Microprocessors & Interfacing

MASM

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Exercise

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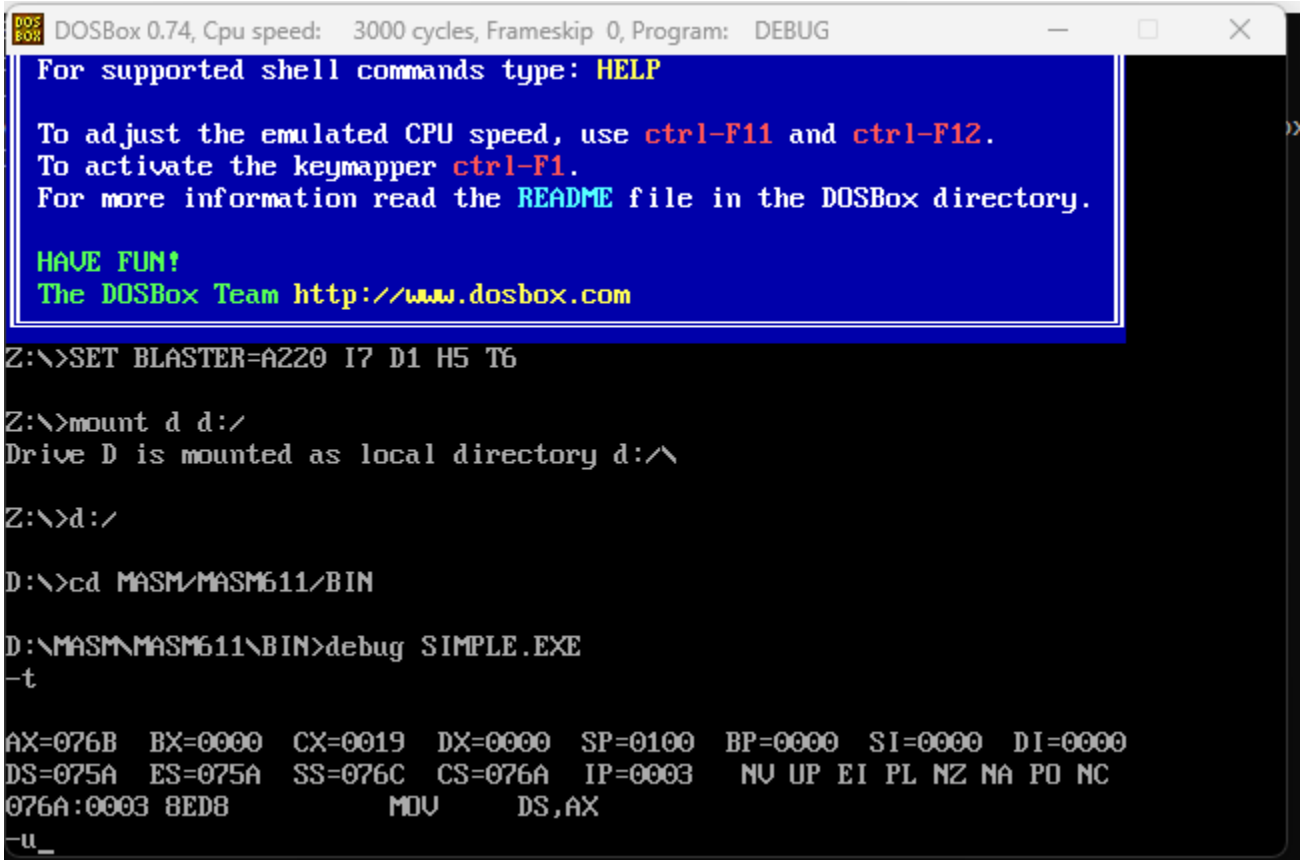
Write a program to take two numbers as input from the user and print its addition and subtraction results.

