МИНОБРНАУКИ РОССИИ

САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ

ЭЛЕКТРОТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

«ЛЭТИ» ИМ. В.И. УЛЬЯНОВА (ЛЕНИНА)

Кафедра МО ЭВМ

ОТЧЕТ

по лабораторной работе №3

по дисциплине «Операционные системы»

Тема: Исследование организации управления основной памятью

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Санкт-Петербург

2020

Цель работы.

Исследование структур данных и работы функций управления памятью ядра операционной системы.

Выполнение работы.

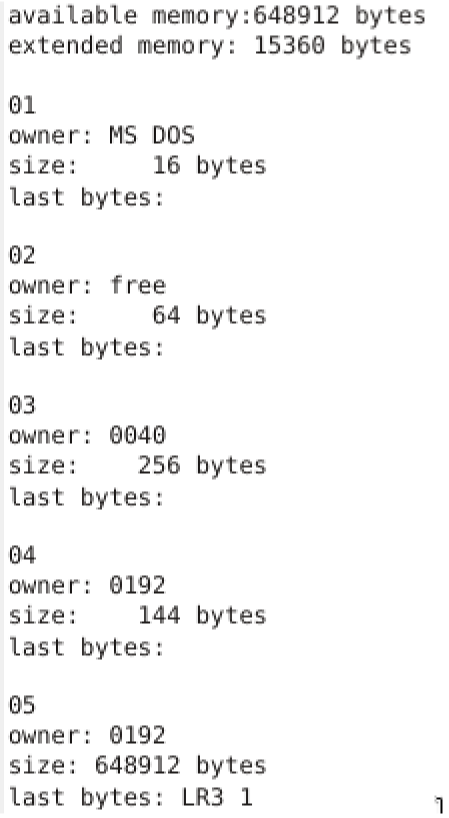
Был написан программный модуль типа **.COM** (представлен в приложении А), который определяет и распечатывает следующую информацию:

1) Количество доступной памяти.

2) Размер расширенной памяти.

3) Выводит цепочку блоков управления памятью.

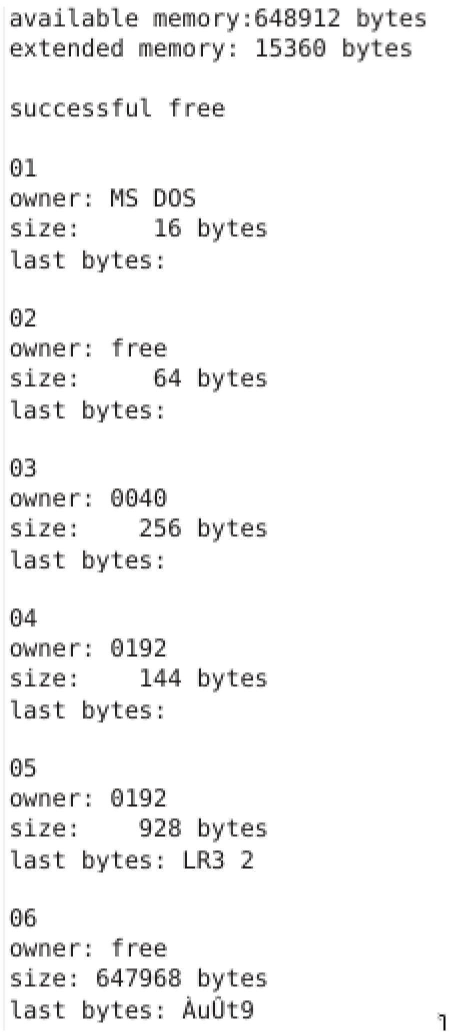
Результат исполнения COM модуля представлен на рисунке 1.



```
available memory:648912 bytes
extended memory: 15360 bytes

01
owner: MS DOS
size:     16 bytes
last bytes:

02
owner: free
size:     64 bytes
last bytes:

03
owner: 0040
size:    256 bytes
last bytes:

04
owner: 0192
size:    144 bytes
last bytes:

05
owner: 0192
size: 648912 bytes
last bytes: LR3 1
```

Рисунок 1 — результат исполнения первого COM модуля

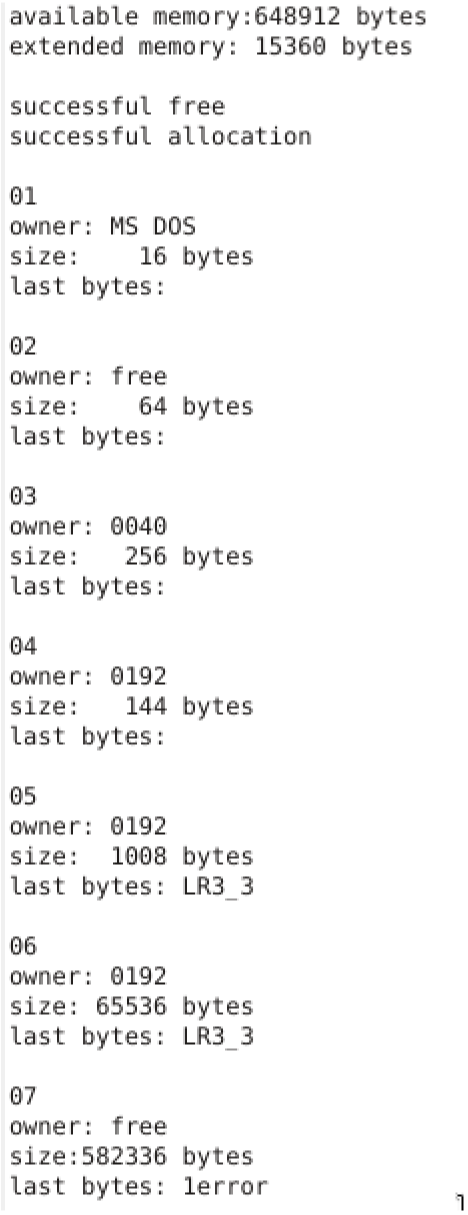
Далее программа была изменена таким образом, чтобы она освобождала память, которую она не занимает. Исходный код представлен в приложении Б, а результат исполнения — на рисунке 2.



```
available memory:648912 bytes
extended memory: 15360 bytes

successful free

01
owner: MS DOS
size:     16 bytes
last bytes:

02
owner: free
size:     64 bytes
last bytes:

03
owner: 0040
size:    256 bytes
last bytes:

04
owner: 0192
size:    144 bytes
last bytes:

05
owner: 0192
size:    928 bytes
last bytes: LR3 2

06
owner: free
size: 647968 bytes
last bytes: ÀuÛt9
```

