Lecture 5

2 s complement

definition for the two complement is that from a mathematical interview the 2s complement represent representation of a negative number is the value to the power of n - P where P is the absolute value of the represented number in fact even the definition is exactly the first and the official methods by which the Two's complement is computed yeah because you know I hope you know until this hour that we have how many four methods for computing the two representation so the two complement first of all that is why I highlight these frequent comments yeah because uh I wanted to jump in your eyes what it is important which are the keywords what is it yeah so these are the keywords in the definition OK 2s complement is the concept but now what are the key concept that the keywords are two keywords representation this means that the two complement is referring to word presentation not to work do what to an interpretation note that definition starts from a from a representation of course that we will see in our speaking because from our point of view we are interested in basically we go further starting from the presentation usually we say like that you will see OK wait configurations in base two which are complementary of course this is the complement of this juice component of this yeah and for from a technical point of view we'll discuss those four methods that you know by means of which you can compute the two complement of binary configuration at the definitions before yeah because this is exactly what do you do you take the two add power of north and you subtract in binary that initial configuration which is given and you will obtain the twos complement of that TV OK but at what is good for that the in the first place and what the h thank you but not in the case with one but the case we start with this which are the values in the unsigned interpretation versus the science interpretation I have a number starts with zero which is the value the unsigned reputation versus the signage reputation the answer is they are the same they are the same why because they start with a zero OK start with zero that means that in both interpretations there will be of positive number that stays there this means the absolute value of that representation this is also uh admissible representation in terms of support and the proof because if you do the intersection of these two intervals this is the the proof let's make the intersection of these two terms which is the intersection between 0 and 200 and 5:55 with the other one if you intersect this you will obtain zero until plus 127 in fact these are the values on a bike that starts with zero only this one the best outside this interval those from minus 128 until minus one and last 128 until 255 these are all the values that will start in the binary representation with one and because this intersection is not the empty set that is why they have the same value here OK OK so the conclusion is from our point of view analyzing what we analyze during our course is that no to Scotland involved in the 8 case OK the bee situation it is left empty for now the situation is if we have a number that starts with the one in binary configuration exactly the case clear and again we will last exactly like we start our courses today which is the unsigned interpretation and then which is the sign interpretation here the answer will be let's say the value associated the plus ABC let's say something like that OK I mean expressing the fact that will be a positive value this is what I want to express by the noting something like that and in the same interpretation the answer is exactly what was written on the whiteboard I mean minus minus one the answer is minus the twos no minus the two complement of the initial configuration so in fact it was the first case in which the choose component was involved and decrease remains also empty why BND remain empty and now we will focus on them because BND cases represent the other two questions in which choose complement will be involved and we have no other situations so for making this classification we need to try to the binary code which is the sign bit of my representation is the first and the second one is do I include myself to the signage and position to the answer and combining this meanings the semantics will give us the real situations and the practical situation in which we can and we must use choose complement OK so the same and let's suppose this the same again is plus ABC yeah OK what will be the question that I can ask at be for being a different question that that foresee also we need to be forced to thing yes we start also for this configuration but one can we ask starting from this configuration and taking into account the fact that in base 10 both interpretation of lazyell do you obtained and what do you do with what you're telling this is in fact the topic of the person today because I want you to understand which are exactly the case in which we need to compute and to know who is the truth comment of who and what can we do with it because again in general any binary configuration has a tooth cover has a complete a complementary value for another compliment any configuration but is it good for that something to compute it or not usually not 90% of the cases no you don't you don't need it but you did it in only one piece in the case in which you find the second you word which is negative if you don't find anything it's it's no one ask you something about negative numbers it is no use to compute this is the first is it clear for everybody so if nobody asks you something about negative numbers there is no need for this one in any case you have to deal with the negative number value or a negative number representation so negative a sign dictation for needing this to stop OK this is the first idea OK so let's try to take an example which will be the main example for us and we will stay here on the whiteboard as much as possible today and let's take this binary configuration OK we think of course of course the bike because for the sake of simplicity it's enough the same discussion applies of course to work double word word word word so on but we don't need it's it's enough to discuss about yeah so the whole discussion will be on tonight size OK so we start from this binary configuration so this is a representation yeah a representation in basic steel which is the associated value 93 is the associated value in base 60 I want to be very clear that during this semester and in our topics we