Title: 시장설계이론1, 계약을 포함하는 매칭 (2)

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- ✓ **Dictated: 강은경, 강성호, 김신희, 김종백, 신원대, 현소형**

[00:00]

This is the case. So, this is the first part. What I should have said is that this contract are acceptable for only those doctors that are involved in this contracts

In other words that they may be doctors that are associated old contracts, but not associated with a new contracts. Okay?

We are not necessarily saying that, those are.. so in other words that those contracts are not available for them at all. Okay?

So, this statement simply says that doctors that are associated with a new contract should like this contracts more than at least weakly more than that contracts that are available to them before.

Okay? If there were also associated with old contracts. Okay? Then between the two they like. Okay?

And of course there are doctors who had contract with different hospital. They also should like the new contract. Okay? Than the old contracts.

In other words simply I mean it is the simplest way to think about it and say it is that any doctors that are associated with new contract

find them better weakly better than their old contract. Okay? So. In other words that we need not require the new contract

somehow to be acceptable to other doctors associated with old contract who made replaced by new doctors. Okay?

So, we don't care about when forming a blocking collation, in other words that I mean this collation does not care about the welfare of all the others outside of collation

in other words that the they may be some doctors who may worst off by being replaced by different doctors. Okay?

But the argument remains exactly the same, namely that this means basically that those contracts are rejected cannot be part of some of this is that,

you know remember this graph? So, this is Xd and Xh. Okay? So, X double prime cannot have any overlap with this rigions.

What is this rigions? This is the rigion RdXd. Right? Okay? So this is RdXd.

And the fix point equation basically suggests that Xh is exactly those contract that are left after getting rid of those contracts that are rejected. Okay?

from the entire set of contracts rejected by the doctors when they have Xd available. Okay?

And so, again the point remain still the case that X prime, double prime cannot include any contract in here. Okay? Which is given by this point.

That was the key step in showing that claim. So, now, we are going to a sort of make a connection with a set of fix points which now we have shown

characterized a set of stable allocations with the familiar algorithm. Okay? That we know.

So, I mean first of all, the fact that.. Let's establish the following. So, let's see what we can get out of the fix point theorm.

Because we know that the Tarski's fix point theorm applies which means that not only do we have nonempty fix points, a set of fix points,

but also the fix points set itself form say complete lattice. Okay? That means that there is the largest element.

Okay? So, let's call it Xh. Okay? So, the fix point is in terms of the set. Right? For h. okay?

And then there is the smallest Xh. Okay? So, if Xh is a fix point, this is true. Okay?

Now, remember that so, what is the stable I mean so fix point gives us a stable allocation? What is stable allocation corresponding to each fix point?

So, this is, think about that. Before that let me do the following one more step. Okay?

[05:00]

So, if you get a fix point which is the largest we know that that exists. Okay? Let's think about the corresponding Xd.

So, remember how we defined Xd. Xd was defined to be X - Rh of Xh. So, fix point is given by the fix point theorem.

Once, you are given the fix point theorem, Xd is given, obtained by this equation. This is just the definition. Nothing more. Okay?

So, if the fix point is largest, get the correnponding Xd is the smallest. Because of the nagative sign here.

You are subtracting of the largest set. In other words if you compare, if another fix point, let's say Xh is the largest fixed point. Okay.

If Xh is a fixed point, since Xh buys the largest fixed point, Xh must be in here. Because you know, the older is given by the set of inclusion.

Remember, just you have to remember what the older what the binal relation we are using.

It's a defined by the set inclusion relationship. So, if this is the case, the corresponding Xd. Okay? Define Xh should mean that Xd. Okay?

In other words that this Xd is the smallest set for all corresponding Xd. Okay? So, this is true.

Okay? So, this the a top part is given by the fact, by difinition and the fact that there is the largest fixed point and there is the smallest fixed point.

And olders given by set inclusion which means that there is a fixed point. So, you must dominate it by set inclusion.

You must dominate the smallest you know, fixed point in terms of set inclusion. That's given by the fixed point theorem.

This is given simply by the difinition of Xd, how we define Xd. Okay? So, we know that.

Now, that implies a relationship across different fixed rankings. So, we can compare based on this we can compare across different fixed point

in terms of welfares of doctors and hospitals. Okay. Because how the you know, from this associated stable ilocation.

Remember these are not by substable allocations. Stable allocation is an intersection of the two.

And in particular we have already established that, this is a stable allocation. Okay?

