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######################################################################
#
# polyinterp: Constructs Lagrange Interpolating Polynomial
#
# Given n distinct "data points" (x_i,f_i) , i = 1 ... n, and a name,
# this procedure returns the unique polynomial (in name) of degree
# n - 1 which passes through (interpolates) all the points.
#
# Input parameters:
#
#    ldata:    list of lists, which defines (x_i,f_i)
#    var:      name, returned interpolating polynomial is
#              a polynomial in 'var'
#
# Usage example:
#
#    > polyinterp([ [0,1], [1,6], [2,4], [3,0] ], 'x' );
#
#                              3      2
#                         5/6 x  - 6 x  + 61/6 x + 1
#
# Implementation notes:
#
#    This routine converts the list of input pairs (each pair
#    itself a two-element list) to separate *sequences* of
#    the x_i and f_i.  You could also build up separate *lists*
#    but it is syntactically easier to build sequences in Maple.
#
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polyinterp := proc(ldata::list(list),var::name)
#-----------------------------------------------------------------------
#  Local variables:
#
#     n:         number of data points
#     i,   j:    loop variables used in evaluation of Lagrange formula
#     sx, sf:    for building up sequences of x_i, f_i respectively
#     num, den:  for building up the numerators and denominators of the
#                characteristic polynomials.
#     p:         for building up the interpolating polynomial itself
#
#-----------------------------------------------------------------------
   local  n,   i,   j,   sx,   sf,   num,   den,   p;

#-----------------------------------------------------------------------
#  Determine number of data points
#-----------------------------------------------------------------------
   n  := nops(ldata);
#-----------------------------------------------------------------------
#  Initialize polynomial and x_i and f_i sequences
#-----------------------------------------------------------------------
   p  := 0;
   sx := NULL;
   sf := NULL;
#-----------------------------------------------------------------------
#  Convert input list-of-lists into separate sequences of x_i and f_i
#-----------------------------------------------------------------------
   for i from 1 to n do;
      sx := sx , ldata[i][1];
      sf := sf , ldata[i][2];
   od;
```

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#---------------------------------------------------------------------
#  For each of the x_i ...
#---------------------------------------------------------------------
   for i from 1 to n do;
#---------------------------------------------------------------------
#     ... build up the numerators and denominators of the ith
#     characteristic polynomial.  First initialize the numerator
#     and denominator ...
#---------------------------------------------------------------------
      num := 1;
      den := 1;
#---------------------------------------------------------------------
#     ... and then build them up using the Lagrange formula.  Note that
#     both the numerator and denominator are products of n - 1
#     terms, one term for each j = 1..n such that j <> i.
#---------------------------------------------------------------------
      for j from 1 to n do;
         if j <> i then
            num := num * (var   - sx[j]);
            den := den * (sx[i] - sx[j]);
         fi
      od;
#---------------------------------------------------------------------
#     Update the polynomial
#---------------------------------------------------------------------
      p := p + sf[i] * (num / den);
   od;
#---------------------------------------------------------------------
#  Return the polynomial in expanded form
#---------------------------------------------------------------------
   expand(p);

end:
```