

CPSC 457 - Assignment 5 – Part 1

Due date: **Friday, December 8, 2017 at 11:59pm.**

Individual assignment. No group work allowed.

Weight: 8% of the final grade.

Link to the assignment web page:

<https://sites.google.com/site/cpsc457fall2017/assignments/assignment-5>

Q1 – Written question (5 marks)

Assume an OS has five free memory partitions of 100KB, 500KB, 200KB, 300KB and 600KB:

free	P10	free	P11	free	P12	free	P13	free
100KB	30KB	500KB	30KB	200KB	30KB	300KB	30KB	600KB

The OS needs to place 4 new processes in memory in the following order: P1 of 212KB, P2 of 417KB, P3 of 112KB and P4 of 426KB. Draw the diagrams of the partitions after the OS has placed the processes using 4 different algorithms: first-fit, best-fit, worst-fit and next fit. The resulting diagrams must show the size of each partition, and the status of each partition, similar to the figure above. If a process cannot be placed, indicate that below the diagram. Please start the placement algorithms from the first partition.

Q2 – Written question (5 marks)

Consider a system with 1KB (1024 bytes) page size. What are the page numbers and offsets for the following addresses?

Address	Page number	Offset
2375		
19366		
30000		
256		
16385		

Q3 – Written question (5 marks)

Consider a system with a 32-bit logical address space and 4KB page size. The system supports up to 512MB of physical memory. How many entries are there in each of the following?

- A conventional single-level page table.
- An inverted page table.

Show your calculations.

Q4 – Written question (5 marks)

Consider a system where a direct memory reference takes 200ns.

- a) If we add a single-level page table stored in memory to this system, how much time would it take to locate and reference a page in memory?
- b) If we also add a TLB, and 75% of all page-table references are found in the TLB, what is the effective access time ? Assume that searching TLB takes 10ns.

Show your calculations.

Q5 – Written question (5 marks)

Consider the following page reference string:

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

Assume there are 3 frames in the physical memory and all frames are initially empty. Illustrate how pages are placed into the frames according to the LRU and the optimal replacement algorithms. How many page faults would occur for each algorithm? Show your work.

Q6 - Programming question (20 marks)

Write a simulator (`pagesim.c` or `pagesim.cpp`) of three page replacement algorithms: optimal, LRU and clock. Your simulator will read in a reference string from standard input, and then run a simulation using all three algorithms. At the end of the simulation your program will output the following statistics for each algorithm:

1. the contents of the frames; and
2. the number of page faults.

For the clock algorithm you can use the single reference bit implementation. At the beginning of the simulation all frames are empty. The number of available frames will be specified on the command line.

Example input file `test1.txt`:

```
1 2 3 4 1 2 5 1 2 3 4 5
```

Sample output:

```
$ ./pagesim 4 < test1.txt
Optimal:
- frames: 4 2 3 5
- page faults: 6
LRU:
- frames: 5 2 4 3
- page faults: 8
Clock:
- frames: 4 5 2 3
- page faults: 10
```

You can make the following assumptions:

- Number of available frames will be between 0 and 20 (inclusive).
- Number of entries in the reference string will be at most 5000.

- Frame numbers will be non-negative integers smaller than 100.

Q7 - Programming question (30 marks)

The details of this question will be released separately. Please stay tuned.

Submission

You should submit 4 files for this assignment:

- Answers to the written questions combined into a single file, called either `report.txt` or `report.pdf`. Do not use any other file formats.
- Your solution to Q6 called `pagesim.c` or `pagesim.cpp`.
- Your solution to Q7 called `impl.cpp`.

Since D2L will be configured to accept only a single file, you will need to submit an archive, eg. `assignment5.tgz`. To create such an archive, you could use a command similar to this:

```
$ tar czvf assignment5.tgz report.pdf impl.cpp pagesim.cpp
```

General information about all assignments:

1. All assignments must be submitted before the due date listed on the assignment. Late assignments or components of assignments will not be accepted for marking without approval for an extension beforehand. What you have submitted in D2L as of the due date is what will be marked.
2. Extensions may be granted for reasonable cases, but only by the course instructor, and only with the receipt of the appropriate documentation (e.g. a doctor's note). Typical examples of reasonable cases for an extension include: illness or a death in the family. Cases where extensions will not be granted include situations that are typical of student life, such as having multiple due dates, work commitments, etc. Forgetting to hand in your assignment on time is not a valid reason for getting an extension.
3. After you submit your work to D2L, make sure that you check the content of your submission. It's your responsibility to do this, so make sure that you submit your assignment with enough time before it is due so that you can double-check your upload, and possibly re-upload the assignment.
4. All assignments should include contact information, including full name, student ID and tutorial section, at the very top of each file submitted.
5. Assignments must reflect individual work. Group work is not allowed in this class nor can you copy the work of others. For further information on plagiarism, cheating and other academic misconduct, check the information at this link:
<http://www.ucalgary.ca/pubs/calendar/current/k-5.html>.
6. You can and should submit many times before the due date. D2L will simply overwrite previous submissions with newer ones. It's better to submit incomplete work for a chance of getting partial marks, than not to submit anything.

7. Only one file can be submitted per assignment. If you need to submit multiple files, you can put them into a single container. The container types supported will be ZIP and TAR. No other formats will be accepted.
8. Assignments will be marked by your TAs. If you have questions about assignment marking, contact your TA first. If you still have questions after you have talked to your TA then you can contact your instructor.