

# NS-2 Simulation

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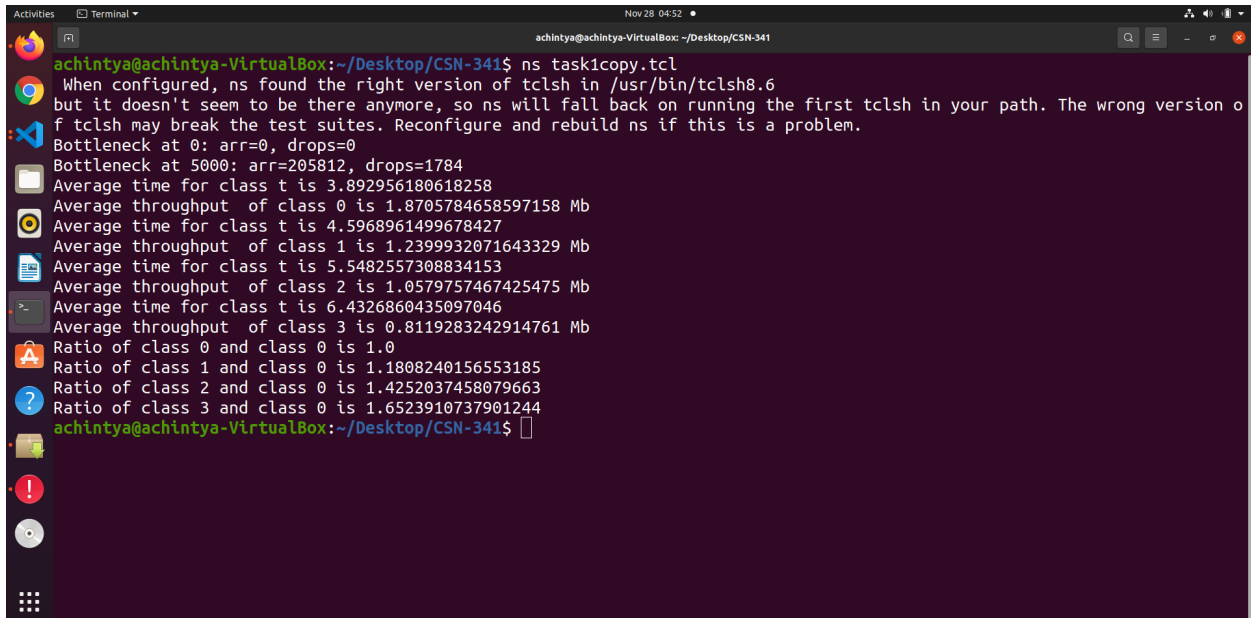
The github link to the project is

[https://github.com/achintyanath/CSN-341\\_Network\\_Simulator](https://github.com/achintyanath/CSN-341_Network_Simulator)

## Task 1

We stimulate our result for five different values of p

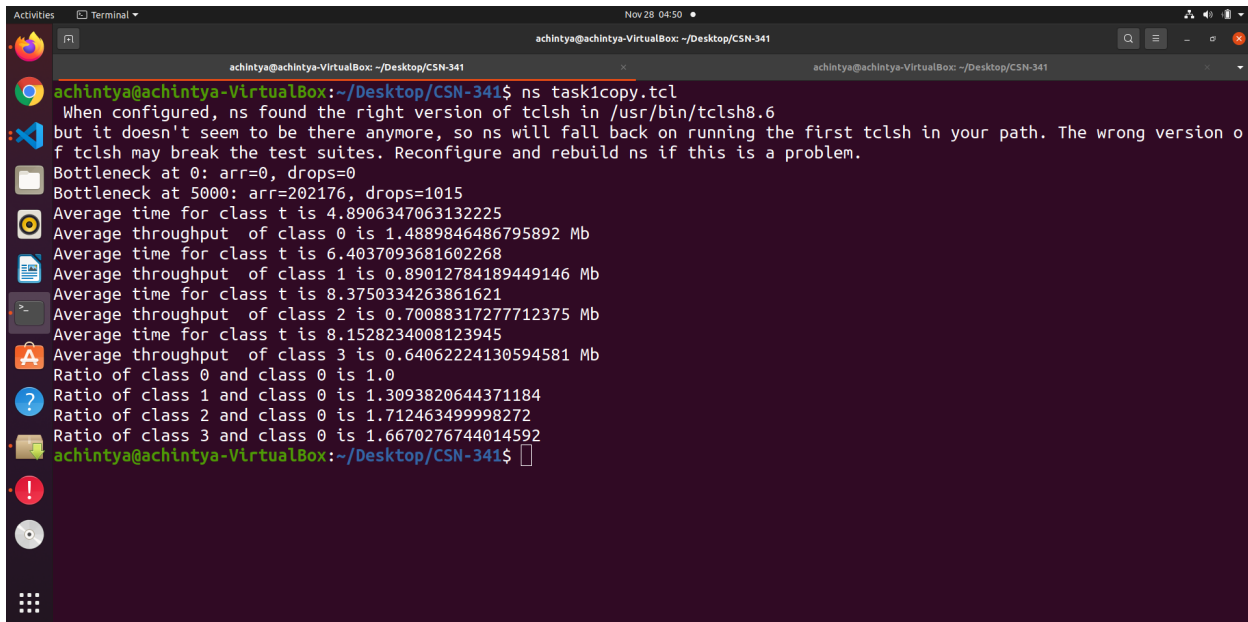
1.  $p=0.1\%$



```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskcopy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=205812, drops=1784
Average time for class t is 3.892956180618258
Average throughput of class 0 is 1.8705784658597158 Mb
Average time for class t is 4.5968961499678427
Average throughput of class 1 is 1.2399932071643329 Mb
Average time for class t is 5.5482557308834153
Average throughput of class 2 is 1.0579757467425475 Mb
Average time for class t is 6.4326860435097046
Average throughput of class 3 is 0.8119283242914761 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.1808240156553185
Ratio of class 2 and class 0 is 1.4252037458079663
Ratio of class 3 and class 0 is 1.6523910737901244
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 3.892956180618258  
Average throughput of class 0 is 1.8705784658597158 Mb  
Average time for class 1 is 4.5968961499678427  
Average throughput of class 1 is 1.2399932071643329 Mb  
Average time for class 2 is 5.5482557308834153  
Average throughput of class 2 is 1.0579757467425475 Mb  
Average time for class 3 is 6.4326860435097046  
Average throughput of class 3 is 0.8119283242914761 Mb  
Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.1808240156553185  
Ratio of class 2 and class 0 is 1.4252037458079663  
Ratio of class 3 and class 0 is 1.6523910737901244

## 2. $p=0.5\%$

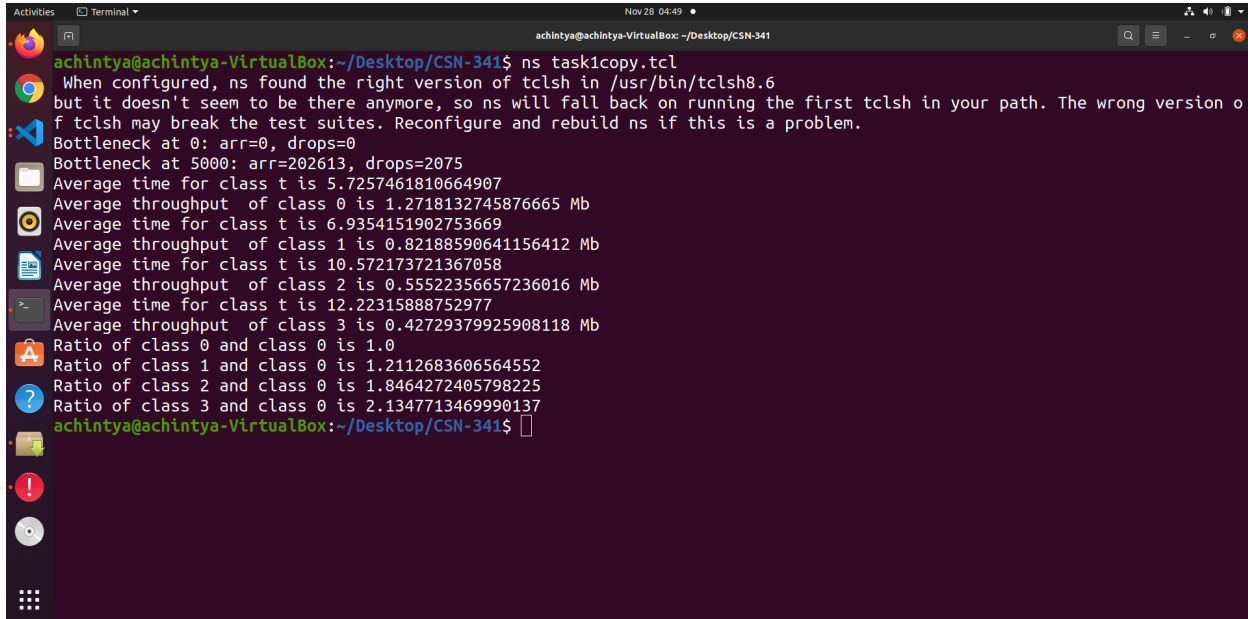


