

COMPSCI 677 Spring 2022

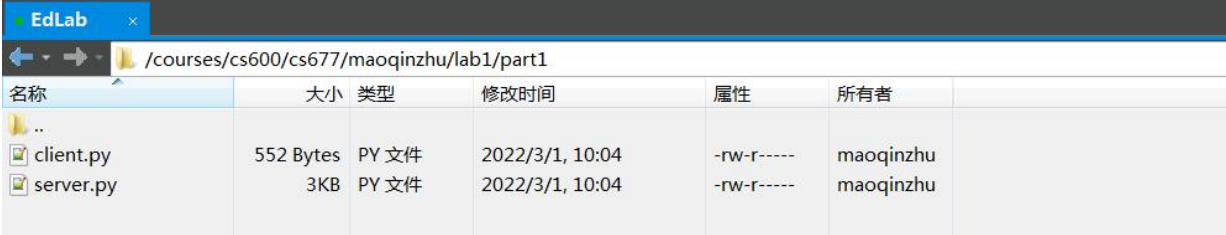
Lab 1: Toy Store - Output

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Part 1 - Implementation with Socket Connection and Handwritten Thread Pool

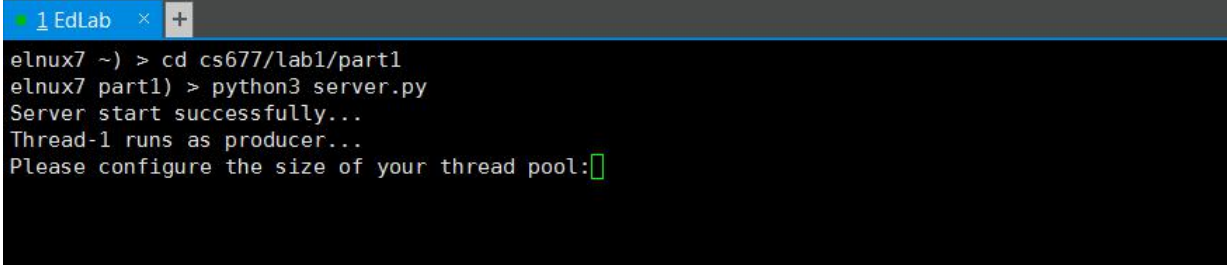
1. Server Startup Screenshots

EdLab View- Log in the UMass EdLab remote server, and upload our source code files “client.py” and “server.py” as follows.



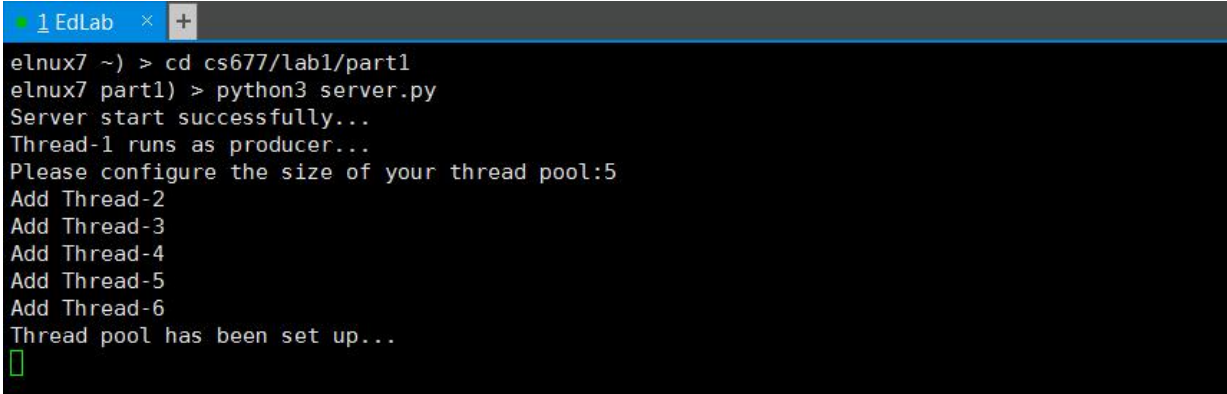
名称	大小	类型	修改时间	属性	所有者
..					
client.py	552 Bytes	PY 文件	2022/3/1, 10:04	-rw-r-----	maoqinzhu
server.py	3KB	PY 文件	2022/3/1, 10:04	-rw-r-----	maoqinzhu

Server Startup- After cd into current directory where you put your files (e.g cd cs677/lab1/part1), start up the server using command **\$ python3 server.py**. Now, the server is running, and the “producer” thread starts correctly.



```
eInux7 ~) > cd cs677/lab1/part1
eInux7 part1) > python3 server.py
Server start successfully...
Thread-1 runs as producer...
Please configure the size of your thread pool:█
```

Configure the size of thread pool by simply typing an integer number **N**. Then “consumer” threads will be added to our thread pool.



```
eInux7 ~) > cd cs677/lab1/part1
eInux7 part1) > python3 server.py
Server start successfully...
Thread-1 runs as producer...
Please configure the size of your thread pool:5
Add Thread-2
Add Thread-3
Add Thread-4
Add Thread-5
Add Thread-6
Thread pool has been set up...
█
```

2. Functional Test Output

Client Terminal- Now we can look at the console at our local machine. Ensure the IP address & port number in file “client.py” are correct, and we can successfully connect to the server using command **\$ python client.py**. Then tell the server which toy you are about to query.

Note that the price and stock of toys are static parameters in file “server.py”. Here we provide you screenshots of 3 different types of query requests.

```
6
7 # product category
8 products={'Tux':{'price':25.99, 'stock': 5},
9           'Whale':{'price':34.99, 'stock':0}}
10
```

Query Tux: considering that Tux is one of the toys which is in stock, server returns the price of Tux, that is 25.99 successfully. And also we can check out the latency of each query as shown below.

```
File Actions Edit View Help
(labuser@kali)-[~/lab1/part1]
└─$ python Client.py
Please type the toy name:Tux
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):3
Query: Tux
From Server: 25.99
Latency: 0.01149344442749023 s
Query: Tux
From Server: 25.99
Latency: 0.011084794998168945 s
Query: Tux
From Server: 25.99
Latency: 0.009958982467651367 s
(labuser@kali)-[~/lab1/part1]
└─$
```

Query Whale: considering that Whale is one of the toys which is out of stock, server returns 0 correctly. And also we can check out the latency of each query as shown below.

```
File Actions Edit View Help
(labuser@kali)-[~/lab1/part1]
└─$ python Client.py
Please type the toy name:Whale
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):3
Query: Whale
From Server: 0
Latency: 0.012356996536254883 s
Query: Whale
From Server: 0
Latency: 0.013092994689941406 s
Query: Whale
From Server: 0
Latency: 0.00991201400756836 s
(labuser@kali)-[~/lab1/part1]
└─$
```

Query Tiger: considering that Tiger can not be found, server returns -1 correctly. And also we can check out the latency of each query as shown below.

```
File Actions Edit View Help
(labuser@kali)~[~/lab1/part1]
$ python Client.py
Please type the toy name:Tiger
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):1
Query: Tiger
From Server: -1
Latency: 0.012197256088256836 s
(labuser@kali)~[~/lab1/part1]
$
```

Server Terminal- Now we can look at the console at remote EdLab server. Ensure the port number listening in file “server.py” are correct, and we can successfully set up a socket-based connection with the client.

