# PAGE RANK: HOW DOES GOOGLE WORK? 11

Alright guys so in the previous videos you were introduced to the concept of directed graphs. You have seen how you can work with directed graph using your networkx package as well as i had introduced you to this game of points distribution. So we had seen the concepts. So let us see as i had said one snap you had done the calculation what happens if we keep repeating this? So let us first try simulating this in excel that is the spread sheet we will try simulating it because we are doing it for some thousand times manually if you do there is a possibility that after some iterations you may get some fractions as well so you may have some errors if you do it manually so let us use this spread sheet software and let us see what happens. Let me open new sheet, i ma opening the new spread sheet so let us say we are starting with ok let us say we are starting with hundred points per a node we have the nodes a b and c let us use the same columns for ease of understanding we start with hundred points so i have given hundred points to all three of them and i have asked them to exchange based on the rule and after exchange what happens we had seen. What will be the new points that will be accumulated we have seen let us refresh once new points of A is nothing but old points of C just it will retain that so what is the new value here this is the time one let us say at time t is equal to one this is the values they are initially equal values all hundred points each so at time two what happens? What are the old points of C is what A will have so let me say equal to C one old points and so what for B what is the new points of B is? Half of the old points of A so i will say equal to old points of A is A one here divided by two, half that's why i am dividing it ok so for C what is the new points? Half of old points of A plus old points of B because C is liked by both this people so it will get more points so half of old points of A and old points of B we have to add them up. Let us fill that formula half of old points of A i will say A one by two plus what is it whole points of B so its B one ok so as i have said it is hundred, fifty and one fifty  so this calculation we have done it. What happens if we repeat it for further iterations? So in excel if you drag it the formula will get copied automatically it will get adjusted that is nice feature available in this software so will drag it and see what happens see these are the values after some ten iterations so it is hundred, fifty, one fifty so that one fifty came here half of it comes here so some kind of jugluary happens and that every point as i have said the sum will be constant. The sum is equal to let me give the space so tha you can understand this is the points and this is the statistics we are calculating let us see we are calculating the sum equal to A one plus B one plus C one ok this is the sum so i need to copy the same formula here as well see the individual points the distribution differs but the sum of the three values remains constant so this is something similar to your law of conservation of energy in your physics, energy can neither be created nor be destroyed it will keep getting transferred from one form to another form right so something like that the points are neither created nor destroyed that keeps getting transferred from one party to other party in the system that's what is happening in this game so we have done this for ten iterations right so let us further extend it let say for some twenty iterations what happens? So some values have occurred so let u stake this let us even see the sum see the sum remains constant with irrespective of whatever is the distribution here among the three items the sum remains constant factor twenty some sort of convergence that is occurring that is by convergence i mean between the previous one and the next one there is no much difference or it exactly

remains the same that is what i mean by convergence let us see what happens when do we get convergence let us now fast forward and let us i mean we had check by ten iterations right first we check for the first ten then we check for the twenty and we keep on checking like this know so let us check for lot of iterations so let us some ok so i have checked for some another fifteen iterations so it appears to converge but here its one nineteen point nine nine and one twenty point something fifty nine point nine nine nine one twenty it appear to converge. Ok let us further extend let us see what happens ok. Let us further extent let us see what happens. Let me say i ma extending till one forty see here there is an exact convergence one twenty, one twenty, sixty, sixty, one twenty one twenty and it will remains the same irrespective here after how many ever times you repeat it remains the same let us see where this first convergence has occurred so at the sixty sixth iterations it was one twenty sixty six one twenty sort of a stable state has been reached, sixty seven the same sixty eight the same after that how many ever you repeat the same points distribution is preserved and of you want to see the sum let us extend and see let us extend and see here let us extend and see the sum alright so till here see the sum of three hundred from the beginning till the end and after sum the exchange of points keep happening to see we initially began hundred hundred hundred equally the three hundred points were equally distributed to the three parties they were asked to exchange as per the rules so the points after one exchange changed after another exchange there is further change in points in so that keep kept on shuffling the distribution kept on changing but irrespective of distribution sum always remain constant so you can see that the property that has to be observed and this convergence factor is used in your page rank algorithm so we had simulated this using the spread sheet so let us now get into the programming part and simulate it using our python programming skills. This will be done in the next part.