```
; Projecto
; Definicao de constantes
CR              EQU     0Ah
FIM_TEXTO       EQU     '@'
INT_MASK_ADDR   EQU     FFFAh
INT_MASK        EQU     1000101010000001b
INT_MASKINI     EQU              0000000000000010b
LEDS            EQU              FFF8h
INTS            EQU              FFF9h
IO_READ         EQU     FFFFh
IO_POS          EQU     FFFCh
IO_WRITE        EQU     FFFEh
SP_INICIAL      EQU     E000h
DSP1            EQU              FFF0h
DSP2            EQU              FFF1h
DSP3            EQU              FFF2h
DSP4            EQU              FFF3h
Mais            EQU              2Bh
Menos           EQU              2Dh
Traco           EQU              7Ch
Jog2            EQU              23h
Jog1            EQU              58h
INIText1        EQU              0B21h
INIText2        EQU     0C1Ch
FIMText1        EQU              0A20h
FIMText2        EQU     0B1Ah
FIMText3        EQU              0C1Bh
Esquerda        EQU              4005h
Direita         EQU              4006h
Cima            EQU              4007h
Baixo           EQU              4008h
Temporizador    EQU              FFF6h
INITemp         EQU              FFF7h
Nivel1R5        EQU              100d
Nivel2R5        EQU              200d
Nivel3R5        EQU              400d
Nivel4R5        EQU              600d
LCD_PORT        EQU              FFF4h
LCD                      EQU            FFF5h


                         ORIG    8000h
VarTexto1       STR     'Bem-vindo ao TRON ', FIM_TEXTO
VarTexto2       STR     'Pressione I1 para comecar ', FIM_TEXTO
FimTexto1       STR        '  Fim do Jogo  ', FIM_TEXTO
FimTexto2       STR     'Pressione I1 para recomecar', FIM_TEXTO
TextoWin1       STR     'O jogador 1 venceu esta ronda', FIM_TEXTO
TextoWin2       STR     'O jogador 2 venceu esta ronda', FIM_TEXTO
Contador        WORD    0007h
Tempo           WORD    0000h
ProxPos1        WORD    Baixo
ProxPos2        WORD    Cima
Vencedor        WORD    0000h
Pos1            WORD    0c19h
Pos2            WORD    0c38h
PosIni1         WORD    0c19h
PosIni2         WORD    0c38h
Posicoes        TAB              1900h
Mais1           WORD    0110h
Mais2           WORD    0141h
Mais3           WORD    1610h
Mais4           WORD    1641h
```

```
Menos1          WORD    0111h
Menos2          WORD    1611h
FMenos1         WORD    0141h
FMenos2         WORD    1641h
Traco1          WORD    0210h
Traco2          WORD    0241h
FTraco1         WORD    1610h
FTraco2         WORD    1641h
Tempo1          WORD    48d
Tempo2          WORD    48d
Tempo3          WORD    48d
Tempo4          WORD    48d
Tempo5          WORD    48d
TempoMax1       WORD    48d
TempoMax2       WORD    48d
TempoMax3       WORD    48d
TempoMax4       WORD    48d
Vit11           WORD    48d
Vit21           WORD    48d
Vit12           WORD    48d
Vit22           WORD    48d
TextLCD1        STR              'TEMPO MAX:', FIM_TEXTO
TextLCD2        STR              'J1: ', FIM_TEXTO
TextLCD3        STR              'J2: ', FIM_TEXTO


                         ORIG    FE00h
INT0            WORD    J2E
                         ORIG    FE01h
INT1            WORD    Comeca
                         ORIG    FE07h
INT7            WORD    J1D
                         ORIG    FE09h
INT9            WORD    J1E
                         ORIG    FE0Bh
INTB            WORD    J2D
                         ORIG    FE0Fh
INTF            WORD     Timer

                         ORIG    0000h
                         JMP     Inicio

Comeca:         MOV              R1, R0
                         RTI

Timer:          PUSH    R1
                         MOV             R1, 1h
                         DEC             M[Contador]
                         INC             M[Tempo5]
                         MOV             M[Temporizador], R1
                         MOV             M[INITemp], R1
                         POP             R1
                         RTI

J2E:            MOV              R3, Esquerda
                         RTI

J2D:            MOV              R3, Direita

                         RTI

J1E:            MOV              R2, Esquerda
                         RTI
```

```
J1D:             MOV             R2, Direita
                 RTI


; ----------------------------------------------------------------
; --------------------Escrita de Janela---------------------------
; ----------------------------------------------------------------



EscMais:         MOV             R1, M[Mais1]
                 MOV             M[IO_POS], R1
                 ADD             R1, Posicoes
                 PUSH    R4
                 MOV             R4, 1d
                 MOV             M[R1], R4
                 POP             R4
                 MOV             R1, Mais
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1

                 MOV             R1, M[Mais2]
                 MOV     M[IO_POS], R1
                 ADD             R1, Posicoes
                 PUSH    R4
                 MOV             R4, 1d
                 MOV             M[R1], R4
                 POP             R4
                 MOV             R1, Mais
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1

                 MOV             R1, M[Mais3]
                 MOV     M[IO_POS], R1
                 ADD             R1, Posicoes
                 PUSH    R4
                 MOV             R4, 1d
                 MOV             M[R1], R4
                 POP             R4
                 MOV             R1, Mais
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1

                 MOV             R1, M[Mais4]
                 MOV     M[IO_POS], R1
                 ADD             R1, Posicoes
                 PUSH    R4
                 MOV             R4, 1d
                 MOV             M[R1], R4
                 POP             R4
                 MOV             R1, Mais
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1
                 RET
CicloTraco1:     MOV             R3, M[Traco1]
CicloTra1:       MOV     M[IO_POS], R3
                 PUSH    R4
                 MOV             R4, R3
                 ADD             R4, Posicoes
