MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT MAC

Artificial Intelligence Project
Vision Project

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Additions to Vision Library

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MODIFIED LAP

Additions have been made to LAP as described in the PDP-6 write-up.

(1) Numerical constants

The "C" format field may also be used as a means of generating full word numerical constants.

Examples: (MOVE 2 (C 3,14159265))

(SKIPG 3 (C 77042776))

(MOVE 1 (C 4)) [better still, (MOVEI 1 4)]

(2) Reference to the current assembly location

The atom "*" has for value the address (fixed point integer) of the current assembly location.

Example: (JUMPA 1 *) is equivalent to L1 (JUMP 1 L1)

(3) Relative addresses

If a list appears in place of any LAP field, the sum of the

numbers computed by the assembler for individual elements is taken as the value for the list.

Examples: (JUMPGE 2 (* 2))

(MOVE (ACC DISP) (C 510))

(PUSHJ 5 (L1 -2))

(4) Machine Instruction Definitions

Use full-word octal constant with trailing zeros.

Example: (OPS MOVE 200 000 000000 PUSHJ 260 000 000000)

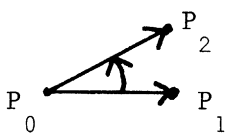
ANGBTN

A LISP program of three arguments (P_0 P_1 P_2) each of which represents a point in the euclidean sense, whose output is the angle between the directed line segments $\overrightarrow{P_0 P_1}$ $\overrightarrow{P_0 P_2}$.

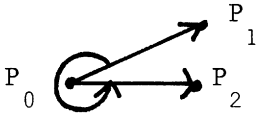
INPUT Three lists, P_0 P_1 P_2, each a list of two floating-point numbers which are respectively the x and y coordinates of the euclidean points represented.

OUTPUT The angle α, $0 \leq \alpha < 2\pi$, in radians between $\overrightarrow{P_0 P_1}$ and $\overrightarrow{P_1 P_2}$.

Examples:

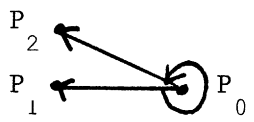


$\pi/6$



$5\pi/6$

[Note the meaning of "directed line segment".]



$5\pi/6$

ALGORITHM DESCRIPTION The arctangent function is computed by means of a Hastings rational approximation and is accurate to better than one digit in the fourth decimal place.

ALARMS None.

AVAILABILITY As a symbolic LAP file ANGBTN JONL on the vision library tape, which must be assembled by one of the later versions of LAP (such as the one currently on the vision library tape).

ANGDIS

INPUT Same as for ANGBTN.

OUTPUT A list of two floating-point numbers; the first is α as described under "OUTPUT" for ANGBTN, and the second is the square of the distance between P_0 and P_2.

ALGORITHM Calls ANGBTN.

ALARMS None.

AVAILABILITY A symbolic LAP file ANGDIS 28 on tape JONL I.

ABS

INPUT A LISP number x.

OUTPUT $|x|$ as a LISP number.

ALARMS None provided.

AVAILABILITY Symbolic LAP, on same file as ANGBTN.

ANGLES

A LISP program which augments a polygonal approximation to a closed curve by tacking on the value of the inside angle at each vertex as well as the square of the distance to the next vertex.

INPUT A list of points. (Each point is a list of two floating-point numbers which represents a vertex at a polygonal approximation to some closed curve.) The points must be listed in order either clockwise or counter-clockwise, and the curve should not intersect or overlap itself. The first point should be listed twice, at the front of the list and at the end, so that an n-point approximation is a list of length n + 1.

OUTPUT A 3-list: (1) The augmented polygon list.

(2) The area of the polygon (positive, floating-point)

(3) "CLICK" or "CNTK" indicating clockwise or counterclockwise ordering.

The original polygon list, i.e. the input, has only the x and y coordinates for each vertex; the augmented list in addition provides the inside angle for each vertex and the square of the distance to the next-in-order vertex. Thus each element $(x_i\ y_i)$ of the input becomes $(x_i\ y_i\ \alpha_i\ d_i^2)$ in the output.

AVAILABILITY On tape JONL II as file ANGSEG XX when XX is a version number.