```
achintya@achintya-VirtualBox: ~/Desktop/CSN-341
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskicopy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=202176, drops=1015
Average time for class t is 4.8906347063132225
Average throughput of class 0 is 1.4889846486795892 Mb
Average time for class t is 6.4037093681602268
Average throughput of class 1 is 0.89012784189449146 Mb
Average time for class t is 8.3750334263861621
Average throughput of class 2 is 0.70088317277712375 Mb
Average time for class t is 8.1528234008123945
Average throughput of class 3 is 0.64062224130594581 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.3093820644371184
Ratio of class 2 and class 0 is 1.712463499998272
Ratio of class 3 and class 0 is 1.6670276744014592
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class t is 4.8906347063132225  
Average throughput of class 0 is 1.4889846486795892 Mb  
Average time for class t is 6.4037093681602268  
Average throughput of class 1 is 0.89012784189449146 Mb  
Average time for class t is 8.3750334263861621  
Average throughput of class 2 is 0.70088317277712375 Mb  
Average time for class t is 8.1528234008123945  
Average throughput of class 3 is 0.64062224130594581 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.3093820644371184  
Ratio of class 2 and class 0 is 1.712463499998272  
Ratio of class 3 and class 0 is 1.6670276744014592

### 3. $p=1\%$

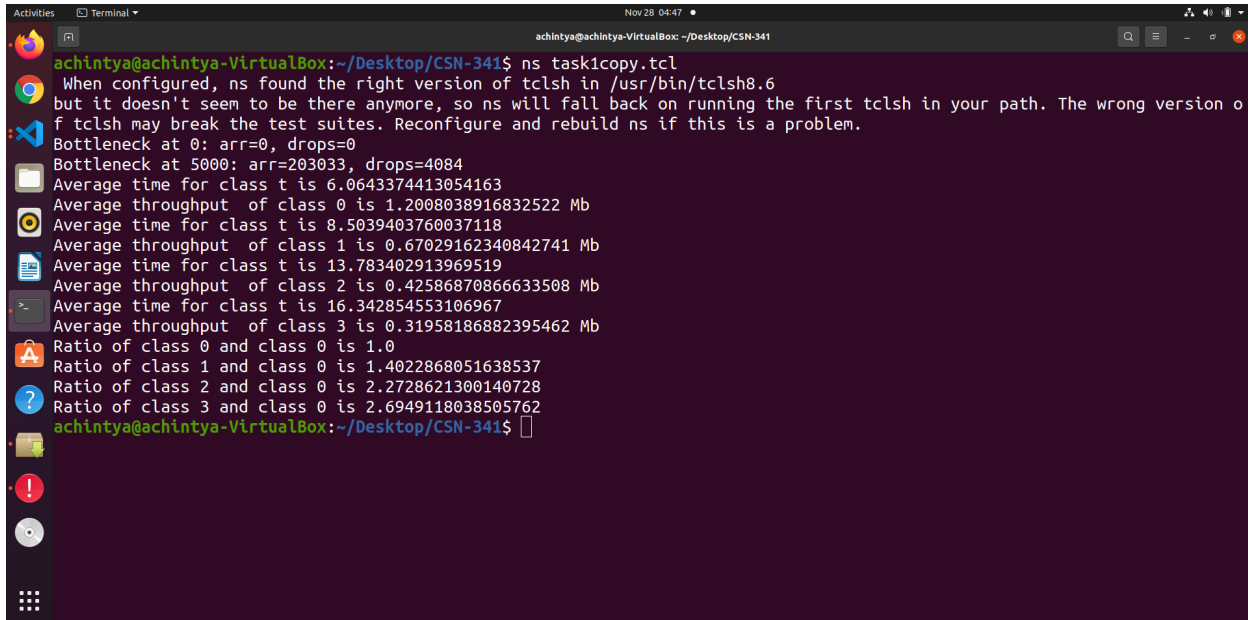


```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskcopy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version o
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=202613, drops=2075
Average time for class t is 5.7257461810664907
Average throughput of class 0 is 1.2718132745876665 Mb
Average time for class t is 6.9354151902753669
Average throughput of class 1 is 0.82188590641156412 Mb
Average time for class t is 10.572173721367058
Average throughput of class 2 is 0.55522356657236016 Mb
Average time for class t is 12.22315888752977
Average throughput of class 3 is 0.42729379925908118 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.2112683606564552
Ratio of class 2 and class 0 is 1.8464272405798225
Ratio of class 3 and class 0 is 2.1347713469990137
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 5.7257461810664907  
Average throughput of class 0 is 1.2718132745876665 Mb  
Average time for class 1 is 6.9354151902753669  
Average throughput of class 1 is 0.82188590641156412 Mb  
Average time for class 2 is 10.572173721367058  
Average throughput of class 2 is 0.55522356657236016 Mb  
Average time for class 3 is 12.22315888752977  
Average throughput of class 3 is 0.42729379925908118 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.2112683606564552  
Ratio of class 2 and class 0 is 1.8464272405798225  
Ratio of class 3 and class 0 is 2.1347713469990137

#### 4. $p=2\%$

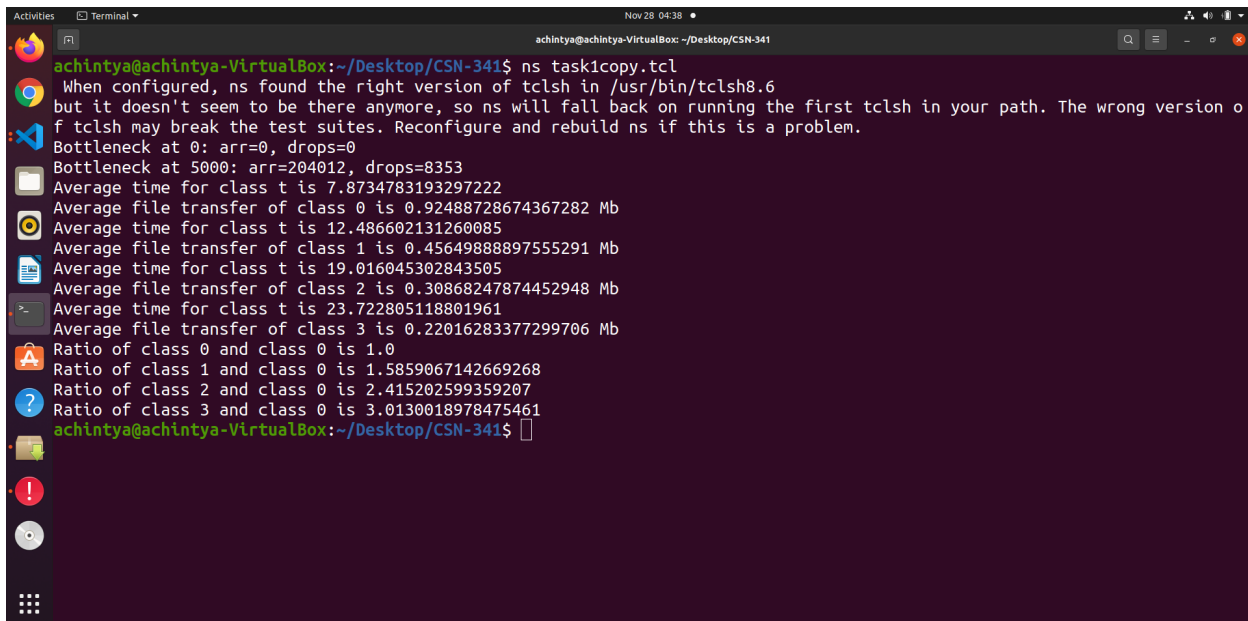


