```
video:3C00
video:3C00
; °
video:3C00
                           This file is generated by The Interactive Disassembler (IDA)
                     ; °
video:3C00
                                            Licensed to: Unknown User ;-)
                     ; °
                          Copyright (c) 1999 by DataRescue sa/nv, <ida@datarescue.com>
video:3C00
video:3C00
video:3C00
video:3C00
                     ; Processor:
video:3C00
                                       280
video:3C00
                     ; Target assembler: ASxxxx by Alan R. Baldwin v1.5
video:3C00
                           .area idaseg (ABS)
video:3C00
                            .hd64 ; this is needed only for HD64180
video:3C00
video:3C00
video:3C00
                     ; Segment type: Regular
; segment 'video'
video:3C00
video:3C00
                            .org 0x3C00
video:3C00
video:3C00 ?? ?? ??+video ram:.ds 0x400
                                                          ; DATA XREF:
update bullet+84 o
video:3C00 ?? ?? ?? ??+
video:3C00 ?? ?? ?? ??+; end of 'video'
                                                          ; update bullet+91 o ...
video:3C00 ?? ?? ?? ??+
ram:4300
ram:4300
                  ; Segment type: Regular
; segment 'ram'
ram:4300
ram:4300
                          .org 0x4300
ram:4300
ram:4300 ??
                   fire throttle:.ds 1
                                                        ; DATA XREF: handle fire+5 r
ram:4300
                                                        ; handle fire+C|w ..
ram:4301 ??
                   invaders left:.ds 1
                                                        ; DATA XREF: update bullet+62|r
                                                        ; update bullet+69 w ...
ram:4301
ram:4302 ?? ??
                                                        ; DATA XREF:
                  row 1 invader addr:.ds 2
animate invaders+2|r
ram: 430\overline{2}
find_end_of_lowest_invader_row+15|r ...
ram:4304 ?? ?? row_2_invader_addr:.ds 2 animate_invaders+13|r
                                                       ; DATA XREF:
ram: 4304
find_end_of_lowest_invader_row+E|r ...
ram:4306 ?? ?? row_3_invader_addr:.ds 2 animate_invaders+19|r
                                                        ; DATA XREF:
ram:4306
ram:4308 ?? ?? row_4_invader_addr:.ds 2 animate_invaders+1F|rram:4300
                                                       ; DATA XREF:
ram:4308
find_end_of_lowest_invader_row|r ...
ram: 430A*??
                  invader_dir:.ds 1
                                                        ; DATA XREF: code:49DC-w
ram:430A*
                                                        ; animate and move invaders+3|r
                                                        ; DATA XREF:
ram:430B*??
                  ufo TTL:.ds 1
check and start ufo+16|w
ram:430B*
                                                        ; update ufo+35 r ...
ram:430C*??
                                                        ; DATA XREF: update bullet+C9|w
                 ufo timer:.ds 1
ram:430C*
                                                        ; check_and_start_ufo|r ...
                                                        ; DATA XREF: handle_fire+15 r
ram:430D ??
                   ufo_dir:.ds 1
ram:430D
                                                        ; handle fire+1A w ...
ram:430D
                                                        ; something with UFO
(direction?)
ram:430E*??
                  wave no:.ds 1
                                                        ; DATA XREF: code:49CF w
                                                        ; code:49FC|r ...
ram:430E*
ram:430F ??
                  no lives:.ds 1
                                                        ; DATA XREF:
update_score_and_chk_bonus_life+1D|r
ram:430F
update_score_and_chk_bonus_life+21|w ...
                  ; end of 'ram'
ram:430F
ram:430F
```

```
code:4310*
                                   ; File Name
                                                          : tandy.bin
code:4310*
                                   ; Format
                                                       : Binary File
                                   ; Base Address: 0000h Range: 4310h - 5000h Loaded length: 0CF0h
code:4310*
code:4310*
code:4310*
code:4310*
                                   ; Segment type: Pure code
                                   ; segment 'code'
code:4310*
code:4310*
                                                 .org 0x4310
code:4310*00
                                   ufo active:.db 0
                                                                                                   ; DATA XREF: handle fire+F|r
code:4310*
                                                                                                    ; update bullet+C6+\overline{w} ...
                                                                                                    ; DATA XREF: handle_fire r
code:4311*00
                                   bullet active:.db 0
                                                                                                    ; handle fire+1F w ...
code: 4311*
code:4312*C9
                                  unused_4312:.db 0xC9
                                                                                                    ; DATA XREF: code:49C9-w
code:4312*
                                                                                                    ; code:4AC1 w ...
code:4313*B0 45
                                                                                                    ; DATA XREF: handle_fire+23 r
                                  base_centre:.dw 0x45B0
code:4313*
                                                                                                    ; check_and_handle_move+17 r
code:4315*01
                                                                                                    ; DATA XREF: code:49C6-w
                                   unused 4315:.db 1
code:4316 40 3C
                                   init_row_1_invader_addr:.dw video_ram+0x40 ; DATA XREF: code:4A1E or code:4A1E
code:4318 C0 3C
                                   init_row_2_invader_addr:.dw video_ram+0xC0
init_row_3_invader_addr:.dw video_ram+0x140
code:431A 40 3D
                                   init row 4 invader addr:.dw video ram+0x1C0
code:431C C0 3D
                                                                                                 ; DATA XREF: handle_fire+2A|w
code:431E*53 3E
                                   bullet addr:.dw video ram+0x253
code:431E*
                                                                                                    ; update_bullet+1|r
code:4320*60
                                   game timer:.db 0x60
                                                                                                    ; DATA XREF: code:4F02|w
code:4320*
                                                                                                    ; code:4F26 r ...
code:4321*2B
                                  invader timer:.db 0x2B
                                                                                                    ; DATA XREF: code:4A98 w
code:4321*
                                                                                                    ; code:4F6C|r ...
                                  keybd_state:.db 0
                                                                                                    ; DATA XREF: code:49D8 w
code:4322*00
                                                                                                    ; code:4F17 r ..
code:4322*
code:4323 A0 B6 BF B9+invader 30pt:.db 0xA0, 0xB6, 0xBF, 0xB9, 0x90, 0x1A, 1, 0x20, 0x86,
0x20, 0x89
code:4323 90 1A 01 20+
                                                                                                    ; DATA XREF: code:4570 o
code:4323 86 20 89 20+
                                                                                                     ; code:4A72 o
code:4323 00
                                                 .db 0x20, 0
code: 4330 9C B7 BF BB+invader 20pt: db 0x9C, 0xB7, 0xBF, 0xBB, 0xAC, 0x1A, 1, 0x8C, 0x83,
0x20, 0x83
code:4330 AC 1A 01 8C+
                                                                                                    ; DATA XREF: code:457C-o
code:4330 83 20 83 8C+
                                                                                                     ; code:4A7B-o
code:4330 00
                                                 .db 0x8C, 0
code:433D BE BB BF B7+invader 10pt:.db 0xBE, 0xBB, 0xBF, 0xBT, 0xBD, 0x1A, 1, 0x8C, 0x83,
0x20, 0x83
code:433D BD 1A 01 8C+
                                                                                                    ; DATA XREF: code:4588 o
code:433D 83 20 83 8C+
                                                                                                    : code:4A84-o
                                            .db 0x8C, 0
.db 0x8C, 0xB7, 0xB7, 0xB7, 0xB7, 0x8C, 0
code:433D 00
code:434A 8C B7 B7 B7+ufo:
                                                                                                   ; DATA XREF: code:4594 o
code:434A B7 8C 00
code: 434A
                                                                                                     ; check_and_start_ufo+2A o
code:4351 B8 BF BF+shield: .db 0xB8, 0xBF, 0xBF, 0xBF, 0xBF, 0xBF, 0xBA, 0xIA, 8, 8, 1,
0x8F
code:4351 BF BF B4 1A+
                                                                                                     ; DATA XREF: code:4A4B o
code:4351 08 08 01 8F+ ..db 0x8F, 0x83, 0x83, 0x85, 0x8F, 0x8F, 0 code:4364 B8 BC BF BC+player: .db 0xB8, 0xBC, 0xBF, 0xBC, 0xB4, 0 ; DATA XREF: code:4AA1|o
code:436A 82 84 20 88+explosion:.db 0x82, 0x84, 0x20, 0x88, 0x81, 0x1A, 1, 0x88, 0x81, 0x20,
0x82
code:436A 81 1A 01 88+
                                                                                                     ; DATA XREF: update_bullet+53 o
code:436A 81 20 82 84+
                                                .db 0x84, 0
                                                .db 0;
code:4377 00
code:4378 00
code:4379 1B 01 20 20+blank space:.db 0x1B, 1, 0x20, 0x20, 0x20, 0x20, 0x20, 0x1A, 1, 0x20,
code:4379 20 20 20 1A+
                                                                                                    ; DATA XREF: update bullet+5C-o
code:4379 01 20 20 20+ .db 0x20, 0x20, 0x20, 0 code:4388 50 4C 41 59 aPlay: .ascii 'PLAY'
                                                                                                    ; DATA XREF: code:4564-o
code:438C 09 D6 3C
                                                .db 9, 0xD6, 0x3C
code:438F 54 41 4E 44+aTandyInvaders:.ascii 'TANDY
                                                                                            INVADERS'
code:43A3 09 54 3D
                                                .db 9, 0x54, 0x3D
code:43A6 2A 20 53 43+aScoreAdvanceTa:.ascii '* SCORE ADVANCE TABLE *'
code:43A6 4F 52 45 20+
                                               .db 0
code:43BE 2A 20 54 41+aTandyElectroni:.ascii '* TANDY ELECTRONICS *'; DATA XREF: code:4558 of code:4558 of code:4558 of code:4568 of co
code:43BE 4E 44 59 20+
                                                                                                    ; code:45BB-o
code: 43BE 45 4C 45 43+
                                                 db 0
code:43D4 3C 2D 2D 2D+a30Points:.ascii '<---- 30 POINTS' ; DATA XREF: code:45A0 o
code:43E6 09 1E 3E .db 9, 0x1E, 0x3E code:43E9 3C 2D 2D 2D+a20Points:.ascii '<----
                                                                            20 POINTS'
code:43FB 09 9E 3E
                                               .db 9, 0x9E, 0x3E
```

```
code:43FE 3C 2D 2D 2D+a10Points:.ascii '<---- 10 POINTS'
                            .db 9, 0x1E, 0x3F
code:4410 09 1E 3F
code:4413 3C 2D 2D 2D+a_Mystery:.ascii '<----
                                                  MYSTERY'
code:4413 2D 20 20 20+
                             .db 0
code:4427 50 52 45 53+aPressZKeyToMov:.ascii 'PRESS "Z" KEY TO MOVE LEFT'
code:4427 53 20 22 5A+
                                                            ; DATA XREF: code:45C7 o
code:4441 09 13 3D
                             .db 9, 0x13, 0x3D
code:4444 50 52 45 53+aPressXKeyToMov:.ascii 'PRESS "X" KEY TO MOVE RIGHT' code:445F 09 93 3D .db 9, 0x93, 0x3D
code:4462 50 52 45 53+aPressKeyToFire:.ascii 'PRESS " " KEY TO FIRE !'
code:4479 09 13 3E .db 9, 0x13, 0x3E code:447C 50 52 45 53+aPressRKeyToSta:.ascii 'PRESS "R" KEY TO START'
code:447C 53 20 22 52+ .db 0 code:4493 47 20 41 20+aGAMEOVER:.ascii 'G A M E - O V E R' ; DATA XREF: code:494B+o
code:4493 4D 20 45 20+
                             .db 0
code:44A5 20 20 53 43+aScore00000High:.ascii ' SCORE 00000
HIGH-SCOR!
code:44A5 4F 52 45 20+
                                                            ; DATA XREF: code:4544-o
code:44A5 20 30 30 30+
code:44A5 30 30 20 20+
                             .ascii 'E 00000'
                             .db 0
code:44E5
                      code · 44E5
code:44E5
code:44E5
code:44E5
                     display message:
                                                             ; CODE XREF: code:4547 p
code:44E5 C5
                                                             ; code:455B-p ...
code:44E5
                             push
                                     bс
code:44E6
                     loc_0_44E6:
                                                             ; CODE XREF:
code:44E6
display_message+15|j
                                     a, (hl)
                                                            ; get character
code: 44\overline{E}6 7E
                             ld
code:44E7 B7
                                                            ; finished?
                             or
code:44E8 28 19
                             jr
                                     Z, loc 0 4503
                                                            ; yes, exit
code:44EA FE 01
                             ср
code:44EC 20 0E
                                     NZ, loc_0_44FC
                             jr
code:44EE 06 05
                             ĺd
                                     b, #5
a, #8
                                                            ; 5 characters to print
code:44F0 3E 08
                             ld
                                                             ; backspace
code:44F2
code:44F2
                     loc 0 44F2:
                                                            ; CODE XREF:
display_message+12|j
code:44F2 D5
code:44F3 CD 33 00
                             push
                                     de
                                     0x33
                             call
                                                            ; display character
code:44F6 D1
                             pop
                                     de
code:44F7 10 F9
                                     loc 0 44F2
                             djnz
                                                            ; loop
code:44F9
code:44F9
                     loc_0_44F9:
                                                            ; CODE XREF:
display_message+1C|j
code:44F9 23
                             inc
                                     h1
                                                             ; next character
code:44FA 18 EA
                             jr
                                     loc 0 44E6
code: 44FC
code:44FC
code:44FC
                     loc 0 44FC:
                                                            ; CODE XREF:
display_message+7↑j
code:44FC D5
                             push
                                     de
code:44FD CD 33 00
                             call
                                     0x33
                                                            ; display character
code:4500 D1
                                     de
                             pop
code:4501 18 F6
                                     loc 0 44F9
                             jr
code:4503
code:4503
code: 4503
                     loc 0 4503:
                                                             ; CODE XREF:
display message+3↑j
code: 4503 C1
                                     bc
                             pop
code:4504 C9
                             ret
                     ; End of function display_message
code:4504
code:4504
code:4505
code:4505
                     ; ΰΰΰΰΰΰΰΰΰΰΰΰΰΰΰ S U B R O U T I N E
code:4505
code: 4505
code:4505
                     display_message_slowly:
                                                            ; CODE XREF:
display_message_slowly+11+j
code:4505 7E
                                                            ; code:494E|p
code: 4505
                             1 d
                                   a, (hl)
                                                             ; get character
```

```
code:4506 B7
                                                                ; done?
code:4507 C8
                               ret
                                       Ζ
                                                                ; yes, exit
code:4508 D5
                               push
                                       de
code:4509 C5
                               push
                                       bc
code:450A CD 33 00
                               call
                                       0x33
                                                                ; display character
code:450D 01 00 23
                                                                ; ~130ms
                               ld
                                       bc, #8960
code:4510 CD 60 00
                               call
                                       0x60
                                                                ; delav
code:4513 C1
                                       bс
                               gog
code:4514 D1
                                       de
                               pop
code:4515 23
                               inc
                                       hl
                                                                ; next character
code:4516 18 ED
                                       display_message_slowly
                                                               ; loop through message
                               jr
                      ; End of function display_message_slowly
code:4516
code: 4516
code: 4518
                       ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code:4518
code:4518
code: 4518
code:4518
                      wipe_screen_left_to_right_slow:
                                                               ; CODE XREF: code:454F|p
code:4518 D9
                                                                ; code: 45AF p ...
code:4518
                               exx
code:4519 21 FF 3B
                                       hl, #0x3BFF
                               1d
                                                                ; start of video (-1)
                                       b, #0x40 ; '@'
code:451C 06 40
                               1 d
                                                                ; characters/line
code:451E
code:451E
                      loc_0_451E:
                                                                ; CODE XREF:
wipe_screen_left_to_right_slow+19|j
code:451E C5
                               push
code:451F 23
                               inc
                                       hl
                                                                ; next column
code:4520 E5
                               push
                                       hl
                                       b, #0xF
code:4521 06 0F
                               ld
                                                                ; 15 lines
                                       a, #0x20 ; ' '
code:4523 3E 20
                                                                ; space
                               ld
                                       de, #0x40 ; '@'
code:4525 11 40 00
                               ld
                                                                ; next line address
code:4528
                                                                ; CODE XREF:
code:4528
                      loc 0 4528:
wipe_screen_left_to_right_slow+12|j
code:4528 77 ld
                                       (hl), a
                                                                ; display character
code:4529 19
                               add
                                       hl, de
                                                                ; next line
code:452A 10 FC
                                       loc_0_4528
                               djnz
                                                                ; loop all lines
code:452C CD 60 4E
                               call
                                       delay_1_5ms
code:452F E1
                                       hl
                               gog
code:4530 C1
                                       bc.
