Eclipse, Kliezl P. Exercise 4.1 – 2

Q: *Alternating glasses*

a. There are 2*n* glasses standing next to each other in a row, the first *n* of them filled with a soda drink and the remaining *n* glasses empty. Make the glasses alternate in a filled-empty-filled-empty pattern in the minimum number of glass moves. [Gar78]

b. Solve the same problem if 2*n* glasses – n with a drink and n empty – are initially in a random order

A: Assume that glasses are numbered from 1 to 2*n* (left to right)

a. The glasses are divided into a smaller group and will pour its second glass to the penultimate (next to last) glass. The first and last two glasses in the group is sorted, and its remaining glasses in the middle becomes the new smaller group of unsorted glasses which will repeat the same procedure. This is repeated *n/2* times if *n* is even or (*n* – 1)/2 times if *n* is odd (a small group is formed as *i* increases until *i* is greater than or equal to *n*).

ALGORITHM:
i ← 1
    while *i* < *n* **do**
        glass (2*n* + *i*) ← glass (*i* + 1)
        glass (*i* + 1) ← empty
        i ← *i* + 2

Pour the filled glass (i + 1) to the empty glass (2n + i)

b. Since there are many possible random orders for the given problem, the goal then is for all glasses in odd number to be filled and all glasses in even number to be empty. In case an odd-number glass (glass 1) is empty, find a filled even-number glass (glass 2) and pour the soda from glass 2 to glass 1. On the other hand, in case an even-number glass (glass 1) is filled, find an empty odd-number glass (glass 2) and pour the soda from glass 1 to glass 2.

ALGORITHM:
i ← 1
while *i* < 2*n*
    j ← *i* + *1*
    if *i* is odd and glass *i* is empty, **then**
        while glass *j* is empty *// check if there is a filled even-number glass*
            j ← *j* + 2
        glass *i* ← glass *j*
        glass *j* ← empty
    else if *i* is even and glass *i* is filled, **then**
        while glass *j* is filled *// check if there is an empty odd-number glass*
            j ← *j* + 2
        glass *j* ← glass *i*
        glass *i* ← empty
    i ← *i* + 1

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