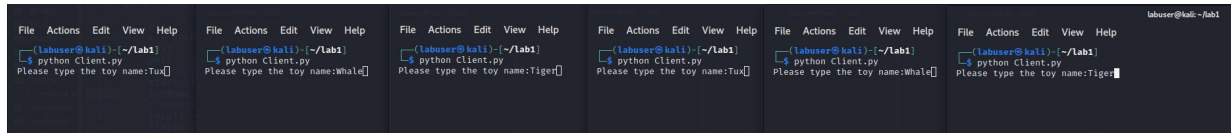
When query requests sequentially come from clients, the outputs of server are shown as follows. We can clearly see which “consumer” thread in the thread pool is handling with the current request from clients.

```
eLinux7 part1) > python3 server.py
Server start successfully...
Thread-1 runs as producer...
Please configure the size of your thread pool:5
Add Thread-2
Add Thread-3
Add Thread-4
Add Thread-5
Add Thread-6
Thread pool has been set up...
('76.74.66.19', 51146) connected...
Thread-2 fetches a request from the queue!
Query has been done, Thread-2 is available!
('76.74.66.19', 51147) connected...
Thread-4 fetches a request from the queue!
Query has been done, Thread-4 is available!
('76.74.66.19', 51148) connected...
Thread-6 fetches a request from the queue!
Query has been done, Thread-6 is available!
('76.74.66.19', 51154) connected...
Thread-3 fetches a request from the queue!
Query has been done, Thread-3 is available!
('76.74.66.19', 51155) connected...
Thread-5 fetches a request from the queue!
Query has been done, Thread-5 is available!
('76.74.66.19', 51156) connected...
Thread-2 fetches a request from the queue!
Query has been done, Thread-2 is available!
('76.74.66.19', 51163) connected...
Thread-4 fetches a request from the queue!
Query has been done, Thread-4 is available!
('76.74.66.19', 51164) connected...
Thread-6 fetches a request from the queue!
Query has been done, Thread-6 is available!
('76.74.66.19', 51171) connected...
Thread-3 fetches a request from the queue!
Query has been done, Thread-3 is available!
█
```

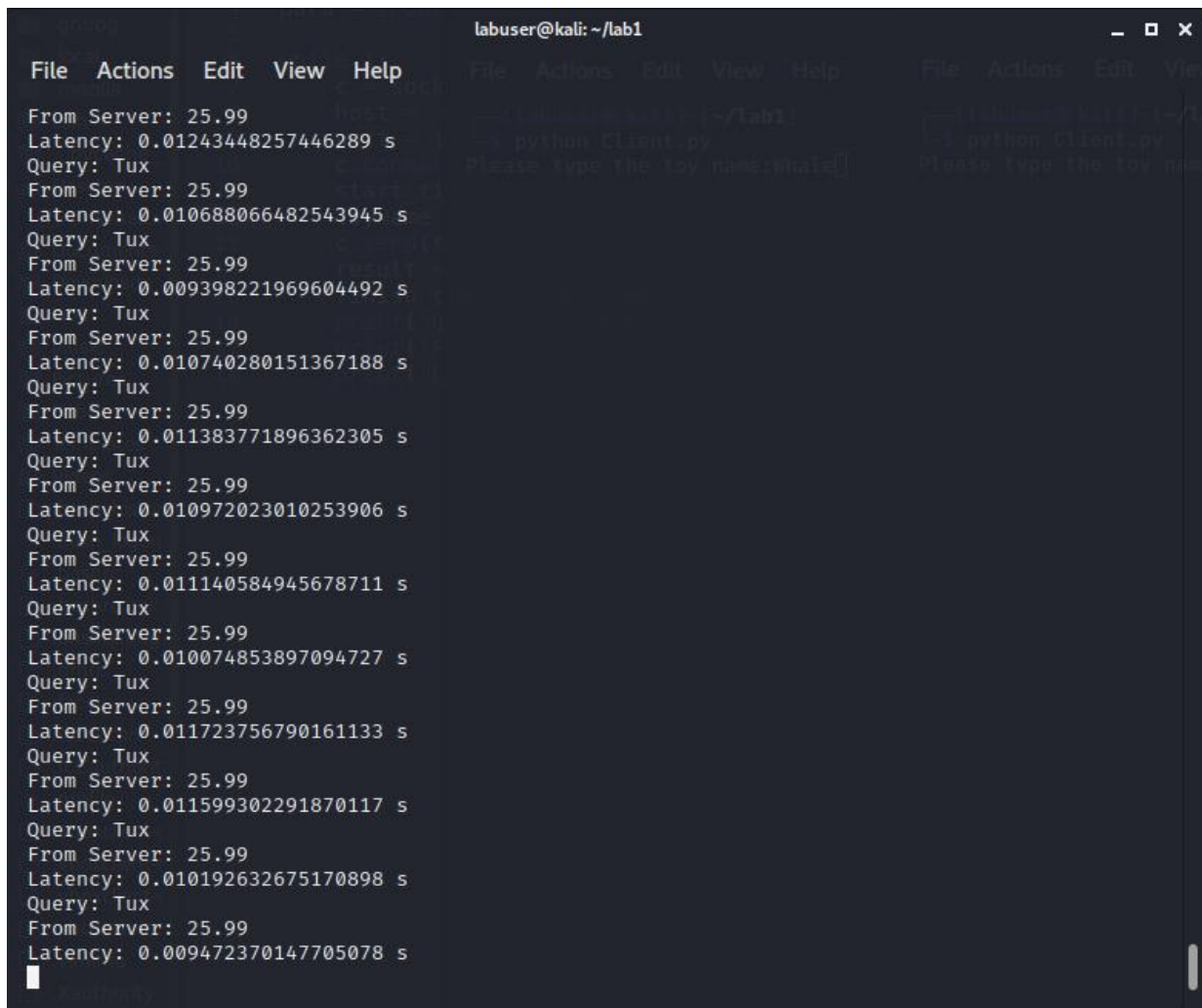
3. Load Test Output

Client Terminal- Similarly, before sending the request, all the configurations are the same as what we show you in functional test. But here we vary the number of clients from 1 to 6 and measure the latency as the load goes up.

Open 6 terminals and type in the toy name as follows. Simulate different number of clients, and we can check out the latency of each query as shown below.



1 Client connected screenshot: only one client tux connects to the server.



2 Clients connected screenshot: two clients connect to the server.

```
labuser@kali: ~/lab1

File Actions Edit View Help
From Server: 25.99
Latency: 0.014760255813598633 s
Query: Tux
From Server: 25.99
Latency: 0.010591745376586914 s
Query: Tux
From Server: 25.99
Latency: 0.020953893661499023 s
Query: Tux
From Server: 25.99
Latency: 0.011368751525878906 s
Query: Tux
From Server: 25.99
Latency: 0.012510299682617188 s
Query: Tux
From Server: 25.99
Latency: 0.012139558792114258 s
Query: Tux
From Server: 25.99
Latency: 0.010204315185546875 s
Query: Tux
From Server: 25.99
Latency: 0.013633251190185547 s
Query: Tux
From Server: 25.99
Latency: 0.012410879135131836 s
Query: Tux
From Server: 25.99
Latency: 0.013860940933227539 s
Query: Tux
From Server: 25.99
Latency: 0.014066696166992188 s
Query: Tux
From Server: 25.99
Latency: 0.019192218780517578 s
█

labuser@kali: ~/lab1
python Client.py
Please type the toy name: Tiger[]
```

3 Clients connected screenshot: three clients connect to the server.

```
labuser@kali: ~/lab1

File Actions Edit View Help
From Server: 25.99
Latency: 0.010142803192138672 s
Query: Tux
From Server: 25.99
Latency: 0.01165008544921875 s
Query: Tux
From Server: 25.99
Latency: 0.010995626449584961 s
Query: Tux
From Server: 25.99
Latency: 0.010608434677124023 s
Query: Tux
From Server: 25.99
Latency: 0.012538671493530273 s
Query: Tux
From Server: 25.99
Latency: 0.010365962982177734 s
Query: Tux
From Server: 25.99
Latency: 0.015410423278808594 s
Query: Tux
From Server: 25.99
Latency: 0.021363258361816406 s
Query: Tux
From Server: 25.99
Latency: 0.013766765594482422 s
Query: Tux
From Server: 25.99
Latency: 0.03222298622131348 s
Query: Tux
From Server: 25.99
Latency: 0.01941537857055664 s
Query: Tux
From Server: 25.99
Latency: 0.023859024047851562 s
█

File Actions Edit View Help
From Server: 0
Latency: 0.010953664779663086 s
Query: Whale
From Server: 0
Latency: 0.01025700569152832 s
Query: Whale
From Server: 0
Latency: 0.012413978576660156 s
Query: Whale
From Server: 0
Latency: 0.009203910827636719 s
Query: Whale
From Server: 0
Latency: 0.012729644775390625 s
Query: Whale
From Server: 0
Latency: 0.010215997695922852 s
Query: Whale
From Server: 0
Latency: 0.014296293258666992 s
Query: Whale
From Server: 0
Latency: 0.02558445930480957 s
Query: Whale
From Server: 0
Latency: 0.014898300170898438 s
Query: Whale
From Server: 0
Latency: 0.012989521026611328 s
Query: Whale
From Server: 0
Latency: 0.03180527687072754 s
Query: Whale
From Server: 0
Latency: 0.017493009567260742 s
█

File Actions Edit View Help
From Server: -1
Latency: 0.011940240859985352 s
Query: Tiger
From Server: -1
Latency: 0.011270999908447266 s
Query: Tiger
From Server: -1
Latency: 0.012319087982177734 s
Query: Tiger
From Server: -1
Latency: 0.010451316833496094 s
Query: Tiger
From Server: -1
Latency: 0.010366678237915039 s
Query: Tiger
From Server: -1
Latency: 0.011133670806884766 s
Query: Tiger
From Server: -1
Latency: 0.015230178833007812 s
Query: Tiger
From Server: -1
Latency: 0.018405914306640625 s
Query: Tiger
From Server: -1
Latency: 0.013399362564086914 s
Query: Tiger
From Server: -1
Latency: 0.035863637924194336 s
Query: Tiger
From Server: -1
Latency: 0.01745915412902832 s
Query: Tiger
From Server: -1
Latency: 0.023874282836914062 s
█
```


