

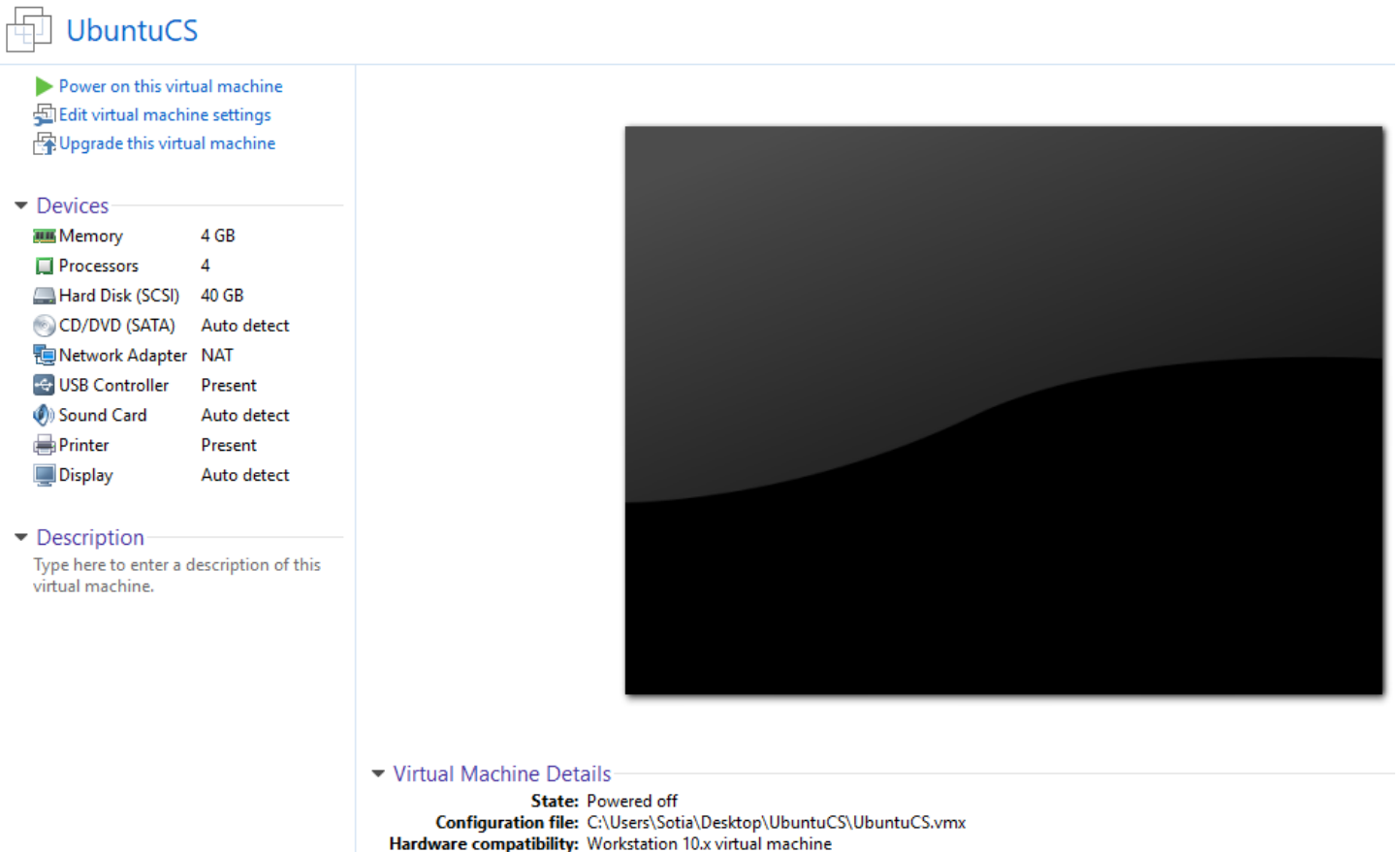
# ΕΠΛ 425: Τεχνολογίες Διαδικτύου

## 1<sup>η</sup> Άσκηση

Όνομα: Σώτια Γρηγορίου

Ταυτότητα: 930184

Έχω χρησιμοποιήσει ένα Ubuntu virtual machine μέσω του VMware Workstation Pro, όπως φαίνεται στην εικόνα πιο κάτω, επειδή για κάποιο λόγο δεν με άφηνε να τρέξω τον κώδικα μου στο AWS EC2. Στην επιλογή Processors άλλαξα την τιμή πρώτα σε 1 για 1 CPU, μετά σε 2 για 2 CPUs και τέλος σε 4 για 4 CPUs.



