Welcome students to the

course Bachelor of Science.

Course title is data structures,

title of the unit is hashing and

module name is hashtable reordering,

resolving, collusion by open addressing.

In this lecture we are going to

discuss about re hashing method.

Hashtable reordering will also see

dissolving collusion by open addressing.

There are three different method.

One is linear probing,

quadratic probing and double

hashing at the end of the lecture,

student will be able to

define what is rehashing.

They'll be able to explain

hashtable reordering techniques.

They will be able to explain collusion

resolution by open addressing.

They will be able to explain linear probing,

quadratic probing and double hashing.

So first we will see what

is a re hashing method.

The hashing is a collusion

resolution technique.

In re hashing technique,

the table is the size that is the size of the

table is doubled by creating a new table.

There are situations in which

the rehashing is required.

One is when table is completely

full and other valleys when

insertion fail due to overflow.

Next we have hashtable reordering,

so there are several techniques

of hashtable reordering.

First method is ordered hash table method

wherein the set of items that hash

into the same location are maintained

in descending order of the key.

Then we have a second method

that is brands method.

It involves rehashing the search

argument until an empty slot is found.

And it is useful to improve average search

time for successful successful retrieval.

And it is also useful to improve

average search time for successful

retrievals when double hashing is used.

Then we'll see,

resolving collusion by open

addressing in hashing.

Hash function is used to compute

the hash value for a key.

So when a hash value of a key maps to an

already occupied bucket of the hash table,

collusion occurs.

So in order to resolve those collusion,

we have the method of open addressing,

which is also called as closed hashing.

Or when addressing is a method in

which hash collusion is resolved

by probing or searching through

alternative locations in the array

until either the target record is

found or an unused array slot is found.

In open addressing,

all elements are stored in

the hashtable itself.

There are three methods of open addressing.

First one is linear probing.

Second one is quadratic probing and

the third one is double hashing.

So first we will see the

method of linear probing.

In linear probing we linearly probe for

next slot the gap between two probes is 1.

So let us say H of X be the slot

index computed using a hash function

and north be the size of the table.

So if slot H of X mod N is full,

then we will try H of X + 1 mod north.

If H of X + 1 mod N is also full,

then we will try H of X + 2 mod

north and so on till we find the

empty slot in the hash table.

So here we have an example.

Say the if the tables are is 7

and see if we want to insert some

number of keys in the hash table.

And the hash function which

is chosen over here is.

A key mod 7.

So say if I want to insert key 15.

In that case I will be applying

the hash function, so 50 mod 7.

I'll get answer as one.

So in the hash table I will have

to see whether index one or the

address one is full or empty.

If it is empty then I can just insert value

50 in the hash table so you can see in

the diagram which is shown on the screen.

Index one it is empty,

so we are inserting value 50 at address one,

then the next key value is 700, so 700 mod 7.

We are getting addresses zero,

so zero index is also empty.

So we can just insert 700 at index zero.

Then we have next value that

is 76 key value 76.

So after applying the hash function

we are getting hash value as six.

So index six is also empty,

so we can just insert 76 at

index six or address 6.

Next key value is 85,

so after applying the hash function

we are getting the hash value as one.

And if you see in the hash

table one is already occupied.

OK,

So what we will have to do is we

will have to increment the value

by 1 S again we will have to

apply the hash function so the.

Hash function will be like this 1 + 1 mod 7,

so we will be getting answer as to.

We can just check whether

address two is empty or not.

If it is empty we can just insert that value.

So 85 is getting inserted at address two.

So like this all other values are inserted.

Then we have this second method

that is quadratic probing in

quadratic probing method we look

for I squared slot in ith iteration.

Let H of X with a slot index

computed using the hash function

and north be the table size.

If slot H of X mod N is full,

then we then we try H of X + 1 into one mod.

And if that sort is also full then

we will try H of X + 2 into 2.

Basically we are finding we are just.

Or squaring the iteration number.

So this process is repeated for all the

values of I until an empty slot is found.

So here I have one example

of quadratic probing.

