

FC-0306-2
QRMT: Foundations of Computer Science

Midterm Examination
Extra Credit

Problem Statement:

Imagine you are a Jewish soldier from the first century fighting during the [Great Revolt](#). You and your company of soldiers are trapped in a cave during the [Siege of Yodfat](#) by the opposing Roman forces. Committed to your legion and faith, you would rather choose to die than surrender. To make this happen, your company devises a system to kill off each other until only one soldier remains.

All the soldiers in the legion stand in a circle. The first soldier kills the person to his left, the next surviving soldier kills the person to their left, and so on, until only one remains. This is a tale attributed to the famed Romano-Jewish soldier and historian [Josephus](#).¹

More generally, this problem can be interpreted as having two parameters, n and k . The n parameter denotes the number of soldiers in the circle and the k parameter can be understood as a step parameter; After each kill, we skip $k-1$ living people and kill the next living person. The example in the previous paragraphs is under the assumption of $k = 2$.

Where would you position yourself in this circle to ensure that you are the last person alive?

1 - [Popular Mechanics Article](#) accessed on 2nd November, 2022

Instructions

To claim the extra credit, you are expected to solve the above problem by writing down an algorithm to determine the ideal starting position. Briefly state why you are choosing your particular method and why it might be best. Given that there are n soldiers, solve the problem when the next person being killed is to the immediate left ($k = 2$) and describe why your algorithm is correct, complete, and provide an account of its time complexity using a recurrence relation.

We are looking for creativity in the approach you use, mathematical rigour and completeness of the solution.

Submission

This is an extra-credit component of your midterm examination. Your scores on this component will be added to your exam scores.

Bring a printed/written copy of your work to the Midterm Examination. Make sure to write your name on the front page. You are encouraged to collaborate with your peers and make use of the internet. If you are using any external resources, don't forget to cite them.

We will only be accepting written work submitted before the Midterm Examination starts (7th November). There will be no exceptions to this.
