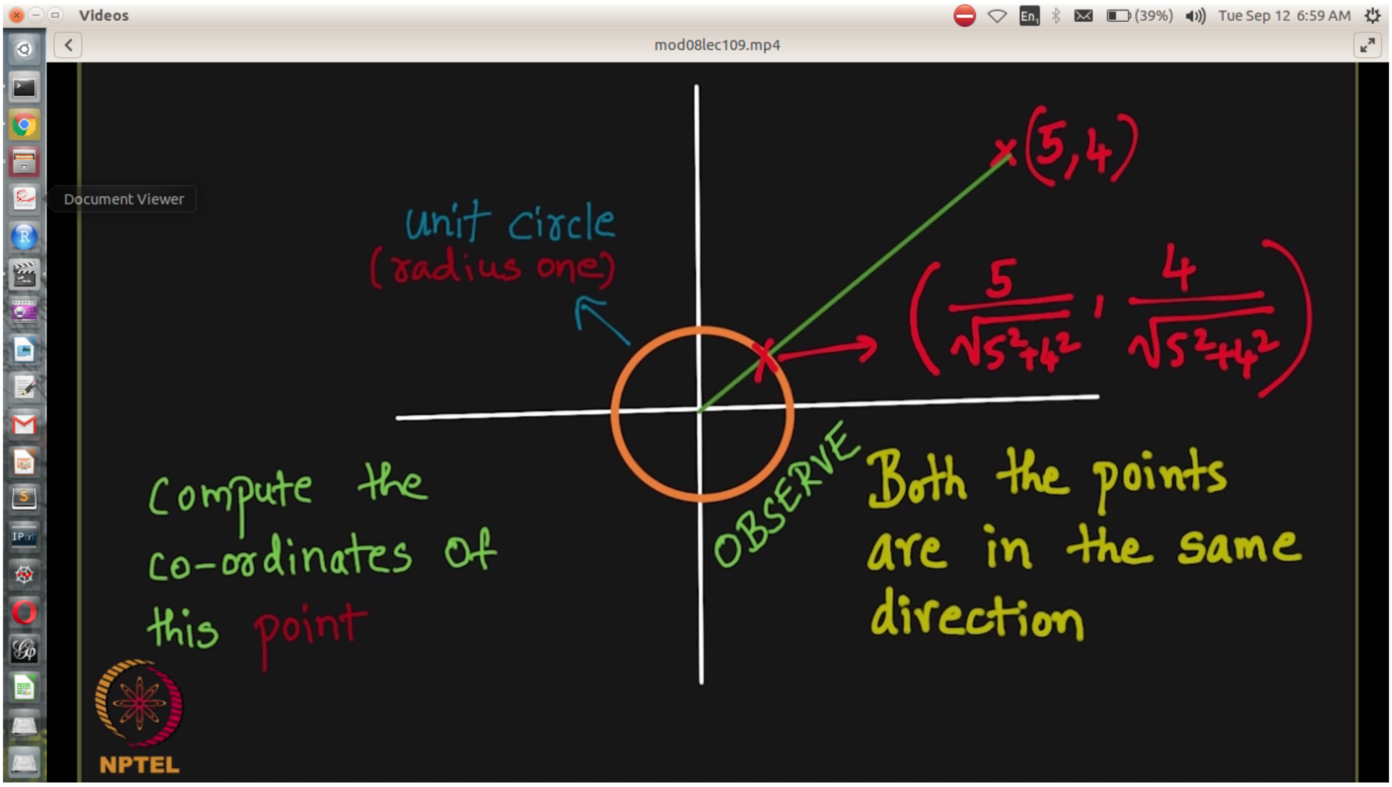
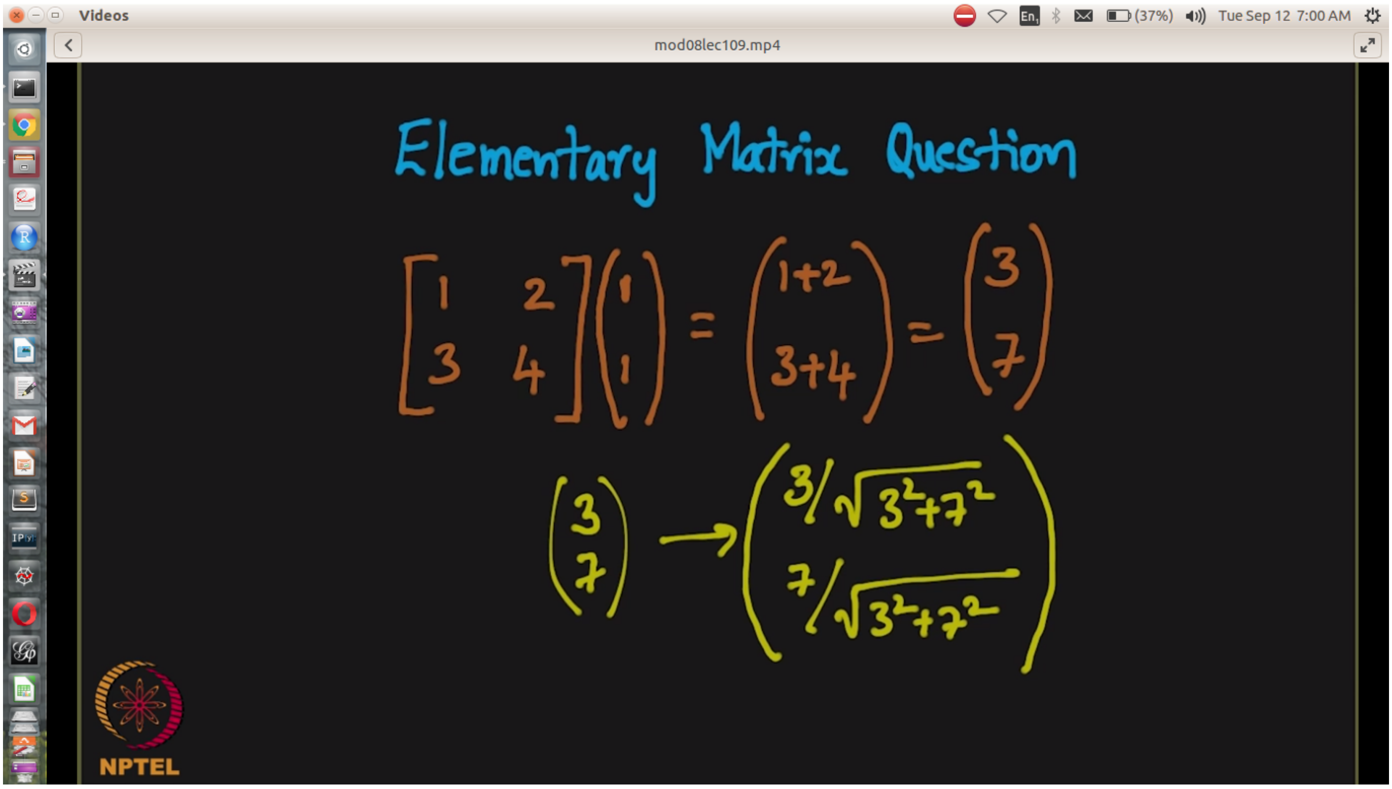
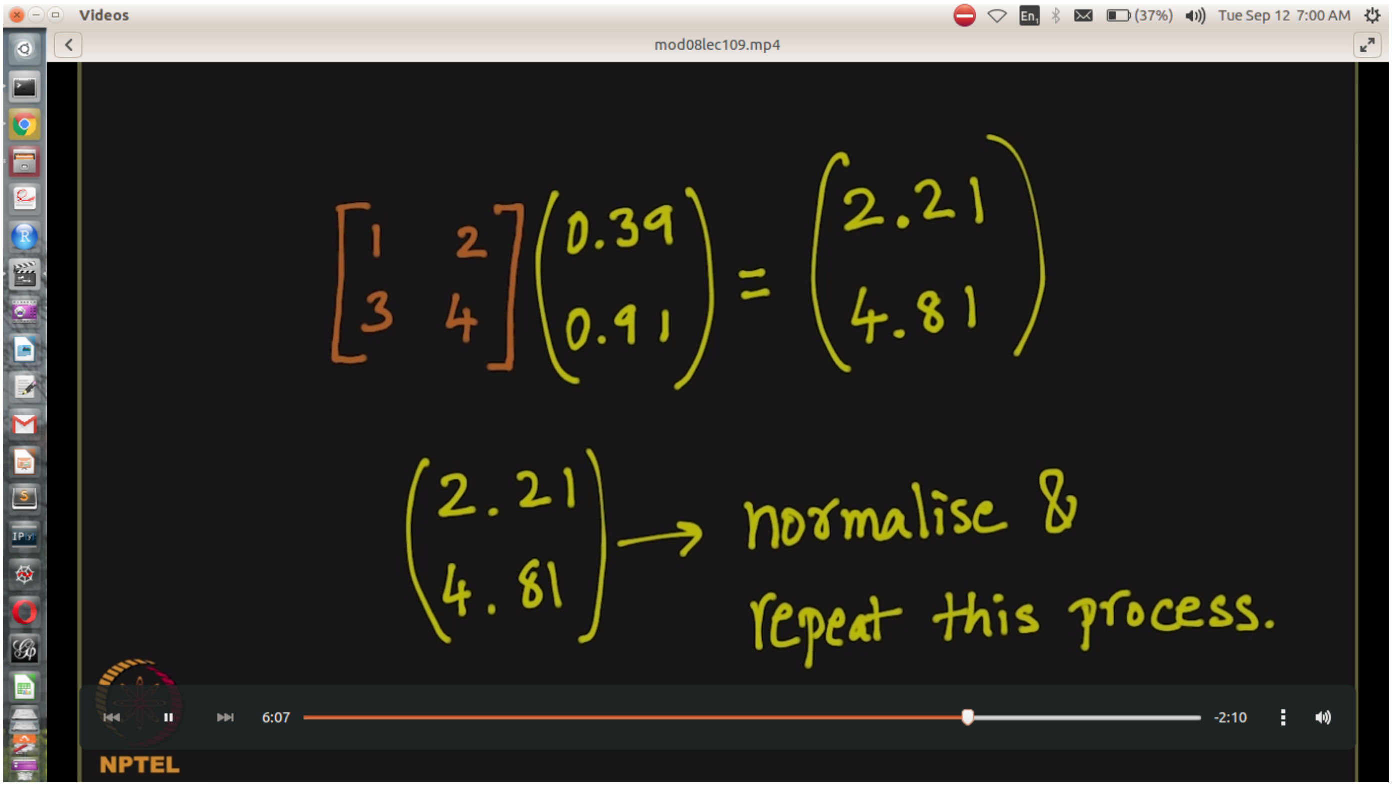
