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REPORT
BATTLE SHIP

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1 Introduction

1. Battleship is a strategic board game between 2 players. It focuses on the process of planning deducting skill of both players. The game rules can be found in [1], in summary: 1. In a classic game, each player sets up a fleet of battleships on their map (a 10x10 grid). A fleet must contain a predefined set of battleships with different sizes. For example, a fleet of ships can consist of 5 2x1 ships, 3 3x1 ships, 1 5x1 ship.



Figure 1: Example of the battleship game in real life

2. After the ships have been positioned, the game proceeds in a series of rounds. In each round, each player takes a turn to announce a target square in the opponent's grid which is to be shot at. The opponent announces whether or not the square is occupied by a ship. If it is a "hit", the player who is hit marks this on their own or "ocean" grid (with a red peg in the pegboard version), and announces what ship was hit.
3. If all of a player's ships have been sunk, the game is over and their opponent wins

2 Implementation

2.1 Overview

Each player's board: Each player has a board of cells, usually divided into fixed-sized cells (e.g., 10x10 cells).

1. Place War: Each player places warriors on his board without letting the opponent know their location. The combatants come in different sizes and shapes, for example: boats, aircraft carriers, destroyers, storm ships, etc.
2. Turn: Players take turns choosing a cell on the opponent's board to attack. They announce the location of the cell they want to attack (e.g. "Column A, row 3"). The opponent will notify if they attack or miss (the shot doesn't hit).
3. Determining a war has been sunk: If the player attacks part of a war, the opposition will announce that the war has been sunk.
4. Win: The game continues until all of either player's warriors have been sunk. That player will be the winner

When developing this game in the MIPS board implementation, we need a way to place the ship, check the shoot and check whether there's still valid ship

There needs to be a suitable data structure to store information about each player, the positions of the ships, and other information like played, last time, etc. We also need to handle user interaction so they can select cells to attack and can see the results.

Developing a Battleship game in the MIPS assembly would require the use of commands, control structures, and complex data structures.

2.2 Data Structures

- Data Structure type: no specific type, cause my idea is to store the input data in needed registers and do arithmetic and logic function.
- Purpose: cause input data is limit, so the way I solve problem with registers will give a better processing time
- Benefit: cause data is stored in separated register, it's extremely easy to access data
- Complexity: in the worst case, the user input are wrong and too many loops are operated by the user. The complexity of the function is $O(12n)$

2.3 Pseudocodes

Input Player_1_name

Input Player_2_name

#Input player 1 ship

Input row/column of head/tail for a 4x1_ship

Valid check and store data of 4x1_ship

Input row/column of head/tail for 2 3x1_ships

Valid check and store data of 3x1_ships

Input row/column of head/tail for 3 2x1_ships

Valid check and store data of 2x1_ship

#Input player 2 ship

Input row/column of head/tail for a 4x1_ship

Valid check and store data of 4x1_ship

Input row/column of head/tail for 2 3x1_ships

Valid check and store data of 3x1_ships

Input row/column of head/tail for 3 2x1_ships

Valid check and store data of 2x1_ship

#Game phase

Input Player1 + Player2 loop

If input is correct, set data input to 49

Game over when all register of 1 player equal 49

2.4 Codes

.data

```
welcome: .asciiiz "***: Welcome to BATTLE SHIP! \n"
siri: .asciiiz "***: They call me Sirius, the supporter. \n"
again: .asciiiz "Place your ship fail! \n "
again1: .asciiiz "Invalid! \n"
tenP1: .asciiiz "Sirius: Player 1, what can i call you (max 9 characters): \n"
p1: .asciiiz "Player1: "
p2: .asciiiz "Player2: "
sirius: .asciiiz "Sirius: "
player1name: .space 10
player2name: .space 10
chaomung: .asciiiz "Sirius: Nice to meet you, "
tenP2: .asciiiz "Sirius: How about you, player 2. \n"
str: .asciiiz "Player2: You can call me "
Intro: .asciiiz "Now, let me tell you some information about BATTLE SHIP \n"
comma: .asciiiz ", "
enter: .asciiiz "\n"
Intro1: .asciiiz "Both of you are competitors \n"
Intro2: .asciiiz "You will have 6 ships and 49 blocks for each of you \n"
Intro3: .asciiiz "Place the ship carefully, shoot each other and win the game \n"
Intro4: .asciiiz "Have fun, both of you :> \n"
prepare: .asciiiz "Now, let's prepare for the fight. \n"
prepare1: .asciiiz "Place your 4x1 ship, "
prepare2: .asciiiz "Place your first 3x1 ship, "
prepare3: .asciiiz "Place your second 3x1 ship, "
prepare4: .asciiiz "Place your first 2x1 ship, "
prepare5: .asciiiz "Place your second 2x1 ship, "
prepare6: .asciiiz "Place your third 2x1 ship, "
insert: .asciiiz "Please insert row of head, collumn of head, row of tail and collumn of tail. \n"
begin: .asciiiz "Now both of you are ready. For each turn, both of you get one shot. \n"
begin1: .asciiiz "GOOD LUCK!!! \n"
fight: .asciiiz "READYYYYYYYYY!!!!!! SHOOTTTTTTTTOOOOOO! \n"
fight1: .asciiiz "Enter row and collumn of the square you want to shoot, "
miss: .asciiiz "You missed. Opponent phase! \n"
ns: .asciiiz "HIT !!! \n"
turn: .asciiiz "Opponent phase \n "
victory: .asciiiz "The victory belong to "
zero: .float 0.0
one: .float 1.0
two: .float 2.0
three: .float 3.0
six: .float 6.0
seven: .float 7.0
fn: .float 49.0
```

