Lord Of The Strings

Rules and Regulations

December 24, 2019

1 Introduction

Lord Of The Strings at Pravega 2020 is a online programming contest open to coders nationwide.The participants will be asked to program AIs to play *Kryptochase.*These AI's will be pitted against each other untill a champion emerges.

2 Kryptochase

Kryptochase is a game of pursuit and evasion played on the planet *Krypton.*

Krypton consists of many cities, each uniquely labelled by a permutation[1] of the first 400 natural numbers[2].Kandor being the capital city was assigned lexographically smallest permutation[3]

Krypton has really peculiar yet intresting map.In Krypton two cities are *directly connected* to each other if and only if the labelling of one city is obtained by applying one of the following operations on other labelling :-

- Right Shift- This operation shifts every element of the permutation to its right i.e if b is the resulting permutation after applying this operation to a then $b_{i+1} = a_i \ \ \forall\ i \in [1, n-1]$ and $b_1 = a_n$, where a and b are permutations of $(1, 2, ..., n)$.[4]
- Left Shift - This operation shifts every element of the permutation to its left i.e if b is the resulting permutation after applying this operation to a

[1]In mathematics, permutation is the act of arranging the members of a set into a sequence or order, or, if the set is already ordered, rearranging (reordering) its elements—a process called permuting

[2]1, 2, 3, ...

[3]Lexographically Smallest Permutation - Lexicographic order is order defined on aggregate types by prioritisation of their items.In our case a permutation a is less than b if the smallest i such that $a_i > b_i$ is greater than smallest j such $b_j > a_j$, this definition holds on the assumption of the existence of a i such that $a_i > b_i$, if there exists no such i then it is trivial that the latter is greater.

[4]Here all the permutations we are considering are 1-indexed

then $b_i = a_{i+1} \ \forall\, i \in [1, n-1]$ and $b_n = a_1$, where a and b are permutations of $(1, 2, ..., n)$.

- Alt Swap - To understand what this operation does we have to divide the initial permutation p of $(1, 2, 3, ...)$ into two sub-sequences a and b such that $a_i = p_{2i}\ \forall i \in [1, \lfloor n/2 \rfloor]$ and $b_j = p_{2j-1}\ \forall j \in [1, \lfloor n/2 \rfloor]$.Now we will create the resulting permutation q from the two permutation a and b , $q_i = a_{(i-1/2)}\ \forall i \in \{2k-1 | k \in [1, n]\}$ and $q_j = a_{j/2}\ \forall j \in \{2k | k \in [1, n]\}$.
- Half-Reverse - If b is the resulting permutation after applying this operation to a then $b_i = a_{\lceil (n/2) \rceil + i}\ \forall i \in [1, \lfloor n/2 \rfloor]$ and $b_i = a_{i - \lceil (n/2) \rceil}\ \forall i \in [\lceil n/2 \rceil, n]$

The following table demonstrates the use of the above operations:-

Operation	Initial Labelling	Final Labelling	Initial Labelling	Final Labelling
Right Shift	$[1, 2, 3, 4, 5]$	$[5, 1, 2, 3, 4]$	$[1, 2, 3, 4]$	$[4, 1, 2, 3]$
Left Shift	$[1, 2, 3, 4, 5]$	$[2, 3, 4, 5, 1]$	$[1, 2, 3, 4]$	$[2, 3, 4, 1]$
Alt Swap	$[1, 2, 3, 4, 5]$	$[2, 1, 4, 3, 5]$	$[1, 2, 3, 4]$	$[2, 1, 4, 3]$
Half-Reverse	$[1, 2, 3, 4, 5]$	$[3, 4, 5, 1, 2]$	$[1, 2, 3, 4]$	$[3, 4, 1, 2]$

Krypton is a home to a great civilization which boasted advanced science and technology.But it is now on the verge of destruction.Jor-el's last hope to save his only child, Kar-el is the only escape pod which is stolen by 3 members of General Zod's army. To bring back the stolen pod Jor-el recruites 5 of his trusted Kryptonian's.But its not an easy task to accomplish as they only have 250 wolus[5] before the planet dies.

