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Tanggal Praktikum : 17 September 2019



```

Bochs for Windows - Console
Microsoft Windows [Version 6.3.9600]
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C:\Users\ASUS_White>cd..
C:\Users>cd..
C:\>cd os
C:\OS>setpath
C:\OS>Path=C:\OS\Dev-Gpp\bin;C:\OS\Bochs-2.3.5;c:\OS\Perl;C:\Windows;C:\Windows\System32
C:\OS>cd lab
C:\OS\Lab>cd lab2
C:\OS\Lab\Lab2>dir
Volume in drive C has no label.
Volume Serial Number is D03B-D6E4

Directory of C:\OS\Lab\Lab2

17/09/2019 18:18 <DIR> .
17/09/2019 18:18 <DIR> ..
18/09/2019 08:49 8.352 bochs.log
15/12/2006 16:18 1.625 bochsrc.brcx
17/09/2019 17:29 15.876 boot.asm
17/09/2019 17:29 112 dosasm.asm
15/12/2006 13:52 78 dosfp.bat
17/09/2019 18:26 1.474.560 floppy.img
15/12/2006 17:47 7.712 kernel.asm
17/09/2019 18:18 611 kernel1.htm
15/12/2006 16:21 228 Malefile
15/12/2006 12:20 44 s.bat
10 File(s) 1.589.872 bytes
2 Dir(s) 8.399.781.888 bytes free

C:\OS\Lab\Lab2>cd..
C:\OS\Lab>cd..
C:\OS>cd Bochs-2.3.5
C:\OS\Bochs-2.3.5>bximage
=====
          bximage
=====
Disk Image Creation Tool for Bochs
$Id: bximage.c,v 1.32 2006/06/29 07:29:33 vruppert Exp $
=====

Do you want to create a floppy disk image or a hard disk image?
Please type hd or fd. [hd]d

Choose the size of floppy disk image to create, in megabytes.
Please type .0.16, .0.18, .0.32, .0.36, .0.72, 1.2, 1.44, 1.68, 1.72, or 2.88.
[1.44] 1.44

I will create a floppy image with

 1 heads
 2 sectors per track=18
 total sectors=2880
 total bytes=1474560

What should I name the image?
[floppya].img floppy.img

The disk image 'floppya.img' already exists. Are you sure you want to replace it?
Please type yes or no. [no] yes

Writing: [] Done.

I wrote 1474560 bytes to floppy.img.

The following line should appear in your bochsrc:
  floppy: image="Floppya.img", status=inserted
(The line is stored in your windows clipboard, use CTRL-U to paste)

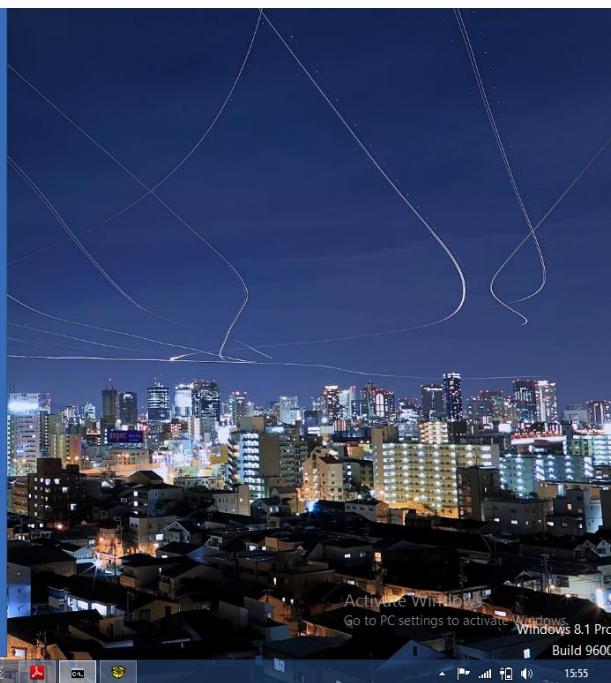
Press any key to continue
C:\OS\Bochs-2.3.5>dir
Volume in drive C has no label.
Volume Serial Number is D03B-D6E4

Directory of C:\OS\Bochs-2.3.5

07/09/2019 11:34 <DIR> .
07/09/2019 11:34 <DIR> ..
15/09/2007 14:24 131.072 BIOS-bochs-latest
16/09/2007 11:01 65 BIOS-bochs-legacy
16/09/2007 16:02 1.540.896 bochs.brcx
21/11/2002 09:08 766 bochs.ico
16/09/2007 16:22 2.248.192 bochsdby.exe
14/10/2006 11:40 10.599 bochsout.txt
16/09/2007 15:27 35.599 bochsout-sample.txt
11/12/2006 08:51 1.610 bochsrc.brcx
16/09/2007 16:22 11.776 bxcommit.exe
16/09/2007 16:22 18.432 bximage.exe
16/09/2007 16:22 131.072 bximage.txt
09/07/2005 01:39 26.932 COPYING.txt
11/12/2006 08:43 262.144 disk
03/09/2015 13:42 <DIR> dixlinux
03/09/2015 13:42 <DIR> dos
03/09/2015 13:42 <DIR> dos
18/09/2019 15:52 1.474.560 floppy.img
03/09/2015 13:42 <DIR> keymaps
16/09/2007 15:22 7.688 penguin.exe
21/11/2002 09:08 3.310 penguin.ico
16/09/2007 15:58 3.901 README.txt
10/04/2001 02:04 10.012 sb16ctrl.exe

C:\OS\Bochs-2.3.5>

