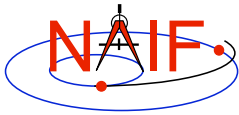


Other Useful Functions (Using FORTRAN Examples)

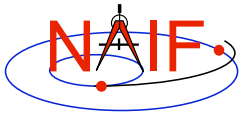
March 2006



Overview

- **Language-specific status**
- **Text I/O***
- **File Operations***
- **String Manipulation***
- **Searching, Sorting and Other Array Manipulations**
- **Windows (also referred to as schedules)**
- **Associative Arrays**
- **Sets and Cells**
- **Constants and Unit Conversion**
- **Numerical Functions**

* These routines provide capabilities similar to some of Perl's text manipulation functions



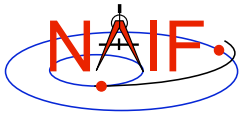
CSPICE and Icy Versions

Navigation and Ancillary Information Facility

- Many of the routines described in this tutorial have a CSPICE API equivalent (a CSPICE “wrapper”)
 - Exceptions are:
 - » Logical unit utilities
 - » Symbol tables
 - » Numerical functions and decisions (other than brackets)
 - » Arithmetic functions
 - » Text I/O support (other than rdtex_c and prompt_c)
 - » Array operations (other than searching and sorting)
 - » Math functions
- Just a few routines have an Icy equivalent at present
- NAIF is slowly adding more “wrappers” to the CSPICE library and interface routines to Icy.

Other Useful Functions

3



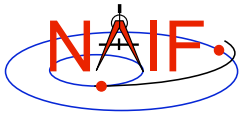
Text I/O

Navigation and Ancillary Information Facility

- Text files provide a simple, human readable mechanism for sharing data.
- The Toolkit contains several utility routines to assist with the creation and parsing of text, and with the reading and writing of text files.
 - RDTEXT: read a line of text from a text file
 - TOSTDO: write a line of text to standard output
 - PROMPT: display a prompt, wait for and return user’s response.
 - TXTOPN: open a new text file returning a logical unit.
 - WRITLN: write a line of text to the file attached to a logical unit.

Other Useful Functions

4



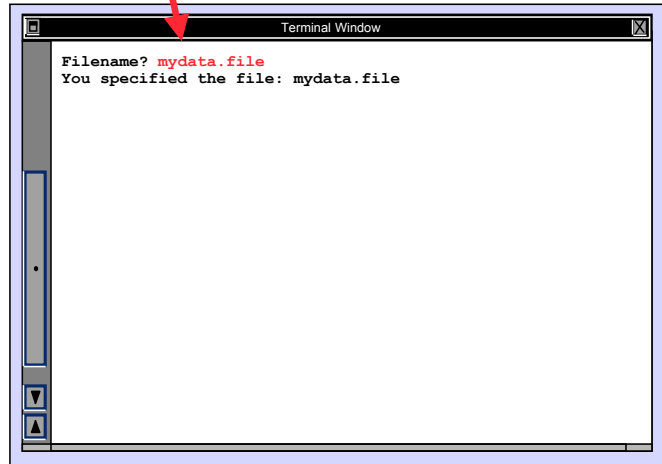
Text I/O - 2

Navigation and Ancillary Information Facility

```
CALL PROMPT ( 'Filename? ', NAME )  
CALL TOSTDO ( 'You specified the file: '// NAME )
```

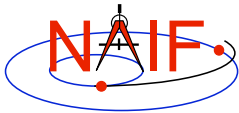
Now that we have the filename, read
and process its contents

```
CALL RDTEXT ( NAME, LINE, EOF )  
DO WHILE ( .NOT. EOF )  
    process the line just read  
    CALL RDTEXT ( NAME, LINE, EOF )  
END DO
```



Other Useful Functions

5



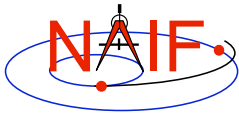
File Operations

Navigation and Ancillary Information Facility

- **Logical unit management - applicable to FORTRAN**
 - RESLUN: (reserve logical unit) prohibits SPICE systems from using specified units
 - FRELUN: (free logical unit) places “reserved” units back into service for SPICE
 - GETLUN: (get logical unit) locates an unused, unreserved logical unit.
- **Determining whether or not a file exists**
 - (Boolean): EXISTS (*filename*)
- **Deleting an existing file**
 - DELFIL (*filename*)