                               pop
                                       loc_0_451E
code:4531 10 EB
                                                                ; loop all columns
                               djnz
code:4533 D9
                               exx
code:4534 C9
                               ret
                       ; End of function wipe_screen_left_to_right_slow
code: 4534
code:4534
code: 4535
code: 4535
code: 4535
                      START:
code:4535 F3
                               di
code:4536 3E 0F
                               ld
                                       a, #0xF
code:4538 CD 33 00
                               call
                                       0x33
                                                                ; display character
                                       sp, #0x428A
code:453B 31 8A 42
                               1 d
code:453E 21 C0 3F
                               ٦d
                                       hl, #video_ram+0x3C0
                                                                ; cursor position
code:4541 22 20 40
                               ld
                                       (0x4020), \overline{h}1
code:4544 21 A5 44
                               ld
                                       hl, #aScore00000High
                                                                ; " SCORE 00000
code:4547 CD E5 44
                               call
                                       display message
                                       a, \#0x20;
code:454A 3E 20
code:454C 32 FF 3F
                                       (video ram+0x3FF), a
                               ld
code:454F
code:454F
                      attract_loop:
                                                                ; CODE XREF: code:45D6-j
code:454F CD 18 45
                                                                ; code:4960 j
code:454F
                               call
                                       wipe screen left to right slow
                                       hl, \#video_ram+0\times39\overline{4}
code:4552 21 94 3F
                               ld
                                                               ; cursor position
code:4555 22 20 40
                                       (0x4020), \overline{h}1
                               ld
code:4558 21 BE 43
                                                               ; "* TANDY ELECTRONICS *"
                               1d
                                       hl, #aTandyElectroni
                                       display_message
hl, #video_ram+0x9E
code:455B CD E5 44
                               call
code:455E 21 9E 3C
                               ld
                                                                ; cursor position
                                       (0x4020), \overline{h}1
code:4561 22 20 40
                               ٦d
                                                                ; "PLAY"
code: 4564 21 88 43
                                       hl, #aPlav
                              1 d
code:4567 CD 66 4E
                               call
                                       print_slow_and_check_for_R_key
code:456A 21 92 3D
                                       hl, #video_ram+0x192
                                                              ; cursor position
                              1 d
code:456D 22 20 40 code:4570 21 23 43
                                       (0x4020), \overline{h}1
                              1 d
                                       hl, #invader_30pt
                              1 d
code:4573 CD E5 44
                              call
                                       display_message
```

```
code:4576 21 12 3E
                                ld
                                        hl, #video ram+0x212
                                                                  ; cursor position
code:4579 22 20 40
                                         (0x4020), \overline{h}1
code:457C 21 30 43
                                        hl, #invader_20pt
                                ld
code:457F CD E5 44
                                call
                                        display message
                                        hl, #video ram+0x292
code:4582 21 92 3E
                                1d
                                                                  ; cursor poition
code:4585 22 20 40
                                         (0x4020), \overline{h}1
                                ld
code:4588 21 3D 43
                                ld
                                        hl, #invader 10pt
                                        display_message
hl, #video ram+0x312
code:458B CD E5 44
                                call
code:458E 21 12 3F
                                ld
                                                                  ; cursor position
code:4591 22 20 40
                                        (0x4020), \overline{h}1
                               ld
code:4594 21 4A 43
                                ld
                                        hl, #ufo
code:4597 CD E5 44
                                call
                                        display_message
                                        hl, #video_ram+0x19E
(0x4020), hl
code:459A 21 9E 3D code:459D 22 20 40
                                                                  ; cursor position
                                1 d
                                ٦d
code:45A0 21 D4 43
                                        hl, #a30Points
                                                                  ; "<---- 30 POINTS"
                                ld
code:45A3 CD 66 4E
                                        print_slow_and_check_for_R_key
                                call
                                        bc, #0xFFFF
0x60
                                                                 ; ~1s
code:45A6 01 FF FF
                                1 d
code: 45A9 CD 60 00
                                call
                                                                  : delav
code:45AC CD 60 00
                                        0x60
                                                                  ; delay
                                call
code:45AF
                       loc_0_45AF:
code: 45AF
code:45AF CD 18 45
                               call
                                        wipe_screen_left_to_right_slow
code:45B2 CD D9 45
                                call
                                         check_for_R_key
                                        hl, #video_ram+0x394
(0x4020), hl
code:45B5 21 94 3F
                                ld
code:45B8 22 20 40
                                ld
                                                                ; "* TANDY ELECTRONICS *"
code:45BB 21 BE 43
                                ld
                                        hl, #aTandyElectroni
code:45BE CD E5 44
                               call
                                        display message
code:45C1 21 93 3C
                                ld
                                        hl, #video ram+0x93
code:45C4 22 20 40
                               ld
                                        (0x4020), h1
code:45C7 21 27 44
                                        hl, #aPressZKeyToMov ; "PRESS \"Z\" KEY TO MOVE
                                ld
LEFT"
code:45CA CD 66 4E
                                call
                                        print slow and check for R key
code:45CD 01 FF FF
                                        bc, #65535
                                                                ; ~1s
                               ld
                                call
                                         0x60
code:45D0 CD 60 00
                                                                  ; delay
code:45D3 CD 60 00
                                call
                                        0x60
                                                                  ; delay
code:45D6 C3 4F 45
                                        attract loop
                                qŗ
code:45D9
                        ; ΰΰΰΰΰΰΰΰΰΰΰΰΰΰΰ Ν Β Β Ο U Τ Ι Ν Ε
code:45D9
code:45D9
code: 45D9
code:45D9
                       check for R key:
                                                                  ; CODE XREF: code:45B21p
code:45D9 3A 04 38
a, (0x3804)
                                                                  ; read keyboard
code:45DC FE 04
                                                                  ; "R"?
                                ср
                                         #4
code:45DE CA C2 49
                                jр
                                        Z, start_game
                                                                  ; yes, skip
code:45E1 C9
                               ret
code:45E1
                       ; End of function check_for_R_key
code:45E1
code:45E2
                        ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:45E2
code:45E2
code:45E2
code:45E2
                       compare_video_addresses:
                                                                 ; CODE XREF: update bullet+26|p
code:45E2 E5
                                                                  ; update_bullet+36 p ...
code:45E2
                                        h1
                                                                  ; bullet address
                                push
                                                                  ; video address to check
code:45E3 D5
                                push
                                         de
code:45E4 7C
                                ld
                                        a, h
code:45E5 BA
                                ср
                                        d
                                                                  ; same MSB?
code:45E6 28 06
                                        Z, loc 0 45EE
                                                                  ; yes, continue
                                jr
                                        NC, loc 0 45F4
code:45E8 30 0A
                                                                  ; continue if bullet below
                                jr
code:45EA
code:45EA
                       no hit:
                                                                  ; CODE XREF:
compare_video_addresses+10|j
code: 45EA AF
                                                                  ; flag no hit
                                        а
code: 45EB
                      loc_0 45EB:
code:45EB
                                                                  ; CODE XREF:
compare_video_addresses+14/j
code:45EB D1
                                                                  ; compare_video_addresses+18|j
code:45EB
                                pop
                                        de
code:45EC F1
                                pop
                                        h1
code:45ED C9
                                ret
code: 45EE
code:45EE
```

```
code:45EE
                        loc 0 45EE:
                                                                       ; CODE XREF:
compare_video_addresses+4\(\bar{1}\)j
code:45EE 7D
                                  ld
                                           a, 1
code:45EF BB
                                  ср
                                                                      ; same address?
                                           е
                                                                      ; yes, continue
; exit if bullet above
code:45F0 28 06
                                           Z, loc 0 45F8
                                  jr
code:45F2 38 F6
                                           C, no hit
                                  jr
code:45F4
code:45F4
                         loc 0 45F4:
                                                                      ; CODE XREF:
compare video addresses+6 j
code: 45F4 3E FF
                                           a, #0xFF
                                                                       ; flag bullet right/below
code:45F6 18 F3
                                  jr
                                           loc_0_45EB
code:45F8
code: 45F8
code:45F8
                        loc 0 45F8:
                                                                       ; CODE XREF:
compare_video_addresses+Efj
code:45F8 3E 20
code:45FA 18 EF
                                           a, #0x20 ; ' '
                                  ٦d
                                                                     ; flag bullet match
                        jr loc_0_45EB
; End of function compare_video_addresses
code:45FA
code:45FA
code:45FC
                         ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 45FC
code:45FC
code:45FC
code:45FC
                         animate invaders:
                                                                       ; CODE XREF:
animate_and_move_invaders+2B|p
code:45FC E5
                                                                       ; code:4B91|p
code:45FC
                                  push
                                           hl
code:45FD C5
                                  push
                                           hl, (row_1_invader_addr)
b, #0x3F; '?'
code:45FE 2A 02 43
                                  ld
code:4601 06 3F
                                  ld
                                                                       ; characters/line-1
code:4603
code:4603
                         animate_top_row:
                                                                       ; CODE XREF:
animate_invaders+10|j
code:4603 7E
                                  1d
                                           a, (hl)
                                                                       ; get character from video
code:4604 CB 7F
                                                                      ; graphic character?
                                  bit
                                           7, a
code:4606 28 03
                                           Z, loc_0_460B
                                  jr
                                                                      ; no, skip
code:4608 EE 0F
                                           #0xF
                                                                       ; invert top 4 pixels
                                  xor
code:460A 77
                                  ld
                                           (hl), a
                                                                       ; display
code:460B
                         loc_0_460B:
code:460B
                                                                       ; CODE XREF:
animate invaders+A↑j
code:460B 23
code:460C 10 F5
                                                                       ; next video address
                                  inc
                                           h1
                                                                       ; loop thru line
                                  djnz
                                           animate_top_row
code:460E D5
code:460F 2A 04 43
                                  push
                                           de
                                           hl, (row_2_invader_addr)
                                  1d
code:4612 CD 25 46
                                  call
                                           animate_invader_row
code:4615 2A 06 43
                                  ld
                                           hl, (row_3_invader_addr)
code:4618 CD 25 46
                                  call
                                           animate invader row
code:461B 2A 08 43
                                  ld
                                           hl, (row 4 invader addr)
code:461E CD 25 46
                                  call
                                           animate_invader_row
code:4621 D1
                                  pop
                                           de
code:4622 C1
                                  pop
                                           bc
code:4623 E1
                                           hl
                                  pop
code:4624 C9
                                  ret
code:4624
                        ; End of function animate_invaders
code:4624
code: 4625
code: 4625
                          ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4625
code:4625
code:4625
                        animate invader row:
                                                                      ; CODE XREF:
animate invaders+16↑p
                                                                       ; animate_invaders+1C\uparrowp ...
code:46\overline{2}5 E5
code:4625
                                  push
                                           hl
                                                                       ; invader row addr
                                           b, #0x40 ; '@'
code:4626 06 40
                                                                       : characters/line
                                  1 d
code:4628
                         loc_0_4628:
code:4628
                                                                       ; CODE XREF:
animate_invader_row+15/j
code:4628 7E
                                           a, (hl)
                                  1 d
                                                                       ; get character from video
code:4629 FE 8C
                                           #0x8C ; 'Œ'
                                  ср
                                          Z, loc_0_4636
#0x83; 'f'
NZ, loc_0_4639
a, #0x8C; 'E'
code:462B 28 09
                                  jr
code:462D FE 83 code:462F 20 08
                                  ср
                                                                      ; not part of animation, skip
                                  jr
code:4631 3E 8C
                                  ٦d
                                                                       ; 0x83->0x8C
```

```
code:4633 77
                                 ld
                                          (hl), a
                                                                     ; display
code:4634 18 03
                                          loc_0_4639
                                 jr
code:4636
code:4636
                        loc 0 4636:
                                                                     ; CODE XREF:
animate invader row+6↑j
code:4636 3E 83
code:4638 77
                                        a, #0x83 ; 'f'
                                                                    ; 0x8C->0x83
                                 ٦d
                                          (hl), a
                                                                     ; display
code:4639
code:4639
                                                                     ; CODE XREF:
                        loc_0_4639:
animate_invader_row+A^jj
                                                                    ; animate_invader_row+F<sup>†</sup>j
; next video address
code:4639 23
code:4639
                                 inc
                                          h1
                                          loc 0 4628
                                                                     ; loop thru line
code:463A 10 EC
                                 djnz
code:463C E1
                                 pop
                                          h1
code:463D C9
                                 ret
                        ; End of function animate_invader_row
code: 463D
code:463D
code:463E
                        ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code: 463E
code:463E
code:463E
code:463E
                        move_video_line_right_HL:
                                                                    ; CODE XREF:
check and handle move+14|p
code: 463E E5
                                                                     ; update ufo+2A p ...
code:463E
                                 push
                                          hl
code:463F 11 3E 00
                                 ld
                                          de, #0x3E ; '>'
                                                                    ; start at right end
code:4642 19
                                 add
                                          hl, de
code:4643 E5
                                 push
                                          hl
code:4644 D1
                                 pop
                                          de
code:4645 13
                                                                    ; DE = end of row
                                 inc
                                          de
code:4646 06 3F
                                          b, #63
                                 ld
                                                                    ; number of characters/line-1
                                          a, (de)
code:4648 1A
                                 ld
                                                                    ; get character from end of row
code:4649 CB 7F
                                 bit
                                          7, a
                                                                    ; graphic?
code:464B 28 03
                                          z, loc_0_4650
                                                                    ; no, skip
                                 ir
                                          a, \#0x\overline{2}0^-; ''
code:464D 3E 20
                                 ĺd
                                                                    ; space
code:464F 12
                                 ld
                                          (de), a
                                                                    ; display space
code:4650
                        loc 0 4650:
                                                                    ; CODE XREF:
code:4650
move_video_line_right_HL+Dfj
code:4650 CB 7E
                                                                    ; move video line right HL+1C|j
                                                                    ; graphic character left byte?
code:4650
                                          7, (hl)
                                 bit.
code:4652 28 04
                                          z, loc_0_4658
                                                                    ; no, skip
                                 jr
code:4654 7E
code:4655 12
                                 1d
                                          a, (hl)
                                                                    ; get character left byte
                                 1 d
                                          (de), a
                                                                    ; display to the right
code:4656 36 20
                                          (h1), #0x20; ''
                                 1 d
                                                                    ; display space at left-hand
byte
code:4658
                       loc 0 4658:
                                                                     ; CODE XREF:
code:4658
move_video_line_right_HL+14\(\dagger)\)j code:4658 2B
                                 dec
                                          hl
code:4659 1B
                                 dec
                                          de
code:465A 10 F4
                                 djnz
                                          loc_0_4650
                                                                     ; loop through line
code:465C E1
                                          hl
                                 pop
code:465D 36 20
                                 ld
                                          (hl), #0x20 ; ' '
                                                                     ; display space
code:465F C9
                                 ret
code:465F
                        ; End of function move video line right HL
code:465F
code:4660
code:4660
                         ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:4660
code:4660
code:4660
                        move_video_line_left_HL:
                                                                    ; CODE XREF:
check and handle move+2B p
code: 4660 E5
                                                                    ; update_ufo+32|p ...
code:4660
                                          hl
                                 push
code:4661 E5
                                          hl
                                 push
code:4662 D1
                                 pop
                                          de
code: 4663 23
                                 inc
                                          h1
code: 4664 06 3F
                                          b, #63
                                 1d
                                                                    : characters/line-1
code:4666 1A
                                 1d
                                          a, (de)
                                                                    ; get character LH byte
code:4667 CB 7F code:4669 28 03
                                 bit
                                          7, a
                                                                    ; graphic?
                                          Z, loc_0_466E
                                 jr
                                                                    ; no, skip
                                          a, \#0x\overline{2}0^-; ''
code:466B 3E 20
                                 ٦d
                                                                     ; space
```

```
code:466D 12
                                  ld
                                           (de), a
                                                                       ; display space LH byte
code:466E
                        loc_0_466E:
                                                                      ; CODE XREF:
code:466E
{\tt move\_video\_line\_left\_HL+9} \\ \hline{\tt j}
code:466E CB 7E
                                                                      ; move video line left HL+18-j
code:466E
                                           7, (hl)
Z, loc_0_4676
                                                                      ; graphic RH byte?
                                  bit
code:4670 28 04
                                                                      ; no, skip
; get character from video (RH
                                  jr
code:4672 7E
                                  ld
                                           a, (hl)
bvte)
                                           (de), a (hl), #0x20; ''
code:4673 12
                                  ld
                                                                      ; display LH byte
code:4674 36 20
                                  ld
                                                                      ; space RH byte
code:4676
code:4676
                         loc 0 4676:
                                                                       ; CODE XREF:
\verb|move_video_line_left_HL+10| | \overline{j}|
code:4676 23
                                           hl
                                  inc
code:4677 13
                                  inc
                                           de
code:4678 10 F4
                                           loc_0_466E
                                  djnz
                                                                      ; loop thru row
code: 467A E1
                                  pop
                                           h1
                                           de, #0x3F ; '?'
code:467B 11 3F 00
                                  1d
code:467E 19
                                  add
                                           hl, de
                                           (hl), #0x20 ; ' '
code:467F 36 20
                                  1 d
                                                                      ; display space on end of row
code:4681 C9
                                  ret
                         ; End of function move_video_line_left_HL
code:4681
code:4681
code:4682
                         ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 4682
code:4682
code:4682
code:4682
                         add_10_to_score:
                                                                       ; CODE XREF:
{\tt update\_score\_and\_chk\_bonus\_l\bar{i}fe} {\tt p}
code: 4682 E5
code:4683 C5
                                  push
                                           bc
code:4684 21 CC 3F
                                  ld
                                           hl, #video ram+0x3CC
                                                                      ; tens digit
                                           add_1_to_score_digit
NZ, loc_0_46A1
code:4687 CD A4 46
                                 call
code:468A 20 15
                                                                      ; skip if no carry
                                  jr
code:468C 2B
                                  dec
                                           hl
                                                                      ; hundreds digit
code:468D CD A4 46
                                  call
                                           add_1_to_score_digit
                                           NZ, loc_0_46A1
code:4690 20 OF
                                                                      ; skip if no carry
                                  ir
code:4692 2B
                                  dec
                                           hl
                                                                      ; thousands digit
                                           add_1_to_score_digit NZ, loc_0_46A1
code:4693 CD A4 46
                                  call.
                                                                      ; skip if no carry ; tens of thousands digit
code:4696 20 09
                                  ir
code:4698 2B
                                  dec
                                           hl
                                           add_1_to_score_digit NZ, loc_0_46A1
code:4699 CD A4 46
                                  call
code:469C 20 03
                                                                      ; skip if no carry
                                  jr
code:469E CD B0 46
                                  call
                                           zero_score
code:46A1
code:46A1
                         loc_0_46A1:
                                                                       ; CODE XREF:
add_10_to_score+81j
code:46A1 C1
                                                                      ; add 10 to score+Eîj ...
code:46A1
                                  pop
                                           bc
code:46A2 E1
                                           hl
                                  pop
code:46A3 C9
code:46A3
                         ; End of function add 10 to score
code: 46A3
code: 46A4
code:46A4
code:46A4
code:46A4
                         add 1 to score digit:
                                                                      ; CODE XREF:
add_10_to_score+5<sup>p</sup>
code:46A4 7E
                                                                      ; add_10_to_score+Bîp ...
                                                                      ; get score digit
code:46A4
                                  ٦d
                                           a, (hl)
                                           #0x39; '9'
                                                                      ; 9?
code:46A5 FE 39
                                  ср
code:46A7 28 03
                                           Z, flag_carry
                                                                      ; yes, skip
                                  jr
code:46A9 3C
                                                                      ; add 1
                                  inc
                                           а
code:46AA 77
                                  1d
                                           (hl), a
                                                                       : store
code:46AB C9
                                  ret
code: 46AC
code:46AC
code:46AC
                        flag_carry:
                                                                      : CODE XREF:
add_1_to_score_digit+3fj
code:46AC 36 30
code:46AE AF
                                  1d
                                           (hl), #0x30 ; '0'
                                                                      ; set to 0
                                           а
                                  xor
                                                                       ; flag carry
                                  ret
code:46AF C9
```

```
code:46AF
                          ; End of function add 1 to score digit
code:46AF
code:46B0
code:46B0
                            ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:46B0
code:46B0
code:46B0
                                                                           ; CODE XREF:
                          zero_score:
add_10_to_score+1C\pcode:46B0_21_C9_3F
                                                                           ; code:49EF|p
code:46B0
                                              hl, #video_ram+0x3C9
                                    ld
                                                                           ; score
code:46B3 06 05
                                              b, #5
                                    ld
                                                                           ; 5 digits to zap
code:46B5
                                                                           ; CODE XREF: zero_score+8|j
code:46B5
                          loc_0_46B5:
code:46B5 36 30
                                              (hl), #0x30 ; '0'
                                                                           ; set digit to 0
                                    ld
code:46B7 23
                                                                           ; next digit
                                    inc
                                              h1
code:46B8 10 FB
                                              loc_0_46B5
                                                                           ; loop thru all score digits
                                    djnz
code:46BA C9
                                    ret
code:46BA
                           ; End of function zero_score
code:46BA
code:46BB
                           ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 46BB
code:46BB
code:46BB
code:46BB
                          update_score_and_chk_bonus_life:
                                                                           ; CODE XREF:
update_score_and_chk_bonus_life+27\fi
code: 46BB CD 82 46
                                                                           ; update bullet+50|p ...
code:46BB
                                     call
                                              add_10_to_score
code:46BE 21 CC 3F
                                              hl, #video_ram+0x3CC
                                                                           ; tens digit of score
                                    ld
                                              a, (hl)
#0x30; '0'
code:46C1 7E
                                                                           ; get digit
                                    ld
code:46C2 FE 30
                                     ср
                                                                           ; 0?
code:46C4 20 1C
                                              NZ, loc 0 46E2
                                                                           ; no, exit
                                    jr
code:46C6 2B
                                    dec
                                              hl
                                                                           ; hundreds digit
code:46C7 7E
                                                                           ; get digit
; 5?
