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CABLE: CENTRATOM - TELEX 400302 - 1

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THIRD COLLEGE ON MICROPROCESSORS:
TECHNOLOGY AND APPLICATIONS IN PHYSICS

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INTRODUCTION TO THE FLEX OPERATING SYSTEM

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These are preliminary lecture notes, intended only for distribution to participants. Missing or extra copies are available from the Secretariat.

INTRODUCTION TO FLEX

- ROSY COMMANDS:

• INSPECT/MODIFY MEMORY:

M-COMPARE, M-DUMP, M-FILL, M-LIST

M-LOAD, M-MODIFY, M-VERIFY, COPY, SEARCH

• INSPECT/MODIFY REGISTERS:

REG-DISPLAY, REG-MODIFY

• DEBUGGING:

BP-CLEAR, IF-SET, DECODE, SYMBOLS,

TRACE

• EXECUTION / I-O:

GO, RESTART, MON-EXEC, SLAVE, TRACE, FLEX

• MISCELLANEOUS:

HELP, DATA-CONNECT, SET-N-TRACE

- MONITOR CALLS:

USER CALLS TO PARTS OF THE MONITOR.

ALSO USED BY THE MONITOR ITSELF.

• CHARACTER/TEXT INPUT/OUTPUT

• SETTING OF VECTORS, I/O PARAMETERS

• NUMBER INPUT/OUTPUT

• ERROR MESSAGES

• TASK ACTIVATION/DE-ACTIVATION ; CLOCK

ROSY MONITOR DOES NOT HAVE:

- FILE SYSTEM
- EDITOR
- ASSEMBLER
- HIGH-LEVEL LANGUAGE PROCESSOR.

THREE SERVICES ARE PROVIDED BY FLEX:

FLEX MAKES USE OF ROSY ROUTINES:

- CHARACTER INPUT/OUTPUT FROM/TO TERMINAL
- DISK DRIVER ROUTINES
- TASK ACTIVATION FOR PRINTER SPOOLING.

HOW DO WE GET INTO FLEX?

- SWITCH ON; (RESET)
- WAIT FOR: ROSY>
- THEN TYPE FLEX (OR F).
- SYSTEM ASKS FOR DATE.
- TYPE IN MM DD YY (e.g. 10 11 85)
- AFTER A FEW SECONDS: +++

AN ASIDE: ALWAYS WATCH THE "PROMPT"

IT INDICATES THAT THE SYSTEM EXPECTS
INPUT FROM THE KEYBOARD
AND IT TELLS YOU WHICH SYSTEM HAS
CONTROL OF THE MACHINE.

MANITC: ROSY>
FLEX +++
EXTACT #

START-UP OF FLEX.

ROSY >f

6809 FLEX V3.01

DATE (MM,DD,YY)? 10 10 85

```
*****
*
* INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
*
* Microprocessors Laboratory
*
* WELCOME
*
* to the
*
* THIRD COLLEGE ON MICROPROCESSORS
*
* TRIESTE
*
* 7 OCTOBER - 1 NOVEMBER 1985
*
*****
```

```
+++date
OCTOBER 10, 1985
+++list.pim
NUMBER EQU $10
POPO EQU $20
ORG $100
START NOP
LDA ##40
SUBA #NUMBER
STA DIFF
ADDA #POPO
STA DIFF+1
SWI
FCB 0
DIFF RMB 2
END
```

← EXAMPLES OF FLEX COMMANDS.

RESULT OF "FILES"