                 PUSH    R1
                 MOV             R1, 1d
```

```
                 MOV             M[R4], R1
                 POP             R1
                 POP             R4
                 MOV             R1, Traco
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1
                 ADD             R3, 0100h
                 CMP             R3, M[FTraco1]
                 BR.NZ   CicloTra1
                 RET

CicloTraco2:     MOV             R3, M[Traco2]
CicloTra2:       MOV     M[IO_POS], R3
                 PUSH    R4
                 MOV             R4, R3
                 ADD             R4, Posicoes
                 PUSH    R1
                 MOV             R1, 1d
                 MOV             M[R4], R1
                 POP             R1
                 POP             R4
                 MOV             R1, Traco
                 MOV             M[R2], R1
                 MOV             M[IO_WRITE], R1
                 ADD             R3, 0100h
                 CMP             R3, M[FTraco2]
                 BR.NZ   CicloTra2
                 RET

CicloMenos1:     MOV             R3, M[Menos1]
CicloMe1:        MOV     M[IO_POS], R3
                 PUSH    R4
                 MOV             R4, R3
                 ADD             R4, Posicoes
                 PUSH    R1
                 MOV             R1, 1d
                 MOV             M[R4], R1
                 POP             R1
                 POP             R4
                 MOV             R1, Menos
                 MOV             M[R2], R1
                 MOV             M[IO_WRITE], R1
                 ADD             R3, 0001h
                 CMP             R3, M[FMenos1]
                 BR.NZ   CicloMe1
                 RET

CicloMenos2:MOV      R3, M[Menos2]
CicloMe2:        MOV             M[IO_POS], R3
                 PUSH    R4
                 MOV             R4, R3
                 ADD             R4, Posicoes
                 PUSH    R1
                 MOV             R1, 1d
                 MOV             M[R4], R1
                 POP             R1
                 POP             R4
                 MOV             R1, Menos
                 MOV             M[R2], R1
                 MOV     M[IO_WRITE], R1
                 ADD             R3, 0001h
                 CMP             R3, M[FMenos2]
```

```
                         BR.NZ    CicloMe2
                         RET
; ----------------------------------------------------------------
; ----------------------Escrita dos Jogadores---------------------
; ----------------------------------------------------------------
Jogador1:       MOV              R1, M[PosIni1]  ;Posicao do primeiro Jogador
                MOV              M[Pos1], R1
                MOV              M[IO_POS], R1
                PUSH     R4
                MOV              R4, R1
                ADD              R4, Posicoes
                MOV              R3, 1d
                MOV              M[R4], R3
                POP              R4
                MOV              R3, Jog1
                MOV              M[IO_WRITE], R3
                RET

Jogador2:       MOV              R1, M[PosIni2]                  ;Posicao do Segu
ndo Jogador
                MOV              M[Pos2], R1
                MOV      M[IO_POS], R1
                PUSH     R4
                MOV              R4, R1
                ADD              R4, Posicoes
                MOV              R3, 1d
                MOV              M[R4], R3
                POP              R4
                MOV              R3, Jog2
                MOV              M[IO_WRITE], R3
                RET


; ----------------------------------------------------------------
; -------------------------Escrita no LCD-------------------------
; ----------------------------------------------------------------

EscSTRLCD:      PUSH     R6
                PUSH     R7
                MOV              R6, 1000000000000000b
                MOV              M[LCD_PORT], R6

                MOV              R2, TextLCD1
                MOV              R6, 1000000000000000b
                CALL     EscCarLCD

                MOV              R2, TextLCD2
                MOV              R6, 1000000000010000b
                CALL     EscCarLCD

                MOV              R2, TextLCD3
                MOV              R6, 1000000000011010b
                CALL     EscCarLCD

                MOV              R2, M[Vit11]
                MOV              R6, 1000000000010011b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2
```

```
                MOV              R2, M[Vit21]
                MOV              R6, 1000000000011101b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Vit12]
                MOV              R6, 1000000000010100b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Vit22]
                MOV              R6, 1000000000011110b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Tempo1]
                MOV              R6,     1000000000001011b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Tempo2]
                MOV              R6,     1000000000001100b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Tempo3]
                MOV              R6,     1000000000001101b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, M[Tempo4]
                MOV              R6,     1000000000001110b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                MOV              R2, 115d
                MOV              R6,     1000000000001111b
                MOV      M[LCD_PORT], R6
                MOV      M[LCD], R2

                POP              R7
                POP      R6
                RET

EscCarL:        PUSH     R1
                MOV      R1, M[SP+3]
                MOV      M[LCD], R1
                POP      R1
                RETN     1

EscCarLCD:  PUSH     R1
            PUSH     R2
CicloL:     MOV          M[LCD_PORT], R6
                MOV          R1, M[R2]
            CMP      R1, FIM_TEXTO
            JMP.Z    FimEscL
                PUSH     R1
            CALL     EscCarL