4 Clients connected screenshot: four clients connect to the server.

File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help
From Server: 25.99	Query: Whale				From Server: 0	Query: Tiger				From Server: 0.01715540885925293 s	Query: Tiger				From Server: 25.99	Query: Tiger			
Latency: 0.01805400848388672 s	Latency: 0.011474370956420898 s				From Server: 0	Latency: 0.016542673110961914 s				From Server: -1	Latency: 0.013203859329223633 s				From Server: 25.99	Latency: 0.015006303787231445 s			
Query: Tux	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	Query: Tiger				From Server: 25.99	Query: Tux			
From Server: 25.99	Latency: 0.01138758659362793 s				From Server: 0	From Server: -1				From Server: 0.013203859329223633 s	From Server: 25.99				From Server: 25.99	Latency: 0.012435436248779297 s			
Latency: 0.01363229751586914 s	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	Latency: 0.013357162475585938 s				From Server: 25.99	Query: Tux			
Query: Tux	From Server: 0				From Server: 0	From Server: -1				From Server: 0.013357162475585938 s	From Server: 25.99				From Server: 25.99	Latency: 0.011413812637329102 s			
From Server: 25.99	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	Query: Tux				From Server: 25.99	Query: Tux			
Latency: 0.015014886856079102 s	Latency: 0.01920771598815918 s				From Server: 0	From Server: -1				From Server: 0.013736963272094727 s	From Server: 25.99				From Server: 25.99	Latency: 0.012259721755981445 s			
Query: Tux	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	From Server: 25.99				From Server: 25.99	Query: Tux			
From Server: 25.99	Latency: 0.014977126720581055 s				From Server: 0	From Server: -1				From Server: 0.010155439376831055 s	From Server: 25.99				From Server: 25.99	Latency: 0.012681007385253906 s			
Latency: 0.011882305145263672 s	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	Query: Tux				From Server: 25.99	Query: Tux			
Query: Tux	From Server: 0				From Server: 0	From Server: -1				From Server: 0.010155439376831055 s	From Server: 25.99				From Server: 25.99	Latency: 0.011989355087280273 s			
From Server: 25.99	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	From Server: 25.99				From Server: 25.99	Query: Tux			
Latency: 0.011009454727172852 s	Latency: 0.011462211608886719 s				From Server: 0	From Server: -1				From Server: 0.012131214141845703 s	From Server: 25.99				From Server: 25.99	Latency: 0.015954971313476562 s			
Query: Tux	Query: Whale				From Server: 0	Query: Tiger				From Server: -1	From Server: 25.99				From Server: 25.99	Query: Tux			
From Server: 25.99	Latency: 0.010409355163574219 s				From Server: 0	From Server: -1				From Server: 0.014496326446533203 s	From Server: 25.99				From Server: 25.99	Latency: 0.015126943588256836 s			
Latency: 0.011748552323287695 s	Query: Whale				From Server: 0	From Server: -1				From Server: 0.04110097885131836 s	From Server: 25.99				From Server: 25.99	Query: Tux			
Query: Tux	From Server: 0				From Server: 0	From Server: -1				From Server: 0.025293588638305664 s	From Server: 25.99				From Server: 25.99	Latency: 0.01253199577331543 s			
From Server: 25.99	Latency: 0.01262655258178711 s				From Server: 0	Query: Tiger				From Server: -1	From Server: 25.99				From Server: 25.99	Query: Tux			
Latency: 0.012903928756713867 s	Query: Whale				From Server: 0	From Server: -1				From Server: 0.012371063232421875 s	From Server: 25.99				From Server: 25.99	Latency: 0.012430996295776367 s			
Query: Tux	Latency: 0.010393857955932617 s				From Server: 0	Query: Tiger				From Server: -1	From Server: 25.99				From Server: 25.99	Query: Tux			
From Server: 25.99	From Server: 0				From Server: 0	From Server: -1				From Server: 0.012371063232421875 s	From Server: 25.99				From Server: 25.99	Latency: 0.017978668212890625 s			
Latency: 0.010232925415039062 s	Query: Whale				From Server: 0	From Server: -1				From Server: 0.012371063232421875 s	From Server: 25.99								

5 Clients connected screenshot: five clients connect to the server.

File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: 1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.013933420181274414 s					Latency: 0.0146275619506836 s					Latency: 0.013165712356567383 s					Latency: 0.01634049415588379 s					Latency: 0.010443687438964844 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.013410568237304688 s					Latency: 0.012376070022583008 s					Latency: 0.012096405029296875 s					Latency: 0.012881755828857422 s					Latency: 0.015015840530395508 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.012245655059814453 s					Latency: 0.014052629470825195 s					Latency: 0.0110292720306396484 s					Latency: 0.03458285331726074 s					Latency: 0.012098955154418945 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.01468658447265625 s					Latency: 0.011647939682006836 s					Latency: 0.01196908950805664 s					Latency: 0.02565932273864746 s					Latency: 0.011992692947387695 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.022227764129638672 s					Latency: 0.01267099380493164 s					Latency: 0.012594223022460938 s					Latency: 0.012350082397460938 s					Latency: 0.018889188766479492 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.013991594314575195 s					Latency: 0.013317346572875977 s					Latency: 0.02074078369140625 s					Latency: 0.011260986328125 s					Latency: 0.0142564773559597031 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.011984825134277344 s					Latency: 0.013084173202514648 s					Latency: 0.019113540649414062 s					Latency: 0.012605905532836914 s					Latency: 0.0155069828033444727 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.01246333122253418 s					Latency: 0.01702404022216797 s					Latency: 0.06751084327697754 s					Latency: 0.012573957443237305 s					Latency: 0.0165825653076172 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.010745048522949219 s					Latency: 0.011358022689819336 s					Latency: 0.023602724075317383 s					Latency: 0.017457008361816406 s					Latency: 0.016997098922729492 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.0161893367767334 s					Latency: 0.012031793594360352 s					Latency: 0.011494874954223633 s					Latency: 0.013403364181518555 s					Latency: 0.02330303192138672 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.012747049331665039 s					Latency: 0.010500431060791016 s					Latency: 0.011705875396728516 s					Latency: 0.02934408187866211 s					Latency: 0.011592388153076172 s				
Query: Tux	From Server: 25.99				Query: Whale	From Server: 0				Query: Tiger	From Server: -1				Query: Tux	From Server: 25.99				Query: Whale	From Server: 0			
Latency: 0.010315656661987305 s					Latency: 0.014882087707519531 s					Latency: 0.012329816818237305 s					Latency: 0.012093305587768555 s					Latency: 0.015158426895141602 s				

6 Clients connected screenshots: In this case, the number of clients(that is 6) is larger than the size of the thread pool(that is 5). We run all of the 6 clients, and we can check out the latency of each query as shown below.