                                    ld
                                              a, (hl)
                                              #0x35 ; '5'
code:46C8 FE 35
                                    ср
                                              NZ, loc 0 46E2
code:46CA 20 16
                                    jr
                                                                           ; no, skip
code:46CC 2B
                                                                           ; thousands digit
                                    dec
                                              hl
code:46CD 7E
                                    ld
                                              a, (hl)
                                                                           ; get digit
; 1?
                                              #0x31 ; '1'
code:46CE FE 31
                                    ср
code:46D0 20 10
                                              NZ, loc_0_46E2
                                                                           ; no, skip
                                    iΥ
code:46D2 2B
code:46D3 7E
                                                                           ; tens of thousands digit
                                    dec
                                              hl
                                              a, (hl)
                                    ld
                                                                           ; get digit
                                              #0x30 ; '0'
code:46D4 FE 30
                                                                           : 0?
                                    ср
                                              NZ, loc_0_46E2
code:46D6 20 0A
                                     jr
                                                                           ; no, skip
                                              a, (no_lives)
code:46D8 3A 0F 43
                                    1d
code:46DB 3C
                                    inc
                                                                           ; bonus life
code:46DC 32 0F 43
                                    1 d
                                              (no lives), a
code:46DF CD 90 4E
                                    call
                                              display_lives_left
code:46E2
                          loc_0_46E2:
code:46E2
                                                                           ; CODE XREF:
update_score_and_chk_bonus_life+9^j
code: 46E2 10 D7
update_score_and_chk_bonus_life+F<sup>†</sup>j ...
code: 46E2
                                              update_score_and_chk_bonus_life
                                    djnz
code:46E4 C9
code:46E4
                          ; End of function update_score_and_chk_bonus_life
code:46E4
code:46E5
code:46E5
                           ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:46E5
code:46E5
code:46E5
                          handle fire:
                                                                           ; CODE XREF: code:4F23 p
code:46E5 3A 11 43
                                    ld
                                              a, (bullet active)
code:46E8 B7
                                                                           ; already fired?
                                    or
                                              а
code:46E9 C0
                                              ΝZ
                                                                           ; yes, return
                                    ret
code:46EA 3A 00 43
                                              a, (fire_throttle)
                                    1 d
code:46ED B7
                                                                           ; waiting for throttle?
                                    or
code:46EE CO
                                              NZ
                                                                           ; yes, return
                                    ret
code:46EF 3E 14
code:46F1 32 00 43
                                              a, #20
                                    1d
                                                                           ; init throttle value
                                              (fire_throttle), a a, (ufo_active)
                                    1 d
code:46F4 3A 10 43
                                    1 d
code:46F7 B7
                                    or
                                              а
                                                                           ; on-screen?
code:46F8 20 08 code:46FA 3A 0D 43
                                              NZ, loc_0_4702
a, (ufo_dir)
                                     jr
                                                                           ; yes, skip
                                    1 d
code:46FD EE 01
                                    xor
                                              #1
                                                                           ; toggle direction
```

```
code:46FF 32 0D 43
                                 ld
                                          (ufo dir), a
code:4702
code:4702
                                                                     ; CODE XREF: handle_fire+13↑j
                        loc_0_4702:
code:4702 3E 01
                                ld
                                          a, #1
code:4704 32 11 43
                                 1d
                                          (bullet active), a
                                                                    ; flag fired
code:4707 D9
                                 exx
code:4708 2A 13 43
                                 ld
                                          hl, (base centre)
code:470B 11 C0 FF
                                                                     ; -64
                                 ld
                                          de, #0xFFC0
code:470E 19
                                                                     ; video address of row above
                                 add
                                          hl, de
code:470F 22 1E 43
                                          (bullet addr), hl
                                 ld
                                                                     ; save
                                          a, (hl)
#0x20; ''
code:4712 7E
                                                                     ; get character from video
                                 ld
code:4713 FE 20
                                                                     ; space?
                                 ср
                                          NZ, loc 0 4807
(hl), #0x5B; '['
code:4715 C2 07 48
                                                                    ; no, skip
; display player bullet
                                 jр
code:4718 36 5B
                                 1 d
code:471A D9
                                 exx
code: 471B C9
                                 ret
code:471B
                        ; End of function handle fire
code: 471B
code:471C
                         ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 471C
code:471C
code:471C
code:471C
                        update bullet:
                                                                     ; CODE XREF: update bullet+EC | j
code:471C D9
                                                                     ; code:4F39|p
code:471C
code:471D 2A 1E 43
                                          hl, (bullet_addr)
                                 ld
                                          a, (hl)
#0x5B; '['
code:4720 7E
                                 ld
                                                                     ; get character from video
code:4721 FE 5B
                                                                     ; player bullet?
                                 ср
code:4723 20 1A
                                          NZ, handle_bullet_hit
                                 jr
                                                                     ; no, skip
code:4725 36 20
code:4727 11 C0 FF
                                 ld
                                          (h1), \#0x2\overline{0}; ''
                                                                     ; display space
                                          de, #0xFFC0
                                 ld
code:472A 19
                                 add
                                          hl, de
                                                                     ; address of row above
code:472B CB 54
                                 bit
                                          2, h
                                                                     ; off the top of the screen?
code:472D 28 61 code:472F 7E
                                          Z, delete_bullet
                                                                     ; yes, skip
                                 jr
                                          a, (hl)
#0x80 ; '€'
                                 ld
                                                                     ; get character from video
code:4730 FE 80
                                                                     ; graphic space?
                                 Cρ
                                          Z, display_bullet
code:4732 28 04
                                                                     ; yes, skip
                                 jr
code:4734 FE 20
                                          #0x20 ; '
                                                                     ; space?
                                 ср
code:4736 20 07
                                          NZ, handle bullet hit
                                                                    ; no, skip
                                 ir
code:4738
                                                                     ; CODE XREF: update bullet+16↑j; update bullet+E0∱j
                        display_bullet:
code: 4738
code:4738 36 5B
code: 4738
                                          (hl), #0x5B; '['
                                                                     ; display player bullet
                                 1d
code: 473A
code:473A
                        loc_0_473A:
                                                                     ; CODE XREF: update_bullet+E8|j
code:473A 22 1E 43
                                          (bullet_addr), hl
                                                                     ; update bullet address
                                 1 d
code:473D D9
                                 exx
code:473E C9
                                 ret
code: 473F
code:473F
code:473F
                        handle bullet hit:
                                                                     ; CODE XREF: update bullet+7<sup>†</sup>j
code:473F 11 40 3C
                                                                     ; update bullet+1A↑j
code:473F
                                 1d
                                          de, #video ram+0x40
                                                                     ; 2nd line on display
code:4742 CD E2 45
                                 call
                                          compare_video_addresses
code:4745 B7
                                 or
                                                                      bullet in top line now?
                                          Z, check_and_handle_ufo_hit ; yes, skip
7, (hl) ; graphic character?
code:4746 28 54
                                 jr
code:4748 CB 7E
                                          7, (hl)
                                 bit
code:474A CA EA 47
                                          Z, chk and handle bullet hits bomb; no, skip
                                 jр
code:474D E5
                                                                     ; bullet address
                                 push
code:474E CD 4A 48
                                          find_end_of_lowest_invader_row
                                 call
code:4751 D1
                                                                     ; bullet address
                                          de
                                 pop
code:4752 CD E2 45
                                 call
                                          compare video addresses
code:4755 B7
                                 or
                                                                     ; have we hit an invader?
                                          а
code:4756 D5
                                 push
                                          de
                                                                     ; bullet address
code:4757 E1
                                                                     ; bullet address
                                          hl
                                 pop
code:4758 CA 0B 48
                                          Z, handle shield hit
                                                                     ; no, must be a shield
                                 jр
                                          get_invader_address
(0x4020), h1
code:475B CD 28 4D
                                 call
code:475E 22 20 40
                                 ld
                                                                     ; set cursor position
code:4761 7E
                                          a, (hl)
                                 ٦d
                                                                     ; get character from video
code:4762 06 03
                                                                     ; default to 30 pts
                                 1 d
                                          b. #3
                                          #0xA0 ; ' '
code:4764 FE A0
                                                                     ; 30pt invader character?
                                 ср
                                          Z, loc_0_476C
code:4766 28 04
                                 jr
                                                                     ; yes, skip
code:4768 38 01
                                          C, loc_0_476B
                                                                     ; 20pt invader character, skip
                                 jr
code: 476A 05
                                 dec
                                                                     ; 10pt invader
code:476B
```

```
code:476B
                     loc 0 476B:
                                                             ; CODE XREF: update bullet+4C1j
code:476B 05
code:476C
                     loc_0_476C:
code:476C
                                                             ; CODE XREF: update bullet+4A^j
code:476C CD BB 46
                             call
                                     update score and chk bonus life
code:476F 21 6A 43
                             ld
                                     hl, #explosion
code:4772 CD E5 44
                             call
                                     display message
code:4775 CD 5A 4E code:4778 21 79 43
                                     delay_15ms
hl, #blank space
                             call
                             ld
code:477B CD E5 44
                             call
                                     display message
code:477E 3A 01 43
                             ld
                                     a, (invaders_left)
code:4781 3D
                             dec
                                                             ; end of wave?
                                     а
code:4782 CA 74 48
                                     Z, end_of_wave
(invaders_left), a
                              jр
                                                             ; yes, go
code:4785 32 01 43
                             1d
code:4788 11 00 00
                                     de, #0
                             ld
code:478B CD 85 49
                                     update_invader_row_addresses
                             call
code:478E 18 06
                                     clear_bullet_active
                             jг
code: 4790
code:4790
code:4790
                                                             ; CODE XREF: update_bullet+11^j
                     delete_bullet:
                                     de, #0x40 ; '@'
code:4790 11 40 00
                             1 d
                                                             ; characters/line
                             add
code:4793 19
                                     hl, de
                                                             ; next row
                                      (hl), #0x20 ; ' '
code:4794 36 20
                             ld
                                                             ; display space
code:4796
code:4796
                     clear bullet active:
                                                             ; CODE XREF: update_bullet+721j
code:4796 AF
                                                             ; update bullet+82 | j ...
code:4796
code:4797 32 11 43
                             ld
                                      (bullet active), a
                                                             ; clear fired flag
code:479A D9
                              ехх
code:479B C9
code:479C
code:479C
                     code:479C
                                                             ; CODE XREF: update bullet+2Afj
code:479C CB 7E
code:479E 28 F6
                                     hl, #video_ram
code:47A0 21 00 3C
                              ĺd
code:47A3 06 40
                             ld
                                     b, #64
                                                             : characters/line
code:47A5
                     loc_0_47A5:
                                                             ; CODE XREF: update bullet+8E-i
code: 47A5
code:47A5 CB 7E code:47A7 20 03
                                                             ; graphic character? ; yes, skip
                                     7, (hl)
                             bit
                                     NZ, loc_0_47AC
                              ir
                                                             ; next video address
code:47A9 23
                              inc
                                     h1
                                     loc_0_47A5
code:47AA 10 F9
                                                             ; loop thru line
                             djnz
code:47AC
code:47AC
                     loc_0_47AC:
                                                             ; CODE XREF: update_bullet+8Bfj
code:47AC E5
                             push
                                     h1
code:47AD 21 00 3C
                                     hl, #video_ram
                             1 d
code:47B0 CD 7E 4C code:47B3 21 06 00
                             call
                                      clear_video_line_HL
                                                             ; wipe UFO
                             ld
                                     hl, \#\overline{6}
                                                             ; RAND(1-6)
code:47B6 CD 1D 4D
                             call
                                     rand
code:47B9 45
                             ld
                                     b, 1
                                                             ; get result
code:47BA AF
                             xor
                                                             ; clear carry
                                     а
code:47BB 0E 05
                                     c, #5
                                                             ; 50 pts
                             1d
code:47BD
code:47BD
                                                             ; CODE XREF: update_bullet+A2|j
                     loc_0_47BD:
code:47BD 81
                             add
                                      a, c
                                                             ; multiplier
code:47BE 10 FD
                                      loc 0 47BD
                             dinz
                                                             ; calc ufo score
code:47C0 47
                             ld
                                     b, a
code:47C1 F5
                             push
                                      af
code:47C2 CD BB 46
                             call
                                     update score and chk bonus life
code:47C5 F1
                             pop
                                      af
code:47C6 E1
                                     h1
                             pop
code:47C7 22 20 40
                                      (0x4020), hl
                              ld
                                                             ; cursor position
                                     b, #10
code:47CA 06 0A
                             ld
code:47CC 5F
                              ld
                                                             ; bonus/10
                                     e, a
                                     hl, #0
d, 1
code:47CD 21 00 00
                             1 d
code:47D0 55
                             ld
code:47D1
code:47D1
                     loc_0_47D1:
                                                             ; CODE XREF: update_bullet+B6|j
code:47D1 19
                                     hl, de
                             add
                                     loc_0_47D1
a, #0x3C; '<'
code:47D2 10 FD
                                                             ; calc bonus
                             dinz
code:47D4 3E 3C
                             1d
                                                             ; display character
; display integer in HL
code:47D6 CD 33 00
                             call
                                     0 \times 33
code:47D9 CD AF OF
                                     OxFAF
                             call
                                     a, #0x3E ; '>'
code:47DC 3E 3E
                             1d
```

```
code:47DE CD 33 00
                            call
                                    0x33
                                                           ; display character
code:47E1 AF
                            xor
code:47E2 32 10 43
                                    (ufo_active), a
                            ld
                                                           ; flag inactive
code:47E5 32 0C 43
                                    (ufo timer), a
                                                           ; reset timer
                            ld
code:47E8 18 AC
                            jr
                                    clear bullet active
code:47EA
code:47EA
code:47EA
                    chk and handle bullet hits bomb:
                                                          ; CODE XREF: update bullet+2E1j
code:47EA E5
                            push
                                    hl
code:47EB 21 03 00
                                    hl, #3
                                                           ; RAND(1-3)
                            ld
code:47EE CD 1D 4D
                            call
                                    rand
code:47F1 7D
                            1d
                                                           ; get result
                                    a, 1
code:47F2 E1
                                    h1
                            pop
code:47F3 FE 03
                                    #3
                            ср
code:47F5 F5
                            push
                                    af
code:47F6 C4 0A 4E
                                    NZ, handle_bullet_destroys_bomb
                            call
code: 47F9 F1
                            pop
                                    af
code:47FA FE 02
                            ср
                                    #2
code:47FC DA 38 47
                            jр
                                    C, display_bullet
                                                          ; RAND=1
                                    NZ, clear_bullet_active; RAND=3 (h1), #0x20; ' ' ; displa
code:47FF C2 96 47
                            jр
code:4802 36 20
                            ld
                                                         ; display space
                                    loc 0 473A
code:4804 C3 3A 47
                            jр
code:4807
code:4807
code:4807
                     loc_0_4807:
                                                           ; CODE XREF: handle_fire+30<sup>†</sup>j
                           exx
code:4807 D9
code:4808 C3 1C 47
                                   update bullet
                           jр
code:480B
code:480B
code:480B
                    handle shield hit:
                                                           ; CODE XREF: update bullet+3C<sup>†</sup>j
code:480B CD 2E 48
                                    erode_shield_from_bullet
                            call
                                    clear bullet active
code:480E 18 86
                            jr
code:480E
                    ; End of function update bullet
code:480E
code:4810
                     ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4810
code:4810
code:4810
code:4810
                    erode_shield_from_bomb:
                                                          ; CODE XREF:
handle_drop_new_bomb+90|j
code:4810 E5
                                                           ; update_bombs+96|p
code:4810
                            push
                                    h1
code:4811 C5
                            push
                                    bc
                                    a, (hl)
code:4812 7E
                            1d
                                                          ; get character from video
code:4813 4F
                            1 d
                                    c, a
code:4814 3E BC
                            1 d
                                    a, #0xBC ; '¾'
code:4816 A1
                            and
code:4817 B9
                            ср
code:4818 20 08
                                    NZ, loc_0_4822
                                    a, \#0xB\overline{0};
code:481A 3E B0
                            lд
code:481C A1
                            and
code:481D B9
                            ср
code:481E 20 02
                            jr
                                    NZ, loc_0_4822
code:4820 3E 20
                                    a, \#0x2\overline{0};
code: 4822
code:4822
                    loc 0 4822:
                                                           ; CODE XREF:
erode shield from bomb+81 j
code: 4822 FE 80
                                                           ; erode shield from bomb+E<sup>†</sup>j
code:4822
                                    #0x80 ; '€'
                            Ср
                                    NZ, loc_0_4828
a, #0x20; ''
code:4824 20 02
                            ir
code:4826 3E 20
code:4828
                    loc 0 4828:
                                                           ; CODE XREF:
code: 4828
erode_shield_from_bomb+14\uparrowj
code: 4828 77
                            ld
                                    (hl), a
                                                          ; update character
code:4829 C1
                            pop
                                    bc
code:482A E1
                            pop
                                    h1
                    jp dec_bomb_count
; End of function erode_shield_from_bomb
code:482B C3 57 4D
code:482B
code:482B
code:482E
                     ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code: 482E
```

```
code:482E
code:482E
                          erode_shield_from_bullet:
                                                                          ; CODE XREF: update_bullet+EF<sup>↑</sup>p
code:482E
code:482E E5
                                                                          ; bullet address
                                  push
code:482F C5
                                    push
                                             bc
code:4830 7E
                                              a, (hl)
                                                                          ; get character from video
code:4831 4F
                                    ld
                                              c, a
                                              a, #0x8F ; ' '
code:4832 3E 8F
                                    ld
                                                                          ; top 4 cells?
code:4834 A1
                                    and
                                             С
code:4835 B9
                                                                          ; match?
                                    ср
                                             NZ, loc_0_4840
a, #0x83; 'f'
code:4836 20 08
                                                                          ; no, skip
; top 2 cells?
                                    jr
code:4838 3E 83
                                    ld
code:483A A1
                                    and
                                             C
code:483B B9
                                                                          : match?
                                    ср
code:483C 20 02
                                             NZ, loc_0_4840
                                                                          ; no, skip
                                    jr
                                             a, \#0x2\overline{0};
code:483E 3E 20
                                    ٦d
code:4840
                          loc 0 4840:
                                                                          : CODE XREF:
code: 4840
erode_shield_from_bullet+8↑j
                                                                          ; erode_shield_from_bullet+E^jj
code: 4840 FE 80
                                              #0x80 ; '€'
code:4840
                                    ср
                                                                          ; blank graphic?
