CS 4400: Computer Systems
Problem Set 19

1. Problem 9.15 from the textbook.

2. Consider an allocator that uses an implicit free list. The layout of each allocated and free memory block is as follows:

```
            31                             2 1 0
             ----------------------------------
Header      |    Block Size (bytes)      |     |
            |____________________________|_____|
            |                                  |
            |                                  |
            |                                  |
            |                                  |
            |                                  |
            |__________________________________|
Footer      |    Block Size (bytes)      |     |
            |____________________________|_____|
```

Each memory block, either allocated or free, has a size that is a multiple of eight bytes. Thus, only the 29 higher order bits in the header and footer are needed to record block size, which includes the header and footer. The usage of the remaining three lower order bits is as follows:

- `bit 0` indicates the use of the current block: 1 for allocated, 0 for free.
- `bit 1` indicates the use of the previous adjacent block: 1 for allocated, 0 for free.
- `bit 2` is unused and is always set to 0.

Given the contents of the heap shown on the left, what are the new contents of the heap (in the right table) after a call to `free(0x400b010)` is executed? *Your answer should be the contents of each blank cell in the table on the right, expressed as hex values.* E.g., "After a call to `free(0x400b010)`, the value `0x`__________ is stored at address `0x400b028`."

Note that addresses grow from bottom up. Assume that the allocator uses immediate coalescing, that is, adjacent free blocks are merged immediately each time a block is freed.

Address	
0x400b028	0x00000012
0x400b024	0x400b611c
0x400b020	0x400b512c
0x400b01c	0x00000012
0x400b018	0x00000013
0x400b014	0x400b511c
0x400b010	0x400b601c
0x400b00c	0x00000013
0x400b008	0x00000013
0x400b004	0x400b601c
0x400b000	0x400b511c
0x400affc	0x00000013

Address	
0x400b028	
0x400b024	0x400b611c
0x400b020	0x400b512c
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0x400b018	
0x400b014	0x400b511c
0x400b010	0x400b601c
0x400b00c	
0x400b008	
0x400b004	0x400b601c
0x400b000	0x400b511c
0x400affc	