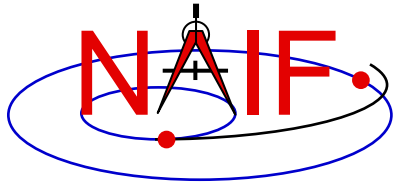


Navigation and Ancillary Information Facility

# Introduction to the Family of SPICE Toolkits

January 2018

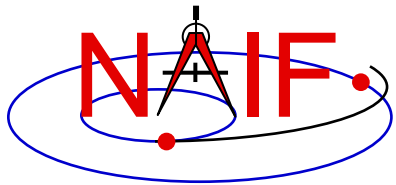


# Topics

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## Navigation and Ancillary Information Facility

- **Architecture**
- **Contents**
- **Characteristics**
- **Versions**
- **Capabilities**
- **Directory Structure**
- **Application Programs**
- **Utility Programs**
- **Documentation**
- **Backup: Currently Supported Environments**

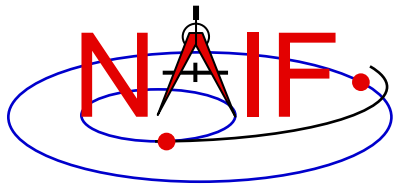


# Toolkit Architecture

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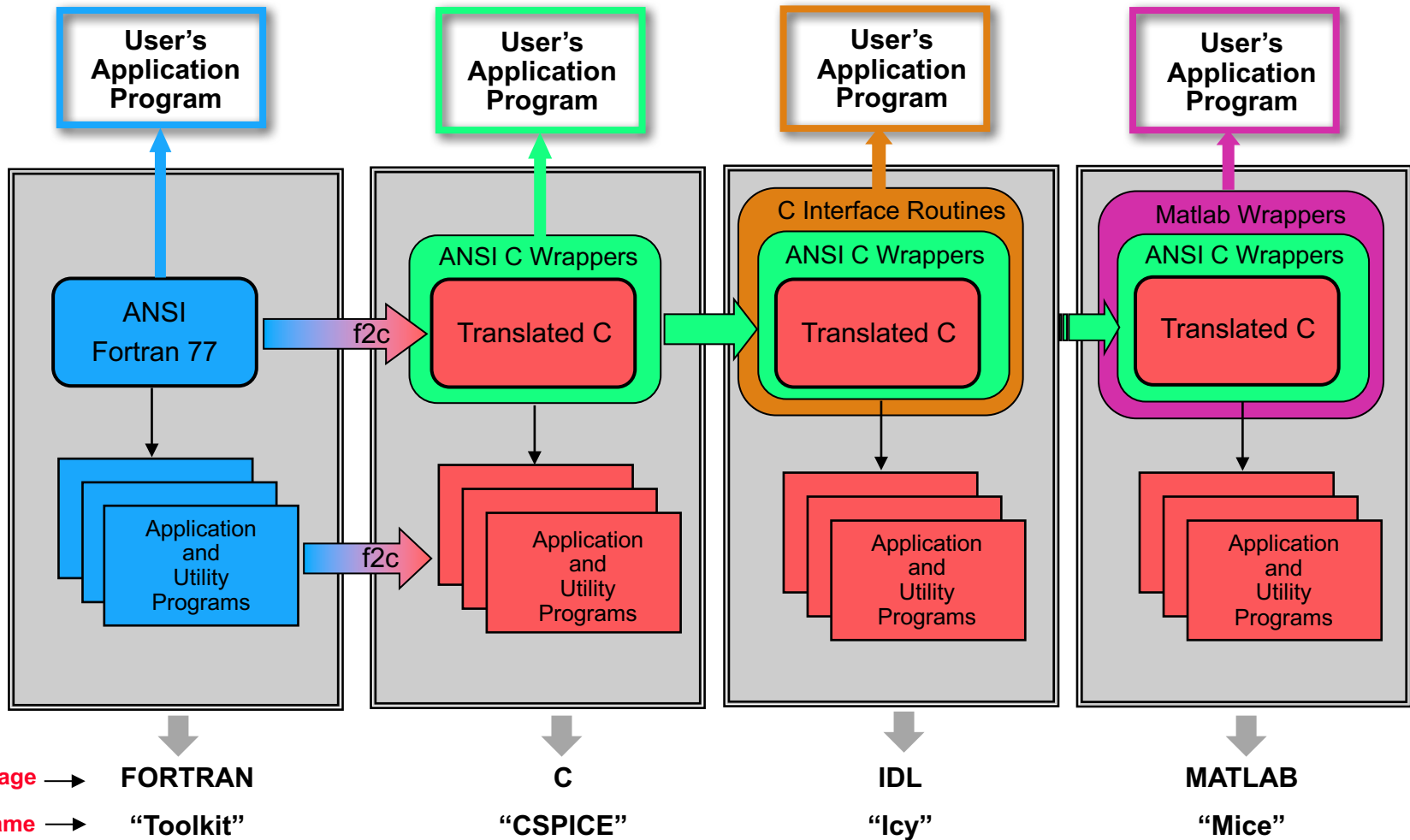
Navigation and Ancillary Information Facility