Рисунок 2 — результат исполнения второго COM модуля

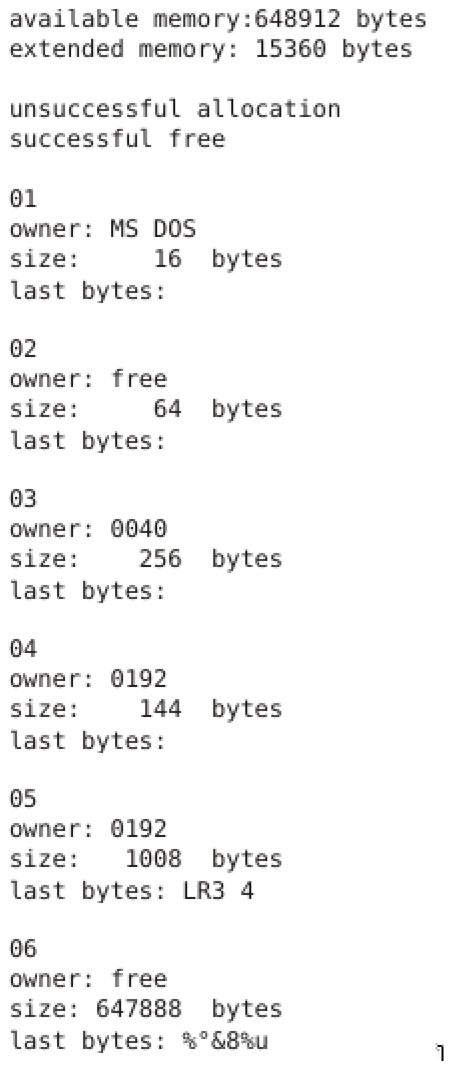
Далее программа была изменена таким образом, чтобы после освобождения памяти программа запрашивала 64Кб памяти. Исходный код представлен в приложении В, а результат исполнения — на рисунке 3.



```
available memory:648912 bytes
extended memory: 15360 bytes

successful free
successful allocation

01
owner: MS DOS
size:    16 bytes
last bytes:

02
owner: free
size:    64 bytes
last bytes:

03
owner: 0040
size:   256 bytes
last bytes:

04
owner: 0192
size:   144 bytes
last bytes:

05
owner: 0192
size:  1008 bytes
last bytes: LR3_3

06
owner: 0192
size: 65536 bytes
last bytes: LR3_3

07
owner: free
size:582336 bytes
last bytes: 1error
```

Рисунок 3 — результат исполнения третьего COM модуля

Далее программа была изменена таким образом, чтобы память запрашивалась до освобождения. Исходный код представлен в приложении Г, а результат исполнения — на рисунке 4.



```
available memory:648912 bytes
extended memory: 15360 bytes

unsuccessful allocation
successful free

01
owner: MS DOS
size:     16  bytes
last bytes:

02
owner: free
size:     64  bytes
last bytes:

03
owner: 0040
size:    256  bytes
last bytes:

04
owner: 0192
size:    144  bytes
last bytes:

05
owner: 0192
size:   1008  bytes
last bytes: LR3 4

06
owner: free
size: 647888  bytes
last bytes: %°&8%u
```

Рисунок 4 — результат исполнения четвертого COM модуля

Контрольные вопросы.

1) Что означает «доступный объём памяти»?

Это максимальный размер памяти, который может быть выделен программе.

2) Где MCB блок Вашей программы в списке?

В первой, второй и четвёртой программах блоками программы являются четвертый и пятый блоки. В третьей программе — это блоки с третьего по шестой.

3) Какой размер занимает программа в каждом случае?

Первая — занимает 649056 байта.

Вторая — занимает 1072 байт, остальное было освобождено.

Третья — занимает 1152 байт + выделенные 64Кб.

Четвёртая — занимает 1152 байт.

Вывод.

В ходе выполнения лабораторной работы были исследованы структуры данных и работа функций управления памятью ядра операционной системы.