File Actions Edit View Help	File Actions Edit View Help	File Actions Edit View Help	File Actions Edit View Help	File Actions Edit View Help	File Actions Edit View Help
Query: Tux From Server: 25.99 Latency: 0.0108170599338789 s Query: Tux From Server: 25.99 Latency: 0.012848615664632305 s Query: Tux From Server: 25.99 Latency: 0.01325702667236281 s Query: Tux From Server: 25.99 Latency: 0.016887664794921875 s Query: Tux From Server: 25.99 Latency: 0.01886639058285742 s Query: Tux From Server: 25.99 Latency: 0.016802310943605316 s Query: Tux From Server: 25.99 Latency: 0.02928041567993616 s Query: Tux From Server: 25.99 Latency: 0.046942949295843945 s Query: Tux From Server: 25.99 Latency: 0.013857384322324219 s Query: Tux From Server: 25.99 Latency: 0.01315879821773438 s Query: Tux From Server: 25.99 Latency: 0.01069069086914062 s	Query: Whale From Server: 0 Latency: 0.014764670510864258 s Query: Whale From Server: 0 Latency: 0.015181303624291992 s Query: Whale From Server: 0 Latency: 0.019546803195190429 s Query: Whale From Server: 0 Latency: 0.014270670154742111 s Query: Whale From Server: 0 Latency: 0.014189770153308594 s Query: Whale From Server: 0 Latency: 0.019018054362324188 s Query: Whale From Server: 0 Latency: 0.012331724166870117 s Query: Whale From Server: 0 Latency: 0.010473821924194336 s Query: Whale From Server: 0 Latency: 0.024239540108097656 s Query: Whale From Server: 0 Latency: 0.02543234825134773 s Query: Whale From Server: 0 Latency: 0.014766925220876172 s Query: Whale From Server: 0 Latency: 0.029489755630492164 s	Query: Tiger From Server: -1 Latency: 0.01428596442260742 s Query: Tiger From Server: -1 Latency: 0.01272499088178711 s Query: Tiger From Server: -1 Latency: 0.012705515263672 s Query: Tiger From Server: -1 Latency: 0.01211094856262207 s Query: Tiger From Server: -1 Latency: 0.014088153839111328 s Query: Tiger From Server: -1 Latency: 0.0120298568725586 s Query: Tiger From Server: -1 Latency: 0.01861286163310078 s Query: Tiger From Server: -1 Latency: 0.01838083439086914 s Query: Tiger From Server: -1 Latency: 0.013875613212585449 s Query: Tiger From Server: -1 Latency: 0.016527652740478516 s Query: Tiger From Server: -1 Latency: 0.014766925133181477 s Query: Tiger From Server: -1 Latency: 0.012897968292236328 s	Query: Tux From Server: 25.99 Latency: 0.01536345481872586 s Query: Tux From Server: 25.99 Latency: 0.01313344650268555 s Query: Tux From Server: 25.99 Latency: 0.01246190071189597 s Query: Tux From Server: 25.99 Latency: 0.0135452747344907 s Query: Tux From Server: 25.99 Latency: 0.009472574544833984 s Query: Tux From Server: 25.99 Latency: 0.015018173397827148 s Query: Tux From Server: 25.99 Latency: 0.024293576583862305 s Query: Tux From Server: 25.99 Latency: 0.01208198155029297 s Query: Tux From Server: 25.99 Latency: 0.0133663445119043 s Query: Tux From Server: 25.99 Latency: 0.02487082712524414 s Query: Tux From Server: 25.99 Latency: 0.0157599960685859 s Query: Tux From Server: 25.99 Latency: 0.01348017825317383 s	Query: Whale From Server: 0 Latency: 0.01312661189594727 s Query: Whale From Server: 0 Latency: 0.012901067733764648 s Query: Whale From Server: 0 Latency: 0.01491060256958088 s Query: Whale From Server: 0 Latency: 0.012588977813720703 s Query: Whale From Server: 0 Latency: 0.01529765129809355 s Query: Whale From Server: 0 Latency: 0.0172362327556836 s Query: Whale From Server: 0 Latency: 0.0127313785444336 s Query: Whale From Server: 0 Latency: 0.0189513139724731445 s Query: Whale From Server: 0 Latency: 0.01316164978379942 s Query: Whale From Server: 0 Latency: 0.018619216918945312 s Query: Whale From Server: 0 Latency: 0.0145370962325957 s Query: Whale From Server: 0 Latency: 0.0261690616607666 s	Query: Tiger From Server: -1 Latency: 0.017359972800012207 s Query: Tiger From Server: -1 Latency: 0.015087376245117188 s Query: Tiger From Server: -1 Latency: 0.011754751025444336 s Query: Tiger From Server: -1 Latency: 0.01566338539132353 s Query: Tiger From Server: -1 Latency: 0.0176810245874023 s Query: Tiger From Server: -1 Latency: 0.013805413397094727 s Query: Tiger From Server: -1 Latency: 0.01662379837031328 s Query: Tiger From Server: -1 Latency: 0.013824224472045898 s Query: Tiger From Server: -1 Latency: 0.0141468876464848 s Query: Tiger From Server: -1 Latency: 0.01843281551578 s Query: Tiger From Server: -1 Latency: 0.01529644500732422 s Query: Tiger From Server: -1 Latency: 0.017449617385864258 s

Server Terminal- When multiple requests come, the outputs of server are shown as follows. We can clearly see which “consumer” thread in the thread pool is handling with request from clients.

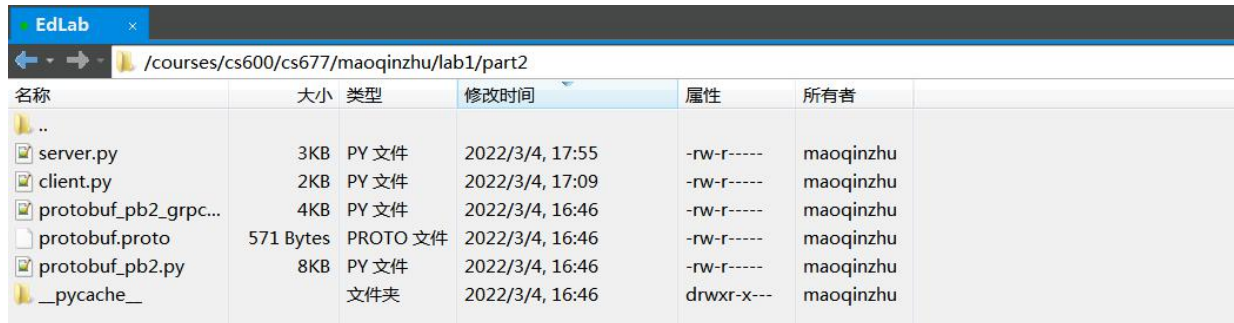
```
1 EdLab × +
Thread-3 fetches a request from the queue!
('76.74.66.19', 62784) connected...
Query has been done, Thread-3 is available!
Thread-4 fetches a request from the queue!
Query has been done, Thread-4 is available!
('76.74.66.19', 62787) connected...
Thread-6 fetches a request from the queue!
Query has been done, Thread-6 is available!
('76.74.66.19', 62785) connected...
Thread-4 fetches a request from the queue!
('76.74.66.19', 62786) connected...
Query has been done, Thread-4 is available!
Thread-2 fetches a request from the queue!
Query has been done, Thread-2 is available!
('76.74.66.19', 62788) connected...
Thread-4 fetches a request from the queue!
Query has been done, Thread-4 is available!
('76.74.66.19', 62789) connected...
Thread-5 fetches a request from the queue!
('76.74.66.19', 62790) connected...
Query has been done, Thread-5 is available!
Thread-2 fetches a request from the queue!
Query has been done, Thread-2 is available!
('76.74.66.19', 62792) connected...
Thread-5 fetches a request from the queue!
Query has been done, Thread-5 is available!
('76.74.66.19', 62791) connected...
('76.74.66.19', 62793) connected...
Thread-3 fetches a request from the queue!
Query has been done, Thread-3 is available!
Thread-6 fetches a request from the queue!
Query has been done, Thread-6 is available!
('76.74.66.19', 62794) connected...
Thread-2 fetches a request from the queue!
Query has been done, Thread-2 is available!
('76.74.66.19', 62796) connected...
Thread-6 fetches a request from the queue!
Query has been done, Thread-6 is available!
('76.74.66.19', 62795) connected...
Thread-4 fetches a request from the queue!
Query has been done, Thread-4 is available!
```


Part 2 - Implementation with gRPC and Built in Thread Pool

1. Server Startup Screenshots

EdLab View

Log in the UMass EdLab remote server, and upload our source code files as follows.



