1. In class we considered the effective access time (EAT) for a paged system using a translation looksaside buffer (TLB). Assume that a memory access in a system takes one unit of time. Assume that we are using a paged memory allocation scheme. Further assume that if we add a TLB, the access time for the TLB is .01 time unit and the probability of a TLB hit is .85. Answer the following questions:

- Assuming we add a TLB with the characteristics specified above, what is the EAT in time units?
- What is the total access time for a (paged) memory reference assuming we start with a logical address and we are not using a TLB?
- How does the time in your answer compare to the total access time for a (paged) memory reference assuming we are not using a TLB? Explain your answer in terms of the components of the difference.

2. We also considered the effective access time (EAT) for a demand paging system. We used the formula

\[ EAT = [(1-p)(\text{memory access time})] + p \text{ (page fault time)} \]

where \( p \) is the page fault rate (see section 9.2 of the text).

Assume that the memory access time is 400 nanoseconds and the page fault time is 400 milliseconds. What value of \( p \) gives an EAT that is 1.25 times the memory access time (i.e., gives a performance degradation of at most 25%)?

3. Consider a system using demand paging and the following reference string:

```
1 3 5 7 2 3 2 7 2 5 2 3 5 1 2 5
```

Draw a diagram as we did in class showing the contents of memory each time there is a page fault for a memory with three frames for each of the optimal, FIFO, and LRU page replacement methods, and state how many replacements are done for each algorithm.

Now consider expanding the memory size to four frames. Consider the FIFO algorithm. Does this reference string result in an instance of Belady’s anomaly? Explain why or why not.