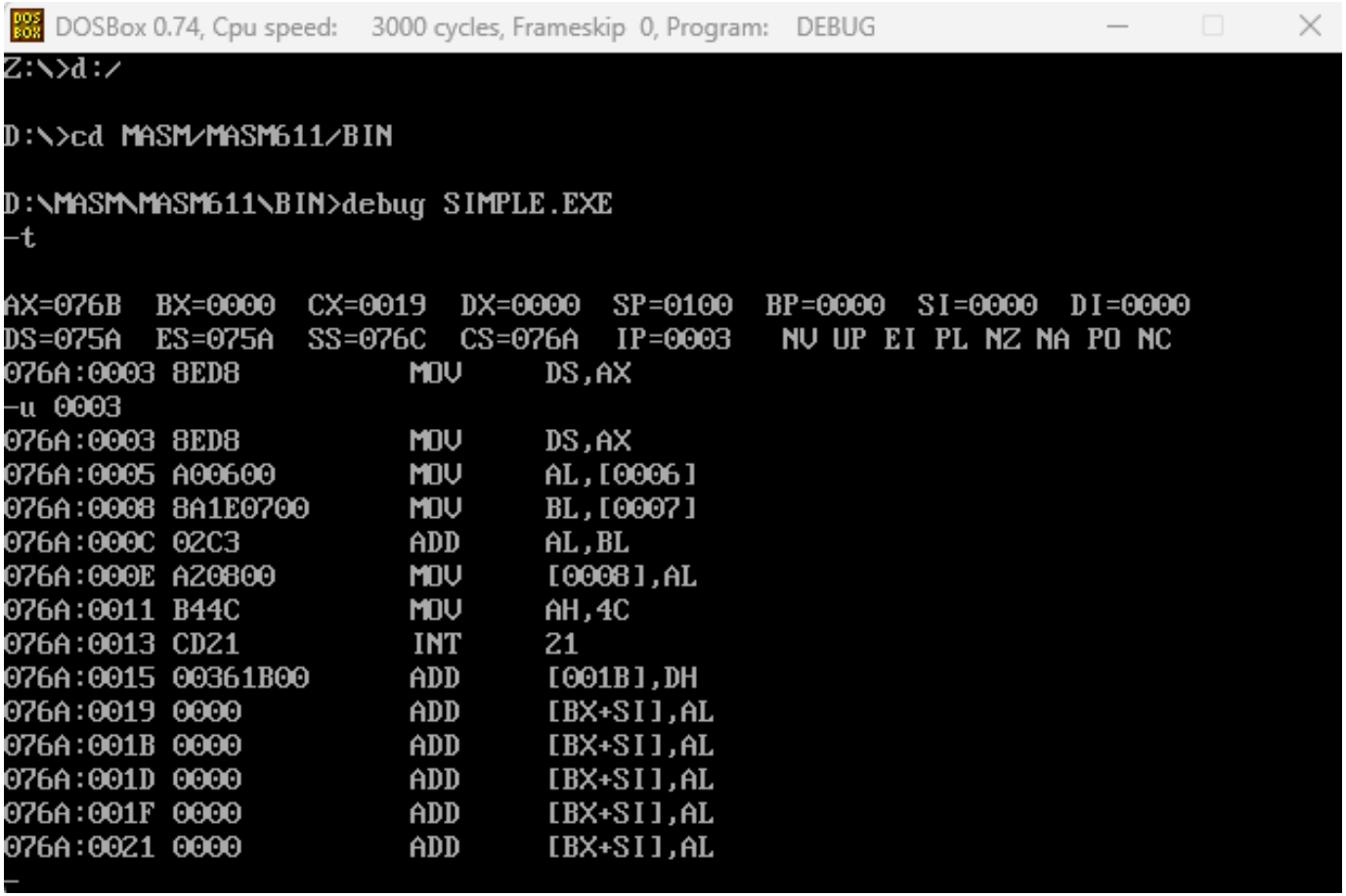
Questions

- .exit and int 21h with AH= 4CH is same?
- Why cant we move data to DS directly?

How to debug in MASM?



How to debug in MASM?



ASCII Conversion

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- Input from and output to the console is performed in ASCII format

Hex	Value	Hex	Value	Hex	Value	Hex	Value	Hex	Value	Hex	Value	Hex	Value	Hex	Value
00	NUL	10	DLE	20	SP	30	0	40	@	50	P	60	`	70	p
01	SOH	11	DC1	21	!	31	1	41	A	51	Q	61	a	71	q
02	STX	12	DC2	22	"	32	2	42	B	52	R	62	b	72	r
03	ETX	13	DC3	23	#	33	3	43	C	53	S	63	c	73	s
04	EOT	14	DC4	24	$	34	4	44	D	54	T	64	d	74	t
05	ENQ	15	NAK	25	%	35	5	45	E	55	U	65	e	75	u
06	ACK	16	SYN	26	&	36	6	46	F	56	V	66	f	76	v
07	BEL	17	ETB	27	'	37	7	47	G	57	W	67	g	77	w
08	BS	18	CAN	28	(	38	8	48	H	58	X	68	h	78	x
09	HT	19	EM	29	)	39	9	49	I	59	Y	69	i	79	y
0A	LF	1A	SUB	2A	*	3A	:	4A	J	5A	Z	6A	j	7A	z
0B	VT	1B	ESC	2B	+	3B	;	4B	K	5B	[	6B	k	7B	{
0C	FF	1C	FS	2C	,	3C	<	4C	L	5C	\	6C	l	7C	|
0D	CR	1D	GS	2D	-	3D	=	4D	M	5D	]	6D	m	7D	}
0E	SO	1E	RS	2E	.	3E	>	4E	N	5E	^	6E	n	7E	~
0F	SI	1F	US	2F	/	3F	?	4F	O	5F	_	6F	o	7F	DEL

ASCII Conversion

How to perform the conversion?