## 1 CPU:

```
Problems @ Javadoc Declaration Console
<terminated> Client [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:36:30 PM)
Client 9: 0.8035066666666907 seconds.
Client 2: 0.8040633333333573 seconds.
Client 7: 0.804340000000024 seconds.
Client 8: 0.8046133333333574 seconds.
Client 5: 0.8048866666666906 seconds.
Client 6: 0.805160000000024 seconds.
Client 4: 0.8054366666666907 seconds.
Client 3: 0.8057133333333573 seconds.
Client 1: 0.8059866666666906 seconds.
Client 10: 0.8062533333333574 seconds.
Average Communication Latency for all Clients: 0.8050516666666907 seconds.
```

```
Problems @ Javadoc Declaration Console
Server [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:36:27 PM)
Server listening to: 0.0.0.0/0.0.0.0:9999
Waiting for requests...
Average server's throughput for now: 12.408487405385284
Average server's throughput for now: 12.41310996371338
Average memory utilization for now: 1040224.0
Average memory utilization for now: 2397520.0
Average server's throughput for now: 12.408491990688027
Average memory utilization for now: 1495453.3333333333
Average server's throughput for now: 12.406567405714434
Average memory utilization for now: 1009218.0
Average server's throughput for now: 12.404490319761829
Average memory utilization for now: 753289.6
Average server's throughput for now: 12.403447130748887
Average memory utilization for now: 567610.6666666666
Average server's throughput for now: 12.402043457238733
Average memory utilization for now: 460899.4285714286
Average server's throughput for now: 12.400862711138089
Average memory utilization for now: 392219.0
Average server's throughput for now: 12.399318955312529
Average memory utilization for now: 337758.22222222225
Average server's throughput for now: 12.39757270508236
Average memory utilization for now: 221739.2
```

## 2 CPUs:

```
Problems @ Javadoc Declaration Console
<terminated> Client [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:44:22 PM)
Client 5: 0.788410000000032 seconds.
Client 7: 0.7881466666666986 seconds.
Client 8: 0.7886766666666987 seconds.
Client 3: 0.7889466666666987 seconds.
Client 1: 0.7892166666666987 seconds.
Client 2: 0.789480000000032 seconds.
Client 4: 0.7897433333333653 seconds.
Client 6: 0.790020000000032 seconds.
Client 9: 0.790460000000032 seconds.
Client 10: 0.7909400000000321 seconds.
Average Communication Latency for all Clients: 0.7894303333333654 seconds.
```

```
Problems @ Javadoc Declaration Console
Server [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:44:16 PM)
Server listening to: 0.0.0.0/0.0.0.0:9999
Waiting for requests...
Average server's throughput for now: 12.507037485399735
Average server's throughput for now: 12.504689258471927
Average server's throughput for now: 12.504689258471927
Average server's throughput for now: 12.502612800754763
Average server's throughput for now: 12.503994408752765
Average memory utilization for now: 170468.0
Average server's throughput for now: 12.495514682192287
Average memory utilization for now: 369686.6666666667
Average server's throughput for now: 12.49059246902641
Average memory utilization for now: 191922.2857142857
Average memory utilization for now: 581563.4285714285
Average memory utilization for now: 1019909.7142857143
Average memory utilization for now: 1506961.142857143
Average server's throughput for now: 12.485801699456717
Average memory utilization for now: 1312140.5714285714
Average memory utilization for now: 1026193.0
Average server's throughput for now: 12.482477666834221
Average memory utilization for now: 573764.4444444445
Average server's throughput for now: 12.4802840619717
Average memory utilization for now: 343187.2
```

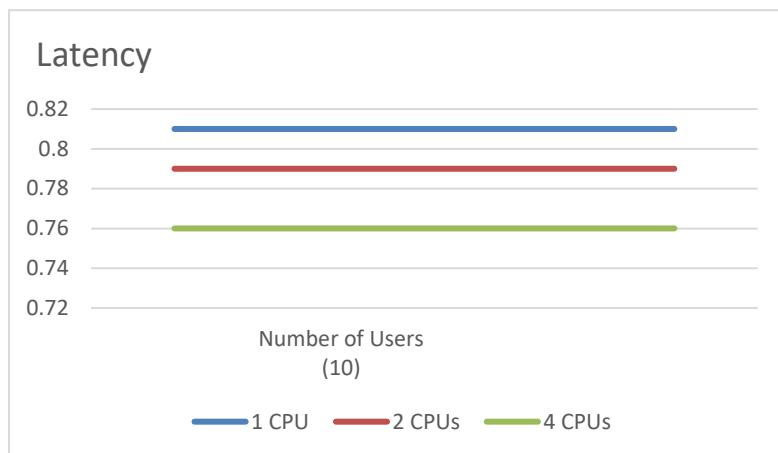
#### 4 CPUs:

```
Problems @ Javadoc Declaration Console
<terminated> Client [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:53:01 PM)
Client 5: 0.758080000000024 seconds.
Client 2: 0.7589033333333574 seconds.
Client 8: 0.7583566666666907 seconds.
Client 3: 0.7586233333333574 seconds.
Client 6: 0.7591666666666907 seconds.
Client 7: 0.7594300000000241 seconds.
Client 9: 0.7602300000000242 seconds.
Client 1: 0.7599600000000242 seconds.
Client 4: 0.7596966666666908 seconds.
Client 10: 0.7605066666666908 seconds.
Average Communication Latency for all Clients: 0.7596206666666907 seconds.
```

```
Problems @ Javadoc Declaration Console
Server [Java Application] /usr/lib/jvm/java-7-oracle/bin/java (Oct 8, 2017, 8:53:00 PM)
Server listening to: 0.0.0.0/0.0.0.0:9999
Waiting for requests...
Average server's throughput for now: 12.521129542195062
Average server's throughput for now: 12.521390810916586
Average server's throughput for now: 12.520476472119677
Average memory utilization for now: 426164.0
Average server's throughput for now: 12.515027744138917
Average server's throughput for now: 12.51087511922758
Average server's throughput for now: 12.502778198021542
Average server's throughput for now: 12.503780984086347
Average server's throughput for now: 12.50600944428031
Average server's throughput for now: 12.519823053167515
Average memory utilization for now: 562834.4
Average server's throughput for now: 12.508354792511623
Average memory utilization for now: 681869.6
Average memory utilization for now: 869676.8
Average memory utilization for now: 443214.4
Average memory utilization for now: 648360.0
Average memory utilization for now: 495229.6
Average memory utilization for now: 546637.6
Average memory utilization for now: 700337.6
Average memory utilization for now: 683568.0
```