ПРИЛОЖЕНИЕ А

СОДЕРЖИМОЕ ФАЙЛА LAB3_1.ASM

```
TESTPC     SEGMENT
           ASSUME  CS:TESTPC, DS:TESTPC, ES:NOTHING, SS:NOTHING
           ORG     100H

START:     JMP     BEGIN
; data
NEW_LINE          db 10,13,'$'
STR_MEM_AVAILABLE db 'available memory:       bytes',10,13,'$'
STR_MEM_EXTENDED  db 'extended memory:       bytes',10,13,'$'
STR_MCB_SIZE      db 'size:        bytes',10,13,'$'
STR_OWNER         db 'owner: $'
STR_LAST_BYTES    db 'last bytes: $'
STR_FREE          db 'free$'
STR_OSXMSUBM      db 'OS XMS UMB$'
STR_TOP_MEM       db "driver's top memory$"
STR_MSDOS         db 'MS DOS$'
STR_TAKEN386      db "386MAX UMB's block$"
STR_BLOCKED386    db 'blocked by 386MAX$'
STR_OWNED386      db '386MAX UMB$'

PRINT_NEW_LINE  PROC near
      push DX
      push AX

      mov DX, offset NEW_LINE
      mov AH, 09h
      int 21h

      pop AX
      pop DX
      ret
PRINT_NEW_LINE  ENDP

PRINT_BYTE      PROC near
; prints AL as two hex digits
      push BX
      push DX
      call BYTE_TO_HEX
      mov BH, AH

      mov DL, AL
      mov AH, 02h
      int 21h

      mov DL, BH
      mov AH, 02h
      int 21h

      pop DX
      pop BX
      ret
PRINT_BYTE    ENDP

TETR_TO_HEX       PROC near
      and      AL,0Fh
      cmp      AL,09
      jbe      NEXT
      add      AL,07
NEXT:
      add      AL,30h
      ret
TETR_TO_HEX   ENDP

BYTE_TO_HEX   PROC  near
; AL --> two hex symbols in AX
      push     CX
      mov      AH,AL
      call     TETR_TO_HEX
      xchg     AL,AH
      mov      CL,4
      shr      AL,CL
      call     TETR_TO_HEX ; AL - high digit
      pop      CX          ; AH - low digit
      ret
BYTE_TO_HEX  ENDP
```

```
WORD_TO_DEC PROC near
; convert AX to dec, SI - adress of low digit
           push     AX
           push     BX
           push     CX
           push     DX
           mov      CX,10
loop_bd2:  div      CX
           or       DL,30h
           mov      [SI],DL
           dec      SI
           xor      DX,DX
           cmp      AX,0
           jnz      loop_bd2
end_l2:    pop      DX
           pop      CX
           pop      BX
           pop      AX
           ret
WORD_TO_DEC ENDP

; CODE
BEGIN:

PRINT_AVAILABLE_MEMORY:
      mov AH, 4Ah
      mov BX, 0FFFFh
      int 21h
      mov AX, BX
      mov BX, 10h
      mul BX

      mov SI, offset STR_MEM_AVAILABLE
      add SI, 22
      call WORD_TO_DEC
      mov DX, offset STR_MEM_AVAILABLE
      mov AH, 09h
      int 21h

PRINT_EXTENDED_MEMORY:
      mov AL, 30h
      out 70h, AL
      in AL, 71h
      mov BL, AL
      mov AL, 31h
      out 70h, AL
      in AL, 71h
      mov AH, AL
      mov AL, BL

      mov SI, offset STR_MEM_EXTENDED
      add SI, 21
      xor DX, DX
      call WORD_TO_DEC
      mov DX, offset STR_MEM_EXTENDED
      mov AH, 09h
      int 21h

PRINT_MCBS:
      ; get first mcb's address
      mov AH, 52h
      int 21h
      mov AX, ES:[BX-2]
      mov ES, AX
      mov CX, 0

      NEXT_MCB:
            call PRINT_NEW_LINE
            inc CX
            mov AL, CL
            call PRINT_BYTE
            call PRINT_NEW_LINE

            mov DX, offset STR_OWNER
            mov AH, 09h
            int 21h

            ; get owner
            mov BX, ES:[1h]
```

```
; match owner
mov DX, offset STR_FREE
cmp BX, 0000h
je MCB_MATCHED
mov DX, offset STR_OSXMSUBM
cmp BX, 0006h
je MCB_MATCHED
mov DX, offset STR_TOP_MEM
cmp BX, 0007h
je MCB_MATCHED
mov DX, offset STR_MSDOS
cmp BX, 0008h
je MCB_MATCHED
mov DX, offset STR_TAKEN386
cmp BX, 0FFFAh
je MCB_MATCHED
mov DX, offset STR_BLOCKED386
cmp BX, 0FFFDh
je MCB_MATCHED
mov DX, offset STR_OWNED386
cmp BX, 0FFFEh
je MCB_MATCHED

jmp MCB_NOT_MATCHED

; print owner
MCB_MATCHED:
      mov AH, 09h
      int 21h
      jmp MCB_MATCH_END
MCB_NOT_MATCHED:
      mov AL, BH
      call PRINT_BYTE
      mov AL, BL
      call PRINT_BYTE

MCB_MATCH_END:
call PRINT_NEW_LINE

; get size
mov AX, ES:[3h]
mov BX, 10h
mul BX

; print size
mov SI, offset STR_MCB_SIZE
add SI, 11
call WORD_TO_DEC
mov DX, offset STR_MCB_SIZE
mov AH, 09h
int 21h

; print last 8 bytes
mov DX, offset STR_LAST_BYTES
mov AH, 09h
int 21h

push CX
mov CX, 8
mov BX, 0
mov AH, 02h
PRINT_LAST_BYTES:
      mov DL, ES:[BX+8h]
      int 21h
      inc BX
      loop PRINT_LAST_BYTES
      call PRINT_NEW_LINE
pop CX

; check if last block
mov AL, ES:[0h]
cmp AL, 5Ah
je PRINT_MCBS_END

; get next block's address
mov AX, ES:[3h]
mov BX, ES
add BX, AX
inc BX
mov ES, BX
```

```
            jmp NEXT_MCB

      PRINT_MCBS_END:




; return to DOS
           xor     AL,AL
           mov     AH,4Ch
           int     21H
TESTPC     ENDS
           END     START     ; module end START - entry point
```

