UNDERSTANDING LARGE SOFTWARE SYSTEMS WITH THE UTILITY XREF

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ABSTRACT

When a software system reaches a certain size, arteriosclerosis sets in. That is, the system becomes harder and harder to add new features and even more difficult to understand. Worse, the insertion of new features often introduces new programming errors as well as revealing ones already present but previously unmanifested. For Fortran programs, the 100,000 line size is critical. XREF fights hardening of the arteries by providing the user information on the organization, variable usage, and common block use within the software system.

XREF is language independent. That is, it works, for example, with CAL, C, CIVIC, and CFT complied subprograms. XREF performs its global symbol analysis from either the BUILD library file or the object (binary) file. Naturally more useful information is obtained when a symbol table is generated by the compiler. Specifically, eight global reports are produced. The most helpful report consists of a listing of all symbols contained in the BUILD library or binary file, the subprograms that use the symbol and the relocation basis (either local or common block name) of each symbol. Five secondary reports are provided for each subprogram.

MASTER *rb*

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INTRODUCTION

As most people who work on large software systems have experienced, as a software system gets larger and larger, it becomes more and more difficult to understand. Most of the life cycle cost of a large program is not in its development. Rather, it is maintenance that really makes software expensive. Maintenance is often a code work for "changes in external specification" and not just repair of errors or changes to accommodate new operating environments. One more problem with any long term software effort is the constant turn over in people. At Livermore, we have software efforts going on whose originators have long since retired. Turnover in programming staff seems to be faster than turnover in physicists, but nevertheless changes in personnel on any project are inevitable.

XREF was written to aid new and old staff in the never ending battle to understand what has been programmed and how new features can be added. It produces a set of useful reports based on the contents of the binary (object) file or the BUILD library of a program. More details are contained in the following section.

GENERAL DESCRIPTION

XREF performs a global code analysis of BUILD library files or binary files consisting of routines compiled by CIVIC, CFT, CFT77, or any other compiler which generates standard (UNICOS) symbol tables. XREF is patterned on BINED written by Terry H. Gong for the 7600. XREF produces 8 reports on the primary output file and a subprogram by subprogram analysis on the secondary output file.

The eight reports are:

1. a sorted list of subprogram names and various identification information;
2. the entry points contained in each subprogram;
3. the subprogram in which each entry is found;
4. the common blocks used by each subprogram;
5. a list of subprograms which use each common block;
6. a list of externals called by each subprogram;
7. a list of subprograms which call each subprogram; and finally,
8. a list of subprograms which use each symbol.

This last report consists of a listing of all symbols contained in the BUILD library or binary file, the subprograms that use the symbol and whether the symbol is local to the subprogram or the

name of the common block in which the symbol is contained.

The primary output is written to an 8-bit ASCII print file whose name is formed by the concatenation of H and the current suffix with the name of the input file truncated to 6 characters, if necessary. The primary output file contains a header consisting of the name of the binary file, the machine on which XREF was run, the suffix under which it was run, and the date and time when XREF was run. After the above mentioned eight reports, the primary output listing is completed with the XREF execution time in seconds including the CPU, I/O, system and total times.

The secondary report contains the following information for each subprogram:

1. subprogram name
2. entry points
3. external references
4. local variables used
5. variables used in each common block.

The secondary output file is written to an 8-bit ASCII print file whose name is formed by the concatenation of P and the current suffix with the first six characters of the input file name. After the above mentioned subprogram by subprogram breakdown, the secondary output listing is completed with the XREF execution time in seconds including the CPU, I/O, system, and total times. Note that currently NLTSS provides a zero rather than the correct system time.

RESTRICTIONS

XREF analyzes only one binary file or BUILD library file at a time. For maximum usefulness, the individual subprogram modules within the binary or library file should contain a symbol table.

The current version can handle as many subprogram names, entry point names, common block names, external references, local variables and common variables as will fit into memory on the computer on which XREF is run. The exact amount depends on the maximum field length allowed, the garbage collection scheme used by the supporting routines, and the order in which nominal initial sizes are exceeded.

Currently XREF only used the first eight letters of symbol names. This could be extended easily to 16 or even 24 at the price of more memory requirements and much greater complexity of formatting the print outs.

When the compiler sets the necessary flags, XREF indicates the usage of a variable in a subprogram. That is, it distinguishes between variables referenced and variables defined. Variables defined are indicated by an = sign before the subprograms in which the variables are set. Note that at the present time not all compilers set the flags appropriately. CIVIC appears to still be the best in this regard.

The primary and secondary output file lengths are limited to 512,000 decimal words but

may be extended in the operating system. There are no help facilities or interactive commands. Standard FORTLIB error messages and those given below are provided.