            INC      R2
                INC          R6
            BR       CicloL
```

```
FimEscL:    POP      R2
            POP      R1
            RET


; ------------------------------------------------------------------
; --------------------Funcoes auxiliares a escrita------------------
; ------------------------------------------------------------------


EscCar:       PUSH     R1
              MOV      R1, M[SP+3]
              MOV      M[IO_WRITE], R1
              POP      R1
              RETN     1

EscString:  PUSH     R1
            PUSH     R2
Ciclo:      MOV      M[IO_POS], R6
              MOV      R1, M[R2]
            CMP      R1, FIM_TEXTO
            JMP.Z    FimEsc
              PUSH     R1
            CALL     EscCar
            INC      R2
              INC              R6
            BR       Ciclo
FimEsc:     POP      R2
            POP      R1
            RET




; ------------------------------------------------------------------
; --------------------Inicio do Programa----------------------------
; ------------------------------------------------------------------

Inicio:     MOV      R7, SP_INICIAL
            MOV      SP, R7
              MOV      R7, INT_MASKINI
            MOV      M[INT_MASK_ADDR], R7
              MOV              R2, FFFFh
              CALL     LeTam
              MOV              M[IO_POS], R2
              MOV      R2, VarTexto1
              MOV              R6, INIText1
              MOV              M[IO_POS], R6
            CALL     EscString
              MOV      R2, VarTexto2
              MOV              R6, INIText2
              MOV              M[IO_POS], R6
            CALL     EscString
            CALL     EscSTRLCD
            MOV              R7, 0000000000000000b
            MOV              M[LEDS], R7
            ENI
            MOV              R1, 0001h
Ciclo2:       CMP              R1, R0
            BR.NZ    Ciclo2
Jogo:         CALL     LeTam
            CALL     LeNivel
```

```
            MOV              R2, FFFFh
            MOV              M[IO_POS], R2
            CALL     Apaga
            CALL     EscMais
            CALL     CicloTraco1
            CALL     CicloTraco2
            CALL     CicloMenos1
            CALL     CicloMenos2
            CALL     Jogador1
            CALL     Jogador2
            CALL     LimpaDados
            CALL     LeNivel
            CALL     EscDSP
            MOV      R7, INT_MASK
            MOV      M[INT_MASK_ADDR], R7
            JMP              JogoComeca




; ------------------------------------------------------------------
; --------------------Funcao Fim de jogo----------------------------
; ------------------------------------------------------------------


LimpaDados:   PUSH     R7
              MOV              R7, 48d
              MOV              M[Tempo1], R7
              MOV              M[Tempo2], R7
              MOV              M[Tempo3], R7
              MOV              M[Tempo4], R7
              MOV              M[Tempo5], R7
              POP      R7
              RET

; ------------------------------------------------------------------
; --------------------Funcao Fim de jogo----------------------------
; ------------------------------------------------------------------

Fim:          CALL     Apaga
              PUSH     R2
              MOV              R2, 0000h
              CMP              R2, M[Vencedor]
              POP      R2
              JMP.Z    EscWin1
              JMP              EscWin2

EscWin1:      MOV      R2, TextoWin1
              MOV              R6, FIMText2
              MOV              M[IO_POS], R6
              CALL     EscString
              JMP              ContFim


EscWin2:      MOV      R2, TextoWin2
              MOV              R6, FIMText2
              MOV              M[IO_POS], R6
              CALL     EscString
              JMP              ContFim


ContFim:      MOV              R7, M[TempoMax1]
              CMP              R7, M[Tempo1]
```

```
            JMP.N     ActTemp
            JMP.P     ContEsc
            MOV              R7, M[TempoMax2]
            CMP              R7, M[Tempo2]
            JMP.N     ActTemp
            JMP.P     ContEsc
            MOV              R7, M[TempoMax3]
            CMP              R7, M[Tempo3]
            JMP.N     ActTemp
            JMP.P     ContEsc
            MOV              R7, M[TempoMax4]
            CMP              R7, M[Tempo4]
            JMP.N     ActTemp
            JMP.P     ContEsc


ActTemp:    MOV              R2, M[Tempo1]
            MOV              M[TempoMax1], R2
            MOV              R6,    1000000000001011b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Tempo2]
            MOV              M[TempoMax2], R2
            MOV              R6,    1000000000001100b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Tempo3]
            MOV              M[TempoMax3], R2
            MOV              R6,    1000000000001101b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Tempo4]
            MOV              M[TempoMax4], R2
            MOV              R6,    1000000000001110b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

ContEsc:    MOV       R2, FimTexto1
            MOV              R6, FIMText1
            MOV              M[IO_POS], R6
            CALL      EscString

            MOV       R2, FimTexto2
            MOV              R6, FIMText3
            MOV              M[IO_POS], R6
            CALL      EscString

            MOV              R2, M[Vit11]
            MOV              R6, 1000000000010011b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Vit21]
            MOV              R6, 1000000000011101b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Vit12]
```

```
            MOV              R6, 1000000000010100b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV              R2, M[Vit22]
            MOV              R6, 1000000000011110b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2


            MOV              R2, 115d
            MOV              R6,       1000000000001111b
            MOV       M[LCD_PORT], R6