Let's go back. if it's not clear. This is how we defined this. Right? In a section is just a optimal choice.

And we just stick to the familiar interpretation. Xh is by the opportunity set. Okay? in the largest fixed point. Okay?

And that means whatever you find the hospitals find optimal from the fact must be stable allocation.

Likewise whatever the doctors find optimal from this set is also stable allocation. They are the same. Okay?

So, this is what the doctors get. This is one stable allocation. Let's use this notation. Okay?

Corresponding to the largest fixed point. Okay? Consider another one. Another sort of genetic fixed point which gives us another stable allocation.

Okay? Then we can ask nearly can we say anything in terms of comparison of these two from the perspective of doctors and hospitals. Okay?

What can we say? Okay? Now, here. Let's focus on this hospitals first. Okay?

[10:00]

Hospitals, this is the result of a choosing optimaly from set X bar h. This is a result of choosing optimaly for the hospitals from set Xh. Okay?

Every contracts in here are in here because of this. Okay? Which results are better for the hospitals? This is better for the hospitals. Okay?

So, this stable allocation is uniformly better for all hospitals and strictly for some hospitals I think. Right?

Because they are different to the extend of their different allocations of course in weakly they are sort of.. This is weak inclusion.

So, they could be exactly same as long as they are different. There are some hospitals that are strictly better. But no hospital is worth soft.

when moving from this stable allocation to that stable allocation. So, it's very nice. Because the set inclusion simply gives us this nice results.

from the doctors perspective however every set of every contracts that are included here are included here. Okay?

So, therefore when moving from this set, this stable allocation to that stable allocation. Doctors how worth soft uniformly. Okay?

So, we get this polarization. But in fact this is true for any stable allocation. So, if you give me any two stable allocations. Okay?

And in one stable allocation the associated opportunity set for the hospitals dominates the other one.

Then, we can say that hospitals are better off in this contract than that contract is this stable allocation.

And the opposite is true for the doctors. So, we get this polarization of interest here as well. So, those results carry over are extended to this more general setting

which allowed for which are preferences. And allow for contracts as well. Okay?

Which is not to say however that if you give me two stable allocations, they are comparable in this set.

Because after all lattice is simply a patialy older set. Because there are elements in the set that may not be comparable in terms of the binal relation that we have there.

Okay? But, if this is comparable from the perpective one side, it's also comparable in the opposite

direction from the perpective of the other side.

So, we get that as well. And of course comparison here is also the same. Right? This is worst for the hospitals. This is best for the doctors.

Okay. That's very nice. But we are going to do more than that. So, in fact now, let's remember

the second and third claims implications of the fixed point theorem that the largest fixed point can be found by running this operator repeatedly starting from the largest element of the [?1:16:32].

So, what is the largest element of this in terms of set inclusion? X itself. Right? So, X is the largest set.

We start from there. Okay? So, now we are.. Actually this is not that. In fact the opposite but here. What was X?

I mean so the running a valuable set is actually Xh. Right? So, we take the biggest set the whole set itself.

as this opportunity set for the hospitals. We are going to find the largest Xh. Okay?

So, that will correspond to hospital proposing deffered acceptance algorithm as you will see. Let me do the opposite way however.

Doctor proposing deffered acceptance algorithm. So, there basically what's smallest? Smallest is null set. Okay?

So, we are going to do null set here. Okay? That means that the associated Xd is what? If you start with null set, you will reject nothing. Okay?

So, therefore, X here. So you get start with the process where the entire set that available to the doctors.

And the null set available to the hospitals. And then we sort of an iteratively subtract off contracts that are rejected by each side. Okay?

[15:00]

So, the doctors basically make offers from these sets. Okay? So, those offers that are not made.

Okay. So, and then doctors make their offers. Okay. And then hospitals hold the best offers and reject others. That's the standard approach.

So, we know what the algorithm works in general. So, but let's start with this here.

So, it step one. Doctors start with X. Okay? And then what the doctors do next is that from the set which sets, okay?