OPERATION

The controllee for XREF can be obtained from mass storage via:

XP READ .743150:XREF

The execute line is

XREF binary_file_name

where binary_file_name is the name of BUILD library or binary (object) file consisting of eight or fewer characters.

If binary_file_name is omitted, a request for it will be made. The primary output file is named by concatenating H (for high speed print file), with the current suffix, and the first 6 characters of the binary file name. The secondary output file is named by concatenating P (for print file), with the current suffix and the binary file name truncated to 6 characters, if necessary. The drop file name is +XREFy, where y is the current suffix.

For example, the execute line

XREF CLIFF

typed under suffix A will produce the primary output file HACLIFF, the secondary output file PACLIFF, and the drop file +XREFA.

EXAMPLES OF OUTPUT

The two appendices give examples of running XREF on the binary produced by compiling XREF. Appendix I is the primary output file, while Appendix II contains the secondary output file. Lines with the number "1" in column 1 begin a new page.

ERROR MESSAGES

The following table of error messages and explanations is provided to aid the user.

<u>Message</u>		<u>Explanation</u>
Too many input symbols	-	Too many file names were specified on the execute line or in response to the request for the input binary file name.
Too many letters in file name	-	Input file name is restricted to eight or fewer characters.
Input file does not exist	-	An open attempt on the input file returned a length file size. Restart XREF with the correctly spelled input file name.
Cannot create output file	-	There is insufficient disk space to create an output file.

REVISIONS

The original XREF program was written in late summer 1981 and installed September 1, 1981. It was revised in 1986 because the old FORTLIB memory management routines were deleted and a new scheme was adopted. Both the 1988 and the 1990 revisions were made necessary by changes in symbol table formats.

REFERENCES

1. Terry Gong, BINED, UR-111 (June 3, 1971).
2. Paul Thompson, SYMEDIT, Lawrence Livermore National Laboratory, Livermore, CA 94550, UCIR-1339 (February 4, 1980).
3. Cray Research, Inc., Debug Tables Internal Reference Manual, SM-0225D (1990).

APPENDIX I

1 f i l e - - - b x r e f l 8 d a t e 1 1 - 1 2 - 9 0 t i m e 1 0 : 5 8 : 0 6 m a c h y s u f f i x a

1	subprogram	sequence number	program size	compiled by	date	time
	ACLICHE	1	0000005	ncivicy	11-12-90	10:44:03
	BUF	3	0000044	ncivicy	11-12-90	10:44:03
	CNSUB	4	0000172	ncivicy	11-12-90	10:44:03
	EPTSUB	5	0000200	ncivicy	11-12-90	10:44:03
	EXTSUB	6	0000210	ncivicy	11-12-90	10:44:03
	FINDUSE	7	0000225	ncivicy	11-12-90	10:44:03
	FINSYM	8	0000266	ncivicy	11-12-90	10:44:03
	GETSPACE	25	0000012	ncivicy	11-12-90	10:44:03
	LOCSub	9	0000262	ncivicy	11-12-90	10:44:03
	MAIN.	2	0000347	ncivicy	11-12-90	10:44:03
	RELSpace	26	0000012	ncivicy	11-12-90	10:44:03
	REPORT	10	0000245	ncivicy	11-12-90	10:44:03
	REPORT1	11	0000072	ncivicy	11-12-90	10:44:03
	REPORT2	12	0000132	ncivicy	11-12-90	10:44:03
	SNSUB	13	0000445	ncivicy	11-12-90	10:44:03
	SYMSUB	14	0000204	ncivicy	11-12-90	10:44:03
	TABLZAP	15	0000072	ncivicy	11-12-90	10:44:03
	TIMING	16	0000043	ncivicy	11-12-90	10:44:03
	XERR	17	0000036	ncivicy	11-12-90	10:44:03
	XERRCR	18	0000012	ncivicy	11-12-90	10:44:03
	Z3F	19	0000035	ncivicy	11-12-90	10:44:03
	ZCSORT	20	0000103	ncivicy	11-12-90	10:44:03
	ZCSORT4	21	0000121	ncivicy	11-12-90	10:44:03
	ZLSORT	22	0000101	ncivicy	11-12-90	10:44:03
	ZNSORT	23	0000100	ncivicy	11-12-90	10:44:03
	ZSORT	24	0000074	ncivicy	11-12-90	10:44:03

1	subprogram	entry points
	-----	-----
	ACLICHE	ACLICHE
	BUF	BUF
	CNSUB	CNSUB
	EPTSUB	EPTSUB
	EXTSUB	EXTSUB
	FINDUSE	FINDUSE
	FINSYM	FINSYM
	GETSPACE	GETSPACE
	LOCSUB	LOCSUB
	MAIN.	MAIN.
	RELSpace	RELSpace
	REPORT	REPORT
	REPORT1	REPORT1
	REPORT2	REPORT2
	SNSUB	SNSUB
	SYMSUB	SYMSUB
	TABLZAP	TABLZAP
	TIMING	TIMING
	XERR	XERR
	XERRCR	XERRCR
	ZBF	ZBF
	ZCSORT	ZCSORT
	ZCSORT4	ZCSORT4
	ZLSORT	ZLSORT
	ZNSORT	ZNSORT
	ZSORT	ZSORT

