# ADAS Subroutine xxspln

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      SUBROUTINE XXSPLN( LSETX , IOPT  , FINTX ,
     &                   NIN   , XIN   , YIN   ,
     &                   NOUT  , XOUT  , YOUT  ,
     &                   DY
     &                 )
C-----------------------------------------------------------------------
C
C  ****************** FORTRAN77 SUBROUTINE: XXSPLN *********************
C
C  PURPOSE:           TO INTERPOLATE/EXTRAPOLATE USING CUBIC SPLINES
C
C                     (IF IOPT < 0 NO EXTRAPOLATION TAKES PLACE = VALUES
C                      SET TO ZERO).
C
C  CALLING PROGRAMS:  GENERAL USE
C
C  SUBROUTINE:
C
C  I/O   : (L*4)  LSETX   = .TRUE.  => SET UP SPLINE PARAMETERS RELATING
C                                      TO 'XIN' AXIS.
C                           .FALSE. => DO NOT SET UP SPLINE PARAMETERS
C                                      RELATING TO 'XIN' AXIS.
C                                      (I.E. THEY WERE SET IN A PREVIOUS
C                                            CALL )
C                           ( 'LSETX' IS ALWAYS RETURN AS '.FALSE.'  ON
C                             RETURN FROM THE SUBROUTINE ).
C                           ** IMPORTANT: SEE NOTES BELOW ON 'LSETX' **
C  INPUT : (I*4)  IOPT    = SPLINE END CONDITIONS/EXTRAPOLATION CONTROL
C                           SWITCH - SEE NOTES BELOW
C                           I.E. DEFINES THE BOUNDARY DERIVATIVES.
C                                (VALID VALUES = 0, 1, 2, 3, 4)
C                           IF IOPT < 0 THEN NO EXTRAPOLATION TAKES
C                           - ANY VALUES REQUIRING EXTRAPOLATION WILL BE
C                             SET TO ZERO (END CONDITIONS AS FOR IOPT=0)
C  INPUT : (R*8)  FINTX   = INTERPOLATING X-COORDINATE TRANSFORMATION.
C                           EXTERNAL FUNCTION (SEE ROUTINES BELOW)
C
C  INPUT : (I*4)  NIN     = NUMBER OF KNOTS
C  INPUT : (R*8)  XIN()   = X-VALUES OF KNOTS
C  INPUT : (R*8)  YIN()   = Y-VALUES OF KNOTS
C
C  INPUT : (I*4)  NOUT    = NUMBER OF OUTPUT VALUES TO BE INTERPOLATED
C                           EXTRAPOLATED.
C  INPUT : (R*8)  XOUT()  = X-VALUES AT WHICH INTERPOLATION/EXTRAPOLA-
C                           TION REQUIRED
C  OUTPUT: (R*8)  YOUT()  = INTERPOLATED/EXTRAPOLATED Y-VALUES FOR
C                           REQUESTED 'XOUT()' VALUES.
C
C  OUTPUT: (R*8)  DY()    = INTERPOLATED DERIVATIVES
C
C          (I*4)  NKNOTS  = PARAMETER = MAXIMUM  NUMBER OF KNOTS ALLOWED
C          (I*4)  NIOPT   = PARAMETER = MAXIMUM  VALUE OF IOPT ALLOWED
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C
C          (I*4)  I       = GENERAL ARRAY USE
C          (I*4)  K       = INDEX OF 'XOUT()' VALUE FOR INTERPOLATION/
C                           EXTRAPOLATION.
C          (I*4)  NIN0    = 'NIN' - 1
C          (I*4)  INTER   = INDEX OF CLOSEST/NEXT HIGHEST VALUE OF
C                           'XIN()' TO THE VALUE OF 'XOUT()' BEING
C                           INTERPOLATED/EXTRAPOLATED.
C          (I*4)  NOPT    = VALUE OF  'IOPT' USED IN  CALCULATING  END-
C                           CONDITIONS   FOR  STORED  'X-VALUE'  SPLINE
C                           PARAMETERS.   (NOTE:  IF  'IOPT < 0',  THEN
C                           'NOPT = 0'.) - I.E. 'NOPT = MAX( 0, IOPT )'.
C
C          (R*8)  XK      = VALUE OF 'XOUT(K)' BEING INTERPOLATED/
C                           EXTRAPOLATED
C          (R*8)  XKK     = TRANSFORMED VALUE OF 'XOUT(K)' BEING
C                           INTERPOLATED/EXTRAPOLATED.