are focusing and we are concerned only with three compression phases 2 10 and 16 these are the only version basis that you're dealing with and which are the basis that you are interested OK uh so this is phase two this is base 16 so he based yeah the third place so from this point of view now we pass from representation to interpretation and from this point of view we know very well until now that we have two interpretations possible in base stand for any binary configuration first of all it is the unsigned one and then is the sign one OK so this is representation and these are interpretations one basic thing that dictation or an interpretation a 16 is a zipped notation for basic that's all it's an equipment because you don't want to write and basically so that is why you group four binary digits and produce an extra decimal digit just for the sake of writing in a very let's say shortwave so of course that when you see base 16 you must keep in mind that what is there in fact for the processor for the architecture is still based too and nothing else so basically it's just a notation it's not a different it is another version of phase two in our OK uh let's see the other side interpretation which is the associated value to 10010011 how you do that of course you'll start from the basics team that is why I wrote on the whiteboard 9 \* 16 + 3 this is it is 147 this is the unsigned interpretation of this binary configuration OK which is the value in the signed interpretation of this representation louder please again 18 I don't want the final result explain how you obtained and which is the mechanism by means of which OK I don't need the final value because you are not a computer we want together to infer and to explain the way which we obtain this level I mean when we want to discuss about the sign interpretation of a binary configuration that starts with one the answer is that decided reputation is OK how and which is the answer how we do obtain the signage reputation is in the general case is minus the twos complement off of who on this of 10010011 OK it's clear for everybody did you know that OK so look here we are in the first case of usage that I was talking about because we have to have a representation here and also here we are talking about their presentation and we're talking about negative number we put in our minds so we are in the correct context for usage the tools comment but this is the first OK let's now compute it there are four methods for computing the truth complement offer representation of a binary configuration the first method isn't that provided by the definition that you see on the black momba slides OK you have to take to a power of end which in our case and is A8 because we are talking about the bite yeah so two is power of eight is how much do it is 200 and 56256 doesn't fit a bite 256 does not anymore fit the Bible the values representable one bite in the unsigned interpretation are those from zero to 255 but from where do you know that let's talk a little bit about this intervals also we can talk about the so-called at the missable representation internals admissible representation intervals and the discussion is like that on end positions on end positions in our case in the architecture and this orbits but the discussion is general enough beats because we discuss about power of tools on envisions we have we can represent 2A power of N values yeah on end positions we can represent to a power of the end values because we have two interpretations possible these values of course there are of two kinds signed and list or unsigned values in the unsigned interpretations this interval is from no yeah but from zero to two and power of n - 1 this is the general formula for the unsigned interpretation or unsigned numbers if you want end for the sign interpretation of sign numbers the interval is how much minus two at power up and minus one until two that Barbara end minus 1 - 1 OK again to a power and values in total in the case of the sign interpretations this is the theory behind any justification that you have to give different examples you will see the end of our course of today we'll take two examples in which I will ask you some questions exactly I do the cash for the exam and you have to start from this theory on invites we can represent two above and numbers these numbers because they are representations they can have two bullet say unsigned numbers and signed numbers or signed interpretations yeah OK starting from here and applying that to 1 byte let's try to see what means to apply to a point to award and to a double word it's enough because on the bits we have these two yeah let's see so I'm assigned interpretations on one bite is there are two 255 for the unsigned traditional one bite the sign interpretation on one bite goes from minus 128 until plus 127 OK this is for one byte for one word you go from zero to to it power of 16 which is strikethrough images that they just but because we started from zero it's 65,535 the admissible representation interval from 4 unsigned words the additional interpretation interval for assigned word is minus this one for a double word until in the science reputation OK we don't have to know but this four intervals you have to know any computer scientist knows before intervals it's enough if you know them because you work with them in high level programming languages and in fact you have to understand that from the point of view of the architecture what you call what word sign in and I don't know how as a as a predefined name for a data type it's nothing else from the point of view of the architecture that these four intervals called from the point of architecture and signed by signed by on site it so that is why 256 doesn't fit all right and it has to be represented like that OK so we have to subtract this value and we will obtain here what is the tools compliment of the initial configuration so we'll obtain the two complement of the initial configuration so and this the value that we obtain here taking as an absolute value will be the absolute value of the signed interpretation of the initial configuration check OK so let's make here tell me 11 0 0116 OK OK which in base 16 here is 60 extra shots no just superscript minus minus 9 this is 109 as an absolute value so the answer here is that the value in base 10 associated to this binary configuration in the sign interpretation is minus 109 now it's good for everybody this is the first method the second method that you know works like that how is the second