```



```

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(The line is stored in your windows clipboard, use CTRL-U to paste)

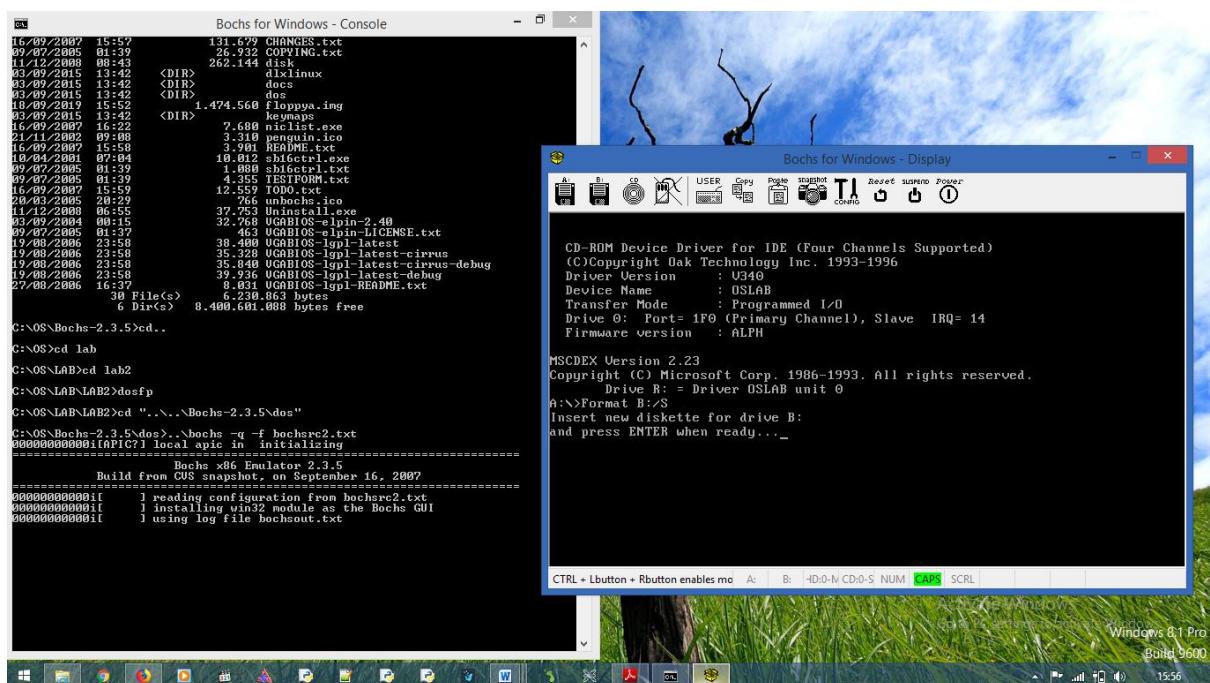
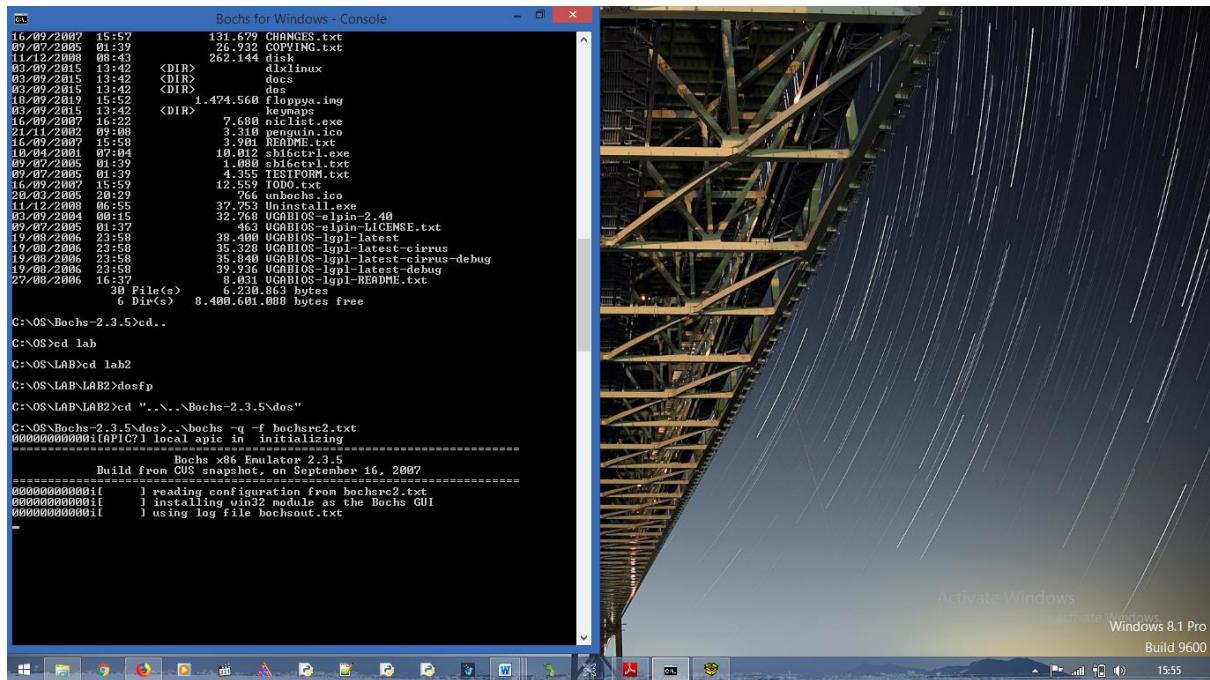
Press any key to continue
C:\OS\Bochs-2.3.5>dir
Volume in drive C has no label.
Volume Serial Number is D03B-D6E4

Directory of C:\OS\Bochs-2.3.5

07/09/2019 11:34 <DIR> .
07/09/2019 11:34 <DIR> ..
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16/09/2007 11:01 65 BIOS-bochs-legacy
16/09/2007 16:02 1.540.896 bochs.brcx
21/11/2002 09:08 766 bochs.ico
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11/12/2006 08:51 1.610 bochsrc.brcx
16/09/2007 16:22 11.776 bxcommit.exe
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16/09/2007 15:22 7.688 penguin.exe
21/11/2002 09:08 3.310 penguin.ico
16/09/2007 15:58 3.901 README.txt
10/04/2001 02:04 10.012 sb16ctrl.exe

C:\OS\Bochs-2.3.5>

