good morning to all of you we continue with our discussion on electrostatics
 so today we will start a very important topic in electrostatics that is electrostatic potential energy you have all learnt about gravitational field and when you have an object in the gravitational field to move the object you need to exert an extra force
 so imagine we have we have the ground surface here and i need to move an object from a certain height to another height
 so there is a gravitational force which is trying to pull the object below and i need to apply a force against the gravitational field to move the object up and
 so i have to do work to move the object from a certain height to a larger height which means that work which i am doing actually gets stored in the form of a potential energy of the object
 so the potential energy i can define a potential energy which means that i the object has some energy here i move the object from one height to another height i am moving the object against the gravitational field and i am doing work on the object and
 so when the external force does work on the system the energy of the system increases and
 so the potential energy of the object increases here
 so this is a example in gravitational field which you must have studied earlier on in fact if i leave the object here the object falls down on its own accord the field pulls the object down and the potential energy of the object gets converted to kinetic energy we have a similar situation in electrostatics where we can define an electrostatic potential energy
 so suppose let me assume that there is an electric field pointing down uniform electric field pointing downwards ah let me call this as the x axis this is some axis which called z axis
 so i have a uniform electric field pointing downwards
 so if i have a charge here say let me take a charge q
 so the charge q will be acted upon by an electrostatic force depending on the sign of the charge the electrostatic force is either downwards or upwards
 so to move the charge from this point another point i have to apply an external force and in that process the external force does work on the system
 so let me assume that i have a an object at this point
 so let me call this position as x i and this position as x f i stands for initial f stands for final
 so my electric field is pointing downwards
 so as you can see from here electric field is some constant times i cap with the minus sign the electric field is pointing in the minus x direction x direction is pointing upwards
 so what is the force electrostatic force on the on the charge is minus q e naught i cap that is electrostatic force to move the object to move the charge from x i to x f i need to apply an external force which is negative of this which is minus f electric which is equal to q e naught i cap
 so i have to apply a force in the upward direction here to move the to move the charge
 so that is the force that i have to apply externally and what is the distance i must move the distance i must move is ah
 so let me call this l vector is x f minus x i into i cap
 so i start from x i and move to x f and the i am moving like this from here to here
 so the length which i am moving the the distance by which i am moving is x f minus x into i cap

so the work done by the external force on the charge is equal to f external dot l which is equal to q e naught into x f minus x i

so if i call this height h this is equal to q e naught h

so this is the work done by the external force to move the charge from x i to x f and this work gets stored in the form of potential energy of the charge please note that this is the work done by the external force on the charge

so this equation is true for all kinds of charges

so let me try to draw a figure here which which sees what happens with various charges

so i have the electric field pointing down

so suppose my charge was positive and i move from here to here

so the work done the work done is equal to q e naught h and q is positive

so w is greater than zero that means i need to do work on this chart in taking it from this point to this point x i to x f

so if i call the initial energy of the charge as u i and final energy as u f you see here in this case u f is greater than u i the potential energy at this point is more than potential energy at this point

so i have to do work on the charge in taking the positive charge from here to here now what will happen if the charge was negative

so if the charge was minus q again x i to x f now in this case the work done is equal to q e naught h is less than zero because q is negative q is negative here

so if the initial energy is again u i and finite energy is u f in this case u f is less than u i

so i am moving like this

so in moving a positive charge from x i to x f i have increased the potential energy of the charge in moving the charge from x i to x f with the negative charge the potential energy has got decreased what is happening what is the difference between these two cases in this case the positive charge there was an electrostatic force on the positive charge which was downwards and i am moving the charge against the electrostatic force here for the negative charge the electric field is pointing down and i am trying to move up the force on the negative charge is upwards and

so my movement is along the direction of the electrostatic force and in which case actually the field does work on the charge and

so the charge comes out to be negative the work done comes out to be negative which means that the final energy of the charge is less than the initial energy

so you can do similar plots for example if the electric field was pointing downwards and my charge was going from here to here this is x i this is x f if this is a positive charge then i am moving in the direction of electric field

so you can show that u f is less than u i in the other case where e is like this and if i have a negative charge and going from x i to x f by moving like this the electrostatic force on the charge is upwards and i am moving against

so u f is greater than u i here

so depending on the direction of electrostatic force if i have to move the charge against the electrostatic force the work done by the external agent on the charge is positive and

