```lua
local b4={}; for k,_ in pairs(_ENV) do b4[k]=k end
local as,asserts,atom,copy,csv,failures,firsts,fmt,go
local help,inc,isa, klass,last,map,o,obj,old,push,rand,randi
local rnd,rogues,settings,slots,sort,the,xpects
local BAG, NB,NUM, RANGE, SYM
local the -- user settings. derived from `help`. can be changed via command line
help = [[

./duo [OPTIONS] : data miners using/used by optimizers.
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Understands "N" items by peeking at at few (maybe zero) items.

OPTIONS
  -ample  max items in a 'SAMPLE'       : 512
  -bins   max number of bins            : 16
  -Debug  one crash, show stackdump     : true
  -h      show help                     : false
  -p      coefficient on distance calcs : 2
  -round  print to 'round' decimals     : 2
  -seed   random number seed            : 10019
  -Some   max number items to explore   : 512
  -Tiny   bin size = #t^'Tiny'          : .5
  -todo   start up action ('all'=every) : -]]

-- ## Library stuff
-- ### OO stuff
-- New instance
function as(mt,t) return setmetatable(t,mt) end
-- New class
function klass(s,   t)
  t= {_is=s, __tostring=o, __index=t}
  return as({__call=function(_,...) return t.new(...) end},t) end

-- ### List stuff
function last(t)      return t[#t] end
function firsts(a,b)  return a[1] < b[1] end -- used for sorting`
function sort(t,f)    table.sort(t,f); return t end
function push(t,x)    table.insert(t,x); return x end
function inc(d,k)     d[k]= 1+(d[k] or 0); return k end -- used for counting

function map(t,f,  u)
  u={};for k,v in pairs(t) do u[#u+1]=f(v) end; return u; end

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

-- ### Display stuff
fmt = string.format

function slots(t,  u)
  u={}; for k,_ in pairs(t) do u[1+#u]=k end; return sort(u) end

function o(t,     show)
  function show(k) return fmt(":%s %s", k, t[k]) end
  t= #t>0 and map(t,tostring) or map(slots(t),show)
  return (t._is or "").."{"..table.concat(t,", ").."}" end

function rnd(x,d,  n)
  n=10^(d or the.round)
  return type(x)~="number" and x or math.floor(x*n+0.5)/n end

-- ### OS Stuff
function atom(x)
  if x=="true" then return true elseif x=="false" then return false end
  return tonumber(x) or x end

function csv(file)
  file = io.input(file)
  return function(    t)
    x=io.read();
    if x then
      t={}; for y in x:gsub("%s+",""):gmatch"([^,]+)" do t[1+#t]=atom(y) end
      return #t>0 and t
    else io.close(file) end end end

-- ### Settings stuff
function settings(help,       t)
  t = {}
  help:gsub("\n [-]([^%s]+)[^\n]*%s([^%s]+)", function(flag, x)
    for n,txt in ipairs(arg) do
      if   txt:sub(1,1)=="-" and flag:match("^"..txt:sub(2)..".*")
      then x = x=="false" and"true" or x=="true" and"false" or arg[n+1] end end
    t[flag] = atom(x) end)
  return t end

-- ### Random stuff
function randi(lo,hi) return math.floor(0.5 + rand(lo,hi)) end
function rand(lo,hi)
  the.seed = (16807 * the.seed) % 2147483647
  return (lo or 0) + ((hi or 1) - (lo or 0)) * the.seed / 2147483647 end

-- ### Math stuff
function xpects(t,       sum,n)
  sum,n = 0,0
  for _,one in pairs(t) do n= n + one.n; sum= sum + one.n*one:div() end
  return sum/n end

-- ### Error stuff
failures=0
function asserts(test,msg)
  msg=msg or ""
  if test then return print(" PASS : "..msg) end
  failures = failures+1
  print(" FAIL : "..msg)
  if the.Debug then assert(test,msg) end end