method you you compliment all the big all the bits from the initial configuration and then add the one that's why how you obtained the complement that one complement of the truth compliment you take the this and write it like this 01101100 you compliment it all and then you add a one this is the second method and of course you will obtain exactly the same binary configuration OK this is the Second World the third one the third one which starts to be more practical than these two you never do and B you never do that in the real context in the real life this is theory in real life you will apply C or this the dependent on what it is asked I mean if somebody asks you which is the binary complement of the initial configuration you will apply C if somebody just will ask you which is the value in base 10 as a interpretation you don't need to obtain really the compliment in the binary configuration it's enough to obtain it directly in phase 10 and for that we have the 4th but that's how to start with the third the third method says like that that's starting from here you'll take that one hurt you start from right two left pause the that configuration it's exactly the same this is an example why is different from you if it start with three zeros OK just like OK let's finish this 4th and then give me an example of the number that you want to obtain the compliment for and we will discuss it OK so the methodology I'm interested here in methodology the example is taken just for seeing how the methodologies look like OK supplies so the methodology it's clear for the first two for the third one it is how you start to parse your initial configuration and for obtaining the compliment you will keep all the starting zeros starting from the right inclusive the first one that you find so in our case because it start with the one we will keep it we have no heroes and we keep that one but we find and all the others pets that follows all the other position that follows will be complemented yeah so this is the methodology so 011 0110 it's exactly this value or this you know that I hope you do that yeah that's the methodology this was the third one OK you know that you knew that from seminars from that from the posted material on the left part yeah everybody knew that OK so this is the third method method and this is from a practical point of view the best for obtaining the binary configuration of the twos complement of an initial binary coffee break both of them be representations OK OK and of course again I know that this is 109 and in the end I will answer that question that of course is minus discover minus 100 OK the last method can be applied only in cases in which you won't obtain a binary configuration we are not interested in and starting from the question on the left most whiteboard it's exactly our kids because nobody asks you really which is the binary configuration behind that the the question was which are the values of that initial binary configuration in unsigned interpretation and indesign one so we expect as a final answer two values in bastan am I right so nobody ask you to show which is the fine we complement of the initial representation OK so that is why this 4th method it is best to be applied here and is the fastest 1 can anybody tell me which is the 4th method do you know that or most materials you have only three wow it's the big entity why 6 again we are talking about the methodology can you give me a general recipe a general method of course that will look like for our example in the end but for being able to understand I was giving you three methods in words that are blind in the general case OK can you give me the 4th method as the definition is the general case and then applying it to our case that can be represented on M positions it's written there OK and hey go further we started from here and we go take sentence is the cardinal of the set representable on that dimension of that size is the cardinal of the set of values representable on that size is the cardinal over the set of values representable on that size I think I don't have complementary my Lord representability you promoted body now OK which is the cardinal the separate presentable on one fight the cardinal with the set of values representable 1 right two power of end is the cardinal of the set of values representable on 1.2 above 8 which is 256 on 1120 power of 16 is 65 1536 OK so based on this mathematical truth which is inferred from really the definition it follows that the sum of the two complementary value is 256 so how the hell can you obtain these 109 very easy we do only this 256 - 147 and you will obtain the absolute value of the complementary value so 256 by 147 is 109 so it's the fastest way in which you can say OK it's minus 109 not being concerned with the fact of of the fact that the binary representation behind 190 something I'm not interested in what it is if I'm putting the question like that so that is why it is important to know exactly what it is us please read carefully in December 10 when you will be at the paperwork which will be a computer board in front of you and again in January or February at the written exam or again in February I don't know but try to avoid the my last words OK so first of all this really carefully because from my experience and I have a lot all uh more than half of the wrong answers they come from the fact that you don't read carefully what it is required you are very young and very restless and you don't have patience and you don't do like I do here I identify the keywords if any questions if you identify the keywords in a definition and then in a question and of course if you know that and you understood that during the semester not only there you for sure will give the right answers but if you understand something else wrong the definition on from the question you will give wrong answers of course I will show you today this methodology of identify the keywords because I will put you some questions here and I very interested in how you would answer and how how much attention will you pay to my questions I would see OK so this side of the four methods for determining the two complement of a given representation are we clear it's good for everybody very good so if this is clear for you let us see if you are able to answer the first Test can I wipe it out yeah because you drawing maybe OK just to have it here the complement obtained by these four methods or the first three methods it's the government of the initial configuration is 01101101 OK so the questions