RECURSION 06

Alright guys hope you had seen a few examples of our recursion work, this is yet another mathematical function or mathematical sequence i would say which can be easily computed using recursion. So this is what we call as the Fibonacci sequence let me give you some explanations in commands before we start off with the coding. So we are going to see what is called the Fibonacci sequence. I guess you guys are familiar with it, still let me give you a brief overview so the Fibonacci sequence starts with zero and one this is the zeroth Fibonacci sequence same like computers it here the counting starts from zero, zeroth Fibonacci sequence is zeroth Fibonacci number is zero let me write one by one that's better, zeroth Fibonacci number is zero sorry i am sorry for this, zeroth Fibonacci number is zero the first Fibonacci number is one second Fibonacci number is nothing but now you have got two numbers let me put it ok, given that you have got two numbers you add this two numbers and you got the result has zero plus one is one so this is your second Fibonacci number. The third Fibonacci number is nothing but add the last two one plus one two, two is your answer, the fourth Fibonacci number is one plus two three, three is your answer, the fifth Fibonacci number is three plus two five this is your answer and so on and keeps going keeps on going it is a infinite sequence basically. The initial two values are nothing but the seed values they had given, these are the in our recursion terminology this is the base case or the anchor case, this is the base case or the anchor case for these two things we know the value we can directly written the value, you can directly say this is the value, they say i won the first Fibonacci number they can directly say first Fibonacci number is one if someone is asking you the tenth Fibonacci number something like that you don't know you need to calculate it so using zero and one you find two, using one and two you find three, using two and three you find four so do you see a bigger value of the Fibonacci number that is the nth Fibonacci number depends on the value of n minus one Fibonacci number plus n minus two Fibonacci number so it depend on the previous two values right? so here we can apply recursion and we can easily find the nth Fibonacci number so our objective here is to find the nth Fibonacci number, Fibonacci number we can have the iteration of the code too but in this case i would leave the iterative version of the Fibonacci number as an exercise for you guys please do try it, it is not very easy it requires some amount of thinking but it's not herculean task something like it it's not rocket science it is do able so you need to invest some amount of time you invest some amount of thinking, if you do that you can find iterative way how to find the Fibonacci number, so that i would leave it as an exercise, i would demonstrate the recursive way for you. Ok so let us start off i need to define Fibonacci, i would say Fibonacci of n, nth Fibonacci number is what i want to find, i know the zeroth Fibonacci number and first Fibonacci number, zeroth Fibonacci number is zero, first number is one so in this case i need to return if given n is zero i need to return zero, if the given n is one i need to return one so if n is zero or one i need to return back n itself so that is my base case ok that is why i had given a space here as well this is the base case and maybe i will put a dash here this is the base case and this are derived from the base numbers ok so this is the base case so let me first put it, if n is less than two and similar to that the negative value of n Fibonacci is not defined we need

