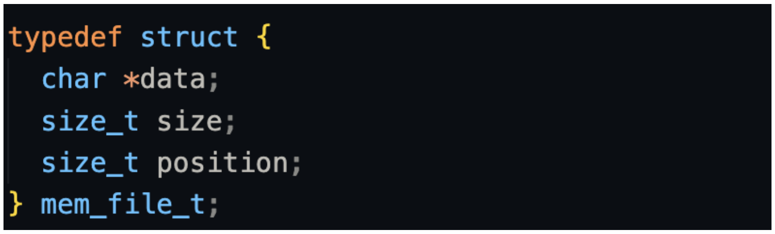
Group_7 Assignment_3 report

Specifications

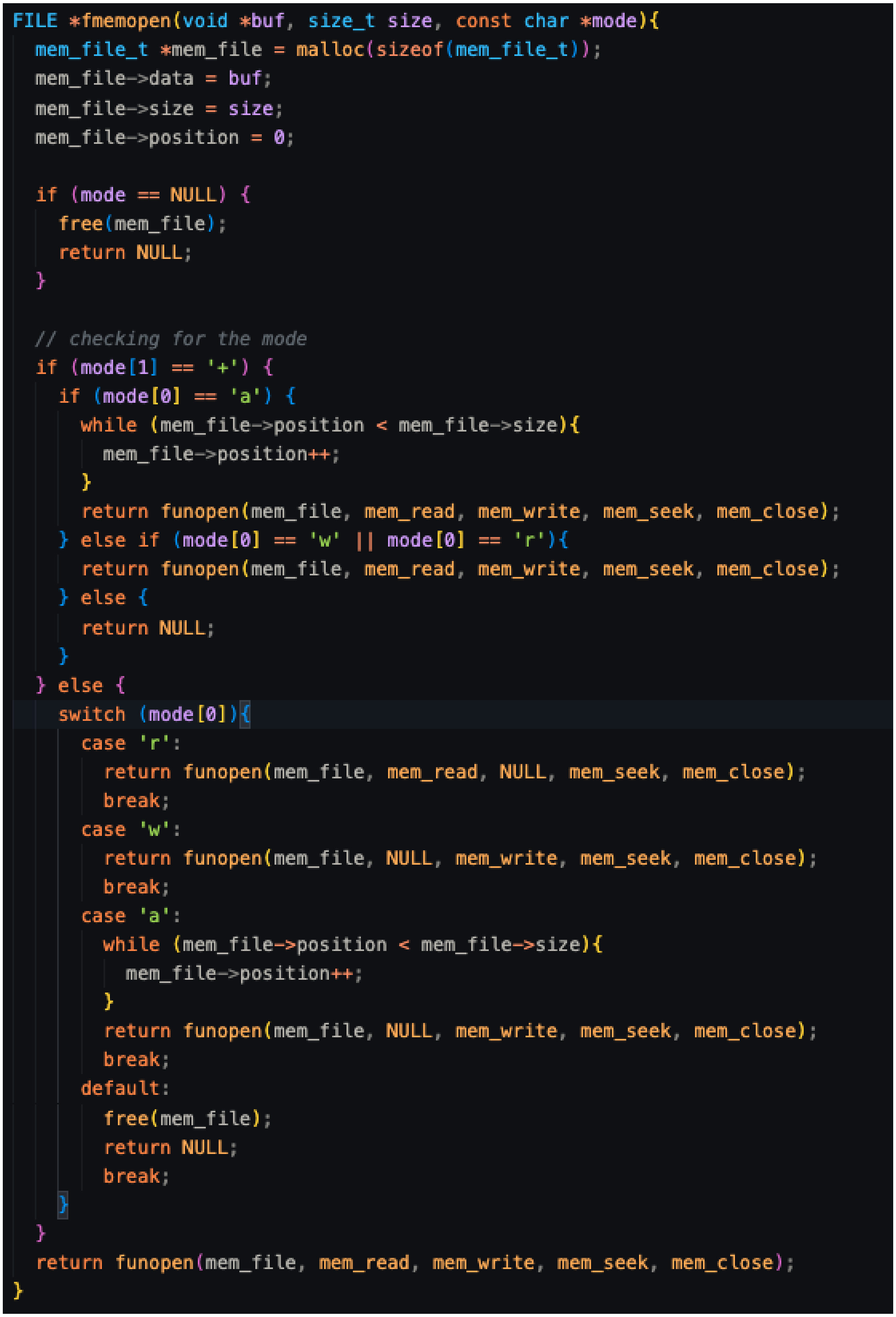
BSD-based systems provide a function called `funopen` that allows us to intercept read, write, seek, and close calls on a stream. Use this function to implement `fmemopen` for FreeBSD.

