Lab 4 Report

Exercise1. pmalloc()

Basic Idea:- We first think about what a malloc function does. 1) Allocate a chunk of memory big enough to satisfy the request, and return a pointer to it.
So, for our implementation of malloc with guard page, the most important thing to keep in mind is Alignment. It is often required that pointers be aligned to the integer size (which is also the pointer size.). Since our meta-data block is already aligned, the only thing we need is to align the size of the data block.
We tackle this task by using simple mathematic. Here are the step by step description :-

1) First we calculate the page size by calling sysconf() function and giving _SC_PAGE_SIZE as the argument. Sysconf() provides a way to determine values for system limits or options at the run time.
2) Next we call original malloc to create memory specified by the user. In addition of passing size in malloc, we pass size + page size-1 and saves the pointer returned by malloc into *tempPtr. Which actually helps us in pointing near to the guard page and start of the protection region.
3) We point to the guard page(protection region) by using this function:- char * Protect = (char *)(((long)tempPtr + size + pagesize-1) & ~(pagesize - 1)); In this function we first add up pointer returned by malloc that is tempPtr with size and pagesize -1 and then perform the bitwise AND operation with NOT of pagesize -1. By doing this we will get the location at which guard buffer is starting.
4) Then we used mprotect function which control the protection of pages to protect our guard page.
5) Next to calculate padding we used or calculated the offset which is the difference between the starting point of guard buffer and the pointer returned by the original malloc. And than subtracted it with the size provided by the user using our pmalloc() function.
6) After this we used this memset() function to write 0 to the tempPtr.
7) At last we need to return the **modified address** to the user, because we only want to return memory developer or user has asked for. We don't want to return the whole memory which includes guard page.

Exercise 3. calloc()