

Tutorial No. 0

Parallel Programming and Concurrency

Exercise 1

1. The part of a program that must be executed sequentially accounts for 40 % of the program's execution time on a single processor. What is the limit for the overall speedup that can be achieved by running the program on a multiprocessor machine?
2. We now suppose that the sequential part accounts for 30 % of the program's execution time. Let s_n be the speedup obtained on n processors, assuming the rest of the program is perfectly parallelizable. We seek to double the overall speedup by rewriting the sequential part to speed it up by a factor of k . What should be our target for the value of k to achieve our goal?
3. Suppose now that the sequential part can be sped up three-fold, and when we do so, the modified program takes half the time of the original on n processors. What fraction of the overall execution time did the sequential part account for?

Exercise 2

Write the pseudo-code for the operations $P()$ and $V()$ of a semaphore

Exercise 3

A tribe of savages eats communal dinners from a large pot that can hold M servings of stewed missionary. When a savage wants to eat, he helps himself from the pot, unless it is empty. If the pot is empty, the savage wakes up the cook and then waits until the cook has refilled the pot.

Write the code modelling the behavior of any number of savages and the cook. Synchronization should be performed with semaphores. Synchronization constraints are:

- Savages shall not get serving from an empty pot;
- The cook shall not refill the pot if it is not empty.

Exercise 4

A barber shop has one barber, one barber chair, and n chairs for waiting customers, if any, to sit on. If there are no customers present, the barber sits down in the barber chair and falls asleep. When a customer arrives, he has to wake up the sleeping barber. If additional customers arrive while the barber is cutting a customer's hair, they either sit down (if there are empty chairs) or leave the shop (if all chairs are full). Program the behavior of the barber and the customers, using semaphores for the synchronization.

Exercise 5

A unisex bathroom is used by both men and women, with the following constraints:

- There cannot be men and women in the bathroom at the same time;
- There should never be more than three persons simultaneously in the bathroom.

Solve the synchronization problem with semaphores.