1 entry found in subprogram

AC LICHE	AC LICHE
BUF	BUF
CNSUB	CNSUB
EPTSUB	EPTSUB
EXTSUB	EXTSUB
FINDUSE	FINDUSE
FINSYM	FINSYM
GETSPACE	GETSPACE
LØCSUB	LØCSUB
MAIN.	MAIN.
RELSpace	RELSpace
REPORT	REPORT
REPORT1	REPORT1
REPORT2	REPORT2
SNSUB	SNSUB
SYMSUB	SYMSUB
TABLZAP	TABLZAP
TIMING	TIMING
XERR	XERR
XERRCR	XERRCR
ZBF	ZBF
ZCSØRT	ZCSØRT
ZCSØRT4	ZCSØRT4
ZLSØRT	ZLSØRT
ZNSØRT	ZNSØRT
ZSØRT	ZSØRT

1	subprogram	calls

ACLICHE		
BUF	IOSTATUS	RDABS
CNSUB	BUF	GETSPACE
EPTSUB	BUF	GETSPACE
EXTSUB	BUF	GETSPACE
FINDUSE	Q8BF0LEP	Q8FNTI
FINSYM	Q8BF0LEP	Q8FNTI
GETSPACE	MZALLOC	
LOCSUB	'UF	EMPTY
MAIN.	BUF	CNSUB
RELSPACE	MSGLINK	OPEN
REPORT	MZDALLOC	
REPORT1	EXIT	FINDUSE
REPORT2	TIMING	ZBF
SNSUB	Q8BF0LEP	Q8FNTI
SYMSUB	Q8BF0LEP	Q8FNTI
TABLZAP	BUF	EPTSUB
TIMING	BUF	GETSPACE
XERR	Q8BF0LEP	Q8FNTI
XERRCR	EXIT	Q8BF0LEP
ZBF	XERR	Q8FNTI
ZCSORT		
ZCSORT4		
ZLSORT		
ZNSORT		
ZSORT		

1	subprogram	called by						
		CNSUB	EPTSUB	EXTSUB	LOCSUB	MAIN.	SNSUB	SYMSUB
	BUF							
	CNSUB	MAIN.						
	CREATE	MAIN.						
	DROPPFILE	MAIN.						
	EMPTY	LOCSUB						
	EPTSUB	SNSUB						
	EXIT	REPORT	XERR					
	EXTSUB	SNSUB						
	FINDUSE	REPORT						
	FINSYM	REPORT						
	GETSPACE	CNSUB	EPTSUB	EXTSUB	LOCSUB	MAIN.	SNSUB	SYMSUB
	GETSYMB	MAIN.						
	I0STATUS	BUF						
	LOCSUB	MAIN.						
	MPROMPT	MAIN.						
	MSGFRR	MAIN.						
	MSGLINK	MAIN.						
	MZALL0C	GETSPACE						
	MZDALL0C	RELSpace						
	OPEN	MAIN.						
	Q8BF0LEP	CNSUB REPORT2	EPTSUB SNSUB	EXTSUB TIMING	FINDUSE XERR	FINSYM	LOCSUB	MAIN. REPORT
	Q8FMTI	CNSUB REPORT2	EPTSUB SNSUB	EXTSUB TIMING	FINDUSE XERR	FINSYM	LOCSUB	MAIN. REPORT
	Q8TF0LP	CNSUB XERR	EPTSUB	EXTSUB	FINDUSE	FINSYM	LOCSUB	REPORT REPORT1 REPORT2
	RDABS	BUF						
	RELSpace	CNSUB	EPTSUB	EXTSUB	LOCSUB	SNSUB	SYMSUB	
	REPORT	MAIN.						
	REPORT1	REPORT						

