```lisp
;- vim: ts=2 sw=2 et :
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;-         .-------.
;-         | Ba    | Bad <----.  planning= (better - bad)
;-         |    56 |          |  monitor = (bad - better)
;-         .-------.------.   |
;-                 | Be   |   v
;-                 |    4 | Better
;-                 .------.
;;;; Brknbad
; Explore the world better. Explore the world for good.

;;; Settings
; If the `main` function finds any of these flags on the command line, then
; these defaults will be updated. Note one shorthand: for the flags with default
s
; of `t` or `nil` then calling those flags on the command line (without args) wi
ll
; flip those settings.
(defvar *options* '(
  about     "brknbad: explore the world better, explore the world for good.
         (c) 2022, Tim Menzies

         OPTIONS: "
  cautious  ("-c"  "abort on any error     "  t)
  dump      ("-d"  "stack dumps on error    "  nil)
  enough    ("-e"  "enough items for a sample "  512)
  far       ("-F"  "far away              "  .9)
  file      ("-f"  "read data from file     "  "../data/auto93.csv")
  help      ("-h"  "show help              "  nil)
  license   ("-l"  "show license            "  nil)
  p         ("-p"  "euclidean coefficient   "  2)
  seed      ("-s"  "random number seed      "  10019)
  todo      ("-t"  "start up action         "  "nothing")))

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;-   |__] |___ |__| |__] |  | |___ ___]
;;; Glolabls
(defvar *tests* nil)    ; list of test functions
(defvar *fails* 0)      ; counter for test failires
(defvar *seed* 10019)   ; initial value random nunber seed

;-   _  _ ____ ____ ____ ____ ____
;-   |\/| |__| |    |__/ |  | [__
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;- Macros
; Short hand for access option fields.
(defmacro ? (x) ;;
  `(third (getf *options* ',x)))

; Shorthand for recurisve calls to slot-values.
(defmacro o (s x &rest xs)
  (if xs `(o (slot-value ,s ',x) ,@xs) `(slot-value ,s ',x)))

; Ensure `a` has a cells `(x . number)` (where number defaults to 0).
(defmacro has (x a)
  `(cdr (or (assoc ,x ,a :test #'equal)
            (car (setf ,a (cons (cons ,x 0) ,a))))))

; Define a test function (see examples at end of file).
(defmacro deftest (name params &body body)
  `(progn (pushnew ',name *tests*) (defun ,name ,params  ,@body)))

; A ile reading iterator.
(defmacro with-csv ((lst file &optional out) &body body)
  (let ((str (gensym)))
    `(let (,lst) (with-open-file (,str ,file)
                   (loop while (setf ,lst (read-line ,str nil)) do ,@body))
       ,out)))

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;-
;-  (quote
;-     (an (elegant (weapon
;-          (for (a (more
;-              (civilized age))))))))

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;;; Functtions
;; Coerce
; Coerce `x` from a string to a non-string.
(defmethod str2thing (x) x)
(defmethod str2thing ((x string))
  (let ((x (string-trim '(#\Space #\Tab) x)))
    (if (equal x "?")
      #\?
      (let ((y (ignore-errors (read-from-string x))))
        (if (numberp y) y x))))))

; Divide `s` on `sep`.
(defun str2list (s &optional (sep #\,) (x 0) (y (position sep s :start (1+ x))))
  (cons (subseq s x y) (and y (str2list s sep (1+ y)))))

;; Random stuff
; Unlike LISP, it is easy to set the seed of this random number genertor.
(labels ((park-miller (&aux (multiplier 16807.0d0) (modulus 2147483647.0d0))
                      (setf *seed* (mod (* multiplier *seed*) modulus))
                      (/ *seed* modulus)))
  (defun randf (&optional (n 1)) (* n (- 1.0d0 (park-miller))))
  (defun randi (&optional (n 1)) (floor (* n (park-miller)))))

; Return sample from triangular distribution doi.org/10.1016/j.mcm.2008.06.013
(defun triangle (&optional (c .5) &aux (u (randf)) (v (randf)))
  (+ (* (- 1 c) (min u v)) (* c (max u v))))

; Return sample from normal distribution.
(defun normal (&optional (mu 0) (sd 1))
  (+ mu (* sd (sqrt (* -2 (log (randf)))) (cos (* 2 pi (randf))))))

;; Stats
; Return `p`-th item from seq.