```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskcopy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version o
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=203033, drops=4084
Average time for class t is 6.0643374413054163
Average throughput of class 0 is 1.2008038916832522 Mb
Average time for class t is 8.5039403760037118
Average throughput of class 1 is 0.67029162340842741 Mb
Average time for class t is 13.783402913969519
Average throughput of class 2 is 0.42586870866633508 Mb
Average time for class t is 16.342854553106967
Average throughput of class 3 is 0.31958186882395462 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.4022868051638537
Ratio of class 2 and class 0 is 2.2728621300140728
Ratio of class 3 and class 0 is 2.6949118038505762
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 6.0643374413054163  
Average throughput of class 0 is 1.2008038916832522 Mb  
Average time for class 1 is 8.5039403760037118  
Average throughput of class 1 is 0.67029162340842741 Mb  
Average time for class 2 is 13.783402913969519  
Average throughput of class 2 is 0.42586870866633508 Mb  
Average time for class 3 is 16.342854553106967  
Average throughput of class 3 is 0.31958186882395462 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.4022868051638537  
Ratio of class 2 and class 0 is 2.2728621300140728  
Ratio of class 3 and class 0 is 2.6949118038505762

## 5. p=4%

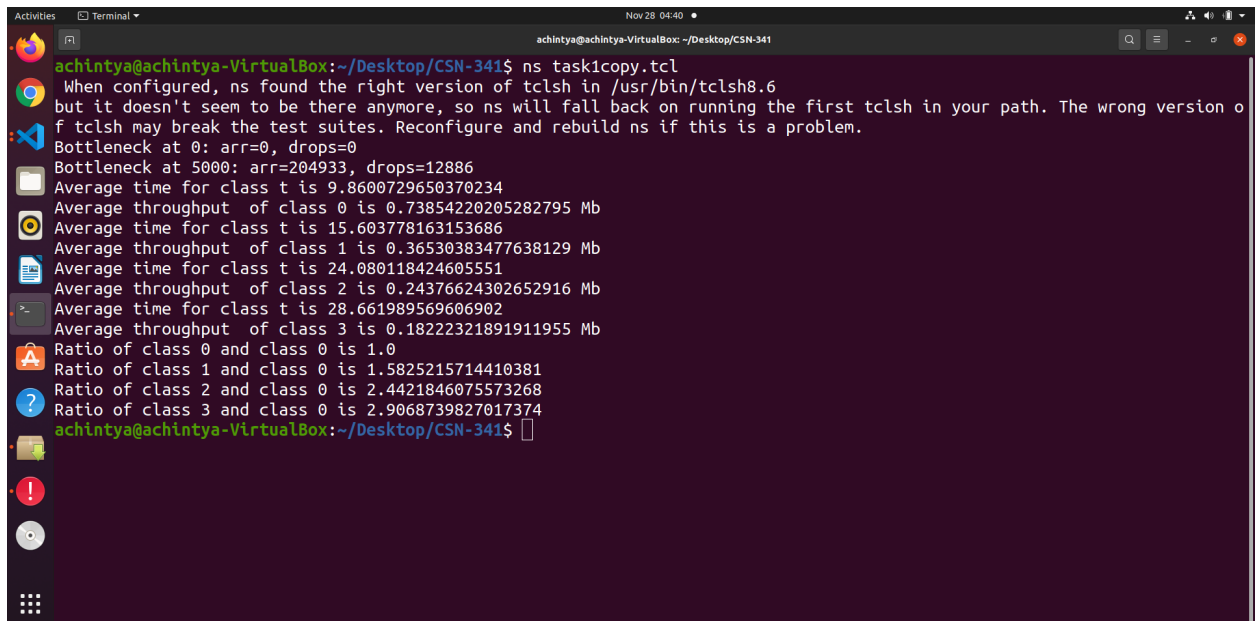


```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskcopy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=204012, drops=8353
Average time for class t is 7.8734783193297222
Average file transfer of class 0 is 0.92488728674367282 Mb
Average time for class t is 12.486602131260085
Average file transfer of class 1 is 0.45649888897555291 Mb
Average time for class t is 19.016045302843505
Average file transfer of class 2 is 0.30868247874452948 Mb
Average time for class t is 23.722805118801961
Average file transfer of class 3 is 0.22016283377299706 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.5859067142669268
Ratio of class 2 and class 0 is 2.415202599359207
Ratio of class 3 and class 0 is 3.0130018978475461
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 7.8734783193297222  
Average file transfer of class 0 is 0.92488728674367282 Mb  
Average time for class 1 is 12.486602131260085  
Average file transfer of class 1 is 0.45649888897555291 Mb  
Average time for class 2 is 19.016045302843505  
Average file transfer of class 2 is 0.30868247874452948 Mb  
Average time for class 3 is 23.722805118801961  
Average file transfer of class 3 is 0.22016283377299706 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.5859067142669268  
Ratio of class 2 and class 0 is 2.415202599359207  
Ratio of class 3 and class 0 is 3.0130018978475461

## 6. p=5%



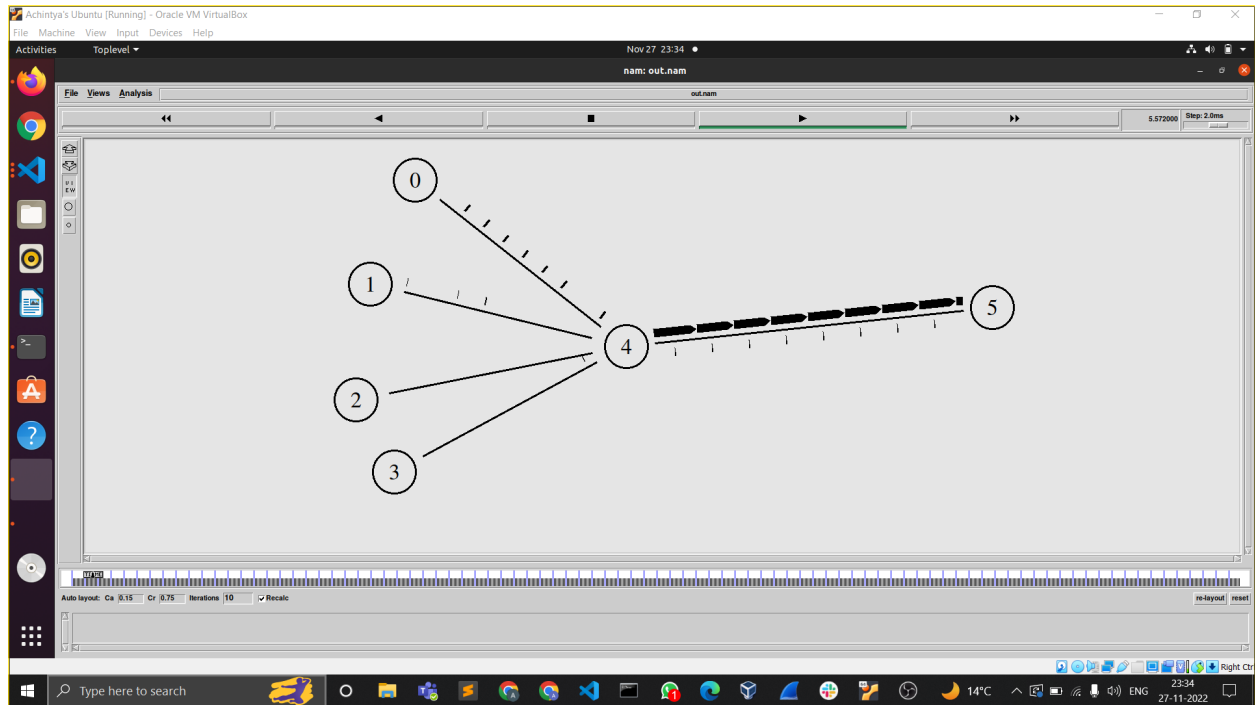
A terminal window titled 'Terminal' with a dark background. The prompt is 'achintya@achintya-VirtualBox: ~/Desktop/CSN-341'. The user has run 'ns taskcopy.tcl'. The output shows a warning about tcsh, then bottleneck statistics at 0 and 5000, followed by average time and throughput for four classes, and finally ratios of each class to class 0.

