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Exercise 4: Memory Management, File Systems (10 points)

Given: April 28, 2023
Deadline: May 16, 2023

Objectives

- Understand memory allocation, initialization, access and deallocation
- Understand basic operations (open, read, write, and close) to deal with files

Tasks

- Task 1: Memory Management (6 points)
- Task 2: File System (3 points)
- Task 3: Virtual vs. Physical Memory (1 point)

Instructions

- You can solve this exercises in teams of two.
- Submit the solution of each task with detailed comments that clarify your solution.
- Show your solution and upload it to https://adam.unibas.ch.
- Provide all deliverables as an archive file.
- In total, at least 65% of exercise points have to be obtained (with a min of 30% of each exercise).

Task 1: Memory Management **(6 points)**

You are given three source files, namely T1-1.c, T1-2.c, T1-3.c, your task is to understand and compile each of them. Each file has a certain issue that you must identify, report, and fix.

- T1-1.c is a simple program that asks users to enter a number representing the total number of random samples generated by the program. All generated samples are between 0 and 9. The program displays a histogram (number of repetitions) of each value in that range. Users reported that the issue appears when they pass a large number to the program, such as 10^7. Your task is to explain why this issue happens, and you must fix it.
- T1-2.c is a malfunctioning program. The `update` function has a bug, i.e., the `update` function takes two arguments: both are integer arrays. All items within the first array are initialized to -1. The second array contains indices that must be used to update their corresponding items of the first array if possible. Once you execute the code, it will give a segmentation fault. Your task is to explain why this happens and fix the `update` function.
- T1-3.c is a program that sorts a sequence of positive integers (using count sort). The program is working correctly and you may verify that by compiling and executing the program. However, users reported that sometimes when the `count_sort` function is called repeatedly in a loop, the program crashes unexpectedly. Your task is to read the code, identify the cause of this issue, and fix it.
  Hint: you can use external tools such as Valgrind.

Task 2: File System **(3 points)**

Given the source file T2.c, you must implement the TODOs in this file. You have two functions to implement: `readLinesCount` and `writeLinesCount`. Once you see the `main` function, you will realize that the program accepts multiple arguments: The first argument represents the number of its following arguments. Each of these arguments is a path to a file. The program opens each file and counts its lines; it then writes each line count to an output file, called output.txt.

- implements `readLinesCount` that takes a path to a certain file and returns the count of the lines within the file.
- implements `writeLinesCount` that takes a path to an output file and an integer. The function then appends the integer to the given file as a newline.

Task 3: Virtual vs. Physical Memory **(1 point)**

Explain the difference between virtual and physical memory.