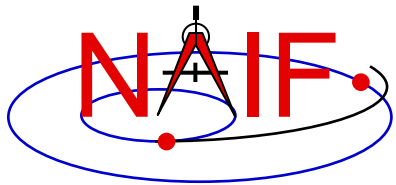
- **The SPICE Toolkit is officially available in Fortran, C, IDL (Interactive Data Language) and MATLAB.**
  - <https://naif.jpl.nasa.gov/naif/toolkit.html>
  - A beta Java Native Interface version (JNISpice) is also available
    - » [https://naif.jpl.nasa.gov/pub/naif/misc/JNISpice\\_N0066/](https://naif.jpl.nasa.gov/pub/naif/misc/JNISpice_N0066/)
- **The Toolkits are packaged and delivered as standalone products.**
  - The IDL, MATLAB and JNISpice Toolkits by necessity also include the complete C Toolkit.
- **Other people have created Python toolkits, available from their own websites.**
  - <https://naif.jpl.nasa.gov/naif/links.html>



# Toolkit Architecture Pictorial

Navigation and Ancillary Information Facility



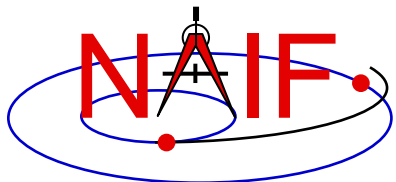


# Fortran Toolkit

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Navigation and Ancillary Information Facility

- **“Toolkit,” the Fortran 77 Toolkit.**
  - **Developed first: in use since February 1990.**
  - **Contains code written in ANSI Standard Fortran 77.**
    - » **A few widely supported non-ANSI extensions are used, for example `DO WHILE, DO...END DO`.**
  - **Compiles under a wide variety of Fortran compilers.**
    - » **While NAIF cannot guarantee proper functioning of SPICE under F90/F95 compilers except on officially supported environments, those compilers might properly compile SPICELIB with the resulting libraries being callable from F90/F95 code if that compiler supports the F77 standard.**

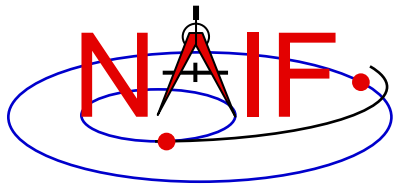


# C Toolkit

Navigation and Ancillary Information Facility

- **“CSPICE,” the C-language Toolkit**
  - Designed to duplicate the functionality of the Fortran Toolkit.
  - All CSPICE source code is in ANSI C.
    - » The Fortran SPICE Toolkit code is converted to ANSI C using the automatic translation program `f2c`.
    - » High-level functions have been hand-coded in C and documented in C style in order to provide a natural C-style API. These functions are called “wrappers.”
    - » Most wrappers encapsulate calls to C functions generated by `f2c`
      - The simpler wrappers do their work in-line to boost performance
    - » `f2c`'d functions may be called directly, but this is strongly discouraged since `f2c`'d functions emulate Fortran functionality:
      - Call by reference
      - Fortran-style array indexing
      - Fortran-style strings

continued on next page

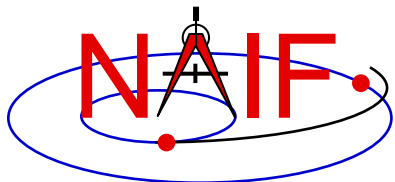


# C Toolkit, continued

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## Navigation and Ancillary Information Facility

- **CSPICE runs under a wide variety of ANSI C compilers.**
- **CSPICE functions may be called from within C++ source code.**
  - » **CSPICE prototypes are protected from name mangling.**
- **Current CSPICE Limitations**
  - » **Not all “Required Reading” reference documents have been converted to C style, with C examples.**
    - **Eventually all will be converted.**
  - » **CSPICE wrappers do not exist for every API provided in the Fortran toolkits.**
    - **But CSPICE does include all the most commonly used modules.**
    - **More will be added as time permits.**
  - » **In some very limited cases, code generated by f2c fails to emulate Fortran accurately. Should not be a problem.**
    - **List-directed I/O has some problems (not consequential for CSPICE).**
    - **Treatment of white space in text output is slightly different in CSPICE.**
    - **Logical unit-to-file name translation does not handle file name “synonyms” properly under Linux: once opened with a specified name, a file must be referred to using the same name throughout a program run.**