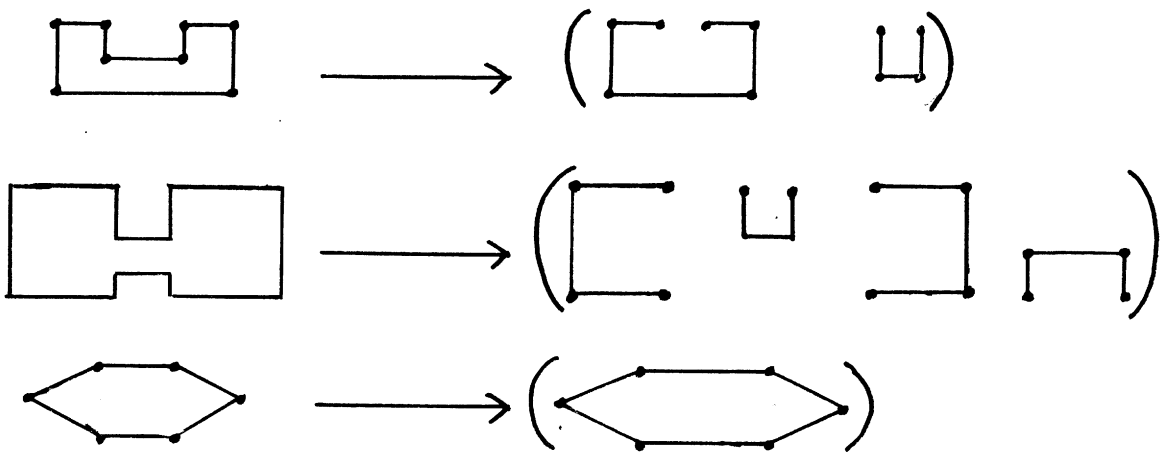
SGMNTS

A LISP program designed to aid pattern recognition by figure boundary analysis.

INPUT The output of ANGLES, or equivalent.

OUTPUT A list of segments each of which is a subpart of the input. The segments are ordered in the output such that pieced together end-to-end they reconstruct the original figure (which presumably is a polygonal approximation to some other figure). These segments represent a parsing of the boundary of the figure such that a "hole" in the boundary is pieced into one segment and a "non-hole" segment of boundary is pieced into one output segment. Informally speaking, for a non-convex figure, if a two-dimensional lasso were thrown around the figure and drawn tight, a "hole" would be the area between the lasso and the figure boundary (at the concave spots).

Example:



ALGORITHM Uses ANGLES as a subroutine and calls ROTL, GBBLUP, ANGDIS which are all contained on the SGMNTS file. Both ANGLES and ANGDIS call a modified upward-compatible version of ANGBTN also on the file.

ALARMS None.

AVAILABILITY On tape JONL II file ANGSEG XX where the two digits XX are simply a sequence number in the continuing development of the program.

MAZ

INPUT A list of LISP numbers ℓ and a LISP number n.

OUTPUT A list of the first n moments about zero of the numbers in ℓ.

ALARMS None.

AVAILABILITY On tape JONL I as file MAZ MANDV

MANDV

INPUT A list of LISP numbers ℓ.

OUTPUT The mean μ and variance σ^2 of the numbers in ℓ, as a list $(\mu\ \sigma^2)$.

AVAILABILITY on tape JONL I as file MAZ MANDV.

ROTL

A LISP program which rotates a list so that the head member satisfies a condition specified in the arguments.

INPUT A list ℓ and a predicate of one argument r.

OUTPUT The list ℓ rotated so that (r ℓ') is true.

ALARMS If no member of ℓ satisfies r then NIL is returned.

ALGORITHM A copy of ℓ is used so that the algorithm may actually manipulate the list using NCONL and RPLACD, thereby avoiding costly appends.

AVAILABILITY On the same file as SGMNTS.

SQRT

INPUT LISP number x.

OUTPUT LISP number $\sqrt{x}$.

ALARMS None.

ALGORITHM Four iterations of Newton's method with first approximation as

$$x \div 2^{\left\lceil \frac{\log_2 x}{2} \right\rceil}$$, i.e. the floating exponent is divided by 2.

AVAILABILITY Same as ABS and ANGBTN.

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