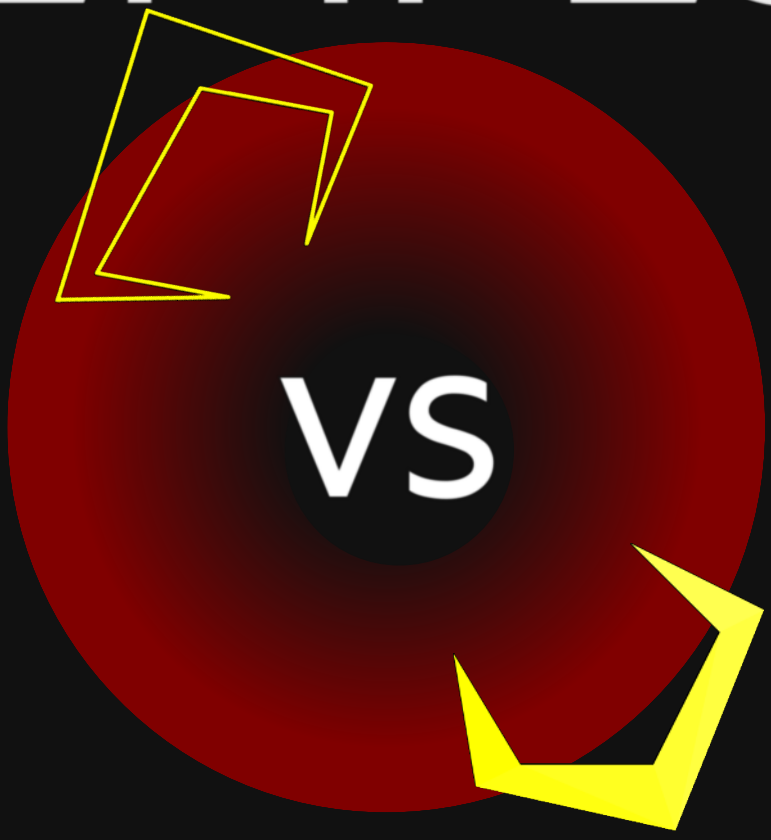
TEMPEST



TEMPEST

THE MAKING AND REMAKING OF ATARI'S ICONIC VIDEOGAME

TEMPEST
VS
TEMPEST

Notes on the Source Code of Two Video Games

For Edna.

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Contents

attract mode admin

There is naturally a bit of administrative overhead associated with operating a game in 'attract mode'. In case you may be wondering, 'attract mode' is when a game cabinet sits unattended and is attempting to attract customers. The manufacturer can display a colourful title screen and high score tables, maybe play a tune. But often the most effective way of getting people to play your game is to show the game being played. This allows the uninitiated to get a sense of what they're missing out on and also gives them an idea of how to proceed when they enter their first coin. Providing this kind of demonstration gameplay means devising some rudimentary intelligence in the game logic that will mimic the activity of a fairly competent paying customer. Fortunately, in *Tempest* there are only two things that a player actually does: move and shoot. This means that our task of emulating a player negotiating a level in *Tempest* is simpler than it might at first appear. We can split it out into two separate concerns, and if we solve each one we will have an artificial player that can help bring in some business.

