CS 4375/5340 Fall 2023

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**C Pointer Exercises**

Question 1

Consider the following declarations and assignments.

int \*a, b[5], c, \*d[5];

for(c=0; c<5; c++) {

b[c] = 1+c;

}

\*d = b;

a = &c;

c = (\*d)[3];

What are the TYPE and VALUE of each of the following expressions after execution of the assignment statements? (if the expression is invalid, write “Illegal Expression”, and if it is an address describe what it is the address of).

TYPE VALUE

1. a
2. \*a
3. b
4. \*b
5. c
6. &b[1]
7. d
8. \*d
9. \*\*d
10. \*\*b

Question 2

What would be the output from the program below? Try to figure out the answer without running the program and then run the program to check your answer.

#include <stdio.h>

#include <stdlib.h>

int \*fun(int \*a, int \*b, int s);

int main() {

int \*arr = NULL, x = 6, y = 7, i;

arr = fun(&x, &y, 5);

printf("x = %d y = %d\n", x, y);

if (arr != NULL) {

for (i = 0; i < 5; i++) {

printf("arr[%d] = %d\n", i, arr[i]);

}

free(arr);

}

}

int \*fun(int \*a, int\*b, int s) {

int \*tmp, i;

tmp = malloc(sizeof(int) \* s);

if (tmp != NULL) {

for (i = 0; i < s; i++) {

tmp[i] = i + \*b;

}

\*a = tmp[2];

\*b = 8;

}

return tmp;

}

Question 3

3.1. What would be the output from the program below? Try to figure out the answer without running the program and then run the program to check your answer.

3.2. What do you think you will see if you use change array\_ptr[1] to array\_ptr[2] in the last line? Explain.

#include <stdio.h>

int main() {

int array[] = {45, 67, 89};

int \*array\_ptr = array;

int i;

for (i = 0; i < 3; i++) {

printf("array element %d: %d\n", i, \*array\_ptr);

array\_ptr++;

}

array\_ptr = &array[1];

printf("array\_ptr[1] = %d\n", array\_ptr[1]);

}

Questions 4 and 5 refer to the xv6 code at <https://github.com/mit-pdos/xv6-riscv> .

Question 4. Refer to the definitions of struct proc and the proc array in files kernel/proc.h and kernel/proc.c, respectively.

1. Write a C statement that assigns the pid of the parent of proc[4] to the integer variable ppid.

1. Assuming that the process with child\_pid has been orphaned – i.e., its parent has died, write a C statement that changes its parent to its parent’s parent.
2. Write a loop that prints the pid of each process along the parent chain from mypid to the init process, assuming the init process does not have a parent.

Question 5. In writing OS code, we often use queues of processes that are waiting on something, for example the ready queue of processes that are waiting to be scheduled to run. Design a process queue data structure with a head and a tail and that uses a new pointer field in struct proc to point to the next process in the queue. Write the code for enqueue that adds a process to the tail of the queue and for dequeue that removes a process from the head of the queue.