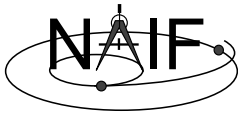




# Other Useful Functions

## (Using FORTRAN Examples)

October 2007



## Overview

---

Navigation and Ancillary Information Facility

- **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 `rdtext_c` and `prompt_c`)
    - » Array operations (other than searching and sorting)
    - » Math functions
- Not all routines have an Icy or Mice equivalent at present
- NAIF is slowly adding more “wrappers” to the CSPICE library and interface routines to Icy and Mice.

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



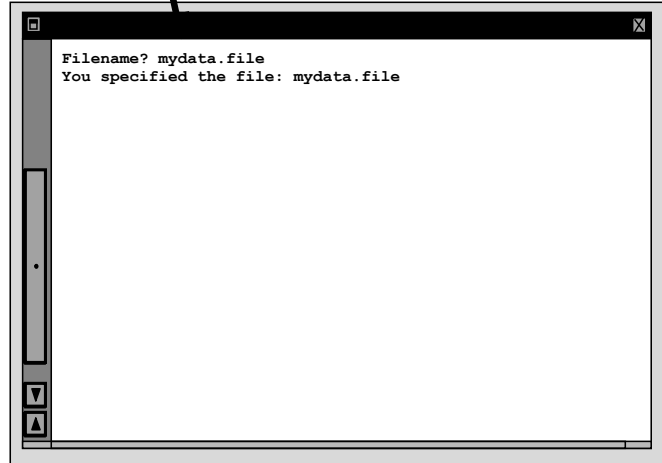
## Text I/O - 2

Navigation and Ancillary Information Facility

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

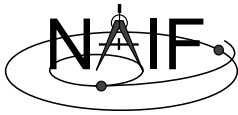
Now that we have the filename, read  
and process its contents

```
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

6



# String Manipulation - Parsing 1

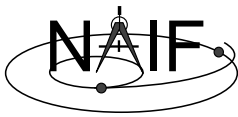
---

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

7



# 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

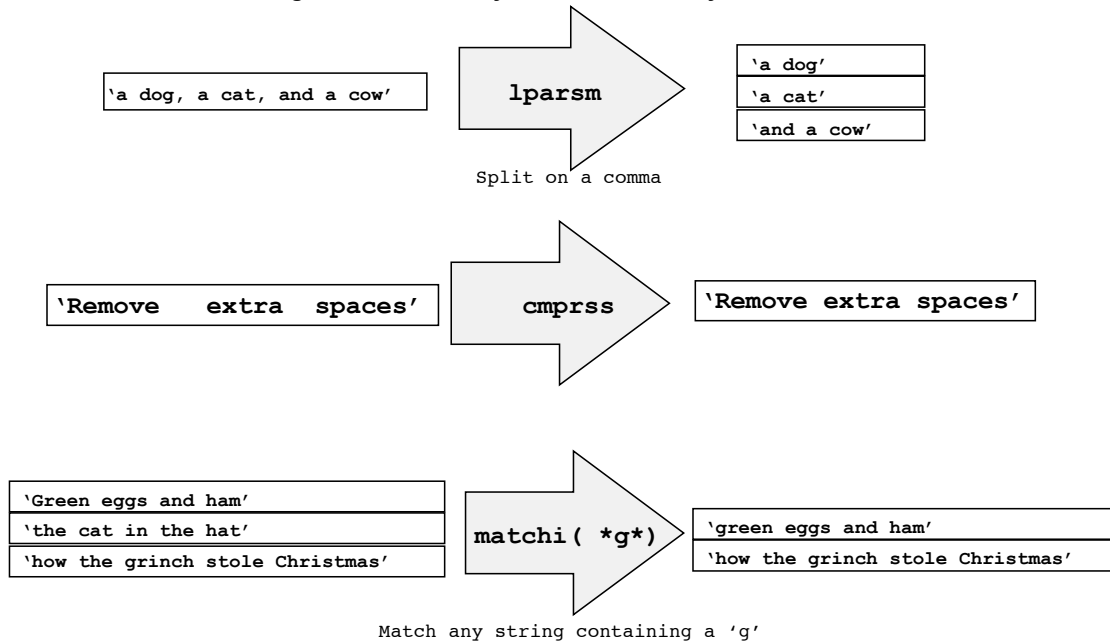
Other Useful Functions

8



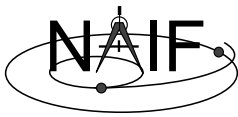
## String Manipulation - Parsing

Navigation and Ancillary Information Facility



Other Useful Functions

9



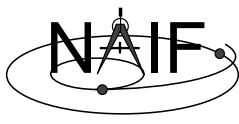
## String Manipulation - Creating (1)

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

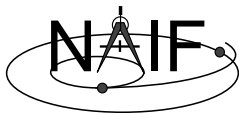
10



## 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 REPMCT ( '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**



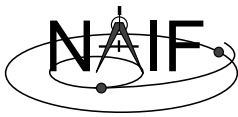
## Searching, Sorting and Other Array Manipulations

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