They make the best offers for them. Okay? Which means that those sets they don's offer, let's regard them as rejected offers. Okay?

and we are talking about those contracts that are offered by doctors ok?

so this is what this is set of contract that are proposed by doctors

hospitals get those contracts ok?

and then they make what thaey choose reject contracts ok? From those sets

so that comes here

hospitals when receiving this set

so that are contracts that are proposed to them are the apportuniy set at that point

for hospitals

from those set hospitals decide what it accepts what it rejects come those contracts

these are the contracts that hospitals reject ok?

if you subtrack them off from x in the next step

what happens to doctors

doctors may be offers, some of these are rejected

so [?17:31] that mean those offers that I have not been made ok?

so these are the contracts that I have not yet been rejected by the hospitals

that means that those contracts are offered and rejected and you take them out

and those contracts have not yet been made ok?

those are the contracts that are remaining available still

if the contracts are available, accepted that best included here as well

in other words that this is what doctors found to be available to them in the second period which includes

those contracts that are proposed and accepted

and those contracts that are have not yet been proposed ok?

and then doctors among those them uh propose optimal contracts

those whose proposing are having accepted in the past

they would be proposed essentially

and those whose contracts have been proposing have been rejected

would have to find may propose something else

so those that regardless in other words that

what's available to the doctors at that point is those contracts have not yet rejected

and then among those the doctors may decide to propose new contracts

and what have not been proposed rejected contract

so therefore the hospitals then get new set of contracts

that are not yet rejected which includes the contracts that are offered to them ok? At that point

includes both contracts that are offered to them and the contracts have been reproposed to them ok?

so as the process goes along in this way so restart with our biggest set for the doctors as opportunity set

smallest set for hospitals opportunity set ok?

doctor's set of contracts shrink as time goes

hospital's set of available contracts are in expense

at some point this process is motony process and that is fini number of interation

[20:00]

that is necessary to each a fix point the process stops and each point you have found fix point

which satisfies pair of equation ok?

and also we have found the large step fix point from the perspective of doctors

so which is like the smallest fix point according to our definition

and you can opposite may around you can start with the largest set of hospitals in the smallest set of doctors

what this could response to would be the hospital proposing deffered acceptanc algorithm

what is available because the only thing is that this is accumulated set

in other words that those that have been accepted are continue to be available at that point at each step

so those are so far we have all of the characters we have so far

main character agence existence, optimality right? Of the stable set of namely that

we have so far shown that the stable location exist

and that is doctor optimal stable location

then you can find you can obtain by learning doctor optimal deffered acceptance

and there is hospital optimal stable location

you can find by learning the hospital proposing deffered acceptance algorithm

and they all could respond to the largest and smallest strict point

and then we also found that the this polarization of interest

also continue to call general setup

here is set of a little remark

I guess that we have set everything

and also doctor optimal also hospital was ok?

we already found that to be the case

because of this equation redefined

here are some additional remarks are relating to out of mistakes actually that

halfield milgram made

so they show that we this assumption substitute preferences on the side of the hospitals

we have all these nice resaults including the existence of stable matching, stable location

but they show this is also necessary

how can you feel something is necessary?

here is the way that they try to show it

suppose that there is one hospital whose preferences fail this conditional substitutable preferences

fail the substitutability condition

then you can come up with any example including that hospital and all of the hospitals whose preferences are substitutable

ok? Where stable matching, stable location doesn't exist

that's the sense in each that substitutability is necessary

if you just relax substitutability just for one hospital

but if you give freedom of choosing whatever preferences you like for all the other agence

including all the other doctors, the other hospitals

subjected constrains of satisfying substitutability for all other hospitals

but otherwise you have entire freedom to choose any ordinal ranking on the part of the doctors

any ranking on the part of the hospitals as long as they have substable

then you can come up with an example

where there is no stable location

turns out that claim is so whatever implication of that

[25:00]

the implication of that will be that you know this result that we have so far doesn't mean necessarrily that

the search for stable location we hopeless

if you go beyond sustitutable preferences ok?

but necessity means that in fact there is essence will be hopefully to go beyond to hope to

find a stable location generally in an environment which fail stability

which doesn't mean that you can come up with any example

where some hospital's preferences are not substitutable

and yet stable location exist

you may be able to find that

be carefully interpreting a necessity claim, a necessity result generally including this case as well

there are this kind of necessity claim is made all of literaturally micro economic theory

so you have to be careful at that means in anyway

that claim turns out not to be true

so [?26:10] found the counter example

how do you find the counter example that's kind of

because of the nature of the necessity claim mean it's actually

unclear how one can actually go finding

I mean you can find that the they are approved may not go through

there is some gap in the prove

but still you know it's not a easy task but

he found out and then somehow they work together to produce a comment on their paper