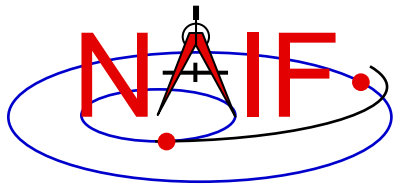


# IDL Toolkit

Navigation and Ancillary Information Facility

- **“Icy,” the Interactive Data Language Toolkit**
  - Provides an IDL-callable “wrapper” interface for many CSPICE wrapper routines.
    - » **Example:**
      - CSPICE: `spkezc ( targ, et, ref, abcorr, obs, state, &time );`
      - Icy: `spkezc, targ, et, ref, abcorr, obs, state, ltime`
    - » **NAIF will add additional interfaces to Icy as time permits.**
  - **By necessity all Icy Toolkit packages include the complete CSPICE Toolkit.**
    - » **Additional Icy software components are:**
      - IDL interface wrappers (implemented in ANSI C)
      - Icy cookbook programs (implemented in IDL)
    - **Icy Documentation**
      - » **Icy Reference Guide**
        - Principal documentation showing how to call Icy wrappers.
        - Each Icy wrapper has an HTML page containing usage examples serving as the Icy “module header”.
      - » **Icy Required Reading**
        - Provides background information essential for programming with Icy.- **See the “IDL\_Interface” tutorial for details**

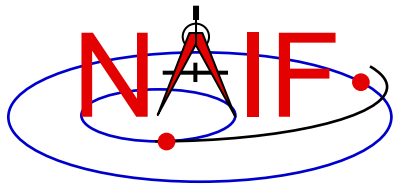




# Matlab Toolkit

Navigation and Ancillary Information Facility

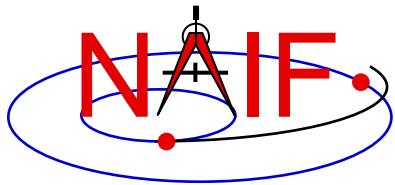
- **“Mice,” the Matlab Toolkit**
  - Mice provides a Matlab-callable “wrapper” interface for many CSPICE wrapper routines
    - » **Example:**
      - CSPICE: `spkezt_c ( targ, et, ref, abcorr, obs, state, &time );`
      - Mice: `[state, ltime] = cspice_spkezt( targ, et, ref, abcorr, obs)`
  - **By necessity all Mice Toolkit packages include the complete CSPICE Toolkit.**
    - » **Additional Mice software components are:**
      - Matlab interface wrappers (implemented in Matlab wrapper scripts calling the ANSI C based interface library)
      - Mice cookbook programs (implemented in Matlab script)
  - **Mice Documentation**
    - » **Mice Reference Guide**
      - Principal documentation showing how to call Mice wrappers
      - Each Mice wrapper script has a documentation header containing usage examples, serving as SPICE “module header”, available from the `help` command. This documentation also exists as an HTML page.
    - » **Mice Required Reading**
      - Provides background information essential for programming with Mice
- **See the “Matlab\_Interface” tutorial for details**



# Python Toolkits

Navigation and Ancillary Information Facility

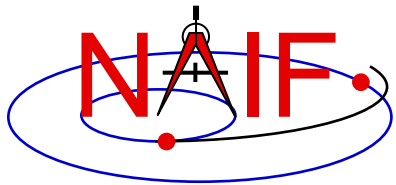
- **Some SPICE users have created their own Python wrappers for CSPICE and offer this Toolkit to interested persons.**
  - The functionality provided is likely less than what's available in CSPICE.
  - The documentation provided is likely somewhat minimal.
- **Links to two of these are available from the NAIF website here:**
  - <https://naif.jpl.nasa.gov/naif/links.html>
- **While we have reason to believe these are good products, NAIF has not been involved in creating, testing or using these Toolkits.**
  - Prospective users should consult with the authors regarding functionality and quality.



# Toolkit Contents

Navigation and Ancillary Information Facility

- **Software**
  - Subroutine libraries, with source code
    - » **SPICELIB (Fortran)**
    - » **CSPICE (C)**
    - » **Icy (C)**
    - » **Mice (C and Matlab scripts)**
  - Executable programs
    - » **Application and utility programs**
    - » **A few example programs (called “cookbook” programs)**
  - Installation/build scripts (normally you do NOT need to use these)
- **Documentation**
  - Available in plain text and HTML
- **Example Data**
  - Sample kernel files (supplied only for use with cookbook example programs, **not valid for general use**).

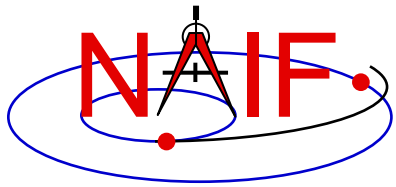


# Toolkit Characteristics

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Navigation and Ancillary Information Facility

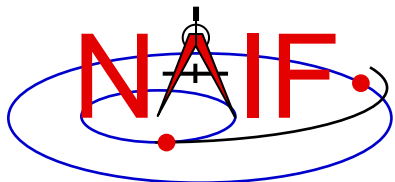
- **Computations are identical in all languages.**
- **For a given computer and operating system, all Toolkits use identical kernel files.**
  - Refer to the “Porting Kernels” tutorial for information about using kernels received from a machine different from what you are using.
- **Code is well tested before being released to users.**
- **New Toolkits are always backwards compatible.**
  - An application that worked when linked against an older Toolkit will link and work, without need for changes, using a new Toolkit.
  - Past functionality is never changed or removed, except that:
    - » enhancements of existing routines are allowed.
    - » NAIF reserves the right to fix bugs.
- **Extensive user-oriented documentation is provided.**
  - Includes highly documented source code.