            MOV       M[LCD], R2

            MOV       R7, INT_MASKINI
            MOV       M[INT_MASK_ADDR], R7
            MOV       R1, 0001h

            CALL      EscDSP
Leds2:      CALL      Leds1
            CMP              R1, R0
            BR.NZ     Leds2
            MOV              R7, 0000000000000000b
            MOV              M[LEDS], R7
            CALL      Apaga
            JMP       Jogo


Leds1:      MOV              R7, 0000000000000001b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000000010b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000000100b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000001000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000010000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000100000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000001000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000010000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000100000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000001000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000010000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000100000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0001000000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0010000000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0100000000000000b
            MOV              M[LEDS], R7
            MOV              R7, 1000000000000000b
            MOV              M[LEDS], R7
            MOV              R7, 0000000000000000b
```

```
                         MOV              M[LEDS], R7
                         RET
; ------------------------------------------------------------------------
--------------
; --------------------Funcao que apaga ecra e tabela de posicoes--------------
--------------
; ------------------------------------------------------------------------
--------------
Apaga:        PUSH     R7
                         PUSH     R4
                         PUSH     R5
                         MOV              R5, 0020h
                         MOV              R4, R0
                         MOV              R7, Posicoes
Apg:          MOV              M[R7], R0
                         MOV              M[IO_POS], R4
                         MOV              M[IO_WRITE], R5
                         INC              R4
                         INC              R7
                         CMP              R4, 1900h
                         BR.NZ    Apg

                         POP              R5
                         POP              R4
                         POP              R7
                         RET

; ------------------------------------------------------------------------
; --------------------Verificacao de Tamanho----------------------------
; ------------------------------------------------------------------------


LeTam:        PUSH     R5
                         DSI
                         MOV              R5, M[INTS]
                         AND              R5, 0000000000000011b
         CMP          R5, 0000000000000000b
         JMP.Z        Tam4
         CMP          R5, 0000000000000001b
         JMP.Z        Tam1
         CMP          R5, 0000000000000010b
         JMP.Z        Tam2
         JMP          Tam3

Tam1:         MOV              R5, 0c1ch
                         MOV              M[PosIni1], R5
                         MOV              R5, 0c35h
                         MOV              M[PosIni2], R5
                         MOV              R5, 0118h
                         MOV              M[Mais1], R5
                         MOV              R5, 0139h
                         MOV              M[Mais2], R5
                         MOV              R5, 1618h
                         MOV              M[Mais3], R5
                         MOV              R5, 1639h
                         MOV              M[Mais4], R5
                         MOV              R5, 0119h
                         MOV              M[Menos1], R5
                         MOV              R5, 1619h
                         MOV              M[Menos2], R5
```

```
                         MOV              R5, 0139h
                         MOV              M[FMenos1], R5
                         MOV              R5, 1639h
                         MOV              M[FMenos2], R5
                         MOV              R5, 0218h
                         MOV              M[Traco1], R5
                         MOV              R5, 0239h
                         MOV              M[Traco2], R5
                         MOV              R5, 1618h
                         MOV              M[FTraco1], R5
                         MOV              R5, 1639h
                         MOV              M[FTraco2], R5
                         JMP              FimTam

Tam2:         MOV              R5, 0c19h
                         MOV              M[PosIni1], R5
                         MOV              R5, 0c38h
                         MOV              M[PosIni2], R5
                         MOV              R5, 0610h
                         MOV              M[Mais1], R5
                         MOV              R5, 0641h
                         MOV              M[Mais2], R5
                         MOV              R5, 1110h
                         MOV              M[Mais3], R5
                         MOV              R5, 1141h
                         MOV              M[Mais4], R5
                         MOV              R5, 0611h
                         MOV              M[Menos1], R5
                         MOV              R5, 1111h
                         MOV              M[Menos2], R5
                         MOV              R5, 0641h
                         MOV              M[FMenos1], R5
                         MOV              R5, 1141h
                         MOV              M[FMenos2], R5
                         MOV              R5, 0710h
                         MOV              M[Traco1], R5
                         MOV              R5, 0741h
                         MOV              M[Traco2], R5
                         MOV              R5, 1110h