                                             NZ, loc_0_4846
a, #0x20;''
code:4842 20 02
                                                                          ; no, skip
code:4844 3E 20
code:4846
code:4846
                          loc_0_4846:
                                                                          ; CODE XREF:
erode_shield_from_bullet+141j
code: 4846 77
                                    1 d
                                             (hl), a
                                                                          ; update character
code:4847 C1
                                    gog
code:4848 E1
                                             hΊ
                                    pop
code:4849 C9
code:4849
                          ; End of function erode shield from bullet
code:4849
code:484A
                          ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:484A
code:484A
code:484A
                                                                          ; CODE XREF: update bullet+32↑p
                          find_end_of_lowest_invader_row:
                                                                          ; update_bombs+7D|p
code:484A 2A 08 43
code:484A
                                             hl, (row 4 invader addr)
                                    ld
code:484D 7C
                                              a, h
                                    ٦d
                                                                          ; any invaders left in row?
code:484E B7
                                    or
                                              а
                                             NZ, loc_0_4862
hl, (row_3_invader_addr)
a, h
code:484F 20 11
                                    ir
                                                                          ; yes, continue
code:4851 2A 06 43 code:4854 7C
                                    1 d
                                    1 d
code:4855 B7
                                    or
                                                                          ; any invaders left in row?
                                             NZ, loc_0_4862
hl, (row_2_invader_addr)
code:4856 20 0A
                                    jr
                                                                          ; yes, continue
code:4858 2A 04 43
                                    1d
code:485B 7C
                                              a, h
                                    1d
code:485C B7
                                    or
                                                                           ; any invaders left in row?
code:485D 20 03
                                             NZ, loc_0_4862
                                                                           ; yes, continue
                                    jr
                                             hl, (row_1_invader_addr)
code:485F 2A 02 43
                                    ld
code:4862
code:4862
                          loc 0 4862:
                                                                           ; CODE XREF:
find_end_of_lowest_invader_row+5^j
code: 4862 D5
\begin{array}{c} \texttt{find\_end\_of\_lowest\_invader\_row+C\uparrowj} \ \dots \\ \texttt{code:} 4862 & \texttt{push} \end{array}
code:4863 C5
                                    push
                                              bc
code:4864 11 3F 00
                                              de, #63
                                    ld
                                                                          ; characters/line-1
code:4867 19
                                    add
                                              hl, de
                                                                          ; start at end of line
code:4868 06 3F
                                             b, #63
                                                                          ; characters/line-1
code:486A
code:486A
                         loc 0 486A:
                                                                          ; CODE XREF:
find end of lowest invader row+25|j
code:486A CB 7E code:486C 20 03
                                                                          ; graphic character?
                                  bit
                                              7, (hl)
                                                                          ; yes, return
; previous video address
; loop thru line
                                              NZ, loc_0_4871
                                    ir
code:486E 2B
                                    dec
                                              h1
code:486F 10 F9
                                              loc 0 486A
                                    djnz
code:4871
                          loc_0_4871:
code:4871
                                                                          : CODE XREF:
find_end_of_lowest_invader_row+22^j
code: 4871 C1
                                              bc
                                   pop
code:4872 D1
                                    pop
                                              de
code:4873 C9
                                    ret
code: 4873
                          ; End of function find_end_of_lowest_invader_row
code:4873
```

```
code:4874
code:4874
                                                           end_of_wave:
                                                                                                                                                                             ; CODE XREF: update bullet+661j
code:4874 C3 F5 49
                                                                                jр
                                                                                                         new wave
                                                              ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U
code: 4877
code:4877
                                                            check_for_graphic_in_column:
                                                                                                                                                                           ; CODE XREF:
animate and move invaders+CFp
code:4877 11 40 00 code:4877
                                                                                                                                                                             ; code:4B8B-p
                                                                                                    de, #64
b, #13
                                                                                    1d
                                                                                                                                                                              : characters/line
code:487A 06 0D
                                                                                    ld
code:487C
                                                            loc_0_487C:
code:487C
                                                                                                                                                                              ; CODE XREF:
check_for_graphic_in_column+Abj
code:487C CB 7E
code:487E 20 06
                                                                                                          7, (hl)
                                                                                    bit.
                                                                                                                                                                             ; graphic character?
                                                                                                          NZ, loc_0_4886
                                                                                    jr
                                                                                                                                                                             ; yes, skip
code:4880 19
                                                                                    add
                                                                                                          loc_0_487C
                                                                                                          hl, de
                                                                                                                                                                             ; next line
code:4881 10 F9
                                                                                    djnz
                                                                                                                                                                             ; loop thru 13 lines
                                                                                                           a, \frac{1}{8}0\overline{x}20; ''
code:4883 3E 20
                                                                                   1d
                                                                                                                                                                             ; flag no match
                                                                                   ret
code:4885 C9
code:4886
code:4886
code:4886
                                                             loc 0 4886:
                                                                                                                                                                               ; CODE XREF:
check_for_graphic_in_column+7↑j
code: 4886 AF
                                                                                                                                                                              ; flag match
code:4887 C9
                                                                                     ret
code:4887
                                                             ; End of function check for graphic in column
code:4887
code:4888
                                                                  ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4888
code:4888
code:4888
                                                              check_and_handle_move:
code:4888
                                                                                                                                                                              ; CODE XREF: code:4F2B-p
code:4888 3A 08 38
                                                                                   1\overline{d}
                                                                                                           \bar{a}, (0x3808)
                                                                                                                                                                              ; keyboard
                                                                                                                                                                              ; "X" or "Z" pressed?
code:488B E6 05
                                                                                    and
                                                                                                                                                                             ; no return
; "Z"?
code:488D C8
                                                                                   ret
                                                                                                           Z
code:488E FE 04
                                                                                                           #4
                                                                                   ср
                                                                                                          NC, handle_move_left
                                                                                                                                                                            ; yes, skip
; right-most position for base
code:4890 30 16
                                                                                    jr
                                                                                  ĩd
code:4892 3A BB 3F
                                                                                                           a, (video_ram+0x3BB)
code:4895 CB 7F
                                                                                                                                                                             ; graphic character?
                                                                                  bit.
                                                                                                           7, a
code:4897 C0
                                                                                                                                                                              ; yes, return (can't move
                                                                                   ret
                                                                                                          NZ
right)
code:4898 D9
                                                                                   exx
code:4899 21 80 3F code:489C CD 3E 46
                                                                                                          hl, #video_ram+0x380
move_video_line_right_HL
                                                                                  ld
                                                                                                                                                                             ; base row
                                                                                   call
code:489F 2A 13 43
                                                                                  ld
                                                                                                           hl, (base_centre)
code:48A2 23 code:48A3 22 13 43
                                                                                    inc
                                                                                                          hl
                                                                                                                                                                              ; move player right
                                                                                   1d
                                                                                                           (base centre), hl
code:48A6
code:48A6
                                                          loc_0_48A6:
                                                                                                                                                                              ; CODE XREF:
check_and_handle_move+35|j
code: 48A6 D9
code:48A7 C9
code:48A8
code:48A8
                                                              handle move left:
                                                                                                                                                                              ; CODE XREF:
check and handle_move+81j
code: 48A8 C0
                                                                                    ret
                                                                                                          NZ
code:48A9 3A 84 3F
                                                                                    ld
                                                                                                           a, (video_ram+0x384)
                                                                                                                                                                        ; left-most position for base
                                                                                                                                                                              ; graphic character?
code:48AC CB 7F
                                                                                                           7, a
                                                                                    bit
                                                                                                                                                                              ; yes, return (can't move left)
code:48AE CO
                                                                                                          NZ.
                                                                                   ret
code:48AF D9
                                                                                    exx
code:48B0 21 80 3F
                                                                                                                                                                             ; base row
                                                                                                          hl, #video_ram+0x380
                                                                                   ld
code:48B3 CD 60 46
                                                                                                          move_video_line_left_HL
                                                                                   call
code:48B6 2A 13 43
                                                                                  1 d
                                                                                                          hl, (base_centre)
code:48B9 2B
                                                                                   dec
                                                                                                                                                                              ; move player left
                                                                                                          h1
code:48BA 22 13 43
                                                                                                          (base_centre), hl loc_0_48A6
                                                                                   ld
                                                          jr loc_0_48A6; End of function check_and_handle_move
code:48BD 18 E7
code: 48BD
code:48BD
```

```
code:48BF
                     ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:48BF
code:48BF
code: 48BF
code:48BF
                    check and start ufo:
                                                         ; CODE XREF: code:4F44|p
                         - 1<u>d</u>
code:48BF 3A 0C 43
                                   a, (ufo timer)
code:48C2 3C
                           inc
                                                         ; increment timer
                                   а
code:48C3 32 0C 43
                           ld
                                   (ufo timer), a
code:48C6 C0
                           ret
                                   NΖ
                                                         ; not time for ufo yet
code:48C7 3A 01 43
                                   a, (invaders_left)
                           ld
code:48CA FE 08
                                                         ; less than 8 invaders
                           ср
remaining?
code:48CC D8
                           ret
                                                         ; ves, return
code:48CD 3A 10 43
                                  a, (ufo active)
                           ld
code:48D0 B7
                           or
                                                         ; on-screen?
code:48D1 C0
                                   NZ
                           ret
                                                         ; yes, return
code: 48D2 D9
                           exx
code:48D3 3E 41 code:48D5 32 0B 43
                                   a, #65
                           1d
                           1 d
                                   (ufo_TTL), a
code:48D8 3A 0D 43
                           1 d
                                   a, (ufo_dir)
                                                         ; left?
code:48DB B7
                            or
code:48DC 28 05
                                   Z, loc 0 48E3
                            jr
                                                         ; yes, skip
code:48DE 21 00 3C
                            ld
                                   hl, #video_ram
                                                         ; start on left
code:48E1 18 03
                                   loc_0_48E6
                           jr
code:48E3
code:48E3
code:48E3
                    loc 0 48E3:
                                                         ; CODE XREF:
check_and_start_ufo+1Dfj
code:48E3 21 3A 3C
                                  hl, #video ram+0x3A
                                                         ; start on right
code:48E6
                                                         ; CODE XREF:
code:48E6
                    loc_0_48E6:
check and start ufo+22↑j
code:48E6 22 20 40 code:48E9 21 4A 43
                            1 d
                                   (0x4020), hl
                                                         ; update cursor position
                            ld
                                   hl, #ufo
code:48EC CD E5 44
                            call
                                   display_message
code:48EF 3E 01
code:48F1 32 10 43
                                   a, #1
                           ld
                                                         ; flag on-screen
                           ld
                                   (ufo_active), a
code:48F4 D9
                           exx
code:48F5 C9
                           ret
                    ; End of function check_and_start_ufo
code:48F5
code:48F5
code:48F6
                    ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code: 48F6
code:48F6
code:48F6
code:48F6
                    update_ufo:
                                                         ; CODE XREF: code:4F41 p
code:48F6 3A 10 43
                           1 d
                                   a, (ufo active)
code:48F9 B7
                            or
                                                         ; ufo on-screen?
code:48FA C8
                           ret
                                                         ; no, return
code:48FB D9
                            exx
code:48FC 21 00 3C
                           1 d
                                   hl, #video_ram
code:48FF 06 3F
                           ld
                                   b, #63
                                                         ; characters/line-1
code:4901
code:4901
                    loc_0_4901:
                                                         ; CODE XREF: update_ufo+15|j
code:4901 7E
                                   a, (hl)
                                                         ; get character from video
                           ld
                                   #0xBB ; '»'
code:4902 FE BB
                            ср
                                   Z, loc_0_490F
#0xB7; '.'
code:4904 28 09
                            jr
                                                         ; yes, alternate
code:4906 FE B7
                            ср
code:4908 28 09
                                   Z, loc 0 4913
                           jr
code:490A
code:490A
                    loc 0 490A:
                                                         ; CODE XREF: update ufo+1B-j
code:490A 23
                                                         ; update ufo+1F|j
code:490A
                            inc
                                   hl
                                                         ; next video address
                                                         ; loop thru line
code:490B 10 F4
                                   loc 0 4901
                           dinz
code:490D 18 08
                                   move_ufo
                           jr
code:490F
code:490F
                    loc_0_490F:
                                                         ; CODE XREF: update_ufo+E↑j
code: 490F
code:490F 36 B7
                                   (hl), #0xB7; '.'
                           1 d
                                                         ; display
code:4911 18 F7
                                   loc_0_490A
                           jr
code: 4913
code: 4913
```

```
code:4913
                    loc 0 4913:
                                                          ; CODE XREF: update ufo+12<sup>†</sup> j
code:4913 36 BB
                                    (hl), #0xBB ; '»'
                            ld
                                                          ; display
code:4915 18 F3
                                    loc_0_490A
                            jr
code:4917
code:4917
code:4917
                    move ufo:
                                                          ; CODE XREF: update ufo+17↑j
code:4917 3A 0D 43
                            ld
                                    a, (ufo_dir)
code:491A B7
                                                          ; left?
                            or
code:491B 28 08
                            jr
                                    Z, move ufo left
                                                          ; yes, skip
                                   hl, #video_ram
move_video_line_right_HL
code:491D 21 00 3C
                            ĺd
code:4920 CD 3E 46
                            call
                                    ufo_TTL_tick
code:4923 18 06
                            jr
code: 4925
code:4925
code: 4925
                                                          ; CODE XREF: update ufo+251j
                    move_ufo_left:
code:4925 21 00 3C
                                    hl, #video_ram
                            Īd
code:4928 CD 60 46
                                    move_video_line_left_HL
                            call
code:492B
code:492B
                    ufo_TTL_tick:
                                                          ; CODE XREF: update_ufo+2D1j
code:492B 3A 0B 43
                            1 d
                                    a, (ufo_TTL)
code:492E 3D
                            dec
                                                          ; ufo still active?
code:492F 32 0B 43
                            ld
                                    (ufo TTL), a
code:4932 28 02
                                    Z, f\overline{l}ag\_ufo\_inactive
                                                          ; no, skip
                            jr
code:4934
code:4934
                    loc_0_4934:
                                                          ; CODE XREF: update_ufo+44|j
code:4934 D9
                            exx
code:4935 C9
code: 4936
code:4936
code:4936
                    flag ufo inactive:
                                                          ; CODE XREF: update ufo+3C<sup>†</sup>j
                                                          ; flag ufo inactive
code:4936 AF
                            xor
                                   (ufo_active), a loc_0_4934
code:4937 32 10 43
                            ld
code:493A 18 F8
                            jr
                     ; End of function update ufo
code:493A
code:493A
code:493C
code:493C
code:493C
                                                          ; CODE XREF: code: 4AB4 - j
                    game over:
code:493C 31 8A 42
                                                          ; code:4B45-i
                                   sp, #0x428A
hl, #video_ram+0x19
code:493C
                            1 d
code:493F 21 19 3C
                                                          ; cursor position
                            1 d
code:4942 22 20 40 code:4945 21 00 3C
                            ٦d
                                    (0x4020), hl
                            1d
                                    hl, #video_ram
                                                          ; start of video
code:4948 CD 7E 4C
                            call
                                    clear_video_line_HL
code:494B 21 93 44
                            ld
                                    hl, #aGAMEOVER
                                                          ; "G A M E - O V E R"
code:494E CD 05 45
                            call
                                    display_message_slowly
code:4951 CD 5F 4C
                            call
                                    check for new high score
code:4954 01 FF FF
                            ld
                                    bc, \#6553\overline{5}
                                                          ; ~1s
code:4957 CD 60 00
                            call
                                    0x60
                                                          ; delay
code:495A CD 60 00
                            call
                                    0x60
                                                          ; delay
                                    0x60
code:495D CD 60 00
                            call
                                                          ; delay
code:4960 C3 4F 45
                                    attract loop
                            jр
code:4963
code:4963
                      ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4963
code:4963
code:4963
                    display invader row:
                                                          ; CODE XREF: code:4A78 p
code:4963 E5
                                                          ; code:4A81 p ...
                            push
code:4963
                                    h1
code:4964 D5
                            push
                                    de
code:4965 C5
                            push
                                    bc
code:4966 06 0A
                                    b, #10
                                                          ; 10 invaders/row
                            ld
code:4968 D5
                            push
                                    de
code:4969 11 40 00
                                    de, #64
                            ld
code:496C ED 52
                                                          ; line above
                                    hl, de
                            sbc
code:496E D1
                            pop
                                    de
code:496F 23
                            inc
                                    h1
code:4970
code:4970
                    loc_0_4970:
                                                          ; CODE XREF:
display_invader_row+1C|j
code:4970 22 20 40
                            1 d
                                    (0x4020), hl
                                                          ; cursor position
code:4973 D5
                            push
                                    de
```

```
code:4974 E5
                               push
                                        hl
code:4975 EB
                                        de, hl
                               ex
code:4976 CD E5 44
                               call
                                        display_message
code:4979 E1
                                        hl
                               pop
code:497A 11 06 00
                                        de, #6
                               1d
                                                                 ; offset to next invader
code:497D 19
                               add
                                        hl, de
                                                                 ; update video address
code:497E D1
                                        de
                               pop
code:497F 10 EF
                                        loc 0 4970
                                                                ; loop thru 10 invaders
                               dinz
code:4981 C1
                                        bc
                               gog
code:4982 D1
                                        de
                               pop
code:4983 E1
                               pop
                                       hl
code:4984 C9
                               ret
code:4984
                       ; End of function display_invader_row
code: 4984
code:4985
                       ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 4985
code: 4985
code: 4985
code: 4985
                       update_invader_row_addresses:
                                                         ; CODE XREF: update_bullet+6Fîp
code:4985 E5
                               push
                                       h1
code:4986 D5
                               push
                                        de
code:4987 C5
                               push
                                        bc
code:4988 2A 02 43
                               ld
                                        hl, (row_1_invader_addr)
code:498B CD B0 49
                               call
                                        find_1st_invader_on_row
code:498E 22 02 43
                               ld
                                        (row 1 invader addr), hl
code:4991 2A 04 43
                              ld
                                        hl, (row_2_invader_addr)
code:4994 CD B0 49
                               call
                                        find 1st invader on row
code:4997 22 04 43
                              ld
                                        (row_2_invader_addr), hl
code:499A 2A 06 43
                               ld
                                        hl, (row_3_invader_addr)
                              call
code:499D CD B0 49
                                       find 1st invader on row
code:49A0 22 06 43
                               ld
                                        (row 3 invader addr), hl
code:49A3 2A 08 43
                              ld
                                        hl, (row 4 invader addr)
code:49A6 CD B0 49
                                        find 1st invader on row
                               call
code:49A9 22 08 43
                               ld
                                        (row_4_invader_addr), hl
code:49AC C1
                                       bc
                               pop
code:49AD D1
                                        de
                               gog
code:49AE E1
                                       hl
                               pop
code:49AF C9
                               ret
code:49AF
                       ; End of function update invader row addresses
code: 49AF
code:49B0
                       ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code:49B0
code: 49BO
code:49B0
                       find_1st_invader_on_row:
                                                                 ; CODE XREF:
code:49B0
update_invader_row_addresses+6 p
code:49B0 E5
update_invader_row_addresses+F<sup>↑</sup>p ...
code: 49B0
                               push
                                                                 ; invader row address
                                       h1
                                       b, #63
code:49B1 06 3F
                               1d
                                                                 ; characters/line-1
code:49B3
code:49B3
                       loc 0 49B3:
                                                                 ; CODE XREF:
find_1st_invader_on_row+9Fj
code: 49B3 7E
                               1d
                                        a, (hl)
                                                                ; get character from video
code:49B4 CB 7F
                               bit
                                        7, a
                                                                ; graphic?