# Toolkit Versions

Navigation and Ancillary Information Facility

- **Toolkit Version**
  - **SPICE Toolkits have an associated Version number**
    - » **Example: “N0066” (also written as “N66”)**
  - **The version number applies to all language implementations for all supported platforms.**
- **When does NAIF release a new SPICE Toolkit version?**
  - » **Not according to a fixed schedule**
  - » **Primarily driven by availability of significant new capabilities**
    - **For example, addition of the digital shape kernel subsystem (DSK)**
  - » **On rare occasion a Toolkit update is released to fix bugs, improve documentation, or satisfy an urgent request from a flight project.**

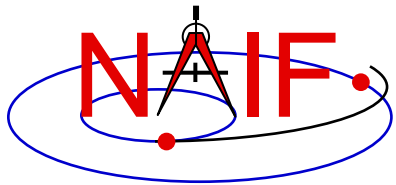


# Toolkit Library Overview

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Navigation and Ancillary Information Facility

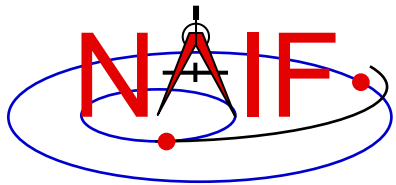
- **Toolkit libraries contain a broad set of capabilities related to the computations needed for determining “observation geometry” and time conversions.**
  - **Examples appear on the next several pages**
- **Not all functionality is present in all four language versions of the Toolkit library.**
  - **The Fortran (Toolkit) and C (CSPICE) Toolkits provide almost identical functionality.**
  - **The IDL (Icy) and Matlab (Mice) Toolkits duplicate most functionality available in the C Toolkits.**
    - » **We add additional interfaces as time permits.**



# Toolkit Library Capabilities - 1

Navigation and Ancillary Information Facility

- **Kernel read access**
  - “Load” kernels
  - Get state or position vectors (SPK)
  - Get orientation of planets, natural satellites, etc. (PCK)
  - Get body shape parameters or physical constants (PCK)
  - Get orientation of spacecraft or spacecraft instruments or structures (CK, FK)
  - Get instrument parameters (e.g., FOV) (IK)
  - Get digital shape data (DSK)
  - Query binary EK files (EK-ESQ)
- **Kernel write access**
  - SPK writers
  - CK writers
  - PCK writers (only for binary PCK files)
  - DSK writers

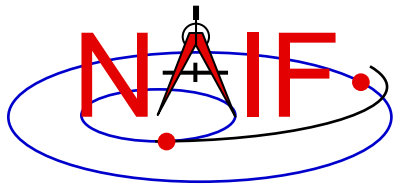


# Toolkit Library Capabilities - 2

Navigation and Ancillary Information Facility

- **Additional ephemeris functions**
  - Classical osculating elements
  - Two-body Keplerian propagation
  - NORAD two line elements sets (TLE) propagation
  - Light time and Stellar aberration computation
- **Frame transformations**
  - Obtain 3x3 matrices for frame transformations of positions
  - Obtain 6x6 matrices for frame transformations of states
- **Time conversions**
  - Conversion between standard systems: TDB, TT (TDT), UTC
  - Conversion between SCLK and other systems
  - Parsing and formatting
- **Geometry finder calculations**
  - Find times or time spans when a specified geometric situation is true
  - Find times or time spans when a specified geometric parameter is within a given range, or is at a maximum or minimum

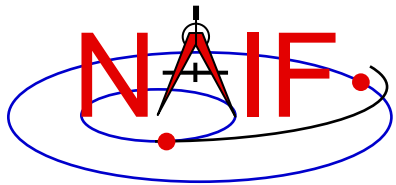




# Toolkit Library Capabilities - 3

## Navigation and Ancillary Information Facility

- **Math**
  - Vector/Matrix operations
  - Rotations, Euler angles, quaternions
  - Coordinate conversion (systems: latitudinal, cylindrical, rectangular, RA and DEC, spherical, geodetic, planetographic)
  - Geometry: ellipsoids, ellipses, planes
  - High-level functions: illumination angles, sub-observer point, sub-solar point, surface intercept point.
- **Constants**
  - Julian date of epoch J2000, SPD (seconds per day), PI, etc.
- **Strings**
  - Parsing: find tokens, words
  - Numeric conversion
  - Pattern matching
  - Replace marker, substring
  - Suffix, prefix
  - Case conversion
  - Find first/last non-blank character, first/last printing character

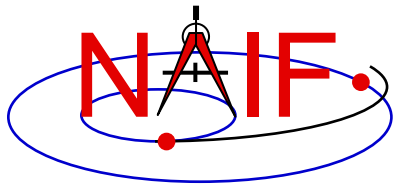


# Toolkit Library Capabilities - 4

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## Navigation and Ancillary Information Facility

- **Arrays**
  - Sorting, finding order vector, reordering
  - Searching: linear, binary
  - Insertion and deletion
- **Name/ID code conversion**
  - Bodies
  - Frames
- **I/O support**
  - Logical unit management (Fortran toolkits)
  - Open, read, write text files
  - Kernel pool API
- **Exception handling**
  - Control exception handling behavior: mode, set message, assign output device.