                         MOV              M[FTraco1], R5
                         MOV              R5, 1141h
                         MOV              M[FTraco2], R5
                         JMP              FimTam

Tam3:         MOV              R5, 0c1ch
                         MOV              M[PosIni1], R5
                         MOV              R5, 0c35h
                         MOV              M[PosIni2], R5
                         MOV              R5, 0618h
                         MOV              M[Mais1], R5
                         MOV              R5, 0639h
                         MOV              M[Mais2], R5
                         MOV              R5, 1118h
                         MOV              M[Mais3], R5
                         MOV              R5, 1139h
                         MOV              M[Mais4], R5
                         MOV              R5, 0619h
                         MOV              M[Menos1], R5
                         MOV              R5, 1119h
                         MOV              M[Menos2], R5
                         MOV              R5, 0639h
                         MOV              M[FMenos1], R5
```

```
                    MOV             R5, 1139h
                    MOV             M[FMenos2], R5
                    MOV             R5, 0718h
                    MOV             M[Traco1], R5
                    MOV             R5, 0739h
                    MOV             M[Traco2], R5
                    MOV             R5, 1118h
                    MOV             M[FTraco1], R5
                    MOV             R5, 1139h
                    MOV             M[FTraco2], R5
                    JMP             FimTam

Tam4:       MOV             R5, 0c19h
                    MOV             M[PosIni1], R5
                    MOV             R5, 0c38h
                    MOV             M[PosIni2], R5
                    MOV             R5, 0110h
                    MOV             M[Mais1], R5
                    MOV             R5, 0141h
                    MOV             M[Mais2], R5
                    MOV             R5, 1610h
                    MOV             M[Mais3], R5
                    MOV             R5, 1641h
                    MOV             M[Mais4], R5
                    MOV             R5, 0111h
                    MOV             M[Menos1], R5
                    MOV             R5, 1611h
                    MOV             M[Menos2], R5
                    MOV             R5, 0141h
                    MOV             M[FMenos1], R5
                    MOV             R5, 1641h
                    MOV             M[FMenos2], R5
                    MOV             R5, 0210h
                    MOV             M[Traco1], R5
                    MOV             R5, 0241h
                    MOV             M[Traco2], R5
                    MOV             R5, 1610h
                    MOV             M[FTraco1], R5
                    MOV             R5, 1641h
                    MOV             M[FTraco2], R5
                    JMP             FimTam


FimTam:         ENI
                    POP     R5
                    RET

; -------------------------------------------------------------------------------
----------
; --------------------------------Escolha do nivel----------------------------
----------
; -------------------------------------------------------------------------------
----------
LeNivel:        PUSH    R5
                    DSI
                    MOV             R5, M[INTS]
                    AND             R5, 0000000000111100b
        CMP         R5, 0000000000000100b
        JMP.Z       ModN1
        CMP         R5, 0000000000001000b
        JMP.Z       ModN2
```

```
                    CMP             R5, 0000000000010000b
                    JMP.Z           ModN3
                    CMP             R5, 0000000000100000b
                    JMP.Z           ModN4
                    JMP             FimNivel

ModN1:      MOV             R5, 49d
                    MOV             M[Tempo3], R5
                    MOV             R5, 0005h
                    MOV             M[Contador], R5
                    JMP             FimNivel

ModN2:      MOV             R5, 50d
                    MOV             M[Tempo3], R5
                    MOV             R5, 0003h
                    MOV             M[Contador], R5
                    JMP             FimNivel

ModN3:      MOV             R5, 52d
                    MOV             M[Tempo3], R5
                    MOV             R5, 0002h
                    MOV             M[Contador], R5
                    JMP             FimNivel

ModN4:      MOV             R5, 54d
                    MOV             M[Tempo3], R5
                    MOV             R5, 0001h
                    MOV             M[Contador], R5
                    JMP             FimNivel


FimNivel:       ENI
                    POP     R5
                    RET


; -------------------------------------------------------------------------------
----------
; --------------------Inicio do jogo, temporizador e nivel ---------------
----------
; -------------------------------------------------------------------------------
----------




JogoComeca: MOV         R1, 7d
                    MOV             M[Contador], R1
                    MOV             R1, Baixo
                    MOV             M[ProxPos1], R1
                    MOV             R1, Cima
                    MOV             M[ProxPos2], R1
                    MOV             M[Tempo], R0
                    MOV             R1, 1h
                    MOV             M[Temporizador], R1
                    MOV             M[INITemp], R1
CicloTimer:     MOV             R2, R0
                    MOV             R3, R0
CT:             CALL    LePausa
                    CALL    EscDSP
                    CALL    MudaTempos
                    CMP             M[Contador], R0
```

```
                             BR.NZ    CT
Movimentos1:    CMP          R2, Esquerda
                JMP.Z        EsqJog1
                CMP                   R2, Direita