```



Command Prompt

```
11/12/2008 06:55 37,753 Uninstall.exe
03/09/2008 00:15 32,768 UGRBIOS-rlwpin
09/07/2005 01:37 463 UGRBIOS-rlpin
19/06/2006 23:58 38,400 UGRBIOS-1gpl
09/06/2006 23:58 39,736 UGRBIOS-1gpl
19/06/2006 23:58 38,840 UGRBIOS-1gpl
19/06/2006 23:58 39,936 UGRBIOS-1gpl
27/08/2006 16:11 8,031 UGRBIOS-1gpl
30 File(s) 8.031,063 bytes
6 Dir(s) 0.400,601,000 bytes Free

C:\OS\Bochs-2.3.5>cd..
C:\OS>cd lab
C:\OS\LAB>ed lab2
C:\OS\LAB\LAB2>dfsp
C:\OS\LAB\LAB2>ed "..\..\Bochs-2.3.5\dos"
C:\OS\Bochs-2.3.5\dos>.bochs -q -f bochsrc2.txt
000000000001(APIC7) local apic in initializing
Bochs is exiting with the following message:
[VGAC] 1 POWER button turned off.

C:\OS\Bochs-2.3.5\dos>cd "C:\OS\LAB\LAB2"
C:\OS\LAB\LAB2>
C:\OS\LAB\LAB2>..\..\bochs-2.3.5\bochs -q -f boch
000000000001(APIC7) local apic in initializing
Bochs is exiting with the following message:
[VGAC] 1 POWER button turned off.

C:\OS\LAB\LAB2>boot.asm
C:\OS\LAB\LAB2>
```

boot.asm - Notepad

```
; LAB-2 : boot-strap loader - real mode
; digunakan untuk memindahkan file OS/kernel
; dari floppy disk ke dalam RAM (memori kerja PC).
;*****
```

;Mengatur mode kerja 16 bit (real-mode)
[BITS 16]

;Menentukan lokasi awal dari program
[ORG 0x0000]

```
=====
;(1) BLOK STARTER
; loncat ke label START
=====
jmp START

;(2) BLOK ID FAT12
; Keterangan format FAT12 pada floppy disk
=====
```

boot.asm - Notepad

```
; **** LAB-2 : boot-strap loader - real mode
; digunakan untuk memindahkan file OS/kernel
; dari floppy disk ke dalam RAM (memori kerja PC).
;*****  
  
; Mengatur mode kerja 16 bit (real-mode)
[BITS 16]  
  
; Menentukan lokasi awal dari program
[ORG 0x0000]  
  
=====  
;(1) BLOK STARTER
; loncat ke label START  
=====  
jmp START  
  
=====  
;(2) BLOK ID FAT12
; Keterangan format FAT12 pada floppy disk  
=====  
  
OEM_ID db "MY -OS"
BytesPerSector dw 0x0200
SectorsPerCluster db 0x01
ReservedSectors dw 0x0001
TotalFATs db 0x02
MaxRootEntries dw 0x00E0
TotalSectorsSmall dw 0x0840
MediaDescriptor db 0xF0
SectorsPerFAT dw 0x0009
SectorsPerTrack dw 0x0012
NumHeads dw 0x0002
HiddenSectors dd 0x00000000
TotalSectorsLarge dd 0x00000000
```

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Go to PC settings to activate Windows.

boot.asm - Notepad

```
TotalSectorsLarge dd 0x00000000
DriveNumber db 0x00
Flags db 0x00
Signature db 0x29
VolumeID dd 0xFFFFFFFF
VolumeLabel db "QUASI BOOT"
SystemID db "FAT12 "  
  
=====  
;(3) Blok BOOT CODE  
=====  
START:  
; Mengatur lokasi kode program pada alamat 7C00:0000, dan mengatur REGISTER SEGMENT
cli ; matikan aktifitas interupsi
    mov ax, 0x07C0
    mov ds, ax
    mov es, ax
    mov fs, ax
    mov gs, ax  
  
; Mengatur lokasi stack
    mov ax, 0x0000
    mov ss, ax
    mov sp, 0xFFFF ; sp bergerak dari alamat atas ke bawah
    sti ; aktifkan aktifitas interupsi  
  
; Menampilkan text di layar
    mov si,msgLoading ; mengambil lokasi text yang di simpan dalam 'msgloading'
    call DisplayMessage  
  
LOAD_ROOT:  
; menghitung ukuran 'root directory' dan menyimpannya dalam register 'cx'
    xor cx,cx
    xor dx,dx
    mov ax,0x0020 ; Ukuran satu nama direktori sepanjang 32 byte
```

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```

bootasm - Notepad
File Edit Format View Help
        mov     ax,0x0020          ; Ukuran satu nama direktori sepanjang 32 byte
        mul     WORD [MaxRootEntries]    ; Total lokasi direktori 32 x 224 (heksa 0x00E0)=7168
        div     WORD [BytesPerSector]    ; lokasi sektor yang digunakan untuk menyimpan direktori 7168/512 (0x0200) = 14
        xchg   ax, cx              ; Ukuran 'root direktori' = 14 sektor

; menghitung jumlah sektor yang digunakan untuk menyimpan FAT
; untuk mencari lokasi awal sektor ROOT DIREKTORI di simpan di register 'ax'
; hasil disimpan pada variabel 'datasector'
        mov     al,BYTE [TotalFATs]      ; jumlah FAT (2 copy)
        mul     WORD [SectorsPerFAT]    ; dikalikan dengan jumlah sektor yang digunakan FAT (9 sektor/FAT)
        add     ax, WORD [ReservedSectors] ; tambah cadangan sektor (1 sektor) simpan di 'ax'
        mov     WORD [datasector], ax    ; pindahkan hasilnya ke variabel 'datasector'(<19 sektor)
        add     WORD [datasector], cx    ; tambah dengan ukuran 'root direktori' (14),
        ; jadi total 33 sektor untuk menyimpan 2 FAT (Field Allocation Table)
        ; dan data 'ROOT DIREKTORI'

