Give an intuition that why the algorithm works (terminates and gives the correct expected answer).

The algorithm is working correctly because when a node gets a packet, it first compares the UID of the received packet to its own UID and transfers the packet with the higher UID to the next node. We also employ a statues variable, which is used to determine the statues of each node and to end the game. A critical assumption to keep in mind is that all nodes are configured before the game begins. We also assume that the TCP protocol is being used, which indicates that the connection between the nosed is oriented and that no packets are lost in the network.

What happens if we use UDP instead of TCP?

If we use UDP instead of TCP, we may lose packets since UDP is a best-effort protocol with no assurance of delivery. So the program is not working correctly.

What happens if the UIDs generated are not unique?

If the UIDs generated are not unique, that is, if two or more nodes have the same UID, there are two possibilities. First, if the generated unique IDs are less than the leader's ID, the program will function properly and appropriately identify the leader. However, if the generated unique IDs are the highest ID, when the first node with the highest node changes the id inside the packet and the second node with the same highest id receives the packet, it marks itself as the "leader" because it receives a packet with the same ID and this node will become the leader, not the first node that already changed the UID of the packet.

Given your algorithm in part 1, can you calculate the chance of any two UIDs to be equal?

Since the number of nodes should be at most 16-bit unsigned integer, the upper bound use for generating random number is 65535 or 0xffff, it means each node will be assigned a number between 0 to 65535. So, for two different nodes x and y, we have 65535 options for each node. All combinations of x and y is 65535 * 65535. Out of those combinations, we have 65535 options with x = y. Hence the probability of x being equal to y is $\frac{65535}{65535 * 65535} = 1/65535$. If we have n nodes in network, the probability that at least 2 nodes have the same UID is: $(2, n) * 1/65535 = \frac{n!}{2!*(n-2)!} * 1/65535$