                JMP.Z        DirJog1
Movimentos2:    CMP                   R3, Esquerda
                JMP.Z        EsqJog2
                CMP                   R3, Direita
                JMP.Z        DirJog2
ContinuaM:      JMP                   MovJog1
FimMovimentos:  JMP                   VerificaNivel


; -------------------------------------------------------------------------------
; ---------------------------------Verificacao de Pausa--------------------------
; -------------------------------------------------------------------------------


LePausa:        PUSH    R5
                             DSI
CicloP:         MOV          R5, M[INTS]
                AND          R5, 0080h
                CMP          R5, 0080h
                BR.Z    CicloP
FimPausa:       ENI
                             POP     R5
                             RET


; -------------------------------------------------------------------------------
; ---------------------------Escrita Display-------------------------------------
; -------------------------------------------------------------------------------



EscDSP:                      PUSH    R7
                             MOV          R7, M[Tempo4]
                             MOV          M[DSP1], R7
                             MOV          R7, M[Tempo3]
                             MOV          M[DSP2], R7
                             MOV          R7, M[Tempo2]
                             MOV          M[DSP3], R7
                             MOV          R7, M[Tempo1]
                             MOV          M[DSP4], R7
                             POP          R7
                             RET


; -------------------------------------------------------------------------------
; ---------------------------Muda ASCII Tempos-----------------------------------
; -------------------------------------------------------------------------------


MudaTempos:                  PUSH    R7
                             MOV          R7, M[Tempo5]
                             CMP          R7, 58d
                             BR.Z    IncTemp4
                             POP          R7
                             RET
```

```
IncTemp4:       MOV          R7, 48d
                MOV          M[Tempo5], R7
                INC          M[Tempo4]
                MOV          R7, M[Tempo4]
                CMP          R7, 58d
                BR.Z    IncTemp3
                POP          R7
                RET

IncTemp3:       MOV          R7, 48d
                MOV          M[Tempo4], R7
                INC          M[Tempo3]
                MOV          R7, M[Tempo3]
                CMP          R7, 58d
                BR.Z    IncTemp2
                POP          R7
                RET

IncTemp2:       MOV          R7, 48d
                MOV          M[Tempo3], R7
                INC          M[Tempo2]
                MOV          R7, M[Tempo2]
                CMP          R7, 58d
                BR.Z    IncTemp1
                POP          R7
                RET

IncTemp1:       MOV          R7, 48d
                MOV          M[Tempo2], R7
                INC          M[Tempo1]
                POP          R7
                RET




; ------------------------------------------------------------------------
; ---------------------Verificacao de colisÃfo---------------------------
; ------------------------------------------------------------------------


Embater1:       PUSH    R1
                PUSH    R2
                MOV          R1, 1d
                MOV          R2, M[Pos1]
                ADD          R2, Posicoes
                CMP          M[R2], R1
                JMP.Z   Win2
                POP          R2
                POP          R1
                RET


Embater2:       PUSH    R1
                PUSH    R2
                MOV          R1, 1d
                MOV          R2, M[Pos2]
                ADD          R2, Posicoes
                CMP          M[R2], R1
                JMP.Z   Win1
                POP          R2
                POP          R1
```

```
                   RET
; -----------------------------------------------------------------------------
----------
; --------------------Incremento das vitorias dos jogadores-------------------
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; -----------------------------------------------------------------------------
----------


Win1:          MOV              R2, 0000h
               MOV              M[Vencedor], R2
               MOV              R2, 57d
               CMP              M[Vit12], R2
               BR.Z    IncVit11
               INC              M[Vit12]
               POP              R2
               POP              R1
               JMP              Fim


IncVit11:      INC              M[Vit11]
               MOV              R2, 48d
               MOV              M[Vit12], R2
               POP              R2
               POP              R1
               JMP              Fim
Win2:          MOV              R2, 0001h
               MOV              M[Vencedor], R2
               MOV              R2, 57d
               CMP              M[Vit22], R2
               BR.Z    IncVit21
               INC              M[Vit22]
               POP              R2
               POP              R1
               JMP              Fim
IncVit21:      INC              M[Vit21]
               MOV              R2, 48d
               MOV              M[Vit22], R2
               POP              R2
               POP              R1
               JMP              Fim




; -----------------------------------------------------------------------------
------
; --------------------Funcoes auxiliares aos movimentos----------------------
------
; -----------------------------------------------------------------------------
------




MovJog1:       MOV              R4, M[ProxPos1]
               CMP              R4, Cima
               JMP.Z   MJ1C
               CMP              R4, Baixo
```

```
               JMP.Z   MJ1B
               CMP              R4, Direita
               JMP.Z   MJ1D
               JMP              MJ1E