REPORT2	REPORT								
SNSUB	MAIN.								
SYMSUB	CNSUB								
TABLZAP	REPORT								
TIMEDATE	MAIN.								
TIMEUSED	TIMING								
TIMING	REPORT								
XERR	MAIN.	XERRCR							
XERRCR	MAIN.								
ZBF	CNSUB	EPTSUB	EXTSUB	FINDUSE	FINSYM	LOCSUB	REPORT	REPORT1	REPORT2
ZCSORT	LOCSUB	SYMSUB							
ZCSORT4	FINSYM								
ZLSORT	REPORT								
ZNSORT	REPORT								
ZSORT	EXTSUB	REPORT1	REPORT2						

i	symbol	reloc bas	found in	CNSUB RELSUB XERR	EXTSUB REPORT	EXTSUB REPORT1	FINDUSE REPORT2	FINSYM SNSUB	GETSPACE SYMSUB	LOCSUB TIMING
	\$ARGS	local	BUF MAIN. XERR							
	\$BTAREA	local	ACLICHE LOCSUB TABLZAP ZNSORT	BUF MAIN. TIMING ZNSORT	CNSUB RELSUB XERR	EPTSUB REPORT XERRCR	EXTSUB REPORT1 ZBF	FINDUSE REPORT2 ZCSORT	FINSYM SNSUB ZCSORT4	GETSPACE SYMSUB ZLSORT
	\$TNB	local	ACLICHE LOCSUB TABLZAP ZNSORT	BUF MAIN. TIMING ZNSORT	CNSUB RELSUB XERR	EPTSUB REPORT XERRCR	EXTSUB REPORT1 ZBF	FINDUSE REPORT2 ZCSORT	FINSYM SNSUB ZCSORT4	GETSPACE SYMSUB ZLSORT
	\$TRS	local	CNSUB REPORT1	EPTSUB REPORT2	EXTSUB SNSUB	FINDUSE SYMSUB	FINSYM XERRCR	LOCSUB	MAIN.	REPORT
	%DSP	local	ACLICHE LOCSUB TABLZAP ZNSORT	BUF MAIN. TIMING ZNSORT	CNSUB RELSUB XERR	EPTSUB REPORT XERRCR	EXTSUB REPORT1 ZBF	FINDUSE REPORT2 ZCSORT	FINSYM SNSUB ZCSORT4	GETSPACE SYMSUB ZLSORT
	A	local	= ZBF	= ZNSORT						
	ASSOC	local	= ZLSORT							
	B	local	= ZBF	= ZLSORT						
	BLANK	local	ZBF							
	BLSV	local	= EPTSUB	= EXTSUB						
	BUF\$	local	= BUF							
	BUFF	local	BUF							
	BUFFER	CBUFFER	= FINSYM	= LOCSUB	= SYMSUB	= TABLZAP				
	BUFSV	local	= LOCSUB							
	CALLRTN	local	= FINDUSE							
	CCTR	local	= CNSUB							
	CHARA	local	ZBF	ZCSORT	ZCSORT4	ZNSORT	ZNSORT			
	CHARB	local	= ZBF	ZLSORT						
	CLEN	local	MAIN.							
	COM	COMMON	= CNSUB	REPORT	SYMSUB					
	COMASS	COMMON	= CNSUB	REPORT						
	COMCTR	CTR	= CNSUB	REPORT	SYMSUB					
	COMP	SUBPR0	REPORT	= SNSUB						

COMPT	SUBPRO	= CNSUB	REPORT	= SNSUB		
COUNT	local	= REPORT1				
CPU	local	= TIMING				
DARRAY	ONE	CNSUB	= EPTSUB	= EXTSUB	= LOCSUB	= REPORT2 = SYMSUB
DARRAY	local	= ZCSORT	= ZCSORT4			
DATE	SUBPRO	REPORT	= SNSUB			
DFLAG	local	= FINSYM				
DL.000	local	CNSUB	EPTSUB	EXTSUB	FINDUSE	FINSYM
		REPORT2	SNSUB	SYMSUB	TABLZAP	XERR
DL.001	local	CNSUB	EPTSUB	EXTSUB	FINDUSE	FINSYM
		SNSUB	SYMSUB	TABLZAP	FINDUSE	FINSYM
DL.002	local	CNSUB	EPTSUB	EXTSUB	FINDUSE	FINSYM
DL.003	local	FINDUSE	FINSYM	LOCSUB	SNSUB	
DL.004	local	FINDUSE	SNSUB			
DL.005	local	FINDUSE	SNSUB			
DL.006	local	FINDUSE	SNSUB			
DL.007	local	SNSUB				
DL.008	local	SNSUB				
DL.009	local	SNSUB				
EFLAG	local	= FINSYM				
ELSV	local	= EPTSUB	= EXTSUB			
EPT	ENTRYS	= EPTSUB	FINDUSE	REPORT		
EPTASS	ENTRYS	= EPTSUB	FINDUSE	REPORT		
EPTCTR	CTR	= EPTSUB	FINDUSE	REPORT		
EPTPT	SUBPRO	= EPTSUB	REPORT	= SNSUB		
EXT	EXTERN	= EXTSUB	FINDUSE	REPORT		
EXTASS	EXTERN	= EXTSUB	REPORT			
EXTCTR	CTR	= EXTSUB	REPORT			
EXTPT	SUBPRO	= EXTSUB	FINDUSE	REPORT	= SNSUB	
FLSV	local	= EPTSUB	= EXTSUB	= SNSUB		