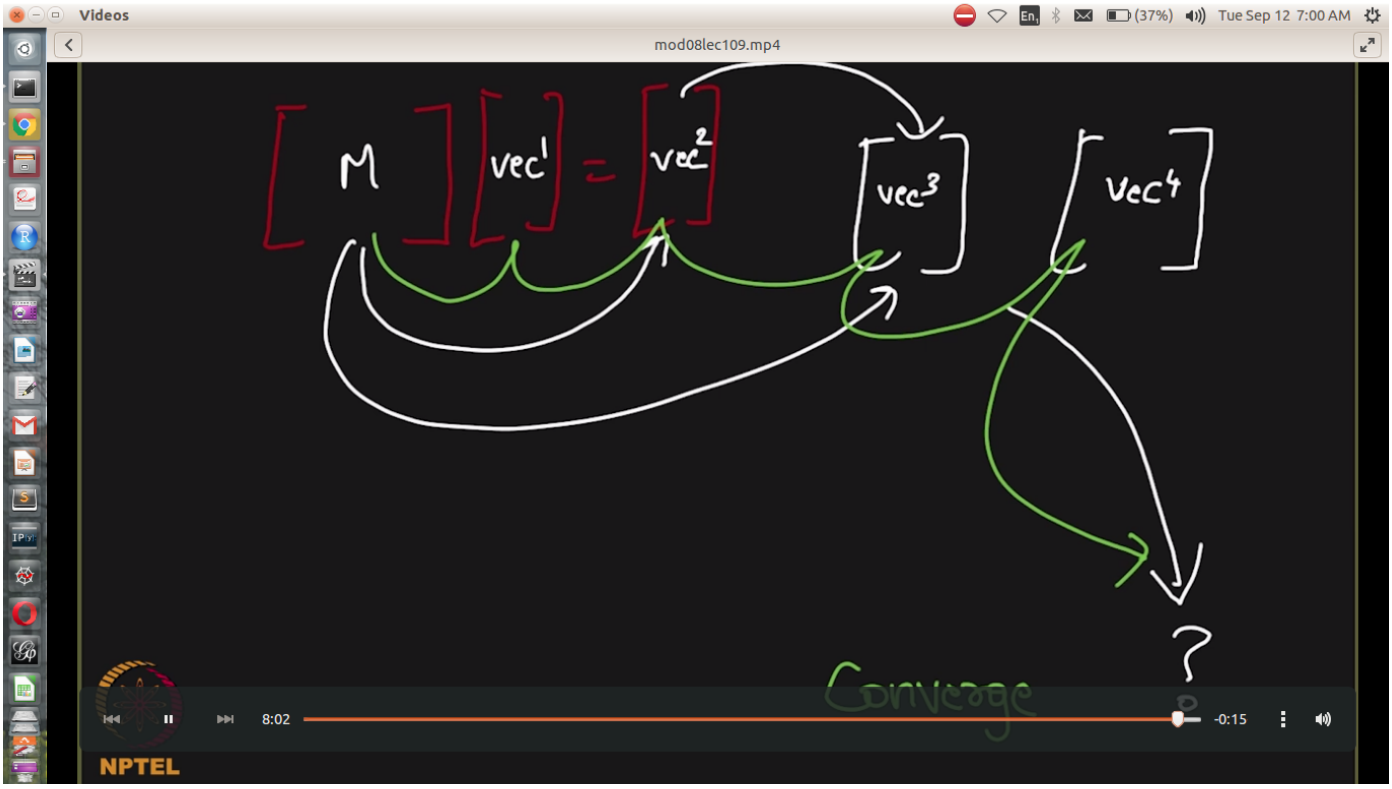
Lec109 : Link Analysis (Continued) - Matrix Multiplication (Pre-Requisite 1)