MovJog2:       MOV              R4, M[ProxPos2]
               CMP              R4, Cima
               JMP.Z   MJ2C
               CMP              R4, Baixo
               JMP.Z   MJ2B
               CMP              R4, Direita
               JMP.Z   MJ2D
               JMP              MJ2E



; -----------------------------------------------------------------------------
-------------------------
; --------------------Funcoes que escreve a nova posicao no ecra, jogador
-------------------------
; -----------------------------------------------------------------------------
-------------------------


MJ1C:          MOV              R4, M[Pos1]
               SUB              R4, 0100h
               MOV              M[IO_POS], R4
               MOV              M[Pos1], R4
               CALL    Embater1
               ADD              R4, Posicoes
               PUSH    R3
               MOV              R3, 1d
               MOV              M[R4], R3
               POP              R3
               MOV              R4, Jog1
               MOV              M[IO_WRITE], R4
               JMP              MovJog2
MJ1B:          MOV              R4, M[Pos1]
               ADD              R4, 0100h
               MOV              M[IO_POS], R4
               MOV              M[Pos1], R4
               CALL    Embater1
               ADD              R4, Posicoes
               PUSH    R3
               MOV              R3, 1d
               MOV              M[R4], R3
               POP              R3
               MOV              R4, Jog1
               MOV              M[IO_WRITE], R4
               JMP              MovJog2
MJ1E:          MOV              R4, M[Pos1]
               DEC              R4
               MOV              M[IO_POS], R4
               MOV              M[Pos1], R4
               CALL    Embater1
               ADD              R4, Posicoes
               PUSH    R3
               MOV              R3, 1d
               MOV              M[R4], R3
               POP              R3
               MOV              R4, Jog1
```

```
                    MOV             M[IO_WRITE], R4
                    JMP             MovJog2

MJ1D:       MOV             R4, M[Pos1]
                    INC             R4
                    MOV             M[IO_POS], R4
                    MOV             M[Pos1], R4
                    CALL    Embater1
                    ADD             R4, Posicoes
                    PUSH    R3
                    MOV             R3, 1d
                    MOV             M[R4], R3
                    POP             R3
                    MOV             R4, Jog1
                    MOV             M[IO_WRITE], R4
                    JMP             MovJog2




; ----------------------------------------------------------------------------
--------------------------
; -------------------Funcoes que escreve a nova posicao no ecra, jogador 2----
--------------------------
; ----------------------------------------------------------------------------
--------------------------


MJ2C:       MOV             R4, M[Pos2]
                    SUB             R4, 0100h
                    MOV             M[IO_POS], R4
                    MOV             M[Pos2], R4
                    CALL    Embater2
                    ADD             R4, Posicoes
                    PUSH    R3
                    MOV             R3, 1d
                    MOV             M[R4], R3
                    POP             R3
                    MOV             R4, Jog2
                    MOV             M[IO_WRITE], R4
                    JMP             FimMovimentos
MJ2B:       MOV             R4, M[Pos2]
                    ADD             R4, 0100h
                    MOV             M[IO_POS], R4
                    MOV             M[Pos2], R4
                    CALL    Embater2
                    ADD             R4, Posicoes
                    PUSH    R3
                    MOV             R3, 1d
                    MOV             M[R4], R3
                    POP             R3
                    MOV             R4, Jog2
                    MOV             M[IO_WRITE], R4
                    JMP             FimMovimentos
MJ2E:       MOV             R4, M[Pos2]
                    DEC             R4
                    MOV             M[IO_POS], R4
                    MOV             M[Pos2], R4
                    CALL    Embater2
                    ADD             R4, Posicoes
```

```
                    PUSH    R3
                    MOV             R3, 1d
                    MOV             M[R4], R3
                    POP             R3
                    MOV             R4, Jog2
                    MOV             M[IO_WRITE], R4
                    JMP             FimMovimentos

MJ2D:       MOV             R4, M[Pos2]
                    INC             R4
                    MOV             M[IO_POS], R4
                    MOV             M[Pos2], R4
                    CALL    Embater2
                    ADD             R4, Posicoes
                    PUSH    R3
                    MOV             R3, 1d
                    MOV             M[R4], R3
                    POP             R3
                    MOV             R4, Jog2
                    MOV             M[IO_WRITE], R4
                    JMP             FimMovimentos



; -----------------------------------------------------------------------
---
; -------------------Verificacao e mudanca de nivel----------------------
---
; -----------------------------------------------------------------------
---


VerificaNivel: PUSH   R7
                    MOV             R7, M[Tempo3]
                    CMP             R7, 49d; Nivel1R5
                    JMP.N   Nivel1
                    CMP             R7, 50d; Nivel2R5
                    JMP.N   Nivel2
                    CMP             R7, 52d; Nivel3R5
                    JMP.N   Nivel3
                    CMP             R7, 54d; Nivel4R5
                    JMP.N   Nivel4
                    JMP             Nivel5

Nivel1:     MOV             R7, 0007h
                    MOV             M[Contador], R7