名称	大小	类型	修改时间	属性	所有者
..					
server.py	3KB	PY 文件	2022/3/4, 17:55	-rw-r-----	maoqinzhu
client.py	2KB	PY 文件	2022/3/4, 17:09	-rw-r-----	maoqinzhu
protobuf_pb2_grpc...	4KB	PY 文件	2022/3/4, 16:46	-rw-r-----	maoqinzhu
protobuf.proto	571 Bytes	PROTO 文件	2022/3/4, 16:46	-rw-r-----	maoqinzhu
protobuf_pb2.py	8KB	PY 文件	2022/3/4, 16:46	-rw-r-----	maoqinzhu
__pycache__		文件夹	2022/3/4, 16:46	drwxr-x---	maoqinzhu

Server Startup

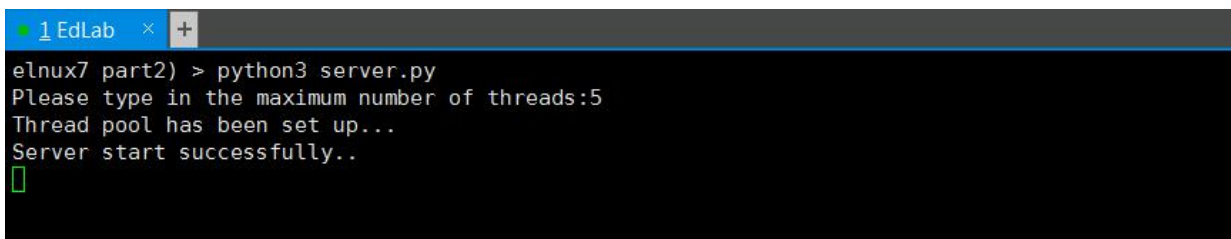
After cd into current directory where you put your files (e.g cd cs677/lab1/part2), you should install gRPC using **\$ pip install grpcio_tools**

Then you start up the server using command **\$ python3 server.py**

Now, the server is running, and the “producer” thread starts correctly.

```
eLinux7 ~) > cd cs677/lab1/part2
```

```
eLinux7 part2) > pip install grpcio_tools
Collecting grpcio_tools
  Downloading grpcio_tools-1.44.0-cp38-cp38-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (2.4 MB)
    | 2.4 MB 5.8 MB/s
Requirement already satisfied: setuptools in /usr/lib/python3/dist-packages (from grpcio_tools) (45.2.0)
Collecting grpcio>=1.44.0
  Downloading grpcio-1.44.0-cp38-cp38-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (4.3 MB)
    | 4.3 MB 10.7 MB/s
Requirement already satisfied: protobuf<4.0dev,>=3.5.0.post1 in /usr/local/lib/python3.8/dist-packages (from grpcio_tools) (3.12.2)
Requirement already satisfied: six>=1.5.2 in /usr/local/lib/python3.8/dist-packages (from grpcio>=1.44.0->grpcio_tools) (1.16.0)
Installing collected packages: grpcio, grpcio-tools
Successfully installed grpcio-1.44.0 grpcio-tools-1.44.0
```



```
eLinux7 part2) > python3 server.py
Please type in the maximum number of threads:5
Thread pool has been set up...
Server start successfully..
[]
```

Configure the size of thread pool by simply typing an integer number **N**.

Then “consumer” threads will be added to our thread pool.

2. Functional Test Output

Client Terminal- Now we can look at the console at our local machine. Ensure the IP address & port number in file “client.py” are correct, and we can successfully connect to the server using command **\$ python client.py**. Then tell the server which toy you are about to query.

Note that the price and stock of toys are static parameters in file “server.py”. Here we provide you screenshots of different types of query requests.

```
54 # Set up toy database
55 # Static parameters(price and stock) to be set
56 def initDataData():
57     catagories = []
58     toy_tux = protobuf_pb2.Toy(name='Tux', stock=100, price=25.99) # Follow the message structure Toy defined in proto file
59     toy_whale = protobuf_pb2.Toy(name='Whale', stock=100, price=34.99)
60     toy_elephant = protobuf_pb2.Toy(name='Elephant', stock=100, price=29.99)
61     toy_bird = protobuf_pb2.Toy(name='Bird', stock=50, price=39.99)
62     catagories.append(toy_whale)
63     catagories.append(toy_tux)
64     catagories.append(toy_elephant)
65     catagories.append(toy_bird)
66     return catagories
67
```

Query Tux: considering that Tux is one of the toys which is in stock, server returns the price of Tux, that is 25.99 successfully. And also we can check out the latency of each query as shown below.

```
File Actions Edit View Help
(labuser@kali)-[~/lab1/part2]
$ python client.py
Please type in toy name: Tux
Please type in method(query or buy): query
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):3

Query: Tux
Price: 25.99, Stock: 100
Latency: 0.04188179969787598 s

Query: Tux
Price: 25.99, Stock: 100
Latency: 0.03304338455200195 s

Query: Tux
Price: 25.99, Stock: 100
Latency: 0.037835121154785156 s
(labuser@kali)-[~/lab1/part2]
$
```

Query Bird: considering that Bird is one of the toys which is in stock, server returns the price of Bird, that is 39.99 successfully. And also we can check out the latency of each query as shown below.

```
File Actions Edit View Help
(labuser@kali)-[~/lab1/part2]
$ python client.py
Please type in toy name: Bird
Please type in method(query or buy): query
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):2

Query: Bird
Price: 39.99, Stock: 50
Latency: 0.04297804832458496 s

Query: Bird
Price: 39.99, Stock: 50
Latency: 0.05867505073547363 s
(labuser@kali)-[~/lab1/part2]
$
```

Query Tiger: considering that Tiger is not a valid input, server returns -1 and catch the exception correctly. And also we can check out the latency of each query as shown below.

```
labuser@kali: ~/lab1/part2
File Actions Edit View Help
(labuser@kali)~[~/lab1/part2]
$ python client.py
Please type in toy name: Tiger
Please type in method(query or buy): query
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):1

Query: Tiger
Price: -1.0, Stock: -1
Latency: 0.049718618392944336 s
(labuser@kali)~[~/lab1/part2]
$
```

Buy Tux: considering that Tux is one of the toys which is in stock. If we send 3 request of buying, the stock is reduced by 3 correctly. And also we can check out the latency of each query as shown below.

```
labuser@kali: ~/lab1/part2
File Actions Edit View Help
(labuser@kali)~[~/lab1/part2]
$ python client.py
Please type in toy name: Tux
Please type in method(query or buy): buy
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):3

From Server: 1
Your order has been placed successfully!!!
Latency: 0.039925336837768555 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.04342532157897949 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.04064464569091797 s
(labuser@kali)~[~/lab1/part2]
$ python client.py
Please type in toy name: Tux
Please type in method(query or buy): query
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):1

Query: Tux
Price: 25.99, Stock: 97
Latency: 0.03862404823303223 s
(labuser@kali)~[~/lab1/part2]
$
```

Now if we input -1 when the console asks how many requests we wanna send. It will not stop sending requests of buying until Tux is out of stock. And finally, we can catch an exception correctly.

```
labuser@kali: ~/lab1/part2
File Actions Edit View Help
(labuser@kali)~[~/lab1/part2]
$ python client.py
Please type in toy name: Tux
Please type in method(query or buy): buy
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):-1
```

```
File Actions Edit View Help
Latency: 0.03878664970397949 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.03722095489501953 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.03951716423034668 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.033651113510131836 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.03518366813659668 s

From Server: 1
Your order has been placed successfully!!!
Latency: 0.03689980506896973 s

From Server: 0
Latency: 0.03981637954711914 s
What we catch: Exception('Sorry, this toy is out of stock...')
(labuser@kali)~/lab1/part2
$ python client.py
Please type in toy name: Tux
Please type in method(query or buy): query
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):1

Query: Tux
Price: 25.99, Stock: 0
Latency: 0.047444820404052734 s
(labuser@kali)~/lab1/part2
$
```