Lec110 : Link Analysis (Continued) - Convergence in Repeated Matrix Multiplication (Pre-Requisite 1)

In [4]:

```
import numpy as np

A = np.mat('1 2; 3 4')
v = np.mat('1; 1')

print A*v
```

```
[[3]
 [7]]
```

In [5]:

```
import numpy as np

A = np.mat('1 2; 3 4')
v = np.mat('1; 1')
print v
print "#"*20
for i in range(10):
    z = A*v
    z = z/np.linalg.norm(z)#denominator sqrt(a^2+ b^2)
    v = z
    print z
    print "*"*20
```

```
[[1]
 [1]]
####################
[[ 0.3939193 ]
 [ 0.91914503]]
********************
[[ 0.41750017]
 [ 0.90867684]]
********************
[[ 0.41586776]
 [ 0.9094251 ]]
********************
[[ 0.41598089]
 [ 0.90937336]]
********************
[[ 0.41597305]
 [ 0.90937694]]
********************
[[ 0.41597359]
 [ 0.90937669]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
```

In [6]:

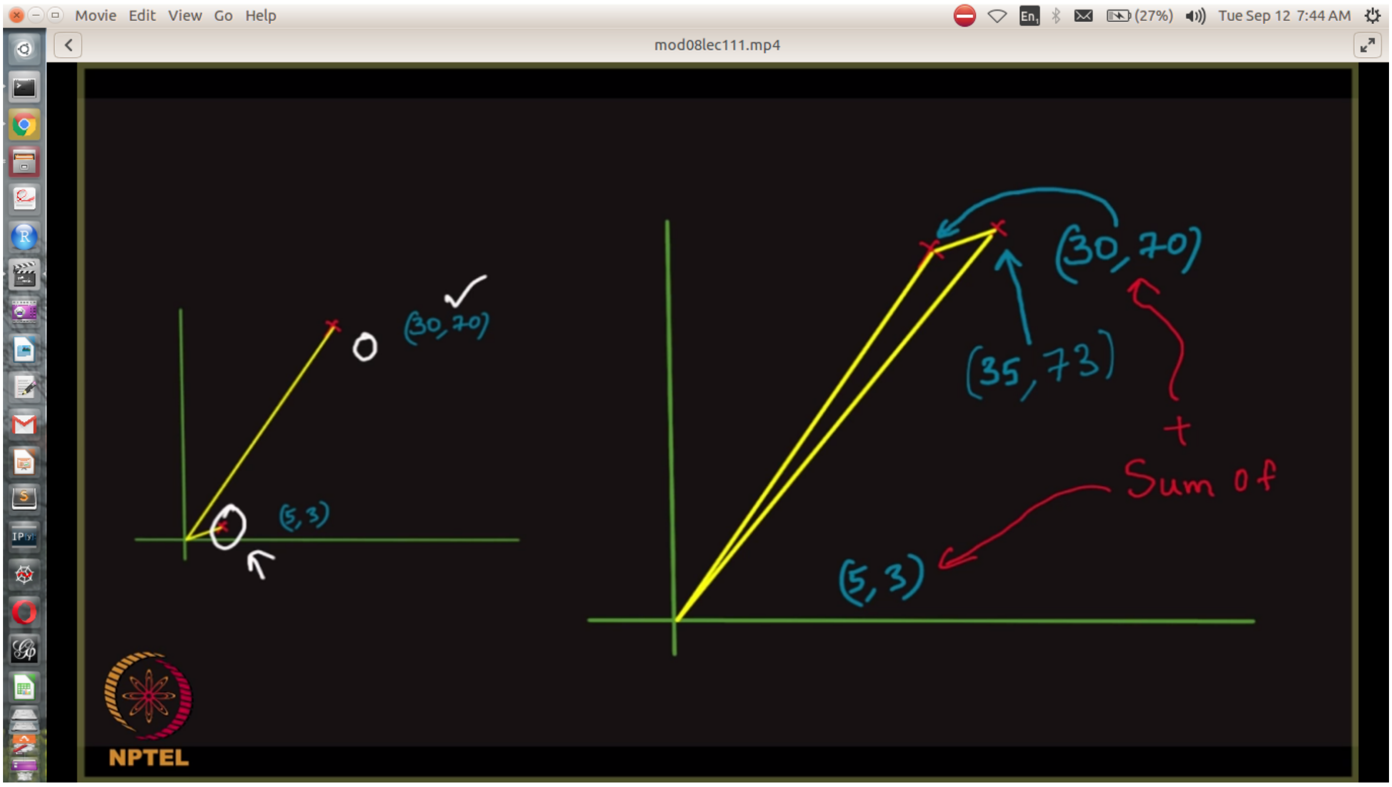
```
import numpy as np

A = np.mat('1 2; 3 4')
v = np.mat('4; 11')
print v
print "#"*20
for i in range(10):
    z = A*v
    z = z/np.linalg.norm(z)#denominator sqrt(a^2+ b^2)
    v = z
    print z
    print "*"*20
```