FILES ON DRIVE NUMBER 0

ERRORS.SYS	FLEX.SYS	CAT.CMD	DIR.CMD	COPY.CMD
LIST.CMD	ASN.CMD	DELETE.CMD	RENAME.CMD	TTYSET.CMD
P.CMD	SAVE.CMD	EDIT.CMD	ASMB.CMD	ASM.CMD
APPEND.CMD	BUILD.CMD	EXEC.CMD	JUMP.CMD	DATE.CMD
D.CMD	LINK.CMD	VERSION.CMD	PROT.CMD	VERIFY.CMD
PRINT.CMD	QCHECK.CMD	I.CMD	XOUT.CMD	PUTLDR.CMD
HELP.CMD	TMODE.CMD	GETVAX.CMD	PRIVAX.CMD	FILES.CMD
DUMPDISK.CMD	FORMAT.CMD	LOAD.CMD	COPYF.CMD	CREATE.CMD
FILETEST.CMD	FREE.CMD	RUN.CMD	BASIC.CMD	MTEST09.CMD
EPROM.CMD	WPS.CMD	DELETE.HLP	BUILD.HLP	DATE.HLP
APPEND.HLP	ASN.HLP	FREE.HLP	GET.HLP	VERIFY.HLP
JUMP.HLP	CAT.HLP	COPYF.HLP	LIST.HLP	EXEC.HLP
COPY.HLP	I.HLP	P.HLP	PRINT.HLP	O.HLP
XOUT.HLP	RENAME.HLP	SAVE.HLP	QCHECK.HLP	WHELP.TXT
GUIDE.TXT	MEMO.TXT	MONCALLS.TXT	SINETAB.TXT	STARTUP.TXT
STARTUP2.TXT	DIVIDE.TXT	D_MULT.TXT	MOUSE.TXT	WELCOME.TXT
COPYD.TXT	SI.TXT	MOUSE.BIN	MOUSE.SYM	SI2.TXT
KERNEL.TXT				

RESULT OF "CAT"

CATALOG OF DRIVE NUMBER 0
DISK: FLTS1085 #1

NAME	TYPE	SIZE	PRT
ERRORS	.SYS	9	
FLEX	.BYS	23	
CAT	.CMD	3	
DIR	.CMD	5	
COPY	.CMD	5	
LIST	.CMD	3	
ASN	.CMD	1	
DELETE	.CMD	2	
RENAME	.CMD	1	
TTYSET	.CMD	2	
P	.CMD	1	
SAVE	.CMD	2	
EDIT	.CMD	28	
ASMB	.CMD	48	
ASM	.CMD	52	
APPEND	.CMD	3	
BUILD	.CMD	1	
EXEC	.CMD	1	
JUMP	.CMD	1	
DATE	.CMD	2	
MOUSE	.TXT	15	
WELCOME	.TXT	2	
COPYD	.TXT	1	
SI	.TXT	1	
MOUSE	.BIN	2	
MOUSE	.SYM	2	
SI2	.TXT	1	
KERNEL	.TXT	34	

SECTORS LEFT = 708

RESULT OF "DIR"

DIRECTORY OF DRIVE NUMBER 0
DISK: FLTS1085 #1 CREATED: 10-SEP-85

FILE#	NAME	TYPE	R	BEGIN	END	SIZE	DATE	PRT
1	ERRORS	.SYS	R	01-01	01-09	9	10-SEP-85	
2	FLEX	.SYS		01-0A	01-20	23	10-SEP-85	
3	CAT	.CMD		02-01	02-03	3	10-SEP-85	
4	DIR	.CMD		02-04	02-08	5	10-SEP-85	
5	COPY	.CMD		02-09	02-0D	5	10-SEP-85	
6	LIST	.CMD		02-0E	02-10	3	10-SEP-85	
7	ASN	.CMD		02-11	02-11	1	10-SEP-85	
8	DELETE	.CMD		02-12	02-13	2	10-SEP-85	
9	RENAME	.CMD		02-14	02-14	1	10-SEP-85	
10	TTYSET	.CMD		02-15	02-16	2	10-SEP-85	
11	P	.CMD		02-17	02-17	1	10-SEP-85	
12	SAVE	.CMD		02-18	02-19	2	10-SEP-85	
13	EDIT	.CMD		02-1A	03-15	28	10-SEP-85	
14	ASMB	.CMD		03-16	05-05	48	10-SEP-85	
15	ASM	.CMD		05-06	06-19	52	10-SEP-85	
16	APPEND	.CMD		06-1A	06-1C	3	10-SEP-85	
17	BUILD	.CMD		06-1D	06-1D	1	10-SEP-85	
18	EXEC	.CMD		06-1E	06-1E	1	10-SEP-85	
19	JUMP	.CMD		06-1F	06-1F	1	10-SEP-85	
20	DATE	.CMD		06-20	07-01	2	10-SEP-85	
21	O	.CMD		07-02	07-03	2	10-SEP-85	
22	LINK	.CMD		07-04	07-04	1	10-SEP-85	
72	MEMO	.TXT		0D-18	0F-10	57	10-SEP-85	
73	MONCALLS	.TXT		0F-11	0F-17	7	10-SEP-85	
74	SINETAB	.TXT		0F-18	0F-1B	4	10-SEP-85	
75	STARTUP	.TXT		0F-1C	0F-1C	1	10-SEP-85	
76	STARTUP2	.TXT		0F-1D	0F-1D	1	10-SEP-85	
77	DIVIDE	.TXT		0F-1E	0F-20	3	10-SEP-85	
78	D_MULT	.TXT		10-01	10-02	2	10-SEP-85	
79	MOUSE	.TXT		10-03	10-11	15	10-SEP-85	
80	WELCOME	.TXT		10-12	10-13	2	10-SEP-85	
81	COPYD	.TXT		10-1A	10-1A	1	17-SEP-85	
82	SI	.TXT		10-1B	10-1B	1	17-SEP-85	
83	MOUSE	.BIN		10-16	10-17	2	10-SEP-85	
84	MOUSE	.SYM		10-18	10-19	2	10-SEP-85	

