     it.best = str(o)[-1]!="="
46     return it
47
48 def COLS(names: list[str]) -> COLS:
49     t = [COL(at=i, of=s) for i,s in enumerate(names)]
50     return o(it=COLS, names=names,
51             all = t,
52             x = [c for c in t if c.of[-1] not in "+-X"],
53             y = [c for c in t if c.of[-1] != "X" and c.of[-1] in "+-"])
54
55 def DATA(rows: ROWS = None) -> DATA:
56     return adds(rows, o(it=DATA, n=0, rows=[], cols=None))
57
58

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59     # add(i: o, v: ATOM | ROW) -> ATOM | ROW:
60     def add(i: o, v: ATOM | ROW) -> ATOM | ROW:
61         if v=="": return v
62         i.n += 1
63         if SYM is i.it: i.has[v] = 1 + i.has.get(v,0)
64         elif NUM is i.it:
65             v = float(v)
66             i.mu += v
67             i.m2 += d*(v - i.mu)
68             i.sd = 0 if i.n < 2 else sqrt(i.m2/(i.n - 1))
69         elif DATA is i.it:
70             i.cols += [add(c,v[c.at]) for c in i.cols.all]
71         else: i.cols = COLS(v)
72     return v
73
74 def adds(src: str | Iterable = None, it: o | None = None ) -> o:
75     if it is None: return o()
76     if str(src)[-4:]=="csv":
77         with open(src, encoding="utf-8") as f:
78             for line in f:
79                 if line.startswith(" "):
80                     if add(it,line) == None: break
81                 else: add(it,line)
82         return it
83
84 #
85 def norm(num: NUM, v: ATOM) -> float:
86     return 1 / (1 + exp(-1.702 * (v - num.mu)/(num.sd + le-32)))
87
88 def bin(col: COL, v: ATOM) -> int | ATOM:
89     return floor(the.bins * norm(col,v)) if v!="?" and NUM is col.it else v
90
91 def dist(src: Iterable) -> float:
92     d,n=0,0
93     for d1 in src:
94         d += d1**2
95     d += d1** the.p
96     return (d/n)**(1/the.p)
97
98 def disty(data: DATA, row: ROW) -> float:
99     return dist(abs(norm(row,col[at])-col.best)) for col in data.cols.y)
100
101 def distx(data: DATA, row1: ROW, row2: ROW) -> float:
102     return dist(_aha(row1,col[row1[at]],row2[col.at])) for col in data.cols.x)
103
104 def _aha(col, col, a1: ATOM, b: ATOM) -> float:
105     if col==col: return 0
106     if SYM is col.it: return a != b
107     a,b = norm(col.a), norm(col.b)
108     a = a if a != "?" else (0 if b>0.5 else 1)
109     b = b if b != "?" else (0 if a>0.5 else 1)
110     return abs(a - b)
111
112 #
113 def scoreGet(data, row):
114     return sum(x.bins[b].mu for x in data.cols.x
115                if (b := bin(x, row[x.at])) in x.bins)
116
117 def scorePut(data, row, score):
118     for x in data.cols.x:
119         if (b := bin(x, row[x.at])) != "?":
120             x.bins[b] = x.bins.get(b) or NUM(x.at, b)
121             add(x.bins[b], score)
122
123 def score(data, eps=0):
124     best_score, best_row = le32, None
125     seen, rows, model = set(), shuffle(data.rows), DATA([data.cols.names])
126     for row in enumerate(rows):
127         if len(seen) >= the.Budget: break
128         add(model, row)
129         scorePut(model, row, disty(model, rows))
130         seen.add(id(row))
131         if j % the.er == 0:
132             candidate = min(rows[j1 : j+20], key=lambda r: scoreGet(model, r))
133             if (score := disty(model, candidate)) < best_score - eps:
134                 best_score, best_row = score, candidate
135
136 return best_row
137
138

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139     # -----
140     def test_h(_) -> None:
141         print(__doc__)
142     def test_the(_) -> None:
143         print(the)
144
145     def test_s(n: str) -> None:
146         the.seed = float(n); random.seed(the.seed)
147
148     def test_sym_() -> None:
149         print(adds("aaabb",SYM()))
150
151     def test_num_() -> None:
152         box_muller(mu, sd)
153         return mu + sd * sqrt(-2 * log(rand())) * cos(2 * pi * rand())
154
155     def test_data(f) -> None:
156         data = DATA(the.file)
157         print(data.cols.x[-1])
158         print(len(data.rows))
159
160     def test_disty_():
161         y = data = NUM(), DATA(the.file)
162         Y=lambda row: floor(100*disty(data, row))
163         for r in sorted(data.rows, key=Y)[:20]:
164             print(Y(r),r)
165
166     def test_distx_():
167         xs = data = NUM(), DATA(the.file)
168         X=lambda row: floor(100*distx(data, row, data.rows[0]))
169         for r in sorted(data.rows, key=X)[:20]:
170             print(X(r),r)
171
172     def test_score_():
173         d = DATA(the.file).d
174         _tests= {k:fun for k,fun in vars().items() if "test_" in k}
175
176     def test_all_():
177         for k,fun in _tests.items(): print("\n----- "+k); fun()
178
179     #
180     if __name__ == "__main__":
181         for n, s in enumerate(sys.argv):
182             if fn := vars().get(f"test_{s.replace('-', '_')}"):
183                 fn(sys.argv[n+1] if n < len(sys.argv)-1 else None)
184

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