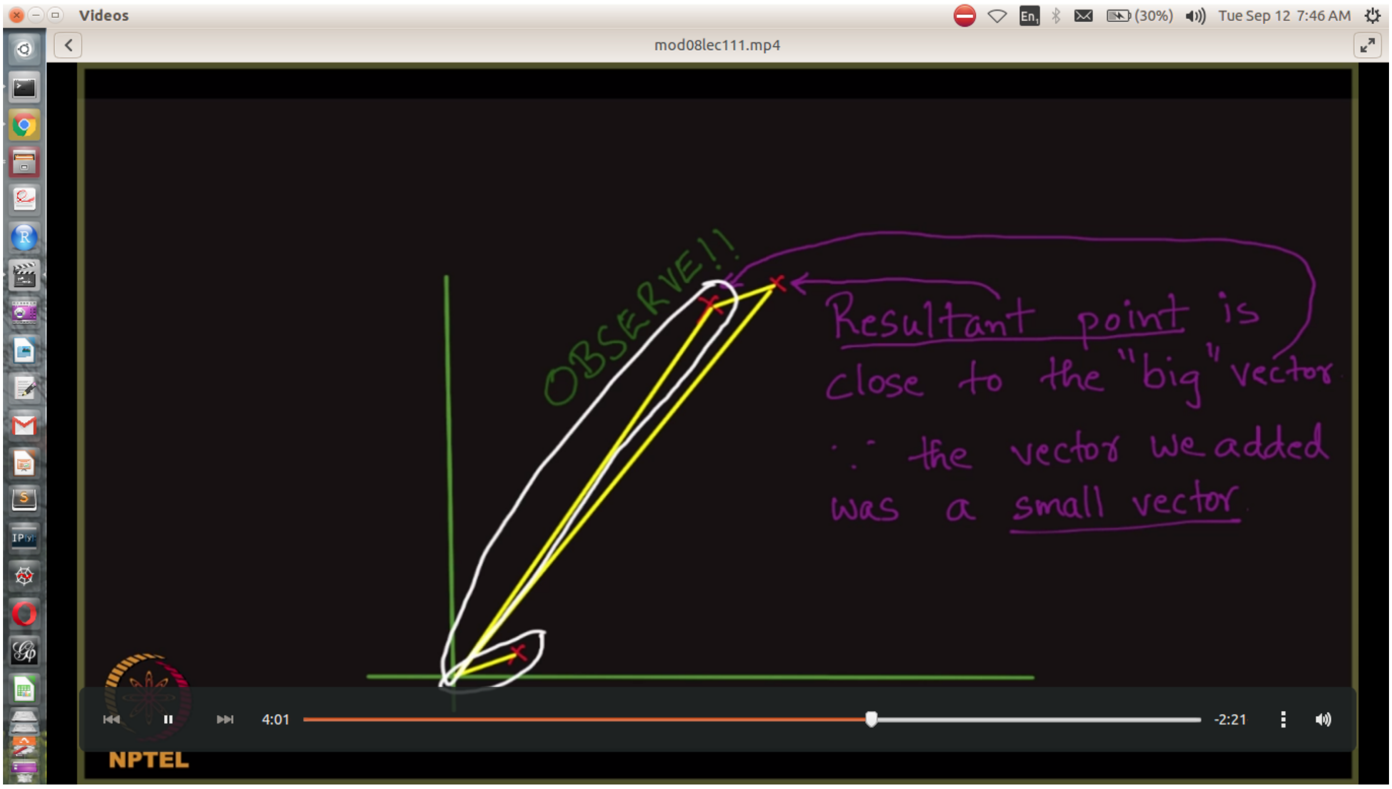
```
[[ 4]
 [11]]
####################
[[ 0.42111131]
 [ 0.90700897]]
********************
[[ 0.41561741]
 [ 0.90953954]]
********************
[[ 0.41599824]
 [ 0.90936542]]
********************
[[ 0.41597185]
 [ 0.90937749]]
********************
[[ 0.41597368]
 [ 0.90937665]]
********************
[[ 0.41597355]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
[[ 0.41597356]
 [ 0.90937671]]
********************
```

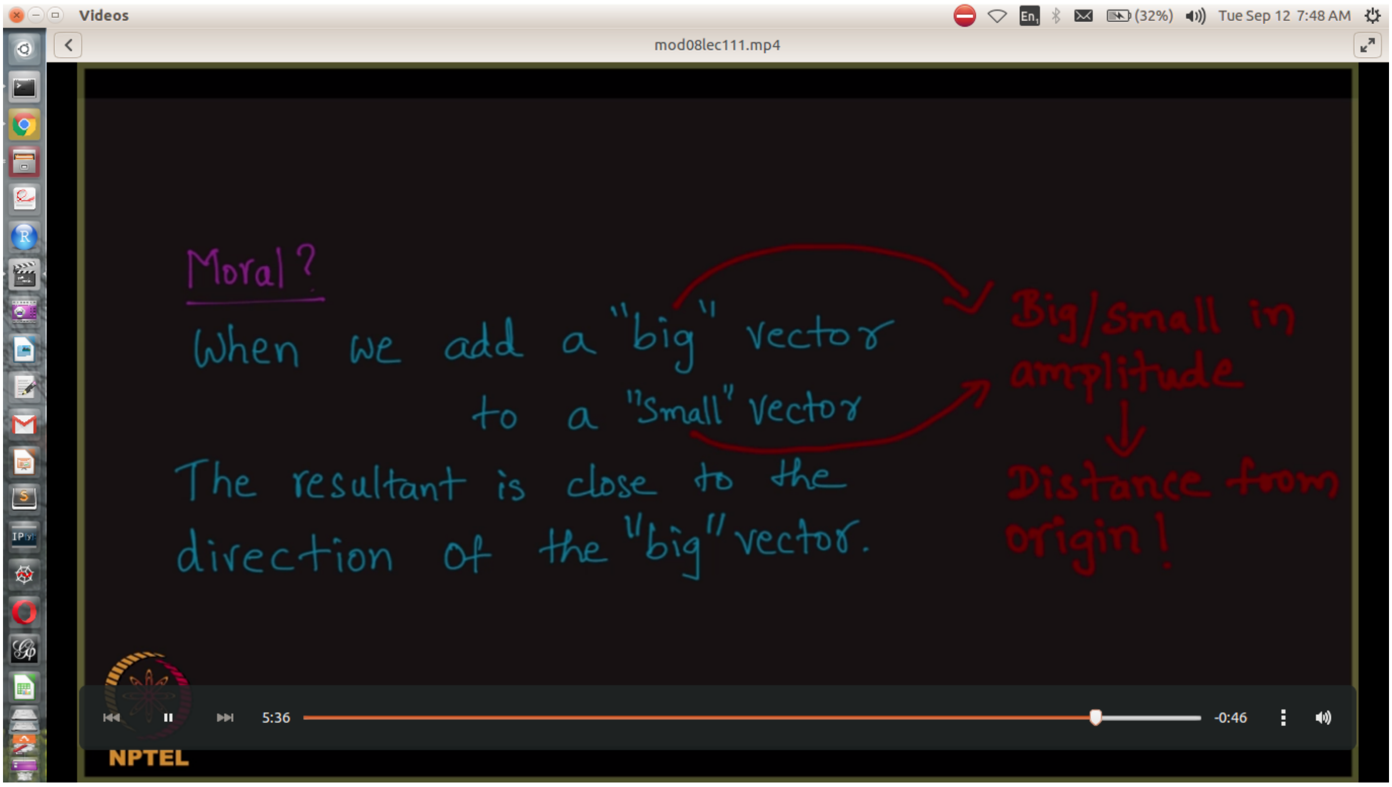
- Inference : No matter where we start from(v), A converges to a constant vector