ПРИЛОЖЕНИЕ Б

СОДЕРЖИМОЕ ФАЙЛА LAB3_2.ASM

```
      TESTPC     SEGMENT
           ASSUME  CS:TESTPC, DS:TESTPC, ES:NOTHING, SS:NOTHING
           ORG     100H

START:     JMP     BEGIN
; data
NEW_LINE          db 10,13,'$'
STR_MEM_AVAILABLE db 'available memory:       bytes',10,13,'$'
STR_MEM_EXTENDED  db 'extended memory:       bytes',10,13,'$'
STR_FREE_SUCCESS  db 'successful free',10,13,'$'
STR_FREE_ERROR    db 'unsuccessful free',10,13,'$'
STR_MCB_SIZE      db 'size:        bytes',10,13,'$'
STR_OWNER         db 'owner: $'
STR_LAST_BYTES    db 'last bytes: $'
STR_FREE          db 'free$'
STR_OSXMSUBM      db 'OS XMS UMB$'
STR_TOP_MEM       db "driver's top memory$"
STR_MSDOS         db 'MS DOS$'
STR_TAKEN386      db "386MAX UMB's block$"
STR_BLOCKED386    db 'blocked by 386MAX$'
STR_OWNED386      db '386MAX UMB$'

PRINT_NEW_LINE  PROC near
      push DX
      push AX


      mov DX, offset NEW_LINE
      mov AH, 09h
      int 21h


      pop AX
      pop DX
      ret
PRINT_NEW_LINE  ENDP

PRINT_BYTE      PROC near
; prints AL as two hex digits
```

```
      push BX
      push DX

      call BYTE_TO_HEX
      mov BH, AH

      mov DL, AL
      mov AH, 02h
      int 21h

      mov DL, BH
      mov AH, 02h
      int 21h

      pop DX
      pop BX
      ret
PRINT_BYTE    ENDP

TETR_TO_HEX       PROC near
      and      AL,0Fh
      cmp      AL,09
      jbe      NEXT
      add      AL,07
NEXT:
      add      AL,30h
      ret
TETR_TO_HEX   ENDP

BYTE_TO_HEX   PROC  near
; AL --> two hex symbols in AX
      push     CX
      mov      AH,AL
      call     TETR_TO_HEX
      xchg     AL,AH
      mov      CL,4
      shr      AL,CL
      call     TETR_TO_HEX ; AL - high digit
      pop      CX          ; AH - low digit
      ret
```

```
BYTE_TO_HEX  ENDP

BYTE_TO_DEC   PROC  near
; convert AL to dec, SI - adress of low digit
           push     CX
           push     DX
           xor      AH,AH
           xor      DX,DX
           mov      CX,10
loop_bd:   div      CX
           or       DL,30h
           mov      [SI],DL
           dec      SI
           xor      DX,DX
           cmp      AX,10
           jae      loop_bd
           cmp      AL,00h
           je       end_l
           or       AL,30h
           mov      [SI],AL
end_l:     pop      DX
           pop      CX
           ret
BYTE_TO_DEC    ENDP

WORD_TO_DEC PROC near
; convert AX to dec, SI - adress of low digit
           push     CX
           push     DX
           mov      CX,10
loop_bd2:  div      CX
           or       DL,30h
           mov      [SI],DL
           dec      SI
           xor      DX,DX
           cmp      AX,0
           jnz      loop_bd2
end_l2:    pop      DX
           pop      CX
           ret
WORD_TO_DEC ENDP
```

```
; CODE
BEGIN:

PRINT_AVAILABLE_MEMORY:
      mov AH, 4Ah
      mov BX, 0FFFFh
      int 21h
      mov AX, BX
      mov BX, 10h
      mul BX

      mov SI, offset STR_MEM_AVAILABLE
      add SI, 22
      call WORD_TO_DEC
      mov DX, offset STR_MEM_AVAILABLE
      mov AH, 09h
      int 21h

PRINT_EXTENDED_MEMORY:
      mov AL, 30h
      out 70h, AL
      in AL, 71h
      mov BL, AL
      mov AL, 31h
      out 70h, AL
      in AL, 71h
      mov AH, AL
      mov AL, BL

      mov SI, offset STR_MEM_EXTENDED
      add SI, 21
      xor DX, DX
      call WORD_TO_DEC
      mov DX, offset STR_MEM_EXTENDED
      mov AH, 09h
      int 21h

      call PRINT_NEW_LINE
```

```
FREE_MEMORY:
      mov BX, offset END_OF_PROGRAM
      add BX, 10h
      shr BX, 1
      shr BX, 1
      shr BX, 1
      shr BX, 1

      mov AH, 4Ah
      int 21h

      jnc FREE_SUCCESS
      jmp FREE_ERROR

      FREE_SUCCESS:
            mov DX, offset STR_FREE_SUCCESS
            jmp FREE_MEMORY_END
      FREE_ERROR:
            mov DX, offset STR_FREE_ERROR

      FREE_MEMORY_END:
      mov AH, 09h
      int 21h

PRINT_MCBS:
      ; get first mcb's address
      mov AH, 52h
      int 21h
      mov AX, ES:[BX-2]
      mov ES, AX
      mov CX, 0

      NEXT_MCB:
            call PRINT_NEW_LINE
            inc CX
            mov AL, CL
            call PRINT_BYTE
            call PRINT_NEW_LINE

            mov DX, offset STR_OWNER
            mov AH, 09h
            int 21h

            ; get owner
            mov BX, ES:[1h]

            ; match owner
            mov DX, offset STR_FREE
            cmp BX, 0000h
            je MCB_MATCHED
            mov DX, offset STR_OSXMSUBM
            cmp BX, 0006h
            je MCB_MATCHED
            mov DX, offset STR_TOP_MEM
            cmp BX, 0007h
            je MCB_MATCHED
            mov DX, offset STR_MSDOS
            cmp BX, 0008h
            je MCB_MATCHED
            mov DX, offset STR_TAKEN386
            cmp BX, 0FFFAh
            je MCB_MATCHED
            mov DX, offset STR_BLOCKED386
            cmp BX, 0FFFDh
            je MCB_MATCHED
            mov DX, offset STR_OWNED386
            cmp BX, 0FFFEh
            je MCB_MATCHED

            jmp MCB_NOT_MATCHED

            ; print owner
            MCB_MATCHED:
                  mov AH, 09h
                  int 21h
                  jmp MCB_MATCH_END
            MCB_NOT_MATCHED:
                  mov AL, BH
                  call PRINT_BYTE
                  mov AL, BL
                  call PRINT_BYTE

            MCB_MATCH_END:
            call PRINT_NEW_LINE

            ; get size
            mov AX, ES:[3h]
            mov BX, 10h
            mul BX

            ; print size
            mov SI, offset STR_MCB_SIZE
            add SI, 11
            call WORD_TO_DEC
            mov DX, offset STR_MCB_SIZE
            mov AH, 09h
            int 21h

            ; print last 8 bytes
            mov DX, offset STR_LAST_BYTES
            mov AH, 09h
            int 21h

            push CX
            mov CX, 8
            mov BX, 0
            mov AH, 02h
            PRINT_LAST_BYTES:
                  mov DL, ES:[BX+8h]
                  int 21h
                  inc BX
                  loop PRINT_LAST_BYTES
                  call PRINT_NEW_LINE
            pop CX

            ; check if last block
            mov AL, ES:[0h]
            cmp AL, 5Ah
            je PRINT_MCBS_END
```

```
            ; get next block's address
            mov AX, ES:[3h]
            mov BX, ES
            add BX, AX
            inc BX
            mov ES, BX

            jmp NEXT_MCB

      PRINT_MCBS_END:




; return to DOS
           xor     AL,AL
           mov     AH,4Ch
           int     21H

   END_OF_PROGRAM:
TESTPC     ENDS
           END     START     ; module end START - entry point
```