[illegible]

[illegible]

LFLEN	LFNAME	LFNAME1	LINE	LLAST	LOC	LOCAL	LOFFSET	LSTART	LT.001	LT.002	M	MACH	MAINRTN	MAXCOM	MAXD	MAXEPT	MAXEXT	MAXNAME	N	NA	NAMECTR	NAMECTR	NAMEPT	NAMEPT	NB	NSYM	NUMNRD	DBUFFER	CBUFFER

PCOM	COMMON	= CNSUB	MAIN.	REPORT	SYMSUB	
PCOMASS	COMMON	= CNSUB	MAIN.	REPORT		
PCOMP	SUBPRO	MAIN.	REPORT	= SNSUB		
PCOMPT	SUBPRO	CNSUB	MAIN.	REPORT	= SNSUB	
PDARRAY	ONE	CNSUB	EPTSUB	EXTSUB	= LØCSUB	REPORT2 = SYMSUB
PDATE	SUBPRO	MAIN.	REPORT	= SNSUB		
PEPT	ENTRYS	= EPTSUB	FINDUSE	MAIN.	REPORT	
PEPTASS	ENTRYS	= EPTSUB	FINDUSE	MAIN.	REPORT	
PEPTPT	SUBPRO	EPTSUB	MAIN.	REPORT	= SNSUB	
PEXT	EXTERN	= EXTSUB	FINDUSE	MAIN.	REPORT	
PEXTASS	EXTERN	= EXTSUB	MAIN.	REPORT		
PEXTPT	SUBPRO	EXTSUB	FINDUSE	MAIN.	REPORT	= SNSUB
PNAMEPT	SUBPRO	MAIN.	REPORT	REPORT1	= SNSUB	TABLZAP
PSIZE	SUBPRO	MAIN.	REPORT	= SNSUB		
PSUBNAME	SUBPRO	FINDUSE	FINSYM	MAIN.	REPORT	REPORT1 REPORT2 = SNSUB
PTEMP	local	CNSUB	EPTSUB	EXTSUB	LØCSUB	SYMSUB
PTIME	SUBPRO	MAIN.	REPORT	= SNSUB		
PUSED	SUBPRO	FINDUSE	MAIN.	REPORT2	= SNSUB	TABLZAP
SIZE	SUBPRO	REPORT	= SNSUB			
SUBNAME	SUBPRO	FINDUSE	FINSYM	REPORT	REPORT1	REPORT2 = SNSUB
SUBNAME	local	= ZNSORT				
SYMCTR	CTR	FINSYM	= LØCSUB	REPORT	= SYMSUB	= TABLZAP
SYS	local	= TIMING				
TEM	local	= REPORT2	= ZCSORT	= ZCSORT4	= ZLSORT	= ZNSORT
TEMA	local	= ZSORT				
TEMP	local	= CNSUB	= EPTSUB	= EXTSUB	= LØCSUB	= SNSUB = SYMSUB
TIME	SUBPRO	REPORT	= SNSUB			
TOT	local	= TIMING				
TTY	SYSFIL	LØCSUB	MAIN.	REPORT	XERRCR	
UNKNOWN	local	SNSUB				

USED	SUBPRG	= FINDUSE	REPORT2	SNSUB	TABLZAP	REPORT1	REPORT2	SNSUB
VSIV	local	= LOCSUB	= SYMSUB					
VLHSV	local	= LOCSUB	= SYMSUB					
VLSV	local	= LOCSUB	= SYMSUB					
VRHSV	local	= LOCSUB	= SYMSUB					
VRSV	local	= LOCSUB	= SYMSUB					
HCSV	MISC	= CNSUB	= LOCSUB					
WOUT	SYSFIL	FINDUSE	FINSYM	MAIN.	REPORT	REPORT1	REPORT2	
WOUT1	SYSFIL	CNSUB	EFTSUB	EXTSUB	LOCSUB	MAIN.	REPORT	SNSUB
XIO	local	= TIMING						
XLSV	local	= EXTSUB						
XXX	local	= REPORT1	= REPORT2					
XXXASS	local	= REPORT2						
XXXCTR	local	= REPORT2						
XXXPT	local	= REPORT1						
ZBF\$	local	= ZBF						

xref execution time (seconds):
cpu= 0.3643 i/o= 0.1670 system= 0.0000 total= 0.5313

APPENDIX II

1. subprogram --- ACLICHE

entry points are

ACLICHE

external references are

local variables used are

\$BTAREA \$TNB %DSP

2. subprogram --- MAIN.

entry points are

MAIN.