FLEX COMMANDS

THE FLEX COMMANDS RESIDE ON DISK
(EXCEPT MON AND GET)

+++ 0·LIST·CMD, 1·SNOOPY·OUT 2

+++ LIST SNOOPY 2

(NOTE: SEPARATION IS , OR A SPACE)

THE MOST USED FLEX COMMANDS ARE:

+++ FILES +++ CAT +++ DIR

+++ MON

+++ LIST, <file spec> [, <line range>] [, N]

+++ PRINT, <file spec>

+++ COPY, <file spec>, <file spec>

+++ SAVE, <file spec>, <begin addr>, <end addr> [, <tr. addr>]

+++ DELETE, <file spec>

+++ RENAME, <file spec 1>, <file spec 2>

+++ P, <command>

+++ O, <file spec>, <command>

+++ GET, <file spec>

+++ LOAD, <file spec>

+++ ASM, <file spec> + options

+++ EDIT, <file spec> + options

EXAMPLES:

+++ P, LIST, MYFILE.TXT EQ TO +++ PRINT, MYFILE

+++ O, CONTENTS, DIR, 0

+++ LIST, CONTENTS

EDITOR

EVOKED WITH:

+++ EDIT, <file spec>

eg. +++ EDIT, TEST1

2 CASES: i) FILE EXISTS.

EDITOR READS IT, THEN:

#

ii) FILE DOES NOT EXIST.

EDITOR RESPONDS WITH:

NEW FILE.

1.00=

NOW YOU START TYPING!

OUR EDITOR IS LINE ORIENTED, WITH THE NOTION OF "CURRENT LINE".

THUS THE COMMAND P WILL LIST THE CURRENT LINE.

YOU CAN FORCE A LINE TO BECOME THE CURRENT LINE.

14P WILL LIST LINE 14

14P5 WILL LIST LINES 14, 15, 16, 17 AND 18

^P! WILL LIST ALL LINES

SIMILARLY:

14D WILL DELETE LINE 14

14D5 WILL DELETE LINES 14, 15, 16, 17 AND 18

A FORCES CURRENT LINE TO BE AT THE TOP OF THE FILE.

! FORCES THE LAST LINE OF THE FILE TO BE THE CURRENT LINE.

THE EDITOR IS THE ONLY

EDITOR TRIED AT!