ПРИЛОЖЕНИЕ В

СОДЕРЖИМОЕ ФАЙЛА LAB3_3.ASM

```
      TESTPC     SEGMENT
           ASSUME  CS:TESTPC, DS:TESTPC, ES:NOTHING, SS:NOTHING
           ORG     100H

START:     JMP     BEGIN
; DATA
NEW_LINE             DB 10,13,'$'
STR_MEM_AVAILABLE    DB 'AVAILABLE MEMORY:        BYTES',10,13,'$'
STR_MEM_EXTENDED     DB 'EXTENDED MEMORY:        BYTES',10,13,'$'
STR_FREE_SUCCESS     DB 'SUCCESSFUL FREE',10,13,'$'
STR_FREE_ERROR       DB 'UNSUCCESSFUL FREE',10,13,'$'
STR_ALLOCATE_SUCCESS DB 'SUCCESSFUL ALLOCATION',10,13,'$'
STR_ALLOCATE_ERROR   DB 'UNSUCCESSFUL ALLOCATION',10,13,'$'
STR_MCB_SIZE         DB 'SIZE:        BYTES',10,13,'$'
STR_OWNER            DB 'OWNER: $'
STR_LAST_BYTES       DB 'LAST BYTES: $'
STR_FREE             DB 'FREE$'
STR_OSXMSUBM         DB 'OS XMS UMB$'
STR_TOP_MEM          DB "DRIVER'S TOP MEMORY$"
STR_MSDOS            DB 'MS DOS$'
STR_TAKEN386         DB "386MAX UMB'S BLOCK$"
STR_BLOCKED386       DB 'BLOCKED BY 386MAX$'
STR_OWNED386         DB '386MAX UMB$'

PRINT_NEW_LINE  PROC NEAR
      PUSH DX
      PUSH AX

      MOV DX, OFFSET NEW_LINE
      MOV AH, 09H
      INT 21H

      POP AX
      POP DX
      RET
PRINT_NEW_LINE  ENDP
```

```
PRINT_BYTE      PROC NEAR
; PRINTS AL AS TWO HEX DIGITS
      PUSH BX
      PUSH DX

      CALL BYTE_TO_HEX
      MOV BH, AH

      MOV DL, AL
      MOV AH, 02H
      INT 21H

      MOV DL, BH
      MOV AH, 02H
      INT 21H

      POP DX
      POP BX
      RET
PRINT_BYTE    ENDP

TETR_TO_HEX      PROC NEAR
      AND      AL,0FH
      CMP      AL,09
      JBE      NEXT
      ADD      AL,07
NEXT:
      ADD      AL,30H
      RET
TETR_TO_HEX   ENDP

BYTE_TO_HEX   PROC  NEAR
; AL --> TWO HEX SYMBOLS IN AX
      PUSH    CX
      MOV      AH,AL
      CALL    TETR_TO_HEX
      XCHG    AL,AH
      MOV      CL,4
      SHR      AL,CL
      CALL    TETR_TO_HEX ; AL - HIGH DIGIT
      POP      CX          ; AH - LOW DIGIT
      RET
BYTE_TO_HEX  ENDP

BYTE_TO_DEC   PROC  NEAR
; CONVERT AL TO DEC, SI - ADRESS OF LOW DIGIT
            PUSH     CX
            PUSH     DX
            XOR      AH,AH
            XOR      DX,DX
            MOV      CX,10
LOOP_BD:   DIV      CX
            OR       DL,30H
            MOV      [SI],DL
            DEC      SI
            XOR      DX,DX
            CMP      AX,10
            JAE      LOOP_BD
            CMP      AL,00H
            JE       END_L
            OR       AL,30H
            MOV      [SI],AL
END_L:      POP      DX
            POP      CX
            RET
BYTE_TO_DEC    ENDP

WORD_TO_DEC PROC NEAR
; CONVERT AX TO DEC, SI - ADRESS OF LOW DIGIT
                PUSH     AX
                PUSH     BX
            PUSH     CX
            PUSH     DX
                XOR           CX,CX
            MOV      BX,10
LOOP_BD2:
                DIV      BX
            OR       DL,30H
            MOV      [SI],DL
            DEC      SI
            XOR      DX,DX
```

```
           CMP       AX,0H
           JNZ       LOOP_BD2
END_L2:    POP       DX
           POP       CX
              POP       BX
              POP       AX
           RET

WORD_TO_DEC ENDP

; CODE
BEGIN:

PRINT_AVAILABLE_MEMORY:
      MOV AH, 4AH
      MOV BX, 0FFFFH
      INT 21H
      MOV AX, BX
      MOV BX, 10H
      MUL BX

      MOV SI, OFFSET STR_MEM_AVAILABLE