;
; Memindahkan isi root direktori ke memori RAM pada alamat 7C00:0200
;

        mov     bx, 0x0200            ; lokasi awal memori untuk menampung pembacaan sektor
        call    ReadSectors

;
; mencari nama file OS
;
        mov     cx, WORD [MaxRootEntries] ; baca semua file dalam root direktori
        mov     di, 0x0200              ; lokasi awal berisi copy ROOT DIREKTORI

.LOOP:
        push   cx                  ; ukuran nama FILE dan DIREKTORI sebanyak 11 karakter
        mov     cx, 0x000B            ; Mengambil nama FILE yang dicari
        mov     si, ImageName         ; nama FILE tersimpan dalam variabel ImageName
        ; file diberi nama 'MYKERNELBIN'

        push   di                  ; Bandingkan dengan daftar file root direktori
        rep    cmpsb

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```

```

bootasm - Notepad
File Edit Format View Help
        rep    cmpsb                ; Bandingkan dengan daftar file root direktori
        pop    di                  ; jika file sudah ditemukan loncat ke label LOAD_FAT
        je     LOAD_FAT             ; ; jika file sudah ditemukan loncat ke label LOAD_FAT
        pop    cx                  ; Nama file berikutnya
        add    di, 0x0020            ; ; periksa lagi
        loop   .LOOP                ; ; Jika nama file tidak ada loncat ke label FAILURE

        jmp    FAILURE              ; ; Jika nama file tidak ada loncat ke label FAILURE

LOAD_FAT:
;
; Simpan nomor awal cluster tempat menyimpan data file 'MYKERNELBIN'
        mov    si,msgCRLF
        call   DisplayMessage
        mov    dx,WORD [di + 0x001A]
        mov    WORD [cluster], dx      ; Cluster pertama file 'MYKERNELBIN',
                                    ; byte ke 0xA (26) dari 32 byte, dibelakang nama file
                                    ; register 'di' menunjuk lokasi byte pertama dari namafile
;
; Menghitung jumlah sektor yang digunakan untuk menyimpan FAT
; hasilnya disimpan pada register 'cx'
        xor    ax, ax
        mov    al,BYTE [TotalFATs]      ; Jumlah FAT, pada FAT12 ada 2 copy FAT
        mul    WORD [SectorsPerFAT]    ; dikalikan dengan jumlah sektor/FAT (9)
        mov    cx, ax

; Mencari nomor awal sektor lokasi FAT
; hasil disimpan di reg 'ax'
        mov    ax, WORD [ReservedSectors] ; sesuaikan dengan jumlah sektor cadangan (1 sektor)

; baca isi FAT pindahkan ke lokasi memory (7C00:0200)
        mov    bx, 0x0200            ; pindahkan FAT di atas lokasi bootcode
        call   ReadSectors

; baca isi file 'KERNEL_BIN' pindahkan ke memori dengan lokasi (0100:0000)
        mov    si,msgCRLF
        call   DisplayMessage        ; menampilkan text di layar
        mov    ax, 0x0100              ; atur segmen kode target CS = 0x0100

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```

boot.asm - Notepad

```

File Edit Format View Help
        mov    ax, 0x0100          ; atur segmen kode target CS = 0x0100
        mov    es, ax              ; atur target IP= 0x0000
        push   bx
        push   bx

LOAD_IMAGE:
        mov    ax, WORD [cluster] ; Nomor cluster awal 'KERNEL_BIN'
        pop    bx
        call   ClusterLBA         ; Lokasi awal memori untuk menyimpan 'KERNEL_BIN'
                                ; konversi dagta cluster to LBA (nomor sektor)
                                ; hasil di simpan di 'ax' (nomor sektor yang harus di baca)

        xor    cx, cx
        mov    cl, BYTE [SectorsPerCluster] ; Jumlah sektor yang di baca
        call   ReadSectors
        push   bx

; Baca cluster berikutnya
        mov    ax, WORD [cluster] ; identifikasi posisi cluster saat ini
        mov    cx, ax              ; copy cluster saat ini ke 'cx'
        mov    dx, ax              ; copy cluster saat ini ke 'dx'
        shr    dx, 0x0001          ; bagi dengan 2 (posisi bit di geser ke kanan 1 digit)

; nomor sekarang di tambah (1/2 nomor cluster)
        add    cx, dx
        mov    bx, 0x0200          ; (3/2) nilai cluster saat ini
        add    bx, cx              ; lokasi FAT di memory
        mov    dx, WORD [bx]       ; index FAT
        test   ax, 0x0001          ; baca dua byte dari FAT
        jnz   .ODD_CLUSTER

.EVEN_CLUSTER:
        and   dx, 000011111111111b ; jika angkanya genap ambil 12 bit terbawah
        jmp   .DONE
.ODD_CLUSTER:
        shr   dx, 0x0004          ; jika angkanya ganjil ambil 12 bit teratas
.DONE:
        mov   WORD [cluster], dx ; simpan nomor cluster yang baru
        cmp   dx, 0xFFFF           ; Periksa sudah mencapai bagian akhir file
        jb    LOAD_IMAGE

```

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```

File Edit Format View Help
        jb    LOAD_IMAGE
DONE:
        mov   si, msgCRLF
        call  DisplayMessage
        push  WORD 0x0100
        push  WORD 0x0000
        retf

FAILURE:
        mov   si, msgFailure
        call  DisplayMessage
        mov   ah, 0x00
        int   0x16                ; Tunggu penekanan tombol keyboard
        int   0x19                ; reboot

*****  

; PROCEDURE DisplayMessage  

; Menampilkan string yang tersimpan pada alamat yang ditunjuk oleh 'ds:si'  

; menggunakan program pada BIOS  

*****  

DisplayMessage:
        lodsB
        or    al, al
        jz   .DONE
        mov   ah, 0x0E
        mov   bh, 0x00
        mov   bl, 0x07
        int   0x10
        jmp   DisplayMessage
.DONE:
        ret

*****  

; PROCEDURE ReadSectors  

; Membaca sektor sebanyak angka yang tersimpan pada register 'cx'  

; mulai dari nomor sektor, sesuai angka yang tersimpan pada register 'ax'  

; dipindahkan ke lokasi memori yg ditunjuk oleh kombinasi register 'es:bx'  

*****