so the potential energy increases if the movement is along the direction of the charge of the of the electrostatic force the work done is negative and the potential energy decreases this is also consistent with gravitational ah situation where if i have to move against the gravitational field the potential energy increases if i move to along the direction of gravitational force the potential energy decreases the difference between gravitational and electrostatics is in gravitation there is only one force of attraction there is no poles of repulsion while in the case of electrostatics you can have either

attraction or repulsive forces and

so you can have combinations of positive and negative charges moving against the electric field or along the directional electric field

so i leave it as a exercise to you to draw similar figures for e pointing upwards

so you may practice electric field is pointing upwards you find out what are the initial and final energies whether they increase or decrease depending on the charge plus q or minus q and whether you are moving upwards or downwards

so i leave this as a small exercise to you and that will help you to understand whether the potential energy increases or decreases in the various situations now in the example which i looked at i just took the charge vertically up from one point another point now it means

so happen that my movement may not be vertical

so let me consider the following problem this is my x this is z axis

so electric field is again pointing downwards uniform electric field everywhere

so my objective is to move from one point to another point here

so ah let me call the coordinates of this point x i z i and this is x f z

so i start from x i z i and i have to move to this point

so let me call this a and let me call this b

so i have to move a charge let me take a positive charge i have to charge plus q from a to b now obviously i can have different paths to take the charge from a to b i can move for example first horizontally and then go vertically let me call this path one i can go vertically first and then go horizontally let me call this path two or i can go straight straight like this path three

so i can either take the charge first horizontally here and then take it up or i can take it first up to the same height and then horizontal or i can take it at an angle from a to b straight lets

so let us try to calculate what is the work done in moving the charge from a to b along these three paths

so let me look at path one now

so path one

so let me call this c and let me call this d

so path one first i go from a to c and then from c to d

so in going from a to c let me calculate the work done

so ah the electric field as we as before is minus e naught i cap l vector which i am moving from a to c is is equal to ah z f minus z i into k cap remember that c the coordinates of c are actually x i z f

so i am not change the x coordinate i only change the z coordinate and

so this vector connecting a to c is nothing but z of minus z i into k cap

so the work done in moving charge from a to c is equal to ah

so f external dot d l dot sorry l and the f external is minus f electrostatics dot l vector which is equal to plus e naught i cap into q the charge which i am having

so the force s q times electric field dot z f minus z i into k cap which is equal to zero because i dot k is equal to zero

so i am actually moving from a to c i do not have to do any work which becomes a little obvious because now the electrostatic force is vertical and i am moving horizontally

so the displacement is perpendicular to the electric field

so this displacement is perpendicular to the force that i am applying then i have to apply and

so i do not have to do any work in taking the charge from a to c now from c to b i have to calculate the work done and this we have already done before calculating the work done to move vertically we have just calculated and that

happens to be

so work done is equal to q e naught into x f minus x i

so the total work done in moving from a to b via c that means a to c and this c to b total work done is actually equal to q e naught x f minus x i now let me try to calculate for this other path path two which is going from a to d and then from d to b

so first is a to d

so a to d is essentially going from this point vertically up

so the z coordinate of these two are equal x coordinate has changed

so just like before what we did the charge is taken vertically up

so from going from a to d the work done is equal to q e naught into x f minus x i in going from d to b just like in going from a to c i have to move perpendicular to the electrostatic field and

so no work is being done

so d to b work done is equal to zero

so total work done by the external force in moving from a to b by r d is equal to q e naught x f minus x i which is the same as the work done in moving the charge from a to b via c these two terms are equal

so now let me calculate what is the work done in going from a to b along path three the path three is now not straight at an angle

so path three

so path three i have essentially i am moving along an oblique direction from a to b

so let me calculate this vector l vector

so for path 3 l vector is equal to x f minus x i into i cap plus z f minus z i into k cap look at this point this point has coordinates x i z i this point has coordinates x f z f

so this vector joining x i z i to x f z f is x f minus x i i cap plus z of minus z i k cap and the external force again is equal to ah minus of a electric force which is equal to q e naught i cap

so work done is equal to f external dot l which is equal to q e naught i cap dot x f minus x i i cap plus z f minus z i k cap which is nothing but q e naught x f minus x i because i cap dot k cap is equal to zero which is the same as the work done in taking the charge from a to b via c