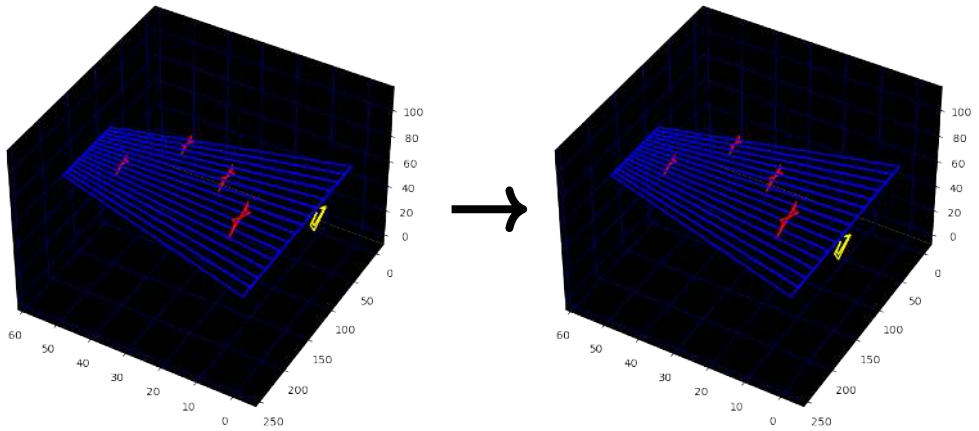
When we get our 'attract mode' up and running we have a small bit of setup to perform first. The demonstration player is only given one life, and the level they will play is chosen at random from the first eight.

```
        BIT QSTATUS    ; CHECK FOR ATTRACT MODE..
        IFPL           ; IF IT IS ENABLED THEN..
        LDY I,1        ; LOAD 1 INTO Y REGISTER.
        STY LIVES1     ; AND STORE THAT AS AVAILABLE LIVES.
        LDA RANDOM     ; STORE A RANDOM NUMBER IN ACCUMULATOR.
        AND I,7        ; CLAMP IT TO BETWEEN 0 AND 7.
        ENDIF
        STA X,WAVEN1   ; USE THE RANDOM NUM TO SELECT LEVEL.
        STA CURWAV     ; STORE IT AS THE CURRENT LEVEL TOO.
```

With this environment for our player established we can first figure out how to make him move.

movement admin

This one is surprisingly easy. At any given moment we just have to decide whether the cursor (representing the player) is going to move left or right. The only thing that should ever affect this decision is whether the movement gets us nearer the same line as the enemy that is nearest the top of the web. The diagram below shows this decision-making in action. We are much nearer the line of the invader that is second farthest away from us, but rather than move right towards that enemy, we move left: towards the enemy that is closest to reaching the top of the web.



This approach, while it may be suboptimal in some ways, has the merit of being very simple and we can implement it in a compact routine on the page opposite.

This routine consists of two steps. The first identifies the invader that has advanced furthest along the web. The second then decides in which direction we must move to get nearer to that invader.

The first step is a simple matter of finding the invader with the highest 'Z Position' (which is measured on the Y axis by *Tempest* and stored in the `INVAY` array for each invader). The second step depends on finding the shortest distance between the line the player's cursor is in and that of the selected invader. A subroutine called `POLDEL` is used to calculate this, and the direction is indicated by whether the value is positive (to the left) or negative (to the right).

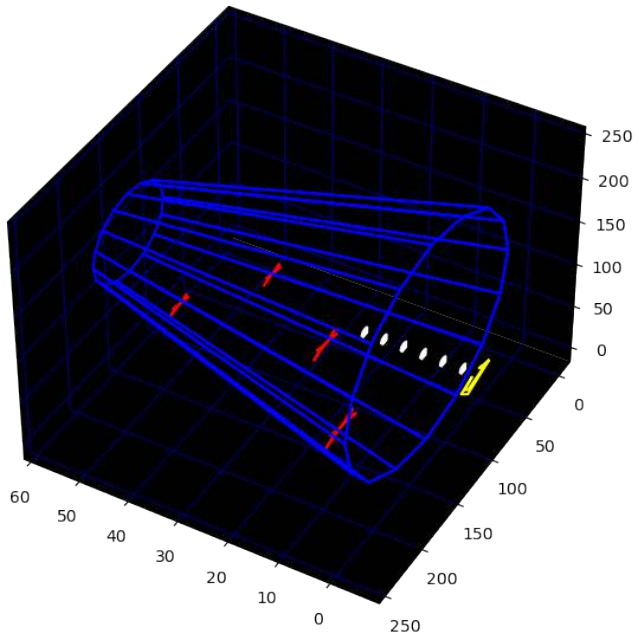
```
   .SBTTL  PLAY-AUTO MOVE OF CURSOR
AUTOCU:
  LDA I,-1          ; STORE -1 IN THE ACCUMULATOR.
  STA TEMP0         ; USE IT TO INITIALISE TEMP0.
  STA TEMP1         ; USE IT TO INITIALISE TEMP1.

  ; GET THE INDEX OF THE INVADER THAT IS FURTHEST ADVANCED
  ; ALONG THE WEB.
  LDX WINVMX        ; GET THE NUMBER OF INVADERS.
  BEGIN             ; LOOP FOR ALL INVADERS
    LDA X,INVAY     ; GET CURRENT INVADER'S DEPTH POSITION.
    IFNE            ; IF IT HAS ONE THEN..
      CMP TEMP0     ; IS IT THE HIGHEST SO FAR?
      IFCC          ; IF IT IS THEN..
      STA TEMP0     ; STORE THE NEW HIGHEST POSITION.
      STX TEMP1     ; STORE THE INDEX OF HIGHEST INVADER.
      ENDIF
    ENDIF
    DEX             ; GO THE NEXT INVADER.
  MIEND             ; LOOP UNTIL WE'VE CHECKED THEM ALL.

  ; FIGURE OUT IF MOVING LEFT OR RIGHT GETS US NEARER TO THE
  ; FURTHEST ADVANCED INVADER.
  LDX TEMP1         ; STORE INDEX TO FURTHEST ADVANCED INVADER IN X.
  IFPL              ; IF WE FOUND ONE THEN..
    LDA X,INVAL1    ; GET THE LINE THE INVADER IS ON.
    LDY CURSL1      ; GET THE LINE THE PLAYER IS ON.
    JSR POLDEL      ; CALCULATE HOW FAR AWAY ONE IS FROM THE OTHER.
    TAY             ; STORE THE RESULT IN Y REGISTER.
    IFNE            ; IF PLAYER IS NOT ALREADY ON SAME LINE AS ENEMY..
      IFPL          ; THEN IF RESULT FROM POLDEL IS POSITIVE..
      LDA I,-9      ; MOVE LEFT..
      ELSE          ; OTHERWISE..
      LDA I,9       ; MOVE RIGHT.
      ENDIF
    ENDIF
  ENDIF
  RTS
```