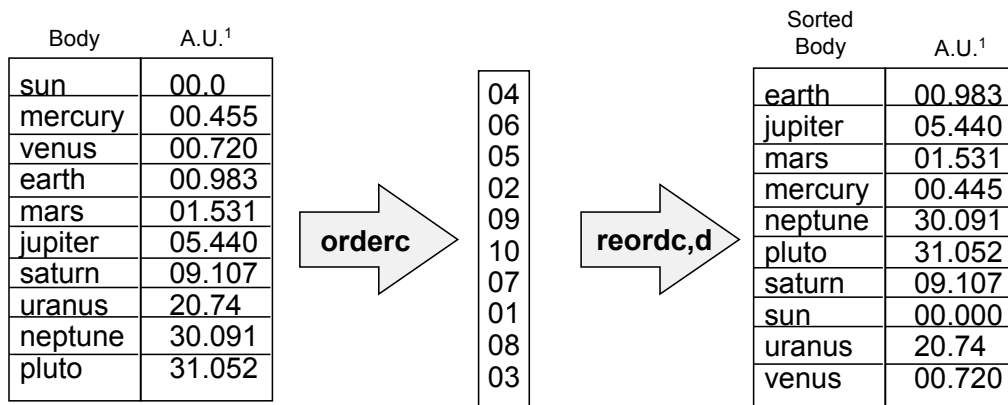
Other Useful Functions

13



## Searching, Sorting and Other Array Manipulations

Navigation and Ancillary Information Facility



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

<sup>1</sup> Distance in A.U. at Jan 01, 2006.


Other Useful Functions

14



## Windows\*

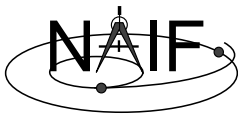
Navigation and Ancillary Information Facility

- 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 *NotBehind* contain intervals of time when Huygens is not behind Saturn as seen from earth.
  - Let window *Goldstone* contain intervals of time when Huygens is above the Goldstone horizon.
  - Huygens can be tracked from Goldstone during the intersection of these two windows (*Track* = *NotBehind* \* *Goldstone*).
- See *windows.req* for more information.

\*Windows are sometimes referred to as **schedules**.

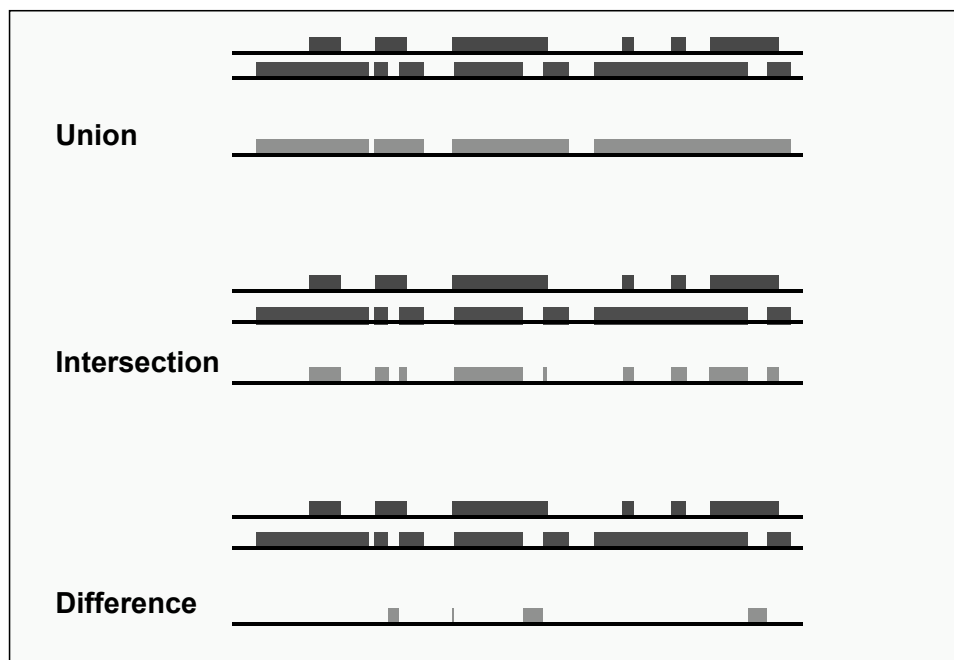
Other Useful Functions

15



## Windows Math

Navigation and Ancillary Information Facility



Other Useful Functions

16





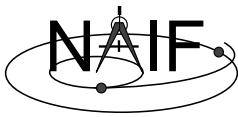
# Symbol Tables

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/ hashes) 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

17



# 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

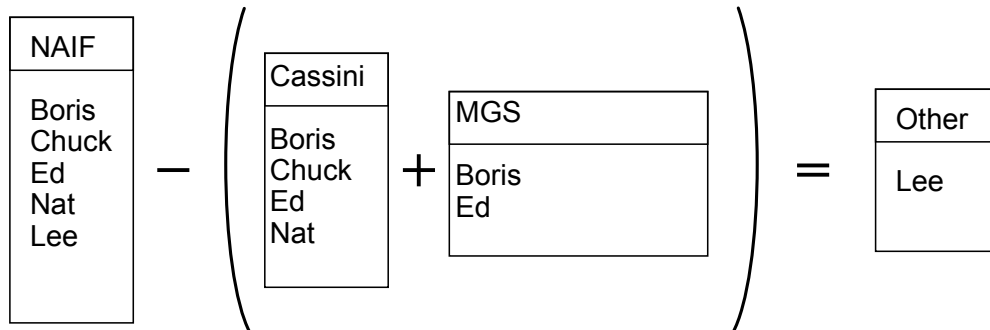
Other Useful Functions

18



## Sets and Cells - 2

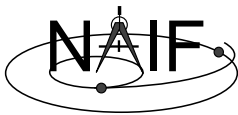
Navigation and Ancillary Information Facility



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

Other Useful Functions

19



## 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

20



# 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