                                       hl
NZ, loc_0_49BF
code:49B6 23
code:49B7 20 06
                                                                ; next video address
                               inc
                               ir
                                                                ; yes, skip
code:49B9 10 F8
                                        loc_0_49B3
                                                                ; find 1st invader on row
                               djnz
code:49BB E1
                               pop
                                        hl
code:49BC 26 00
                                       h, #0
                                                                 ; flag no invaders on row
code:49BE C9
                               ret
code:49BF
code:49BF
code:49BF
                       loc 0 49BF:
                                                                 ; CODE XREF:
find_1st_invader_on_row+7\(\bar{1}\)j
code:49BF E1
code:49C0 19
                                        hl
                                                                 ; invader row address
                               pop
                               add
                                       hl, de
                                                                 ; ???
code:49C1 C9
                               ret
code: 49C1
                       ; End of function find 1st invader on row
code: 49C1
code: 49C2
code: 49C2
                                                                 ; CODE XREF:
code:49C2
                       start_game:
```

```
check for R key+5↑j
code: 49C2 AF
                                 xor
code:49C3 32 0C 43
                                          (ufo_timer), a
code:49C6 32 15 43
                                 ld
                                          (unused 4315), a
code:49C9 32 12 43
                                 ld
                                          (unused 4312), a
code:49CC 32 0D 43
                                          (ufo_dir), a
                                 ld
code:49CF 32 0E 43
                                 ld
                                          (wave no), a
code:49D2 32 10 43
                                 ld
                                          (ufo active), a
                                          (bullet active), a
code:49D5 32 11 43
                                 ld
                                          (keybd_state), a
code:49D8 32 22 43
                                ld
code:49DB 3C
                                 inc
code:49DC 32 0A 43
                                ld
                                          (invader dir), a
code:49DF 3E 05
code:49E1 32 0C 43
                                 ٦d
                                          a, #5
                                          (ufo timer), a
                                 1d
code:49E4 3E 03
                                          a, #3
                                 ld
code:49E6 32 0F 43
                                1d
                                          (no_lives), a
code:49E9 CD 90 4E code:49EC 31 8A 42
                                 call
                                         display_lives_left sp, #0x428A
                                1 d
code:49EF CD B0 46
                                 call
                                          zero_score
code:49F2 CD 31 4E
                                          display_GOOD_LUCK
                                 call
code:49F5
code:49F5
                        new_wave:
                                                                    ; CODE XREF: code:4874<sup>†</sup>j
code:49F5 31 8A 42
                                          sp, #0x428A
                                 1d
code:49F8 AF
                                 xor
code:49F9 32 11 43 code:49FC 3A 0E 43
                                 1d
                                          (bullet_active), a
                                                                    ; clear fired flag
                                 1 d
                                          a, (wave_no)
code:49FF 3C
                                                                    ; next wave number
                                 inc
code:4A00 FE 07
                                 ср
                                          #7
                                                                    ; highest?
code:4A02 20 02
                                          NZ, loc_0_4A06
                                 jr
                                                                    ; no, skip
                                         a, #1
code:4A04 3E 01
                                                                    ; reset to 1
code:4A06
code:4A06
                        loc 0 4A06:
                                                                    ; CODE XREF: code:4A0211
code:4A06 32 0E 43
                                ld
                                          (wave_no), a
code:4A09 E6 06
                                 and
                                          #6
                                                                    ; 2/4/6
                                          de, #0x40 ; '@'
code:4A0B 11 40 00
                                 ld
                                                                    ; characters/line
code:4A0E 62
                                 ld
                                          h, d
code:4A0F 6B
                                 ld
                                                                    ; hl = 0 \times 0040
                                          1, e
                                          b, #1
code:4A10 06 01
                                 ld
code:4A12 FE 02
                                          #2
                                                                    ; compare wave no with 2
                                 ср
                                                                    ; wave_no=1, skip
                                         C, loc_0_4A1C
Z, loc_0_4A1A
code:4A14 38 06
                                 ir
code:4A16 28 02
                                                                    ; wave_no=2, skip
                                 iΥ
code:4A18 04
                                 inc
code: 4A19 19
                                         hl, de
                                 add
code:4A1A
                        loc_0_4A1A:
                                                                    ; CODE XREF: code:4A161i
code: 4A1A
code:4A1A 04
                                i.nc
                                         b
                                         hl, de
code:4A1B 19
                                 add
code:4A1C
code:4A1C
                        loc_0_4A1C:
                                                                    ; CODE XREF: code:4A14<sup>†</sup>j
code:4A1C EB
                                         de, hl
                                ex
code:4A1D
code:4A1D
                        calc_invader_row_addr:
                                                                    ; CODE XREF: code:4A40|j
                                push
code:4A1D C5
                                         bс
code:4A1E DD 21 16 43
                                 ld
                                          ix, #init_row_1_invader_addr
                                         iy, #row_1_invader_addr
b, #4
code:4A22 FD 21 02 43
                                 1d
code:4A26 06 04
                                 ld
                                                                    ; 4 rows of invaders
code:4A28
code:4A28
                        loc_0_4A28:
                                                                    ; CODE XREF: code:4A3D/j
code:4A28 DD 6E 00
                                ld
                                         1, 0(ix)
code:4A2B DD 66 01
                                ld
                                          h, 1(ix)
code:4A2E 19
                                 add
                                         hl, de
                                                                    ; calc video address for
invader row
                                          0(iy), l
code:4A2F FD 75 00
                                 ld
code:4A32 FD 74 01
                                 ٦d
                                          1(iy), h
                                                                    ; store
code:4A35 DD 23
                                 inc
                                          ix
code:4A37 DD 23
                                inc
                                          ix
                                                                    ; next row address
code:4A39 FD 23
                                 inc
                                          iy
code:4A3B FD 23
                                inc
                                          iv
code:4A3D 10 E9
                                          loc 0 4A28
                                                                    ; loop thru all rows of
                                djnz
invaders
code:4A3F C1
                                pop
                                          bc
code:4A40 10 DB
                                         calc_invader_row_addr
wipe_screen_left_to_right_slow
                                djnz
code:4A42 CD 18 45
                                call
code:4A45 21 09 3F
                                          hl, \#video_ram+0x309 ; cursor position
                                1d
code:4A48 22 20 40 code:4A4B 21 51 43
                                          (0x4020), \overline{h}1
                                1 d
                                                                    ; shield #1
                                1 d
                                         hl, #shield
code:4A4E E5
                                 push
                                         h1
```

```
code:4A4F CD E5 44
                                call
                                        display_message
code:4A52 21 17 3F
                                        hl, #video_ram+0x317
                                ld
                                                                  ; cursor position
code:4A55 22 20 40
                                         (0x4020), \overline{h}1
                                ld
code:4A58 E1
                               pop
                                        hl
code:4A59 E5
                               push
                                        h1
                                                                  ; shield #2
code:4A5A CD E5 44
                                call
                                        display message
code:4A5D 21 24 3F
                                ld
                                        hl, #video ram+0x324
                                                                  ; cursor position
code:4A60 22 20 40
                                        (0x4020), \overline{h}1
                               ld
code:4A63 E1
                               gog
                                        hl
                               push
code:4A64 E5
                                                                  ; shield #3
code:4A65 CD E5 44
                                        display_message
hl, #video_ram+0x331
                                call
code:4A68 21 31 3F
                               ld
                                                                  ; cursor position
                                        (0x4020), \overline{h}1
code:4A6B 22 20 40
                               1 d
code:4A6E E1
                                                                  ; shield #4
                                        h1
                               pop
code:4A6F CD E5 44
                               call
                                        {\tt display\_message}
code:4A72 11 23 43
                                        de, #invader_30pt
                               1 d
code:4A75 2A 02 43
                               1 d
                                        hl, (row_1_invader_addr)
code: 4A78 CD 63 49
                               call
                                                                  ; display 1st row of invaders
                                        display_invader_row
                                        de, #invader_20pt
hl, (row_2_invader_addr)
code:4A7B 11 30 43
                               1d
code:4A7E 2A 04 43
                               1 d
code:4A81 CD 63 49
                               call
                                                                  ; display 2nd row of invaders
                                        display_invader_row
code:4A84 11 3D 43
                               1d
                                        de, #invader_10pt
code:4A87 2A 06 43
                               1d
                                        hl, (row 3 invader addr)
code:4A8A CD 63 49
                                call
                                        display_invader_row
                                                                  ; display 3rd row of invaders
code:4A8D 2A 08 43
                               ld
                                        hl, (row_4_invader_addr)
code:4A90 CD 63 49
                                call
                                        display_invader_row
                                                                 ; display 4th row of invaders
                                        a, #40
code:4A93 3E 28
                                ld
                                                                  ; number of invaders left
code:4A95 32 01 43
                                ld
                                         (invaders left), a
code:4A98 32 21 43
                               ld
                                        (invader_timer), a
code: 4A9B
                       init_and_display_player_base:
    ld hl, #video_ram+0x384
code:4A9B
                                                                  ; CODE XREF: code:4AD9|j
code:4A9B 21 84 3F
                                                                  ; cursor position
code:4A9E 22 20 40
                                        (0x4020), h1
                                ld
code:4AA1 21 64 43
                                ld
                                        hl, #player
                                        display_message
hl, #video_ram+0x386
(base_centre), hl
code:4AA4 CD E5 44
                                call
                                                                  ; draw player base
code:4AA7 21 86 3F
                                ld
code:4AAA 22 13 43
                                ld
                                                                  ; center of base
code:4AAD C3 FB 4E
                                        init_turn
                                jр
code: 4AB0
code: 4ABO
code: 4AB0
                       decrement_player_life:
                                                                  ; CODE XREF: code: 4B2A-
code:4ABO 3A OF 43
                               1d
                                        a, (no_lives)
                               dec
code:4AB3 3D
                                        а
                                                                  ; any lives left?
code:4AB4 CA 3C 49
                                jр
                                        Z, game over
                                                                  ; no, exit
code:4AB7 32 0F 43 code:4ABA CD 90 4E
                               ٦d
                                        (no_lives), a
                                        display_lives_left
                               call
code:4ABD AF
                               xor
code:4ABE 32 11 43
                                1d
                                        (bullet_active), a
                                                                  ; clear fired flag
                                        (unused_4312), a restore_space_characters
code:4AC1 32 12 43
                               1d
code:4AC4 CD 3B 4D
                                call
code:4AC7 21 80 3F
                               ld
                                        hl, #video_ram+0x380
code:4ACA CD 7E 4C
                                call
                                        clear_video_line_HL
code:4ACD 01 FF FF
                               ld
                                        bc, \#65535
                                                                  ; ~1s
code:4AD0 CD 60 00
                                call
                                        0x60
                                                                  ; delay
code:4AD3 CD 60 00
                               call
                                        0x60
                                                                  ; delay
                                        sp, #0x428A
init_and_display_player_base
code:4AD6 31 8A 42
                                ld
code:4AD9 C3 9B 4A
                               jр
code: 4ADC
                        ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4ADC
code: 4ADC
code: 4ADC
code: 4ADC
                       invert display:
                                                                  ; CODE XREF:
animate player hit+4|p
code: 4ADC 21 00 3C
                                                                  ; animate_player_hit+B|j ...
                                        hl, #video_ram
bc, #0x400
code: 4ADC
                                ld
code:4ADF 01 00 04
                                                                  : video ram size
                               1 d
code: 4AE2
                                                                 ; CODE XREF:
                       loc_0_4AE2:
code: 4AE2
invert_display+1C|j
code: 4AE2 7F
                                1 d
                                        a, (hl)
                                                                  ; get character
                                        #0x20 ; ' '
code:4AE3 FE 20
                                ср
                                                                  ; space?
                                        NZ, loc 0 4AE9
code:4AE5 20 02
                                jr
                                                                  ; no, skip
                                        (hl), #0x80 ; '€'
code:4AE7 36 80
                               1 d
                                                                  ; graphic space
code: 4AE9
                       loc_0_4AE9:
                                                                  ; CODE XREF: invert_display+9<sup>†</sup>j
code: 4AE9
```

```
code:4AE9 CB 7E
                             bit
                                     7, (hl)
                                                             ; graphics character?
code:4AEB 28 07
                                     Z, loc_0_4AF4
                             jr
                                                             ; no, skip
code:4AED 7E
                             ld
                                                             ; get character
                                     a, (hl)
code:4AEE 2F
                             cpl
                                                             ; invert
code:4AEF CB FF
                             set
                                     7, a
                                                             ; make graphics character
code:4AF1 CB B7
                                                             ; 1st block of graphics
                                     6, a
                             res
characters
code:4AF3 77
                             ld
                                     (hl), a
                                                            ; display
code:4AF4
                                                            ; CODE XREF: invert display+F^j
code: 4AF4
                     loc 0 4AF4:
code:4AF4 23
                                                             ; next video address
                             inc
                                     hl
code:4AF5 0B
                             dec
                                     bc
code:4AF6 78
                             1d
                                     a, b
code:4AF7 B1
                             or
                                     C
code:4AF8 20 E8
                                     NZ, loc 0 4AE2
                                                           ; loop through screen
                             jr
code:4AFA C9
                             ret
                     ; End of function invert_display
code: 4AFA
code: 4AFA
code:4AFB
                      ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4AFB
code: 4AFB
code: 4AFB
code:4AFB
                     get_player_address:
                                                             ; CODE XREF:
animate_player_hit|p
code: 4AFB 2A 1\overline{3} 43
                             1 d
                                     hl, (base_centre)
code:4AFE 2B
                             dec
                                     hl
code:4AFF 2B
                             dec
                                     hl
code:4B00 C9
                             ret
code:4B00
                     ; End of function get_player_address
code:4B00
code:4B01
                      ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4B01
code:4B01
code:4B01
code:4B01
                     animate base hit:
                                                            ; CODE XREF:
animate_player_hit+8|p
code:4B01 3E A6
                                     a, #0xA6; '¦'
                             ld
                                                             ; hash graphic
code:4B03 06 00
                                     b, #0
                             1 d
                                                             ; 256 times
code:4B05
code:4B05
                     loc 0 4B05:
                                                             ; CODE XREF:
animate_base_hit+16|j
code:4B05 C5
                             push
                                     bc
                                                            ; player base address
code:4B06 E5
                             push
                                     h1
code:4B07 06 05
                                     b, #5
                             1d
                                                             ; 5 chars to display
code:4B09 EE 3F
                                     #0x3F ; '?'
                                                             ; invert hash
                             xor
code:4B0B
                                                             : CODE XREF:
code:4B0B
                     loc_0_4B0B:
animate_base_hit+C|j
                             1d
                                     (hl), a
code:4BOB 77
                                                            ; display hash
code:4B0C 23
                             inc
                                     hl
                                                             ; next video address
code:4B0D 10 FC
                             djnz
                                     loc 0 4B0B
                                                             ; loop through 5 chars
code:4B0F
code:4B0F
                     loc_0_4B0F:
                                                             ; CODE XREF:
animate_base_hit+12|j
code:4BOF E3
                                     (sp), hl
code:4B10 E3
                             ex
                                      (sp), hl
code:4B11 E3
                             ex
                                      (sp), hl
code:4B12 E3
                                     (sp), hl
                                                             ; delay
                             ex
                                                             ; loop 256 times
code:4B13 10 FA
                             djnz
                                     loc 0 4B0F
code:4B15 E1
                                     hl
                             pop
code:4B16 C1
                                     bс
                             gog
code:4B17 10 EC
                                     loc 0 4B05
                                                            ; loop 256 times
                             dinz
code:4B19 C9
                             ret
code:4B19
                     ; End of function animate_base_hit
code:4B19
code: 4B1A
                      ; ΰΰΰΰΰΰΰΰΰΰΰΰΰΰΰ Ν Η Β Ο Ο Τ Ι Ν Ε
code: 4B1A
code:4B1A
code: 4B1A
                                                             ; CODE XREF: code:4B27-p
code: 4B1A
                     animate_player_hit:
code:4B1A CD FB 4A
                             call
                                     get_player_address
code:4B1D E5
                             push
                                     h1
code:4B1E CD DC 4A
                                     invert_display
                             call
code:4B21 E1
                                     h1
                             pop
```

```
code:4B22 CD 01 4B
                               call
                                        animate base hit
code:4B25 18 B5
                                        invert_display
                               jr
code: 4B25
                       ; End of function animate_player_hit
code:4B25
code: 4B27
code: 4B27
                       handle_base_hit:
code:4B27
                                                                 ; CODE XREF: update bombs+93/j
                             call animate_player_hit
jp decrement_player_life
code:4B27 CD 1A 4B
code:4B2A C3 B0 4A
code:4B2D
code: 4B2D
code:4B2D
                       flash_screen_10_times:
                                                                 ; CODE XREF: code:4C02-i
code:4B2D 06 0A
                                                                 ; 10 times
                                       b, #10
                               ld
code:4B2F
                                                                 ; CODE XREF: code:4B43-i
code:4B2F
                       flash_screen:
                             push
code: 4B2F C5
                                       bc
code:4B30 CD DC 4A
                                        invert display
                               call
code:4B33 01 10 27
                                                                 ; ~140ms
                                        bc, #1\overline{0}000
                               ld
code:4B36 CD 60 00
                              call
                                        0x60
                                                                 ; delay
                              call
code:4B39 CD DC 4A
                                        invert_display
code:4B3C 01 10 27
                                        bc, #1\overline{0}000
                                                                 : ~140ms
code:4B3F CD 60 00
                               call
                                        0x60
                                                                 ; delay
code:4B42 C1
                                       bc
                              pop
code:4B43 10 EA
                               djnz
                                       flash screen
                                                                 ; repeat
                                       game_over
code:4B45 C3 3C 49
                              jр
code:4B48
                       ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code: 4B48
code:4B48
code:4B48
code:4B48
                      animate_and_move_invaders:
                                                               ; CODE XREF: code:4F71|p
code:4B48 E5
                               push
                                        hl
code:4B49 D5
                               push
                                        de
code:4B4A C5
                               push
                                        bc
code:4B4B 3A 0A 43
                               ld
                                        a, (invader dir)
code:4B4E B7
                              or
                                                                 ; left?
                                        а
                                       Z, animate_and_move_invaders_left; yes, skip
hl, #video_ram+0x7F ; end of 2nd line on screen
code:4B4F 28 37
                              jr
ld
code:4B51 21 7F 3C
code:4B54 CD 77 48
                              call
                                       check_for_graphic_in_column
code:4B57 B7
                                                                 ; invaders reached RHS of
                              or
                                       а
screen?