C          (R*8)  T1      = INVERSE OF SEPARATION OF KNOTS EITHER
C                           SIDE OF CURRENT KNOT.
C          (R*8)  T2      = (CURRENT KNOT POSITION TO NEXT HIGHEST KNOT
C                            POSITION) DIVIDED BY 'T1'
C          (R*8)  T3      = (CURRENT KNOT POSITION TO NEXT LOWEST  KNOT
C                            POSITION) DIVIDED BY 'T1'
C          (R*8)  T4      = INTERPOLATION FACTOR FOR CURRENT KNOT
C          (R*8)  DL1     = (REQUESTED 'XOUT()' VALUE TO NEXT HIGHEST
C                            KNOT POSITION) DIVIDED BY SEPERATION OF
C                            KNOTS EITHER SIDE OF 'XOUT(K)'.
C          (R*8)  DL2     = (REQUESTED 'XOUT()' VALUE TO NEXT LOWEST
C                            KNOT POSITION) DIVIDED BY SEPERATION OF
C                            KNOTS EITHER SIDE OF 'XOUT(K)'.
C          (R*8)  DL2     = (REQUESTED 'XOUT()' VALUE TO NEXT LOWEST
C          (R*8)  DL3     =  SEPERATION OF KNOTS EITHER SIDE OF
C                            'XOUT(K)' * 'DL1' * 'DL2'.
C
C          (L*4)  LEXTRP  = .TRUE.  => 'EXTRAPOLATION SWITCHED ON'.
C                           .FALSE. => 'EXTRAPOLATION SWITCHED OFF'.
C
C          (R*8)  QVAL()  = VALUE OF 'Q(1)'   : FUNCTION OF 'NOPT'
C          (R*8)  D2VAL() = VALUE OF 'D2(1)'  : FUNCTION OF 'NOPT'
C          (R*8)  D3VAL() = VALUE OF 'D3(1)'  : FUNCTION OF 'NOPT'
C          (R*8)  UVAL() =  VALUE OF 'U(NIN)' : FUNCTION OF 'NOPT'
C          (R*8)  AGRL() =  POLYNOMIAL CONSTANTS FOR CUBIC SPLINE FOR
C                           GIVEN 'XOUT(K)' VALUE.
C          (R*8)  X()     =  TRANSFORMED VALUES OF 'XIN()'
C          (R*8)  H()     =  SEPERATION, ALONG X-AXIS, OF KNOT FROM NEXT
C                           HIGHEST KNOT.
C          (R*8)  Q()     =  SECOND DERIVATIVE FOR KNOT
C          (R*8)  U()     =  TEMPORARY STORAGE OF DECOMPOSED FACTORS
C          (R*8)  DELY() =  SEPERATION, ALONG Y-AXIS, OF KNOT FROM NEXT
C                           HIGHEST KNOT.
C          (R*8)  D1()    =  MULTIPLICATION FACTOR USED IN CALCULATING
C                           'U()'.
C          (R*8)  D2()    =  MULTIPLICATION FACTOR USED IN CALCULATING
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C                          'U()'.
C          (R*8)  D3()   =  MULTIPLICATION FACTOR USED IN CALCULATING
C                          'U()'.
C
C          (L*4)  LUVAL()=  .TRUE. => VALUE OF 'UVAL()' REFERS TO RATE
C                                     OF CHANGE OF SLOPE AT FINAL POINT.
C                           .FALSE.=> VALUE OF 'UVAL()' REFERS TO FINAL
C                                     SLOPE
C                            FUNCTION OF 'NOPT'
C
C NOTES: 'LSETX': SET TO .TRUE. ON ENTRY IF A NEW 'XIN' ARRAY IS BEING
C                 USED.  IF THE 'XIN' AXIS IS THE SAME FOR A NUMBER OF
C                 CALLS THEN DO NOT RESET 'LSETX'  -  THIS  SUBROUTINE
C                 SETS IT TO .FALSE. FOR YOU.   IF THE VALUE OF 'NOPT'
C                 IS CHANGED BETWEEN CALLS THEN THE VALUE  OF  'LSETX'
C                 ON  ENTRY IS TAKEN AS BEING EQUAL TO .TRUE. .