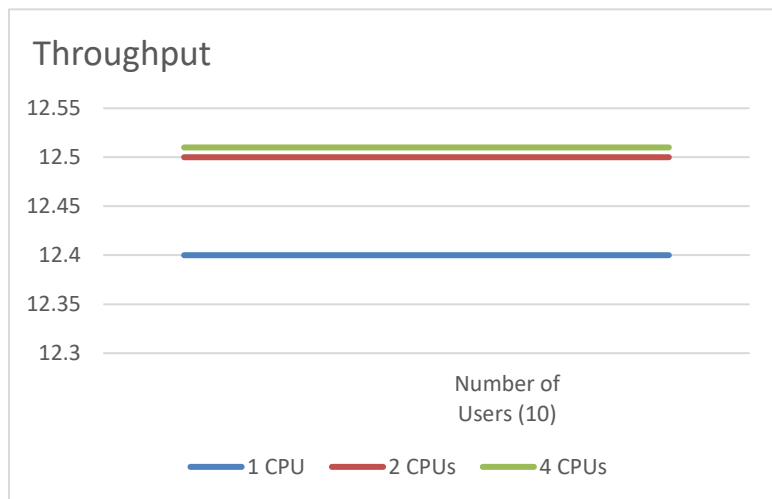
## Plots:

### Latency vs Number of Users



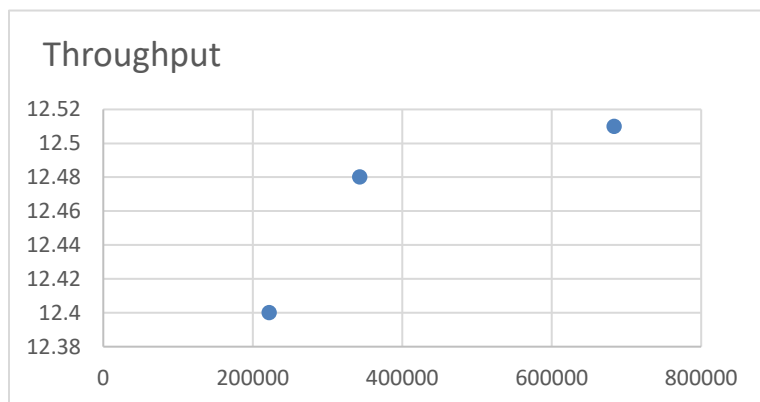
Παρατηρούμε ότι με την αύξηση των CPUs έχουμε μικρότερο communication latency, δηλαδή αφού η επεξεργασία γίνεται ταυτόχρονα σε περισσότερους επεξεργαστές τότε ο χρόνος μεταξύ της αποστολής ενός αιτήματος και της λήψης απάντησης μειώνεται σημαντικά.

### Throughput vs Number of Users



Παρατηρούμε ότι με την αύξηση των CPUs έχουμε μεγαλύτερο throughput, δηλαδή αφού η επεξεργασία γίνεται ταυτόχρονα σε περισσότερους επεξεργαστές τότε ο αριθμός των αιτημάτων που ικανοποιούνται σε κάθε δευτερόλεπτο αυξάνεται σημαντικά.

### Throughput vs Average Memory utilization



Παρατηρούμε ότι καθώς αυξάνει το throughput αυξάνει και το average memory utilization. Αυτό συμβαίνει διότι έχουμε περισσότερους επεξεργαστές και άρα χρειαζόμαστε περισσότερη μνήμη ταυτόχρονα για να επεξεργαστούμε τα αιτήματα.