CS 4760	**Operating Systems**	Test 1
Name:	Spring 2022	Max Pts: 56

Important: This is an open book test; you can use any books, notes, or paper. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem.

1. [6 pt] In general, what are the strategies to exploit spatial locality and temporal locality?
2. [6 pt] What is SIMD? How does it speed up computation?
3. [10 pt] Consider the following program running on a unicore machine:

```
const int n = 50;
int tally;
void total()
{
    for ( int count = 0; count < n; count++ )
        tally++;
}

void main()
{
    tally = 0;
    parbegin
        total();
        total();
    parend;
    printf ( "%d\n", tally );
}
```

   (a) Determine the proper lower bound and upper bound on the final value of the shared variable `tally` output by this concurrent program. Assume processes can execute at any relative speed and that a value can only be incremented after it has been loaded into a register by a separate machine instruction.

   (b) Suppose that an arbitrary number of processes are permitted to execute in parallel under the assumptions of part (a). What effect will this modification have on the range of final value of `tally`?

4. [6 pt] Briefly explain the distinction between a real address and a virtual address.
5. [6 pt] What does it mean to preempt a process?
6. [10 pt] Assume at time 0, no system resources are being used except for CPU and memory. Now consider the following events:

Time	Event
1	P_4 executes a command to read from disk unit 0
2	P_2's time slice expires
2	P_1 executes a command to write to disk unit 1
2	P_0 executes a command to read from disk unit 4
6	P_2 executes a command to write to disk unit 0
6	P_2 is swapped out
9	An interrupt occurs from disk unit 0: P_4's read is complete
10	An interrupt occurs from disk unit 4: P_0's read is complete
11	P_0 terminates
13	An interrupt occurs from disk unit 1: P_1's write is complete
14	P_2 is swapped back in
16	An interrupt occurs from disk unit 0: P_2's write is complete

For each time 3, 6, and 12, identify the state of each process. If a process is blocked, further identify the event on which it is blocked.

7. [6 pt] The bakery algorithm allows two processes to acquire the same number for service. How does it ensure that the critical section problem is solved? Illustrate your answer with the protocol to handle critical section.

8. [6 pt] Initially semaphore `s` is 0. Process p_1 and p_2 execute as follows:

$p1$	p_2
P(s)	V(s)
P(s)	V(s)
V(s)	

What is the value of s after both the processes terminate? Which process will have its first statement terminate first?