- Below is the description of our implementation of `fmemopen`



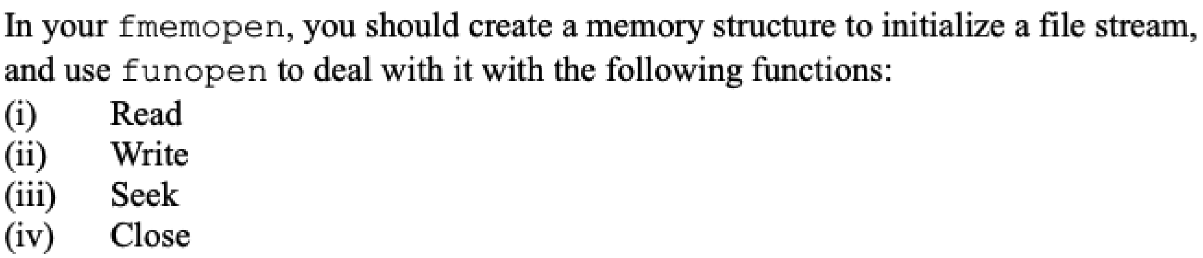
```c
typedef struct {
  char *data;
  size_t size;
  size_t position;
} mem_file_t;
```

  - First, we declare a struct called `mem_file_t`, which is the memory structure of file stream



```
FILE *fmemopen(void *buf, size_t size, const char *mode){
  mem_file_t *mem_file = malloc(sizeof(mem_file_t));
  mem_file->data = buf;
  mem_file->size = size;
  mem_file->position = 0;

  if (mode == NULL) {
    free(mem_file);
    return NULL;
  }

  // checking for the mode
  if (mode[1] == '+') {
    if (mode[0] == 'a') {
      while (mem_file->position < mem_file->size){
        mem_file->position++;
      }
      return funopen(mem_file, mem_read, mem_write, mem_seek, mem_close);
    } else if (mode[0] == 'w' || mode[0] == 'r'){
      return funopen(mem_file, mem_read, mem_write, mem_seek, mem_close);
    } else {
      return NULL;
    }
  } else {
    switch (mode[0]){
      case 'r':
        return funopen(mem_file, mem_read, NULL, mem_seek, mem_close);
        break;
      case 'w':
        return funopen(mem_file, NULL, mem_write, mem_seek, mem_close);
        break;
      case 'a':
        while (mem_file->position < mem_file->size){
          mem_file->position++;
        }
        return funopen(mem_file, NULL, mem_write, mem_seek, mem_close);
        break;
      default:
        free(mem_file);
        return NULL;
        break;
    }
  }
  return funopen(mem_file, mem_read, mem_write, mem_seek, mem_close);
}
```