showing that fact is not the case you can

there is formal failure of substutability

on the which no matter what you assume in terms of the preferences of the others

you may still have stable location

so you can relax a little bit more

so that I mean you don't need I mean

it's not important to really to know precisely

the thing is but what I can say is that

you can relax substitutability a little more

and still guarantee existence of stable location

and yet when you do that I'm not going to go though relaxed notion of substitutability maybe

but in some relaxation

you may get existence of stability guarenteed

so this includes preferences that may not be there are not stable substitutable under the notion of definition of halfied milgram

it's in this is more general

you guarantee existence of stable location even within subjected to this more relaxed notion of substitutability

but you may not get this fixed point characterization

there is a way to preserve at least from the perspect of one side the doctor side

with the difference through relaxation

those are the results that they have restablished

I still think that this sufficent result is more important so

I mean necessity result is kind of interesting but

It's more over exercising clarifying our understading

it's sort of more over exercise really exploring what's the boundary to what extend we can push the model

in still maintain the same sort of set of result

now discussion so far have not dealt with the incentives at all

but you know that there are two sides

one is always the issue about stable allocation or stable matching

the other issue is always about incentives right?

and so what do we know about incentives in the standard simple one to one matchings

well we know that in generall it is impossible right? To expect

I mean so there is no stable matching mechanism

there is also stregegic proof both sides right?

in other words there are examples of preferences under of each

we don't have stretegic proofness in boths sides

but we have one side is stretegic proofness

there is a result due to both and others wish to prove that in fact

stating that there is a doctor optimal stable matching mechanism

[30:00]

what student optimal matching mechnism is stretegic proof for students or doctors

and we know that doctor optimal stable matching can be found by learning doctor proposing deffered acceptance algorithm

there is a result that we have one to one matching and in the many to one matching with responses preferences

now that's the result still carry over to the more general frame like this

this is the subject of this slide

turns out that we need one more assumption ok?

this assumption is called [?30:40] demand

so you don't have to worry about doctor's side for the hospital's side

this will be additional condition, additional assumption

this assumption says that if w prime dominates x prime in this sense

number of optimal contracts that hospital choose is also more alternative in this sense

here in terms of counting nothing more than that ok?

now in terms of setting inclusion set of the different from in nature substatutability we had before

in other words that if the number of contracts that this hospital choose from a small set is no less than

no fewer number of no great number of contracts that the same hospital will choose the bigger set that includes smaller set

as mu from smaller set to bigger set, bigger set includes smaller set ok?

the number of optimal contract the hospital choose can now go down

so what's the relationship with this condition and substitutability condition there is no relationship

this is independent condition

so example given in the paper is of this kind

3 doctors and so this is the hospital preference

these preferences are substitutable

you can say two different ways

so given this set d 1 is a part of optimal choice

if you eliminate d 2 you continue to demand d 1

if you want to hire d 2 when d 1 is available

d also want hire d 2 when d 1 is not available

again d sounds like weak action of reveal preference that's not the case in this case right?

here there is one more thing here

so these preferences are substitutable?

and yet doesn't satisfy this condition right?

why? Because this hospital how many contract does it employ does it sign? Two

because both of them hire both of them and sign one contract each doctor

what about what's the answere here?

this is ths d 3 right?

so therefore number of optimal contracts is one ok?

so as number of set of a available contract expand in this sense of setting inclusion

number of optimal contracts may go down

in this case it fails that assumption

ok so I mention paper in economic metrica which is sort of special case of halfield milgram

[35:00]

so earlier precalled halfield milgram paper

where the contracts that they consider are only include contracts terms they include are only include sallaries, wages

they are assumed preferences

and those preferences in terms out satisfied this assumption

there is a way to map their frame or as the special case and of the halfield milgram

you have to look at the hatfield milgram paper about how to sort of make a link between

in case and hatfield milgram

in terms of this the case

we have a ruler version of ruler hospital ok?

meaning that what does it say

if but then we need assumption, this asumption

so given, substitute ends the laws of aggregative man, then it turns out this case.

They need that the number of contracts that are chosen, must be the same for all stable allocations.

In other words that every doctor and every, this is all each doctor and each hostpital.

so the number of contracts that each doctor signed as same of course, difference stable allocation.

so what does that mean?

because doctor can sign only one contract.

so what this part of the claim implies is that if you are employed,

if you signed some contract with a hospital in one stable allocation,

you must do the same, part with the different hospital.

however, you must be sign with a contract, with some house, hospital, in a different stable allocation.

so this is why which called rural-hospital theorem.