Other Useful Functions

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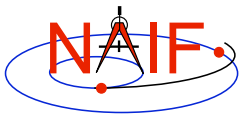
String Manipulation - Parsing 1

Navigation and Ancillary Information Facility

- **Breaking apart a list**
 - **LPARSE**: parses a list of items delimited by a single character
 - **LPARSM**: parses a list of items separated by multiple delimiters
 - **NEXTWD**: returns the next word in a given character string
 - **NTHWD**: returns the nth word in a string and the location of the word in the string
 - **KXTRCT**: extracts a substring starting with a keyword
- **Removing unwanted parts of a string**
 - **CMPRSS**: compresses a character string by removing instances of more than N consecutive occurrences of a specified character
 - **ASTRIP**: removes a set ASCII characters from a string
 - **REMSUB**: removes a substring from a string

Other Useful Functions

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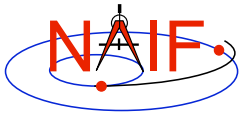
String Manipulation - Parsing 2

Navigation and Ancillary Information Facility

- **Locating substrings**
 - Return the location of the leftmost or rightmost non-blank character
 - » **LTRIM**, **RTRIM**
 - Locate substring or member of specified character set searching forward or backward
 - » **POS**, **CPOS**, **POSR**, **CPOSR**, **NCPOS**, **NCPOSR**
- **Pattern matching**
 - **MATCHI**: matches a string against a wildcard template, case insensitive
 - **MATCHW**: matches a string against a wildcard template, case sensitive
- **Extracting numeric and time data**
 - **NPARSD**, **NPARSI**, **PRSDP**, **PRSINT**, **DXTRCT**, **TPARSE**, **TPARTV**
- **Heavy duty parsing**
 - **SCANIT**

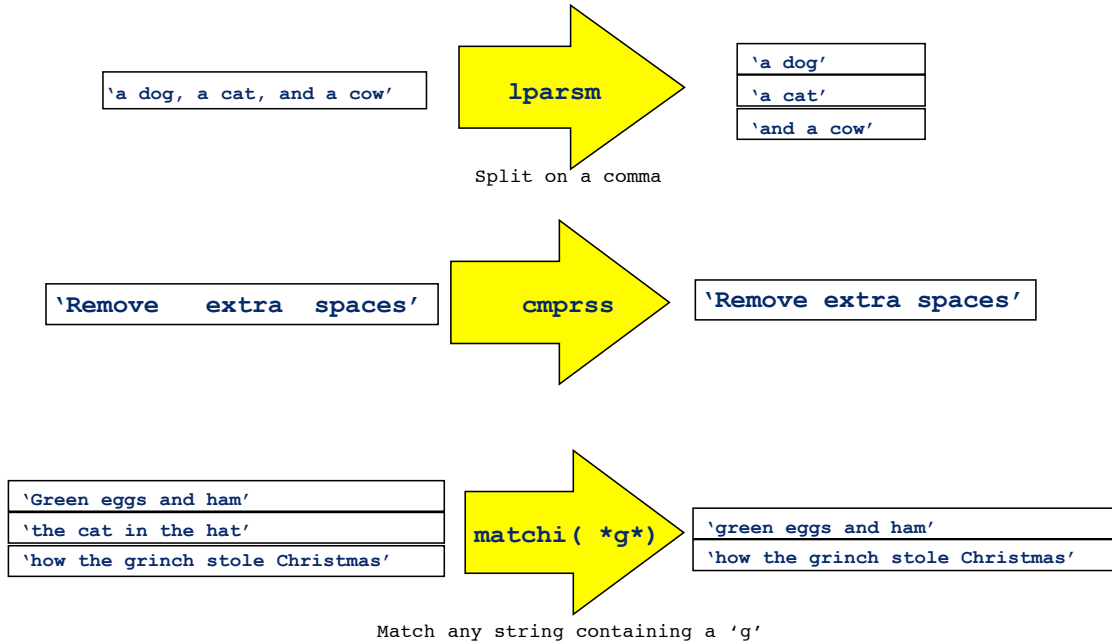
Other Useful Functions

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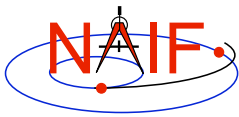
String Manipulation - Parsing