      ADD SI, 22
      CALL WORD_TO_DEC
      MOV DX, OFFSET STR_MEM_AVAILABLE
      MOV AH, 09H
      INT 21H

PRINT_EXTENDED_MEMORY:
      MOV AL, 30H
      OUT 70H, AL
      IN AL, 71H
      MOV BL, AL
      MOV AL, 31H
      OUT 70H, AL
      IN AL, 71H
      MOV AH, AL
      MOV AL, BL

      MOV SI, OFFSET STR_MEM_EXTENDED
      ADD SI, 21
      XOR DX, DX
      CALL WORD_TO_DEC
      MOV DX, OFFSET STR_MEM_EXTENDED
      MOV AH, 09H
      INT 21H

      CALL PRINT_NEW_LINE

FREE_MEMORY:
      MOV BX, OFFSET END_OF_PROGRAM
      ADD BX, 10H
      SHR BX, 1
      SHR BX, 1
      SHR BX, 1
      SHR BX, 1

      MOV AH, 4AH
      INT 21H

      JNC FREE_SUCCESS
      JMP FREE_ERROR

      FREE_SUCCESS:
            MOV DX, OFFSET STR_FREE_SUCCESS
            JMP FREE_MEMORY_END
      FREE_ERROR:
            MOV DX, OFFSET STR_FREE_ERROR

      FREE_MEMORY_END:
      MOV AH, 09H
      INT 21H

ALLOCATE_MEMORY:
      MOV BX, 1000H
      MOV AH, 48H
      INT 21H

      JNC ALLOCATE_SUCCESS
      JMP ALLOCATE_ERROR
```

```
    ALLOCATE_SUCCESS:
        MOV DX, OFFSET STR_ALLOCATE_SUCCESS
        JMP ALLOCATE_MEMORY_END
    ALLOCATE_ERROR:
        MOV DX, OFFSET STR_ALLOCATE_ERROR

    ALLOCATE_MEMORY_END:
    MOV AH, 09H
    INT 21H

PRINT_MCBS:
    ; GET FIRST MCB'S ADDRESS
    MOV AH, 52H
    INT 21H
    MOV AX, ES:[BX-2]
    MOV ES, AX
    MOV CX, 0

    NEXT_MCB:
        CALL PRINT_NEW_LINE
        INC CX
        MOV AL, CL
        CALL PRINT_BYTE
        CALL PRINT_NEW_LINE

        MOV DX, OFFSET STR_OWNER
        MOV AH, 09H
        INT 21H

        ; GET OWNER
        MOV BX, ES:[1H]

        ; MATCH OWNER
        MOV DX, OFFSET STR_FREE
        CMP BX, 0000H
        JE MCB_MATCHED
        MOV DX, OFFSET STR_OSXMSUBM
        CMP BX, 0006H
        JE MCB_MATCHED
```

```
MOV DX, OFFSET STR_TOP_MEM
CMP BX, 0007H
JE MCB_MATCHED
MOV DX, OFFSET STR_MSDOS
CMP BX, 0008H
JE MCB_MATCHED
MOV DX, OFFSET STR_TAKEN386
CMP BX, 0FFFAH
JE MCB_MATCHED
MOV DX, OFFSET STR_BLOCKED386
CMP BX, 0FFFDH
JE MCB_MATCHED
MOV DX, OFFSET STR_OWNED386
CMP BX, 0FFFEH
JE MCB_MATCHED

JMP MCB_NOT_MATCHED

; PRINT OWNER
MCB_MATCHED:
      MOV AH, 09H
      INT 21H
      JMP MCB_MATCH_END
MCB_NOT_MATCHED:
      MOV AL, BH
      CALL PRINT_BYTE
      MOV AL, BL
      CALL PRINT_BYTE

MCB_MATCH_END:
CALL PRINT_NEW_LINE

; GET SIZE
MOV AX, ES:[3H]
MOV BX, 10H
MUL BX

; PRINT SIZE
MOV SI, OFFSET STR_MCB_SIZE
ADD SI, 10
```

```
    call WORD_TO_DEC
    mov DX, offset STR_MCB_SIZE
    mov AH, 09h
    int 21h

    ; print last 8 bytes
    mov DX, offset STR_LAST_BYTES
    mov AH, 09h
    int 21h

    push CX
    mov CX, 8
    mov BX, 0
    mov AH, 02h
    PRINT_LAST_BYTES:
        mov DL, ES:[BX+8h]
        int 21h
        inc BX
        loop PRINT_LAST_BYTES
        call PRINT_NEW_LINE
    pop CX

    ; check if last block
    mov AL, ES:[0h]
    cmp AL, 5Ah
    je PRINT_MCBS_END

    ; get next block's address
    mov AX, ES:[3h]
    mov BX, ES
    add BX, AX
    inc BX
    mov ES, BX

    jmp NEXT_MCB

PRINT_MCBS_END:
```

```
; RETURN TO DOS
           XOR     AL,AL
           MOV     AH,4CH
           INT     21H

   END_OF_PROGRAM:
TESTPC     ENDS
           END     START     ; MODULE END START - ENTRY POINT
```