EXAMPLE OF AN EDIT SESSION

```
+++edit.pim
DELETE BACKUP FILE (Y-N)? y
#^P!
```

```
1.00=NUMBER EQU $10
2.00=POPO EQU $20
3.00= ORG $100
4.00=START NOP
5.00= LDA #$40
6.00= SUBA #NUMBER
7.00= STA DIFF
8.00= ADDA #POPO
9.00= STA DIFF+1
10.00= SWI
11.00= FCB 0
12.00=DIFF RMB 2
13.00= END
```

#01

```
.10= TTL FASULO
.20=*
.30=*
.40=* This program has no useful purpose
.50=*
.60=*
.70=* It adds a few numbers, in immediate addressing mode
.80=* x
.90=*
```

1.00=*

1.10=#
SOME LINES RENUMBERED

1.00=*

#renumber
#^P!

```
1.00= TTL FASULO
2.00=*
3.00=*
4.00=* This program has no useful purpose
5.00=*
6.00=*
7.00=* It adds a few numbers, in immediate addressing mode
8.00=*
9.00=*
10.00=*
11.00=NUMBER EQU $10
12.00=POPO EQU $20
13.00= ORG $100
14.00=START NOP
15.00= LDA #$40
16.00= SUBA #NUMBER
17.00= STA DIFF
18.00= ADDA #POPO
19.00= STA DIFF+1
20.00= SWI
21.00= FCB 0
22.00=DIFF RMB 2
23.00= END
```

#7c/mde/mode/

7.00=* It adds a few numbers, in immediate addressing mode

#11/c/ / define a few numbers

#11b / define a few numbers

#11c / define a few numbers

#11d / define a few numbers

#11e / define a few numbers

#11f / define a few numbers

← EDIT COMMAND
← EDITOR ASKS QUESTION
← LIST WHOLE FILE

← INSERT BEFORE FIRST LINE
← EDITOR TYPES .10=
← USER TYPES THE LINE

← TYPING # STOPS THE EDITOR FROM ASKING MORE NEW LINES.

← ANOTHER EDITOR COMMAND
← LIST ENTIRE FILE

COMMENTS
HAVE NOT
BEEN
ADDED.

← MAKE CORRECTIONS.

EDITOR DOES NOT UNDERSTAND

AGAIN

NOW IT UNDERSTOOD

#13o
 13.00= ORG #100
 OVERLAY program starts at \$100
 13.00= ORG #100 program starts at \$100
 #14c/\$40/\$40 here we start our job/
 ?
 #14p
 14.00=START NOP
 #14c/~~START~~ NOP/NOP here starts the job?
 14.00=START NOP here starts the job?
 #14o
 14.00=START NOP here starts the job?
 OVERLAY
 14.00=START NOP here starts the job.
 #p!
 14.00=START NOP here starts the job.
 15.00= LDA #40
 16.00= SUBA #NUMBER
 17.00= STA DIFF
 18.00= ADDA #POPO
 19.00= STA DIFF+1
 20.00= SWI
 21.00= FCB 0
 22.00=DIFF RMB 2
 23.00= END
 #20c/SWI/SWI program must stop properly!
 20.00= SWI program must stop properly!
 #22o
 22.00=DIFF RMB 2
 OVERLAY reserve two bytes for DIFF and DIFF+1
 22.00=DIFF RMB 2 reserve two bytes for DIFF and DIFF+1
 #p!
 1.00= TTL FASULO
 2.00=x
 3.00=x
 4.00=x This program has no useful purpose
 5.00=x
 6.00=x
 7.00=x It adds a few numbers, in immediate addressing mode
 8.00=x
 9.00=x
 10.00=x
 11.00=NUMBER EQU #10 define a few numbers
 12.00=POPO EQU #20
 13.00= ORG #100 program starts at \$100
 14.00=START NOP here starts the job.
 15.00= LDA #40
 16.00= SUBA #NUMBER
 17.00= STA DIFF
 18.00= ADDA #POPO
 19.00= STA DIFF+1
 20.00= SWI program must stop properly!
 21.00= FCB 0
 22.00=DIFF RMB 2 reserve two bytes for DIFF and DIFF+1
 23.00= END

← MODIFY LINE 13, USING "OVERLAY"

← ORIGINAL
← OVERLAY
← RESULT

← EDITOR DOES NOT UNDERSTAND
(THE STRING "\$40" DOES NOT EXIST IN LINE 14!)
← HERE IS THE PROVE.