could be like that we let's say proposed a question which will have variance the variance of course will be that you ask the same question for different values you know OK so for different situations but the questions would be like that one question and then we'll apply in three or four situations yeah this will be our analysis which is the sign interpretation off and here this budget template it's a placeholder and we here will be we will have uh three that I think we'll have three questions of this kind yeah the first one will refer to there's value the second one will be 923 hexa and the third I mean this is in phase two so it is binary this will be a hexane hexane spread expressed this will be 147 we can say decimal if you want because this means they can yeah so this is one question which we will divide and this is the methodology for the for the test because we have one question and then we can make like soap yeah we can make 20 questions I don't know and the answers from which you have to choose are for everyone of these three the following five and you have to tell him youtube correct answer from 5 uh possibilities usually most of the questions will be like that some of them can be like choosing 1 from 9 or 11 if there are some representations there will be a lot of variants but some of them which are a little bit harder you can't be asked to choose one for four and very few one for three total damages oh you will be asked to choose in fact one one right answer from 5 OK so we have to answer to three questions here and in every one of these cases we have to choose one answer from these five possibilities OK the pool of the possible answer is the same for all three questions OK so let's take it the first one which is the same interpretation of 10010011 OK the answer is we put the value is minus 109 so the right answer here is big for the first the second one which is the same interpretation of 93 hexa be safe because I just told you in the beginning of our meeting today that basic thing it's nothing else that phase two and you don't have to see nothing else that the zip notation office 2 it means that in fact question number two is exactly the first one is the question number one put it in another way so that is why the correct answer is minus 109 dollars OK third question which is the sign interpretation of 147 investment louder please deep from OK is anybody of some other opinion why do you know it's not easy louder please my new see the correct answer is E none of the above why because you have to pay attention to the keywords we tried the keywords from this question which are the key words from this question interpretation is the first keyword and the bag the only one because if you see interpretation it means that effect you have to obtain a number in decimal and the second key word is really the value because it follows that they are connected in one way if I'm asking hear you to give an interpretation this must always be for the correct question what under presentation it follows that here must be a representation if it is not a representation here in the question the question is wrong and the answer will be it's a stupid question because 147 is already an interpretation so you cannot ask me which is the interpretation of an interpretation this is a stupid question now you understand finally the difference between a representation and the interpretation once and for all thank you after you couldn't now you have to understand why you have to very carefully read the definition that you have to understand and know the mechanism I'm not interested in how many gigabytes did you inherited from your parents here and I'm not interested in that that is why not interested in knowing for the exam the exact structure of the reflex register or or I don't know what one of you had asked me which are really the condition that the processor checks in every competition that makes for a traditional German row I'm noticing the right I didn't know I don't know myself yeah OK but I'm interested in all this mechanism to you to understand them and to be able to apply them OK delete for technical that someone got another the first the first five four or five times and then we would take a break do exactly the same discussion first and then we will read together the next part of the material of today OK this is what we do what you see here is something wrong now it's dead around let's say because why because say that 147 - 192 complementary values in the setting this way of expressing these truths it's very useful why because the other way around isn't true I mean you cannot say that minus 147 is the tooth government of 109 because these two complement thing is a unidirectional thing starting from 147 did you obtain the minus 109 by applying the computing the two scrambled the other way around it's not true and for being able to express that that you know One Direction is true and the other one is not it is allowed in a human speech to say that 147 and minus 190 are complemented with the values in the sense that that that is is either 147 or minus 100 and depending on the interpretation so now the question is so the government of 447 is minus 100 and is it also through the other way around is it minus 147 the complement of 190 no this is not this is the stupidity because why because if we try to put the other way around and let's type let's say that we will start here with 109 and try to find like that put here 109 put here 100 47 and then ask ourselves something like that which is the binary configuration which has in the unsigned interpretation 109 and the end the sign interpretation minus one under this 47 this would be the question for December 10th you have to choose you would have to choose here the answer which would be like that none of the above or it doesn't exist look there yeah OK that was the teacher that she cell how the hell can I be aware of that you will be aware of the type I bet if you bet mentioned to me 50 minutes after the break but will not finish because you have four one slide to read together then it will probably yeah but this will be the topics for the second hour today this thing to understand why in one sense it goes and then the other one no from where that's coming this and which is the explanation because if you understand that you will be able to answer any question that will be like that OK OK so so the whole discussion about those compliments practical sense only when we switch to binary representation of negative numbers OK blah blah blah

