

Assignment 1

Algorithm Design

Scenario: You are the manager of a barbershop. Your salon has five (5) barbers, who earn commissions from the services they provide to the salon's customers. There are four types of services, costing \$10, \$20, \$30, and \$40. When a customer comes and requests any one of the services, an available barber is assigned to serve the customer.

The simplest way to schedule the barbers is to sort them using their sign-in times, and assign work to them according to this order and repeat (i.e., in circular order). This scheduling could result in a significant difference in their earnings at the end of the day. To minimize the difference, the manager considers commissions earned so-far, in addition to arrival times, when scheduling the rounds (cycles of assignments) as required to achieve that goal.

You are to design an algorithm that schedules work for the barbers. Your algorithm must satisfy the requirements:

1. No barber can have more than one assignment in any round.
2. Turns (or assignments) in the first round are determined by the FIRST-COME, FIRST-WORK policy, i.e., by the order the barbers arrive (their arrival times do not differ more than a couple of minutes).
3. Subsequent assignments take into account money earned thus far. The rule is if the difference is d (e.g., $d = \$20$) or more, the manager can move the barber who has earned less ahead of those in front. The idea is those who happen to have done small-money services receive more assignments (as rounds may not be complete at end of work day).
4. Work in subsequent rounds is assigned according to the new order until there is a difference of d or more in earnings, which triggers a change in the order of assignments discussed in (3).

A scheduling example, for $d = \$20$:

Barbers (ordered according to their arrival times)	A	B	C	D	E
Total so far	\$100	\$100	\$90	\$90	\$80
Next round	E	A	B	C	D
...
Total so far	E \$190	A \$190	B \$200	C \$200	D \$180
Next round	E	A	D	B	C

Your tasks:

1. Design an algorithm to determine who is next to be assigned.
2. Show that your algorithm can guarantee their income at end of day do not differ more than S dollars. S is what your algorithm can guarantee, which can be a function of rounds and/or the price difference of the offered services.
3. What is the running time of your algorithm?
4. If the barbers could have more than one assignment in a round, would S be smaller?
5. Should the above requirements be modified or dropped, and/or additional requirements be added? What might they be?
6. Implement your algorithm and try it on some input.