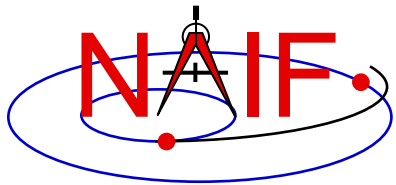


# Toolkit Library Capabilities - 5

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Navigation and Ancillary Information Facility

- **Advanced data types**
  - Cells, Sets
  - Windows (sometimes called schedules)
  - Symbol Tables
  - Planes, Ellipses

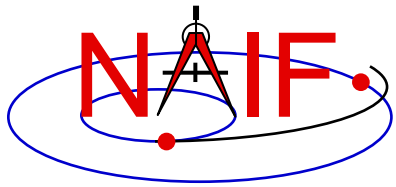


# Toolkit Directory Structure

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Navigation and Ancillary Information Facility

- **The directory structures for the four kinds of Toolkits are almost identical. However...**
  - The CSPICE, Icy and Mice Toolkits also have a directory for include files.
  - The names for application source code directories in CSPICE, Icy and Mice differ slightly from those in the Fortran toolkit.
  - Icy and Mice include additional directories for :
    - » Icy/Mice source code
    - » Icy/Mice cookbook programs
- **The top level directory name for each Toolkit is:**
  - “toolkit” for Fortran Toolkits.
  - “cspice” for C Toolkits.
  - “icy” for IDL Toolkits.
  - “mice” for Matlab Toolkits.

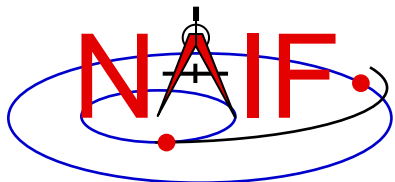


# Toolkit Directory Structure

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Navigation and Ancillary Information Facility

- **The next level is comprised of:**
  - **data**
    - » Cookbook example kernels (use **ONLY** for training with cookbook programs).
  - **doc**
    - » Text documents — \*.req, \*.ug, spicelib.idx/cspice.idx, whats.new, dscripnt.txt, version.txt.
    - » Subdirectory containing HTML documentation, called “html”.
      - The “html” subdirectory contains a single file — the top level HTML documentation index called “index.html” — and a number of subdirectories, one for each of the various groups of documents in HTML format (API Reference Guide pages, User’s Guide pages, etc.).
  - **etc**
    - » In most Toolkits this directory is empty.
  - **exe**
    - » Executables for some SPICE application and utility programs:
      - brief, chronos, ckbrief, commnt, dskbrief, dskeyp, frmdiff, inspekt, mkdsk, mkspk, msopck, spacit, spkdiff, spkmerge, tobin, toxfr, version.
    - » Executables for the several cookbook example programs:
      - simple, states, subpt, tictoc

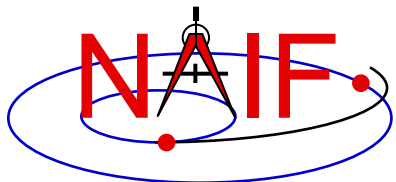


# Toolkit Directory Structure

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## Navigation and Ancillary Information Facility

- **include** (applies only to CSPICE, Icy, and Mice)
  - » **API header files.**
    - File to include in callers of CSPICE is SpiceUsr.h
- **lib**
  - » **Toolkit libraries:**
    - **For Fortran Toolkits**
      - spicelib.a or spicelib.lib (public modules; use these)
      - support.a or support.lib (private modules; don't use these)
    - **For C Toolkits**
      - cspice.a or cspice.lib (public modules; use these)
      - csupport.a or csupport.lib (private modules; don't use these)
    - **For Icy Toolkits:**
      - icy.so or icy.dll (shared object library)
      - icy.dlm (dynamically loadable module)
      - cspice.a or cspice.lib
      - csupport.a or csupport.lib
    - **For Mice Toolkits:**
      - mice.mex\* (shared object library)
      - cspice.a or cspice.lib
      - csupport.a or csupport.lib
- **src**
  - » **Source code directories for executables and libraries**
    - Files have type \*.f, \*.for, \*.inc, \*.pgm, \*.c, \*.h, \*.x, \*.pro, \*.m
    - \*.h files appearing here are not part of the user API