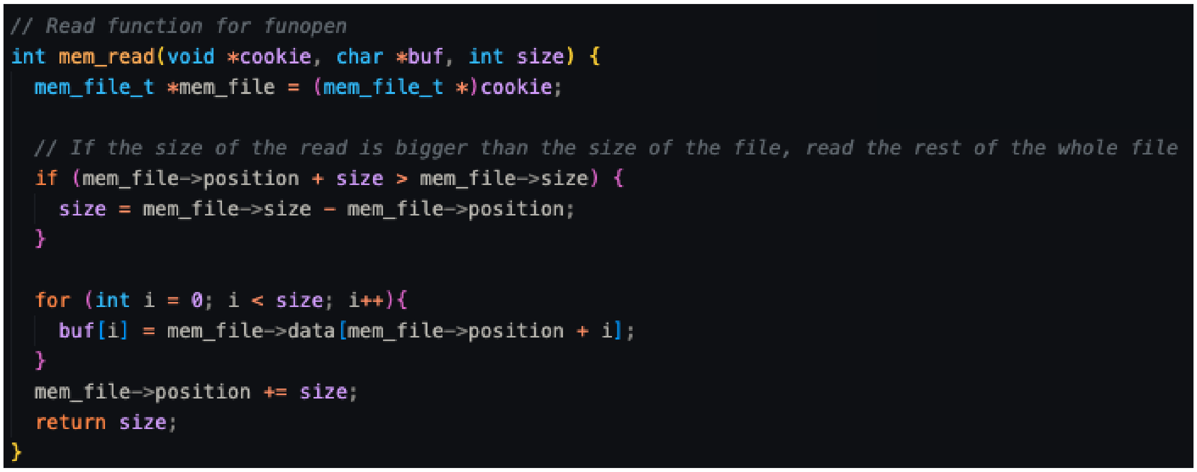
- After the declaration, we implement the func. `fmemopen`
    - We first use `malloc` to create the memory file metadata
    - Next, we check the argument of the mode, and according to the mode, we will decide the argument in the func. `funopen` and return.
        - if the `mode[1]` has a "+" sign, the `funopen` will have four arguments.
        - On the other hand, if the `mode[1]` was not "+" sign, we will replace the `readfn` or `writefn` to `NULL` according to the `mode[0]`



In your `fmemopen`, you should create a memory structure to initialize a file stream, and use `funopen` to deal with it with the following functions:

(i) Read
(ii) Write
(iii) Seek
(iv) Close

- below are four func. we implement for the Read, Write, Seek and Close
- Read

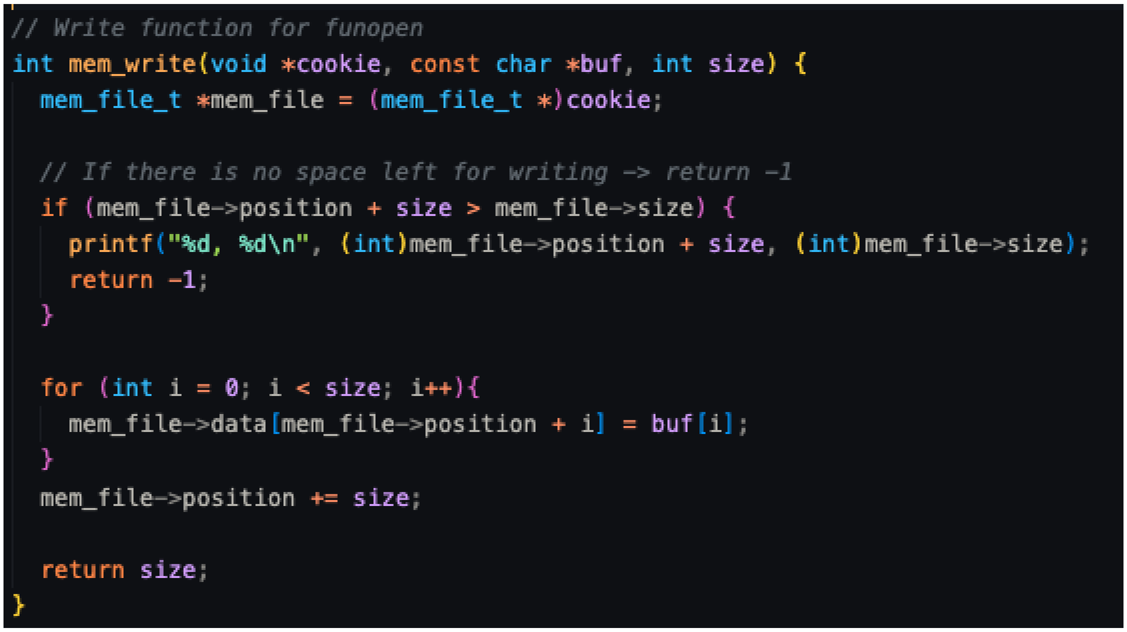


```c
// Read function for funopen
int mem_read(void *cookie, char *buf, int size) {
  mem_file_t *mem_file = (mem_file_t *)cookie;

  // If the size of the read is bigger than the size of the file, read the rest of the whole file
  if (mem_file->position + size > mem_file->size) {
    size = mem_file->size - mem_file->position;
  }

  for (int i = 0; i < size; i++){
    buf[i] = mem_file->data[mem_file->position + i];
  }
  mem_file->position += size;
  return size;
}
```

