

Question 3 Somewhere deep in space the computer AHN has gone crazy and is refusing to open the pod-bay doors between the space station it controls and a pod containing several astronauts. Since they cannot dock the pod with the space station, the astronauts will be forced to take a difficult space walk between the pod and the emergency airlock on the station.

A Space Oddity

Your task in this question is to get the astronauts safely onboard the station, as quickly as possible. Help them stop AHN before it is too late.

Fortunately each astronaut has their own space-suit. Unfortunately they only have one portable oxygen-pack between them, which the suits require to work. This pack can be used simultaneously (if necessary) by two astronauts travelling together, but it cannot provide oxygen for three or more at the same time. Since there is only one pack it will have to be taken back and forth until all the astronauts are safely onboard.

It is a difficult space walk and abilities of the astronauts vary, so their times to travel between the pod and the space station also vary. Two astronauts travelling together move at the speed of the slowest astronaut, since they are kept together by the oxygen-pack.

For example, suppose *A* takes 1 minute, *B* takes 2 minutes, *C* takes 4 minutes and *D* takes 5 minutes. The following combination of walks gets the astronauts onto the space station in 13 minutes. *A* and *D* travel to the station (5 minutes), *A* travels back to the pod (1 minute), *A* and *C* travel to the station (4 minutes), *A* travels back to the pod (1 minute) and finally *A* and *B* travel to the station (2 minutes). It can be done faster!

3(a) Write a program that calculates the fastest way of getting the astronauts onto the space station. Your program should first input a single number n , $1 \leq n \leq 8$, indicating the number of astronauts. The second line will consist of n sorted integers (between 1 and 100), giving the times taken by each astronaut.

[30 marks]

Sample run

```
4
1 2 4 5
12
```

Your output should consist of a line containing the minimum amount of time needed to get the astronauts onto the space station.

3(b) How do you get the astronauts in the example over to the space station in 12 minutes?

[3 marks]

3(c) Explain *briefly* the best possible algorithm (method) you can think of for solving the problem. (Do not worry if you do not know how to program your algorithm). If the input values could be greater, how large a problem would this method be able to solve?

[bonus]

Total marks: 100 (plus bonus).

End of BIO 2001 Round One paper