They say sort of generalization of [?37:24] theorem.

If you are unemployed one stable allocation, you are employed not stable allocation.

If you are employed one stable allocation, you are employed other stable allocation.

in terms of hospital, its in terms of its number of contracts, also in terms of number of doctors it employed.

because, each hospital can assign only one doctor for giving me a contract

I can improve this,

so again, think about that thing here, largest fixed point.

all the hospitals here and think about that.

now compare that against this,

so Xhbar is the largest fixed point.

X,H is any fixed point.

Now this set includes that set .

and therefore, the law of aggregative man means that this is true.

for each hospital, therefore if you sum them up, this also must be all.

here is a little bit different,

this is the associated Xd, so in other words that, this is one that define using this.

in other words that, in these together, forms the same fixed point, given fixed point.

[40:00]

and this claim, basically means what, number of contracts signed by the hospital as a whole.

equals the number of contract signed by the doctor as a whole.

why is this true, and a given stable allocation, the feasibility means that the number of you know,

because of the assumption that the feasibility means that each hospital can sign only one doctor with one contract.

so the number of doctors they all employ other doctors that are all employed.

therefore, this whole, and

this is true, because of this, okey?

if you are given small offset, of course.

right.

those are the same contract we contribute to sign those who are given deny those contract available before may choose not to have any contract, okey?

so this is true.

and then we now notice that this together forms are stable allocation.

and again the doctors that are hired by the hospitals that as a whole must be doctors that are employed, right?

so therefore this must be going to the same.

and that means that everything must be continued equaility, right?

and since..

so what does that mean that means that this is equal, okey?

how come this implies, implies this.

well, turn by turn, this guy must dominate that.

and at the same that there must be equal so that must turn by turn, this guy must be equality that, okey?

and likewise for the doctors.

okey, so let me take 10 more minutes.

I'm sorry I'm running out of, running over time.

but this is the last slide.

so, so we have rural hospital theorem.

again answering the puzzle that no matter what stable allocation machanism you may use the [42:59] hospital that the rural area suffer are not address, are not [43:05].

in other words that as long as you choose the stable matching, okey?

the number of, you know, doctors that the unpopular hospitals attract cannot change.

so that's the implucation of this hospital theorem.

but you're gonna use this.

so it's interesting of its own, right?

but it's also interesting because it's gonna be used to prove the incentive result.

that is, that is, one sided strategy proofness result.

so we already know that it's hopeless to expect to, expect that the… that is a stable machanism.

that's that is a incentive comparable.

that is a strategy proof for the hospital site.

we already had a counter example in the, with responsive preferences.

one of the example, that establish that suggest basically that.

even hospital optimal stable matching is not strategy proof for the hospital.

but doctor optimal stable matching were strategy proof for the doctors.

that result carries out.

that's what I'm going to proof.

the three steps.

so fix the preferences of all other doctors.

the machanism that we're running is doctor optimal stable matching, doctor proposing deffered acceptance algorithm.

we use it.

fix the preference of all the others except for a given doctor D, okey?

and say that given doctor D, it's true preference is this, okey?

now, suppose that by maniplating is preference by lying a bar preference by reporting something else is PD bar, okey?

[45:00]

PD bar includes this, so the Z's are sort of arbitrary contracts, okey?

not necessarily equal to those coincides.

so these are, so different preference which got him contract X implemented.

and he prefers that contract, that he can get by reporting this more than the contract he can get by reporting this truthfully, okey?

so let's start from that, okey?

we're gonna take a three steps to prove that, in fact, this is not cannot possibly the case.

we cannot do better by lying about this preferences.

in the way we show it is follow three steps.

first step if this will the case.

suppose he by lying, by reporting this other contract and as a result getting contract X.

what he could have done, he could have soimply reportedthis XP, X^2B, which is a declaring XTBD only acceptable contract.

he could have gotten X by this, okey?

next have is that if this is the case, he could have done as well by adding the contract that are better than X according to his true prefernces, okey?

declare them as such, as better than X in the arrival order, okey?

could have done better than that by reporting this.

and at the end of the I'm gonna claim that he'll be weakly better by adding let’s inferior to X for him as being inferior.

in other words by truthfully reporting everything he could have done that, okey?

so first of all if given any particular line report PD bar.

he could have accomplish some outcome by doing this.

second of all could have done even weakly better by adding all the contract that are actually better than that to be in fact, better than that, okey?

start but reporting truthfully, okey?

so that will complete the proof.

let me start with step one, okey?

so the premise was this, right?

by reporting this.

he got contract X, right?

suppose that he reports X to be the only acceptable contract.