Navigation and Ancillary Information Facility



Other Useful Functions

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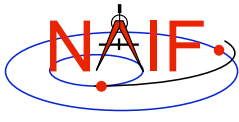
String Manipulation - Creating (1)

Navigation and Ancillary Information Facility

- **Fill in the “Blank”**
 - **REPMC: Replace a marker with a character string.**
CALL REPMC ('The file was: #', '#', 'foo.bar', OUT)
OUT becomes 'The file was: foo.bar'
 - **REPMI: Replace a marker with an integer.**
CALL REPMI ('The value is: #', '#', 7, OUT)
OUT becomes 'The value is: 7'
 - **REPMD: Replace a marker with a double precision number.**
CALL REPMD ('The value is: #', '#', 3.141592654D0, 10, OUT)
OUT becomes 'The value is: 3.141592654E+00'
 - **REPMOT: Replace a marker with the text representation of an ordinal number.**
CALL REPMOT ('It was the # term.', '#', 'L', 2, OUT)
OUT becomes 'It was the second term.'

Other Useful Functions

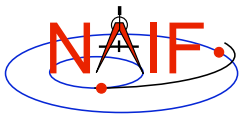
10



String Manipulation - Creating (2)

Navigation and Ancillary Information Facility

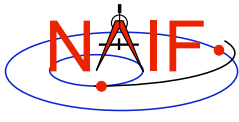
- **Fill in the “Blank” (cont.)**
 - **REPMCT: Replace a marker with the text representation of a cardinal number.**
CALL REPMOT ('Hit # errors.', '#', 6, 'L', OUT)
OUT becomes 'Hit six errors.'
- **Numeric Formatting**
 - **DPFMT: Using a format template, create a formatted string that represents a double precision number.**
CALL DPFMT (PI(), 'xxx.yyyy', OUT)
OUT becomes ' 3.1416'
 - **Others: DPSTR, INTSTR, INTTXT, INTORD**



String Manipulation - Creating (3)

Navigation and Ancillary Information Facility

- **Time formatting**
 - **TPICTR: Given a sample time string, create a time format picture suitable for use by the routine TIMOUT.**
 - **TIMOUT: Converts an input epoch to a character string formatted to the specifications of a user's format picture.**
- **Changing case**
 - **UCASE: Convert all characters in string to uppercase**
 - **LCASE: Convert all characters in string to lowercase**
- **Building strings**
 - **SUFFIX: add a suffix to a string**
 - **PREFIX: add a prefix to a string**



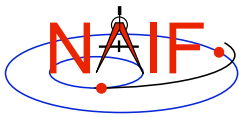
Searching, Sorting and Other Array Manipulations

Navigation and Ancillary Information Facility

- **Sorting arrays**
 - SHELLC, SHELLI, SHELLD, ORDERI, ORDERC, ORDERD, REORDC, REORDI, REORDD
- **Searching ordered arrays**
 - BSRCHC, BSRCHI, BSRCHD, LSTLEC, LSTLEI, LSTLED, LSTLTC, LSTLTI, LSTLTD, BSCHOI
- **Searching unordered arrays**
 - ISRCHC, ISRCHI, ISRCHD, ESRCHC
- **Moving portions of arrays**
 - CYCLAC, CYCLAD, CYCLAI
- **Inserting and removing array elements**
 - INSLAC, INSLAD, INSLAI, REMLAC, REMLAD, REMLAI

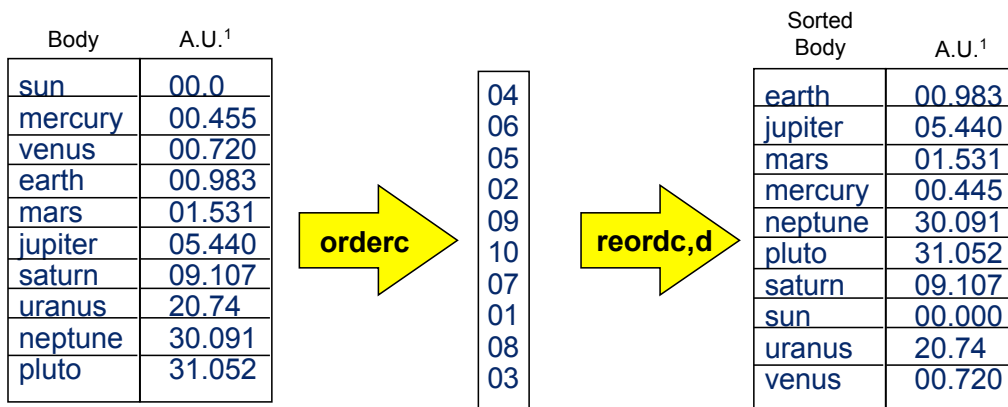
Other Useful Functions

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Searching, Sorting and Other Array Manipulations

