# Q3 Reverse engineer

WebAssembly (Wasm) is a binary format that allows code to be executed efficiently in the browser. It is an important topic in the forefront of current Web security.

Source code：**Program Language Rust**

Backdoor Position：[**Binary backdoor**](https://github.com/Shahzeb892/websokect_chat_app/blob/main/SCCSChatRoom/src/renderer/src/utils/decoder/decoder_bg.wasm)

## POC:

1. **Transform wasm to c code**  
   <https://github.com/WebAssembly/wabt>  
   wasm2c decoder\_bg.wasm >> decoder.c  
   Now we get the deocer.c
2. **Compile decoder.c to decoder.o**

clang -c ./decoder.c -o ./decoder.o -Oz

1. **Statics analysis**

Import into analyze software

Fix type and structure

A computer screen shot of a program code

Description automatically generated

Figure 1 memory use

Now, we know decoder has 5 parameters and para3 has used 84 bytes.

A screen shot of a computer program

Description automatically generated

Init something

**Switch analysis**

case 'a':goto LABEL\_22 (go to case s);

case 'b':

case 'c':

break;

case 'd':goto LABEL\_27 (go to case s next 5 line);

case 's': Code here

case 'w': Code here;

default:goto LABEL\_38;

**LABEL\_38:**  
 A screenshot of a computer code

Description automatically generated

Figure 2 Label\_38

L38: if para2

       jsFunction() // go to label L38 represents an error condition.

Return

**Case w:**

A computer code on a white background

Description automatically generated

Figure 3 case w

From Figure 3, it can be seen that case w is checking the array bounds and will return to case s (label 31).

**Label31:**

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Description automatically generated

Figure 4 backdoor and condition

**Conclution:**

The decoder only accepts 'wasd' as input and performs some operations in a 9x9 array. When the coordinates are [0,6], a vulnerability will be triggered.

1. **Dynamic analysis**

Debugger: Chrome Browser Break at decoder call  
Variable layout:

A screenshot of a computer code

Description automatically generated

Figure 5 WASM var layout

A screenshot of a computer

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Figure 6 Array addressing

Now, we know the 9x9 array is near at 1048204.

Write a script to show it.

const buffer = new Uint8Array(memories.$memory.buffer);

const offset = 1048204;

const length = 81\*4;

const data = buffer.slice(offset, offset + length);

function printBytesInVM(bytes, groupSize) {

  for (let i = 0; i < bytes.length; i += groupSize) {

    const group = bytes.slice(i, i + groupSize);

    console.log(group.map(byte => byte.toString(16).padStart(2, '0')).join(' '));

  }

}

printBytesInVM(data, 36);

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Figure 7 memory

Clean it

        [0, 1, 0, 1, 0, 1, 0, 1, 1],

        [0, 1, 0, 1, 0, 1, 0, 0, 0],

        [0, 0, 0, 0, 0, 1, 1, 1, 0],

        [1, 1, 1, 1, 0, 1, 0, 1, 0],

        [0, 0, 0, 1, 0, 1, 0, 0, 0],

        [1, 1, 0, 1, 0, 1, 0, 1, 1],

        [0, 1, 0, 1, 0, 1, 0, 0, 0],

        [0, 1, 0, 0, 0, 1, 1, 1, 0],

        [0, 0, 0, 1, 0, 0, 0, 0, 0],

1. **Analyze summary**

The decoder function searches for the destination [0,6] in a 9x9 maze based on the input. It moves according to the wasd commands and will exit if it goes out of bounds or collides with a wall during the process.

1. **Solution**

ssddddssssssddddwwaawwddwwwaaw + any comment

1. **Verification**

A screenshot of a computer

Description automatically generated

Figure 8 Backdoor triggered