external references are

BUF CNSUB CREATE DROPFILE GETSPACE GETSYMB
 LOC SUB MPRMPT MSGERR Q8FMTI Q8BFOLEP
 Q8FMTI REPORT SNSUB TIME DATE XERRCR

variables used in common block CBUFFER

LENBUF PBUFFER

variables used in common block ONE

MAXD PDARRAY

variables used in common block SUBPRO

MAXNAME PCOMP PCOMPT PDATE
 PHAMEPT PSIZE PSUBNAME PTIME

variables used in common block COMMON

MAXCOM PCOM PCOMASS

variables used in common block ENTRY

MAXEPT PEPT PEPTASS

variables used in common block EXTERN

MAXEXT PEXT PEXTASS

variables used in common block CTR

ICTR

variables used in common block SYSFIL

PEPTPT PEXTPT
 PUSED

IN	INLEN	LFLN	LFNAME	TTY	MOUT
ROUT1					
variables used in common block MISC					
MAINRTN					
local variables used are					
\$ARGS	\$BIAREA	\$TNB	\$TRS	%DSP	CLEN
HDRREC	HDRSIZ	HDRSIZ	IBUF	IBUILD	IDATE
INFILE	INTYP	INTYP	ISUF	ISYMLN	ISYMTABP
ITIME	LFNAME1	LINE	MACH	NSYM	
3. s u b p r o g r a m --- BUF					
entry points are					
BUF					
external references are					
IOSTATUS RDABS					
variables used in common block SYSFIL					
IN	INLEN				
local variables used are					
\$ARGS	\$BIAREA	\$TNB	%DSP	BUF\$	BUFF
I	IFLAG	ISTAT	LFIRST	LLAST	NUMIRD
4. s u b p r o g r a m --- CNSUB					
entry points are					
CNSUB					
external references are					
BUF	GETSPACE	Q8BF0LEP	Q8FWTI	Q8TF0LP	RELSpace
SYMSUB	ZBF				
variables used in common block ONE					
DARRAY	PDARRAY				
variables used in common block SUBPR0					
COMPT	PCOMPT				
variables used in common block COMMON					
COM	COMASS	MAXCOM	PCOM	PCOMASS	
variables used in common block CTR					

COMCTR	ICTR	JCTR	NAMECTR			
variables used in common block						
SYSFIL						
WOUT1						
variables used in common block						
MISC						
WCSV						
local variables used are						
\$ARGS	\$BTAREA	\$TNB	\$TRS		%DSP	CCTR
DL.000	DL.001	DL.002	I		J	K
LENNEW	LT.001	PTMP	TEMP			
5. s u b p r o g r a m --- EPTSUB						
entry points are						
EPTSUB						
external references are						
BUF	GETSPACE	Q8BFOLEP	Q8FWTI		Q8TFOLP	RELSpace
ZBF						
variables used in common block						
ONE						
DARRAY PDARRAY						
variables used in common block						
SUBPRO						
EPTPT PEPTPT						
variables used in common block						
ENTRYS						
EPT	EPTASS	MAXEPT	PEPT		PEPTASS	
variables used in common block						
CTR						
EPTCTR	ICTR	JCTR	NAMECTR			
variables used in common block						
SYSFIL						
WOUT1						
local variables used are						
\$ARGS	\$BTAREA	\$TNB	\$TRS		%DSP	BLSV
DL.000	DL.001	DL.002	ELSV		FLSV	I
IMAX	J	K	LENNEW		LT.001	PTMP
TEMP						
6. s u b p r o g r a m --- EXTSub						
entry points are						

EXTSUB

external references are

BUF	GETSPACE	Q8BF0LEP	Q8FWTI	Q8TF0LP	RELSpace
ZBF	ZSORT				

variables used in common block ONE

DARRAY PDARRAY

variables used in common block SUBPRO

EXTPT PEXTPT

variables used in common block EXTERN

EXT	EXTASS	MAXEXT	PEXT	PEXTASS
-----	--------	--------	------	---------

variables used in common block CTR

EXTCTR	ICTR	JCTR	NAMECTR
--------	------	------	---------

variables used in common block SYSFIL

WOUT1

local variables used are

\$ARCS	\$BTAREA	\$TNB	\$TRS	BLSV
DL.000	DL.001	DL.002	ELSV	I
IMAX	J	K	LENNEW	PTEMP
TEMP	XLSV			

7. s u b p r o g r a m --- FINDUSE

entry points are

FINDUSE

external references are

Q8BF0LEP	Q8FWTI	Q8TF0LP	ZBF	
			SUBPRO	
EXTPT	PEXTPT	PSUBNAME	PUSED	SUBNAME
			ENTRYS	USED

variables used in common block

EPT	EPTASS	PEPT	PEPTASS
-----	--------	------	---------

variables used in common block EXTERN

EXT PEXT

variables used in common block CTR

EPTCTR	NAMECTR								
variables used in common block									
WOUT									
variables used in common block									
MISC									
MAINRTN									
local variables used are									
\$ARGS	\$BTAREA	\$TNB	\$TRS	%DSP	CALLRTN				
DL.000	DL.001	DL.002	DL.003	DL.304	DL.005				
DL.006	FOUND1	I	ICALLPT	INDMAIN	IRTN				
JCALLS	JRTN	KRTN	LEVEL	LT.001					