This isn't a perfect strategy, as we've already indicated. It means we potentially move away from invaders that are nearer to our line of fire. But it does at least ensure that we are always attempting to kill any enemy that is in danger of reaching the top of the web and overrunning us.

shooting admin

As long as we're trying to get nearer to the enemy that poses the most imminent danger, we should also have a strategy for what we do when we get there. The obvious one is: shoot. And that is indeed what we do, but with some latitude on top that improves our chances of killing any invader that happens to be in our field of fire. Our strategy for shooting, therefore, will be to look at every enemy, and every shot fired by the enemy, and fire a shot in their direction if the line they are on is within two moves from our present position.

This means we will fire a shot along lines even when there isn't an enemy currently there (in the hope that they might move there soon). It also means we no pay attention to how many shots we have already fired or any consideration to whether it might be better to wait for a better opportunity.



Shooting when no one is there: an example of firing player charges when enemies are adjacent.

We implement this simple control logic in the same routine responsible for shooting charges when the player presses the fire button: `FIREPC`.

```
   .SBTTL PLAY - FIRE PLAYER CHARGE
FIREPC:
  LDA CURSL2                ; GET THE PLAYER'S LINE POSITION.
  IFPL                      ; NON-NEGATIVE MEANS THEY'RE ALIVE SO..
  LDA QSTATUS               ; CHECK WHETHER IN ATTRACT MODE..
  IFPL                      ; IF WE ARE THEN..
    LDA CURMOD              ; UNLESS WE'RE DROPPING, CURMOD WILL BE 0.
    STA TEMP0               ; STORE AS OUR PROVISIONAL FIRE DECISION.

    ; LOOP THROUGH ALL INVADERS AND ALL SHOTS FIRED BY INVADERS TO LOOK
    ; FOR ANY ON A LINE NEAR TO THE PLAYER.
    LDX I,NICHARG+NINVAD-1  ; THE NUMBER OF INVADERS PLUS INVADER SHOTS.
    BEGIN                   ; LOOP THROUGH ALL INVADERS + INVADER SHOTS.
      LDA X,CHARY+NPCHAR    ; GET DEPTH OF CURRENT INVADER.
      IFNE                  ; IF NON-ZERO, IT IS IN PLAY SO..
        LDA X,CHARL1+NPCHAR ; GET THE LINE IT'S ON.
        SEC                 ; SET THE CARRY BIT BEFORE SUBTRACTING.
        SBC CURSL1          ; SUBTRACT PLAYER LINE FROM INVADER LINE.
        IFMI                ; IF NEGATIVE MAKE IT AN ABSOLUTE NUMBER..
        EOR I,0FF           ; BY X-OR'ING THE RESULT.
        CLC                 ; AND CLEAR THE CARRY BIT BEFORE..
        ADC I,1             ; ADDING 1 TO THE DIFFERENCE.
        ENDIF
        CMP I,2             ; COMPARE THE RESULT WITH 2..
        IFCC                ; IF THEY ARE LESS THAN 2 LINES APART THEN..
        INC TEMP0           ; SET TEMP0 SO THAT WE WILL FIRE A SHOT.
        ENDIF
      ENDIF
      DEX                   ; MOVE TO THE NEXT INVADER.
    MIEND                   ; LOOP UNTIL ALL INVADERS & SHOTS ARE DONE.
    LDA TEMP0               ; STORE OUR FIRE DECISION IN THE ACCUMULATOR.
  ELSE                      ; IF WE"RE NOT IN ATTRACT MODE THEN..
    LDA SWSTAT              ; READ INPUT FROM THE FIRE BUTTONS..
    AND I,MFIRE             ; IF THE FIRE BITS ARE SET, STORE THE DECISION.
  ENDIF
```

