AACS3064
Computer Systems Architecture

Chapter 10: Keyboard & Screen Processing

Chapter Overview

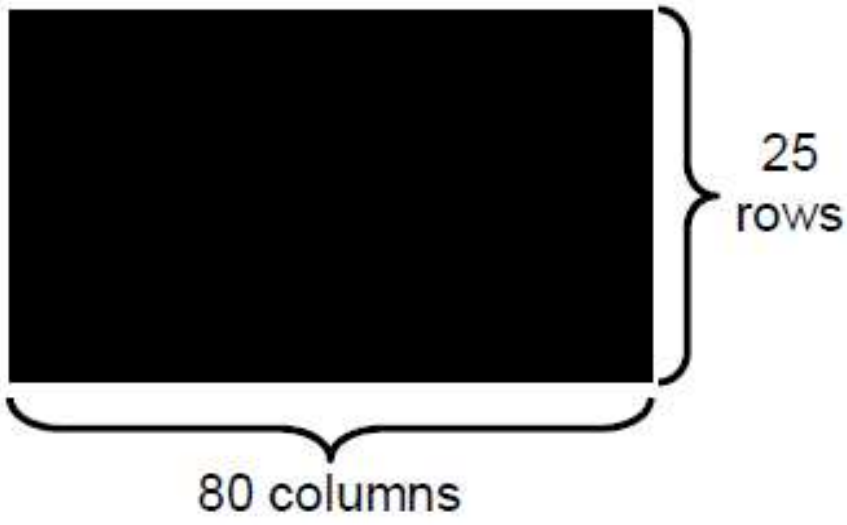
1) Screen Features
2) BIOS Interrupt (INT 10H)
   - Setting the Cursor
   - Scroll the screen
3) MS-DOS Function Calls (INT 21H)
   - Screen Output
   - Keyboard input

1. Screen Features

1. Screen Features

Screen features

- 25 (0 – 24) rows and 80 (0 – 79) columns .
- Upper left at 00, 00
- Upper right at 00, 79
- Lower left at 24, 00
- Lower right at 24, 79
- Center at 12, 39 or 12, 40



1. Screen Features (Continued)

Screen features

Screen location	Decimal format		Hex format	
	Row	Column	Row	Column
Upper left corner	00	00	00H	00H
Upper right corner	00	79	00H	4FH
Center of screen	12	39/40	0CH	27H/28H
Lower left corner	24	00	18H	00H
Lower right corner	24	79	18H	4FH

1. Screen Features (Continued)

Screen features

- The **INT** (interrupt) instruction handles input and output for most purposes.
- Low level interrupts (**INT 10H function**)
  - go directly to BIOS
  - For screen handling
- Higher level interrupts (**INT 21H function**)
  - go to the operating systems
  - For displaying output and accepting keyboard input

1. Screen Features (Continued)

Screen features

- Particular action needed :
  Insert a function value in AH register to identify the type of service the interrupt is to be perform.

INT	10H FUNCTIONS	INT	21H FUNCTIONS
02H	Set Cursor	02H	Display Character
06H	Scroll Screen	07H	Display Character
		09H	Display String
		0AH	Input from Keyboard
		3FH	Input from keyboard
		40H	Display string

2. BIOS Interrupt (INT 10H)

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Setting the cursor

- The cursor' s position determines where the next character is to be displayed or entered.
- Function : 02H

```
MOV   AH, 02H     ;set function (cursor)
MOV   BH, 00      ;set page number 0
MOV   DH, 08      ;set row 8
MOV   DL, 15      ;set column 15
INT   10H         ;Call interrupt service
```

2. BIOS Interrupt (INT 10H) (Continued)

Setting the cursor

- To set the row and column in DX, one MOV instruction can be used with an immediate hex value:

```
MOV   AH, 02H      ;set function (cursor)
MOV   BH, 00       ;set page number 0
MOV   DX, 080FH    ;set row 08 and column 15
INT   10H          ;Call interrupt service
```

2. BIOS Interrupt (INT 10H) (Continued)

Clearing the screen

- **INT 10H function 06H** → Clear or scroll the screen.
- You can clear all or part of a display beginning at any screen location and ending at any higher-numbered location lower on the screen.