.text

lwc1 \$f5, zero

lwc1 \$f6, six

lwc1 \$f8, three

lwc1 \$f9, seven

lwc1 \$f13, two

lwc1 \$f14, one

Get player name

li \$v0, 4

la \$a0, welcome

syscall

li \$v0, 4

la \$a0, siri

li \$v0, 4

la \$a0, tenP1

syscall

li \$v0, 4

la \$a0, p1

syscall

li \$v0, 8

la \$a0, player1name

li \$a1, 10

syscall

li \$v0, 4

la \$a0, enter

syscall

li \$v0, 4

la \$a0, chaomung

syscall

li \$v0, 4

la \$a0, player1name

syscall

li \$v0, 4

la \$a0, tenP2

syscall

li \$v0, 4

la \$a0, str

syscall

li \$v0, 8

la \$a0, player2name

li \$a1, 10

syscall

li \$v0, 4
la \$a0, enter
syscall

li \$v0, 4
la \$a0, chaomung
syscall

li \$v0, 4
la \$a0, player2name
syscall

#Introduce the game
li \$v0, 4
la \$a0, sirius
syscall

li \$v0, 4
la \$a0, Intro
syscall

li \$v0, 4
la \$a0, sirius
syscall

li \$v0, 4
la \$a0, Intro1
syscall

li \$v0, 4
la \$a0, sirius
syscall

li \$v0, 4
la \$a0, Intro2
syscall

li \$v0, 4
la \$a0, sirius
syscall

li \$v0, 4
la \$a0, Intro3
syscall

li \$v0, 4
la \$a0, sirius
syscall

```
li $v0, 4  
la $a0, Intro4  
syscall
```

```
li $v0, 4  
la $a0, sirius  
syscall
```

```
li $v0, 4  
la $a0, prepare  
syscall
```

```
j p1_4x1
```

****Code represent for get ship data:*

```
#Get player 1 ship  
# 4x1 ship  
p1_4x1:  
li $v0, 4  
la $a0, enter  
syscall
```

```
li $v0, 4  
la $a0, sirius  
syscall
```

```
li $v0, 4  
la $a0, prepare1  
syscall
```

```
li $v0, 4  
la $a0, player1name  
syscall
```

```
li $v0, 4  
la $a0, sirius  
syscall
```

```
li $v0, 4  
la $a0, insert  
syscall
```

```
li $v0, 4  
la $a0, p1  
syscall
```

```
li $v0, 6
```



```
syscall
mov.s $f1, $f0
```

```
li $v0, 6
syscall
mov.s $f2, $f0
```

```
li $v0, 6
syscall
mov.s $f3, $f0
```

```
li $v0, 6
syscall
mov.s $f4, $f0
```

```
j check1_4x1
```

```
check1_4x1:
```

```
#check head row
c.lt.s $f1, $f5    # Compare if 0.0 < $f1
c.lt.s $f6, $f1    # Compare if $f1 < 6.0
bc1t wrong        # Branch if $f1 is not within the range
c.lt.s $f2, $f5    # Compare if 0.0 < $f1
c.lt.s $f6, $f2    # Compare if $f1 < 6.0
bc1t wrong        # Branch if $f1 is not within the range
c.lt.s $f3, $f5    # Compare if 0.0 < $f1
c.lt.s $f6, $f3    # Compare if $f1 < 6.0
bc1t wrong        # Branch if $f1 is not within the range
c.lt.s $f4, $f5    # Compare if 0.0 < $f1
c.lt.s $f6, $f4    # Compare if $f1 < 6.0
bc1t wrong        # Branch if $f1 is not within the range
j check2_4x1
```

```
wrong:
```

```
li $v0, 4
la $a0, sirius
syscall
li $v0, 4
la $a0, again
syscall
j p1_4x1
```

```
check2_4x1:
```

```
c.eq.s $f1, $f3
bc1f check2_2_4x1
j check3_1_4x1
check2_2_4x1:
c.eq.s $f2, $f4
bc1f wrong
```