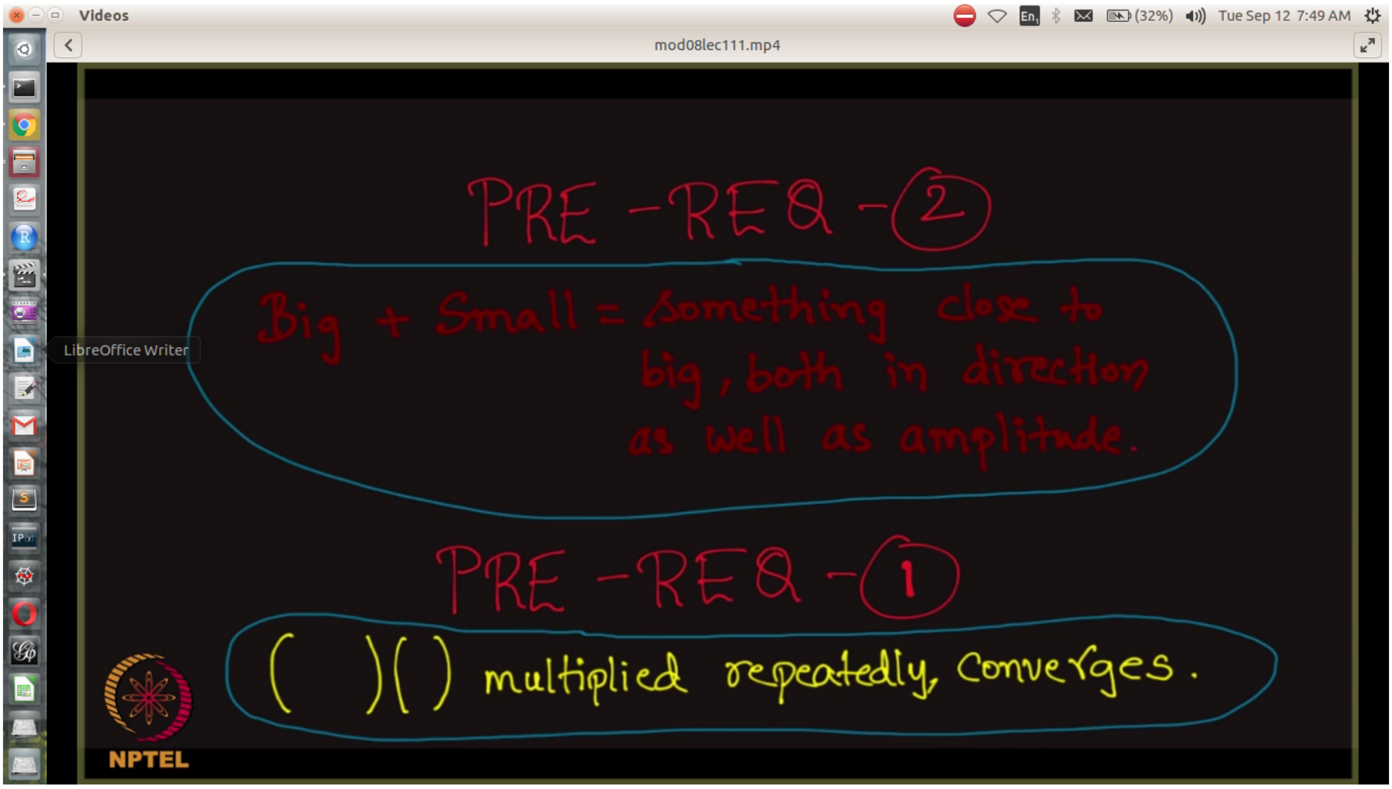
Lec111 : Link Analysis (Continued) - Addition of two vectors (Pre requisite 2)

- A vector with big amplitude (greater length) is called as the big vector

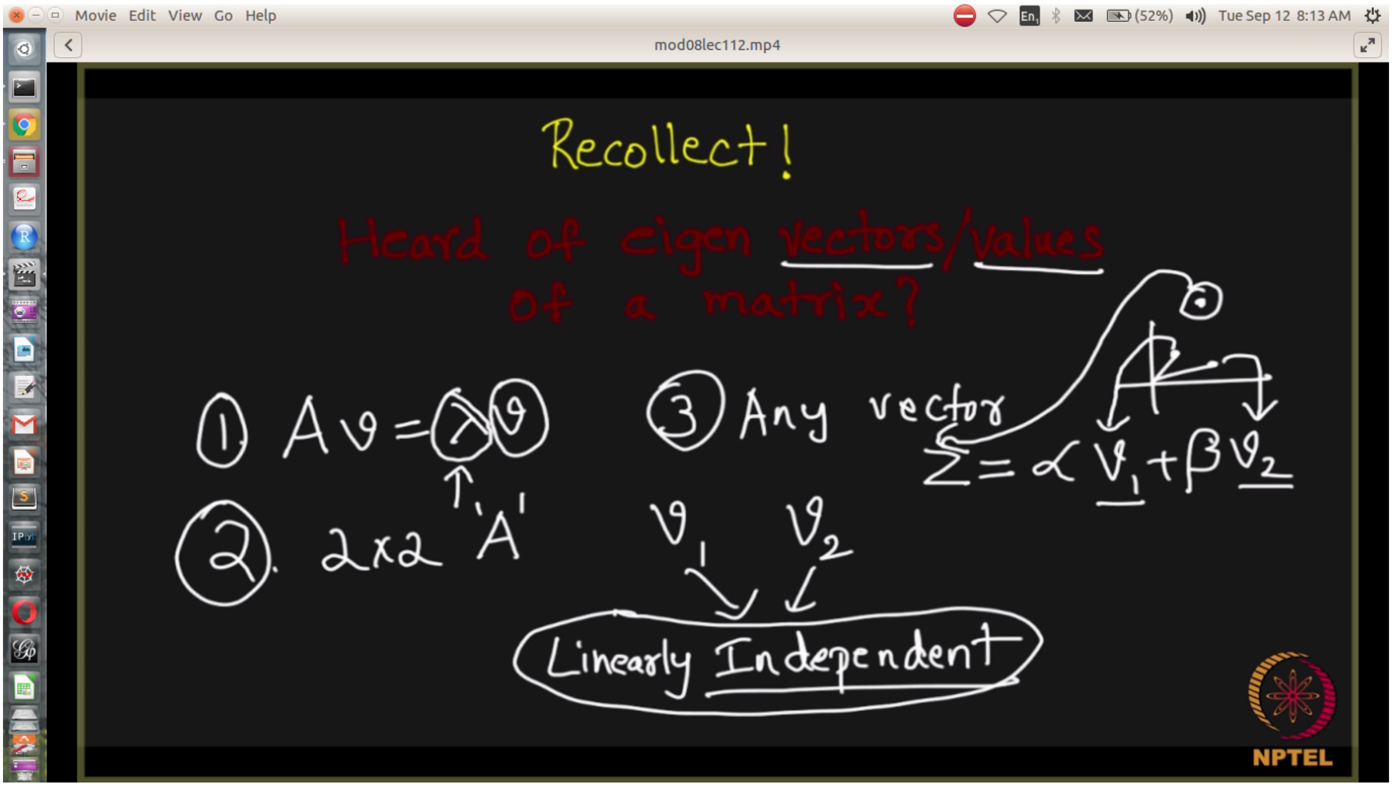

Movie Edit View Go Help
(27%)
Tue Sep 12 7:44 AM
mod08lec111.mp4
(30,70)
(5,3)
(30,70)
(35,73)
+
Sum of
(5,3)
NPTEL

