(a) First-fit

(b) Best-fit

(c) Worst-fit

6. [15 pt] Suppose the following processes arrive at the specified times and immediately compete for the CPU.

Process #	Execution time	Arrival time
p_1	6	1
p_2	2	3
p_3	4	0
p_4	8	3

For each of the following scheduling approaches, answer the following questions:

(a) What is the turnaround time for each process?

(b) What is the average turnaround time?

(c) How much time does each process spend waiting?

(a) FIFO. In the event of simultaneous arrivals, schedule in numerical order.

(b) Shortest job next (nonpreemptive)

(c) Shortest remaining time first

(d) Round robin with quantum = 1 (start scheduling in numerical order)

(e) Round robin with quantum = 2 (start scheduling in numerical order)

CS 376 **Operating Systems** Test 2
Name: Maximum Points: 57

Important: This is an open book test. You can use any books, notes, or paper. *Do not log into the computer during the test.* Any calculations and rough work can be done on the back side of the test pages.

1. [5pt] What is the difference between a program and a process? How do the two differ from a task?

2. [15pt] Measurements of a certain system have shown that the average process runs for a time T before blocking on I/O. A process switch requires a time S, which is effectively wasted (overhead). For round robin scheduling with quantum Q, give a formula for the CPU efficiency for each of the following.

   (a) $Q = \infty$

   (b) $Q > T$

   (c) $S < Q < T$

   (d) $Q = S$

   (e) Q nearly 0

3. [10 pt] Consider the following resource allocation state.

Name	Used	Max
Andy	1	6
Barbara	1	5
Marvin	2	4
Suzanne	4	7
Available		2

   Currently, the system is in a safe state. For the problems, show all your work.

   (a) Draw a process-resource graph corresponding to the system.

   (b) If Suzanne asks for one more unit, does it lead to a safe state or an unsafe one?

   (c) What if the request came from Marvin instead of Suzanne?

4. [2pt] When a process is rolled out of memory, it loses its ability to use the CPU (at least for a while). Describe another situation where a process loses its ability to use the CPU, but where the process does not get rolled out.

5. [10pt] Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of the memory?