Hopefully the indentation above helps apprehend the structure of the above. In the first branch of the if statement we are calculating the fire decision for attract mode by looping through all the invaders and invaders shots. The second branch of the `IF` statement is much shorter by comparison: it reads the input from a human player and determines if the fire button has been pressed or not. The end result in both cases is stored in the accumulator register (`A`). If the value is non-zero it means we should go ahead and fire. Here's the remainder of the `FIREPC` routine. It looks for a vacant slot in the 8 active shots available to the player, if one is free then we can go ahead and fire. Otherwise the player (or in our case the attract mode) will have to try again the next time around.

```
  IFNE                    ; IF THE FIRE DECISION IS NON-ZERO THEN..
    LDX I,NPCHARG-1       ; GET THE NUMBER OF SLOTS FOR BULLETS (8)..
    BEGIN                 ; LOOP THROUGH EACH SLOT LOOKING FOR A SPARE..
      LDA X,CHARY         ; DOES THIS BULLET HAVE A DEPTH POSITION?
      IFEQ                ; IF NOT, THEN IT'S FREE AND WE CAN USE IT.
        INC CHACOU        ; INCREMENT THE BULLETS-USED COUNT.
        LDA CURSY         ; GET THE PLAYER'S DEPTH POSITION.
        STA X,CHARY       ; STORE IT AS THE NEW BULLET'S DEPTH POSITION.
        LDA CURSL1        ; GET THE PLAYER'S CURRENT LINE.
        STA X,CHARL1      ; STORE IT AS THE BULLET'S LINE.
        LDA CURSL2        ; GET THE PLAYER'S CURRENT LINE.
        STA X,CHARL2      ; STORE IT AS THE BULLET'S LINE.
        LDA I,0           ; INITIALIZE TO ZERO..
        STA X,CHARCO      ; THE BULLET'S COLLISION COUNTER.
        JSR SLAUNC        ; PLAY THE BULLET-FIRED SOUND.
        LDA CURSY         ; GET THE PLAYER'S DEPTH.
        JSR COLCHK        ; CHECK FOR COLLISION WITH ENEMY.
        LDX I,0           ; EXIT LOOP BY SETTING X TO 0.
      ENDIF
      DEX                 ; DECREMENT X TO MOVE TO NEXT BULLET.
    MIEND                 ; KEEP LOOPING UNTIL X GETS TO -1.
  ENDIF
```