NOW IT IS OK

GET RID OF ?

LIST FROM CURRENT LINE
TO END

ADD MORE COMMENTS!
USING C AND O

FINAL LISTING

← QUIT THE EDITOR

OTHER IMPORTANT EDITOR COMMANDS:

# RENUMBER	OR	REN
# BOTTOM	OR	B
# TOP	OR	T
# LOG	OR	L
# STOP	OR	S
# FIND	OR	F

FIND/STRING/ WILL FIND (AND LIST) THE LINE
CONTAINING "STRING"

FOR VARIANTS: SEE MANUAL.

TO EDIT THE TEXT, THE FOLLOWING COMMANDS
ARE AVAILABLE:

# APPEND/string/	
# CHANGE/string1/string2/	FOR OPTIONS,
# DELETE	REFINEMENTS,
# INSERT (BELOW CURRENT LINE)	VARIANTS AND
# OVERLAY	OTHER PERFECTING
# PRINT	SEE THE MANUAL!
# REPLACE (= DELETE + INSERT)	

EXAMPLES:

14.00 = HERE ADDA NUMBER

14C/HERE/THERE/

14.00 = THERE ADDA NUMBER

14I

14.1c = * THIS IS AN EXTRA COMMENT

14.2c = * AND ANOTHER

14.3c = *

14.4c = #

YOU QUIT THE EDITOR WITH #S

ASSEMBLER

THE ASSEMBLER WILL BE INVOKED WITH:

+++ ASM, <file spec> + OPTIONS.....
SEE MANUAL!!

IT MAY ASK A FEW QUESTIONS, AND THEN THE DISK
WILL GET SPINNING!

+++ ASM, MYPROG WILL USE MYPROG.TXT
WILL PRODUCE:

- OUTPUT LISTING ON THE SCREEN.
- BINARY OUTPUT ON DISK: MYPROG.BIN
- SYMBOL TABLE ON DISK: MYPROG.SYM

TO GET A HARDCOPY OF THE OUTPUT LISTING:

- i) +++ P, ASM, MYPROG
- ii) +++ O, MYPROG.OUT, ASM, MYPROG
- +++ PRINT, MYPROG.OUT

DIAGNOSTICS ARE INTERSPERSED WITH THE
OUTPUT LISTING. AT END OF LISTING YOU
GET: 47 ERROR(S) DETECTED
FOLLOWED BY THE SYMBOL TABLE.

+++asm.pim
DELETE OLD BINARY (Y-N)? y

← INVOKED ASSEMBLER

← QUESTION

← OUTPUT LISTING

```
*
*
* This program has no useful purpose
*
* It adds a few numbers. in immediate addressing mode
*
*
*
0010 NUMBER EQU $10      define a few numbers
0020 POPO EQU $20
      ORG $100           program starts at $100
      START NOP          here starts the job.
0100 12 40 LDA #$40
0101 86 10 SUBA #NUMBER
0103 80 10 STA DIFF
0105 B7 010F ADDA #POPO
0108 88 20 STA DIFF+1
010A B7 0110 SWI          program must stop properly!
010D 3F FCB 0
010E 00 DIFF RMB 2       reserve two bytes for DIFF and !
F+010F END
```

0 ERROR(S) DETECTED

SYMBOL TABLE:

DIFF	010F	NUMBER	0010	POPO	0020	START	0100
------	------	--------	------	------	------	-------	------

YOU LOAD YOUR PROGRAM WITH:

+++LOAD, MYPROG.BIN (OR SIMPLY "MYPROG")

THIS WILL ALSO LOAD THE SYMBOL TABLE. THUS ROSY KNOWS AND RECOGNIZES THE SYMBOLS YOU USED.

THEN YOU MAY USE SYMBOLS INSTEAD OF ADDRESSES IN YOUR DEBUGGING!

AFTER LOADING, DO:

+++MON

ON THE SAME LINE WILL APPEAR THE RESPONSE:

ROSY>

NOW YOU MAY SET BREAKPOINTS,

INSPECT MEMORY

MODIFY MEMORY

DECODE

SET REGISTERS,

ETC, ETC.