I'll say that it is a stable allocation for him to get access well, okey?

now the reason that he, that is another allocation, okey?

that is another allocation.

so by reporting this, okey?

there is a stable allocation where he get X, okey?

I'm not saying that so far this is the only stable allocation, okey?

that is a stable allocation in which he will get X by reporting this, okey?

how can we see that?

what..

so remember fixing everybody else is preferences by reporting this by submitting this preference.

this doctor was able to get X.

which means that, that is stable allocation.

which is in fact, you know,doctor optimal stable allocation.

where he get X means that the fact that this stable means that any contract that will block X,okey?

that is no blocking collision.

that is no collision that block this contract, okey?

now seem to observe here is that the set of blocking collision have shrunk, okey?

here anything that will block this contract, okey?

we also block here.

because that are more possible blocking.

that are..

so remember you are, you block the contract only by saying something is better than that, okey?

but removing what's a head of them, this contract.

we are reducing the possible ways of blocking contract X.

so it's clear, therefore, that there is stable allocation.

where X is chosen for him, okey?

now that's one step.

the other step is that in fact, we can show, given the law of aggregative man that this is only stable allocation, okey?

[50:00]

why because this is the only possible acceptable contract he can get in any stable allocation. okey?

if he doesn't get X in another stable allocation that means he cannot getting any contract.

that's contradicting the the law of aggregative man,contracting the rural hospital, right?

so if you are employed once in any stable, we have to employ one of the stable allocation.

in any stable, he must get X, okey?

the fact that any stable allocation that he get X means that if you consider any stable allocation where this guy is umemployed, doesn't get X, okey?

that is a blocking collision that block that allocation, okey?

if you take any allocation in which this guy is unemployed, okey?

the fact that this is the only stable allocation means that any such allocation is blocked by some collision, okey?

so that's the observation.

now we will go to step two, okey?

he add, add some other contracts that are truly better than X in the right order, okey?

now in this contract, any collision that blocks the allocation where he is unemployed.

such collision still exist, okey?

so therefore in any stable allocation here, the guy must be employed which means he must get [50:47] are something better.

in fact, in particular we are choosing a doctor proposing deffered acceptance algorithm than he must be equally better, okey?

so therefore he cannot do any worse, here than here, okey?

and then this is trivial in some sense.

because by adding contracts that are inferior to X.

we know that..

okey, so any of any stable allocation that you can get.

so this stable allocation can get from DPDA, okey?

cannot be block, there is no additional collision that will block that.

you cannot block anything that are here with a contract that we declare as inferior, okey?

because this is three guy, this is only guy we changes preferences now than we're from here to there, okey?

so that means that with your preference is truly reported you must still do as well as here which..

I mean which is as weakly preferable to the outcome you have when you report here.

which is weakly preferable to the outcome that you get when you lie in particular way, okey?

so therefore truthful reporting is weakly preferable.

no matter what the other guys do in terms of their preference reporting.

so this is the generalization one sided strategy proofness result.

the thing to do you remember the claim

and that is useful to sort of enjoy the logic here, in some sense.

how, what logic is used to..

it's kind of little bit intricate here.

in the sense that..

but it, the proof sign in the, in Hatfield milgram.

it actually takes a several meeting to be understand, get at the arguments here.

notice also that the argument use here is some what different from the other argument we use for simple one-to-one matching, okey?

there we use so-called blocking lemma,okey?

the proof was in the sense simply are there, although the last that are a little bit subtled as well.

now the fact that this will the more general set up.

mean that , of course this argument works as well.

so we could have proven the one sided stretagy proofness there using this argument as well.

sorry I ran out of time.

and behind.

but will turn to, will turn to the assignment problem.

and I don't think it will take so much time there.

so I, my plan is to almost finish that entire lectures.

because the last part, you know, I don't think that will probably no do in that lecture slides, of lecture three, okey?

and I think that we are not unfortunately we are not quit ready yet to do the second problem set.

but you may try

so you may first read a slides.

may be and I'm gonna actually

in case, I haven't, I might have done it before like few months ago.

I might have sent you this paper, survey paper by

If I haven't, I will send you that paper which includes two sided matching that also assignment problems.

so, therefore the assignment problem you may use that as the, as the text book essentially, okey?