```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns taskcopy.tcl
When configured, ns found the right version of tcsh in /usr/bin/tcsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tcsh in your path. The wrong version o
f tcsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=204933, drops=12886
Average time for class t is 9.8600729650370234
Average throughput of class 0 is 0.73854220205282795 Mb
Average time for class t is 15.603778163153686
Average throughput of class 1 is 0.36530383477638129 Mb
Average time for class t is 24.080118424605551
Average throughput of class 2 is 0.24376624302652916 Mb
Average time for class t is 28.661989569606902
Average throughput of class 3 is 0.18222321891911955 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.5825215714410381
Ratio of class 2 and class 0 is 2.4421846075573268
Ratio of class 3 and class 0 is 2.9068739827017374
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 9.8600729650370234  
Average throughput of class 0 is 0.73854220205282795 Mb  
Average time for class 1 is 15.603778163153686  
Average throughput of class 1 is 0.36530383477638129 Mb  
Average time for class 2 is 24.080118424605551  
Average throughput of class 2 is 0.24376624302652916 Mb  
Average time for class 3 is 28.661989569606902  
Average throughput of class 3 is 0.18222321891911955 Mb

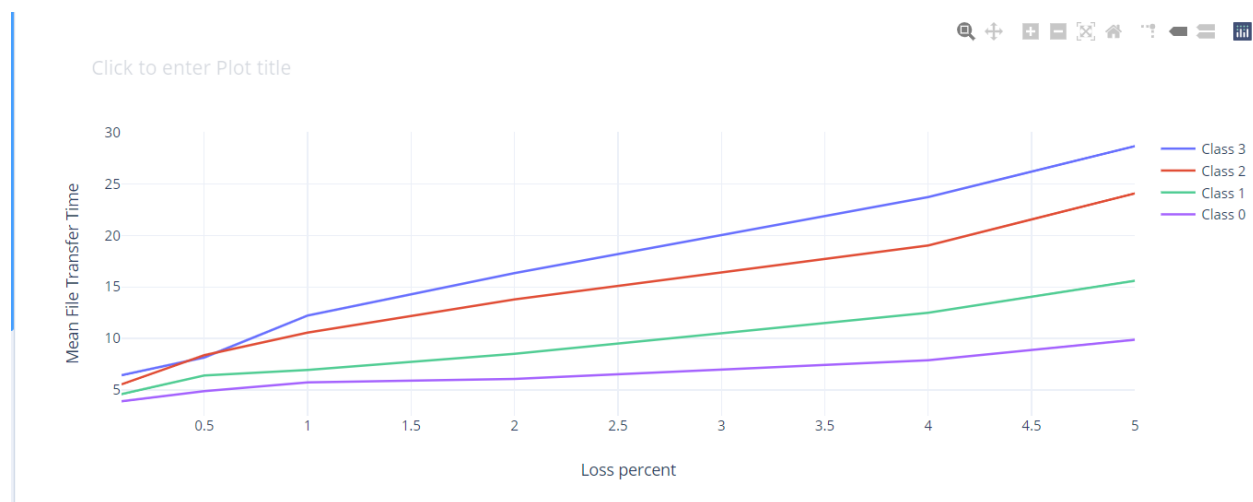
Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.5825215714410381  
Ratio of class 2 and class 0 is 2.4421846075573268  
Ratio of class 3 and class 0 is 2.9068739827017374

Screenshot of simulation:

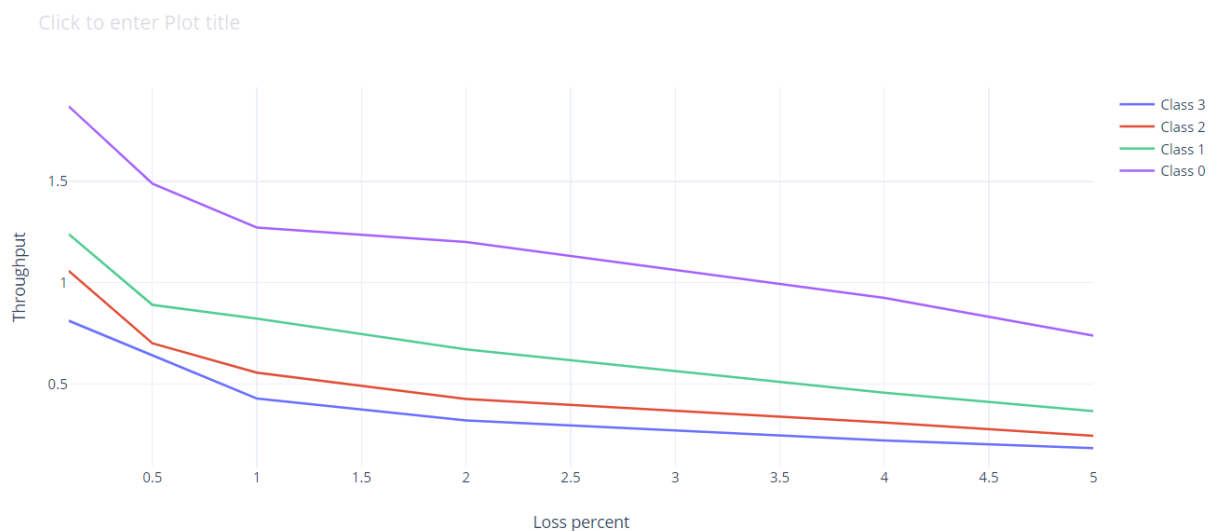




Graph:  
Mean-Time vs Loss Rate



As we can see from the graph that the mean file transfer size keeps on increasing with increase in loss rate. At a certain loss rate, the mean file transfer size is minimum for Class 0 and Highest for Class 1



As we can see from the graph that the throughput keeps on decreasing with increase in loss rate. At a certain loss rate, the throughput is minimum for Class 3 and Highest for Class 0.

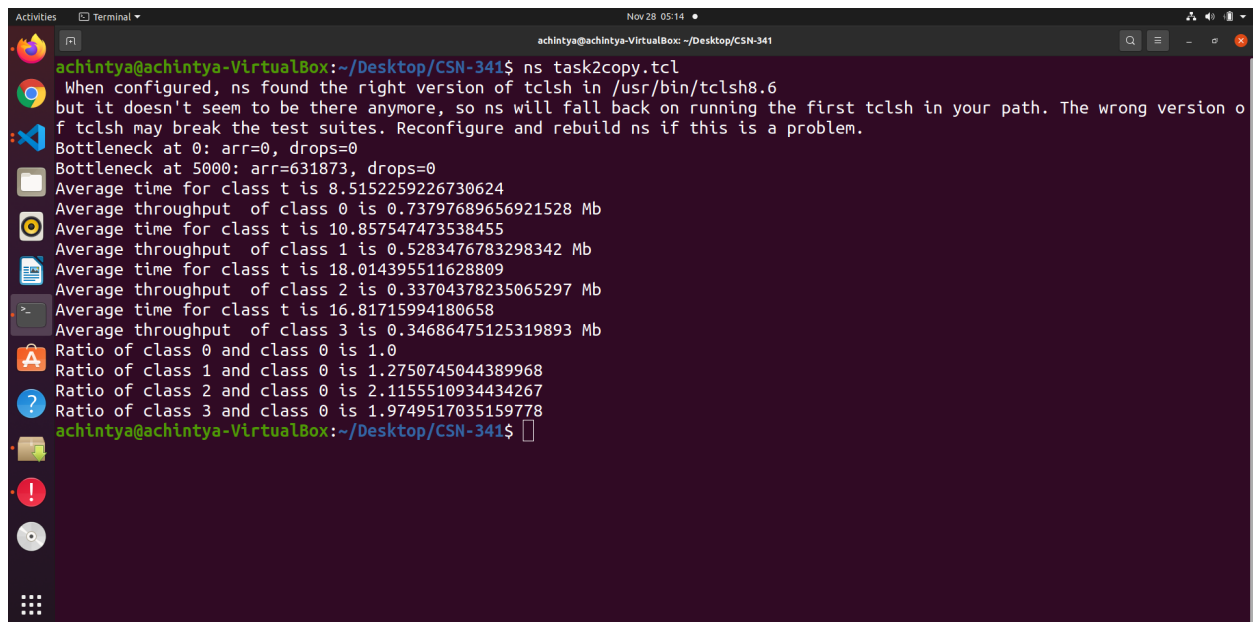
**Video Stimulation can be found in the Github Repository**

## Task 2

The video demonstration can be found at the repo

We have to calculate for load value:

$I=0.7$

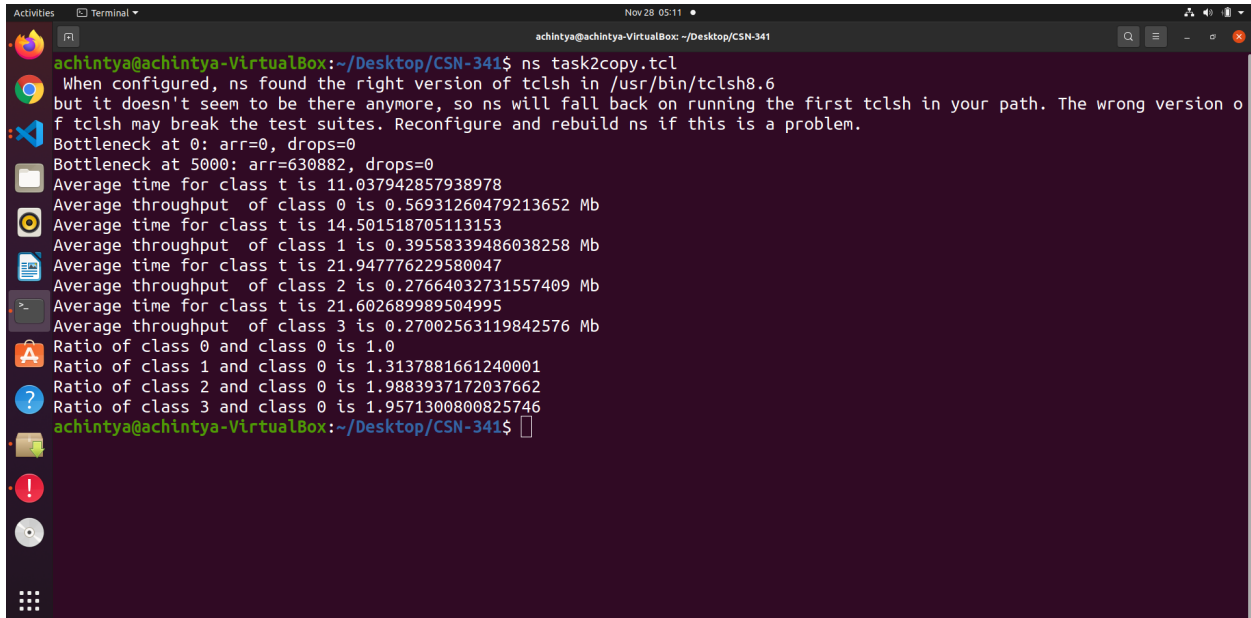


```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns task2copy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=631873, drops=0
Average time for class t is 8.5152259226730624
Average throughput of class 0 is 0.73797689656921528 Mb
Average time for class t is 10.857547473538455
Average throughput of class 1 is 0.5283476783298342 Mb
Average time for class t is 18.014395511628809
Average throughput of class 2 is 0.33704378235065297 Mb
Average time for class t is 16.81715994180658
Average throughput of class 3 is 0.34686475125319893 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.2750745044389968
Ratio of class 2 and class 0 is 2.1155510934434267
Ratio of class 3 and class 0 is 1.9749517035159778
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 8.5152259226730624s  
Average throughput of class 0 is 0.73797689656921528 Mb  
Average time for class 1 is 10.857547473538455  
Average throughput of class 1 is 0.5283476783298342 Mb  
Average time for class 2 is 18.014395511628809  
Average throughput of class 2 is 0.33704378235065297 Mb  
Average time for class 3 is 16.81715994180658  
Average throughput of class 3 is 0.34686475125319893 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.2750745044389968  
Ratio of class 2 and class 0 is 2.1155510934434267  
Ratio of class 3 and class 0 is 1.9749517035159778

I=0.75