```

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```

File Edit Format View Help
;*****
;ReadSectors:
.MAIN
    mov    di, 0x0005          ; mencoba membaca sektor sebanyak 5 kali
                                ; untuk memastikan adanya Error pada DISK
.SECTORLOOP
    push   ax
    push   bx
    push   cx
    call   LBACHS
    mov    ah, 0x02            ; Perintah BIOS untuk membaca sektor
    mov    al, 0x01            ; jumlah sektor yang di baca (1 sektor)
    mov    cl, BYTE [absoluteTrack]
    mov    cl, BYTE [absoluteSector]
    mov    dh, BYTE [absoluteHead]
    mov    dl, BYTE [DriveNumber]
    int    0x13                ; Nomor track, absoluteTrack=0
                                ; Nomor sektor, absoluteSector = 0
                                ; Nomor head, absoluteHead = 0, head ada 2 dengan nomor 0 dan 1
                                ; Nomor drive, 'DriveNumber'=0
    int    0x13                ; memanggil BIOS untuk membaca sektor

    jnc   .SUCCESS             ; Tes hasil pembacaan sektor
                                ; jika C=0 (sukses) loncat ke label '.SUCCESS'
    xor    ax, ax
    int    0x13
    dec    di
    pop    cx
    pop    bx
    pop    ax
    jnz   .SECTORLOOP          ; jika ada error sebelumnya coba baca lagi
    int    0x18
.SUCCESS
    mov    si, msgProgress      ; menampilkan status proses baca sektor
    call   DisplayMessage
    pop    cx
    pop    bx
    pop    ax
    add   bx, WORD [BytesPerSector] ; lokasi memori selanjutnya
    inc    ax                  ; nomor sektor berikutnya
    loop   .MAIN               ; baca sektor berikutnya
                                ; baca sector berikutnya
;*****
```

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```

File Edit Format View Help
loop   .MAIN                 ; baca sector berikutnya
ret

;*****
; PROCEDURE ClusterLBA
; Merubah data nomor cluster menjadi skema alamat LBA
; dengan rumus sebagai berikut
; LBA = (cluster - 2) * sectors per cluster
; nomor cluster di simpan pada register 'ax'
;*****
```

ClusterLBA:

```

    sub   ax, 0x0002            ; nomor cluster - 2, hasil disimpan di 'ax'
    xor   cx, cx
    mov   cl, BYTE [SectorsPerCluster] ; konversi dari byte to word
    mul   cx
    add   ax, WORD [datasector]     ; Nomor sektor pertam lokasi data file 'MYKERNELBIN'
    ret
```

PROCEDURE LBACHS

```

; convert 'ax' LBA addressing scheme to CHS addressing scheme
; absolute sector = (logical sector / sectors per track) + 1
; absolute head   = (logical sector / sectors per track) MOD number of heads
; absolute track  = logical sector / (sectors per track * number of heads)
;*****
```

LBACHS:

```

    xor   dx, dx                ; prepare dx:ax for operation
    div   WORD [SectorsPerTrack] ; calculate
    inc   d1                     ; adjust for sector 0
    mov   BYTE [absoluteSector], d1
    xor   dx, dx                ; prepare dx:ax for operation
    div   WORD [NumHeads]        ; calculate
    mov   BYTE [absoluteHead], d1
    mov   BYTE [absoluteTrack], al
    ret
```

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```
boot.asm - Notepad
File Edit Format View Help
        mov     BYTE [absoluteHead], dl
        mov     BYTE [absoluteTrack], al
        ret

;=====
; Definisi VARIABEL umum
;=====

        absoluteSector db 0x00
        absoluteHead   db 0x00
        absoluteTrack  db 0x00

        datasetor    dw 0x0000
        cluster      dw 0x0000

;=====

; Definisi NAMA file OS/Kernel
; 11 Karakter: Terdiri dari
; 8 karakter untuk nama file,
; 3 karakter untuk extensi
; Tanpa TITIK '.' pemisah
; perintah 'dir' akan menampilkan 'KERNEL.BIN'
;=====

        ImageName  db "KERNEL BIN"

;=====

; Teks yang akan ditampilkan saat mulai proses
; BOOT : Loading kernel ver 0.01
; Di awali dan diakhiri dengan tanda :
; -- 0x0A akhir baris
; -- 0x0A baris baru
; -- 0x00 Karakter 'NULL' pembatas dengan data di bawahnya
;=====

        msgLoading db 0x0D, 0x0A, "Loading kernel ver 0.01 ", 0x0D, 0x0A, 0x00
        msgCRLF   db 0x0D, 0x0A, 0x00
        msgProgress db ".", 0x00