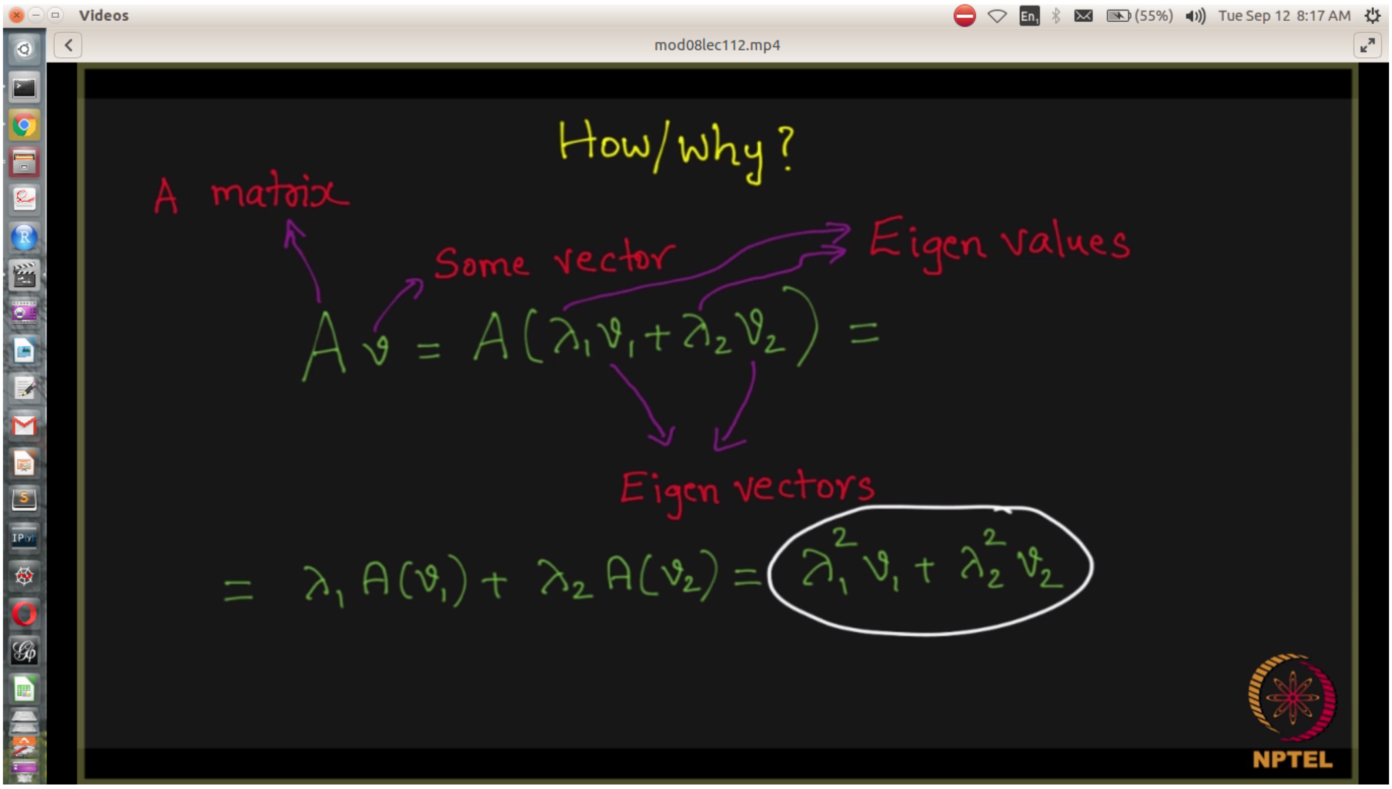

Videos
(30%)
Tue Sep 12 7:46 AM
mod08lec111.mp4
OBSERVE!!
Resultant point is close to the "big" vector
∴ the vector we added was a small vector
4:01
-2:21
NPTEL





Lec112 : Link Analysis (Continued) - Covergence in Repeated Matrix Multiplication - The Details


Movie Edit View Go Help
(52%) Tue Sep 12 8:13 AM
mod08lec112.mp4
Recollect!
Heard of eigen vectors/values of a matrix?
① $Av = \lambda v$
② 2×2 'A'
v_1 v_2
Linearly Independent
③ Any vector
$\Sigma = \alpha v_1 + \beta v_2$
NPTEL


Videos
(55%) Tue Sep 12 8:17 AM
mod08lec112.mp4
How/why?
A matrix
Some vector
Eigen values
$Av = A(\lambda_1 v_1 + \lambda_2 v_2) =$
Eigen vectors
$= \lambda_1 A(v_1) + \lambda_2 A(v_2) = \lambda_1^2 v_1 + \lambda_2^2 v_2$
NPTEL

$$A^K(v) = \underbrace{\lambda_1^K}_{\text{Amplitude}} \; \underbrace{v_1}_{\text{Direction}} + \lambda_2^K v_2 \qquad (\text{Say } \lambda_1 > \lambda_2)$$

Note:

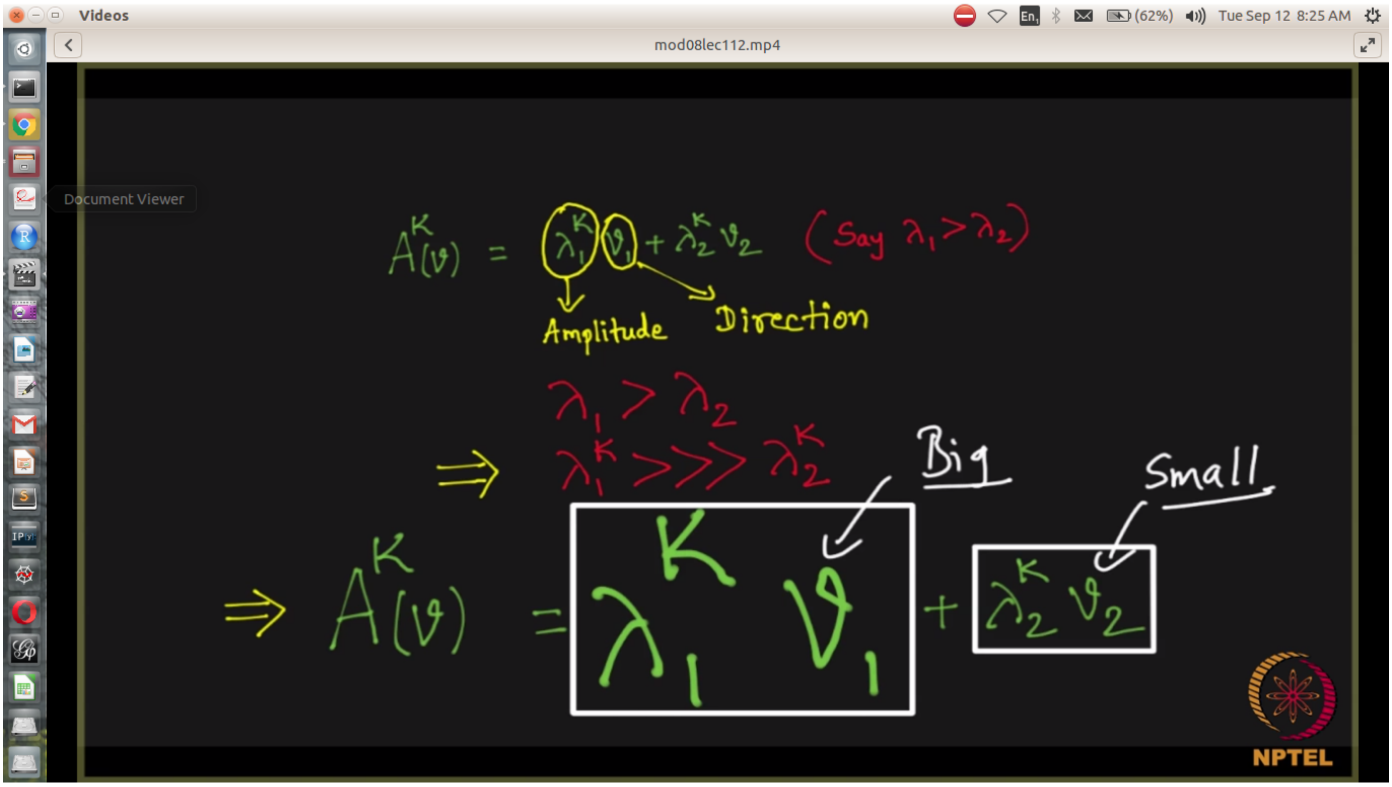
$2, 3 \rightarrow$ One more than

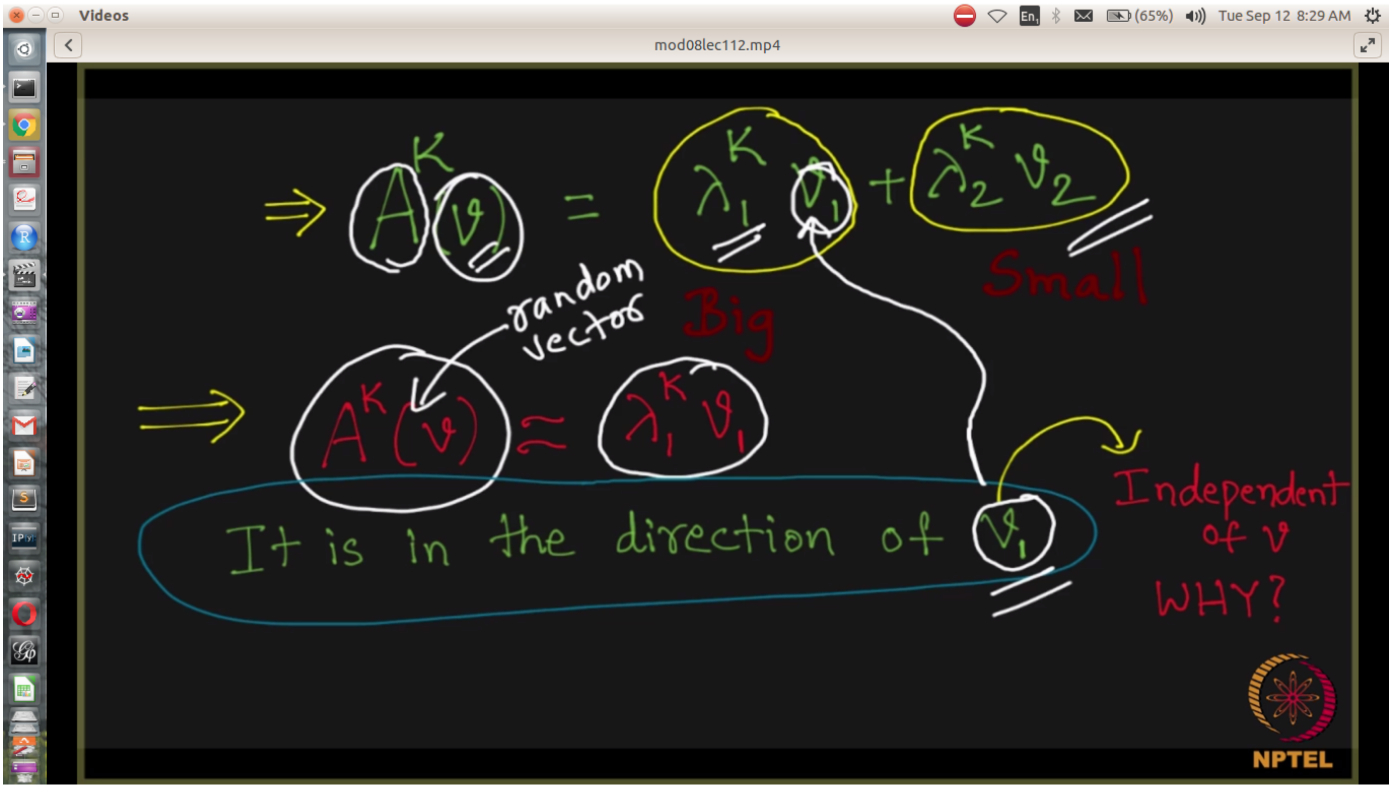
$2^2 = 4, 3^2 = 9 \rightarrow$ More than twice