Again, the table size is 7,

so in order to insert Key 51st I

will be applying the hash function,

so 50 mod 7 I will get hash value as one,

so one is free so I can just

insert value 50 at index one.

Then next value is 707 hundred mod 7.

Again, I'm getting hash value as zero,

so zero is also empty,

so I can just insert 700 at address zero,

then next is 7676 mod 7.

I'm getting a hash value as six,

so six is also empty,

so I can just insert six at address 6.

Next value is 85.

So 85 mod seven we are getting the hash

value as one and one is already occupied.

So over here the collusion is occurring.

So I will have to apply again hash function.

So after applying the hash

function for the second time,

that is we will be finding the

square of the iteration number.

So it is going to be like this 1 + 1

into 1 mod 7 and will get answer as two.

So if you see in the hash table.

Index two is empty,

so we can just insert 85 at

index two or address two.

So like this,

all other values are inserted

in the hash table,

so this is how the quadratic

probing method works.

Then we have the third method of open

addressing that is double hashing.

In double hashing,

the increment factor is not constant

as in linear and quadratic probing.

But it depends on the key.

The increment factor is another

hash function,

hence the name is given double hashing.

So the formula of double hashing

is South of K comma.

I is equal to H of K plus I into

South dash of K mod table size.

So the value of I varies from

zero to table size minus one,

and H is the hash function as dash

is the secondary hash function.

So the search for empty location will

be in the sequence of H of K comma,

edge of K + H dash of K.

Edge of K + 2 into agitation of K

and so on and will be finding a will

be performing more operation on it.

More table size.

So here is one example of double hashing.

Say if we have the keys like 4628,

twenty one thirty

550-739-9950 and the first half function

is H of K is equal to key mod 11.

Over here the table size is 11,

so the value 11 is used.

Then the secondary hash function is

as a dash of K is equal to 7 minus.

Key Mod 7. So now in order to insert

the first key value that is 46 will

have to apply the hash function.

That is 46 mod 11.

We will get the value as two.

So if you can see in the

hash table two is empty,

so we are inserting 46 at index two,

then we will insert next

value that is 2828 mod 11.

We are getting answers 6.

So six is also empty.

Inserting 6 at that particular index.

Sorry, we are inserting 28 at index 6.

Then the next key value is 2121 mod 11.

We will get an answer as 10.

So hash value 10,

the value the space is empty,

so we can just insert key value

21 at that particular place.

Then the next key value is 3535 mod 11.

We are getting answer as two that is

the hash value and if you see in the

hash table two is already occupied.

We cannot insert 35 at index two,

So what we are doing.

We will have to apply this secondary

hash function that is agitation of

K is equal to 7 minus key mod 7,

so below it is shown like when we

apply this secondary hash function

that is 2 + 1 into 7 mod 11,

we will get the answer is 9.

So if you can see in the hashtable

address 9 the data part is empty.

So we can just.

Insert key 35 at that particular address.

So like this,

all other values are inserted in the

hash table using double hashing method.

Here is the comparison chart between

all these three open addressing method.

So first parameter is primary clustering.

Primary clustering means say

many consecutive elements.

When forms a group is called

as primary clustering.

So in the case of linear probing we

overcome this problem or primary

clustering in the case of quadratic probing,

it is not there.

In the case of double hashing.

Also, we do not encounter primary culturing.

Then we have secondary clustering.

Or parameter in the case of linear probing,

we overcome the problem of

secondary clustering also in the

case of quadratic probing.

But it is not in the case of double hashing.

So secondary clustering is when

same hash address will probe

the same sequence of location.

In that case, secondary clustering occurs.

Then the third parameter is

number of probe sequence.

That is north is equal to size of table.

In the case of linear probing

and quadratic probing,

it will be north.

But in the case of double hashing

it is going to be North Square

because we are applying to have.

Hash functions.

Then the last parameter that is case

performance linear probing is best.

In the case of cash performance.

And double hashing it OP works who

are in the case of case performance.

So here are my references. Thank you.