

Program 2

Exercise:

Based on lab 3, remove the static heap array and use **brk()** and **sbrk()** commands to make the heap. Also, implement “best fit”.

Howto:

- Be aware, that the heap size starts at 0, which means, you don’t even have a chunk header. Make sure to catch that condition! Maybe with a global variable “heapsize”?
- From here on, when mymalloc is called, move the program break as far as you need to allocate your first chunk.
- This time make sure, that the chunkhead is part of the PAGESIZE! Also, assume the PAGESIZE is 4096 bytes.
- From now on, move through the chunklist similar to lab3, but if no chunk is free, move the program break further and assign a new chunk!
- If some earlier chunk is free and you allocate less size than that, split as usual.
- Move the program break back again when the last chunk in the list is removed!
- Your analyse function should print the address of the program break!
- Best fit: Search the chunks for the smallest possible chunk which satisfies the request.

Submit:

The whole project folder zipped as filename: **program2.zip**

How we test:

```
byte*a[100];
analyze();//50% points
for(int i=0;i<100;i++)
    a[i]= mymalloc(1000);
for(int i=0;i<90;i++)
    myfree(a[i]);
analyze(); //50% of points if this is correct
myfree(a[95]);
a[95] = mymalloc(1000);
analyze();//25% points, this new chunk should fill the smaller free one
//(best fit)
for(int i=90;i<100;i++)
    myfree(a[i]);
analyze();// 25% should be an empty heap now with the start address
//from the program start
```

You can use following functions (they come handy)

```
chunkhead* get_last_chunk() //you can change it when you aim for performance
{
    if(!startofheap) //I have a global void *startofheap = NULL;
        return NULL;
    chunkhead* ch = (chunkhead*)startofheap;
    for (; ch->next; ch = (chunkhead*)ch->next);
    return ch;
}
void analyze()
{
    printf("\n-----\n");
    if(!startofheap)
    {
        printf("no heap");
        return;
    }
    chunkhead* ch = (chunkhead*)startofheap;
    for (int no=0; ch; ch = (chunkhead*)ch->next,no++)
    {
        printf("%d | current addr: %x |", no, ch);
        printf("size: %d | ", ch->size);
        printf("info: %d | ", ch->info);
        printf("next: %x | ", ch->next);
        printf("prev: %x", ch->prev);
        printf("\n");
    }
    printf("program break on address: %x\n",sbrk(0));
}
```

Result for comparison

no heap, program break on address: 5fff9000

```
0 | current addr: 5fff9000 | size: 368640 | info: 0 | next: 60053000 | prev: 0
1 | current addr: 60053000 | size: 4096 | info: 1 | next: 60054000 | prev: 5fff9000
2 | current addr: 60054000 | size: 4096 | info: 1 | next: 60055000 | prev: 60053000
3 | current addr: 60055000 | size: 4096 | info: 1 | next: 60056000 | prev: 60054000
4 | current addr: 60056000 | size: 4096 | info: 1 | next: 60057000 | prev: 60055000
5 | current addr: 60057000 | size: 4096 | info: 1 | next: 60058000 | prev: 60056000
6 | current addr: 60058000 | size: 4096 | info: 1 | next: 60059000 | prev: 60057000
7 | current addr: 60059000 | size: 4096 | info: 1 | next: 6005a000 | prev: 60058000
8 | current addr: 6005a000 | size: 4096 | info: 1 | next: 6005b000 | prev: 60059000
9 | current addr: 6005b000 | size: 4096 | info: 1 | next: 6005c000 | prev: 6005a000
10 | current addr: 6005c000 | size: 4096 | info: 1 | next: 0 | prev: 6005b000
program break on address: 6005d000
```

```
-----
0 | current addr: 5fff9000 | size: 368640 | info: 0 | next: 60053000 | prev: 0
1 | current addr: 60053000 | size: 4096 | info: 1 | next: 60054000 | prev: 5fff9000
2 | current addr: 60054000 | size: 4096 | info: 1 | next: 60055000 | prev: 60053000
3 | current addr: 60055000 | size: 4096 | info: 1 | next: 60056000 | prev: 60054000
4 | current addr: 60056000 | size: 4096 | info: 1 | next: 60057000 | prev: 60055000
5 | current addr: 60057000 | size: 4096 | info: 1 | next: 60058000 | prev: 60056000
6 | current addr: 60058000 | size: 4096 | info: 1 | next: 60059000 | prev: 60057000
7 | current addr: 60059000 | size: 4096 | info: 1 | next: 6005a000 | prev: 60058000
8 | current addr: 6005a000 | size: 4096 | info: 1 | next: 6005b000 | prev: 60059000
9 | current addr: 6005b000 | size: 4096 | info: 1 | next: 6005c000 | prev: 6005a000
10 | current addr: 6005c000 | size: 4096 | info: 1 | next: 0 | prev: 6005b000
program break on address: 6005d000
```

no heap, program break on address: 5fff9000

Bonus:

We will measure the performance of your code on one and the same computer.

The 5 fastest get 2% bonus on the whole course grade. Be creative!

My results: 521 micro seconds (VirtualBox, Xubuntu, i7-4770, 3.4 GHz)

Test case for speed test (same as above, no print statement except time duration):

```
byte*a[100];
clock_t ca, cb;
for(int i=0;i<100;i++)
    a[i]= mymalloc(1000);
for(int i=0;i<90;i++)
    myfree(a[i]);
    myfree(a[95]);
a[95] = mymalloc(1000);
for(int i=90;i<100;i++)
    myfree(a[i]);
cb = clock();
printf("\nduration: % f\n", (double)(cb - ca);
```