(defun per (seq &optional (p .5) &aux (v (coerce seq 'vector)))
  (elt v (floor (* p (length v)))))

; Find sd from a sorted list.
(defun sd (seq &optional (key #'identity))
  (/ (- (funcall key (per seq .9)) (funcall key (per seq .1))) 2.56))

; Return entropy of symbols in an assoc list.
(defun ent (alist &aux (n 0) (e 0))
  (dolist (two alist) (incf n (cdr two)))
  (dolist (two alist e) (let ((p (/ (cdr two) n))) (decf e (* p (log p 2))))))

;; Main command stuff
; Test predicate (which only calls a stack dump in `(? dump)` is true.
(defun ok (test msg)
  "handle tests within a test function"
  (cond (test (format t "~aPASS ~a~%" #\Tab  msg))
        (t    (incf *fails* )
              (if (? dump)
                (assert test nil msg)
                (format t "~aFAIL ~a~%" #\Tab msg)))))

; Update *options* from command-line. Run the test suite. Before running each
; item, reset the random number seed and the options to standard defaults.
(defun main (&aux (defaults (copy-tree *options*)))
  (labels ((stop () #+clisp (exit *fails*)
                    #+sbcl  (sb-ext:exit :code *fails*))
           (args () #+clisp ext:*args*
                    #+sbcl  sb-ext:*posix-argv*)
           (trim (x) (string-left-trim '(#\Space #\Tab) x))
           (show  (lst)
                  (terpri)
                  (dolist (line (str2list (cadr lst) #\Newline 0))
                    (format t "~&~a~%" (trim line)))
                  (loop for (slot (flag help b4)) on (cddr lst) by #'cddr do
                    (format t " ~a ~a = ~a~%" flag help b4)))
           (cli  (flag b4 &aux (x (member flag (args) :test #'equal)))
                 (cond ((not x) b4 )
                       ((eq b4 t) nil)
                       ((eq b4 nil) t)
                       (t (str2thing (elt x 1)))))
           (test (todo)  (print 1) (when (fboundp todo)
                                     (format t "~a~%" (type-of todo))
                                     (setf *seed* (? seed))
                                     (funcall todo)
                                     (setf *options* (copy-tree defaults)))))
    (loop for (slot (flag help b4)) on (cddr *options*) by #'cddr do
      (setf (getf *options* slot) (list flag help (cli flag b4))))
    (if (? help)
      (show *options*)
      (dolist (todo (if (equalp "all" (? todo)) *tests* (list (? todo))))
        (test (find-symbol (string-upcase todo)))))
    (stop)))
```

```lisp
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;-   ___]    |   |  \  |___|  |___   |   ___]

(defmethod ako ((s symbol) kind) (ako (symbol-name s) kind))
(defmethod ako ((s string) kind)
  "given a column header, comment on its the propertoes of that column"
  (let
    ((l1 '((ignore #\:) (klass #\!) (less #\-) (more #\+) (goal #\+ #\- #\!)))
     (l2 '((num #\$))))
    (and (> (length s) 2)
         (or (member (char s (1- (length s))) (cdr (assoc kind l1)))
             (member (char s 0)               (cdr (assoc kind l2)))))))
;;      ___  _  _  _ __
;;     (_-< | || || '  \
;;     /__/  \_, ||_|_|_|
;;           |__/
(defstruct (sym  (:constructor %make-sym )) (n 0) at name all mode (most 0))

(defun make-sym (&optional (at 0) (name ""))
  (%make-sym :at at :name name))

(defmethod add ((self sym) x)
  (with-slots (n all mode most) self
    (unless (eq x #\?)
      (incf n)
      (let ((now (incf (has x all))))
        (if (> now most)
          (setf most now
                mode x)))))
  x)

(defmethod div ((self sym)) (ent (sym-all self)))
(defmethod mid ((self sym)) (sym-mode self))
;;      _ _   _  _   _ __
;;     | ' \ | || | | '  \
;;     |_||_| \_,_| |_|_|_|

(defstruct (num  (:constructor %make-num )) (n 0) at name
  (all (make-array 5 :fill-pointer 0))
  (size (? enough))
  ok w (hi -1E32) (lo 1E32))

(defun make-num (&optional (at 0) (name ""))
  (%make-num :at at :name name :w (if (ako name 'less) -1 1)))

(defmethod add ((self num) x)
  (with-slots (n lo hi ok all size) self
    (unless (eq x #\?)