                                       Z, set_invader_dir_left ; yes, skip
hl, (row_4_invader_addr)
code:4B58 CA BE 4B
                              ĺd
code:4B5B 2A 08 43
code:4B5E CD 7A 4B
                               call
                                       move_invader_row_right
code:4B61 2A 06 43
                              ld
                                       hl, (row_3_invader_addr)
code:4B64 CD 7A 4B
                               call
                                       move_invader_row_right
code:4B67 2A 04 43
                              ld
                                       hl, (row_2_invader_addr)
                              call
ld
code:4B6A CD 7A 4B
                                       move_invader_row_right
code:4B6D 2A 02 43
                                       hl, (row 1 invader addr)
code:4B70 CD 7A 4B
                              call
                                       move_invader_row_right
code:4B73 CD FC 45
                               call
                                       animate invaders
code:4B76
code:4B76
                      move_invaders_down_ret:
                                                                 ; CODE XREF: code: 4BAC - j
code:4B76 C1
                                                                 ; code:4C1D+j ...
code:4B76
                               pop
code:4B77 D1
                               pop
                                        de
code:4B78 E1
                               pop
                                        h1
code:4B79 C9
                               ret
code:4B79
                       ; End of function animate and move invaders
code:4B79
code:4B7A
                        ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4B7A
code:4B7A
code: 4B7A
                      move_invader_row_right:
code: 4B7A
                                                                 : CODE XREF:
animate_and_move_invaders+\overline{1}6↑p
code:4B7A 7C
animate_and_move_invaders+1C\uparrowp ... code:4B7A
                                        a, h
code:4B7B B7
                                                                 : any invaders left on this
                               or
                                        а
row?
code:4B7C C8
                               ret
                                                                 ; no, return
code:4B7D CD 3E 46
                                       move_video_line_right_HL
                               call
                                        de, \overline{\#}64
code:4B80 11 40 00
                               1 d
                                                                 ; characters/line
```

```
sbc
code:4B83 ED 52
                                   hl, de
                                                          ; line above
code:4B85 C3 3E 46
                                   move_video_line_right_HL
                            jр
code:4B85
                    ; End of function move_invader_row_right
code:4B85
code: 4B88
animate and move invaders left:
animate and move invaders+7<sup>†</sup>j code:4B88 21 40 3C
                            ld
                                   hl, #video ram+0x40
                                                         ; start of 2nd line
code:4B8B CD 77 48
                            call
                                   check_for_graphic_in_column
code:4B8E B7
                                                          ; inavders reached LHS of
                            or
screen?
code:4B8F 28 38
                                   Z, move_invaders_down ; yes, skip
                            ir
code:4B91 CD FC 45
                            call
                                   animate invaders
code:4B94
code:4B94
                                                          ; CODE XREF: code:4BC6+j
                    move_invaders_left:
                                   hl, (row_4_invader addr)
code: 4B94 2A 08 43
                           1 d
code:4B97 CD AE 4B
                                   move_invader_row_left
                            call
code:4B9A 2A 06 43
                            ld
                                   hl, (row_3_invader_addr)
code:4B9D CD AE 4B
                            call
                                   move_invader_row_left
code:4BA0 2A 04 43
                           1d
                                   hl, (row_2_invader_addr)
                           call
code:4BA3 CD AE 4B
                                   move_invader_row_left
code:4BA6 2A 02 43
                            ld
                                   hl, (row_1_invader_addr)
code:4BA9 CD AE 4B
                            call
                                   move_invader_row_left
code:4BAC 18 C8
                            jr
                                   move invaders down ret
code:4BAE
code: 4BAE
code: 4BAE
code: 4BAE
                    move invader row left:
                                                          ; CODE XREF: code:4B97↑p
code:4BAE 7C
                                                          ; code:4B9D↑p ...
code:4BAE
                                   a, h
code:4BAF B7
                                                          ; any invaders left on row?
                            or
                                    а
code:4BB0 C8
                            ret
                                                          ; no, return
                            push
code:4BB1 E5
                                   hl
code:4BB2 CD 60 46
                            call
                                   move_video_line_left_HL
code:4BB5 E1
                                   hl
                            pop
code:4BB6 11 40 00
                                   de, #64
                            ld
                                                          ; characters/line
code:4BB9 ED 52
                                                          ; line above
                            sbc
                                   hl. de
code:4BBB C3 60 46
                                   move video line left HL
                            jр
                    ; End of function move_invader_row_left
code: 4BBB
code: 4BBB
code: 4BBE
code:4BBE
code:4BBE
                    set_invader_dir_left:
                                                          ; CODE XREF:
code:4BBE animate_and_move_invaders+101j
code:4BBE 3A 0A 43 code:4BC1 EE 01
                                   a, (invader_dir)
                            xor
                                   #1
                                                          ; toggle invader direction
                                   (invader_dir), a
move_invaders_left
code:4BC3 32 0A 43
                            ld
code:4BC6 C3 94 4B
                            jр
code:4BC9
code:4BC9
code:4BC9
                    move_invaders_down:
                                                          ; CODE XREF: code:4B8F1i
code:4BC9 3A 11 43
                                  a, (bullet_active)
                           ld
code:4BCC B7
                                                          ; fired?
                            or
                                   Z, loc 0 4BD4
code:4BCD 28 05
                            jr
                                                          ; no, skip
code:4BCF 2A 1E 43
                                   hl, (bullet addr)
                            ĺd
code:4BD2 36 20
                                   (hl), #0x20; '
                                                          ; display space
code:4BD4
code:4BD4
                    loc_0_4BD4:
                                                          ; CODE XREF: code:4BCD1j
code:4BD4 DD 21 08 43
                                   ix, #row_4_invader_addr
                           ld
                                   b, #4
code:4BD8 06 04
                           ld
                                                          ; 4 rows to check
code: 4BDA
code: 4BDA
                    loc_0_4BDA:
                                                          : CODE XREF: code: 4BE9-i
code:4BDA DD 6E 00
                                   1, 0(ix)
                            ld
code:4BDD DD 66 01
                                                          ; hl = invader addr
                            ld
                                   h, 1(ix)
code:4BE0 7C
                                   a, h
                            ٦d
code:4BE1 B7
                                                          ; any invaders left on this
                            or
                                   а
line?
code:4BE2 C4 2E 4C
                                   NZ, move_invader_row_down; yes, call
                            call
code:4BE5 DD 2B
code:4BE7 DD 2B
                           dec
                                   ix
                                                          ; next invader row address
                           dec
                                   ix
code:4BE9 10 EF
                                   loc_0_4BDA
                            djnz
                                                          ; loop thru 4 rows of invaders
```

```
code:4BEB DD 21 08 43
                              ld
                                      ix, #row 4 invader addr
code:4BEF 06 04
                                      b, #4
                                                             ; 4 rows of invaders
                                      de, #video_ram+0x380
code:4BF1 11 80 3F
                                                             ; 2nd last line on screen
code:4BF4
                      loc_0_4BF4:
code: 4BF4
                                                              ; CODE XREF: code: 4COF | j
                        ld
                                      l, 0(ix)
h, 1(ix)
code:4BF4 DD 6E 00
code:4BF7 DD 66 01
                                                              ; HL = invader row addr
                                      get video line below invaders
code:4BFA CD 55 4C
                             call
                                      compare_video_addresses
#0x20 : ' '
code:4BFD CD E2 45
                             call
code:4C00 FE 20
                                      #0x20 ;
                                                              ; invaded?
                             ср
code:4C02 CA 2D 4B
                                      Z, flash_screen_10_times ; yes, exit
                              jр
code:4C05 DD 75 00
                             ld
                                      0(ix), 1
code:4C08 DD 74 01
                             1 d
                                      1(ix), h
                                                              ; update invader row address
code:4C0B DD 2B
                             dec
                                      i×
code:4C0D DD 2B
                             dec
                                                              ; row above
                                      ix
                                      loc_0_4BF4
code:4C0F 10 E3
                                                              ; loop thru 4 rows of invaders
                             djnz
                                      a, (invader_dir) #1
code:4C11 3A 0A 43
                             1 d
code: 4C14 EE 01
                                                              ; toggler invader direction
                             xor
(=right)
code:4C16 32 0A 43
                             1d
                                      (invader_dir), a
                                     a, (bullet_active)
code:4C19 3A 11 43
                             ld
code:4C1C B7
                              or
                                                              ; fired?
code:4C1D CA 76 4B
                                      Z, move invaders down ret; no, skip
                              jр
code:4C20 2A 1E 43
                              ld
                                      hl, (bullet_addr)
                                      a, (h1)
#0x20 ; ' '
code:4C23 7E
                             ld
                                                              ; get character from video
code:4C24 FE 20
                              ср
                                                              ; space?
                                      NZ, move_invaders_down_ret; no, skip (hl), #0x5B; '[' ; display play
code:4C26 C2 76 4B
                              jр
                                                             ; display player bullet
code:4C29 36 5B
                              ld
code:4C2B C3 76 4B
                                     move_invaders_down_ret
                              jр
code:4C2E
code: 4C2E
                       ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4C2E
                      move_invader_row_down:
code:4C2E
                                                             ; CODE XREF: code:4BE2↑p
                                      bс
code:4C2E C5
                            push
code:4C2F E5
                                      hl
                                                             ; invader row address
                             push
code:4C30 11 3F 00
                              ld
                                      de, #63
                                                              ; characters/line
code:4C33 19
                             add
                                      hl, de
                                                              ; next line down, 1 character
left
code:4C34 E5
                             push
                                      h1
code:4C35 13
                                                              ; 64
                              inc
                                      de
code:4C36 19
                                      hl, de
                                                              ; next line down again
                             add
code:4C37 EB
                                      de, hl
                                                              ; DE = 2 lines below, 1
                              ex
character left
                                                              ; invader row+1 address
; 2 video lines
code:4C38 E1
                                     h1
                                      b, #128
code:4C39 06 80
code:4C3B
code:4C3B
                     loc_0_4C3B:
                                                              ; CODE XREF:
move_invader_row_down+1A|j
                              1d
                                      a, (de)
code:4C3B 1A
                                                             ; get character from video
                                      #0x80 ; '€'
code:4C3C FE 80
                                                             ; graphic?
                              ср
code:4C3E 7E
                              ld
                                      a, (hl)
                                                              ; get character from invader
row
                                      NC, loc_0_4C45
#0x80 ; '€'
                                                             ; yes, ok to overwrite
code:4C3F 30 04
                              jr
                                                              ; invader a graphic?
code:4C41 FE 80
                              ср
code:4C43 38 01
                              jr
                                      C, loc_0_4C46
                                                              ; no, skip
code:4C45
                     loc_0_4C45:
                                                              ; CODE XREF:
code:4C45
move_invader_row_down+11↑j
code: 4C45 12
                                      (de), a
                                                              ; move character
code:4C46
; CODE XREF:
code: 4C46 1B
                                      de
code:4C47 2B
                              dec
                                      hl
                                      loc_0_4C3B
code:4C48 10 F1
                                                              ; loop thru 2 lines
                              dinz
code:4C4A E1
                              pop
                                      h1
                                      de, #64
code:4C4B 11 40 00
                              ld
                                                              ; characters/line
code:4C4E ED 52
                                                              ; line above
                                      hl, de
                             sbc
code:4C50 CD 7E 4C
                              call
                                      clear_video_line_HL
code: 4C53 C1
                              pop
code:4C54 C9
                              ret
code:4C54
                     ; End of function move_invader_row_down
code:4C54
code: 4C55
                     ; ΰΰΰΰΰΰΰΰΰΰΰΰΰΰΰ S U B R O U T I N E
code:4C55
```

```
code:4C55
code:4C55
code:4C55
                                                              get_video_line_below_invaders:
                                                                                                                                                                              ; CODE XREF: code:4BFA1p
code:4C55 7C
                                                                                    1\overline{d}
                                                                                                           a, h
code:4C56 B7
                                                                                     or
                                                                                                            а
                                                                                                                                                                               ; any invaders left in row?
code:4C57 C8
                                                                                     ret
                                                                                                            Ζ
                                                                                                                                                                                ; no, return
code:4C58 D5
                                                                                     push
                                                                                                            de
code:4C59 11 40 00
                                                                                      ld
                                                                                                            de, #64
                                                                                                                                                                                ; characters/line
code:4C5C 19
                                                                                     add
                                                                                                           hl, de
                                                                                                                                                                                ; next line
code:4C5D D1
                                                                                    pop
                                                                                                           de
code:4C5E C9
                                                                                     ret
                                                              ; End of function get_video_line_below_invaders
code:4C5E
code:4C5E
code:4C5F
                                                               ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U
code: 4C5F
code: 4C5F
code:4C5F
                                                              check_for_new_high_score:
                                                                                                                                                                               ; CODE XREF: code:49511p
code: 4C5F
code:4C5F 21 C9 3F
                                                                                                           hl, #video_ram+0x3C9
                                                                                    1 d
                                                                                                                                                                               ; score
                                                                                                            de, #video_ram+0x3FA
code:4C62 11 FA 3F
                                                                                     1 d
                                                                                                                                                                               ; high score
                                                                                                           b, #4
code:4C65 06 04
                                                                                      1 d
                                                                                                                                                                               ; 4 digits to compare
code:4C67
code: 4C67
                                                              loc_0_4C67:
                                                                                                                                                                                ; CODE XREF:
check_for_new_high_score+107j
                                                                                                           c, (hl)
code: 4C67 4E
                                                                                      1d
                                                                                                                                                                                ; get score digit
                                                                                                                                                                                ; get high score digit
code:4C68 1A
                                                                                      ld
                                                                                                            a, (de)
code:4C69 B9
                                                                                                                                                                                ; score higher?
                                                                                      ср
code:4C6A 38 06
                                                                                                            C, update_high_score
                                                                                     jr
                                                                                                                                                                               ; yes, skip
code:4C6C C0
                                                                                                                                                                                ; done if not the same
                                                                                      ret
code:4C6D 23
                                                                                      inc
                                                                                                            hl
code:4C6E 13
                                                                                     inc
                                                                                                            de
                                                                                                                                                                                ; next digits
                                                                                                           loc 0 4C67
code:4C6F 10 F6
                                                                                     djnz
                                                                                                                                                                                ; loop through all digits
code:4C71 C9
                                                                                    ret
code:4C72
code:4C72
                                                              update_high_score:
code:4C72
                                                                                                                                                                                ; CODE XREF:
check for new high score+Bfj
code: 4C72 21 C9 3F
code: 4C75 11 FA 3F
                                                                                                           hl, #video_ram+0x3C9
                                                                                      1 d
                                                                                                                                                                               : source = score
                                                                                                            de, #video_ram+0x3FA
                                                                                                                                                                               ; destination = high score
                                                                                     ld
code:4C78 01 05 00
                                                                                      ld
                                                                                                           bc, #5
                                                                                                                                                                                ; 5 digits to copy
code:4C7B ED B0
                                                                                     ldir
                                                                                                                                                                                ; copy
code:4C7D C9
                                                                                     ret
code:4C7D
                                                              ; End of function check_for_new_high_score
code:4C7D
code:4C7E
                                                               code: 4C7E
code:4C7E
code:4C7E
code:4C7E
                                                              clear_video_line_HL:
                                                                                                                                                                                ; CODE XREF: update bullet+94<sup>p</sup>
code:4C7E C5
                                                                                                                                                                                ; code:4948↑p ...
code:4C7E
                                                                                     push
                                                                                                           bc
code:4C7F D5
                                                                                     push
                                                                                                            de
code:4C80 06 40
                                                                                      ld
                                                                                                           b, #64
                                                                                                                                                                                ; characters/line
code:4C82
                                                              loc 0 4C82:
                                                                                                                                                                                ; CODE XREF:
code:4C82
clear video line HL+7|j
code: \overline{4}C82 \ 3\overline{6} \ 20
                                                                                                             (h1), \#0x20; ''
                                                                                      ld
                                                                                                                                                                               ; display space
code:4C84 23
                                                                                                                                                                                ; next video address
                                                                                     inc
                                                                                                            hl
code:4C85 10 FB
                                                                                     djnz
                                                                                                            loc 0 4C82
                                                                                                                                                                               ; clear a line
code:4C87 D1
                                                                                                            de
                                                                                     gog
code:4C88 C1
                                                                                                           bc
                                                                                    pop
code:4C89 C9
                                                                                     ret
                                                              ; End of function clear video line HL
code:4C89
code: 4C89
code:4C8A
                                                               ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code: 4C8A
code:4C8A
code: 4C8A
code:4C8A
                                                              handle_drop_new_bomb:
                                                                                                                                                                                ; CODE XREF: code:4F65-p
                                                                                   exx
code:4C8A D9
code: 4C8B 06 04
                                                                                                           b, #4
                                                                                    1 d
                                                                                                                                                                                ; number of invader rows
code:4C8D DD 21 08 43
                                                                                                           ix, #row_4_invader_addr
                                                                                     ٦d
```

```
code:4C91
code:4C91
                     loc_0_4C91:
                                                              ; CODE XREF:
handle_drop_new_bomb+11|j
code: 4C91 DD 7E 01
                              1d
                                      a, 1(ix)
code:4C94 B7
                              or
                                                               ; any invaders left on this
                                      а
row?
code:4C95 20 08
                              ir
                                      NZ, check and handle new bomb; yes, continue
code:4C97 DD 2B
                              dec
                                      ix
code:4C99 DD 2B
                              dec
                                      iх
                                                              ; next row above
code:4C9B 10 F4
                                      loc_0_4C91
                              djnz
                                                              ; loop thru all rows
code:4C9D
code:4C9D
                                                              ; CODE XREF:
                      init bomb ret:
handle_drop_new_bomb+3B|j
code:4C9D_D9
                                                              ; handle_drop_new_bomb+4E|j ...
code:4C9D
                              exx
code:4C9E C9
                              ret
code:4C9F
code:4C9F
                      check_and_handle_new_bomb:
code:4C9F
                                                              ; CODE XREF:
handle_drop_new_bomb+B<sup>†</sup>j
code:4C9F 2A 13 43
code:4CA2 11 80 C0
                              1 d
                                      hl, (base_centre)
                              1 d
                                      de, \#0xC080
code:4CA5 19
                              add
                                      hl, de
                                                              ; base X position
code:4CA6 EB
                                      de, hl
                                                              ; base X position
                              ex
code:4CA7 DD 6E 00
                              1 d
                                      1, 0(ix)
code:4CAA DD 66 01
                             ld
                                      h, 1(ix)
                                                              ; invader row address
code:4CAD E5
                              push
                                      hl
code:4CAE 21 03 00
                              ld
                                      hl, #3
                                                              ; RAND(1-3)
code:4CB1 CD 1D 4D
                              call
                                      rand
code:4CB4 7D
                              ld
                                      a, 1
                                                              ; get result
code:4CB5 E1
                              pop
                                      hl
                                                              ; invader row address
code:4CB6 FE 01
                                                               ; drop a bomb near the base?
                                      #1
                              ср
code:4CB8 20 4B
                                      NZ, random bomb x position; no, random
                              jr
code: 4CBA
code: 4CBA
                      loc 0 4CBA:
                                                               ; CODE XREF:
handle_drop_new_bomb+84 | j
                                     hl, de
de, #0xFF80
                                                              ; calc bomb X position
; offset of 2 video lines above
code: 4CBA 19
                              add
code:4CBB 11 80 FF
                              ld
code:4CBE
code:4CBE
                                                              ; CODE XREF:
                      loc_0_4CBE:
handle drop_new_bomb+39|j
code:4CBE CB 7E code:4CC0 20 05
                                      7, (hl)
                              bit
                                                              ; invader above bomb position?