```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns task2copy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=630882, drops=0
Average time for class t is 11.037942857938978
Average throughput of class 0 is 0.56931260479213652 Mb
Average time for class t is 14.501518705113153
Average throughput of class 1 is 0.39558339486038258 Mb
Average time for class t is 21.947776229580047
Average throughput of class 2 is 0.27664032731557409 Mb
Average time for class t is 21.602689989504995
Average throughput of class 3 is 0.27002563119842576 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.3137881661240001
Ratio of class 2 and class 0 is 1.9883937172037662
Ratio of class 3 and class 0 is 1.9571300800825746
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class t is 11.037942857938978

Average throughput of class 0 is 0.56931260479213652 Mb

Average time for class t is 14.501518705113153

Average throughput of class 1 is 0.39558339486038258 Mb

Average time for class t is 21.947776229580047

Average throughput of class 2 is 0.27664032731557409 Mb

Average time for class t is 21.602689989504995

Average throughput of class 3 is 0.27002563119842576 Mb

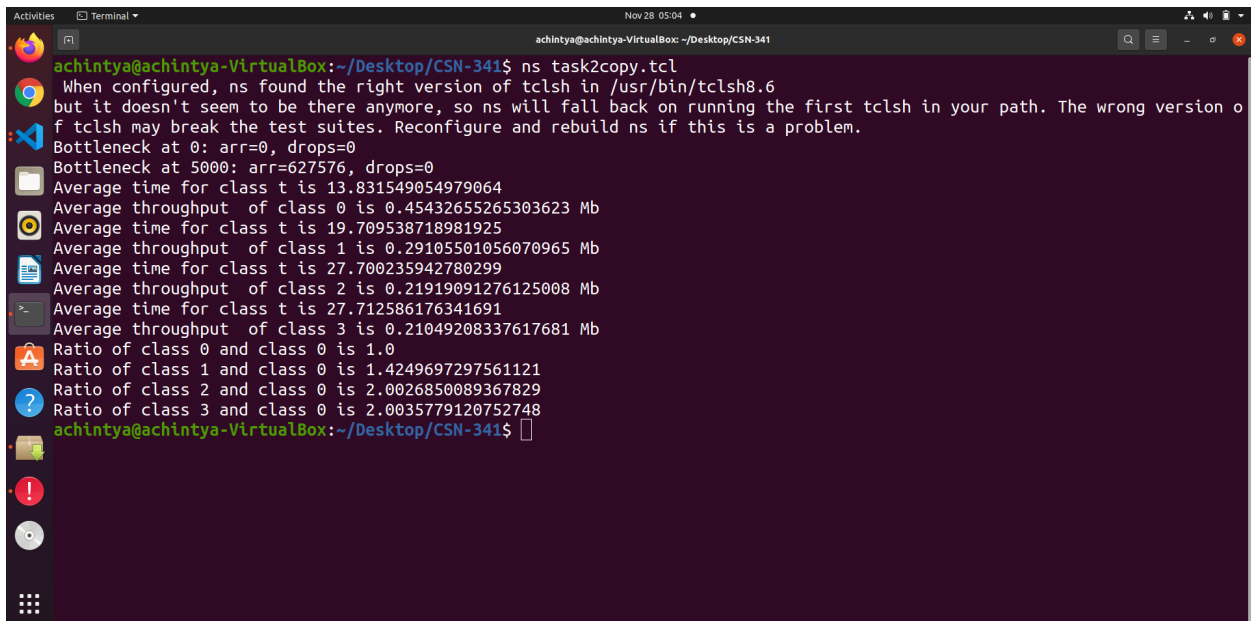
Ratio of class 0 and class 0 is 1.0

Ratio of class 1 and class 0 is 1.3137881661240001

Ratio of class 2 and class 0 is 1.9883937172037662

Ratio of class 3 and class 0 is 1.9571300800825746

For  $\lambda=0.8$



```
achintya@achintya-VirtualBox: ~/Desktop/CSN-341$ ns task2copy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version of
tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=627576, drops=0
Average time for class t is 13.831549054979064
Average throughput of class 0 is 0.45432655265303623 Mb
Average time for class t is 19.709538718981925
Average throughput of class 1 is 0.29105501056070965 Mb
Average time for class t is 27.700235942780299
Average throughput of class 2 is 0.21919091276125008 Mb
Average time for class t is 27.712586176341691
Average throughput of class 3 is 0.21049208337617681 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.4249697297561121
Ratio of class 2 and class 0 is 2.0026850089367829
Ratio of class 3 and class 0 is 2.0035779120752748
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average throughput of class 0 is 0.45432655265303623 Mb