C
C                 THEREFORE 'LSETX' NEED ONLY BE SET TO .TRUE. ON ENTRY
C                 IF EITHER IT IS ITS FIRST CALL OR IF ANY ONE  OF  THE
C                 FOLLOWING VALUES HAS CHANGED:
C
C                 'NIN' , 'FINTX' , 'XIN(I), I=1,NIN'
C
C                 CARE: A VARIABLE MUST BE USED FOR 'LSETX', A CONSTANT,
C                       I.E.  .TRUE. ,  CANNOT BE DIRECTLY TYPED AS  AN
C                       ARGUMENT BECAUSE IT WILL BE CHANGED TO  .FALSE.
C                       ON RETURN.
C
C          SPLINE  END CONDITIONS AND EXTRAPOLATION DEPEND ON 'IOPT' AS
C          FOLLOWS:
C
C          ---------------------------------------------------------------
C          | IOPT  | NOPT |  DY(1)  DDY(1)  |  DY(N)   DDY(N)  |EXTRAP'N|
C          |-------|------|-----------------|------------------|--------|
C          | < 0   |   0  |    -     0.0    |    -      0.0    |  NO    |
C          |   0   |   0  |    -     0.0    |    -      0.0    |  YES   |
C          |   1   |   1  |    -     0.0    | -1.5      -      |  YES   |
C          |   2   |   2  |  0.0     -      |  1.0      -      |  YES   |
C          |   3   |   3  | -0.5     -      | -1.5      -      |  YES   |
C          |   4   |   4  |  0.0     -      |    -      0.0    |  YES   |
C          ---------------------------------------------------------------
C
C             NB. OPTIONS TO BE EXTENDED FOR POWER AND CX APPLICATION
C
C          ---------------------------------------------------------
C           IF ( IOPT.LT.0 ) - NO EXTRAPOLATION TAKES PLACE VALUES SET
C                              TO ZERO (CARE IF LOG OF OUTPUT IS NEEDED).
C           IF ( IOPT.GT.4 ) PROGRAM STOPS
C          ---------------------------------------------------------
C
C           THIS SUBROUTINE IS AN AMENDED  AND STRUCTURED VERSION OF  THE
C           SUBROUTINE  'ESPLINE'  WRITTEN BY  H.P. SUMMERS,   JET   26TH
C           OCTOBER 1989.   IT REMOVES THE COMMON BLOCK  /IONSPL/ ,   THE
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C          SWITCHES 'ISW & ISW2' AND ALSO THE CASE FOR THE INTERPOLATION
C          OF CHARGE STATE VALUES.   IT INTRODUCES THE FEATURE  THAT  AN
C          ARRAY OF INPUT  'X-VALUES'  CAN BE  INTERPOLATED/EXTRAPOLATED
C          IN ONE CALL.
C
C ROUTINES:
C          ROUTINE    SOURCE    BRIEF DESCRIPTION
C          ------------------------------------------------------------
C          FINTX      ------    EXTERNAL  REAL*8  FUNCTION,   USED  TO
C                               TRANSFORM X-COORDINATES.
C
C
C AUTHOR:   PAUL E. BRIDEN (TESSELLA SUPPORT SERVICES PLC)
C           K1/0/81
C           JET EXT. 4569
C
C DATE:     10/08/90 (30/08/90: IOPT = 4 ADDED & 'LUVAL' PARAMETER)
C
C UPDATE:   17/01/91 - PE BRIDEN: ADAS91 - IOPT < 0 ADDED - NO EXTRAP'N.
C                                        - NOPT DEFINITION CHANGED.
C                                        - INTRODUCED 'LEXTRP'.
C UNIX-IDL PORT:
C
C VERSION: 1.1                          DATE: 08-11-95
C MODIFIED: TIM HAMMOND (TESSELLA SUPPORT SERVICES PLC)
C               - FIRST RELEASE
C
C VERSION: 1.2                          DATE: 2/6/99
C MODIFIED: Martin O'Mullane (JET)
C           - SAVE nin0 and inter variables also. All compilers, ie
C             especially g77, do not automatically save (or initialise
C             variables to zero).
C
C VERSION  : 1.3
C DATE     : 10-04-2007
C MODIFIED : Allan Whiteford
C               - Modified documentation as part of automated
C   subroutine documentation preparation.
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      INTEGER             IOPT,        NIN,         NOUT
      LOGICAL             LSETX
      REAL*8              DY(NIN),     XIN(NIN),    XOUT(NOUT)
      REAL*8              YIN(NIN),    YOUT(NOUT)
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