ПРИЛОЖЕНИЕ Г

СОДЕРЖИМОЕ ФАЙЛА LAB3_4.ASM

```
      TESTPC     SEGMENT
           ASSUME  CS:TESTPC, DS:TESTPC, ES:NOTHING, SS:NOTHING
           ORG     100H

START:     JMP     BEGIN
; DATA
NEW_LINE          DB 10,13,'$'
STR_MEM_AVAILABLE DB 'AVAILABLE MEMORY:        BYTES',10,13,'$'
STR_MEM_EXTENDED  DB 'EXTENDED MEMORY:        BYTES',10,13,'$'
STR_FREE_SUCCESS  DB 'SUCCESSFUL FREE',10,13,'$'
STR_FREE_ERROR    DB 'UNSUCCESSFUL FREE',10,13,'$'
STR_ALLOCATE_SUCCESS  DB 'SUCCESSFUL ALLOCATION',10,13,'$'
STR_ALLOCATE_ERROR    DB 'UNSUCCESSFUL ALLOCATION',10,13,'$'
STR_MCB_SIZE      DB 'SIZE:          BYTES',10,13,'$'
STR_OWNER         DB 'OWNER: $'
STR_LAST_BYTES    DB 'LAST BYTES: $'
STR_FREE          DB 'FREE$'
STR_OSXMSUBM      DB 'OS XMS UMB$'
STR_TOP_MEM       DB "DRIVER'S TOP MEMORY$"
STR_MSDOS         DB 'MS DOS$'
STR_TAKEN386      DB "386MAX UMB'S BLOCK$"
STR_BLOCKED386    DB 'BLOCKED BY 386MAX$'
STR_OWNED386      DB '386MAX UMB$'

PRINT_NEW_LINE  PROC NEAR
      PUSH DX
      PUSH AX


      MOV DX, OFFSET NEW_LINE
      MOV AH, 09H
      INT 21H


      POP AX
      POP DX
      RET
PRINT_NEW_LINE  ENDP
```

```
PRINT_BYTE      PROC near
; prints AL as two hex digits
      push BX
      push DX

      call BYTE_TO_HEX
      mov BH, AH

      mov DL, AL
      mov AH, 02h
      int 21h

      mov DL, BH
      mov AH, 02h
      int 21h

      pop DX
      pop BX
      ret
PRINT_BYTE    ENDP

TETR_TO_HEX      PROC near
      and      AL,0Fh
      cmp      AL,09
      jbe      NEXT
      add      AL,07
NEXT:
      add      AL,30h
      ret
TETR_TO_HEX   ENDP

BYTE_TO_HEX   PROC  near
; AL --> two hex symbols in AX
      push     CX
      mov      AH,AL
      call     TETR_TO_HEX
      xchg     AL,AH
      mov      CL,4
      shr      AL,CL
      call     TETR_TO_HEX ; AL - high digit
      POP       CX          ; AH - LOW DIGIT
      RET
BYTE_TO_HEX  ENDP

BYTE_TO_DEC   PROC  NEAR
; CONVERT AL TO DEC, SI - ADRESS OF LOW DIGIT
           PUSH     CX
           PUSH     DX
           XOR      AH,AH
           XOR      DX,DX
           MOV      CX,10
LOOP_BD:   DIV      CX
           OR       DL,30H
           MOV      [SI],DL
           DEC      SI
           XOR      DX,DX
           CMP      AX,10
           JAE      LOOP_BD
           CMP      AL,00H
           JE       END_L
           OR       AL,30H
           MOV      [SI],AL
END_L:     POP      DX
           POP      CX
           RET
BYTE_TO_DEC    ENDP

WORD_TO_DEC PROC NEAR
; CONVERT AX TO DEC, SI - ADRESS OF LOW DIGIT
           PUSH     CX
           PUSH     DX
           MOV      CX,10
LOOP_BD2:  DIV      CX
           OR       DL,30H
           MOV      [SI],DL
           DEC      SI
           XOR      DX,DX
           CMP      AX,0
           JNZ      LOOP_BD2
END_L2:    POP      DX
           POP      CX
           RET
WORD_TO_DEC ENDP

; CODE
BEGIN:

PRINT_AVAILABLE_MEMORY:
      MOV AH, 4AH
      MOV BX, 0FFFFH
      INT 21H
      MOV AX, BX
      MOV BX, 10H
      MUL BX

      MOV SI, OFFSET STR_MEM_AVAILABLE
      ADD SI, 22
      CALL WORD_TO_DEC
      MOV DX, OFFSET STR_MEM_AVAILABLE
      MOV AH, 09H
      INT 21H

PRINT_EXTENDED_MEMORY:
      MOV AL, 30H
      OUT 70H, AL
      IN AL, 71H
      MOV BL, AL