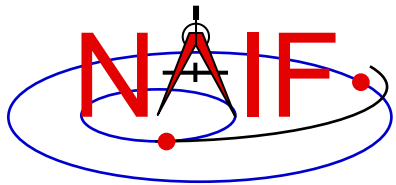


# Toolkit Application Programs

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Navigation and Ancillary Information Facility

- **SPICE Toolkit application programs are available to:**
  - create certain kernel types
  - compare or analyze certain kernel types
  - do various kinds of time conversions
  - and more...
  - See the toolkit\_apps tutorial for details
- **Some additional application programs are available only from the NAIF website:**
  - <http://naif.jpl.nasa.gov/naif/utilities.html>
  - See the non\_toolkit\_apps tutorial for details



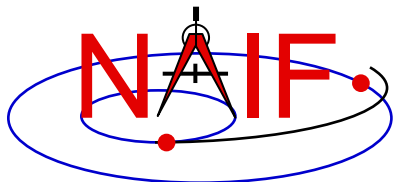
# Toolkit Utility Programs

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Navigation and Ancillary Information Facility

- **SPICE Toolkit utility programs are available to:**
  - **add comments to binary kernels**
    - » `commnt`
  - **read comments from binary kernels**
    - » `commnt`, `spacit`
    - » `inspekt` (only for EK/ESQ files)
  - **summarize coverage of binary kernels**
    - » `brief`, `ckbrief`, `dskbrief`, `spacit`
  - **merge or subset SPK files**
    - » `spkmerge`
  - **indicate current Toolkit version**
    - » `version`
  - **port binary SPICE kernels between incompatible systems (infrequently needed)**
    - » `tobin`, `toxfr`, `spacit`
    - » `bingo` (available only from the NAIF webpage)
  - **port text SPICE kernels between incompatible systems**
    - » `bingo` (available only from the NAIF webpage)
- **See the `toolkit_apps` tutorial for details**

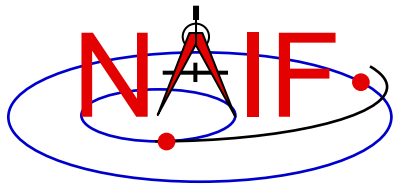




# Toolkit Documentation

Navigation and Ancillary Information Facility

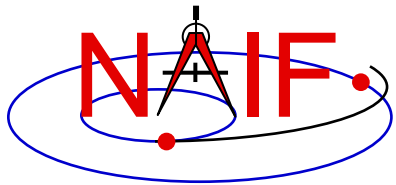
- **All Toolkits include documentation in plain text and HTML formats.**
  - Plain text documents are located under the “doc” directory
  - HTML documents are located under the “<toolkit\_name>/doc/html” (Unix) or “<toolkit name>\doc\html” (Windows) directory
    - » “index.html” is the top level index... your starting point
- **All Toolkits include the following kinds of documents**
  - **Module headers**
    - » They act as primary functional specification: I/O, exceptions, particulars defining behavior of module
    - » They contain code examples
    - » A standard format is used for each routine or entry point
    - » **Location of HTML Module Headers:**
      - Use the “API Reference Guide” link from the top level index
    - » **Location of plain text Module Headers:**
      - Fortran: the top comment block in the source code files under “src/spicelib”
      - C: the top comment block in the source code files under “src/cspice”
      - IDL: Icy Module Headers are not available in plain text format
      - Matlab: accessible via “help *function\_name*” command
    - » You can use Google to view an API header: just search on the API name (e.g. spkezr, spkezr\_c, or cspice\_spkezr (for Icy and Mice)



# Toolkit Documentation

## Navigation and Ancillary Information Facility

- **“Required Reading” documents**
  - » **Extensive technical references for principal subsystems**
    - Provide many low-level details
    - Provide code examples
  - » **HTML versions are accessible using the “Required Reading Documents” link from the top level index.**
  - » **Plain text versions are located under “doc” and have extension “.req”**
  - » **Not all Required Readings were adapted for all languages**
    - Some of the Required Reading documents provided with CSPICE are based upon Fortran SPICE
    - Some of the Required Readings for Icy or Mice toolkits are based upon CSPICE
- **User’s Guides**
  - » **Tell how to use the utility and application programs.**
  - » **HTML versions are accessible using the “User’s Guide Documents” link from the top level index.**
  - » **Plain text versions are located under “doc” and have extension “.ug.”**



# Toolkit Documentation

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Navigation and Ancillary Information Facility

- **Other documents**

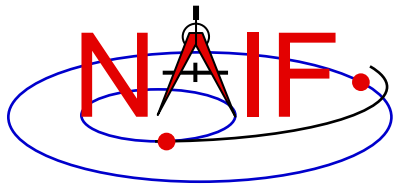
- **Permuted Index**

- » **Maps phrases describing functionality to corresponding module names and file names**
    - » **Shows names of all entry points in Fortran toolkit APIs**
    - » **HTML version is accessible using the “Permuted Index” link from the top level index.**
    - » **Plain text version is located under “doc” and has extension “.idx”:**
      - **Fortran: spicelib.idx**
      - **C: cspice.idx**
      - **IDL: icy.idx and cspice .idx**
      - **Matlab: mice.idx and cspice.idx**