    - for the read func., first we will check if the size we want to read is bigger than the rest of the file stream

        - if it is bigger than the stream, we will read the rest of the file.
        - if it is not bigger than the rest of the stream, we will read the required size
    - Last, we will return the size we have read.

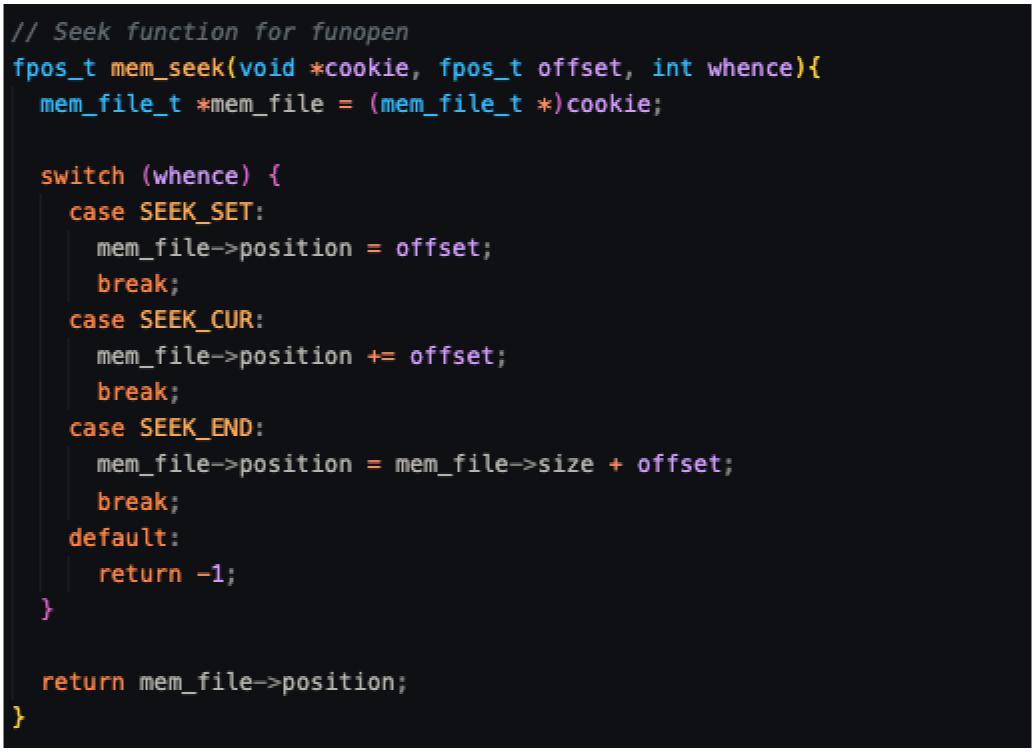
- Write



```
// Write function for funopen
int mem_write(void *cookie, const char *buf, int size) {
  mem_file_t *mem_file = (mem_file_t *)cookie;

  // If there is no space left for writing -> return -1
  if (mem_file->position + size > mem_file->size) {
    printf("%d, %d\n", (int)mem_file->position + size, (int)mem_file->size);
    return -1;
  }

  for (int i = 0; i < size; i++){
    mem_file->data[mem_file->position + i] = buf[i];
  }
  mem_file->position += size;

  return size;
}
```