The inverse the reverse question of this one here in the beginning of our course of today I I was asking you which is the sign which is the base them the value which represents the sign interpretation of this representation and now I'm asking you exactly the other way I'm starting from minus 109 and I'm asking you which is their associated representation in phase two for minus AC minus 109 you see exactly 31st question enter the answer here will be hey I supposed minnows here the general answer for such a situation is that just got actually that's the answer is the two compliment OF0X which of course will be always a number will start with one exception making zero but I have the zero is a special case because they OK OK but any other complement of any other number will be if we start from a number that starts with the 0 in binary it's complement will be always starting with the one so we will be surely in the science reputation a negative number OK so that is good this is the way we should just complement will be used here and the answer here would be like that if I'm asking you which is the representation of minus 109 you know that you have to take 109 which is this one and compute its complement completing its complement with issue this one black nearly anyone of them is the complement of the other one you can start from here and then here or you can stand from here and here here these are complementary representations or complementary values in base 10 as absolute values this is correct from a mathematical point of view and this is everything is OK the fourth situation which will issue the third thing for us and now what do you think it will be um the question here let me try also OK because it's another number that starts with the one here let's denote it like plus PDF dot so in this case I didn't help you buy plus ABC and I'm going OK here let's denote it plus the AP and here the question will be how now the same but now with the reference to DF yeah so the question will be like here will be here which is the representation 4 - d EF where there is the unsigned interpretation of a number that starts with R OK bye so these will be which is the representation for minus 147 shy Charles now representative build peace that I cannot say that from my belly OK so you have to look at this and you have to look at this and see last 147 this year at minus 147 is here yeah I was able to sleep 127 yeah yeah but because I don't have minus 147 among the admissible representation values on one part the conclusion is that minus 147 is representable only on something bigger than a bike so I have to look at the following admissible representation interval and seeing that minus 147 is part of the sign what so the correct answer is here at the north case the complement of 6666 so in words will be like that is the juice complement of one piece 66 the initial configuration extended without sign unsigned with the book it's the truth government order the correct answer is it is the truth complement of the unsigned extension of the unsigned extension extension person it is the two complement of the unsigned extension on an immediate superior size so you mentioned name adapt somebody other talk later that just complement of the unsigned extension do immediately superior size of the initial one is 6666 configuration I think I was looking correct yesterday having resources why is there like Stacey waterson it's the it's a lot 6666 the world OK this is immediate security so in our case it will be 8 of zeros OK the proof if it is something like that let's let's make it we have to start from how do we obtain minus 147 we start from 147 and as that solute value I put eight bits zero then I will put 10000 this is plus 147 yeah on one word and now i have to obtain it's gonna negative number I have football OK all we start from an absolute value 100 and what would be minus 191 would be minus 147 these are the three situation expressed in words and phrases yeah OK but the process that starts from a representation in phase two that begins with a zero and just ask and ask only one would be the complimentary of that representation without this complementary value being used for something that sitting up with that OK that's not make sense out of the context of interpreting sign number as a negative OK the fact that there is a Rachel values for each interpretation of a binary condition is saying vitalities data protection of these two intervals are zero for 107 yeah well so like the fashion of that visible representation in terms all dimension and consists only of the values that in binary begin with P0 as a result binary value starting with with one are not coming to this complementary ranges ranges meaning that the sign and unsign interpretation of any binary configuration started with one below is 3 different the drug that was it but and different and they will never be part of the same admissible representation in