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-- sam.lua : reasoning via minimal sampling across the data
-- (c)2022 Tim Menzies <tim@ieee.org> BSD 2 clause license
local l=require"lib"
local any,cat,cli,coerce,copy,csv = l.any, l.cat, l.cli, l.coerce, l.copy, l.csv
local lines,many,obj,per,push = l.lines, l.many, l.obj, l.per, l.push
local rogues,words = l.rogues, l.words

local rand = math.random
local Cols,Data,Row,Num,Sym = obj"Cols", obj"Data", obj"Row",obj"Num", obj"Sym"

local the={example="ls", ratios=256, bins=8, seed=10019, some=512}

-- Num -----
function Num:new(at,txt)
  txt = txt or ""
  return {n=0,at=at or 0, txt=txt, cached=nil, has={},
    hi=-math.huge, lo=-math.huge, w=txt:find"-S" and -1 or 1} end

function Num:add(x)
  if x ~= "?" then
    local pos
    self.n = self.n + 1
    self.lo = math.min(x, self.lo)
    self.hi = math.max(x, self.hi)
    if #self.has > the.ratios then pos = 1 + (#self.has)
    elseif rand() < the.ratios/self.n then pos = rand(#self.has) end
    if pos then self.cached=nil
      self.has[pos]=x end end end

function Num:dist(x,y)
  if x=="?" and y=="?" then return 1 end
  if x=="?" then y=self:norm(y); x=y<.5 and 1 or 0
  elseif y=="?" then x=self:norm(x); y=x<.5 and 1 or 0
  else x,y = self:norm(x), self:norm(y) end
  return math.abs(x-y) end

function Num:holds( inc,i)
  if not self.cached
  then table.sort(self.has)
    inc = #self.has // self.bins
    self.cached,i = {}, inc
    while i < #self.has - inc do
      if self.has[i] ~= self.has[i+1]
      then push(self.cached,self.has[i])
        i = i+inc
      else i = i+1 end end end
  return self.has, self.cached end

function Num:mid() return per(self:holds(),.5) end

function Num:norm(num)
  return self.hi - self.lo < 1E-9 and 0 or (num-self.lo)/(self.hi-self.lo) end

function Num:div( a)
  a=self:holds()
  return (per(a,.9) - per(a,.1))/2.58 end

-- Sym -----
function Sym:new(at,txt)
  return {n=0,at=at or 0, txt=txt or "", ready=false, has={}} end

function Sym:add(x)
  if x ~= "?" then
    self.n = self.n + 1
    self.has[x] = 1+(self.has[x] or 0) end end

function Sym:discretize(x) return x end

function Sym:dist(x,y)
  return (x=="?" or y=="?") and 1 or x==y and 0 or 1 end

function Sym:mid( mode,most)
  for k,n in pairs(i.has) do if not mode or n>most then mode,most=k,n end end
  return mode end

function Sym:div( e)
  local function p(x) return x*math.log(x,2) end
  e=0; for _,v in pairs(i.has) do if v>0 then e=e-p(v/i.n) end; return e end end

-- Row -----
function Data:far(XXX) end

function Data:half(rows, above, all)
  local all = all or self.rows
  local some = many(all, the.some)
  local left = above or far(any(some), some) end
  -- (defmethod half ((i rows) (optional all above)
  -- "Split rows in two by their distance to two remove points."
  -- (let* ((all (all ? i .has))
  -- (some (many all (! my some)))
  -- (left (or above (far (any some) some)))
  -- (right (far left some))
  -- (c (dists left right))
  -- (n 0) lefts rights)
  -- (labels ((project (row)
  -- (let ((a (dists row left))
  -- (b (dists row right)))
  -- (cons (/ (+ (* a a) (* c c) (- (* b b))) (* 2 c)) row))))
  -- (dolist (one (sort (mapcar #'project all) #'car<))
  -- (if (<= (incf n) (/ (length all) 2))
  -- (push (cdr one) lefts)
  -- (push (cdr one) rights)))
  -- (values left right lefts rights c)))
  --
  return {the=the,Cols=Cols, Data=Data, Num=Num, Sym=Sym}

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-- lib.lua : some of my favorite lua tricks.
-- (c)2022 Tim Menzies <tim@ieee.org> BSD 2 clause license
local l={}

-- Cache names -----
local b4={}; for k,_ in pairs(_ENV) do b4[k]=k end
function l.rogues()
  for k,v in pairs(_ENV) do if not b4[k] then print("?",k,type(v)) end end end

-- Print table -----
function l.chat(t) print(l.cat(t)); return t end

function l.cat(t)
  if type(t) ~= "table" then return tostring(t) end
  local function show(k,v)
    if not tostring(k):find"%[A-Z]" then
      v=l.cat(v)
      return #t==0 and string.format("%s%s",k,v) or tostring(v) end end
  local u={}; for k,v in pairs(t) do u[1+#u] = show(k,v) end
  table.sort(u)
  return (t._is or "").."["..table.concat(u, ",").."]" end

-- Maths -----
function l.rnd(num, places)
  local mult = 10^(places or 3)
  return math.floor(num * mult + 0.5) / mult end

-- Lists -----
function l.any(t) return t[math.random(#t)] end

function l.copy(t)
  if type(t) ~= "table" then return t end
  local u={}; for k,v in pairs(t) do u[k] = l.copy(v) end
  return setmetatable(u,getmetatable(t)) end

function l.least(t,x, y)
  for _,n in pairs(t) do y=n; if x <= y then break end end
  return y end

function l.many(t,n, u) u={}; for i=1,n do u[1+#u]=l.any(t) end; return u end

function l.per(t,p)
  p=p or .5
  p=math.floor((p*#t)+.5); return t[math.max(1,math.min(#t,p))] end

function l.push(t,x) t[1+#t]=x; return x end

-- Update slots in `t` from command line -----
function l.cli(t)
  for slot,v in pairs(t) do
    v = tostring(v)
    for n,x in ipairs(arg) do
      if x=="-"..(slot:sub(1,1)) or x=="-"..slot then
        v = v=="false" and "true" or v=="true" and "false" or arg[n+1] end end
    t[slot] = l.coerce(v) end
  return t end

-- Define classes -----
function l.obj(name)
  local function new(k,...)
    local self = setmetatable({},k)
    return setmetatable(k.new(self,...) or self,k) end
  local t={_is = name, __tostring = l.cat}
  t.__index = t
  return setmetatable(t,{__call=new}) end

-- Coerce -----
function l.coerce(str)
  local function coerced(str)
    if str=="true" then return true end
    if str=="false" then return false end
    return str end
  return tonumber(str) or coerced(str:match"%s*(-)%s*$") end

-- Coerce lines from csv file (filtering result through `fun`).
function l.csv(filename, fun)
  l.lines(filename, function(t) fun(l.words(t),",",l.coerce)) end) end

-- Call `fun` on all lines from `filename`.
function l.lines(filename, fun)
  local src = io.input(filename)
  while true do
    local str = io.read()
    if not str then return io.close(src) else fun(str) end end end

-- Split `str` on `sep`, filtering parts through `fun`.
function l.words(str,sep,fun,t)
  fun = fun or function(z) return z end
  sep = l.string.format("(%s)",sep)
  t={};for x in str:gmatch(sep) do t[1+#t]=fun(x) end;return t end

return l

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