Buy Tiger: considering that Tiger is not a valid input, server returns -1 and catch the exception correctly. And also we can check out the latency of each query as shown below.

```
labuser@kali: ~/lab1/part2
File Actions Edit View Help

(labuser@kali)~/lab1/part2
$ python client.py
Please type in toy name: Tiger
Please type in method(query or buy): buy
Specify how many requests you wanna send (type -1 if you do not wanna stop sending):3

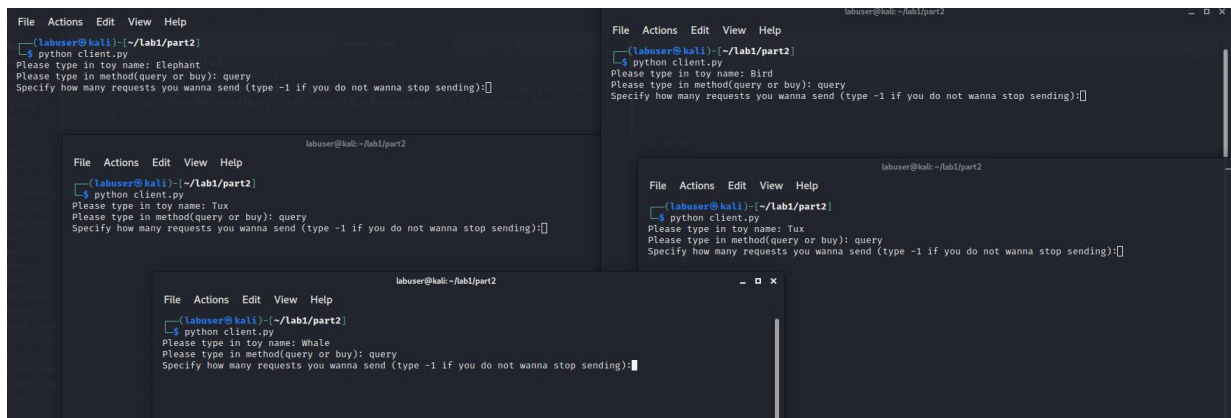
From Server: -1
Latency: 0.03860616683959961 s
What we catch: Exception('Oops, invalid input. We do not have this product...')
(labuser@kali)~/lab1/part2
$
```


3. Load Test Output

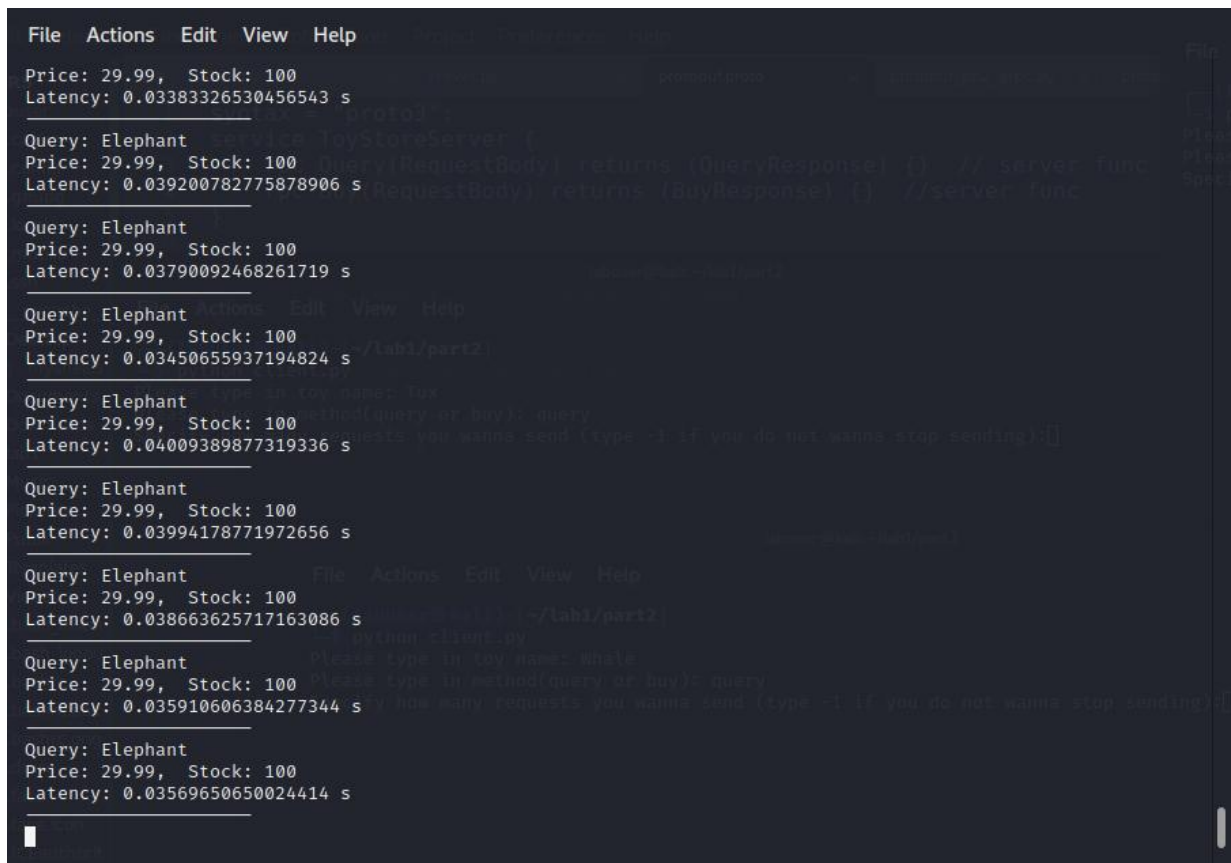
Queue Method

Similarly, here we vary the number of clients from 1 to 5 and measure the latency as the load goes up.

Open 5 terminals and type in the toy name, the method name and the number of requests as follows. Simulate different number of clients, and we can check out the latency of each query as shown below.



1 Client connected screenshot: only one client connects to the server.



2 Clients connected screenshot: two clients connect to the server.

File	Actions	Edit	View	Help	File	Actions	Edit	View	Help
Price: 29.99, Stock: 100 Latency: 0.0347447395324707 s					Price: 34.99, Stock: 100 Latency: 0.03664517402648926 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04312705993652344 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.04083371162414551 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.032042503356933594 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.036719322204589844 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03635215759277344 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.04133033752441406 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03897666931152344 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.03453683853149414 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03314352035522461 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.04382467269897461 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.037095069885253906 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.0375974178314209 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.033804893493652344 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.03558921813964844 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03700399398803711 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.03404855728149414 s				
□					■				

3 Clients connected screenshot: three clients connect to the server.

File	Actions	Edit	View	Help	File	Actions	Edit	View	Help	File	Actions	Edit	View	Help
Price: 29.99, Stock: 100 Latency: 0.04418182373046875 s					Price: 34.99, Stock: 100 Latency: 0.03953886032104492 s					Price: 25.99, Stock: 100 Latency: 0.0449526309967041 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.0417022705078125 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.050875186920166016 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.04064035415649414 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03495931625366211 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.037697792053222656 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.04003334045410156 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.042743682861328125 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.041108131408691406 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.0362548828125 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03556418418884277 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.03604316711425781 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.03303122520446777 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.045047760009765625 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.0399630069732666 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.04213452339172363 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03295302391052246 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.032137393951416016 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.038239240646362305 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04648232460021973 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.046022653579711914 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.043009042739868164 s				
Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04068875312805176 s					Query: Whale Price: 34.99, Stock: 100 Latency: 0.0413813591003418 s					Query: Tux Price: 25.99, Stock: 100 Latency: 0.04387307167053223 s				
□					□					■				