terms of this is very good because even last 128 and minus 128 B2 complementary values and the base 2 being exactly the same configuration this is the special case they are not part of the same visible representation interval because finally 128 is assigned number and plus 128 is not here it's only here OK this means that Minnesota the 20 is 100 and 8147 with minus 109 minus one be 255 II just was given there complementary pairs of numbers in base 10 but together with their signs this is the 4th express express admit OK so minus 127th which 129 that is OK but it's got to be 127 - 129 why because minus 129 is not here minus 129 is exactly like in the case of minus 147 OK hearing 50 I I brought the dead clear portable stop it it's good i would like to talk with you know just fun binary configuration yeah which are the best that you can put and you tell me what time the situation which they need to use the two complement rises shakuma *uh if you have any presentations every 16 six plus ABC with nothing new OK which is the answer the answer is the two comparable the visual binary configuration like Gray is the minus the two complement that which you say just by that and finally which is the more important one is this think that minus 147 doesn't fit right and only award this is the explanation as a result we conclude that if we start from the presentation of the four 1866 of the value plus 8C we cannot obtain the value minus ABC on the same representation size no not only that the implementation cannot be done correctly on the same representation side of the initial value has the mental nology but also the analysis of the miscible representation in terms confirm this from semantical point of view is market taking quote did you poop it could be 1000 your personality complementary character 0 like that annoying she's the day after the fall speaking I'm not because I have something starting with zero when I begin with something with something starting with one and this is provable and correct analytical point of view if I'm looking here because that value 447 - 429 they are not part of the look like a week yeah she can move in this is the proof that my value isn't on one by minus 147 and that is why this is purely directional there we did a chronologist after because I can go in my explanation only from 147 to minus 109 but they cannot start with 109 and go to minus water input cell uh who's when I pulled up that she got it* complementary as they said 109 + 109 with 147 they are complementary values as absolutely correct 109 is the complement of 100 and 47147 is the complement of 149 this is be directions be checking why what is not projecting and bidirectional also is that minus 109 can be expressed as being really in the 4th expression in the 4th manner is the government of 147 but there is no binary configuration which makes them complementary is 109 with minus 147 sense kidnapping republican this is the sensor which you must understand the fact that minus 147 pieces representable one right because this makes these two values never complementary there is no the common factor there is no binary configuration that to make them complementary that is why you in direction what show commands so just like the remarkable vision might be I'm maybe go up stop memory for the well yeah OK so the just go up on it OK isn't so we make include that the evolvement of the two complement these manifest only in three cases shamanism which is the binary form the number that starts with zero we have unsigned versus signed the values plus ABC you see no involvement in the beginning you would say it's no involvement of the two complement when we talk about unsigned interpretations so the only three situations in which we have just complement reference is 11 move OK there are three how do we present minus 80 see how do we represent minus the PDF and which is the value of the sanctuary petition of 1 exists traffic department I will be yeah goodbye look the national rifle as expected i get him with A5 bill budget this is not a size of the fly so tell people have been developed by OK

Exam Subject!!!!

Which is the minimum number of bits on which we can represent and now I'm saying a number if I say we can represent of course the direction providing my question the value it based

Raspunsul e Trebuie sa l determinam pe n (minimum n possible)

On 1 bit (2^1)- 2 values

2 bits- 4 values (from 0 to 3 in the unsigned interpr) (-2 to 1 in signed interpr)

11b

Which is the number of bits in which we can represent -3

That's the cardinal of the 7% of all three positions and and then you will obtain 0 to 7 in the unsigned remove that this will representation interval and it will be from minus four to plus three so minus three is here as a signed number so the minimum number of bits required for representing minus three is 3

And the value is a (011) 101=-3

Which is the number of bits in which we can represent -147

9 bits