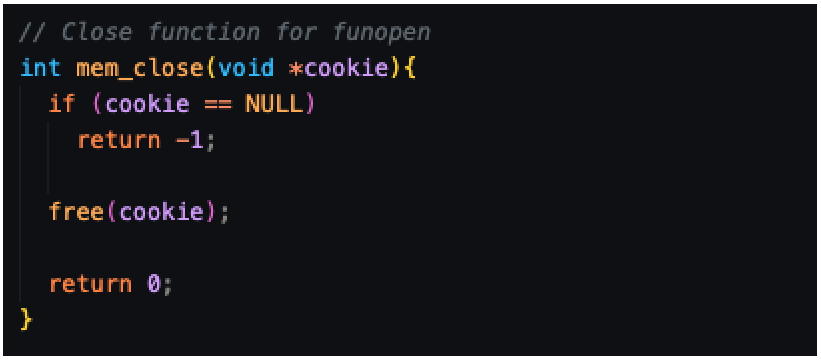
    - for the write func., first we check if the rest space of the stream is big enough for the writing.
        - If it is big enough, we will start writing the data into the stream and return the size we have write
        - If it is too small, we will print out the size problem and return -1

- Seek



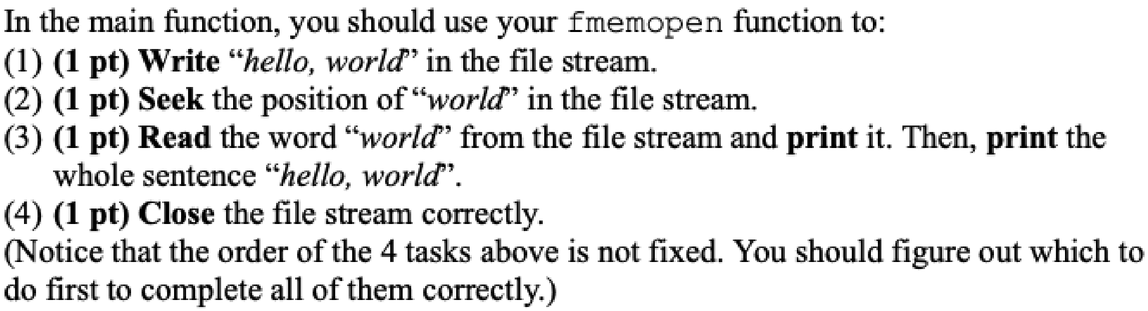
```c
// Seek function for funopen
fpos_t mem_seek(void *cookie, fpos_t offset, int whence){
  mem_file_t *mem_file = (mem_file_t *)cookie;

  switch (whence) {
    case SEEK_SET:
      mem_file->position = offset;
      break;
    case SEEK_CUR:
      mem_file->position += offset;
      break;
    case SEEK_END:
      mem_file->position = mem_file->size + offset;
      break;
    default:
      return -1;
  }

  return mem_file->position;
}
```

  - For the seek func., we use `switch-case` to execute function.
    - If the `whence` is `SEEK_SET`, then the cursor position will move to the `offset` argument position .
    - If the `whence` is `SEEK_CUR`, then the cursor position will become original position plus `offset` position.
    - If the `whence` is `SEEK_END`, then the cursor will be moved to the end of the file.
  - In the end, we will return where the current cursor position is.
- Close



