INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

System Software
CSN-252
One Pass Assembler

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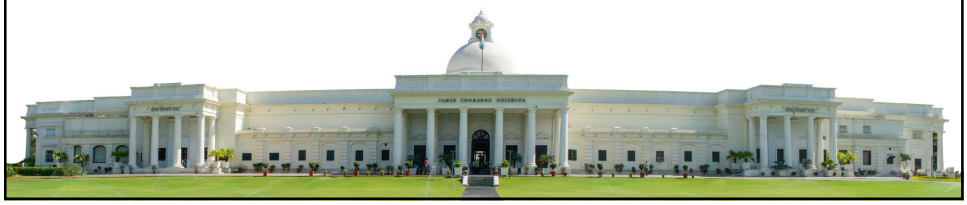

Assembler Design Options

One-pass assemblers

Multi-pass assemblers

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One-Pass Assemblers

- Main problem
  - forward references
    - data items
    - labels on instructions
- Solution
  - data items: require all such areas be defined before they are referenced
  - labels on instructions: no good solution

```
            JEQ   ENDFIL
            :
ENDFIL      LDA   EOF
```

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One-Pass Assemblers

- Two types of one-pass assembler
  - load-and-go
    - produces object code directly in memory for immediate execution
  - the other
    - produces usual kind of object code for later execution

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Load-and-go Assembler

- Characteristics
  - Useful for program development and testing
  - Avoids the overhead of writing the object program out and reading it back
  - Both one-pass and two-pass assemblers can be designed as load-and-go.
  - However one-pass also avoids the over head of an additional pass over the source program
  - For a load-and-go assembler, the actual address must be known at assembly time, we can use an absolute program

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Forward Reference in One-pass Assembler

- For any **symbol that has not yet been defined**
  1. Omit the address translation
  2. Insert the symbol into SYMTAB, and mark this symbol undefined
  3. The address that refers to the undefined symbol is added to a list of forward references associated with the symbol table entry
  4. when the definition for a symbol is encountered, the proper address for the symbol is then inserted into any instructions previously generated according to the forward reference list

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1		copy	start	1000	
2	1000	eof	byte	c'eof'	454f46
3	1003	zero	word	0	000000
4	1006	retadr	resw	1	
5	1009	length	resw	1	
6	100c	buffer	resw	4096	
7	200c	first	stl	retadr	141006
8	200f	cloop	jsub	rdrec	48
9	2012		lda	length	001009
10	2015		comp	zero	281003
11	2018		jeq	endfil	30
12	201b		j	cloop	30200f
13	201e	endfil	ldl	retadr	081006
14	2021		rsub		4c0000
	:				

eof	1000
zero	1003
retadr	1006
length	1009
buffer	100c
first	200c
cloop	200f
rdrec	* → 2010
endfil	201e

16	2024	input	byte	x'f1'	f1
17	2027	maxlen	word	4096	001000
18	202a	rdrec	ldx	zero	041003
19	202d		lda	zero	001003
22	2030	loop	td	input	e02024
23	2033		jeq	loop	302030
24	2036		rd	input	d82024
25	2039		comp	zero	281003
26	203a		jeq	exit	30
27	203d		stch	buffer,x	54900c
28	2040		tlx	maxlen	2c203a
29	2043		jlt	loop	382030
30	2046	exit	stx	length	101009
31	2049		rsub		4c0000
34			end	first	

Eof	1000
Zero	1003
Retadr	1006
Length	1009
Buffer	100c
First	200c
Cloop	200f
Rdrec	202a
Endfil	201e
Input	2024
Maxlen	2027
Loop	2030
Exit	* →203b

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Load-and-go Assembler (Cont.)

- At the end of the program
  - any SYMTAB entries that are still marked with * indicate undefined symbols
  - search SYMTAB for the symbol named in the END statement and jump to this location to begin execution
- The actual starting address must be known at the assembly time

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Producing Object Program

- When external working-storage devices are not available or too slow (for the intermediate file between the two passes)
- Solution:
  - When definition of a symbol is encountered, the assembler must generate another Text record with the correct operand address
  - The loader is used to complete forward references that could not be handled by the assembler
  - The object program records must be kept in their original order when they are presented to the loader

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1		copy	start	1000	
2	1000	eof	byte	c'eof'	454f46
3	1003	zero	word	0	000000
4	1006	retadr	resw	1	
5	1009	length	resw	1	
6	100c	buffer	resw	4096	
7	200c	first	stl	retadr	141006
8	200f	cloop	jsub	rdrec	48
9	2012		lda	length	001009
10	2015		comp	zero	281003
11	2018		jeq	endfil	30
12	201b		j	cloop	30200f
13	201e	endfil	ldl	retadr	081006
14	2021		rsub		4c0000

HCOPY 001000 000000
T001000 06 454f46 000000
T00200C 12 141006 480000 001009 281003 300000 30200f
T002019 02 201e
T00201e -- 081006 4c0000

16	2024	input	byte	x'f1'	f1
17	2025	maxlen	word	4096	001000
18	2028	rdrec	ldx	zero	041003
19	202b		lda	zero	001003
22	202e	loop	td	input	e02024
23	2031		jeq	loop	30202e
24	2034		rd	input	d82024
25	2037		comp	zero	281003
26	203a		jeq	exit	30
27	203d		stch	buffer,x	54900c
28	2040		tlx	maxlen	2c2024
29	2043		jlt	loop	38202e
30	2046	exit	stx	length	101009
31	2049		rsub		4c0000
			end	first	

HCOPY 001000 000000
T001000 06 454f46 000000
T00200C 12 141006 480000 001009 281003 300000 30200f
T002019 02 201e
T00201e 0A 081006 4c0000 f1 001000
T002010 02 2028
T002028 -- 041003 001003 ……
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