CS241 System Programming #11
Memory III: Memory Pools, alignment, Advanced techniques

```
typedef struct _pool_t {
   size_t capacity;
   size_t used;
   char buff[]; // C99. Must be last
} pool_t;

pool_t* create_pool(size_t capacity) {
// fix the mistake(s)
    pool_t * result = malloc(capacity + _______________________);
    assert(result);
    result -> capacity = capacity;

    memset( result ________________________, 0x5a, capacity);

    return result;
}

void* allocate(pool_t* pool, size_t request) {
  assert(pool);
// How would you round to ensure request is a multiple of sizeof(size_t) ?

  request _______________________________

// Leave space for our meta data...
  char * result = pool->buff + used + sizeof(size_t) * 2;

  // Todo: Round up to ensure natural alignment e.g. result%16 is 0.


  result _______________________________

  pool->used = request + (result - pool->buff); // Is this correct?

  assert( *result == _____ );
  size_t* bounds = (size_t*) result;
  bounds[-1] = 0xdeadbeef; // Why this ordering?
  bounds[-2] = request;?

  bounds[ request ] = 0xBAADF00D; // Fix the error

  return result;
}

void free_all(pool_t* pool) { ______________________________ ; }


void deallocate(pool_t* pool, void* ptr) {
  assert(pool && ptr);
  size_t *bounds = ptr;

  assert(bounds[-1] == _______________);
  size_t size = bounds[-1];

  assert( _______________________________);
  memset(ptr, 0x5a, size);
}
```

```
Advanced techniques
```

0. Advantages of memory pools?

1. Using Knuth's *Boundary Tags* to implement coalescing

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2. Additional explicit linked list AKA "Segregated free list": Store memory addresses of next free link

- Store free blocks pointers inside the unused space of the free block. More work to do during free()
- Free Block list can now be in arbitrary searchable order (better performance).

3. Segregated free list: Different lists for different sizes. Advantage?

4. Where would you find a SLAB allocator?

5. Advantages of deferred coalescing?

6. Buddy Allocator (example of segregated free list allocator) & Internal Fragmentation

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