Navigation and Ancillary Information Facility

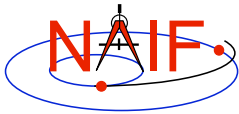


Vector of 'Body' indexes representing the list sorted in alphabetical order.

¹ Distance in A.U. at Jan 01, 2006.


Other Useful Functions

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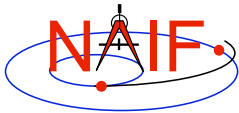


Windows*

Navigation and Ancillary Information Facility

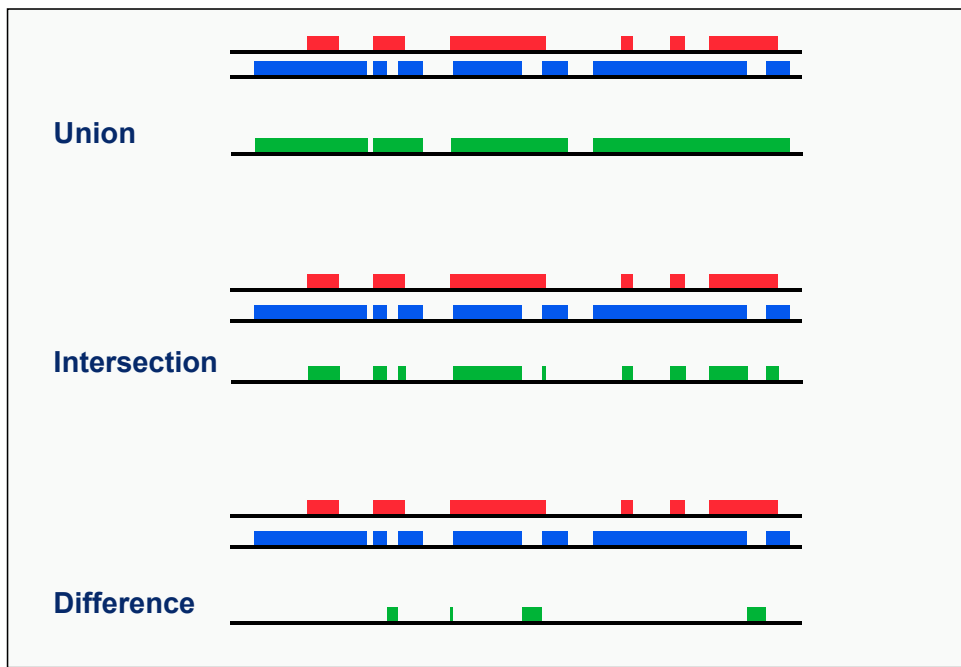
- Windows are collections of ordered, disjoint intervals of double precision numbers. 
- The Toolkit contains a family of routines for creating windows and performing “set” arithmetic on them.
- Frequently used to specify intervals of time when some set of user constraints are satisfied.
 - Let window *Behind* be intervals of times when Huygens is not behind Saturn as seen from earth.
 - Let window *Goldstone* be the intervals of times when Huygens is above the Goldstone horizon.
 - Huygens can be tracked from Goldstone during the intersection of these two windows ($Track = Behind * Goldstone$).
- See *windows.req* for more information.

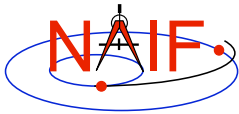
*Windows are sometimes referred to as schedules.