function rogues(b4)
  for k,v in pairs(_ENV) do if not b4[k] then print("?",k,type(v)) end end end


-- ---------------------------------------------------------------------------
-- ## BAGs
BAG=klass""
function BAG.new(t) return as(BAG,t or {}) end
print(BAG{1,10,22})

-- ## RANGEs
RANGE=klass"RANGE"
-- ### Create, add, merge
function RANGE.new(col,lo,hi,has)
  lo = lo or -math.huge
  return as(RANGE, {n=0,score=nil,col=col, lo=lo, hi=hi or lo, has=has or SYM()}
) end

function RANGE.add(i,x,y)
  i.n = n.n+1
  i.hi = math.max(x,i.hi)
  i.lo = math.min(x,i.lo)
  i.has:add(y) end

function RANGE.merge(i,j,      k)
 k = RANGE(i.col, i.lo, j.hi, i.has:merged(j.has))
 k.n = i.n + j.n
 if k.has:div()*1.01 <= xpects{i, j} then return k end end

-- ### Printing stuff
function RANGE.__tostring(i)
  if i.lo == i.hi        then return fmt("%s == %s",i.col.txt,i.lo) end
  if i.lo == -math.huge then return fmt("%s < %s",i.col.txt,i.hi) end
  if i.ho ==  math.huge then return fmt("%s >= %s",i.col.txt,i.lo) end
  return fmt("%s <= %s < %s", i.col.txt, i.lo, i.hi) end

-- ### Queries
function RANGE.div(i) return i.has:div() end

function RANGE.select(i,eg,       x)
  x = eg.has[i.col.at]
  return x=="?" or i.lo <= x and x < i.hi end

function RANGE.eval(i,goal)
    local best, rest, goals = 0,0,{}
  if not i.score then
    function goals.smile(b,r) return r>b and 0 or b*b/(b+r +1E-31) end
    function goals.frown(b,r) return b<r and 0 or r*r/(b+r +1E-31) end
    function goals.xplor(b,r) return 1/(b+r                +1E-31) end
    function goals.doubt(b,r) return 1/(math.abs(b-r)      +1E-31) end
    for x,n in pairs(i.has) do
      if x==goal then best = best+n/i.n else rest = rest+n/i.n end end
    i.score = best + rest < 0.01 and 0 or goals[the.goal](best,rest) end
  return i.score end

-- ---------------------------------------------------------------------------
-- ### SYM: summarize stream of symbols
SYM=klass"SYM"
function SYM.new(n,s)
  return as(SYM,{at=n or 0, txt=s or "", n=0, has={},mode=nil,most=0}) end

function SYM.add(i,x,count)
  if x=="?" then
    count = count or 1
    i.has[x] = count + (i.has[x] or 0)
    if i.has[x] > i.most then i.most,i.mode = i.has[x],x end end
  return x end

-- dist stuff
function SYM.dist(i,x,y) return x=="?" and y=="?" and 1 or x==y and 0 or 1 end

-- stats stuff
function SYM.mid(i) return i.mode end
function SYM.div(i,   e)
  e=0; for _,n in pairs(i.has) do e=e-n/i.n*math.log(n/i.n,2) end; return e end

-- discretization stuff
function SYM.superRanges(i,ranges) return ranges end
function SYM.ranges(i,j,         t,out)
  t,out = {},{}
  for x,n in pairs(i.has) do t[x]= t[x] or SYM(); t[x]:add("best",n) end
  for x,n in pairs(j.has) do t[x]= t[x] or SYM(); t[x]:add("rest",n) end
  for x,stats in pairs(t) do push(out, RANGE(i,x,x,stats)) end
  return out end

function SYM.merge(i,j,     k)
  k= SYM(i.at, i.txt)
  for x,count in pairs(i.has) do k:add(x,count) end
  for x,count in pairs(j.has) do k:add(x,count) end
  return k end

-- ---------------------------------------------------------------------------
-- ## Columns
-- ### NUM: summarize streams of numbers
NUM=klass"NUM"
-- #### Create, add, merge
function NUM.new(n,s)
  return as(NUM,{at=n or 0, txt=s or "", n=0, has={}, ready=false,
                 w=(s or ""):find"-" and -1 or 1}) end

function NUM.add(i,x,     pos)
  if x ~="?" then
    i.n= i.n + 1