A person can only go from one city to another if and only if they are directly connected to each other.Two cities are connected to each other if we can go from one city to another.Both the Kryptonians and Zod's army[6] take 0.125 wolu for moving from one city to another.And also Jor-El knows that the Zod's army had started from Kandor[7].No two person[8] can be in the same city at a given time.Only one member of the Zod's army has the original pod while other two have it's exact fake copy.When two members of the Zod's army are in cities directly connected they can exchange their pods.Jor-El being a excellent scientist could track the position of all the three members of the Zod's army,but Zod damaged the tracking device too, so now the tracking device only works once in a 5 wolus i.e Jor-El could only track Zod's army once in 5 wolus, but it is still efficient enough to find out if there has been an exchange of pods between

[5]Kryptonian Time - 100 thribo (Kryptonian seconds) per dendar (Kryptonian minute). 100 dendaro (Kryptonian minutes) per wolus (Kryptonian hour).

[6]Zod's Army comprises of the three identical robotic equivalent of zod who stole the escape pod.Each individually take 0.125 wolu to move from one city to another.Also eack Kryptonian take 0.125 wolu to move from one city to another.

[7]This does not mean that Zod's army is in Kandor , but it means that they are in some city connected to Kandor

[8]Kryptonians and Zod's army

members of Zod's army.The Kryptonians are strong enough to kill any member of the Zod's army.A Krytonian could kill a member of Zod's army if and only if they are in the same city at a particular time.

3 Submission Details

1. You have to submit two files:-
   - One for Jor-El , so that he can successfully take the pod from Zod's army before the planet dies.
   - Another for General Zod so that his army can succesfully escape from Kryptonians till the planet dies.
2. The Programming Language we support is *Python*
3. Each labelling of the city is a list[9] of lengtn 400.
4. Jor-El's file should contain a source.py file, which should implement the following functions:-
   - **init**- It will take a five-membered list as a argument in which each member of the list is a labelling of the city in Krypton , in which a Kryptonian is present.This initialises the positions of Kryptonians on the planet Krypton.

     The return value of function is **None**
   - **move** -
     It will take a five-membered list as a argument in which each member of the list is a labelling of the city in Krypton , in which a Kryptonian is present.

     The return value of the function is a five-membered list in which each member is a labelling of the city in Krypton , in which the Kryptonian has moved.
   - **info**-
     It takes a four-membered list as a argument in which first three members are labelling of the city in Krypton, in which there is a member of Zod's army.The fourth argument is the index of the current list which has the labelling of the city in which there is a Zod's army member who has the real pod.If any index other than the fourth one is -1 then that member of Zod's army is killed by a Kryptonian.

     The return value of the function is **None**.

[9] Python List

Note:The initial positions of Zod's army will be initialised by **info** function.

5. Zod's file should also contain a source.py file, which should implement the following functions:-

   - **init**- It takes a four-membered list as a argument in which first three members are labelling of the city in Krypton, in which there is a member of Zod's army.The fourth argument is the index of the current list which has the labelling of the city in which there is a Zod's army member who has the real pod.If any index other than the fourth one is -1 then that member of Zod's army is killed by a Kryptonian.This function initialises the position of Zod's army in Krypton.

     The return value of function is **None**

   - **move** -
     It takes a four-membered list as a argument in which first three members are labelling of the city in Krypton, in which there is a member of Zod's army.The fourth argument is the index of the current list which has the labelling of the city in which there is a Zod's army member who has the real pod.If any index other than the fourth one is -1 then that member of Zod's army is killed by Kryptonian.

     The return value of the function is a four-membered list as a in which first three members are labelling of the city in Krypton, in which there is a member of Zod's army.The fourth argument is the index of the current list which has the labelling of the city in which there is a Zod's army member who has the real pod. If any index other than the fourth one is -1 then that member of Zod's army is killed by a Kryptonian.

   - **info**-
     It takes a five-membered list as a argument in which each member is a labelling of the city in Krypton, in which there Kryptonian .

     The return value of the function is **None**.

   Note:The initial positions of Kryptonians army will be initialised by **info** function.

6. Maximum RAM Usage allowed per file is 2GB[10].If any program exceeds the limit it will be lose immediately.

7. Time limit for the given functions are as follows:-

   (a) Jor-el's file

[10]In the battle field one's Zod's program will compete with the Jor-El's program.Both the programs will be alloted with 2GB memory each.

- move - 1s
- init - 0.1s
- info - 0.1s

(b) Zod's file

- move - 0.6s
- init - 0.1s
- info - 0.1s

If any program exceeds the time limit then it will lose immediately.

8. More info on the Submission of your programs will be updated soon.

4 Contact Us

If you have any queries regarding the event you can contact us at
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