      MOV AL, 31H
      OUT 70H, AL
      IN AL, 71H
      MOV AH, AL
      MOV AL, BL

      MOV SI, OFFSET STR_MEM_EXTENDED
      ADD SI, 21
      XOR DX, DX
      CALL WORD_TO_DEC
      MOV DX, OFFSET STR_MEM_EXTENDED
      MOV AH, 09H
      INT 21H
```

```
    CALL PRINT_NEW_LINE

ALLOCATE_MEMORY:
    MOV BX, 1000H
    MOV AH, 48H
    INT 21H

    JNC ALLOCATE_SUCCESS
    JMP ALLOCATE_ERROR

    ALLOCATE_SUCCESS:
        MOV DX, OFFSET STR_ALLOCATE_SUCCESS
        JMP ALLOCATE_MEMORY_END
    ALLOCATE_ERROR:
        MOV DX, OFFSET STR_ALLOCATE_ERROR

    ALLOCATE_MEMORY_END:
    MOV AH, 09H
    INT 21H

FREE_MEMORY:
    MOV BX, OFFSET END_OF_PROGRAM
    ADD BX, 10H
    SHR BX, 1
    SHR BX, 1
    SHR BX, 1
    SHR BX, 1

    MOV AH, 4AH
    INT 21H

    JNC FREE_SUCCESS
    JMP FREE_ERROR

    FREE_SUCCESS:
        MOV DX, OFFSET STR_FREE_SUCCESS
        JMP FREE_MEMORY_END
    FREE_ERROR:
        MOV DX, OFFSET STR_FREE_ERROR
    FREE_MEMORY_END:
    MOV AH, 09H
    INT 21H

PRINT_MCBS:
    ; GET FIRST MCB'S ADDRESS
    MOV AH, 52H
    INT 21H
    MOV AX, ES:[BX-2]
    MOV ES, AX
    MOV CX, 0

    NEXT_MCB:
        CALL PRINT_NEW_LINE
        INC CX
        MOV AL, CL
        CALL PRINT_BYTE
        CALL PRINT_NEW_LINE

        MOV DX, OFFSET STR_OWNER
        MOV AH, 09H
        INT 21H

        ; GET OWNER
        MOV BX, ES:[1H]

        ; MATCH OWNER
        MOV DX, OFFSET STR_FREE
        CMP BX, 0000H
        JE MCB_MATCHED
        MOV DX, OFFSET STR_OSXMSUBM
        CMP BX, 0006H
        JE MCB_MATCHED
        MOV DX, OFFSET STR_TOP_MEM
        CMP BX, 0007H
        JE MCB_MATCHED
        MOV DX, OFFSET STR_MSDOS
        CMP BX, 0008H
        JE MCB_MATCHED
        MOV DX, OFFSET STR_TAKEN386
```

```
cmp BX, 0FFFAh
je MCB_MATCHED
mov DX, offset STR_BLOCKED386
cmp BX, 0FFFDh
je MCB_MATCHED
mov DX, offset STR_OWNED386
cmp BX, 0FFFEh
je MCB_MATCHED

jmp MCB_NOT_MATCHED

; print owner
MCB_MATCHED:
       mov AH, 09h
       int 21h
       jmp MCB_MATCH_END
MCB_NOT_MATCHED:
       mov AL, BH
       call PRINT_BYTE
       mov AL, BL
       call PRINT_BYTE

MCB_MATCH_END:
call PRINT_NEW_LINE

; get size
mov AX, ES:[3h]
mov BX, 10h
mul BX

; print size
mov SI, offset STR_MCB_SIZE
add SI, 11
call WORD_TO_DEC
mov DX, offset STR_MCB_SIZE
mov AH, 09h
int 21h

; print last 8 bytes
mov DX, offset STR_LAST_BYTES
```

```
            MOV AH, 09H
            INT 21H

            PUSH CX
            MOV CX, 8
            MOV BX, 0
            MOV AH, 02H
            PRINT_LAST_BYTES:
                  MOV DL, ES:[BX+8H]
                  INT 21H
                  INC BX
                  LOOP PRINT_LAST_BYTES
                  CALL PRINT_NEW_LINE
            POP CX

            ; CHECK IF LAST BLOCK
            MOV AL, ES:[0H]
            CMP AL, 5AH
            JE PRINT_MCBS_END

            ; GET NEXT BLOCK'S ADDRESS
            MOV AX, ES:[3H]
            MOV BX, ES
            ADD BX, AX
            INC BX
            MOV ES, BX

            JMP NEXT_MCB

      PRINT_MCBS_END:




; RETURN TO DOS
            XOR       AL,AL
            MOV       AH,4CH
            INT       21H

   END_OF_PROGRAM:
TESTPC      ENDS
```

```
        END     START      ; MODULE END START - ENTRY POINT
```