    if     #i.has < the.ample  then pos= #i.has + 1
    elseif rand() < #i.has/i.n then pos= #i.has * rand() end
    if pos then i.ready=false; i.has[pos//1]= x end end
  return x end

function NUM.merge(i,j,         k)
  k = NUM(i.at, i.txt)
  for _,x in pairs(i.has) do k:add(x) end
  for _,x in pairs(j.has) do k:add(x) end
  return k end

-- #### Distance stuff
function NUM.norm(i,x,    a)
  a=i:all(); return  (a[#a]-a[1]) < 1E-9 and 0 or (x-a[1])/(a[#a] - a[1]) end
function NUM.dist(i,x,y)
  if     x=="?" and y=="?" then return 1
  elseif x=="?"            then y= i:norm(y); x=y>.5 and 0 or 1
  elseif y=="?"            then x= i:norm(x); y=x>.5 and 0 or 1
  else   x,y = i:norm(x), i:norm(y) end
  return math.abs(x-y) end

-- #### Queries
function NUM.lo(i)  return i.all()[1]  end
function NUM.hi(i)  return last(i.all()) end
function NUM.mid(i) return i:per(.5) end
function NUM.div(i) return (i:per(.9) - i:per(.1))/2.56 end
function NUM.per(i,p,   a) a=i:all(); return a[math.min(#a, 1+p*#a //1 )] end
function NUM.all(i)
  if not i.ready then table.sort(i.has); i.ready=true end; return i.has end

-- #### Discretization
-- Until no new merges are found, try combining adjacent ranges.
function NUM.superRanges(i,b4)
  local j,tmp,now,after,maybe = 0, {}
  while j < #b4 do
    j = j + 1
    now, after = b4[j], b4[j+1]
    if after then
      maybe = now:merge(after)
      if maybe then now=maybe; j=j+1 end end
    push(tmp,now) end
  return #tmp==#b4 and b4 or i:superRanges(tmp) end

-- Divide `i,j` numbers into `the.bins` ranges.
function NUM.ranges(i,j, yklass)
  local out,lo,hi,gap = {}
  lo  = math.min(i:lo(), j:lo())
  hi  = math.max(i:hi(), j:hi())
  gap = (hi-lo)/the.bins
  for b=1,the.bins do
    here   = lo + (b-1)*gap
    out[b] = RANGE(i, here, here+gap, (yklass or SYM)()) end
  for _,x in pairs(i._has.all) do out[(x-lo)//gap]:add(x,"best") end
  for _,x in pairs(j._has.all) do out[(x-lo)//gap]:add(x,"rest") end
  out[1].lo    = -math.huge
  out[#out].hi =  math.huge
  return out end

NB=klass"NB"
function NB.new() return as(NB, {k=1,m=2,names=BAG(),n, hs=0,h={}, f={}}) end

function NB.read(i, file)
  for row in csv(file) do if row then i:add(n,row) end end end

function NB.add(i, n,row,          k,klass)
  if n==0 then i.names=row else
    k=#row
    if n > 5 then print(row[k], i:classify(row)) end
    klass=row[k]
    if not i.h[klass] then i.hs=i.hs+1; i.h[klass]=0 end
    inc(i.h,row[k])
    i.n=i.n+1
    for col,x in pairs(row) do
      if col~=k and x~="?" then
        inc(i.f, {col,x,klass}) end end end  end

function NB.classify(i,row,      best)
  best=-1
  for klass,nh in pairs(i.h) do
    local prior = (nh+i.k)/(i.n + i.k*i.hs)
    local tmp   = prior
    for col,x in pairs(row) do
      if col ~= #row and x~="?" then
        tmp = tmp * ((i.f[{col,x,klass}] or 0) +i.m*prior)/(nh+i.m) end end
    if tmp > best then best,out=tmp,klass end end
  return klass end

--i:read("../../data/weathernom.csv")
--print(o(i.h))

go={}
function go.copy(   a,b)
  a={1,2,3,{40,50}}; b=copy(a); b[4][1]=400
  asserts(a[4][1]~=b[4][1],"deep copy") end

function go.two() print(2) end

-- start up stuff
the = settings(help)
old = copy(the)
if the.h then
  print(help)
else
  failures = 0
  for _,it in pairs(the.todo=="all" and slots(go) or {the.todo}) do
    if go[it] then print(it); go[it](); the = old end end -- do, then reset
  rogues(b4) end

os.exit(failures)
```