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c===========================================================
c     fdemo1:  Program which demonstrates many of the
c     essential features of Fortran 77. Some 'safe' language
c     extensions are used.
c===========================================================

c===========================================================
c     Source code formatting rules:
c
c     Columns    Use
c
c     1-5        numeric statement label
c     6          continuation character: '&' recommended
c     7-72       statement
c
c     BE EXTREMELY CAREFUL NOT TO TYPE BEYOND COLUMN 72!
c===========================================================
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c-----------------------------------------------------------
c     The 'program' statement names a Fortran main routine.
c     Optional, but recommended and note that there can
c     only be one 'program' (main routine) per executable.
c-----------------------------------------------------------
      program         fdemo1
c===========================================================
c     BEGINNING OF DECLARATION STATEMENTS
c
c     Declarations (or specification statements) must
c     ALWAYS appear before ANY executable statements.
c===========================================================

c-----------------------------------------------------------
c     The 'implicit none' statement is an extension which
c     forces us to explicitly declare all variables and
c     functions (apart from Fortran built in functions).
c     HIGHLY RECOMMENDED.
c-----------------------------------------------------------
      implicit        none

c-----------------------------------------------------------
c     PARAMETERS
c-----------------------------------------------------------
c     The parameter declaration effectively assigns a
c     CONSTANT value to a name.  Note that each
c     parameter statement must be accompanied by an
c     appropriate declaration of the type of the
c     parameter.  Also note that, except in strings,
c     blanks (spaces) are ignored in Fortran---you can
c     use this fact to make code more readable.
c-----------------------------------------------------------
      integer         zero
      parameter     ( zero = 0 )
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c-----------------------------------------------------------
c     Always specify floating point constants using
c     scientific notation.  Use 'd' (instead of 'e') for
c     real*8 constants.
c-----------------------------------------------------------
      real*8          pi
      parameter     ( pi   = 3.141 5926 5358 9793 d0 )

      real*8          tiny
      parameter     ( tiny = 1.0 d-50 )