2. BIOS Interrupt (INT 10H) (Continued)

Clearing the screen

- Load these registers:

AH = function 06H
AL = number of lines to scroll, or
00H for full screen
BH = attribute (color, blinking, etc.)
CX = starting row:column
DX = ending row:column

2. BIOS Interrupt (INT 10H) (Continued)

Attributes

- The attribute byte has the following format :

	Background				Foreground			
Attribute :	BL	R	G	B	I	R	G	B
Bit number :	7	6	5	4	3	2	1	0

- **Bit 7 (BL)** sets blinking (may be disabled)
- **Bits 6 – 4** determine chars' background color
- **Bit 3 (I)** sets normal (if 0) or high intensity (if 1)
- **Bits 2 – 0** determine chars' foreground color

2. BIOS Interrupt (INT 10H) (Continued)

Attributes

- Background : 8 colors
- Foreground : 16 colors

COLOR	I	R	G	B	HEX	COLOR	I	R	G	B	HEX
Black	0	0	0	0	0	Gray	1	0	0	0	8
Blue	0	0	0	1	1	Light Blue	1	0	0	1	9
Green	0	0	1	0	2	Light green	1	0	1	0	A
Cyan	0	0	1	1	3	Light Cyan	1	0	1	1	B
Red	0	1	0	0	4	Light red	1	1	0	0	C
Magenta	0	1	0	1	5	Light Magenta	1	1	0	1	D
Brown	0	1	1	0	6	Yellow	1	1	1	0	E
White	0	1	1	1	7	Bright white	1	1	1	1	F

2. BIOS Interrupt (INT 10H) (Continued)

Clearing the screen

- E.g. Clear the entire screen:

```
MOV   AX, 0600H          ;AH = 06 (scroll)
                         ;AL = 00 (full screen)
MOV   BH, 71H            ;White background (7)
                         ;Blue foreground (1)
MOV CX, 0000H            ;Upper left row:column
MOV DX, 184FH            ;Lower right row:column
INT   10H                ;Call interrupt service
```

2. BIOS Interrupt (INT 10H) (Continued)

Clearing the screen

- E.g.
  Scroll a screen window from row 05, column 00 through row 12, column 79:

```
MOV   AX, 0600H
MOV   BH, 71H
MOV CX, 0500H              ;Upper left row:column
MOV DX, 0C4FH              ;Lower right row:column
INT   10H                  ;Call interrupt service
```

3. MS-DOS Function Calls (INT 21H)

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Screen display - single character

- Load character to display in DL register and function code 02H in AH register.

```
MOV   AH, 02H      ;Request display char
MOV   DL, 61H      ;Char to display
                   ;ASCII for 'a'
INT   21H          ;Call interrupt service
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Screen display – string

- Requires definition of a display string in data area, immediately followed by a dollar sign ($ or 24H) delimiter, which the operation uses to end the display.

```
MSGDB     'Hello!', '$'
MSG1      DB     'Hello!$'

MOVAH, 09H
LEADX, MSG      ; Load address
INT21H
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Screen display - new line

- To display cursor on new line, use Carriage Return (CR) character – **0DH** and Line Feed (LF) character – **0AH**:

```
MOV   AH, 02H     ;For character display
MOV   DL, 0DH     ;CR
INT   21H         ;Display character
MOV   DL, 0AH     ;LF
INT   21H         ;Display character
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input - single character

- INT 21H function 01H → to accept single character from keyboard.
- Load 01H in AH register, character entered is stored in AL register.

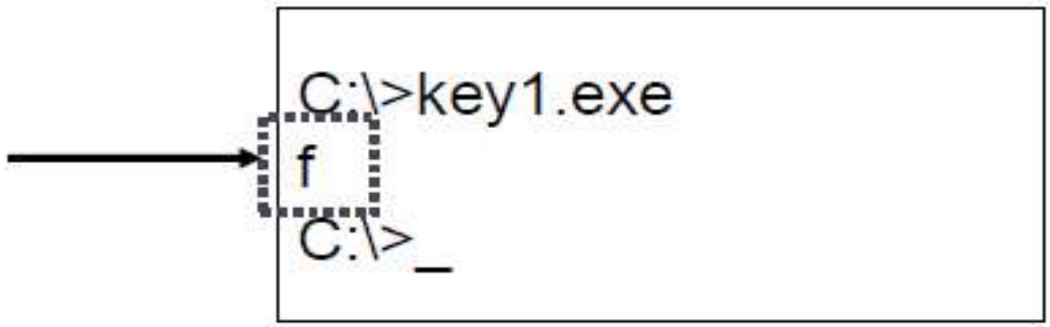
```
MOV   AH, 01H      ;Request keyboard input
INT   21H          ;Call interrupt service
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input - single character

