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A Recursive Formula For Generalized Josephus problem

Asked 9 years, 10 months ago Modified 4 years, 2 months ago Viewed 11k times

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The [Josephus Problem](#) asks where to start taking out every kth person in the circle consisted of n people, such that you are the last "survivor".

The following recursive formula is given:

$$f(1, k) = 1,$$
$$f(n, k) = ((f(n - 1, k) + k - 1) \bmod n) + 1.$$


But this is not enough explanation, so I don't get where does it come from.

Can anyone help?

combinatorics recursion

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edited Dec 1, 2012 at 13:59

 Raphael


71.2k

27

169

367

asked Nov 30, 2012 at 13:48

 Parisa

121

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2 You mean wiki explanation in [general case](#) is not enough? – user742 Nov 30, 2012 at 17:43

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2 Answers

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Let me explain the idea. Assume that indices start from 0. Take N = 6 and K = 3 So initial arrangement looks something like

0->1->2->3->4->5->0.... like a circle.

After round 1 , '2' is eliminated .

0->1->2->3->4->5->0->1...

.... (k)->0->1->2->3->

here (k) denotes the person is killed

Since we ought to start from the last position we killed, so lets look at the updated indices.

Old Index | New Index

3 | 0

4 | 1

5 | 2

and so on.... looking closely we can easily see after each round

OldPosition = (newPosition+k)mod N

Where N is the number of people left before the round started.

Also OldPosition signifies f(N,K)

and New Position signifies f(N-1,K) as one person has already been killed.

So putting it back to OldPostion = (newPostion+k) mod N we get

f(N,K) = (f(N-1,K)+ K) mod N

But this is done only if u have indices starting from 0. If u want to rearrange for indices starting from 1, you can rearrange it to get the above result.

I found a beautiful paper on this

<http://blue.butler.edu/~phenders/InRoads/MathCounts8.pdf>

Hope this helps :)

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edited Jun 21, 2015 at 8:09

 Sukhmeet Singh

156

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3

answered Jun 20, 2015 at 19:34

1 Welcome to [Computer Science](#)! We aim to be a source of information, rather than just a link farm so it would be great if you could at least summarize the contents of the paper and explain how it answers the question. – David Richerby Jun 20, 2015 at 19:52

thanks @DavidRicherby , i have updated my answer on this. – Sukhmeet Singh Jun 21, 2015 at 8:10

For the **rearrange** part, could put it this way: If index start from 1 , then just add 1 to the result when index start from 0 . Similarly, if index start from t , just add t to the result when index start from 0 . – Eric Aug 17, 2020 at 9:32

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Knuth goes through this in the first chapter of his classic math textbook, Concrete Mathematics. His treatment is very understandable.

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answered Jul 10, 2018 at 15:42

 Joel

11


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