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```

bootasm - Notepad

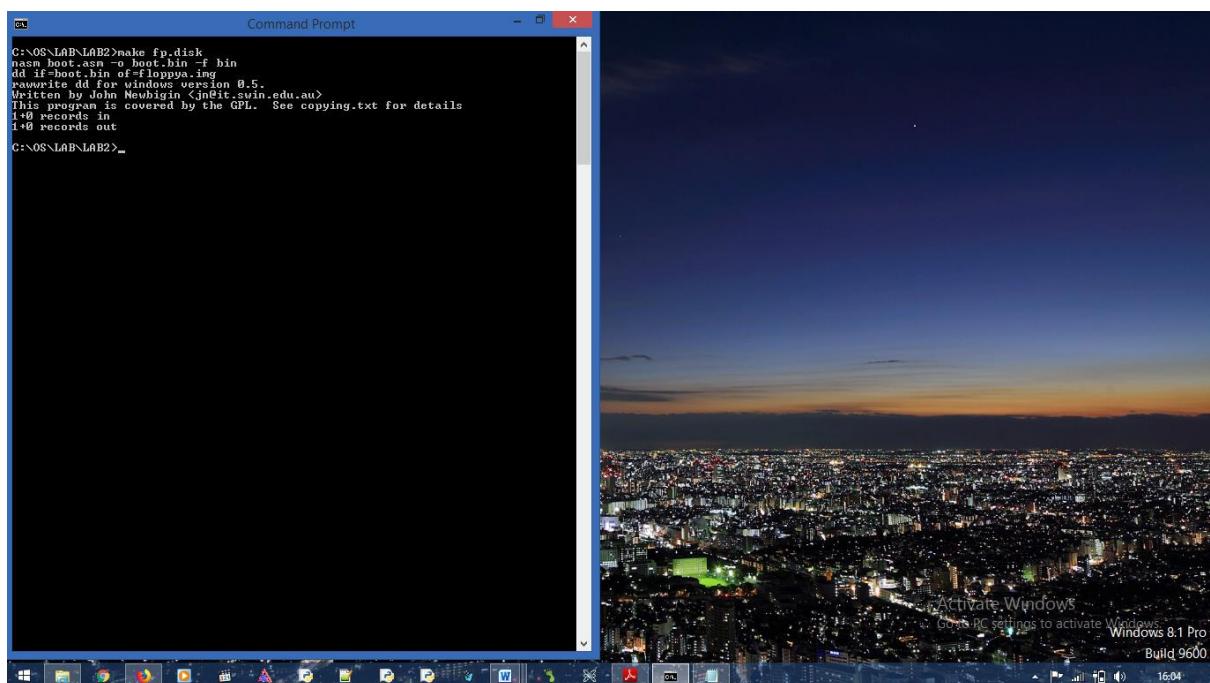
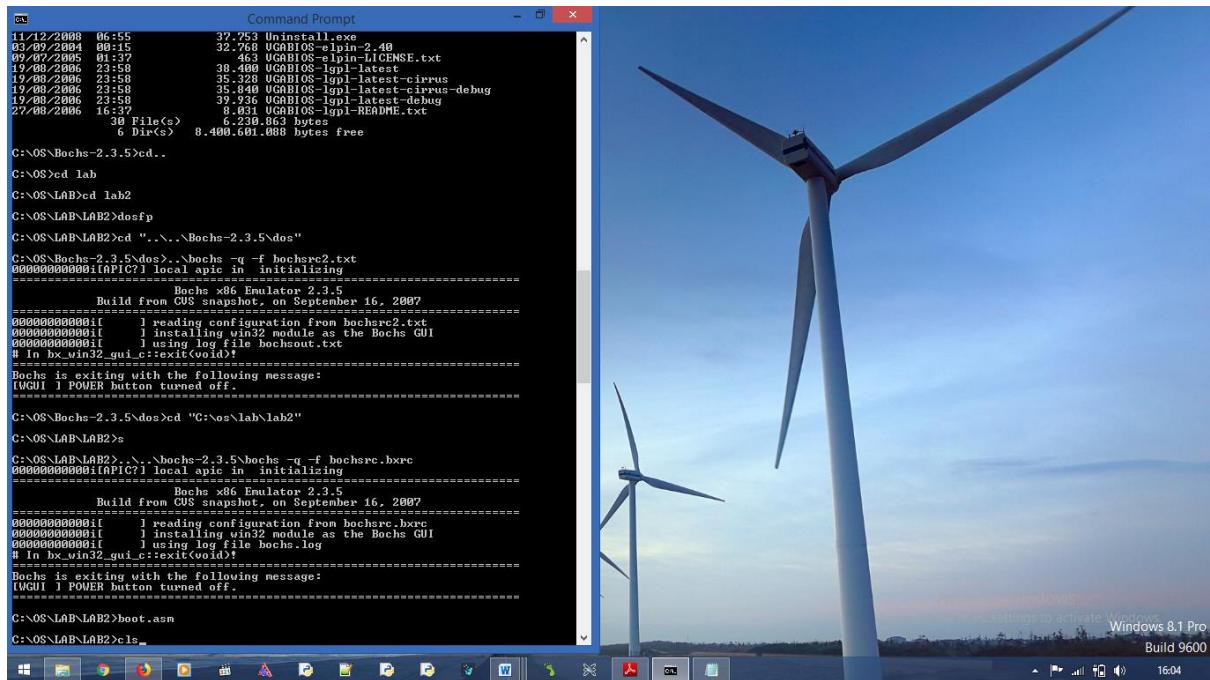
File Edit Format View Help