- Result on MS-DOS prompt:

The entered character is echoed on the screen



3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input - character without echo

- INT 21H function 07H → similar to 01H except character entered is not echoed on screen.
- Could be used to key in a password that is to be invisible.

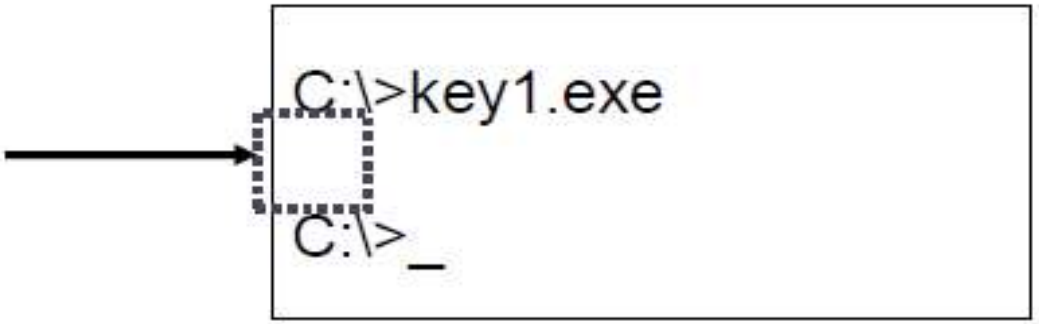
```
MOV   AH, 07H      ;Request keyboard input
INT   21H          ;Call interrupt service
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input - character without echo

- Result on MS-DOS prompt:

The entered character is not echoed on the screen



3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input - string

- INT 21H function 0AH → to accept more than one character from keyboard
- The input area for keyed-in characters requires a **parameter list** containing specified fields that the INT operation is to process.

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input –string

- Parameter list :

1. The name of the parameter list
2. maximum number of input characters.
3. actual number of characters that were entered.
4. The characters that were entered.

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input – string

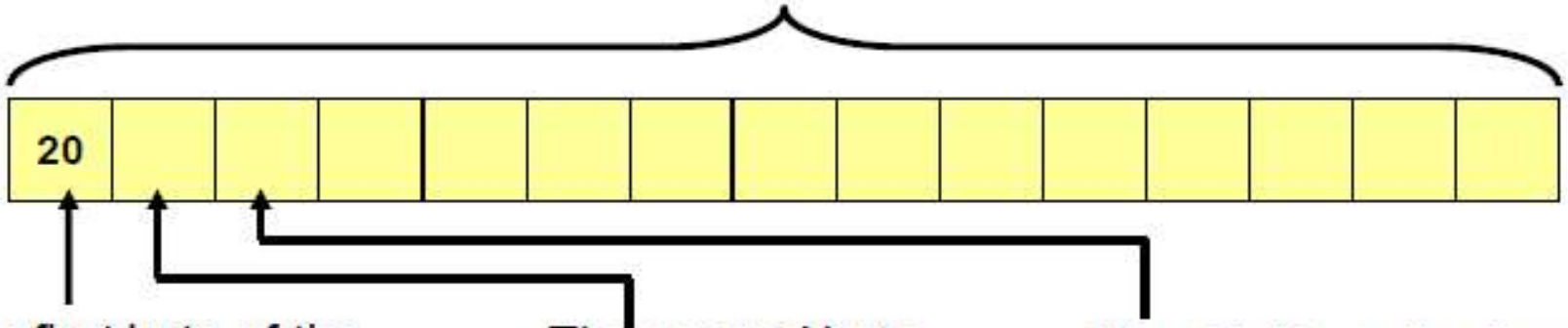
- E.g.