j check3_2_4x1

check3_1_4x1:

sub.s \$f7, \$f2, \$f4

abs.s \$f7, \$f7

c.eq.s \$f7, \$f8

bc1f wrong

j convert4x1_1

check3_2_4x1:

sub.s \$f7, \$f1, \$f3

abs.s \$f7, \$f7

c.eq.s \$f7, \$f8

bc1f wrong

j convert4x1_2

convert4x1_1:

mul.s \$f10, \$f1, \$f9

add.s \$f10, \$f10, \$f2

mul.s \$f11, \$f1, \$f9

add.s \$f11, \$f11, \$f4

c.le.s \$f10, \$f11

bc1f convert4x1a

j convert4x1b

convert4x1a:

mov.s \$f31, \$f10

mov.s \$f30, \$f11

j p1_3x1_1

convert4x1b:

mov.s \$f31, \$f11

mov.s \$f30, \$f10

j p1_3x1_1

convert4x1_2:

mul.s \$f10, \$f1, \$f9

add.s \$f10, \$f10, \$f2

mul.s \$f11, \$f3, \$f9

add.s \$f11, \$f11, \$f4

c.le.s \$f10, \$f11

bc1f convert4x1c

j convert4x1d

convert4x1c:

mov.s \$f31, \$f10

mov.s \$f30, \$f11

j p1_3x1_1

convert4x1d:

mov.s \$f31, \$f11

mov.s \$f30, \$f10

j p1_3x1_1

****Code represent for game phase*

main:

```
li $v0, 4
la $a0, enter
syscall
```

```
li $v0, 4
la $a0, sirius
syscall
```

```
li $v0, 4
la $a0, begin
syscall
```

```
li $v0, 4
la $a0, sirius
syscall
```

```
li $v0, 4
la $a0, begin1
syscall
```

j main1

main1:

```
lwc1 $f0, fn
li $v0, 4
la $a0, enter
syscall
```

```
li $v0, 4
la $a0, sirius
syscall
```

```
li $v0, 4
la $a0, fight
syscall
```

```
li $v0, 4
la $a0, sirius
syscall
```

```
li $v0, 4
la $a0, fight1
syscall
```

```
li $v0, 4
la $a0, playerName
syscall

li $v0, 4
la $a0, p1
syscall

li $v0, 6
syscall
mov.s $f1, $f0

li $v0, 6
syscall
mov.s $f2, $f0

j checkp1

checkp1:
    lwc1 $f5, zero
    lwc1 $f6, six
    #check head row
    c.lt.s $f1, $f5    # Compare if 0.0 < $f1
    c.lt.s $f6, $f1    # Compare if $f1 < 6.0
    bc1t wrong12      # Branch if $f1 is not within the range
    c.lt.s $f2, $f5    # Compare if 0.0 < $f1
    c.lt.s $f6, $f2    # Compare if $f1 < 6.0
    bc1t wrong12      # Branch if $f1 is not within the range

    j cvt1
wrong12:
    li $v0, 4
    la $a0, sirius
    syscall
    li $v0, 4
    la $a0, again1
    syscall
    j main1
cvt1:
    lwc1 $f0, seven
    mul.s $f1, $f1, $f0
    add.s $f1, $f1, $f2
    j check1_1

check1_1:
    c.eq.s $f1, $f31
    bc1f c
```

