CS3500: Operating Systems

Lab 7

Date: 20th Sep 2019

Submission instructions: Submit one .c file for each of the following questions and one pdf file containing the answers to the subjective parts of each of the questions. The pdf file should also contain plots wherever indicated. It is recommended to generate this pdf using pdflatex and plots using TikZ.

1. (2 points) Declare a static array of integers `a` of size 8192. Then in the `main` function, measure the total times taken to access `a[20], a[50], a[80]`. Then measure the total time taken to access `a[1500], a[3000], a[4500]`. Finally, measure again the total time taken to access `a[1500], a[3000], a[4500]`, i.e., access the same memory locations again. Include your reasoning for the above observations in the report.

2. (2 points) Define a static inline function called `step_jump` that has the following structure:

```
__asm__ __volatile__ ("xorl %%eax,%%eax\n"
                      "cmpl $0x1, %%eax\n"
                      "jne L2 \n"
                      "nop;""nop;""nop;" ...
                      "L2: \n"
                      :::);
```

   Here the number of repeating `nop`s is initially set to 10. Now call this function from `main` and measure the time taken to complete it. Now change the number of `nop`s to 100, 1000, 2000, 4000, 5000, and repeat the time measurement. Include your values in your report and reason about the observed numbers.

3. (4 points) Use `malloc` to declare an array of integers spanning 1,024 pages (you should know the page size from the tutorial). Then loop through the array, incrementing exactly one element per page. Measure the time taken to access each such element and plot it in your report. Also include your reasoning for the observed pattern. In particular, can you reason about the size of the TLB?

4. (2 points) Repeat question 1, where the array `a` is allocated within a `hugepage`. Include your observed average numbers for the three scenarios. Also include your reasoning on how these numbers contrast to those in question 1.