                                      NZ, init_new_bomb
                                                             ; yes, continue ; 2 lines above
                              jr
code:4CC2 19
                              add
                                      hl, de
                                      hl, de
loc_0_4CBE
init_bomb_ret
code:4CC3 10 F9 code:4CC5 18 D6
                              dinz
                                                              ; find invader above
                              jr
                                                              ; no invaders, no bomb
code:4CC7
code:4CC7
                      init new bomb:
                                                              ; CODE XREF:
handle_drop_new_bomb+36<sup>†</sup>j
code:4CC7 DD 21 EA 4E
                              1d
                                      ix, #bomb_tbl
code:4CCB 06 04
                              1d
                                     b, #4
code:4CCD
code:4CCD
                     find_free_bomb_entry:
                                                              ; CODE XREF:
handle_drop_new_bomb+4C|j
code: 4CCD DD 7E 01
                              1d
                                      a, 1(ix)
code:4CD0 B7
                              or
                                      а
                                                              ; bomb active?
                                      Z, loc_0_4CDB
code:4CD1 28 08
                              jr
                                                              ; no, continue
                                      add_3_to_ix
find_free_bomb_entry
                              call
code:4CD3 CD 2A 4E
                                                              ; next table location
code:4CD6 10 F5
                             djnz
code:4CD8 C3 9D 4C
                                      init bomb ret
                                                              ; no free entries, return
                              jр
code: 4CDB
code:4CDB
code:4CDB
                      loc 0 4CDB:
                                                               ; CODE XREF:
handle drop new bomb+47fj
code:4CDB CD 28 4D
code:4CDE 11 82 00
                                      get_invader_address
de, #0x82;','
                              call
                                                              ; 2 lines below and 2 chars
                              ld
right
code:4CE1 19
                              add
                                      hl, de
                                                              ; centre under invader
code:4CE2 E5
                              push
                                      h1
                                      hl, #3
code:4CE3 21 03 00
                              1d
                                                              ; rand(1-3)
code:4CE6 CD 1D 4D code:4CE9 11 D2 4E
                              call
                                      rand
                                      de, #base_icon+3
                                                              ; bomb characters
                              1 d
code:4CEC 19
                              add
                                      hl, de
                                                              ; get random character
```

```
code:4CED D1
                                                                  ; centre under invader
                                pop
                                        de
code:4CEE CB 7B
                                        7, e
code:4CF0 28 1E
                                        Z, check_new_bomb_shield
                                jr
code:4CF2
                                                                  ; CODE XREF:
code: 4CF2
                       init bomb entry:
handle drop new bomb+8A|j
                                        a, (de)
#0x20 ; ' '
code: 4CF2 1A
                                                                  ; get character from video
code:4CF3 FE 20
                                                                  ; space?
                                ср
code:4CF5 20 A6 code:4CF7 7E
                                        NZ, init_bomb_ret a, (hl)
                                                                  ; no, exit ; get bomb character from table
                                ir
                                ĺd
code:4CF8 12
                                        (de), a
                                ld
                                                                  ; display
                                        0(ix), e
code:4CF9 DD 73 00
                                ld
code:4CFC DD 72 01
code:4CFF DD 77 02
                                ٦d
                                        1(ix), d 2(ix), a
                                                                  ; store bomb address
                                                                  ; store bomb character
                                1 d
code:4D02 C3 9D 4C
                                        init_bomb ret
                                jр
code: 4D05
code: 4D05
code:4D05
                       random_bomb_x_position:
                                                                  ; CODE XREF:
handle_drop_new_bomb+2Efj
code: 4D05 E5 code: 4D06 21 40 00
                                        h1
                                push
                                        hl, #64
                                1 d
                                                                  : RAND (1-64)
code:4D09 CD 1D 4D
                                call
                                        rand
code:4D0C EB
                                ex
                                        de, hl
                                                                  ; DE = result
code:4D0D E1
                                        hl
                                pop
                                        loc 0 4CBA
code:4D0E 18 AA
                                jr
code:4D10
code:4D10
code:4D10
                       check_new_bomb_shield:
                                                                  ; CODE XREF:
handle_drop_new_bomb+66<sup>†</sup>j
code: 4D10 EB
                                        de, hl
                                                                  ; HL = centre under invader
code:4D11 CB 7E
                                        7, (hl)
                                bit
                                                                  ; graphic character?
code:4D13 EB
                                ex
                                        de, hl
code:4D14 28 DC
                                jr
                                        Z, init_bomb_entry
                                                                ; no, continue
code:4D16 EB
                                ex
                                        de, hl
code:4D17 E5
                               push
code:4D18 D9
                                exx
code:4D19 E1
                               pop
code:4D1A C3 10 48
                                        erode shield from bomb
                                qŗ
                       ; End of function handle_drop_new_bomb
code: 4D1A
code:4D1A
code:4D1D
                        ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4D1D
code:4D1D
code: 4D1D
code:4D1D
                       rand:
                                                                  ; CODE XREF: update_bullet+9A<sup>†</sup>p
code:4D1D D5
                                                                  ; update_bullet+D2↑p ...
code:4D1D
                                push
                                        de
code:4D1E C5
                                push
                                        bc
code:4D1F CD CC 14
                                call
                                        0x14CC
                                                                  ; ROM RAND() function
code:4D22 CD 7F 0A
                                call
                                        0xA7F
                                                                  ; transfer result to HL
code:4D25 C1
                               pop
                                        bc
code:4D26 D1
                                        de
                               pop
code:4D27 C9
                                ret
code:4D27
                       ; End of function rand
code:4D27
code:4D28
                        ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:4D28
code:4D28
code:4D28
                       get invader address:
                                                                  ; CODE XREF: update bullet+3F<sup>↑</sup>p
code:4D28 D5
                                                                  ; handle drop new bomb+51\pmip
code:4D28
                                push
                                        de
code:4D29 7E
                                        a, (hl)
                                ld
                                                                  ; character at video address
                                        #0x30 ; '0'
                                                                  ; any pixels on bottom row of
code:4D2A E6 30
                                and
cell?
code:4D2C 11 C0 FF
                               ld
                                        de, #0xFFC0
                                                                  ; offset of line above
                                        NZ, loc_0_4D32
code:4D2F 20 01
                               jr
                                                                  ; yes, skip (top half of
invader)
code: 4D31 19
                                add
                                        hl. de
                                                                  ; line above (top half of
invader)
code:4D32
                       loc_0_4D32:
                                                                  : CODE XREF:
code: 4D32
get_invader_address+7fj
```

```
code:4D32 CB 7E
                                                                 ; get invader address+D|j
code: 4D32
                                                                ; graphic character?
                                        7, (hl)
code:4D34 2B
                               dec
                                                                ; previous video address
code:4D35 20 FB
                                       NZ, loc 0 4D32
                                                                 ; loop until non-graphic
                               jr
code:4D37 23
                               inc
                                       h1
code:4D38 23
                               inc
                                       hl
                                                                ; 2nd character of invader
code:4D39 D1
                                       de
                               pop
code:4D3A C9
                               ret
code:4D3A
                       ; End of function get invader address
code:4D3A
code:4D3B
                       ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4D3B
code: 4D3B
code:4D3B
code:4D3B
                                                                ; CODE XREF: code:4AC41p
                       restore_space_characters:
code:4D3B 21 00 3C code:4D3E 01 C0 03
                                       hl, #video_ram bc, #0x3C0
                               1 d
                                                                 ; 15 lines (all but last)
                               1 d
code:4D41
                       loc 0 4D41:
                                                                 ; CODE XREF:
code:4D41
restore_space_characters+16Fj
code:4D41 CB 7E
                               hit
                                        7, (hl)
                                                                ; graphics character?
code:4D43 28 05
                                       Z, loc_0_4D4A
                               jr
                                                                ; no, skip
code:4D45 7E
                               ld
                                          (hl)
                                                                ; get character
                                       #0x80 ; '€'
code:4D46 FE 80
                                                                ; graphic space character?
                               ср
code:4D48 20 02
                                       NZ, loc_0_4D4C
                                                                ; no, skip
code:4D4A
code:4D4A
                      loc 0 4D4A:
                                                                 ; CODE XREF:
restore_space_characters+8↑j
code: 4D\overline{4}A \ 36 \ \overline{2}0
                                        (hl), #0x20 ; ' '
                                                                ; convert to space character
code:4D4C
code:4D4C
                      loc 0 4D4C:
                                                                 ; CODE XREF:
\texttt{restore\_space\_characters+}\overline{\texttt{D}} \uparrow \overline{\texttt{j}}
code: 4D4C 23
                                       hl
                                                                 ; next video address
code:4D4D 0B
                               dec
                                       bc
code:4D4E 78
                               ld
                                       a, b
code:4D4F B1
                                                                ; done?
                               or
                                       C
                                                                ; yes, return
; loop through 15 lines
code:4D50 C8
                                       Ζ
                               ret
code:4D51 18 EE
                                       loc 0 4D41
                               jr
                       ; End of function restore_space_characters
code:4D51
code:4D51
code:4D53
                       ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code:4D53
code: 4D53
code:4D53
                                                                ; CODE XREF: update_bombs+20|p
                       delete_bomb:
code:4D53
code:4D53 AF
                                                                 ; update_bombs+60 p ...
code:4D53
                                                                 ; zero bomb address
                                       1(ix), a
code:4D54 DD 77 01
                               1 d
code:4D57
code: 4D57
                      dec_bomb_count:
                                                                 ; CODE XREF:
erode_shield_from_bomb+1B\(\bar{1}\)j
code: 4D57 3A 12 43
                               1 4
                                        a, (unused 4312)
code:4D5A 3D
                               dec
                                                                 ; probably supposed to be bomb
count
code:4D5B 32 12 43
                               ld
                                        (unused_4312), a
code:4D5E C9
                               ret
code:4D5E
                       ; End of function delete bomb
code:4D5E
code:4D5F
code:4D5F
                       ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4D5F
code:4D5F
                       update_bombs:
code:4D5F
                                                                 ; CODE XREF: code:4F61|p
code:4D5F D9
                               exx
code:4D60 DD 21 EA 4E
                               1d
                                       ix, #bomb_tbl
code:4D64 06 04
                                       b, #4
                                                                 ; max 4 bombs
                               ld
code:4D66
code:4D66
                       loc_0_4D66:
                                                                 ; CODE XREF: update_bombs+10|j
code:4D66 DD 7E 01
                                       a, 1(ix)
                               1 d
code:4D69 B7
                                                                ; valid address?
                               or
code:4D6A 20 07
                                       NZ, check_and_update_bomb; yes, skip
                               jr
code:4D6C
                                                                 ; CODE XREF: update bombs+23|j
code: 4D6C
                       next_bomb:
code:4D6C CD 2A 4E
                                                                 ; update_bombs+4B|j ...
```

```
code:4D6C
                            call
                                   add 3 to ix
                                                          ; next bomb entry
code:4D6F 10 F5
                                   loc_0_4D66
                            djnz
                                                          ; loop thru all bombs
code:4D71 D9
                            exx
code:4D72 C9
                            ret
code: 4D73
code:4D73
code:4D73
                    check_and_update_bomb:
                                                         ; CODE XREF: update bombs+Bfj
                                   1, 0(ix)
h, 1(ix)
code:4D73 DD 6E 00
                            1\overline{d}
code:4D76 DD 66 01
                            ld
                                                         ; bomb address
code:4D79 DD 7E 02
                            ld
                                   a, 2(ix)
                                                         ; bomb character
code:4D7C BE
                                   (h1)
                                                         ; same character?
                            ср
code:4D7D 28 05
                                   Z, update bomb
                            jr
                                                         ; yes, continue
code:4D7F CD 53 4D
                            call.
                                   delete bomb
code:4D82 18 E8
                                   next bomb
                            jr
code: 4D84
code: 4D84
code:4D84
                    update_bomb:
                                                          ; CODE XREF: update bombs+1E1i
                                   (hl), #0x20; ''
code:4D84 36 20
                            1 d
                                                          ; display space
code:4D86 11 40 00
                                   de, #64
hl, de
                            1 d
                                                          ; characters/line
code:4D89 19
                            add
                                                          ; next line down
code:4D8A DD 75 00
                            1 d
                                   0(ix), 1
code:4D8D DD 74 01
                            ld
                                   1(ix), h
                                                          ; update bomb address
code:4D90 E5
                           push
                                   hl
code:4D91 11 C0 3F
                            ld
                                   de, #video ram+0x3C0
                                                         ; bottom line of video
code:4D94 CD E2 45
                            call
                                   compare_video_addresses
code:4D97 B7
                            or
                                                          ; reached bottom of screen?
code:4D98 F5
                           push
                                   af
code:4D99 20 2D
                            jr
                                   NZ, delete_bomb_and_loop ; yes, delete bomb
code:4D9B F1
                            pop
                                   af
code:4D9C E1
                            pop
                                   hl
                                                          ; bomb address
code:4D9D 7E
                                   a, (hl)
                            ld
                                                          ; get character from video
                                   #0x5B ; '['
code:4D9E FE 5B
                                                          ; player bullet?
                            ср
code:4DA0 28 0A
                                   Z, handle_bullet_hit_bomb ; yes, skip
                            jr
code:4DA2 FE 81
                                   #0x81 ;
                                                          ; graphic (non-blank)?
                            ср
                                   NC, check_and_handle_bomb_hit; yes, skip a, 2(ix); bomb character
code:4DA4 30 35
                            jr
code:4DA6 DD 7E 02
                            ĺd
                                                         ; bomb character
                                   (hl), a next_bomb
code:4DA9 77
                            ld
                                                          ; display
code:4DAA 18 C0
                            ir
code: 4DAC
code:4DAC
                    \verb|handle_bullet_hit_bomb:|\\
code: 4DAC
                                                         ; CODE XREF: update_bombs+41^j
code: 4DAC E5
                                   h1
                           push
code:4DAD F5 code:4DAE 21 03 00
                            push
                                   af
                                   hl. #3
                            1d
code:4DB1 CD 1D 4D
                            call
                                   rand
code:4DB4 7D
                            ld
                                   a, 1
code:4DB5 FE 02
code:4DB7 38 0F
                            ср
                                   #2
                                   C, delete bomb and loop
                            jr
code:4DB9 20 14
                            jr
                                   NZ, handle bomb destroys bullet
code:4DBB AF
                            xor
code:4DBC 32 11 43
                            1 d
                                    (bullet active), a
code:4DBF CD 53 4D
                            call
                                   delete_bomb
                                                         ; both destroyed
code:4DC2 F1
                                   af
                            pop
code:4DC3 E1
                            pop
                                   hl
code:4DC4 36 20
                            ld
                                   (hl), \#0x20; ''
code:4DC6 18 A4
                                   next bomb
                            jr
code:4DC8
code: 4DC8
code:4DC8
                    delete_bomb_and_loop:
                                                          ; CODE XREF: update bombs+3A<sup>†</sup> j
                                                          ; update bombs+5817 ...
code:4DC8 CD 53 4D
code:4DC8
                            call
                                   delete bomb
code:4DCB F1
                                   af
                            gog
code:4DCC E1
                                   hl
                            pop
code:4DCD 18 9D
                                   next bomb
                            jг
code: 4DCF
code:4DCF
                    handle_bomb_destroys_bullet:
                                                         ; CODE XREF: update bombs+5A1j
code: 4DCF
code:4DCF AF
                            xor
                                   а
code:4DD0 32 11 43
                            1 d
                                   (bullet_active), a
                                                        ; flag inactive
code:4DD3 F1
                            pop
                                   аf
code: 4DD4 E1
                            pop
                                   h1
code:4DD5 DD 7E 02
                            1d
                                   a, 2(ix)
                                                          : bomb character
```

```
code:4DD8 77
                            ld
                                    (hl), a
                                                           ; display
code:4DD9 18 91
                                    next_bomb
                            jr
code:4DDB
code:4DDB
                     check and handle bomb hit:
                                                           ; CODE XREF: update bombs+451j
code:4DDB EB
                            ex
                                    \overline{d}e, h\overline{l}
                            call
code:4DDC CD 4A 48
                                    find end of lowest invader row
code:4DDF CD E2 45
                            call
                                    compare video addresses
code:4DE2 EB
                            ex
                                    de, hl
code:4DE3 E5
                                    hl
                            push
code:4DE4 F5
                            push
                                    af
code:4DE5 FE FF
code:4DE7 28 DF
                                    #0×FF
                            ср
                                    Z, delete_bomb_and_loop
                            iΥ
code:4DE9 F1
                                    af
                            pop
code:4DEA E1
                            pop
                                    h1
code:4DEB 11 80 3F
                                    de, #video ram+0x380
                                                          ; 2nd bottom row
                            1 d
code: 4DEE CD E2 45
                            call.
                                    compare_video_addresses
code:4DF1 B7
                            or
                                                          ; possible shield hit?
code:4DF2 C2 27 4B
                                    NZ, handle_base_hit
                            jр
                                                           ; no, must be player base
code:4DF5 CD 10 48
                            call
                                    erode_shield_from_bomb
code:4DF8 E5
                            push
                                    h1
                                    af
                            push
code:4DF9 F5
code:4DFA 18 CC
                             jr
                                    delete bomb and loop
code:4DFA
                     ; End of function update_bombs
code: 4DFA
code:4DFC
                     ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4DFC
code:4DFC
code:4DFC
code:4DFC
                     zero bullet tbl:
                                                           ; CODE XREF: code: 4EFB p
code:4DFC 21 EA 4E
                      ld
                                  hl, #bomb_tbl
                                    de, #bomb_tbl+1
code:4DFF 11 EB 4E
                            ld
code:4E02 01 0C 00
                                    bc, #0xC
                            ld
code:4E05 36 00
                             ld
                                    (hl), #0
code:4E07 ED B0
                            ldir
code:4E09 C9
                            ret
code:4E09
                     ; End of function zero bullet tbl
code:4E09
code: 4E0A
                     code: 4E0A
code: 4E0A
code: 4E0A
code:4E0A
                    handle_bullet_destroys_bomb:
                                                          ; CODE XREF: update_bullet+DA p
code:4E0A E5
                            push
                                    hl
code:4E0B D9
                            exx
                            pop
code:4E0C D1
                                    de
code:4E0D DD 21 EA 4E
                                    ix, #bomb_tbl
                            1 d
                                    b, #4
code:4E11 06 04
                            ld
                                                           ; max bombs
code:4E13
code: 4E13
                    loc 0 4E13:
                                                           ; CODE XREF:
handle_bullet_destroys_bomb+1A|j
code: 4\overline{E}13 DD \overline{6}E 00
                                    1, 0(ix)
                                                           ; bomb address
code:4E16 DD 66 01
                            ld
                                    h, 1(ix)
                                    compare_video_addresses #0x20; ''
code:4E19 CD E2 45
                            call
code:4E1C FE 20
                                                  ; hit?
