

CSC209H Worksheet: Stacks and Heaps

- Trace the memory usage for the program below. We have set up both stack frames for you, and the location of the heap.

	Section	Address	Value	Label
	Heap	0x23c		
		0x240		
		0x244		
		0x248		
		:	:	
#include <stdlib.h>				
#include <limits.h>				
#include <stdio.h>				
#include <errno.h>				
<hr/>				
int *mkarray1(int a, int b, int c) {	stack frame for mkarray1	0x454		
int arr[3];				
arr[0] = a;		0x458		
arr[1] = b;				
arr[2] = c;		0x45c		
int *p = arr;		0x460		
return p;				
}		0x464		
// Code for other_function() omitted.		0x46c		
int main() {		0x470		
int *ptr = mkarray1(10, 20, 30);		0x474		
other_function();				
printf("%d %d %d\n", ptr[0], ptr[1], ptr[2]);		0x478		
}		0x47c		
<hr/>				
	stack frame for main	0x480		
		0x484		
		0x488		
		0x48c		

- The program in part 1 will not work correctly. Notice the call to `other_function`. Explain to your partner why the program doesn't work. Fix the `mkarray1` function, and trace it again.
- Once you've fixed the code, add a statement to your program to deallocate the memory on the heap as soon as possible.

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4. Trace the memory usage for the program below. We have set up the stack frame for you, and the location of the heap.

	Section	Address	Value	Label
#include <stdio.h>				
#include <stdlib.h>	Heap	0x224		
/* Build an array in dynamic memory to hold multiples of x from x to x*x.		0x228		
Return a pointer to this array.		0x22c		
*/				
int *multiples(int x) {		0x230		
int *a = malloc(sizeof(int) * x);		0x234		
for (int i=0; i < x; i++) {		0x238		
a[i] = (i+1) * x;		0x238		
}		0x23c		
return a;		0x23c		
}		0x240		
int main() {		0x240		
int *ptr;		0x244		
int size = 3;		0x244		
stack frame for multiples				
ptr = multiples(size);		0x470		
		0x474		
for (int i=0; i<size; i++) {		0x478		
printf("%d\t", ptr[i]);		0x478		
}		0x47c		
printf("\n");	stack frame for main	0x47c		
		0x480		
		0x484		
return 0;		0x488		
}		0x48c		

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5. Change the main function so that it calls `multiples` and prints the array in a loop with sizes of 3, 4, and 5. Besides the changes described, do not make any other changes or additions to the code.
6. Trace the memory usage of your changed program. Explain the problem to your partner and then fix it by adding calls to deallocate the memory.