c-----------------------------------------------------------
c     VARIABLES
c-----------------------------------------------------------
c     The main data types we will be using are
c
c     integer,  real*8,  logical,
c     character*1,  character*2, ... etc., character*(*)
c
c     but note that Fortran has support for complex
c     arithmetic.  Note that complex*16 means real*8
c     values are used for both the real and imaginary
c     parts of the variable.
c-----------------------------------------------------------
c     (a) SCALARS
c-----------------------------------------------------------
      real*8         a,        b,        c
      real*8         res1,     res2,     res3,     res4
      integer        i,        j,        k,        n
      integer        ires1,    ires2,    ires3,    ires4
      logical        switch
      logical        lres1,    lres2,    lres3
      complex*16     ca,       cb
```

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c-------------------------------------------------------------
c     (b) ARRAYS
c-------------------------------------------------------------
      integer        n1,       n2,      n3
      parameter    ( n1 = 4,   n2 = 3,  n3 = 2)

c-------------------------------------------------------------
c     (b.1) 1-D ARRAYS:  Note, in a main program, all
c     dimension bounds must be integer parameters or
c     integer constants.
c-------------------------------------------------------------
      real*8         r1a(n1),   r1b(n2)
      integer        i1i(n1)
c-------------------------------------------------------------
c     (b.2) 2-D ARRAYS:
c-------------------------------------------------------------
      real*8         r2a(n1,n2)
c-------------------------------------------------------------
c     (b.3) 3-D ARRAYS:
c-------------------------------------------------------------
      real*8         r3a(n1,n2,n3)

c=============================================================
c     END OF DECLARATION STATEMENTS
c=============================================================
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c===========================================================
c     BEGINNING OF EXECUTABLE STATEMENTS
c===========================================================

c***********************************************************
c     Assignment statements and simple arithmetic
c     expressions
c***********************************************************

c-----------------------------------------------------------
c     Assignment to scalar variables ... again, note
c     the use of scientific notation (d0) to specify
c     a real*8 constant.
c
c     The only valid logical constants are .true. and
c     .false.  (don't forget to include the .'s)
c-----------------------------------------------------------
      a =  0.025d0
      b = -1.234d-16
      c =  1.0d0
      i =  3000
      switch = .true.

c-----------------------------------------------------------
c     Note the use of the continuation character in
c     column 5 to continue a statement on a second line.
c-----------------------------------------------------------
      write(*,*) 'a = ', a,' b = ', b
      write(*,*) ' c = ', c, ' i = ', i,
     &           ' switch = ', switch
      call prompt('Through scalar assignment')
```

```
c-----------------------------------------------------------
c     Arithmetic expressions.  Fortran has standard
c     operator precedences except that the exponentiation
c     operator '**' associates RIGHT to LEFT:  e.g.
c
c     i ** j ** k  is equivalent to  i ** (j ** k)
c
c     Parentheses force evaluation of subexpressions.
c-----------------------------------------------------------
      a = 2.0d0
      b = 3.0d0
      c = 3.0d0

      res1  = a + b
      res2  = a**2 + b**2
      res3  = (a**2 + b**2)**(0.5d0)
      write(*,*) 'res1 = ', res1,' res2 = ', res2
      write(*,*) ' res3 = ', res3
      call prompt('Through real*8 arithmetic expressions')
c-----------------------------------------------------------
c     Notice the integer truncation which occurs when
c     dividing the integer 2 by the integer 3.
c-----------------------------------------------------------
      i = 2
      j = 3
      k = 2

      ires1 = 2 + 3
      ires2 = 2 / 3
      ires3 = i ** j ** k
      ires4 = (i ** j) ** k
      write(*,*) 'ires1 = ', ires1, ' ires2 = ', ires2
      write(*,*) 'ires3 = ', ires3, ' ires4 = ', ires4
      call prompt('Through integer arithmetic expressions')
```

```
c-----------------------------------------------------------
c     "Mixed-mode" computations
c-----------------------------------------------------------

c-----------------------------------------------------------
c     i + j  is  computed using integer arithmetic and
c     the result is converted to a real*8 value before being
c     assigned to res2.
c-----------------------------------------------------------
      res1 = i + j

c-----------------------------------------------------------
c     3 / 4 is evaluated using integer arithmetic (yielding
c     0) and then the value is converted to real*8.
c-----------------------------------------------------------
      res2 = 3 / 4

c-----------------------------------------------------------
c     The appearance of a double precision constant
c     forces the division to be computed using real*8
c     arithmetic
c-----------------------------------------------------------
      res3 = 3 / 4.0d0
      write(*,*) 'res1 = ', res1, ' res2 = ', res2
      write(*,*) ' res3 = ', res3
      call prompt('Through mixed-mode arithmetic')
```

```
c***********************************************************
c     CONTROL STATEMENTS
c***********************************************************

c***********************************************************
c     DO LOOPS
c
c     Note that 'end do' is not Fortran 77, but a safe
c     extension (it is legal Fortran 90).
c***********************************************************

      do i = 1 , 3
         write(*,*) 'Loop 1: i = ', i
      end do
      call prompt('Through loop 1')

c-----------------------------------------------------------
c     The same do loop with the optional loop increment
c     specified explicitly
c-----------------------------------------------------------
      do i = 1 , 3 , 1
         write(*,*) 'Loop 2: i = ', i
      end do
      call prompt('Through loop 2')

c-----------------------------------------------------------
c     Another do-loop with a non-default loop increment ...
c-----------------------------------------------------------
      do i = 1 , 7 , 2
         write(*,*) 'Loop 3: i = ', i
      end do
      call prompt('Through loop 3')
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c-------------------------------------------------------------
c     ... and one with a negative increment
c-------------------------------------------------------------
      do i = 3 , 1 , -1
         write(*,*) 'Loop 4: i = ', i
      end do
      call prompt('Through loop 4')

c-------------------------------------------------------------
c     Nested do-loops.
c-------------------------------------------------------------
      do i = 1 , 3
         do j = 1 , 2
            write(*,*) 'Loop 5: i, j = ', i, j
         end do
      end do
      call prompt('Through loop 5')

c-------------------------------------------------------------
c     Any of the do-loop parameters can be variables,
c     expressions or parameters: safest to ALWAYS use
c     integer values.
c-------------------------------------------------------------
      n = 6
      do i = 2 , n , n / 3
         write(*,*) 'Loop 6: i = ', i
      end do
      call prompt('Through loop 6')
```

```
c*************************************************************
c     LOGICAL EXPRESSIONS
c
c     Note that the Fortran comparison and logical
c     operators all have the form: .operator.
c
c     Comparison:   .eq.    .ne.    .gt.    .lt.
c                   .ge.    .le.
c     Logical:      .not. (unary)
c                   .and.   .or.
c*************************************************************
      a = 25.0d0
      b = 12.0d0

      lres1 = a .gt. b
      lres2 = (a .lt. b)  .or.  (b .ge. 0.0d0)
      lres3 = a .eq. b
      write(*,*) 'lres1 = ', lres1, ' lres2 = ', lres2,
     &           ' lres3 = ', lres3
      call prompt('Through basic conditionals')
c*************************************************************
c     IF-THEN-ELSE STATEMENTS.
c*************************************************************
      if( a .gt. b ) then
         write(*,*) a, ' > ', b
      end if
      call prompt('Through if 1')

      if( b .gt. a ) then
         write(*,*) b, ' > ', a
      else
         write(*,*) a, ' > ', b
      end if
      call prompt('Through if 2')
```

```
c-----------------------------------------------------------
c     Nested IF statement.
c-----------------------------------------------------------
      if( a .gt. b ) then
         if( a .gt. 2 * b ) then
            write(*,*) a, ' > ', 2 * b
         else
            write(*,*) a, ' <= ', 2 * b
         end if
      else
         write(*,*) a, ' <= ', b
      end if
      call prompt('Through nested if')

c-----------------------------------------------------------
c     IF ... ELSE IF .. IF construct can be used in lieu
c     of 'CASE' statement.
c-----------------------------------------------------------
      do i = 1 , 4
         if(      i .eq. 1 ) then
            write(*,*) 'Case 1'
         else if( i .eq. 2 ) then
            write(*,*) 'Case 2'
         else if( i .eq. 3 ) then
            write(*,*) 'Case 3'
         else
            write(*,*) 'Default case'
         end if
      end do
      call prompt('Through case via if')
```

```
c*************************************************************
c     WHILE LOOPS
c
c     The do while( ... ) ... end do construct is valid
c     Fortran 90, and a safe Fortran 77 extension.
c*************************************************************
      a = 0.1d0
      b = 0.0d0
      do while ( b .le. 1.0d0 )
         write(*,*) 'Do while loop: b = ', b
         b = b + a
      end do
      call prompt('Through while loop')

c*************************************************************
c     USING BUILT-IN (INTRINSIC) FUNCTIONS
c*************************************************************
      res1 = sin(0.3d0 * Pi)
      res2 = cos(0.3d0 * Pi)
      res3 = res1**2 + res2**2
      res4 = sqrt(res3)
      write(*,*) 'res1 = ', res1, ' res2 = ', res2
      write(*,*) 'res3 = ', res3, ' res4 = ', res4
      call prompt('Through built-in fcn 1')

c-------------------------------------------------------------
c     atan, acos, asin, etc. return arctangent, arcosine,
c     arcsine etc. in RADIANS
c-------------------------------------------------------------
      res1 = atan(1.0d0)
      write(*,*) 'res1 = ', res1
      call prompt('Through built-in fcn 2')
```