$2^3 = 8, 3^3 = 27 \rightarrow$ More than thrice

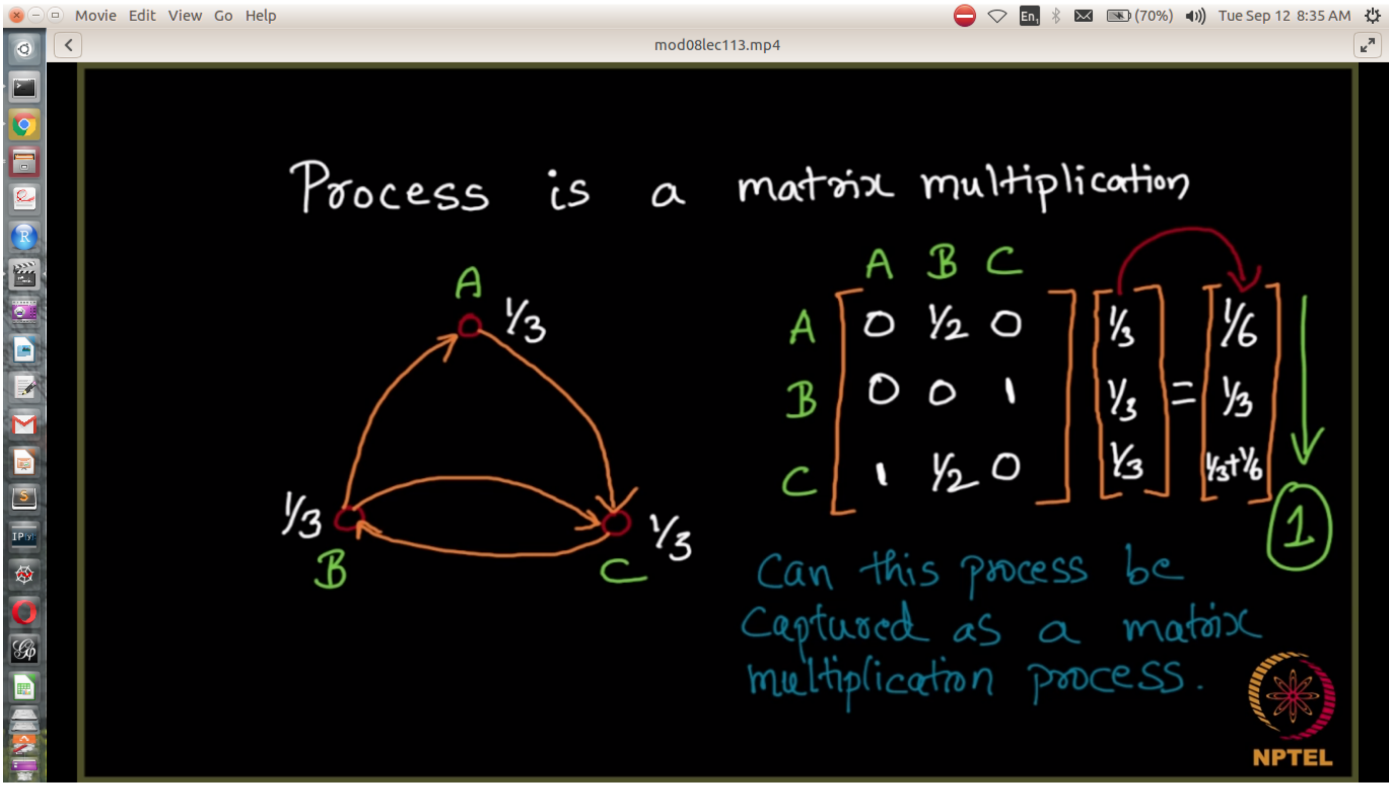
$2^{100}, 3^{100} \rightarrow$ Several folds

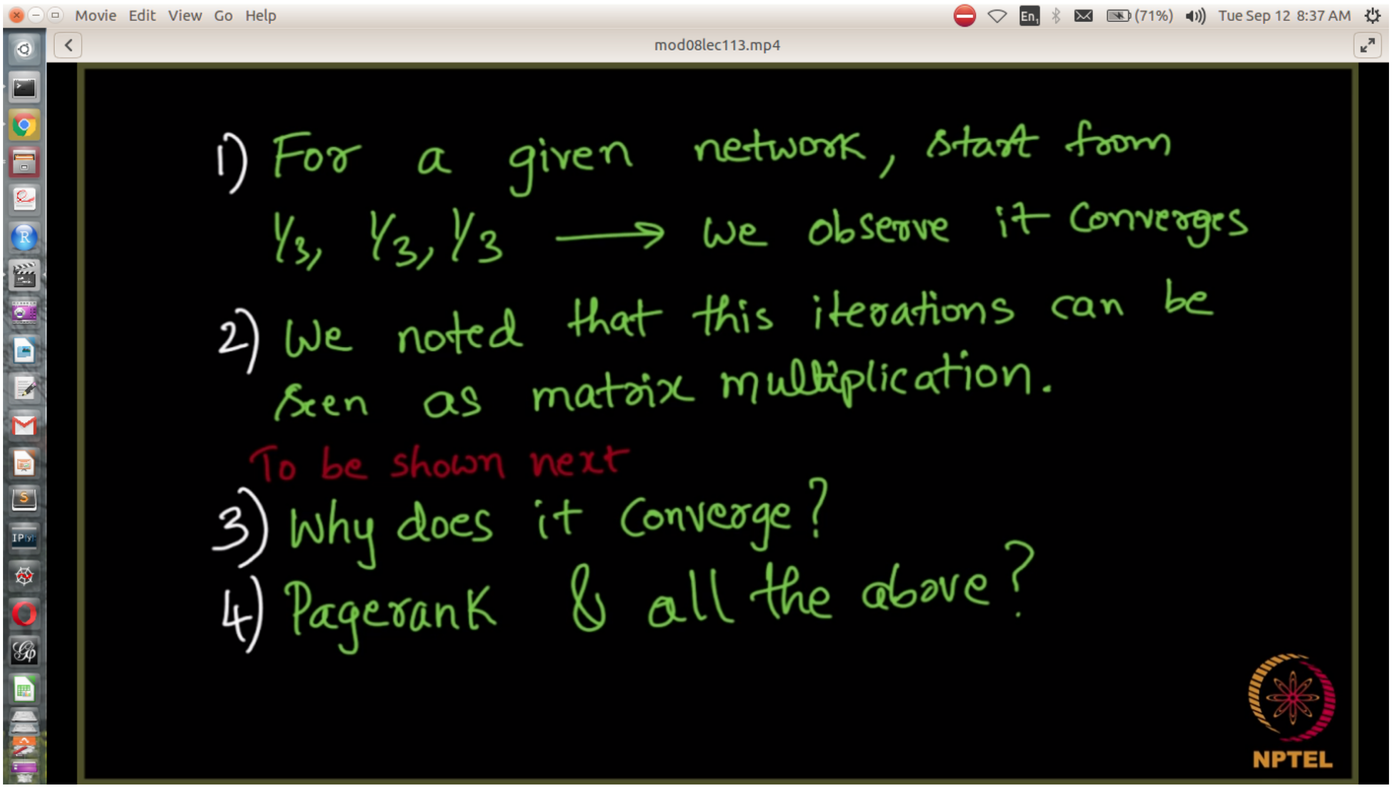
So much that $2^{100}/3^{100} \simeq 0$.





Lec113 : Link Analysis (Continued) - Page Rank as a matrix operation





Lec114 : Link Analysis (Continued) - Page Rank Explained