SMALL TALK IMPLEMENTERS MANUAL

THIS DOCUMENT DESCRIBES THE IMPORTANT STRUCTURES AND
PROCEDURES FOR THE IMPLEMENTATION OF SMALLTALK DONE
AT UCSC IN 1977. WE HAVE RELIED HEAVILY ON THE READERS
FAMILIARITY WITH THE USERS MANUAL FOR THIS SMALLTALK.

NEILLOU
MAJOR STRUCTURES

All objects are represented in one word. The parts of this word are: the type bits, the valptr bits and the active bit. One bit of the type is the fake bit, the rest being the jump bits. Active and fakeop are the boolean forms, the fake bit if on indicates a smalltalk provided object. The jump part of a fake is used as an index for a case statement for passing control to the appropriate piece of code. The following fakos use the valptr field as follows (all other fakos make no use of valptr):

- **TYPE**
- **CELL SPACE**
- **NUMBER**
- **VECTOR SPACE**
- **STRING SPACE**
- **COMMENT**
- **FRAME SPACE**

**CELLS (ATOMS)**

- **The fields in cells are**
- **NAME** indexes the name in string space
- **INSPTR** indexes the value of the cell in vector space
- **ACD** names an access chain in the context tree
- **FAKOJUMPS** index various case statements in vector, string, atom, and boolean objects
- **LINK** indexes another cell in the same hash bucket

**NUMBERS**

- are a full word Burroughs floating/integer number

**STRINGS**

- a string has the following fields:
- **LENGTH** the number characters in the string
- **USE** use count
- **BLOCKLEN** used in (de)allocating strings
- followed by the characters in the string
- The following accessing functions are provided:
- **POINTERTOSTRING** (string object) is a pointer to the characters
- **STRINGLENGTH** (string object) is the length of the string
- **STRINGUSE** (string object) is the use count

**VECTORS**

- a vector has the following fields:
- **LENGTH** number of objects in the vector
- **USE** use count
- **BLOCKLEN** used in deallocating objects
- followed by the objects in the vector and an endofvec object.
- **VECTORLENGTH** (vector object) is the length of the vector.

**FRAMES**
MAJOR STRUCTURES

FRAMES FORM A SPAGHETTI STACK WITH THE FOLLOWING MODIFICATIONS:
THE CONTROL LINK HAS BEEN ELIMINATED (ITS FUNCTION IS IMPLICIT
IN THE CONTROL FLOW OF THE IMPLEMENTATION).
THE FRAME AND EXTENTION HAVE BEEN MERGED (THE EXT IS FIXED LENGTH
IN THIS IMPLEMENTATION).
A SMALL BINDER SCHEME IS USED.

THE FILEDS IN A FRAME ARE:

ALINK        ACCESS LINK
VARS         LINK LIST OF BINDERS USED FOR STORING BINDING INFORMATION
FUSE         USE CUNT
MESSAGE       MESSAGE VECTOR FOR THIS CONTEXT
WHO           THE USER OBJECT WHICH THIS CONTEXT IS CURRENTLY EVALUATING
TOPWHO        THE USER OBJECT FOR WHICH THE CONTEXT WAS CREATED
WHONAME      INDEX OF CELL WHERE WHO CAME FROM IF THERE WAS SUCH A CELL

MESSAGE VECTORS

MESSAGE VECTOR WORDS ARE DIFFERENT FROM THE USUAL WORDS USED
TO REPRESENT VECTORS, THEY ARE USED MAINLY IN THE EVALUATOR,
THEY HAVE THE FOLLOWING TWO FIELED:
BEGINNING      INDEXES THE BEGINNING OF THE VECTOR
ENDING         INDEXES THE FIRST ELEMENT NOT YET CONSUMED

BINDERS

BINDERS ARE USED TO STORE INFORMATION ABOUT A SET OF VARIABLE
BINDINGS, EACH BINDER IS FOR ONE SET OF EITHER LVARS, IVARS, OR
CVARS, THE FILEDS ARE:

KIND          LVARS AND IVARS ARE REPRESENTED BY 0 AND CVARS BY THE
NUMER OF IMPLICIT CVARS (6 CURRENTLY)
BUSY           USE CUNT
BNEXT          NEXT BINDER IN THE LINKED LIST OFF OF VARS
MODELVEC       VECTOR OF CELL INDEXES OF BOUND CELLS
PREVEC         VECTOR OF THE VALUES OF THE CELLS BEFORE BINDING
CURRVEC       VALUES BOUND TO THE CELLS (INCLUDES ALSO THE VALUES OF
THE IMPLICIT VARIABLE FOR CVARS

USER OBJECTS

FAKO IS OFF
TYPE INDEX OF THE CELL WHOSE VALUE THIS OBJECT IS AN INSTANCE
OF
VALPTR        INDEXES A VECTOR WHOSE ELEMENTS ARE MODEL AND VALUE
VECTORS FOR THE CVARS AND EACH OF THE IVARS FROM
THE DIFFERENT CLASSES OF WHICH THIS OBJECT IS AN INSTANCE
THE CVARS VALUES HAVE 6 IMPLICIT VALUES,
(THE LVARS MODEL, IVARS MODEL, CVARS MODEL, DEF VECTOR,
ISNEW VECTOR, AND INIT VECTOR) PLUS THE REST OF THE CVARS
VALUES.
SEE FIGURE 35.
OTHER GLOBAL VARIABLES