4 Clients connected screenshot: four clients connect to the server.

<div>File Actions Edit View Help</div> <div>Price: 29.99, Stock: 100 Latency: 0.03610968589782715 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04152035713195801 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04310202598571777 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03834271430969238 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03407692909240723 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04361605644226074 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04117250442504883 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03499794006347656 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04119324684130664 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 34.99, Stock: 100 Latency: 0.042516469955444336 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03820919990539551 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.036470651626586914 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.04270577430725098 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03392171859741211 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.04001927375793457 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03589868545322266 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.045313119888305664 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03715062141418457 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 25.99, Stock: 100 Latency: 0.03526163101196289 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.0415956974029541 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03725457191467285 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.04379916191101074 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03793168067932129 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03792166709899902 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03285551071166992 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03963518142700195 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.040895700454711914 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 25.99, Stock: 100 Latency: 0.03610682487487793 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.038698673248291016 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.04648303985595703 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03829669952392578 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.0431365966796875 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.043234825134277344 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.037802696228027344 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03783011436462402 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.039426326751708984 s</div> <div></div>
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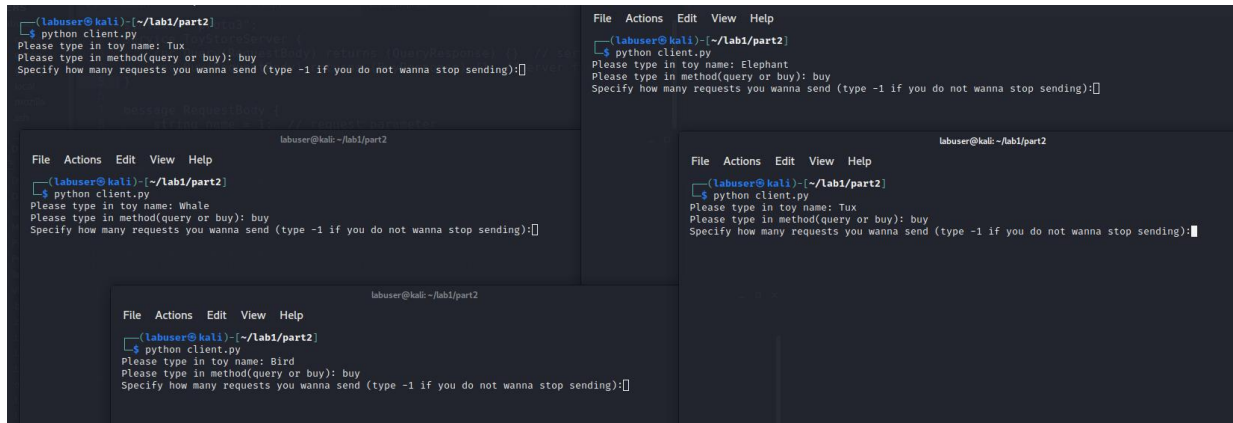
5 Clients connected screenshot: five clients connect to the server.

<div>File Actions Edit View Help</div> <div>Price: 29.99, Stock: 100 Latency: 0.038546085357666016 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03609943389892578 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.03977775573730469 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.05779552459716797 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04564261436462402 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.034723520278930664 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04223513603210449 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.04402102394104004 s</div> <div>Query: Elephant Price: 29.99, Stock: 100 Latency: 0.047208389173583984 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 34.99, Stock: 100 Latency: 0.03914761543273926 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03758525848388672 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.05548429489135742 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.04069876670837402 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.04135870933532715 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.035660743713378906 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03549337387084961 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03911161422729492 s</div> <div>Query: Whale Price: 34.99, Stock: 100 Latency: 0.03846096992492676 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 25.99, Stock: 100 Latency: 0.03448772430419922 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03737163543701172 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.0562746524810791 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.04911303520202637 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.048712968826293945 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.036415815353393555 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03858327865600586 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03907608985900879 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03458595275878906 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 25.99, Stock: 100 Latency: 0.038582801818847656 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03377556800842285 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.035398244857788086 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.05983686447143555 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.04706263542175293 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.04277300834655762 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03670191764831543 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.03991436958312988 s</div> <div>Query: Tux Price: 25.99, Stock: 100 Latency: 0.052962303161621094 s</div> <div></div>	<div>File Actions Edit View Help</div> <div>Price: 39.99, Stock: 50 Latency: 0.03872013092040156 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.042212724685668945 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.05326390266418457 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.04523777961730957 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.0486750602722168 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.04200267791748047 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.04021000862121582 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.03889608383178711 s</div> <div>Query: Bird Price: 39.99, Stock: 50 Latency: 0.048766136169433594 s</div> <div></div>
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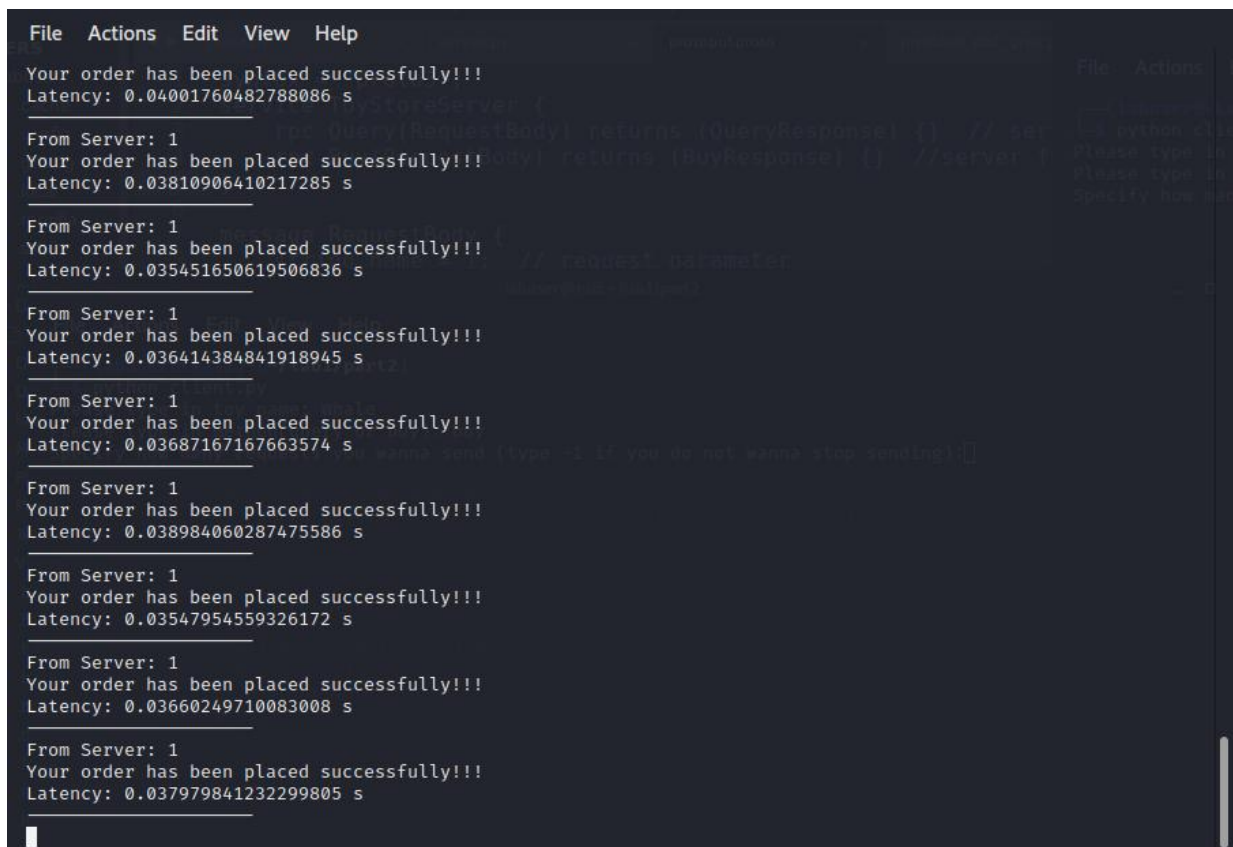
Buy Method

Similarly, here we vary the number of clients from 1 to 5 and measure the latency as the load goes up.