Average time for class 1 is 19.709538718981925

Average throughput of class 1 is 0.29105501056070965 Mb

Average time for class 2 is 27.700235942780299

Average throughput of class 2 is 0.21919091276125008 Mb

Average time for class 3 is 27.712586176341691

Average throughput of class 3 is 0.21049208337617681 Mb

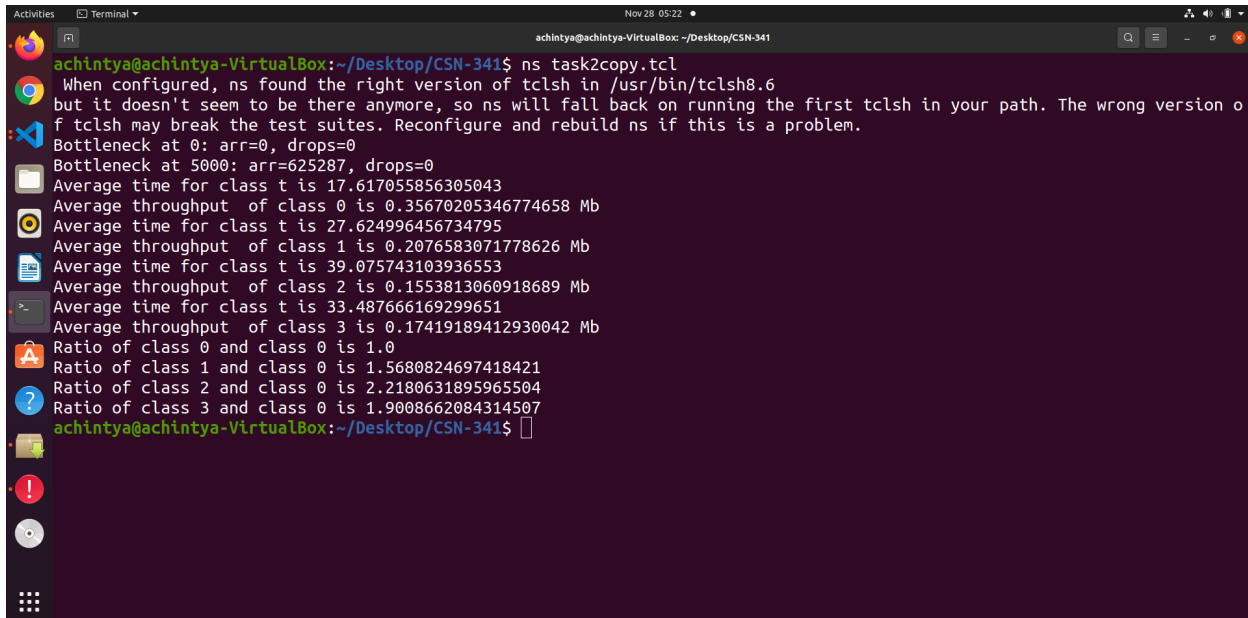
Ratio of class 0 and class 0 is 1.0

Ratio of class 1 and class 0 is 1.4249697297561121

Ratio of class 2 and class 0 is 2.0026850089367829

Ratio of class 3 and class 0 is 2.0035779120752748

l=0.85

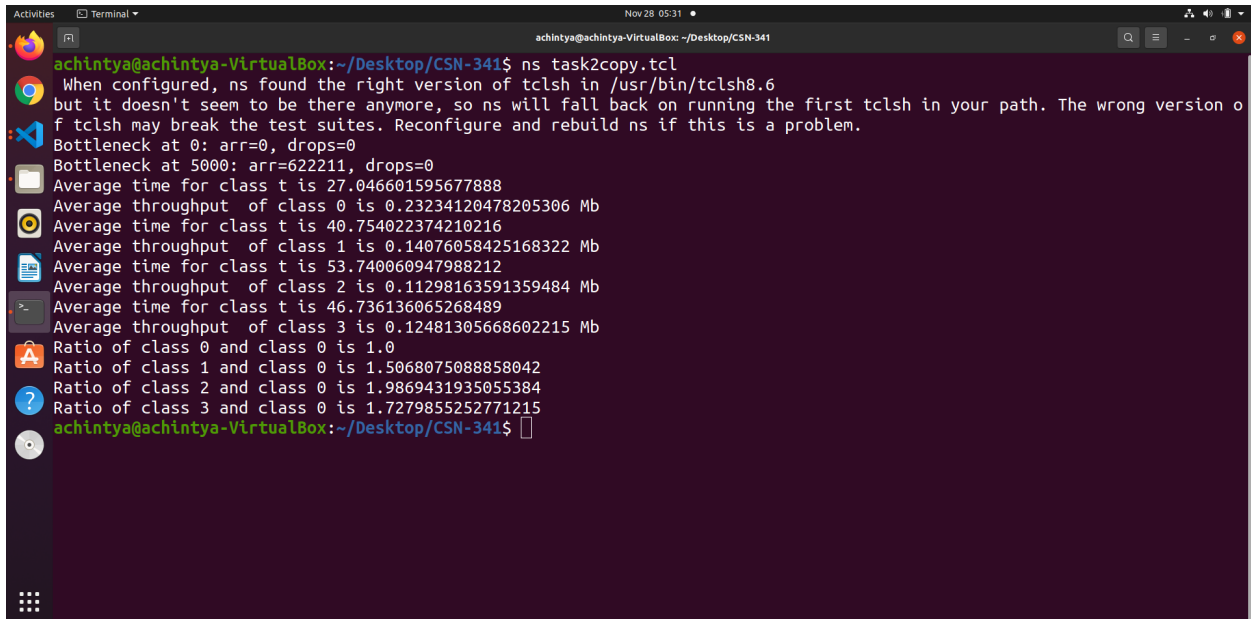
A terminal window titled 'achintya@achintya-VirtualBox: ~/Desktop/CSN-341' showing the output of the command 'ns task2copy.tcl'. The output includes a warning about tclsh version, a bottleneck report, and performance metrics for four classes (0, 1, 2, 3) including average time, throughput, and ratios.

```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns task2copy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version o
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=625287, drops=0
Average time for class t is 17.617055856305043
Average throughput of class 0 is 0.35670205346774658 Mb
Average time for class t is 27.624996456734795
Average throughput of class 1 is 0.2076583071778626 Mb
Average time for class t is 39.075743103936553
Average throughput of class 2 is 0.1553813060918689 Mb
Average time for class t is 33.487666169299651
Average throughput of class 3 is 0.17419189412930042 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.5680824697418421
Ratio of class 2 and class 0 is 2.2180631895965504
Ratio of class 3 and class 0 is 1.9008662084314507
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 17.617055856305043  
Average throughput of class 0 is 0.35670205346774658 Mb  
Average time for class 1 is 27.624996456734795  
Average throughput of class 1 is 0.2076583071778626 Mb  
Average time for class 2 is 39.075743103936553  
Average throughput of class 2 is 0.1553813060918689 Mb  
Average time for class 3 is 33.487666169299651  
Average throughput of class 3 is 0.17419189412930042 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.5680824697418421  
Ratio of class 2 and class 0 is 2.2180631895965504  
Ratio of class 3 and class 0 is 1.9008662084314507