                            ср
                                    Z, loc 0 4E26
code:4E1E CA 26 4E
                                                           ; yes, skip
                            jр
code:4E21 CD 2A 4E
                                    add 3 to ix
                                                           ; next bullet data
                            call
code:4E24 10 ED
                                    loc 0 4E13
                            djnz
                                                           ; loop thru all bullets
code:4E26
code:4E26
                    loc 0 4E26:
                                                           ; CODE XREF:
\verb|handle_bullet_destroys_bomb+14| j
code: 4\overline{E}26 D9
                      exx
                    jp delete_bomb ; ret
; End of function handle_bullet_destroys_bomb
code:4E27 C3 53 4D
                                                           ; returns
code:4E27
code: 4E27
code:4E2A
                     ; ΰΰΰΰΰΰΰΰΰΰΰΰΰΰΰ S U B R O U T I N E
code: 4E2A
code: 4E2A
code: 4E2A
code: 4E2A
                     add_3_to_ix:
                                                           ; CODE XREF:
handle_drop_new_bomb+491p
                                                           ; update_bombs+D↑p ...
code:4E2A DD 23
code: 4E2A
                            inc
                                    ix
```

```
code:4E2C DD 23
                                     inc
                                               ix
code:4E2E DD 23
                                     inc
                                               ix
code:4E30 C9
                                     ret
code:4E30
                           ; End of function add 3 to ix
code:4E30
code:4E31
                           ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:4E31
code:4E31
code:4E31
                           display_GOOD_LUCK:
                                                                            ; CODE XREF: code:49F21p
                                              wipe_screen_left_to_right_slow
code:4E31 CD 18 45
                                    call
                                               hl, #video_ram+0x219
b, #50
code:4E34 21 19 3E code:4E37 06 32
                                                                           ; cursor position
                                     1d
                                                                            ; flash 50 times
                                     1 d
code:4E39
                                                                            ; CODE XREF:
code: 4E39
                           loc_0_4E39:
display_GOOD_LUCK+26|j
code:4E39 C5
                                     push
                                               bc
                                               (0x4020), hl
code:4E3A 22 20 40
                                     1d
                                                                            ; current cursor position
code:4E3D E5
                                     push
                                               hl
code:4E3E 21 D6 4E
                                               hl, #aGoodLuck
                                                                            ; "GOOD LUCK"
                                     1 d
code: 4E41 CD E5 44
                                     call
                                               display_message
                                               delay_15ms
code:4E44 CD 5A 4E
                                     call
code:4E47 E1
                                     pop
                                               hl
                                                                            ; cursor position
code:4E48 22 20 40
                                     ld
                                               (0x4020), hl
code:4E4B E5
                                     push
                                               hl
code:4E4C 21 E0 4E
                                     ld
                                               hl, #blank x9
code:4E4F CD E5 44
                                     call
                                               display message
code:4E52 CD 5A 4E
                                     call
                                               delay_15ms
code:4E55 E1
                                     pop
                                               hl
code:4E56 C1
                                     pop
                                               bc
code:4E57 10 E0
                                     djnz
                                               loc 0 4E39
                                                                            ; loop though all flashes
code:4E59 C9
                                     ret
                           ; End of function display GOOD LUCK
code:4E59
code:4E59
code:4E5A
                           ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code: 4E5A
code: 4E5A
code: 4E5A
                                                                            ; CODE XREF: update_bullet+591p
code: 4E5A
                           delay_15ms:
                                                                            ; display_GOOD_LUCK+13\p ...
code:4E5A 01 E8 03
                                              bc, #1000
code:4E5A
                                     ld
                                                                            ; ~15ms
code:4E5D C3 60 00
                           {\rm jp} 0x60 ; End of function delay_15ms
                                              0 \times 60
                                                                            ; delay
code: 4E5D
code:4E5D
code:4E60
                            ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ SUBROUTINE
code:4E60
code:4E60
code:4E60
code:4E60
                           delay_1_5ms:
                                                                            ; CODE XREF:
wipe_screen_left_to_right_slow+14\partrice{p}
code: 4E60 0\overline{1} 64 \overline{0}0
                                                                            ; code:4F76|p
code:4E60
                                    ld
                                               bc, #100
                                                                            ; \sim 1.5 ms
code:4E63 C3 60 00
                                               0x60
                                                                            ; delay
                                     jр
code:4E63
                           ; End of function delay_1_5ms
code:4E63
code: 4E66
                           ; \hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}}\hat{\mathbf{U}} S U B R O U T I N E
code:4E66
code:4E66
code:4E66
code:4E66
                          print slow and check for R key:
                                                                            ; CODE XREF: code:45671p
code:4E66 E5
                                                                            ; code:45A3↑p ...
code:4E66
                                               h1
                                                                            ; ptr message
                                     push
code:4E67 DD E1
                                    pop
                                               ix
code: 4E69
code:4E69
                           loc 0 4E69:
                                                                            ; CODE XREF:
\verb|print_slow_and_check_for_{\overline{R}}|_{\overline{k}ey+18} + \verb|j|
code: 4E69 DD 7E 00
print_slow_and_check_for_R_key+28|j
code: 4E69
                                               a, 0(ix)
                                                                            ; get character
                                     1 d
code:4E6C B7
                                     or
                                               а
                                                                            ; done?
code:4E6D C8
                                     ret
                                               7.
                                                                            ; yes, exit
code:4E6E FE 09
                                               #9
                                                                            ; cursor position embedded?
                                     ср
code:4E70 20 0E
                                               NZ, loc_0_4E80
                                                                            ; no, skip
                                     jr
```

```
code:4E72 DD 6E 01
                                    1, 1(ix)
code:4E75 DD 66 02
                                    h, 2(ix)
                                                           ; cursor position
code:4E78 22 20 40
                                    (0x4020), hl
                                                           ; set ROM variable
                             ld
                             call
code:4E7B CD 2A 4E
                                    add 3 to ix
code:4E7E 18 E9
                            jr
                                    loc 0 4E69
                                                           ; next character
code: 4E80
code:4E80
                     loc_0 4E80:
code:4E80
                                                           ; CODE XREF:
print slow and check for \overline{R} \overline{k}ey+A\uparrowj
code: 4E80 CD 33 00
                                    0x33
                            call
                                                           ; display character
code:4E83 01 00 05
                                    bc, #1280
                                                           ; ~20ms
                             ld
code:4E86 CD 60 00
                                    0x60
                             call.
                                                           ; delav
code:4E89 CD D9 45
                                    check_for_R_key
                             call
code:4E8C DD 23
                            inc
                                                           ; next character
                                    ix
                                    loc_0 4E69
code:4E8E 18 D9
                             jr
                                                           ; loop
                     ; End of function print_slow_and_check_for_R_key
code:4E8E
code: 4E8E
code:4E90
                     ; ÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛÛ S U B R O U T I N E
code: 4E90
code:4E90
code: 4E90
code:4E90
                    display_lives_left:
                                                           ; CODE XREF:
update_score_and_chk_bonus_life+24\rangle p
code:4E90 E5
                                                           ; code:49E91p ...
code:4E90
                                    hl
code:4E91 D5
                            push
                                    de
code:4E92 C5
                            push
                                    bc
code:4E93 F5
                            push
                                    af
code:4E94 2A 20 40
                                    hl, (0x4020)
                            ld
                                                           ; current cursor position
code:4E97 E5
                            push
                                    hl
code:4E98 21 D0 3F
                                    hl, #video_ram+0x3D0
                            ld
                                                         ; cursor position
code:4E9B 22 20 40
                                    (0x4020), \overline{h}1
                            ld
                                    a, (no_lives)
code:4E9E 3A 0F 43
                            ld
code:4EA1 3D
                            dec
                                                           ; any lives left?
                                    а
code:4EA2 28 14
                                    Z, wipe all ship icons
                            ir
code:4EA4 47
                            ĺd
                                    b, a
                                                           ; number of lives
code: 4EA5
                     loc_0_4EA5:
code:4EA5
                                                           ; CODE XREF:
display_lives_left+1B|j
code:4EA5 21 CF 4E
code:4EA8 CD E5 44
                            ld
                                    hl, #base icon
                            call
                                    display message
                                    loc_0_4EA5
code:4EAB 10 F8
                            djnz
                                                           ; loop thru all icons
code:4EAD 3A OF 43
                            1 d
                                    a, (no_lives)
code:4EB0 47
                            ٦d
                                    b, a
code:4EB1 3E 04
                                    a, #4
                            ٦d
                                    b
code:4EB3 90
                            sub
                                                           ; no. icons to wipe
                                    Z, loc_0_4EC2
code:4EB4 28 0C
                             jr
                                                           ; none, skip
code:4EB6 18 02
                            jr
                                    wipe ship icons
code: 4EB8
code:4EB8
code:4EB8
                     wipe all ship icons:
                                                           ; CODE XREF:
display_lives_left+12<sup>†</sup>j
code: 4EB8 06 03
                            ld
                                  b, #3
                                                           ; max 3 ship icons
code: 4EBA
code: 4EBA
                                                           ; CODE XREF:
                     wipe_ship_icons:
display lives left+26<sup>†</sup>j
code: 4EBA 21 CB 4E
                                                           ; display lives left+30-j
                                    hl, #blank x3
code: 4EBA
                            ld
code:4EBD CD E5 44
                            call
                                    display message
code:4EC0 10 F8
                            djnz
                                    wipe_ship_icons
code:4EC2
code:4EC2
                    loc 0 4EC2:
                                                           ; CODE XREF:
display_lives_left+24fj
code:4EC2 E1
                                    hl
                             gog
code:4EC3 22 20 40
                                    (0x4020), hl
                            1d
                                                          ; restore cursor position
code:4EC6 F1
                            pop
                                    af
code:4EC7 C1
                            pop
                                    bc
code:4EC8 D1
                             pop
                                    de
code: 4EC9 E1
                            pop
                                    h1
code:4ECA C9
                             ret
                     ; End of function display_lives_left
code:4ECA
code: 4ECA
code: 4ECA
```

```
code:4ECB 20 20 20 00 blank x3:.db 0x20, 0x20, 0x20, 0
                                                               ; DATA XREF:
display_lives_left+2A1o
code: 4ECF 88 8E 8C 00 base_icon:.db 0x88, 0x8E, 0x8C, 0
                                                              ; DATA XREF:
display_lives_left+15<sup>o</sup>
code: 4ECF
                                                               ; handle drop new bomb+5F1o
code:4ED3 5C
                      bomb characters:.db 0x5C ; \
                                                              ; bomb characters
code:4ED4 56
                             .db 0x56 ; V
                              .db 0x2A ;
code:4ED5 2A
code:4ED6 47 4F 4F 44+aGoodLuck:.ascii 'GOOD LUCK'
                                                               ; DATA XREF:
display GOOD LUCK+D↑o
code: 4ED6 20 4C 55 43+
                              .db 0
code:4EEO 20 20 20 20+blank_x9:.db 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20, 0x20,
code:4EE0 20 20 20 20+display_GOOD_LUCK+1Bfo
                                                               ; DATA XREF:
                     bomb tbl:.db 0xD1, 0x3E, 0x56
code: 4EEA D1 3E 56
                                                               ; DATA XREF:
handle_drop_new_bomb+3D10
code:4EEA
                                                               ; update_bombs+1îo ...
code:4EED DF 00 56
                              .db 0xDF, 0, 0x56
code:4EF0 92 3F 56
                              .db 0x92, 0x3F, 0x56
code:4EF3 00 00 00
                              .db 0, 0, 0
code:4EF6 00
                              .db
                                     0 ;
code:4EF7 00
                              .db
                                     0 ;
                              .db
                                     0 ;
code:4EF8 00
code:4EF9 00
                              .db
                                     0
code:4EFA 00
                                     0 ;
                              .db
code:4EFB
code:4EFB
code:4EFB
                      init turn:
                                                               ; CODE XREF: code:4AAD^j
code:4EFB CD FC 4D
                                      zero_bullet_tbl
                              call
code:4EFE AF
                              xor
code:4EFF 32 12 43
                              ld
                                       (unused 4312), a
code:4F02 32 20 43
                              ld
                                       (game timer), a
code:4F05
code:4F05
                                                              ; CODE XREF: code:4F95/j
                      game_loop:
code:4F05 3A 40 38
                                      a, (0x3840)
                              ld
                                                               ; read keyboard
code:4F08 57
                              ld
                                      d, a
code:4F09 01 00 02
                                      bc, #0x200
                                                               ; ~7.5ms
                              ld
code:4F0C CD 60 00
                              call
                                      0x60
                                                               ; delav
                                      a, (0x3840)
code:4F0F 3A 40 38
                                                               ; read keyboard
                              ld
code:4F12 AA
                             xor
                                      d
code:4F13 E6 80
                                      #0x80 ; '€'
                                                               ; space - changed state?
                              and
                                      NZ, loc_0_4F26
code:4F15 20 0F
                                                               ; yes, skip
                              iг
                                      a, (keybd_state)
code:4F17 3A 22 43
                              1 d
                                                               ; last read
code: 4F1A 5F
                              1 d
                                       e, a
code:4F1B AA
                              xor
                                      d
                                                               ; changed state?
code:4F1C A2
                              and
                                      d
                                                               ; pressed?
                                      #0x80 ; '€'
code:4F1D E6 80
                              and
                                                               ; space only
code:4F1F 7A
                              1d
                                      a, d
code:4F20 32 22 43
                              1d
                                       (keybd_state), a
                                                               ; store keyboard state
code:4F23 C4 E5 46
                              call
                                      NZ, handle fire
                                                               ; yes, call
code:4F26
code:4F26
                      loc_0_4F26:
                                                               ; CODE XREF: code:4F15<sup>†</sup>j
                             lď.
code:4F26 3A 20 43
                                      a, (game_timer)
code:4F29 E6 03
                                       #3
                                                               ; time to move player?
                              and
code:4F2B CC 88 48
                              call
                                       Z, check_and_handle_move ; yes, call
code:4F2E 3A 11 43
                              ld
                                      a, (bullet_active)
code:4F31 B7
                              or
                                                               ; fired?
code:4F32 28 08
                                       Z, loc 0 4F3C
                              jr
                                                               ; no, skip
code:4F34 3A 20 43
                             ld
                                      a, (game timer)
code:4F37 E6 03
                              and
                                       #3
                                                               ; time to move bullet?
code:4F39 CC 1C 47
                              call
                                      Z, update bullet
                                                               ; yes, call
code:4F3C
code: 4F3C
                      loc 0 4F3C:
                                                               ; CODE XREF: code:4F321j
code:4F3C 3A 20 43
                              ld
                                      a, (game_timer)
code:4F3F E6 07
                              and
                                       #7
                                                               ; time to move UFO?
                                      Z, update_ufo check_and_start_ufo
code:4F41 CC F6 48
                              call
                                                               ; yes, call
code:4F44 CD BF 48 code:4F47 3A 10 43
                              call
                                      a, (ufo_active)
                              ld
code:4F4A B7
                                                               ; on-screen?
                              or
                                      а
                                      NZ, loc_0_4F5A
a, (ufo_timer)
#0x80; '€'
code:4F4B 20 0D
                              jr
                                                               ; yes, skip
                             ĩd
code:4F4D 3A 0C 43
code:4F50 FE 80
                                                               ; time to wipe bonus?
                             ср
                                      NZ, loc_0_4F5A
code: 4F52 20 06
                              jr
                                                               ; no, skip
code:4F54 21 00 3C
                             īd
                                      hl, #video_ram
                              call
code:4F57 CD 7E 4C
                                      clear_video_line_HL
                                                               ; wipe bonus
code: 4F5A
```

```
code:4F5A
                        loc 0 4F5A:
                                                                     ; CODE XREF: code:4F4B1j
code:4F5A 00
                                                                     ; code:4F52<sup>†</sup>j
code: 4F5A
                                 nop
code:4F5B 3A 20 43
                                          a, (game timer)
code:4F5E E6 0F
                                 and
                                          #0×F
                                                                     ; time to update bombs?
code:4F60 F5
                                 push
                                          af
code:4F61 CC 5F 4D
                                 call
                                          Z, update bombs
                                                                     ; yes, call
code:4F64 F1
                                          af
                                 pop
                                          Z, handle_drop_new_bomb
hl, #game_timer
code:4F65 CC 8A 4C
                                 call
code:4F68 21 20 43
                                ld
code:4F6B 34
                                 inc
                                          (hl)
                                                                     ; increment game timer
code:4F6C 3A 21 43
                                          a, (invader timer)
                                 ld
code:4F6F 3D code:4F70 F5
                                 dec
                                          а
                                                                     : tick
                                          af
                                                                     ; time to move invaders?
                                 push
code:4F71 CC 48 4B
                                          Z, animate_and_move_invaders ; yes, call
                                 call
code:4F74 F1
                                 pop
                                          af
code:4F75 F5
                                 push
                                          af
code:4F76 C4 60 4E
                                          NZ, delay_1_5ms
                                 call
code:4F79 F1
                                 pop
                                          af
                                                                     ; invader timer expired?
code:4F7A 20 06
                                 jr
                                          NZ, loc_0_4F82
                                                                     ; no, skip
code:4F7C 3A 01 43
                                          a, (invaders_left)
                                 1 d
code:4F7F 87
                                 add
                                          a, a
code:4F80 D6 01
                                 sub
                                          #1
                                                                     ; calc new invader timer
code:4F82
code:4F82
                        loc_0_4F82:
                                                                     ; CODE XREF: code:4F7A<sup>†</sup>j
code:4F82 32 21 43
                                 ld
                                          (invader timer), a
code:4F85 3A 11 43
                                 ld
                                          a, (bullet_active)
code:4F88 B7
                                 or
                                                                     ; fired?
code:4F89 20 0A
                                          NZ, loc_0_4F95
                                 jr
                                                                     ; yes, skip
code:4F8B 3A 00 43
                                          a, (fire_throttle)
                                 ld
code:4F8E B7
                                 or
code:4F8F 28 04
                                 ir
                                          Z, loc 0 4F95
code:4F91 3D
                                 dec
code:4F92 32 00 43
                                 ld
                                          (fire throttle), a
code:4F95
code:4F95
                        loc_0_4F95:
                                                                     ; CODE XREF: code:4F89<sup>†</sup> j
code:4F95 C3 05 4F
                                                                     ; code:4F8F<sup>†</sup>j
code:4F95
                                          game_loop
                                 jр
code: 4F95
0x36
                                .db 3, 0xE1, 6, 0x20, 0x3E, 0, 0x3D, 0x20, 4, 0x77, 0x23, 0x10 .db 0xFC, 0xAF, 0xC9, 0x3A, 0xC4, 0x4E, 0x6F, 0xCB, 0xA6, 0x5A .db 0x23, 0x56, 0xCD, 0x82, 0x4E, 0x7B, 0xF, 0xF, 0xF, 0xE6,
code:4FAC 4F 47 41 4E+
code:4FAC 45 49 00 81+
code:4FAC 5F 7A FE 30+
. __, OX4E, UX/B, 0XF, 0X

COUGE:4FAC 28 02 77 23+ .db 0xC5, 0x21, 0xC0, 0x4D, 0x4F, 6, 0, 9, 0x7B

code:4FAC 7B 0E 0A 10+; end of 'code'

code:4FAC EC C6 30 77+

code:4FAC 23 26 03 77
code:4FAC 23 36 03 E1+; end of file
```