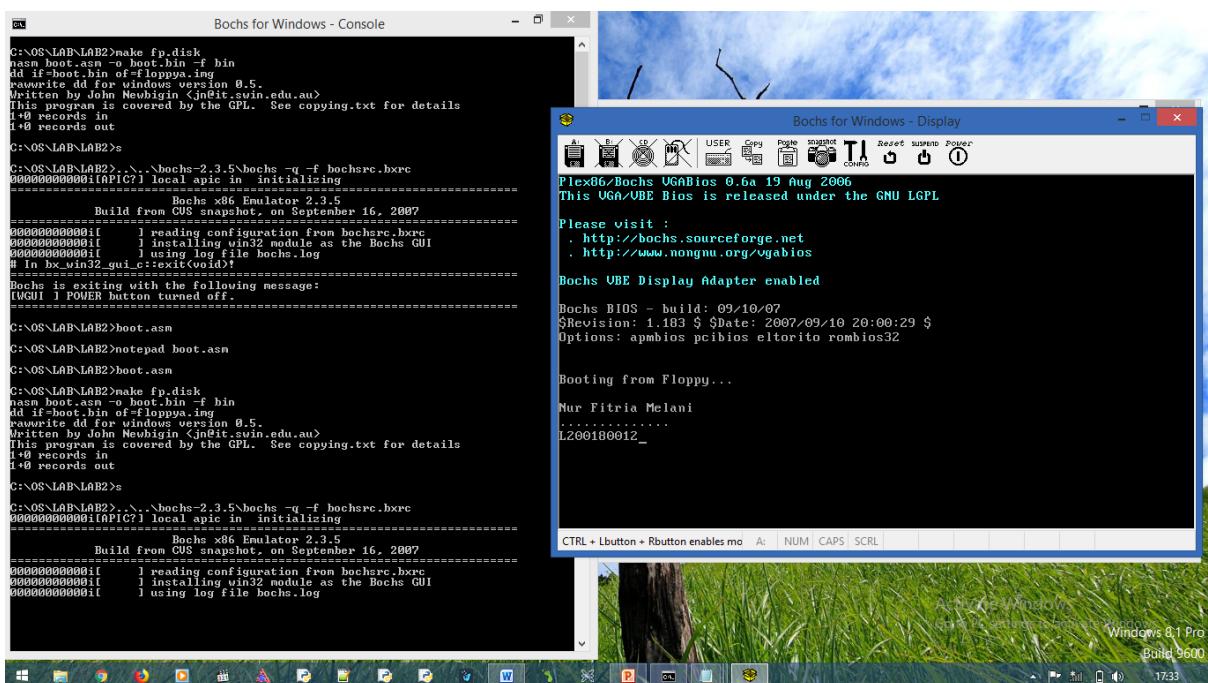
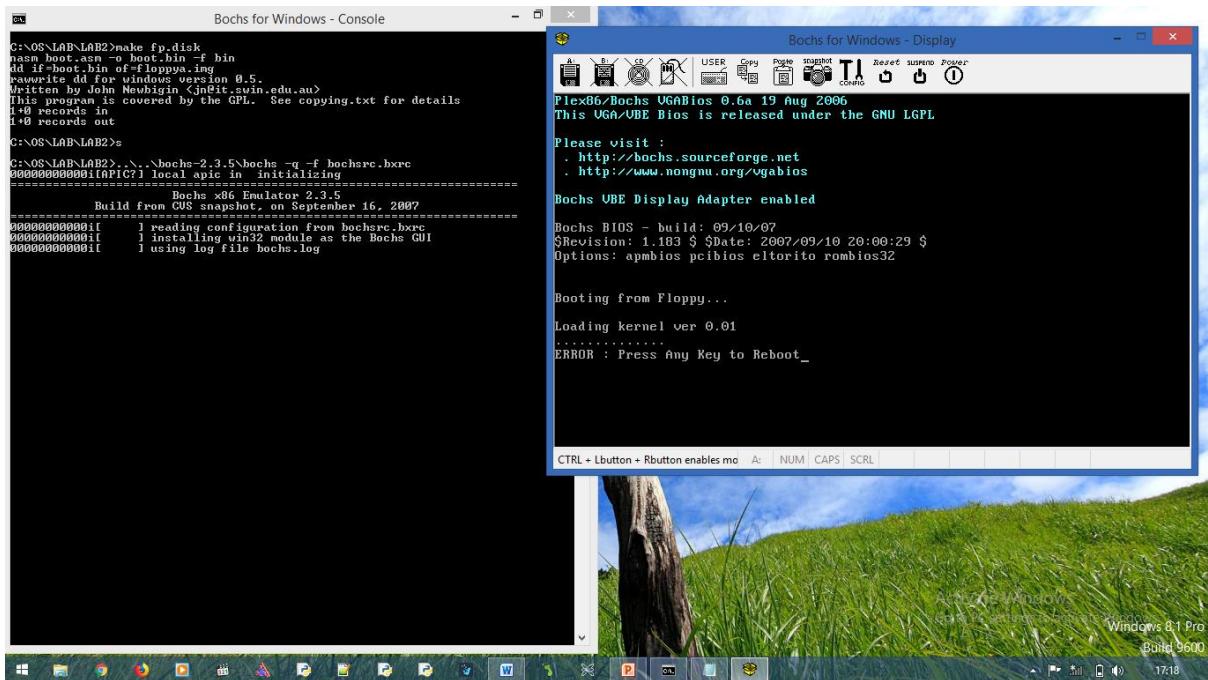
```
;===== ; Definisi NAMA file OS/Kernel ; 11 Karakter: Terdiri dari ; 8 karakter untuk nama file, ; 3 Karakter untuk extensi ; Tanpa TITIK '.' pemisah ; perintah 'dir' akan menampilkan 'KERNEL.BIN' ;===== ImageName db "KERNEL BIN"

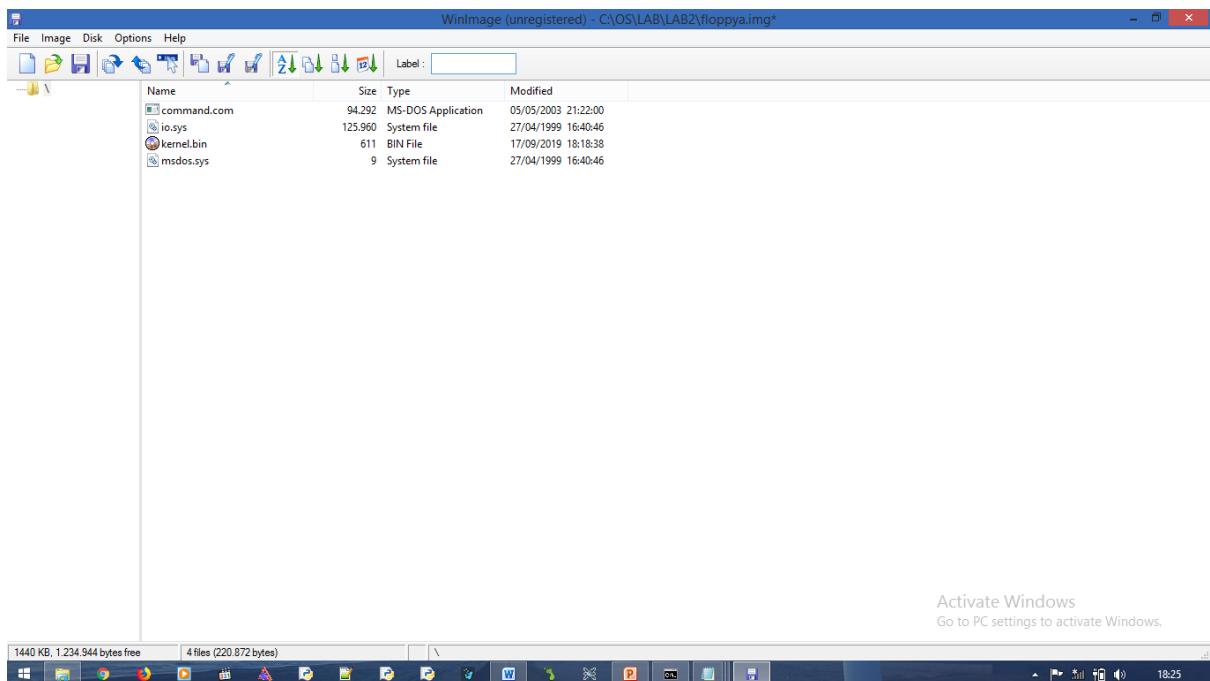
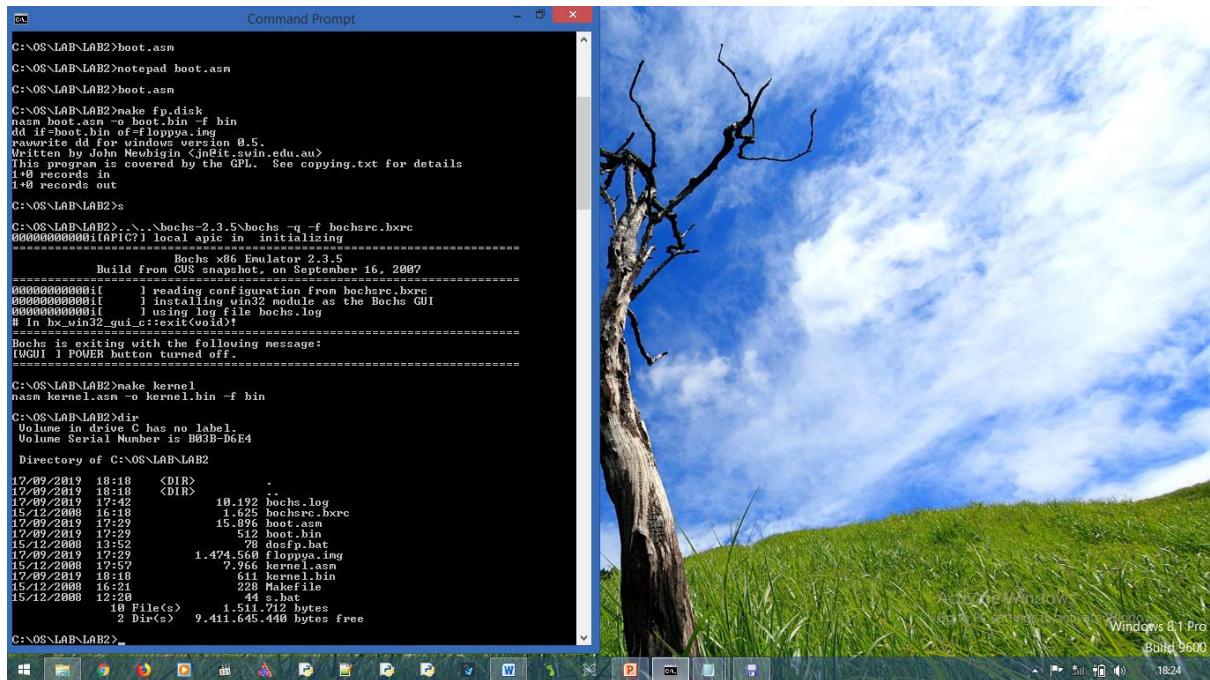
;===== ; Teks yang akan ditampilkan saat mulai proses ; BOOT : Loading kernel ver 0.01 ; Di awali dan diakhiri dengan tanda : ; -- 0x0D akhir baris ; -- 0x0A baris baru ; -- 0x00 Karakter 'NULL' pembatas dengan data di bawahnya ;===== msgLoading db 0x0D, 0x0A, "Loading kernel ver 0.01 ", 0x0D, 0x0A, 0x00 msgCRLF db 0x0D, 0x0A, 0x00 msgProgress db ".", 0x00

;===== ; Teks yang ditampilkan saat terjadi kesalahan BOOT ;===== msgFailure db 0x0D, 0x0A, "ERROR : Press Any Key to Reboot", 0x00

;===== ;(4) BLOK BOOT SIGNATURE ;===== TIMES 510-($-$) DB 0 DW 0xAA55 ;*****
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A screenshot of a Windows 8.1 Pro desktop showing two windows. The foreground window is titled 'Bochs for Windows - Console' and displays the command-line interface for building a kernel (MY KERNEL Ver 0.01) and booting it via floppy disk. The background window is titled 'Bochs for Windows - Display' and shows a dark, industrial-themed 3D rendering of a factory interior with pipes and structures. The taskbar at the bottom shows icons for various applications like File Explorer, Internet Explorer, and Microsoft Word.