```
; Define parameter list for keyboard input area.

PARA_LIST     LABEL  BYTE          ; name
MAX_LEN       DB     20            ; Max no of input chars
ACT_LEN       DB     ?             ; Actual no of input chars
KB_DATA       DB     20  DUP(' ');Data area to store
                                   ;characters entered
; Request keyboard input

MOV           AH, 0AH              ;Request keyboard input
LEA           DX, PARA_LIST        ;Load address of
                                   ;parameter list
INT           21H                  ;Call interrupt service
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input – string

The LABEL directive tells the assembler to align on a byte boundary and gives the location the name PARA_LIST



The first byte of the parameter list contains the max no of input chars. Max input = FFH or 255

The second byte contains the actual no of chars typed, stored in binary format.

The third byte begins a field that is to contain the typed chars, from left to right.

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input – string

- E.g.
  key in a name Wilson+<Enter>

  The parameter list appears :

ASCII:	20	6	W	i	l	s	o	n	#			...
Hex:	14	06	57	69	6C	73	6F	6E	0D	20	20	20	...

3. MS-DOS Function Calls (INT 21H) (Continued)

Keyboard input – string

- This operation accepts and acts on <Backspace> character, but does not add it to the count.
- This operation bypasses extended function keys such as F1, Home, PgUp and Arrows.
  - If you expect the a user to press any of them, use INT 16H or INT 21H function 01H.

3. MS-DOS Function Calls (INT 21H) (Continued)

Clearing the Input Area

- Each character keyed in replaces the previous contents in the input area and remains there until other characters replace them.
- Consider the following successive input:

Input	PARA_LIST (HEX)												
1. Moon	20	04	4D	6F	6F	6E	0D	20	20	20	20	...	20
2. Frank	20	05	46	72	61	6E	6B	0D	20	20	20	...	20
3. Ada	20	03	41	64	61	0D	6B	0D	20	20	20	...	20

3. MS-DOS Function Calls (INT 21H) (Continued)

Clearing the Input Area

- To clear KB_DATA prior to prompting for a name:

```
MOV   CX, 20              ;Initialize for 20 loops
MOV   SI, 0000            ;Start position for name

L10:
MOV   KB_DATA[SI], 20H ;Move blank to name
INC SI                    ;Increment for next char
LOOP L10                  ;Repeat 20 times
```

3. MS-DOS Function Calls (INT 21H) (Continued)

Clearing the Input Area

- Clearing the input area solves the problem of short names being followed by previous data.
- For faster processing, you could clear only positions to the right of the most recently entered name.

3. MS-DOS Function Calls (INT 21H) (Continued)

File Handles

- The keyboard and the screen can be thought of as a "file" , just like other files on your system.

File Handles :

00 for input : normally the keyboard

01 for output : normally the screen

02 for error output : the screen

03 for auxiliary device

04 for printer

3. MS-DOS Function Calls (INT 21H) (Continued)

File Handles – screen output

```
.DATA
      Prompt      DB    'Part Number : ', 0DH, 0AH
.CODE
      MOV AH, 40H ;request display
      MOV BX, 01        ;screen output
      MOV CX, 16        ;number of characters
      LEA DX, PROMPT
      INT 21H
```

3. MS-DOS Function Calls (INT 21H) (Continued)

File Handles – keyboard input

```
.DATA
      KBINPUT     DB    20 DUP(''); Input area
.CODE
      MOV AH, 3FH ;request keyboard input
      MOV BX, 00          ;for keyboard
      MOV CX, 20          ;max 20 chars
      LEA DX, KBINPUT           ; Input area
      INT 21H
```

- E.g. Typing "Intertech Corp"

|Intertech Corp|0DH|0AH

Chapter Review

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3) MS-DOS Function Calls (INT 21H)
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   - Keyboard input