to check that in the main part where we are calling this functionality same as factorial how it is defined just for positive numbers and zero, zero and positive numbers Fibonacci is also defined only from zero for negative numbers it is not defined so let me say zero and one right so let me say n is less than two just return back that n, if it is zero return zero if it is one return one so like that n ok else if it is greater than or equal to two from two onwards we are dependent on the previous values so you should return back the Fibonacci of n minus one plus Fibonacci of n minus two maybe you want the second Fibonacci number you should return Fibonacci of two minus one that is Fibonacci of one plus Fibonacci of zero that is what we calculated, Fibonacci of one is one, Fibonacci of zero is zero so that is the first Fibonacci number is one, zeroth Fibonacci number is zero so zero plus one, one that is how we calculated right? so that is what we are doing you take the previous two Fibonacci numbers and add it is what you are doing, if you need the third one what you do is second plus first, first one you know the value so substitute one, Fibonacci number second Fibonacci number you don't know so you calculate second Fibonacci number plus one for getting second Fibonacci number again you call it for second it is first plus zeroth so zeroth plus one is one, one plus one is two so you will get the third Fibonacci number so you can trace it on a paper and you will understand the working so this is how basically Fibonacci numbers work if it is less than two just return back the same value otherwise return back the sum of previous two values right? This is the intuitive way of explaining Fibonacci numbers see we have translated our institution we have translated the intuition into code very easily all thanks to recursion with this powerful technique we can really made this code very very easier but for iterative version you can write an iterative version i don't say that with iterative version it is totally impossible you can write an iterative version but it requires some amount of thinking invested here ok so i have got the answer so i should take an input n is equal to integer input what i wanted so i will type cast for because of my machine dependency i type cast input enter the positive may be i can say or non negative that is because zero is also defined right! so i should say non even in factorial please make the correction there, it is non negative because zero factorial is one also defined so enter an non negative number, enter a non negative number is the input is the message i got so and from input i will get still i need to check in case that person has by mistake entered an negative number i shouldn't throw at him some, some results that is incorrect so i should throw him i should tell him the suitable message properly so i will print undefined for negative numbers n is less than zero means that it is a negative number whatever input he has given what is undefined? Fibonacci number is undefined for negative numbers. Ok so i will say Fibonacci numbers are undefined for negative numbers ok so i had given it Fibonacci numbers are undefined for negative numbers else if it is not a negative number than i should print the nth nth Fibonacci nth is not correct because we gives first second i have to put st and nd here properly so that formatting is needed i would modify the message instead smartly Fibonacci number at position sorry it is position n is i should call Fibonacci of n alright? I hope you guys can understand this till now see i take a number input a non negative number zero or positive i agree if it is a negative number i will say it is not it is undefined i print this message else i call this functionality Fibonacci or n ok if i call this functionality Fibonacci or n if that number is less than two for zeroth Fibonacci number is zero first Fibonacci number is one so this is something defined as the base case for us so in that case i will return the value of n otherwise i will compute the

sum of previous two Fibonacci numbers right? so this will input the nth Fibonacci number so for first let me verify further let me enter five, if i enter five i should get five as the answer or maybe enter four i should get three as my answer let me verify it first then maybe i will find the other Fibonacci numbers ok let me run the file ok enter an non negative number i will enter so just for verification i enter minus seven Fibonacci numbers are undefined for negative numbers, yeah! I got the proper message ok now let me test it if i enter four the fourth Fibonacci number is three i should get three as my answer let me run it, enter a non negative number let me enter three, sorry four, fourth Fibonacci number is three, third Fibonacci number is two fine you can do it. Let me enter four Fibonacci number at position four is three yeah it is working so now let me find out the tenth Fibonacci number let me do tenth Fibonacci number, Fibonacci number at position ten is fifty five maybe you can list the numbers like this and you can verify but its correct so once its working here definitely it will work for many value so using this program you can find the Fibonacci number at the nth position in the sequence, in the Fibonacci sequence what is the number present at the nth position, so here nth is luckily this is one thing in mathematic which is very close to computer science counting starts from zero so nth number is nothing but for humans counting style n plus oneth number pleas have that in mind here counting starts from zero. I would recommended you guys invest some time thinking if you can do this in an iterative fashion it requires some amount of thinking to make it iterative it is possible it can be done but it is not straight forward it requires some amount of thinking so when you invest some time for thinking in the iterative style you would definitely appreciate the technique recursion because it’s lets you do something straight away from your intuition whatever you understand from someone explanation you can straight away try staring the code recursion allows that thing, that particular thing is difficult when you do it in the iterative way but still it’s not a rocket science it’s doable please do invest some amount of time try doing the iterative version and please do discuss in the discussion form of how you tried the iterative version what are the challenges you faced? Or if you can print the sequence Fibonacci sequence if they are asking the nth Fibonacci number, can you print the sequence starting from zero till the nth Fibonacci number, can you try that variation? You can do a lot of things pleased do explore and keep trying more examples so that you understand how recursion actually works. Thanks for watching, have a nice day.