so what we have seen for the electrostatic case is the work done in going from a to b is the same whether i go from a to b by a c or via d or straight from a to b in fact you can take any arbitrary path connecting a and b and you will find that the work done in moving from a to b is exactly the same as before q e naught x f minus x i

so what this shows is shows us is that the work done is independent of path followed thats a very very important concept these such forces are called conservative forces gravitational force is also conservative force the work done in moving a mass from one position to another position is independent of the path taken and it is a an example of conservative force

so if you have to take a charge from one initial point another final point it does not matter what is the path you follow let me take as another example the because in this case what we had taken was an electrostatic force which was uniform now let me take a case in which the electrostatic field is not uniform and that is a point charge

so let me take a point charge q

so here is my charge

so i want to move from an initial point this distance r i to a final position r f ok that is my

so i want to move from a charge from here to here

so let me assume the charge is cap small q

so i want to move a charge along the radial direction from point r i to a distance r f

so let me call this a and let me call this b

so i want to move a point charge with ah with magnitude q from a point a to a point b

so again

so what is the electrostatic force is q times e which is equal to q q by four pi epsilon zero r square into r cap that is the electrostatic force on the charge

so my external force which i have to apply is minus of electrostatic force which is equal to minus q q by four pi epsilon zero r square r cap and my vector which i am moving is along the radial direction

so you know that the work done if the force is non uniform integral f external dot d l from the initial point of r i to r f from the initial point to the final point the dot product of force external force that i am applying dot d l vector and in this case as you can see d l vector is nothing but d r vector which is actually equal to r d r k r cap d r because the vector is along the r cap direction this is the r cap direction remember we have discussed in coulomb's law that is r cap direction

so the work done now becomes by external force is equal to integral f external dot d l from ah r i to r f which is actually equal to now this is ah the external the force is minus q q by four pi epsilon zero r square ah r cap dot d r r cap from r i to r f which is equal to minus q q by four pi epsilon zero integral r i to r f d r by r square which is equal to minus q q by four pi epsilon zero integral of one by r square is minus one by r r i to r f which is nothing but q q by four pi epsilon zero into one by r f minus one by r

so this this minus signs cancel off and i get q q by 4 pi epsilon 0 into 1 by r f minus 1 by r i that is the work done by the external force in moving the charge small q from this point a to point b where r is the initial distance and r f is the final distance now this equation is valid irrespective of the sign of the charges

so you can see that for example if the charges were both positive

so if the charge capital q is positive and the charge which i am moving is also positive and i move from here to here

so this is a and this is b you see with the positive the force is repulsive the force is in the in this direction the electrostatic force and i am moving in the same direction

so the the initial the final potential energy will be less than the initial potential energy as you can see here the work done because work done was equal to q q by four pi epsilon zero one by r f minus one by r i

so here q and q are both positive r f is greater than ri

so work done is negative

so the field is doing work already the the force is repulsive and i am moving along the direction of the force and

so actually the field does work on the system and i have to do negative work similarly you can calculate suppose i had a plus q here and i had a minus q charge here in going from a to b now ah q times q becomes negative

so work done is equal to

so this is minus q capital q by four pi epsilon zero one by r f minus one by r i this is negative this is negative sign

so this is greater than zero

so u b is greater than u a again this is obvious because this negative charge the electrostatic force is attractive and i have to move the charge against the