j hit
c:
c.eq.s \$f1, \$f30
bc1f c1
j hit1
c1:
c.eq.s \$f1, \$f29
bc1f c2
j hit2
c2:
c.eq.s \$f1, \$f28
bc1f c3
j hit3
c3:
c.eq.s \$f1, \$f27
bc1f c4
j hit4
c4:
c.eq.s \$f1, \$f26
bc1f c5
j hit5
c5:
c.eq.s \$f1, \$f25
bc1f c6
j hit6
c6:
c.eq.s \$f1, \$f24
bc1f c7
j hit7
c7:
c.eq.s \$f1, \$f23
bc1f c8
j hit8
c8:
c.eq.s \$f1, \$f22
bc1f c9
j hit9
c9:
c.eq.s \$f1, \$f21
bc1f c10
j hit10
c10:
c.eq.s \$f1, \$f20
bc1f gg
j hit11
gg:
c.eq.s \$f20, \$f0

```
        bc1f miss1
        j totalcheck1
miss1:
        li $v0, 4
        la $a0, sirius
        syscall

        li $v0, 4
        la $a0, miss
        syscall

        j totalcheck1
hit:
        li $v0, 4
        la $a0, ns
        syscall

        lwc1 $f31, fn

        j main2
hit1:
        li $v0, 4
        la $a0, ns
        syscall

        lwc1 $f30, fn

        j main2
hit2:
        li $v0, 4
        la $a0, ns
        syscall

        lwc1 $f29, fn

        j main2
hit3:
        li $v0, 4
        la $a0, ns
        syscall

        lwc1 $f28, fn

        j main2
hit4:
        li $v0, 4
        la $a0, ns
```

```
                                syscall

                                lwc1 $f27, fn

                                j main2
hit5:                            li $v0, 4
                                la $a0, ns
                                syscall

                                lwc1 $f26, fn

                                j main2
hit6:                            li $v0, 4
                                la $a0, ns
                                syscall

                                lwc1 $f25, fn

                                j main2
hit7:                            li $v0, 4
                                la $a0, ns
                                syscall

                                lwc1 $f24, fn

                                j main2
hit8:                            li $v0, 4
                                la $a0, ns
                                syscall

                                lwc1 $f23, fn

                                j main2
hit9:                            li $v0, 4
                                la $a0, ns
                                syscall

                                lwc1 $f22, fn

                                j main2
hit10:                           li $v0, 4
```

```
        la $a0, ns
        syscall

        lwc1 $f21, fn

        j main2
hit11:
        li $v0, 4
        la $a0, ns
        syscall

        lwc1 $f20, fn

        j main2
totalcheck1:
        c.eq.s $f31, $f30
        bc1f main2
        j e
        e:
        c.eq.s $f30, $f29
        bc1f main2
        j e1
        e1:
        c.eq.s $f28, $f29
        bc1f main2
        j e2
        e2:
        c.eq.s $f27, $f28
        bc1f main2
        j e3
        e3:
        c.eq.s $f26, $f27
        bc1f main2
        j e4
        e4:
        c.eq.s $f25, $f26
        bc1f main2
        j e5
        e5:
        c.eq.s $f24, $f25
        bc1f main2
        j e6
        e6:
        c.eq.s $f23, $f24
        bc1f main2
        j e7
        e7:
```



```
                                c.eq.s $f22, $f23
                                bc1f main2
                                j e8
                                e8:
                                c.eq.s $f21, $f22
                                bc1f main2
                                j e9
                                e9:
                                c.eq.s $f20, $f21
                                bc1f main2
                                j end1
end1:
    li $v0, 4
    la $a0, sirius
    syscall

    li $v0, 4
    la $a0, victory
    syscall

    li $v0, 4
    la $a0, player1name
    syscall

    li $v0, 10
    syscall
```

3 Conclusion

From a programmer's perspective, the game Battleship provides an interesting problem in logic implementation, data structure, and user interaction. Here is a conclusion from a programming perspective:

1. Logic and Algorithm: Battleship game requires a clear logic and effective algorithm to determine, manage and check the positions of battleships. Processing turns, checking shots, and determining sunk ships require an accurate and efficient algorithm.
2. Data Structure: Implementing a Battleship game requires the use of appropriate data structures to store each player's board, the positions of the battleships, and the game state. Using arrays, linked lists, or other data structures can make information management easier.
3. User interaction: The important part of the game is interaction with the player. The design of the user interface or the way users interact with the game needs to be carefully considered to make the gaming experience fun and easy to understand.
4. Testing and debugging: During game development, testing and debugging are important. It is necessary to examine test cases, identify and fix errors to ensure the game works as expected.
5. Development and Expansion: Battleship can be developed and expanded to include new features, such as multiplayer, artificial intelligence, or improved user interface . This requires flexibility in managing source code and data structures.

Overall, the Battleship game is not only an entertaining game but also an interesting challenge for programmers to implement logic, data structures and user interactions effectively.

4 References

- [1] Wikipedia, "Battleship (game)." [Online]. Available:
<https://en.wikipedia.org/wiki/Battleship> (game)