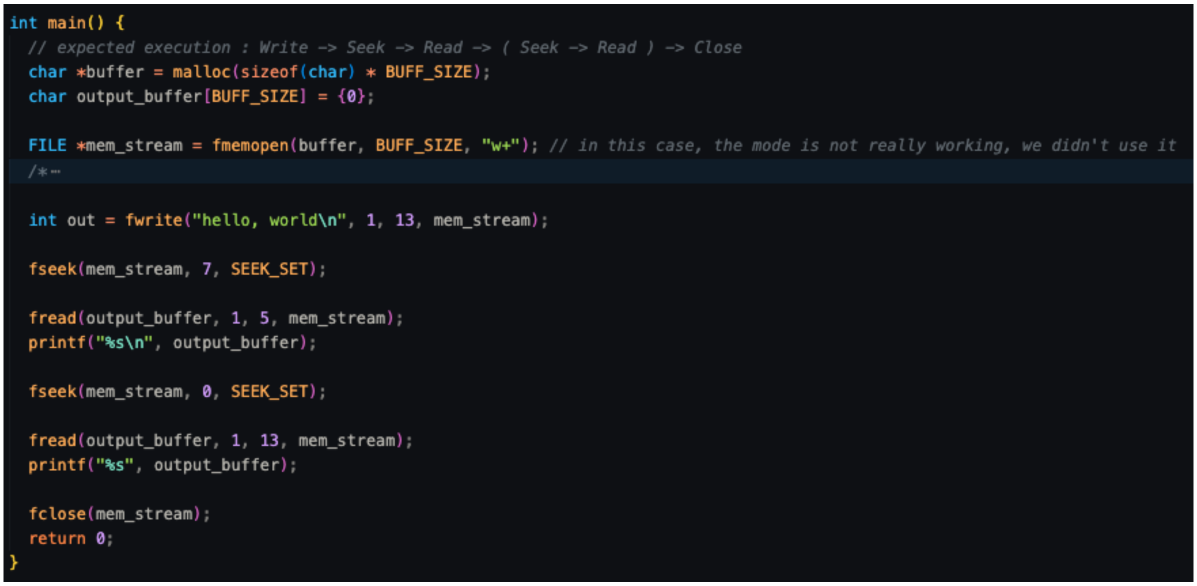
```c
// Close function for funopen
int mem_close(void *cookie){
  if (cookie == NULL)
    return -1;

  free(cookie);

  return 0;
}
```

- For the close func., we first check if the `cookie` is `NULL`
  - If it is `NULL` , then there is nothing to close, the func. will return -1
  - On the other hand, the func. will free the `cookie` and return 0



In the main function, you should use your `fmemopen` function to:
(1) **(1 pt) Write** "*hello, world*" in the file stream.
(2) **(1 pt) Seek** the position of "*world*" in the file stream.
(3) **(1 pt) Read** the word "*world*" from the file stream and **print** it. Then, **print** the whole sentence "*hello, world*".
(4) **(1 pt) Close** the file stream correctly.
(Notice that the order of the 4 tasks above is not fixed. You should figure out which to do first to complete all of them correctly.)

- For the required `main` func., below is the implementation we have done

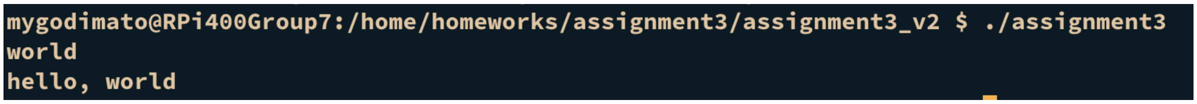


```
int main() {
  // expected execution : Write -> Seek -> Read -> ( Seek -> Read ) -> Close
  char *buffer = malloc(sizeof(char) * BUFF_SIZE);
  char output_buffer[BUFF_SIZE] = {0};

  FILE *mem_stream = fmemopen(buffer, BUFF_SIZE, "w+"); // in this case, the mode is not really working, we didn't use it
  /*…

  int out = fwrite("hello, world\n", 1, 13, mem_stream);

  fseek(mem_stream, 7, SEEK_SET);

  fread(output_buffer, 1, 5, mem_stream);
  printf("%s\n", output_buffer);

  fseek(mem_stream, 0, SEEK_SET);

  fread(output_buffer, 1, 13, mem_stream);
  printf("%s", output_buffer);

  fclose(mem_stream);
  return 0;
}
```

  - First, we call the `fmemopen` to create the memory structure and initialize the file stream.
  - Next, we use `fwrite` to write the "hello, world" into memory stream.
  - Then, we use `fseek` to move the cursor to the head of "world", and `fread` to read the "world" to the buffer and print it out.

    - Again, we use the `fseek` to move the cursor to the head of the memory stream, and `fread` to read out the "hello, world" to the buffer and print it out.
    - In the end, we use the `fclose` to delete the memory stream.

- Below is our execution result on the FreeBSD



```
mygodimato@RPi400Group7:/home/homeworks/assignment3/assignment3_v2 $ ./assignment3
world
hello, world
```