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c-----------------------------------------------------------
c     min and max will return the minimum and maximum
c     respectively of an arbitrary number of arguments
c     of any UNIQUE data type.  Do NOT mix types in
c     a single statement as in
c
c     write(*,*) min(1,2.0d0)
c-----------------------------------------------------------
      write(*,*) 'min(3.0d0,2.0d0) = ', min(3.0d0,2.0d0)
      write(*,*) 'min(1,-3,5,0) = ', min(1,-3,5,0)
      call prompt('Through built-in fcn 3')
c-----------------------------------------------------------
c     mod is particularly useful for calculating when one
c     integer divides another evenly
c-----------------------------------------------------------
      do i = 0 , 1000
         if( mod(i,100) .eq. 0 ) then
            write(*,*) 'i = ', i
         end if
      end do
      call prompt('Through built-in fcn 4')
c-----------------------------------------------------------
c     Stop program execution
c-----------------------------------------------------------
      call prompt('Through fdemo1')
      stop
c===========================================================
c     END OF EXECUTABLE STATEMENTS
c===========================================================

c-----------------------------------------------------------
c     End of program unit (fdemo1)
c-----------------------------------------------------------
      end
```

```
c===========================================================
c     Prints a message on stdout and then waits for input
c     from stdin.
c
c     This is a new program unit (subroutine)
c===========================================================
      subroutine prompt(pstring)
         implicit      none
         character*(*) pstring
         integer       rc
         character*1   resp

         write(*,*) pstring
         write(*,*) 'Enter any non-blank character & '//
     &              'enter to continue'

         read(*,*,iostat=rc,end=900)  resp
c-----------------------------------------------------------
c        Return to calling program.
c-----------------------------------------------------------
         return
 900     continue
c-----------------------------------------------------------
c        Stop program execution.  This section of code is
c        the "end-of-file" handler for standard input
c        (via the end=900 clause of the read statement).
c        In this case, it is acceptable style to exit.
c-----------------------------------------------------------
         stop
c-----------------------------------------------------------
c     End of program unit (prompt).
c-----------------------------------------------------------
      end
```