Windows Math

Navigation and Ancillary Information Facility





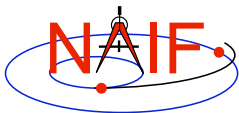
Symbol Tables

Navigation and Ancillary Information Facility

- **Used to associate a set of names with collections of associated values.**
- **The Toolkit supports the use of associative arrays through the use of “structures” (associative arrays/hashtables) called symbol tables.**
 - Values associated with a name are exclusively character, exclusively integer or exclusively double precision
 - Routines to manipulate a symbol table have the form SY***<T> where <T> is the data type of the values (C, D, or I).
- **Operations include:**
 - Insert a symbol
 - Remove a symbol
 - Push/Pop a value onto the list of values associated with a symbol
 - Fetch/Sort values associated with a symbol
- **See *symbols.req* for more information.**

Other Useful Functions

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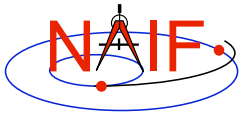
Sets and Cells

Navigation and Ancillary Information Facility

- **Cells are arrays that “know” how many addresses are available for use and how many are currently used.**
 - Routines that use cells typically have simpler interfaces than routines that use arrays.
 - Double Precision, Integer, and Character string cell types supported in the Toolkit.
 - see *cells.req* for more information
- **Sets are cells that contain no duplicate elements and whose elements are ordered in ascending order.**
 - Two Sets can be: intersected, unioned, differenced, differenced symmetrically (union - intersection)
 - See *sets.req* for more information

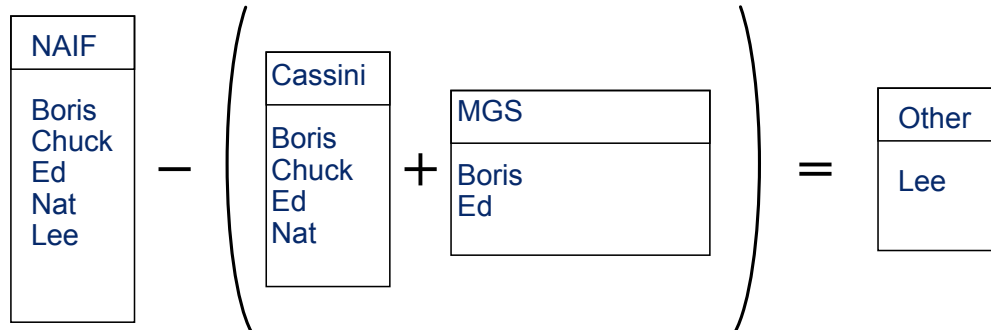
Other Useful Functions

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Sets and Cells - 2

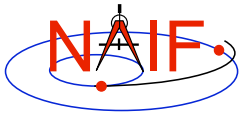
Navigation and Ancillary Information Facility



```
CALL UNIONC ( CASSINI, MGS, PROJECTS)
CALL DIFFC ( NAIF, PROJECTS, OTHER )
```

Other Useful Functions

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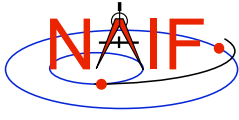
Constants and Unit Conversion

Navigation and Ancillary Information Facility

- **Constants are implemented in the Toolkit as functions.**
 - Thus the changing of a constant by NAIF requires only relinking by the Toolkit user—not recompiling.
 - » Users should NOT change constant functions in the Toolkit.
- **System Constants**
 - DPMIN, DPMAX, INTMIN, INTMAX
- **Numeric Constants**
 - PI, HALFPI, TWOPI, RPD (radians/degree), DPR(degrees/radian)
- **Physical Constants**
 - CLIGHT, SPD, TYEAR, JYEAR
- **Epochs**
 - J2000, J1950, J1900, J2100, B1900, B1950
- **Simple Conversion of Units**
 - CONVRT

Other Useful Functions

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Numerical Functions

Navigation and Ancillary Information Facility

- **Several routines are provided to assist with numeric computations and comparisons.**
- **Functions**
 - Cube root: DCBRT
 - Hyperbolic Functions: DACOSH, DATANH
 - Polynomial Interpolation and Evaluation: LGRESP, LGRINT, LGRIND, POLYDS, HRMESP, HRMINT
 - Chebyshev Polynomial Evaluation: CHBDER, CHBVAL, CHBINT
- **Numerical Decisions**
 - Same or opposite sign (Boolean): SAMSGN, OPPSGN
 - Force a value into a range (bracket): BRCKTD, BRCKTI
 - Determine parity of integers (Boolean): ODD, EVEN
 - Truncate conditionally: EXACT
- **Arithmetic**
 - Greatest common divisor: GCD
 - Positive remainder: RMAINI, RMAIND