HOMEWORK #2

Do the following exercises from the textbook. Explain your work clearly.

2.11. Show the block diagram of a multiple-operand adder with multilevel of carry save adders (CSA's) and one carry lookahead adder (CLA). The adder can receive 10 input numbers where each number has 4 bits. Assume that each level of CSAs has \( D \) delay, and CLA has a delay of \( 2D \). Using such an adder, estimate the minimum time required to add one hundred 4-bit numbers. Show your work.

2.15. Use the shift-and-add multiplication method to multiply two 2’s complement numbers \( X = 1101 \) (multiplier) and \( Y = 1101 \) (multiplicand). Show all your work.

2.23. Consider a processor with a cache and main memory. Out of 100 requests that the processor sends to the cache, let’s assume the following:

- Number of address references satisfied by cache, \( N_c \), is 10.
- Number of address references satisfied by main memory, \( N_m \), is 90.
- Access time for the cache, \( t_c \), is 10 ns.
- Access time for the main memory, \( t_m \), is 90 ns.

a. Compute hit ratio, \( H \), and average access time, \( t_a \), for these assumptions.

b. Now let \( N_c = 60 \) and \( N_m = 40 \). Recompute \( H \) and \( t_a \), and compare the result with that in part a. Is there much improvement in the average access time?

c. From the approximately 5% decrease in the hit ratio, from 0.95 to 0.90, what is the percent of increase in the average access time?

2.25. Given the following reference string: 1, 4, 10, 4, 3, 6, 1, 1, 8, 6, 9, 4, 3, 3, 3, 1. What will be the number of page faults for a system that gives each process a maximum of four frames, using the following:

a. First in, first out.

b. An approximation of least frequently used that keeps a counter for each page. For each reference, the counter for that page is incremented. The page with the lowest count will be replaced. The system also uses a first in, first out algorithm to break ties.

c. Least recently used.

Show all states of the stack and counters.