E.g. Input: 8h

Interrupts – Int 21h

Function 1- Character input with echo

Action:	Reads a character from the standard input device and echoes it to the standard output device. If no character is ready it waits until one is available. I/O can be re-directed, but prevents detection of OEF.
On entry:	AH = 01h
Returns:	AL = 8 bit data input

Interrupts – Int 21h

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Function 2 - Character output

Action:	Outputs a character to the standard output device. I/O can be re-directed, but prevents detection of 'disc full'.
On entry:	AH = 02h DL = 8 bit data (usually ASCII character)
Returns:	Nothing

Interrupts – Int 21h

Function 08- Character input with no echo

Action:	Reads a character from the standard input device without copying it to the display. If no character is ready it waits until one is available.
On entry:	AH = 08h
Returns:	AL = 8 bit data input

Interrupts – Int 21h

Function 09- Output character string

Action:	Writes a string to the display.
On entry:	AH = 09h DS:DX = segment:offset of string
Returns:	Nothing
Notes:	The string must be terminated by the $ character (24h), which is not transmitted. Any ASCII codes can be embedded within the string.

Interrupts – Int 21h

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Function 0Ah - Buffered input

Action:	Reads a string from the current input device up to and including an ASCII carriage return (0Dh), placing the received data in a user-defined buffer Input can be re directed, but this prevents detection of EOF
On entry:	AH = 0Ah DS:DX = segment:offset of string buffer
Returns:	Nothing
Notes:	The first byte of the buffer specifies the maximum number of characters it can hold (1 to 255). This value must be supplied by the user. The second byte of the buffer is set by DOS to the number of characters actually read, excluding the terminating RETURN. If the buffer fills to one less than its maximum size the bell is sounded and subsequent input is ignored. If a CTRL-C is detected an INT 23h is executed. Normal DOS keyboard editing is supported during input

How to enter two digit number?

```
mov ah,0ah
lea dx,num1
int 21h
```

Converting to Hexadecimal

```
convert_loop:
    mov al, [si]          ; Load ASCII character into AL
    cmp al, '0'
    jb input_error        ; Jump if input is not a valid hexadecimal digit
    cmp al, '9'
    jbe numeric_digit     ; Jump if input is between '0' and '9'
    cmp al, 'A'
    jb input_error        ; Jump if input is not a valid hexadecimal digit
    cmp al, 'F'
    ja input_error        ; Jump if input is not a valid hexadecimal digit
    sub al, 'A'; Convert ASCII character 'A'-'F' to numeric value 10-15
    add al, 0ah
```

Numerical value in Hex

```
numeric_digit:
    and al, 0FH             ; Mask high nibble (if any)
    shl ax, cl              ; Shift AL left by 4 (multiply by 16)
    add hex_number, ax      ; Add to the result
    dec cl                  ; Decrement loop counter
    inc si                  ; Move to next character
    loop convert_loop       ; Repeat for the second nibble
```

Exercise

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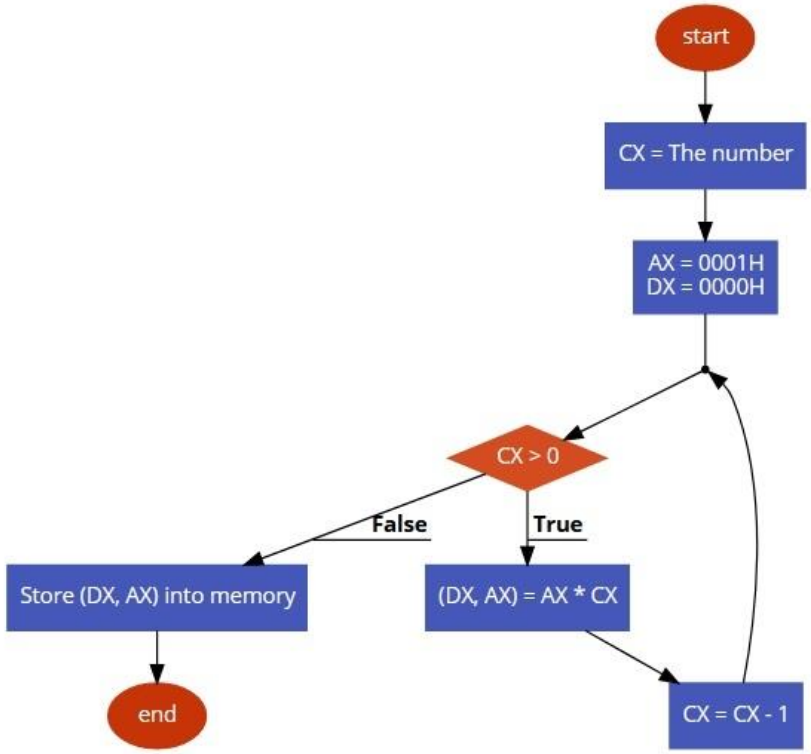
Factorial of a number



Exercise

Can you use stack to solve factorial problem?

References

- http://bbc.nvg.org/doc/Master%20512%20Technical%20Guide/m512techb_int21.htm

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Thank You