USUALLY, YOU WILL DO:

ROSY>GO START

OR

ROSY>GO 2100

ROSY>GO BEGIN OR

ONLY ONE THING NOW REMAINS TO BE DONE: 9

16

17

+++load, pim.bin

```
ROSY >
ROSY >decode 100 110
0100 12 40 NOP
0101 86 40 LDA #40
0103 80 10 SUBA #10
0105 87 010F STA #010F
0108 88 20 ADDA #20
010A 87 0110 STA #0110
010D 3F 00 MON #00
010F 30 50 LEAX 10,0
ROSY >m-li 100 11F
```

← FLEX COMMAND "LOAD"
← BACK TO ROSY
← CHECK PROGRAM IS IN MEMORY.

```
ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F MEM-LIST
0100 12 86 40 80 10 87 01 0F 8B 20 B7 01 10 3F 00 30 ..0.....?.0
0110 50 C8 A5 EC 4A 44 56 44 56 44 56 17 1F F2 ED 4A P...JDDVDDV...J
ROSY >m-mo 10F
010F 30 00
0110 50 00
0111 C8 .
ROSY >
ROSY >go 100
```

← SET 2 BYTES TO p.

← RUN THE PROGRAM

ROSY >m-li 100 11F

```
ADDR 0 1 2 3 4 5 6 7 8 9 A B C D E F
0100 12 86 40 80 10 87 01 0F 8B 20 B7 01 10 3F 00 30 ..0.....?.0
0110 50 C8 A5 EC 4A 44 56 44 56 44 56 17 1F F2 ED 4A P...JDDVDDV...J
ROSY >f
```

← BACK TO FLEX RESULT ARE THERE!

+++delete, pim.bin ← DELETE A FILE FROM DISK

DELETE "0.PIM.BIN" ? y
ARE YOU SURE? y

Is IT REALLY WHAT YOU WANT?

+++files,0 ← CHECK THAT FILE WAS DELETED

FILES ON DRIVE NUMBER 0

ERRORS.SYS	FLEX.SYS	CAT.CMD	DIR.CMD	COPY.CMD
LIST.CMD	ASN.CMD	DELETE.CMD	RENAME.CMD	TTYSET.CMD
P.CMD	SAVE.CMD	EDIT.CMD	ASMB.CMD	ASM.CMD
APPEND.CMD	BUILD.CMD	EXEC.CMD	JUMP.CMD	DATE.CMD
O.CMD	LINK.CMD	VERSION.CMD	PROT.CMD	VERIFY.CMD
PRINT.CMD	QCHECK.CMD	I.CMD	XOUT.CMD	FUTLDR.CMD
HELP.CMD	TMODE.CMD	GETVAX.CMD	PRIVAX.CMD	FILES.CMD
DUMPDISK.CMD	FORMAT.CMD	LOAD.CMD	COPYF.CMD	CREATE.CMD
FILETEST.CMD	FREE.CMD	RUN.CMD	BASIC.CMD	MTEST09.CMD
EPROM.CMD	WPS.CMD	DELETE.HLP	BUILD.HLP	DATE.HLP
APPEND.HLP	ASN.HLP	FREE.HLP	GET.HLP	VERIFY.HLP
JUMP.HLP	CAT.HLP	COPYF.HLP	LIST.HLP	EXEC.HLP
COPY.HLP	I.HLP	P.HLP	PRINT.HLP	O.HLP
XOUT.HLP	RENAME.HLP	SAVE.HLP	QCHECK.HLP	WHELP.TXT
GUIDE.TXT	MEMO.TXT	MONCALLS.TXT	SINETAB.TXT	STARTUP.TXT
STARTUP2.TXT	DIVIDE.TXT	D_MULT.TXT	MOUSE.TXT	WELCOME.TXT
COPYD.TXT	SI.TXT	MOUSE.BIN	MOUSE.SYM	SI2.TXT
KERNEL.TXT	PIM.TXT	PIM.BAK		

+++copy, pim.txt, prime.txt

"PIM.BIN" HAS GONE!

KEEP
YOUR
FINGERS
CROSSED!