                    MOV             R7, R0
                    MOV             M[LEDS], R7
                    POP     R7
                    JMP             CicloTimer
Nivel2:     MOV             R7, 0005h
                    MOV             M[Contador], R7
                    MOV             R7, 0000000000001111b
                    MOV             M[LEDS], R7
                    POP     R7
                    JMP             CicloTimer
Nivel3:     MOV             R7, 0003h
                    MOV             M[Contador], R7
```

```
                        MOV             R7, 0000000011111111b
                        MOV             M[LEDS], R7
                        POP     R7
                        JMP             CicloTimer
Nivel4:         MOV             R7, 0002h
                        MOV             M[Contador], R7
                        MOV             R7, 0000111111111111b
                        MOV             M[LEDS], R7
                        POP     R7
                        JMP             CicloTimer
Nivel5:         MOV             R7, 0001h
                        MOV             M[Contador], R7
                        MOV             R7, 1111111111111111b
                        MOV             M[LEDS], R7
                        POP     R7
                        JMP             CicloTimer

; ------------------------------------------------------------------------------
--------------------
; --------------------Mais funcoes auxiliares ao movimento do jogador 1--------
--------------------
; ------------------------------------------------------------------------------
--------------------


EsqJog1:        PUSH    R6
                        MOV             R6, Direita
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Cima

                        MOV             R6, Esquerda
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Baixo

                        MOV             R6, Cima
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Esq

                        MOV             R6, Baixo
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Esq

DirJog1:        PUSH    R6
                        MOV             R6, Direita
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Baixo

                        MOV             R6, Esquerda
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Cima

                        MOV             R6, Cima
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Dir

                        MOV             R6, Baixo
                        CMP             M[ProxPos1], R6
                        JMP.Z   Jog1Dir
```

```
; ------------------------------------------------------------------------------
--------------------
; -------------------Mais funcoes auxiliares ao movimento do jogador 2---
--------------------
; ------------------------------------------------------------------------------
--------------------


EsqJog2:        PUSH    R6
                        MOV             R6, Direita
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Cima

                        MOV             R6, Esquerda
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Baixo

                        MOV             R6, Cima
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Esq

                        MOV             R6, Baixo
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Esq


DirJog2:        PUSH    R6
                        MOV             R6, Direita
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Baixo

                        MOV             R6, Esquerda
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Cima

                        MOV             R6, Cima
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Dir

                        MOV             R6, Baixo
                        CMP             M[ProxPos2], R6
                        JMP.Z   Jog2Dir

; ------------------------------------------------------------------------------
--------------------
; -------------------Mais funcoes auxiliares ao movimento do jogador 1---
--------------------
; ------------------------------------------------------------------------------
--------------------

Jog1Esq:        MOV             R6, Esquerda
                        MOV             M[ProxPos1], R6
                        POP             R6
                        JMP             Movimentos2
Jog1Dir:        MOV             R6, Direita
                        MOV             M[ProxPos1], R6
                        POP             R6
                        JMP             Movimentos2
Jog1Cima:       MOV             R6, Cima
                        MOV             M[ProxPos1], R6
```

```
                          POP               R6
                          JMP               Movimentos2

Jog1Baixo:      MOV               R6, Baixo
                          MOV               M[ProxPos1], R6
                          POP               R6
                          JMP               Movimentos2

; ------------------------------------------------------------------------------
----------------------
; --------------------Mais funcoes auxiliares ao movimento do jogador 2--------
----------------------
; ------------------------------------------------------------------------------
----------------------

Jog2Esq:        MOV               R6, Esquerda
                          MOV               M[ProxPos2], R6
                          POP               R6
                          JMP               ContinuaM

Jog2Dir:        MOV               R6, Direita
                          MOV               M[ProxPos2], R6
                          POP               R6
                          JMP               ContinuaM

Jog2Cima:       MOV               R6, Cima
                          MOV               M[ProxPos2], R6
                          POP               R6
                          JMP               ContinuaM

Jog2Baixo:      MOV               R6, Baixo
                          MOV               M[ProxPos2], R6
                          POP               R6
                          JMP               ContinuaM
```