8. s u b p r o g r a m --- FINSYM

entry points are

FINSYM

external references are

Q8BF0LEP	Q8FWTI	Q8TF0LP	ZBF	ZCSORT4
----------	--------	---------	-----	---------

variables used in common block

CBUFFER

PBUFFER

variables used in common block

SUBPRO

PSUBNAME SUBNAME

variables used in common block

CTR

SYMCTR

variables used in common block

SYSFIL

WOUT

local variables used are

\$ARGS	\$BTAREA	\$TNB	\$TRS	%DSP	DFLAG
DL.000	DL.001	DL.002	DL.003	EFLAG	I
ICOUNT	ISM	ISTART	ISX	J	K
KCT	LSTART	LT.001			

9. s u b p r o g r a m --- LOCSUB

entry points are

LOCSUB

external references are

BUF	EMPTY	GETSPACE	Q8BF0LEP	Q8FMTI	Q8TF0LP
RELSPACE	ZBF	ZCSORT			

variables used in common block CBUFFER

BUFFER	LENBUF	PBUFFER
--------	--------	---------

variables used in common block ONE

DARRAY	MAXD	PDARRAY
--------	------	---------

variables used in common block CTR

ICTR	JCTR	NAMECTR	SYMCTR
------	------	---------	--------

variables used in common block SYSFIL

TTY	WOUT1
-----	-------

variables used in common block MISC

MCSV

local variables used are

\$ARGS	\$BTAREA	\$TNB	\$TRS	%DSP	BUFSV
DL.000	DL.001	DL.002	DL.003	I	IMAX
J	LENNEW	LOCAL	LT.001	PTEMP	TEMP
VISV	VLHSV	VLSV	VRHSV	VRSV	