      (incf n)
      (setf lo (min x lo)
            hi (max x hi))
      (cond ((< (length all) size)  (vector-push-extend x all) (setf ok nil))
            ((< (randf) (/ size n)) (setf (elt all (randi (length all))) x)
                                          ok nil)))))
  x)

(defmethod holds ((self num))
  (with-slots (ok all) self
    (unless ok (setf all (sort all #'<)))
    (setf ok t)
    all))

(defmethod div ((self num)) (sd   (holds self)))
(defmethod mid ((self num)) (per (holds self)))
;;                    _
;;      __   ___    | |  ___
;;     / _| / _ \   | | (_-<
;;     \__| \___/   |_| /__/

(defstruct (cols (:constructor %make-cols)) all x y klass)

(defun make-cols (names &aux (at -1) x y klass all)
  (dolist (name names (%make-cols :all (reverse all) :x x :y y :klass klass))
    (let* ((what (if (ako name 'num)  #'make-num #'make-sym))
           (now  (funcall what (incf at) name)))
      (push now all)
      (when (not (ako name 'ignore))
        (if (ako name 'goal)  (push  now x) (push now y))
        (if (ako name 'klass) (setf klass now))))))
;;      ___   __ _   ___
;;     / -_) / _` | (_-<
;;     \___| \__, | /__/
;;           |___/

(defstruct (egs  (:constructor %make-egs )) rows cols)

(defun make-egs (&optional from)
  (let ((self (%make-egs)))
    (cond ((consp from)
           (dolist (row from) (add self row)))
          ((stringp from)
           (print 22)
           (with-csv (row from)
             (print (make-cols (mapcar #'str2thing (str2list row))))
             (return-from make-egs nil))))
             ;(add self (mapcar #'str2thing (str2list row))))))
    self))

(defmethod add ((self egs) row)
  (with-slots (cols rows) self
    (if cols
      (push (mapcar #'add cols row) rows)
      (setf cols (make-cols row))))
  row)
;;;   _  _  _  _  _  ___   ___  ___  ___  ___  ___
;;;  | || || \ || ||  |     |  |__  [__    |  [__
;;;  |__||| \||| ||  |     |  |___ ___]   |  ___]

(deftest .cells () (print (mapcar #'str2thing (str2list "23,asda,34.1"))))

(deftest .has ()
  (let (x)
    (incf (has 'aa x))
    (incf (has 'aa x))
    (print x)
    (ok (eql 2 (cdr (assoc 'aa x))) "inc assoc list")))

(deftest .csv (&aux (n 0))
  (with-csv (row (? file)) (incf n))
  (ok (eq 399 n) "reading lines"))

(deftest .normal ()
  (dolist (n '(10000 5000 2500 1250 500 250 125 60 30 15))
    (let (l)
      (setf l (dotimes (i n (sort l #'<)) (push (normal) l)))
      (format t "~5@A : ~6,4f : ~6,4f ~%"  n (sd l) (per l)))))

(deftest .rand (&aux l)
  (dotimes (i 50) (push (randi 4) l))
  (print (sort l #'<)))

(deftest .ent ()
  (let (x)
    (incf (has 'this x) 4)
    (incf (has 'that x) 2)
    (incf (has 'other x) 1)
    (ok (<= 1.378 (ent x) 1.379) "diversity")))

(deftest .num (&aux (num (make-num)))
  (dotimes (i 100000 (print (holds num))) (add num i)))

(deftest .sym (&aux (sym (make-sym)))
  (dotimes (i 100000 (print (sym-all sym))) (add sym (randi 10))))

(deftest .cols (&aux c)
  (setf c (make-cols '("$ss" "age!" "$weight-")))
  (print c))

(deftest .egs ()
 (print 1000000)
 (make-egs (? file)))

;- ---------------------------------------------------------------------------
(main)

;-              .----------.
;-              |          |
;-           -= ____________ =-
;-              ____   ____
;-              |    )=(    |
;-               ---   ---
;-                   ###
;-                 #  =  #              "This ain't chemistry.
;-                 #######               This is art."
```