electrostatic force
so i have to do work on the charge in moving from a to b in which case that work which i do get stored as potential energy of the charge
so you can work out the other combinations here to find out what is the work done by the external agent in moving the charge from an initial point to final point you can take different cases where ri is less than rf rf is more than ri etcetera etcetera and i leave the discussion to you now just like in the earlier case what we will find is
so let me take for example this the charge plus for exam q and i want to move from this point to another point here
so in earlier example which we started discussing the two lines the two initial and final points were along the same radial line now i am taking two points which are not along the same radial line a b like this
so i have to move like this now i want to move from a to b
so i can do different kind of combinations for example first i can move like this along a circular arc along q and then move from here to here i can move from here to here and then move along the circular arc or i can have any combination of position paths for example i can do like this i can move along radial then go like this then move along radial then go like this then move along radial go like this now for example if you look at this path around this path which is a circular arc the movement of this part is exactly perpendicular to the neutral static force at every point at this point electrostatic force is if there is a positive charge electrostatic force is like this and i am moving perpendicular at this point there are static forces like this i am moving perpendicular at this point there are static forces like this i am moving perpendicular till i reach this point and then i move in the same direction as the electrostatic force
so here i do not do any work and here i do the work which i have already calculated as q q by four pi epsilon zero one by r f minus one by r a similarly if you look at this path i go from the distance r i to distance r f along the radial direction and then i move along the circular arc connecting this point to this point along this direction i do the same work as this along the arc i do not work because i am moving perpendicular to the electrostatic force similarly you can calculate for any path what you will find is path independence of work done
so any electrostatic force that you have the work done to move a charge from one initial point to a final point is independent of the path and as i mentioned before this is a characteristic of conservative forces
so what does this imply for example
so let me take ah let me take a following example
so i have a charge and then i am moving i i want to move between path a to b like this and i want to come back
so let me call this c one and c two
so i do a circular path
so i start from a go to b and come back to a from another path along another path
so let me calculate the total work done
so total work done is f external dot d l and this as i mentioned before this circle on the integral sign means its a closed path
so this is equal to a to b along c one f external dot d l plus b to a along c two f external dot d l now i know that as we have discussed integral a to b along c one f external dot d l is equal to integral a to b along c two the second curve f external dot d l which is actually minus of b to a along c two f external total

so the work done in going from here to here is the same as the work done in going from here to here along this path the word done going from here to here is negative of the work done in going from b to a thats what this says
 so you see that these two are equal and of opposite sign which means that i get the following very important ah expression that integral f external dot d l is equal to zero that means in a closed path net work done in a closed path is equal to zero and this is again a characteristic of conservative forces the net work done in carrying a charge from a to b back to a through any two different paths any path is actually zero
 so you may be doing some work in taking a to a to b along c one and then the field does an equal amount of work in bringing the force bringing the charge from b to a along another curve
 so the net work done becomes zero
 so this is again a part of conservative forces and
 so what we can do is with this we can define we can define a potential energy we can now define a potential energy electrostatic potential energy
 so let me again take a point charge remember we had calculated the
 so work done pi external force is equal to q q by four pi sine zero one by r f minus one by r a ok
 so remember in gravitational fields we define the potential energy with respect to some reference
 so normally we say the ground has zero potential energy
 so when i take a object by a certain height i do work on the object and
 so there is a potential energy stored in the object similarly we will define the electrostatic potential energy at any point with respect to a reference potential which is
 so the reference point is usually chosen reference point is usually chosen at infinity and this is zero of potential energy
 so i will assume that if i have a positive capital q charge here if the other charge is at infinity then there is no energy in the system this potential energy is zero and then when i bring the second charge close to this first charge i will do work on the charge and i will change the potential energy
 so in this equation if i substitute r i is equal to infinity and r f is equal to r that means this will give me the work done in bringing a charge from infinity to this point this distance r from here
 so work done in bringing a charge small q from infinity to this point at a distance small r will be given by this equation which i will define as the potential energy here which is potential energy is a potential energy at a position r between these two pair of charges is q q by four pi epsilon zero r please remember because the work done is independent of path followed no matter how i bring the small charge q from infinity to this point i will have to do exactly the same amount of work
 so i can define a potential energy which only depends on this point which is the energy to bring a charge small cube from infinity to this point no matter along which path
 so this this becomes a potential energy at this point
 so this is the potential energy of a pair of charges separated by a small this is a distance smaller
 so if i have a charge capital q capital q and a small q separated by distance r the potential energy
 so this is the potential energy of this pair of charges please remember that if i had calculated the following suppose i say i have a short small q and i bring capital q charge into this point at a distance r from this pole charge i will get the same potential energy the energy is stored as a in the entire

electrostatic system of charges itself and it only depends on the separation between these two charges through this equation q q by four five epsilon zero r and this is the potential energy of this system of charges although i brought in small q from infinity to this point i could have brought capital q from infinity to this point i could have moved both charges from infinity together to bring it to a certain distance small r whenever finally they land up with the separation of small r this pair of charges now has a potential energy which is q q by four pi epsilon zero r

so this is for a pair of charges i can similarly calculate for more charges

so for example suppose my final system has three charges

so i have suppose i have to bring i have to bring three charges q one q two and q three my question is what is the potential energy of this system of three charges