10. s u b p r o g r a m --- REPORT

entry points are

REPORT

external references are

EXIT	FINDUSE	FINSYM	Q8BF0LEP	Q8FMTI	Q8TF0LP
REPORT1	REPORT2	TABLZAP	TIMING	ZBF	ZLSORT
ZNSORT					

variables used in common block SUBPRO

COMP	COMPT	DATE	EPTPT	EXTPT	NAMEPT
PCOMP	PCOMPT	PDATE	PEPTPT	PEXTPT	PNAMEPT
PSIZE	PSUBNAME	PTIME	SIZE	SUBNAME	TIME

variables used in common block COMMON

COM	COMASS	PCOM	PCOMASS
-----	--------	------	---------

variables used in common block ENIRYS

EPT	EPTASS	PEPT	PEPTASS
-----	--------	------	---------

variables used in common block EXTERN

EXT	EXTASS	PEXT	PEXTASS
-----	--------	------	---------

variables used in common block CTR

COMCTR	EPTCTR	EXTCTR	NAMECTR	SYMCTR
--------	--------	--------	---------	--------

variables used in common block SYSFIL

TTY	WOUT	WOUT1
-----	------	-------

local variables used are

\$ARCS	\$BTAREA	\$TNB	\$TRS	%DSP	DL.000
I	J				

11. sub program --- REPORT1

entry points are
REPORT1

external references are

Q8BF0LEP	Q8FWTI	Q8TF0LP	ZBF	ZSORT
----------	--------	---------	-----	-------

variables used in common block SUBPRO

NAMEPT	PNAMEPT	PSUBNAME	SUBNAME
--------	---------	----------	---------

variables used in common block CTR

NAMECTR

variables used in common block SYSFIL

WOUT

local variables used are

\$ARCS	\$BTAREA	\$TNB	\$TRS	%DSP	CJUNT
DL.000	DL.001	I	J	LOC	XXX
XXXPT					

12. sub program --- REPORT2

entry points are
REPORT2

external references are

Q8BF0LEP	Q8FWTI	Q8TF0LP	ZBF	ZSORT
----------	--------	---------	-----	-------

variables used in common block ONE

DARRAY	PDARRAY
--------	---------

variables used in common block SUBPRO

```

PSUBNAME  PUSED  SUBNAME  USED
variables used in common block  CTR
JCTR
variables used in common block  SYSFIL
WOUT

local variables used are
$ARGS  $BTAREA  $INB  $TRS  DL.000
DL.001  I  IEND  J  XXX
XXXASS  XXXCTR

13.  s u b p r o g r a m  ---  SNSUB
entry points are
SNSUB

external references are
BUF  EPTSUB  EXTSUB  GETSPACE  Q8BF0LEP  Q8FNTI
RELSpace

variables used in common block  SUBPRO
COMP  COMPT  DATE  EPTPT  EXTPT  MAXNAME
NAMEPT  PCOMP  PCOMPT  PDATE  PEPTPT  PEPTPT
SUBNAME  PSIZE  PSUBNAME  PTIME  PUSED  SIZE
TIME  USED

variables used in common block  CTR
ICTR  NAMECTR

variables used in common block  SYSFIL
WOUT1

local variables used are
$ARGS  $BTAREA  $INB  $TRS  DL.000
DL.001  DL.002  DL.003  DL.004  DL.006
DL.007  DL.008  DL.009  FLSV  LENMEM
LT.001  PTEMP  TEMP  UNKNOWN

14.  s u b p r o g r a m  ---  SYMSUB
entry points are
SYMSUB

external references are
BUF  GETSPACE  RELSPACE  ZCSORT

```


variables used in common block CBUFFER
 BUFFER LENBUF PBUFFER
 variables used in common block ONE
 DARRAY MAXD PDARRAY
 variables used in common block COMMON
 COM PCOM
 variables used in common block CTR
 COMCTR ICTR JCTR NAMECTR SYMCTR
 local variables used are
 \$ARGS \$BTAREA \$TNB \$TRS DL.000
 DL.001 DL.002 I TEMP I MAX LENNEH
 LT.001 PTEMP J VLHSV VLSV
 VRHSV

15. s u b p r o g r a m --- TABLZAP
 entry points are

TABLZAP

external references are

variables used in common block CBUFFER
 BUFFER PBUFFER
 variables used in common block SUBFR0
 NAMEPT PNAMEPT PUSED USED
 variables used in common block CTR
 NAMECTR SYMCTR
 variables used in common block MISC
 MAINRTN
 local variables used are
 \$BTAREA \$TNB %DSP DL.000 DL.001 I
 J LT.001 LT.002

16. s u b p r o g r a m --- TIMING
 entry points are

TIMING

external references are

Q8BF0LEP Q8FWTI TIMEUSED

local variables used are

\$ARGS \$BTAREA \$TNB %DSP ICPU
IO IOUT ISYS TOT XIO

17. subprogram --- XERR

entry points are

XERR

external references are

EXIT Q8BF0LEP Q8FWTI Q8TF0LP

local variables used are

\$ARGS \$BTAREA \$TNB %DSP DL.000 I
ITTY JW K

18. subprogram --- XERRCR

entry points are

XERRCR

external references are

XERR

variables used in common block SYSFIL

TTY

local variables used are

\$ARGS \$BTAREA \$TNB \$TRS %DSP

19. subprogram --- ZBF

entry points are

ZBF

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	A	B	BLANK
CHARA	CHARB	I	LT.001	LT.002	ZBF\$

20. s u b p r o g r a m --- ZCSORT

entry points are

ZCSORT

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	CHARA	DARRAY	I
IA	JA	K	KA	LA	LA
LT.001	LT.002	M	N	NA	NB
TEM					

21. s u b p r o g r a m --- ZCSORT4

entry points are

ZCSORT4

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	CHARA	DARRAY	I
IA	IOFFSET	JA	K	KA	L
LA	LOFFSET	LT.001	LT.002	M	N
NA	NB	TEM			

22. s u b p r o g r a m --- ZLSORT

entry points are

ZLSORT

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	ASSOC	B	CHARB
IA	IL	JCTR	K	KA	L
LA	LT.001	LT.002	M	NB	TEM

23. s u b p r o g r a m --- ZNSORT

entry points are

ZNSORT

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	CHARA	IA	IN
JS	K	KA	L	LA	LT.001
LT.002	M	NAMECTR	NAMEPT	SUBNAME	TEM

24. S u b p r o g r a m --- ZSORT
entry points are

ZSORT

external references are

local variables used are

\$BTAREA	\$TNB	%DSP	CHARA	IA
IS	JS	K	L	LA
LT.001	LT.002	M	TEMA	

25. S u b p r o g r a m --- GETSPACE
entry points are

GETSPACE

external references are

MZALL0C

local variables used are

\$ARGS	\$BTAREA	\$TNB	%DSP	IDELTA	IPTR
--------	----------	-------	------	--------	------

26. S u b p r o g r a m --- RELSPACE
entry points are

RELSpace

external references are

MZDALL0C

local variables used are

\$ARGS	\$BTAREA	\$TNB	%DSP	IDELTA	IPTR
--------	----------	-------	------	--------	------

xref execution time (seconds):
cpu= 0.3648 i/o= 0.1670 system= 0.0000 total= 0.5318

END

DATE FILMED

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