EXIT: IS USED FOR INDICATING ERROR CONDITIONS, (AND OTHER THINGS
THAT ACT LIKE ERRORS.)
VEC: THE CURRENT MESSAGE VECTOR
RETVAR: USED FOR RETURNING A VALUE FROM A USER OBJECT
DONERETVAR: USED FOR RETURNING A VALUE FROM A DONE WITH
CONTINUEVAR: USED TO RETURN THE VAL TO CONTINUE WITH FROM AN ERROR
CONTINUEINC: USED TO MOVE THE MESSAGE POINTER FOR A CONTINUE FROM AN
ERROR
CURACD: IS THE CURRENT ACCESS CHAIN DESCRIPTOR
FILES: A SWITCH FILE OF TTY, PRINTER, & DISK FILES FOR THE USER.
AND A DISK FILE USED BY FILE.
PIF: INDEXES THE CURRENT PRINTFILE IN FILES
RFILE: INDEXES THE CURRENT READFILE IN FILES
OPENFILE: INDICATES WHETHER A FILE IS OPEN FOR READ, PRINT
OR NOT OPEN (1,2,0 RESPECTIVELY). TTY IS A SPECIAL CASE
BEING OPEN FOR BOTH READ AND PRINT.
PRINTIMAGE IS USED BY STRING
PRINTBUFFER: USED BY PRINT, THERE IS A ROW OF BUFFER FOR EACH FILE
PRINTBUFFER: THE CURRENT LENGTH LEFT IN PRINTBUFFER
PBUFTRI: POINTER TO PLACE TO BE PRINTED NEXT IN THE CURRENT PRINT
BUFFER
PBUFLEN: LENGTH LEFT IN CURRENT PRINT BUFFER
PBUFSIZE: NUMBER OF CHARACTERS PER LINE IN CURRENT PRINT FILE
PBUFWORD: NUMBER OF WORDS PER LINE IN CURRENT PRINT FILE
NOBREAKER: TRUE UNLESS A BREAK HAS BEEN INTERCEPTED DURING OUTPUT TO
THE TTY
PRINTCHARARRAY: KEEPS CHARACTERS USED IN COMMON OUTPUT MESSAGES
CHARACTERTYPE: CHARTYPE: USED BY SCANNER
CURRFRAME: INDEXES THE CURRENT CONTEXT FRAME
CURRCSEL: IF CURRENT OBJECT WAS THE VALUE OF A CELL THEN CURRCSEL IS
AN INDEX TO THAT CELL
NEWCURRCSEL: USED IN UPDATING CURRCSEL
GLOBFRAME: FRAME CONTAINING GLOBAL VARIABLES
GLOBPR: INDEXES THE LAST ALLOCATED GLOBAL VARIABLE IN VECTOR SPACE
CELL: ARRAY OF INDICES OF CELLS FOR THE IMPLICIT CLASS VARIABLES
ALLOCATION

Cells are allocated as a stack (with no pops). Other objects have a use count to indicate how many references there are to them. If this goes to zero the object is deallocated. The use counts are updated by the use of refup and refdown procedures. There is a refup and down for each kind of data structure fake and a global pair for when the object could be of any type.

Numbers, frames, and binders are allocated by use of a free list. Vectors and string are allocated using a buddy system. For vectors the free list heads are kept in a block of size 16 at the beginning of vector space. Internally vectors are 2 words longer than they appear to the user. The first word contains the use the length and the blocklen and the last word is an endofvec object. Internally most vector indexes point to the second word of the vector.

For strings the first 4 characters are used for the use count blocklen, and length.

Symtable is a hash table for cells, it has linked list buckets.
OTHER IMPORTANT PROCEDURES

SEE(CELL INDEX) IS A BOOLEAN PROCEDURE SAYING WHETHER THE NEXT ELEMENT IN VEC IS THE ATOM INDEXING THE SAME CELL.

GETNEXTVECTOR(EMPTY MESSAGE VECTOR) MOVES THE ENDING OF THE VECTOR TO THE NEXT NON-COMMENT UNLESS AT THE END OF THE VECTOR.

