**German University in Cairo**
**Faculty of Media Engineering**
**Department of Computer Science**
**Dr. Nourhan Ehab**

**Analysis and Design of Algorithms**, Winter Term 2022
**Programming Assignment 1: Alpha Keys**

*Due: November* $25^{th}$ *2022*

1. **Problem Description.** Bode Locke, the youngest sibling in the Locke family, discovered that their ancestors house, in which they moved in recently, is full of magical keys. The keys in the house used to whisper to him till he finds them. He found one that can turn a person to a ghost when used on the library door, and one that can set the whole place on fire, and so many other keys with amazing powers. One day, Bode heard the whispers of a key, and after following the whispers he found a very strange new key.

   The new key was actually not just one key but a set of keys **welded** together onto a golden ring with numbers stamped on them representing their **powers**. This can be seen in Figure 1.

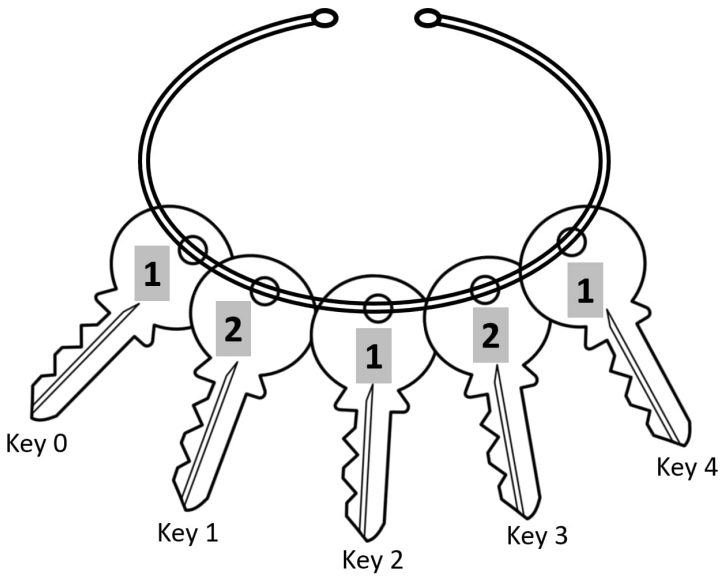


Figure 1: Ring of Keys

With the keys, Bode found the instructions his ancestors left in order to be able to use those keys. If the keys are in the **Alpha** order, he will be able to unlock a gate to the surface of the moon. The **Alpha** unleash the maximum power of the ring, and that is done when the total power of the keys in the **even positions** is the **maximum** they can be.

The thing is, he can not order the keys as he wishes (they are welded). So the only solution is to melt the ring at 2 parts, reverse the cut part and weld it again to the ring for the ring to be complete. This can only be done **once**, otherwise, the ring will be

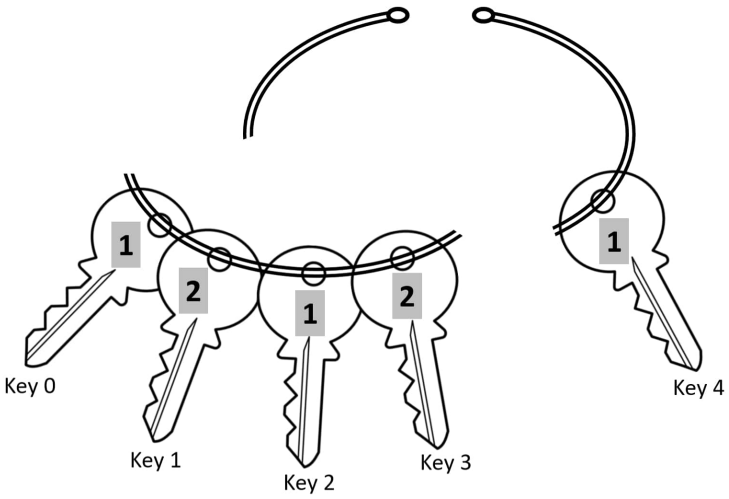


Figure 2: Melt the ring before Key 0 and after Key 3

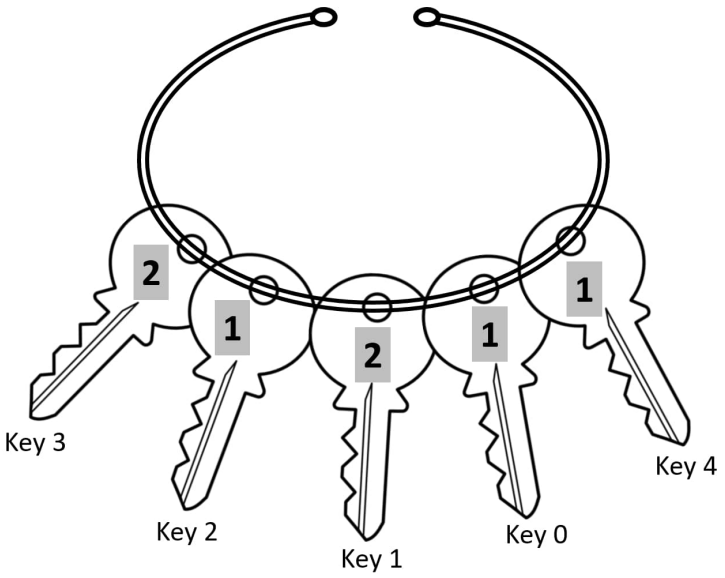


Figure 3: Reverse the cut part and weld to ring

destroyed. An example can be seen in Figures 2 and 3, where the keys were altered to put them in the Alpha form.

So now Bode needs to think if the keys are already in the Alpha form or he needs to reverse part of it.

You goal is to use the **Divide & Conquer** approach to tell Bode, the combined power of the keys at the even positions in their Alpha form. (Hint: Think about using the *largest subrange* problem in Lecture 3.)

Good luck moon walking!!

2. **Deliverables.** You are required to submit one **Java** file titled after your team name (example: `awesome_team.java`) containing the following method.

   `public static int alpha (int[] keys)` that implements a divide and conquer approach to finding the combined power of the keys at the even positions after finding the Alpha form.

3. **Sample Input/Output**

```
keys=[3]
Output: 3

keys=[3,1,2,1]
Output: 5

keys=[1,7,3,4,7,6,2,9]
Output: 26
```

4. **Teams Submission.**

   a) This is assignment is to be done in teams of **three**.

   b) The deadline for team submission is $3^{rd}$ of November.

   c) You must submit your team name and the IDs of the members using the following form: `https://forms.gle/E2vL92Z5G8KyUKf38`.

5. **Submission Guidelines.**

   a) Your assignment will be auto-tested. For this reason, you have to stick to the method signatures and the output format. However, you are allowed to use any helper methods you need.

   b) You must use this link for submission: `https://forms.gle/dbiTfwZbAmfLRANF8`