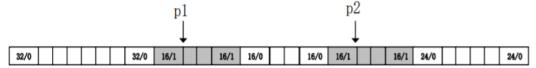# ICS Homework 11

May 23, 2020

1 Organization

1.1 Dynamic Memory Allocation

The figure simulates the initial status of memory at a certain time. Allocated blocks are shared, and free blocks are blank (each block represents 4 bytes). The allocator maintains double-word alignment. Given the execution sequence of memory allocation operations (malloc() or free()) from 1 to 4.


```
1: P3 = malloc(4);
2: P4 = malloc(10);
3: free(P1);
4: P5 = malloc(16);
```

Assume **first-fit** algorithm is used to find free blocks and coalesce immediately. Please draw the status of memory and mark with variables after the **2nd** and **4th** operation is executed.

1.2 Virtual Memory

1.2.1

Which type of address is used in each of following scenarios, virtual or physical address?

1) The address of variables in C program	
2) The address stored in a C pointer	
3) The address of a C pointer	
4) The address used in looking up L1 cache	
5) The value in CR3	
6) The address in L2 PTE	
7) The address in L4 PTE	
8) The value in PC register	

1.3

The lookup of L1 cache usually consists of three steps: locating the set; comparing the tag of each cache line in the set; returning bytes from cache or loading

value from next level memory system. As the lookup uses physical address, the hardware can only start the cache lookup after address translation is completed. How to make cache lookup and address translation parallelized? Show the requirements to the parameters of your paging and cache system.

2 System Software

2.1

Which level would the following data being shared? Answer with *not shared*, *threads*, or *processes*. For example, if X is shared between threads but not shared between processes, answer *threads*.

File descriptor table	
File table	
Stack	
Heap	
Program counter	
Condition code	
Installed handler	
V-node table	