VECEVALI: USED TO EVALUATE A VECTOR.
SETUPI: DOES SETUP FOR WHEN AN OBJECT TAKEN OUT OF A VECTOR IS GIVEN
CONTROL, DOES THE IMPLICIT EVALUATION OF ATOMS AND VECTORS, ALSO THE CHECKING FOR THE ESCAPE COMMANDS \// AND \//.
EVALPIECE: USED TO EVALUATE A PIECE.
EVALOBJECT: USED TO EVALUATE AN OBJECT. FAKOS AND USER OBJECTS ARE HANDLED SEPARATELY. JUMPTOFAKO IS JUST A LARGE CASE STATEMENT, TO EVALUATE A USER OBJECT FIRST A CONTEXT FRAME IS PUSHED AND THE DEF VECTOR IS EVALUATED. THEN IF THERE ARE FURTHER DEF VECTORS FROM HIGHER ORDER CLASSES OF THIS OBJECT THEY ARE EVALUATED IN TURN. THIS EVALUATION OF DEF VECTORS CONTINUES UNTIL EITHER A VALUE IS RETURNED BY ONE OF THE DEF VECTORS AN ERROR OCCURS OR THERE ARE NO MORE DEF VECTORS.
NEXT THE CONTEXT FRAME IS POPPED.
TRACING AND ERROR RESPONSE ARE ALSO DISPATCHED FROM EVALOBJECT.

PUSHFRAME: SETS UP A CONTEXT FRAME, INITIALIZING MESSAGE WHO, WHO_NAME,
AND TOPWHO. IT BINDS THE VARIABLES FOR THE FRAME AND USES AN
AUXILIARY PROCEDURE PBIND TO BIND THE VARIABLES FOR HIGHER ORDER CLASSES. IT ALSO EXTRACTS THE DEF VECTOR FOR EVALOBJECT.
POPFRA ME: UNDOES THE WORK OF PUSHFRAME.
BIND: BINDS A SET OF VARIABLES. FOR EACH CELL IN THE MODEL VECTOR
THE CURRENT VALUE OF THE CELL IS PUT IN THE PREVVEC AND THE NEW
VALUE FROM THE VALUE VECTOR IS PUT IN THE CELL.
LBIND: IS BIND FOR LOCAL VARIABLE.
UNBINDI: REVERSES THE EFFECT OF BINDI. FOR EACH CELL IN THE MODEL VECTOR THE PREVIOUS VALUE IS RESTORED.
ADGLOBAL: CREATES A NEW GLOBAL VARIABLE. GLOBAL VARIABLES ARE
KEPT AS LOCAL VARIABLES IN THE GLOBAL CONTEXT FRAME, NEW
VARIABLES ARE INITIALIZED TO HAVE THE VALUE "NO VALUE".
CELLFIXI: GETS THE VALUE OF A CELL. IF IT IS AN IMPLICIT VARIABLE
IMPLICITFIXI IS CALLED. IF THE ACCESS FOR THE CELL IS NOT THE
CURRENT ADO THEN THE ACCESS CHAIN FROM CURRENTFRAME IS SEARCHED
UNTIL THE CURRENT VALUE OF THE CELL IS FOUND.
IMPLICITFIXI: GETS THE VALUE OF AN IMPLICIT VARIABLE FROM CURRENTFRAME,
IMPLICITASSIGNI: Assigns VALUES TO IMPLICIT VARIABLES. IT CHECKS THAT
THE OBJECT IS A VECTOR AND CALLS FIXVARS IF NECESSARY.
FIXVARS: THE IVARS AND CVARS VECTORS ARE STORED IN TWO PLACES IN THE
VALUE VECTOR OF THE CVARS AND ALSO AS MODEL VECTORS IN THE
OBJECT VECTORS) SO WHEN THEY ARE CHANGED BY ASSIGNMENT THE OTHER
COPY MUST ALSO BE CHANGED. THIS IS WHAT FIXVARS DOES.
COPYSTUFFI: IS USED WHEN THE CVARS OR IVARS ARE CHANGED TO PRESERVE
AS MUCH AS POSSIBLE OF OLD BINDINGS.
ANEW: CREATES A NEW OBJECT.
IF THE NEW OBJECT IS TO BE ABLE TO ACT AS A CLASS CLASSIFY IS
CALLED. THEN THE VECTOR OF MODEL AND VALUE VECTOR PAIRS IS BUILT
UP AND THE ISNEW VECTORS ARE EVALUATED. THEN THE INIT VECTOR IS
EVALUATED. THE PROPER CONTEXTS ARE BOUND FOR THESE EVALUATIONS.
AN AUXILIARY PROCEDURE EVALISNEW IS USED FOR DEALING WITH THE
HIGHER ORDER ISNEW.
CLASSIFY PARS THE WITH VECTOR IN THE MESSAGE TO ANEW AND BUILDS
OTHER IMPORTANT PROCEDURES

THE CVARS VALUE VECTOR,
OTHER

SINIT/SMALL is a file which is filled during initialization, it may be used to print messages to users getting on to Smalltalk, or auto loading of classes etc.

The minimum set of files that should be on the disk to use Smalltalk are:
- OSMALL/SMALL
- ERMSGS/SMALL
- EDITOR/SMALL
- SINIT/SMALL (if used)

These all should be unlocked.

The following files are useful and should exist unlocked on disk if possible:
- OLISTER/SMALL (for listing manuals)
- MANUAL/SMALL (users manual)
- IMPMAN/SMALL (implementers manual)

LABEL 00000000PRINTER00178193USER#SITE J EXECUTE LISTER /SMALL