- **Toolkit Description**

- » **Describes the directory structure and contents of an installed Toolkit**
    - » **Customized based on set of delivered products and platform**
    - » **HTML version is accessible using the “Toolkit Contents” link from the top level index.**
    - » **Plain text version is “doc/dscriptn.txt”**

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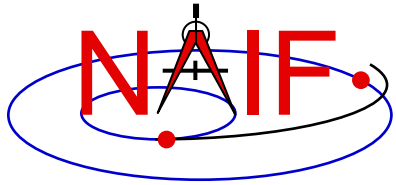


# Toolkit Documentation

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## Navigation and Ancillary Information Facility

- **Introduction to SPICE**
  - » **HTML document containing a brief introduction to the Toolkit and SPICE system; accessible using the “Introduction to the SPICE System” link from the top level index.**
- **What’s New in SPICE**
  - » **Describes new features and bug fixes in each Toolkit release, covering the last 20 years.**
  - » **Plain text version is “doc/whats.new”.**
  - » **HTML version is accessible using the “What’s New in SPICE” link from the top level index.**
- **Toolkit Version Description**
  - » **Indicates Toolkit version**
  - » **Plain text version is “doc/version.txt”**
  - » **Not available in HTML**

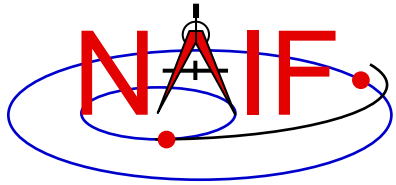


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Navigation and Ancillary Information Facility

## Backup

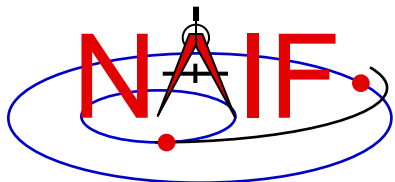
# Supported Environments



# Supported Environments

Navigation and Ancillary Information Facility

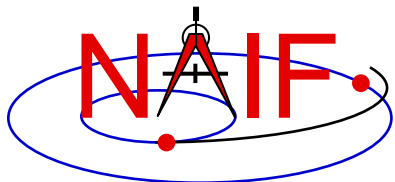
- **NAIF ports the SPICE Toolkit to many popular environments.**
  - Each environment is characterized by
    - » Language
    - » Hardware type (platform)
    - » Operating System
    - » Compiler
    - » Selected compilation options
- **NAIF provides SPICE Toolkit packages for each supported environment.**
  - If you cannot find a package built for the environment of interest to you, contact NAIF.
    - » **Please don't try to use or port a Toolkit built for another environment.**
- **The list of supported environments slowly evolves.**
  - Old ones no longer supportable are terminated.
  - New ones are added based on user interest and available NAIF resources.



# Supported Environments - Fortran

Navigation and Ancillary Information Facility

Product Name	Operating System	Compiler
Mac/Intel, OS-X, Intel FORTRAN, 32bit	OS X 10.11	Intel Fortran 15.0
Mac/Intel, OS-X, Intel FORTRAN, 64bit	OS X 10.11	Intel Fortran 15.0
Mac/Intel, OS-X, gfortran, 32bit	OS X 10.11	gfortran 5.3
Mac/Intel, OS-X, gfortran, 64bit	OS X 10.11	gfortran 5.3
PC, CYGWIN, gfortran, 32bit	Windows/Cygwin 2.5	gfortran 5.4
PC, CYGWIN, gfortran, 64bit	Windows/Cygwin 2.7	gfortran 5.4
PC, Linux, Intel FORTRAN, 32bit	Red Hat Linux (RHE5)	Intel Fortran 10.0
PC, Linux, Intel FORTRAN, 64bit	Red Hat Linux (RHE5)	Intel Fortran 10.0
PC, Linux, g77, 32bit	Red Hat Linux (RHE5)	g77 3.4
PC, Linux, gfortran, 32bit	Red Hat Linux (RHE5)	gfortran 4.3
PC, Linux, gfortran, 64bit	Red Hat Linux (RHE5)	gfortran 4.3
PC, Windows, Intel FORTRAN, 32bit	Windows 7 and above	Intel Fortran 11.1
PC, Windows, Intel FORTRAN, 64bit	Windows 7 and above	Intel Fortran 11.1
Sun/Intel, Solaris, SUN FORTRAN, 32bit	Solaris 10	Sun FORTRAN 95 12.1
Sun/Intel, Solaris, SUN FORTRAN, 64bit	Solaris 10	Sun FORTRAN 95 12.1
Sun/SPARC, Solaris, SUN FORTRAN, 32bit	Solaris 9	Sun FORTRAN 95 8.2