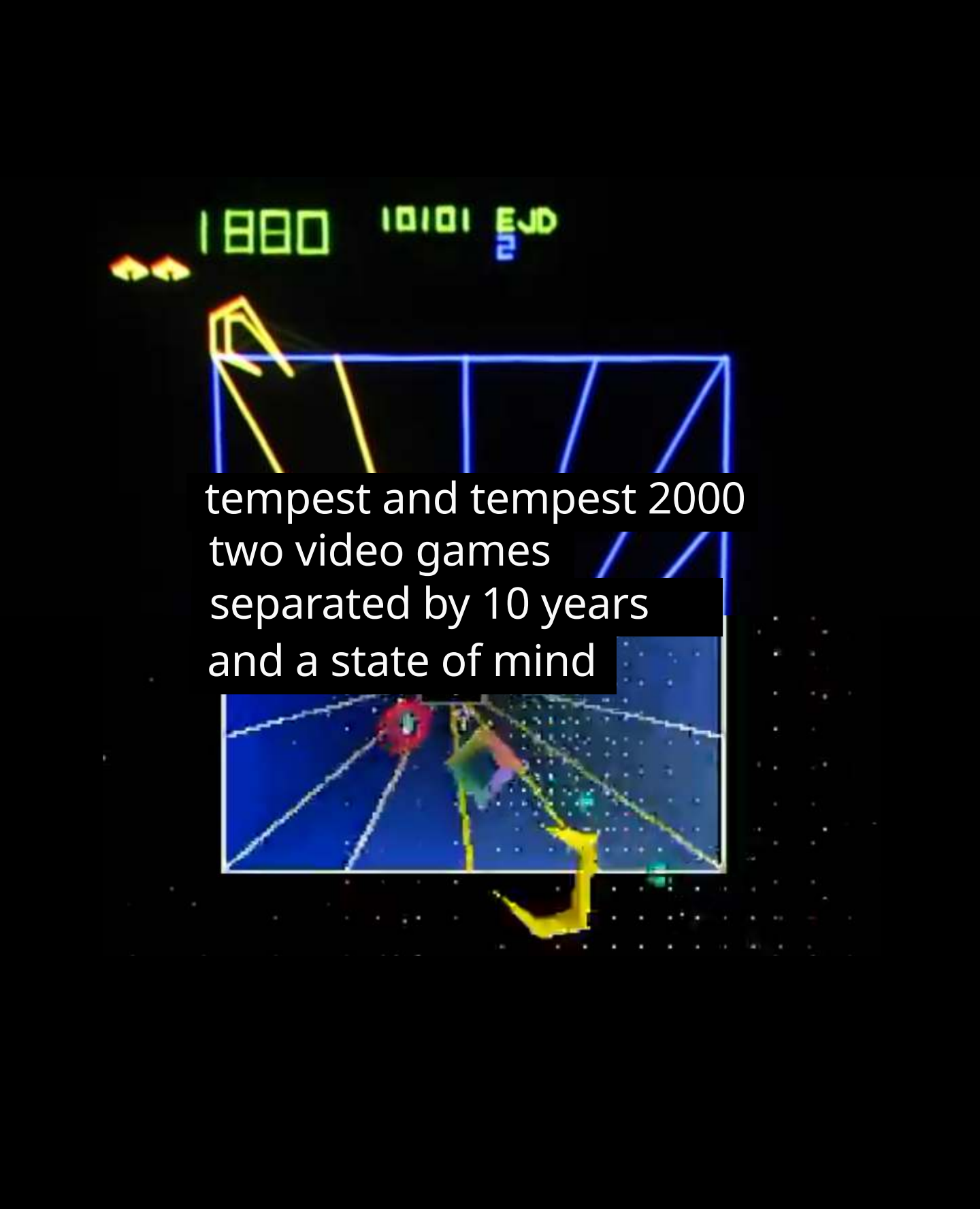
admin on and off

Put the game into attract mode when displaying the high score table.

```
DLADR:  LDA QSTATUS
        AND I,^C<MATRACT!MGTMOD>
                        ;PUT INTO ATTRACT
        STA QSTATUS             ;REQUEST DISPLAY OF LADDER
        LDA I,0                 ;
        STA NUMPLA              ;RETURN TO PLAYER
        LDA I,CLOGO
        STA QNXTSTA             ;REQUEST NEW GAME AFTER
        LDA I,CPAUSE            ;A LONG DELAY
        STA QSTATE
        LDA I,0A0
        STA QTMPAUS
        LDA I,1                 ;DOUBLE TIME
        STA PSCALE
        LDA I,CDHITB
        STA QDSTATE
        RTS
```

```
        .SBTTL PLAY - MOVE CURSOR (MAINLINE)
        LDX I,0
        LDA QSTATUS
        IFPL                    ;ATTRACT?
```

```
        JSR AUTOCU              ;YES, AUTO MOVEMENT
```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2
tempest and tempest 2000
two video games
separated by 10 years
and a state of mind