so i do the following ah procedure first i have nothing here

so i bring charge q one and place at this point because there is no other charge present i have to do no work in bringing q one and placing it here once having placed q one here i bring q two from infinity to this point

so let me call this distance r one two

so what is the ah potential energy between q one and q two

so let me call this u one two is equal to q one q two by four pi epsilon zero r one two product of the two charges divided by four pi silent zero into separation between them that's the potential energy of q one q two pair of charges now with these two charges present here i now bring q three from infinity and place it at this point

so let me call this distance as r one three and this distance as r two three now you see when i bring in q three from infinity i have to do work against the electric field of both q one and q two simultaneously

so what will happen is the work done by me to bring in charge q two will be essentially

so let me let me calculate sorry charge q three let me calculate the work done in bringing q three to this point

so this will be w will be integral f external dot d l which is ah from infinity to this point infinity to this point

so let me call this point c a b c

so this is equal to minus of f electric field dot d l from infinity to c and f electric field is actually the charge both the charges now produce electric field at this point as a function of distance and we know that we electrostatic satisfies principle conservation

so i have q one by four pi epsilon zero r square r cap plus q two let me let me write like this ok

so if electrostatic is equal to ah q one times e one electric field because of charge q one sorry q three the force on this charge q three is q three times e one plus q three times e two e one is electric field produced by charge q one e two is electric field produced by charge q two this is the force of force on the charge q three because of electric field of q one this is the force on the ah charge q three because the electric field produced by q two and

so this is the total electric field that the charge q three has to move against

so the work done will be equal to minus q three times e one dot d l infinity to c minus q three infinity to c e two total now what is this this is the work done in bringing a charge q three this is the work done in bringing a charge q three because of the electric field produced by q one there is no dependent on q two here and that must be as we as we have discussed before q one q three by four pi epsilon zero r one three because e one is electric field produced by q one and this is the work done in bringing q three from infinity to this point at a

distance r one three from here
 so the work done is exactly the same as this equation except that q two gets replaced by q three and this distance r one two gets replaced by r one three
 so i get a four work done which is q one q three by four pi epsilon zero r one three and this is nothing but the work done in bringing charge q three from infinity to this point because of the electric field generated by q two
 so this must be equal to plus q one q two q three by four pi epsilon zero r two three
 so this is the work done in bringing q three to this point
 so the total work done in assembling this charge distribution is the sum of the work done in bringing charge q 2 to this point and the work done in bringing charge q 3 to this point
 so the total work done or total potential energy is equal to q one q two by four pi epsilon zero r one two plus q one q three by four pi sine n zero r one three plus q two q three divided by four pi epsilon zero r two three
 so this is the energy because of q 1 q 2 this is the energy because of q 1 q 3 and this energy because of q 2 q 3 that's the total energy of the system of charges and as i mentioned we associate this potential energy with the entire system of charges i have now brought first i brought q one then i brought q two then i brought q three you can calculate and show that this is independent of whether i bring q one first or q three first as long as finally the charge distribution sits in this particular pattern the work done it will be equal to this and
 so the total potential energy stored in the system is the sum of these three
 so it is independent of the sequence of bringing the of these charges
 so in general you can write you can actually generalize this to any number of point charges and you get the total potential energy
 so having looked at potential energy we now dis we now introduce a very very important concept in electrostatics again which is the electrostatic potential
 so electrostatic potential is the work done by an external force in bringing a unit positive charge work done by an external force in bringing a unit positive charge from infinity to the point is the electrostatic potential at that point
 so it is essentially the work done in bringing a unit positive charge from infinity to that point
 so remember we had discussed if i had a charge capital q and if i have a ah if i bring a small charge q here at a distance r from here the potential energy was u was capital q small q by four pi epsilon zero into one by r f minus one by ri
 so this is the potential energy at this point or change in energy in bringing a charge from r i to r f
 so the potential energy was when i when i put r i is equal to infinity
 so potential energy u becomes q q by four pi epsilon zero r at this point
 so if i take a small charge capital q as unit charge then i will define the potential at the point r as v of r is equal to q by four pi epsilon zero r this is for a point charge the potential of a point charge is essentially given by q by four pi seven zero r
 so if you have a positive charge here as you move along the direction r increases and the potential potential keeps on decreasing
 so this is decreasing like this for a negative charge the potential will be if i move along the same direction for a for a negative charge the potential will be increasing
 so depends on the sign of the charges whether the potential increases or decreases ah as you move away from the charge
 so this is the potential at any point is defined for this is the potential for a point charge