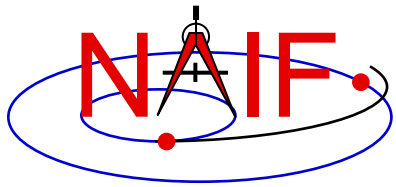


# Supported Environments - C

## Navigation and Ancillary Information Facility

Product Name	Operating System	Compiler
Mac/Intel, OS-X, Apple C, 32bit	OS X 10.11	Apple C 8.0
Mac/Intel, OS-X, Apple C, 64bit	OS X 10.11	Apple C 8.0
PC, CYGWIN, gCC, 32bit	Windows/Cygwin 2.5	gcc 5.4
PC, CYGWIN, gCC, 64bit	Windows/Cygwin 2.7	gcc 5.4
PC, Linux, gCC, 32bit	Red Hat Linux (RHE5)	gcc 4.3
PC, Linux, gCC, 64bit	Red Hat Linux (RHE5)	gcc 4.3
PC, Windows, Microsoft Visual C, 32bit	Windows 7 and above	MS Visual Studio 15.0 C
PC, Windows, Microsoft Visual C, 64bit	Windows 7 and above	MS Visual Studio 15.0 C
Sun/Intel, Solaris, SunC, 32bit	Solaris 10	Sun C 12.1
Sun/Intel, Solaris, SunC, 64bit	Solaris 10	Sun C 12.1
Sun/SPARC, Solaris, gCC, 32bit	Solaris 9	gcc 3.4
Sun/SPARC, Solaris, gCC, 64bit	Solaris 9	gcc 3.4
Sun/SPARC, Solaris, SUN C, 32bit	Solaris 9	Sun C 5.8
Sun/SPARC, Solaris, SUN C, 64bit	Solaris 10	Sun C 5.13

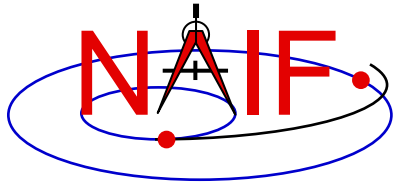




# Supported Environments - IDL

## Navigation and Ancillary Information Facility

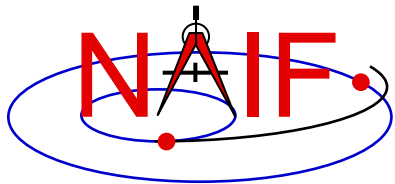
Product Name	Operating System	Compiler, IDL
Mac/Intel, OS-X, Apple C/IDL, 64bit	OS X 10.11	Apple C 8.0, IDL 8.3
PC, Linux, gcc/IDL, 32bit	Red Hat Linux (RHE5)	gcc 4.3, IDL 8.1
PC, Linux, gcc/IDL, 64bit	Red Hat Linux (RHE5)	gcc 4.3, IDL 8.1
PC, Windows, Microsoft Visual C/IDL, 32bit	Windows 7 and above	MS Visual Studio 15.0 C, IDL 8.1
PC, Windows, Microsoft Visual C/IDL, 64bit	Windows 7 and above	MS Visual Studio 15.0 C, IDL 8.1
Sun/Intel, Solaris, SUN C/IDL, 64bit	Solaris 10	Sun C 12.1, IDL 8.3
Sun/SPARC, Solaris, gcc/IDL, 32bit	Solaris 9	gcc 3.4, IDL 7.1
Sun/SPARC, Solaris, gcc/IDL, 64bit	Solaris 9	gcc 3.4, IDL 7.1
Sun/SPARC, Solaris, SUN C/IDL, 32bit	Solaris 9	Sun C 5.8, IDL 7.1



# Supported Environments - MATLAB

Navigation and Ancillary Information Facility

<b>Product Name</b>	<b>Operating System</b>	<b>Compiler, MATLAB</b>
Mac/Intel, OS-X, Apple C, 64bit	OS X 10.11	Apple C 8.0.0, MATLAB R2015a
PC, Linux, gCC, 64bit	Red Hat Linux (RHE5)	gcc 4.3, MATLAB R2010a
PC, Windows, Microsoft Visual C/Matlab, 64bit	Windows 7 and above	MS Visual Studio 15.0 C, MATLAB R2014b
Sun/SPARC, Solaris, SUN C/Matlab, 64bit	Solaris 10	Sun C 5.13, MATLAB R2009b



# Status for Other Environments

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## Navigation and Ancillary Information Facility

- **NAIF is unable to support environments other than those listed on the previous set of charts.**
  - Except an alpha-test version of a Java Native Interface Toolkit is available upon request.
- **The SPICE and CSPICE packages should function as expected on platforms running any Linux OS (Ubuntu, Fedora, etc.), BSD OS (OpenBSD, FreeBSD, etc.), or a Linux based OS environment (minGW) using a standard GCC tool-chain (gfortran or gcc compiler).**
  - Version 4.2 or later for gfortran; 4.0 or later for gcc
- **The Mice package has been successfully built against the octave environment (version > 3.4) on Linux and OS X. Contact NAIF if you have questions concerning use with Octave.**
- **Apple OS9 and earlier computers are no longer supported.**