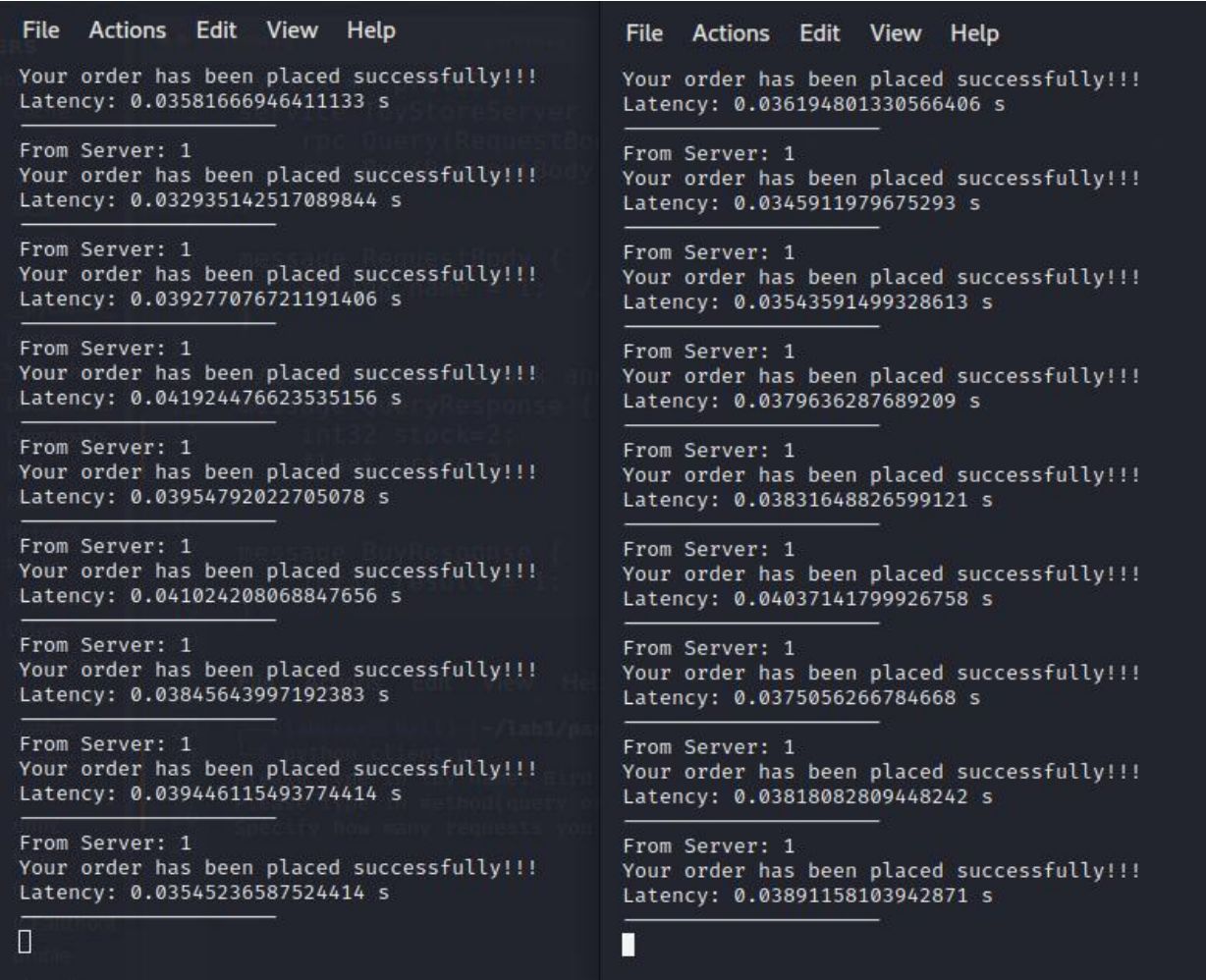
Open 5 terminals and type in the toy name, the method name and the number of requests as follows. Simulate different number of clients, and we can check out the latency of each query as shown below.



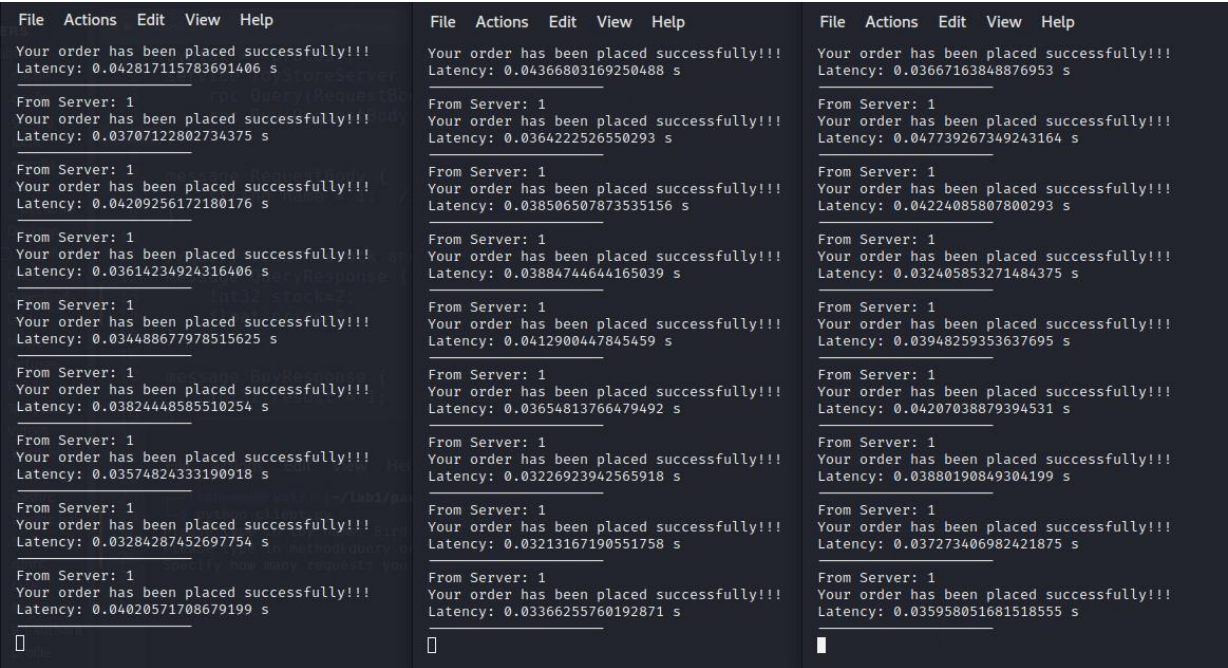
1 Client connected screenshot: only one client connects to the server.



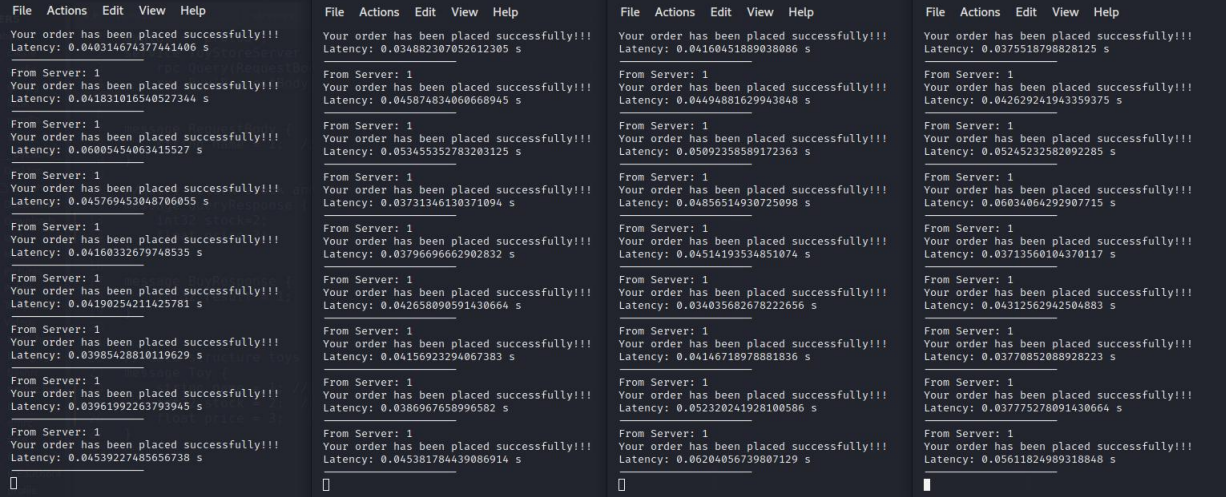
2 Clients connected screenshot: two clients connect to the server.



3 Clients connected screenshot: three clients connect to the server.



4 Clients connected screenshot: four clients connect to the server.



5 Clients connected screenshot: five clients connect to the server.