so for any general electric field distribution you can define an electrostatic potential as the as the work done in bringing a unit positive charge from infinity to that point

so if you have to for example if i had a positive if i have a point charge q

so if i um if this point is say r i and another point is r f what is the work done in being in taking a charge from r i to r f

so work done by the external force will be equal to the potential at the r f minus potential at r i for to bring to take a unit charge unit positive charge

so difference in potential gives me actually the work done in taking a unit positive charge from one point another point

so potential is a very very important concept in electrostatics and ah as you can see here the electric field decreased as one by r square the potential decreases as one by r and there is a unit which is used for potential unit of potential is bolt this is after an italian scientist alessandro volta who was who worked in the years 1745 to 1827.

he was he was a great scientist who did a lot of work in electrostatics and this name is this potential unit potential potential is named after him

so you can also then find another unit for electric field because as you can see here potential is q by four pi epsilon zero r the electric field of the charge would have been q by four pi epsilon zero r square

so you define electric field as volt per meter this is s i unit of ah electric field volt per meter we have seen earlier other units for electric field this is another standard unit which is used for electric field now let me calculate let me do an example to calculate some numerical values of potential

so here is an example

so i have plus 10 nano coulomb i have another charge here minus 10 nano coulomb separated by distance 6 centimeters in the equatorial plane i consider a point here ah this is four centimeter let me call this point a i consider another point here b this is at a distance of four centimeter from here and a third point c which is ah at a distance of four centimeter from here ok

so i have plus ten coulomb minus ten nano coulomb and these two charges generate an electric field i want to calculate the potential at different points

so first let me start calculating potential calculation

so v at a now potentials also satisfy principle of superposition

so the potential at a total potential at a is a potential at a because of plus 10 nano coulomb plus the potential at a because of minus 10 nano coulomb

so if what is this distance if this is r because i am taking a on the equatorial plane this distance is also r

so potential at a is

so let me call this q one and q two q one by four pi epsilon zero r ah

so plus q two by four pi epsilon zero r the distances are equal and q two is equal to minus q one

so this is equal to zero

so the potential at this point is zero because that is an equatorial plane just put this as a positive potential here that would be the negative potential here and

so the total potential at this point a is zero let me try to calculate the potential at the point b

so b at b q one by four pi epsilon zero ah

so this i must calculate these distances now

so let me ah call this ah r one and the other distance r two r one minus q two is minus q one

so four pi epsilon zero r two

so let me substitute this numbers

so v at b is ah ten nano coulomb one by four pi sine zero is nine tenths power nine divided by r one r one is four centimeters

so four into ten to the minus two minus ten nano coulomb four pi epsilon zero term here divided by r two which is four plus six ten centimeters please be careful with units i am using s i units everywhere

so this comes out to be two point two five into ten to the power three minus nine into ten to the power two which is equal to one point three five into ten to the power three volts

so that is the potential at this point

so that is the work done in bringing a unit charge positive charge from infinity to this point and that is equal to one point three five to the power three volts you can similarly calculate the potential at the point c

so b at c will be equal to

so i leave this exercise to you this is minus one point two five into ten to the power three volts please note this point is closer to the negative charge here than the positive charge

so the the total overall potential happens to be zero minus one point two five to the power three volts ah and the potential at a was equal to zero now let me leave a problem to you problem calculate the work done in moving a charge of five nano coulombs from a to b and from a to c

so i leave this exercise to you please calculate what is the work done in moving a charge of 5 nano coulomb from a to b and from a to c i leave the path to you to choose appropriate parts to calculate the potential the work done

so it is an interesting exercise for you to understand calculation of calculation of forces and the potential differences ok now what i would like to do is to look at the potential of a as another example potential of a charge conducting sphere

so i have a sphere of radius r and i have thrown in some charge capital q remember we have discussed that the entire charge will sit on the surface

so i will end my lecture here in the next class what we will do is calculate the potential due to a conducting sphere which has been put excess charge and we will get some interesting results from here thank you you