L =0.9

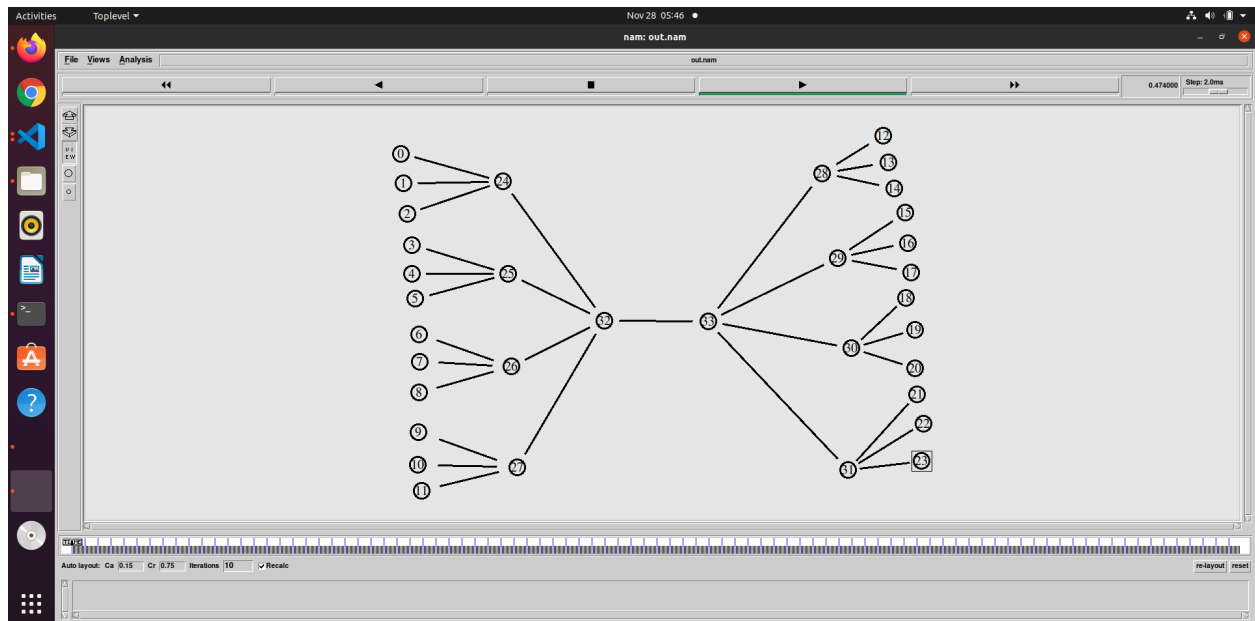


```
achintya@achintya-VirtualBox:~/Desktop/CSN-341$ ns task2copy.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the first tclsh in your path. The wrong version o
f tclsh may break the test suites. Reconfigure and rebuild ns if this is a problem.
Bottleneck at 0: arr=0, drops=0
Bottleneck at 5000: arr=622211, drops=0
Average time for class t is 27.046601595677888
Average throughput of class 0 is 0.23234120478205306 Mb
Average time for class t is 40.754022374210216
Average throughput of class 1 is 0.14076058425168322 Mb
Average time for class t is 53.740060947988212
Average throughput of class 2 is 0.11298163591359484 Mb
Average time for class t is 46.736136065268489
Average throughput of class 3 is 0.12481305668602215 Mb
Ratio of class 0 and class 0 is 1.0
Ratio of class 1 and class 0 is 1.5068075088858042
Ratio of class 2 and class 0 is 1.9869431935055384
Ratio of class 3 and class 0 is 1.7279855252771215
achintya@achintya-VirtualBox:~/Desktop/CSN-341$
```

Average time for class 0 is 27.046601595677888  
Average throughput of class 0 is 0.23234120478205306 Mb  
Average time for class 1 is 40.754022374210216  
Average throughput of class 1 is 0.14076058425168322 Mb  
Average time for class 2 is 53.740060947988212  
Average throughput of class 2 is 0.11298163591359484 Mb  
Average time for class 3 is 46.736136065268489  
Average throughput of class 3 is 0.12481305668602215 Mb

Ratio of class 0 and class 0 is 1.0  
Ratio of class 1 and class 0 is 1.5068075088858042  
Ratio of class 2 and class 0 is 1.9869431935055384  
Ratio of class 3 and class 0 is 1.7279855252771215

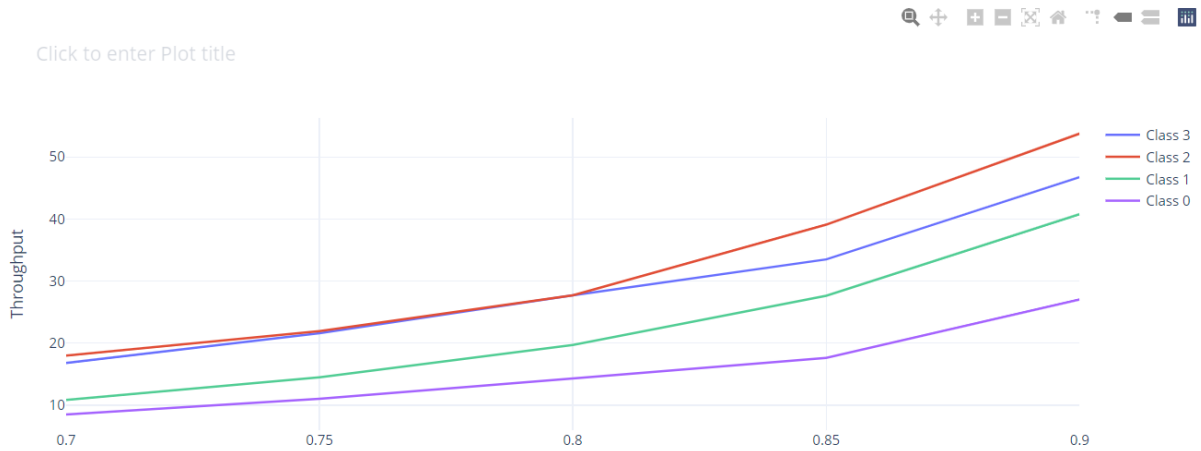
Screenshot of simulation:



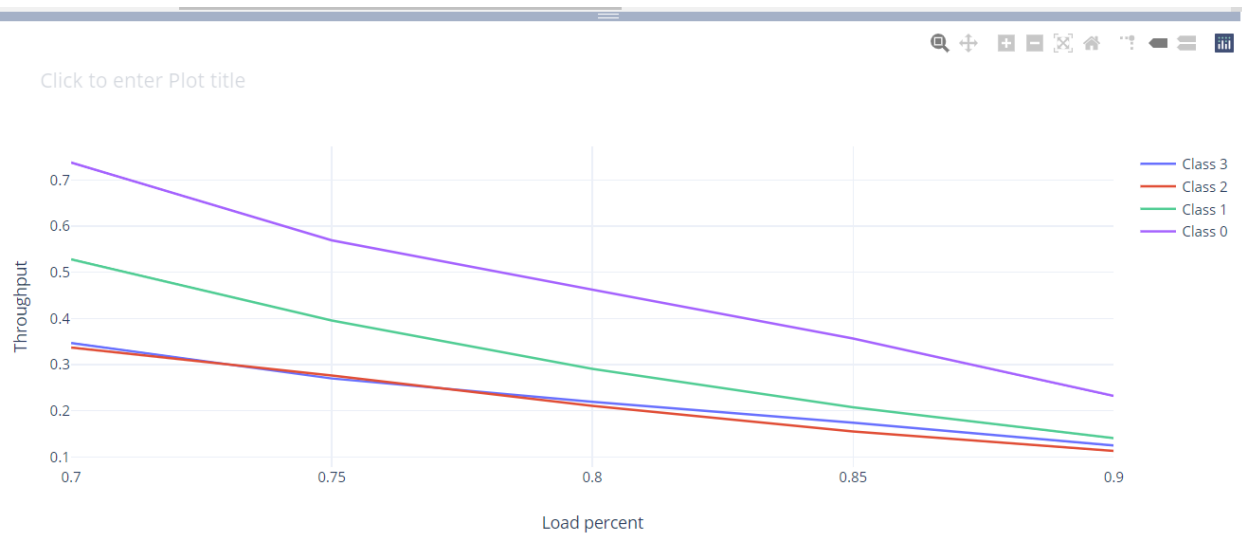
**Video Stimulation can be found in the Github Repository**

Graphs:

Graph of mean file transfer time with the load factor:



With increase in the load the mean transfer file time also increases. As a particular load, Class 0 has minimum File Transfer Time and both Class 2 and Class 3 have almost the same (maximum) File Transfer Time.



With increase in the load the throughput decreases. As a particular load, Class 0 has maximum throughput and both Class 2 and Class 3 have almost the same(minimum) throughput..





## Conclusion

The data received from the simulation are in-accordance with the theoretical values.