

```
In [39]: import numpy as np
import matplotlib.pyplot as plt
import random
```

VM1 1/2CPU

VM2 1/4CPU

VM3 1/8CPU

```
In [40]: vm1cpu = 1/2
vm2cpu = 1/4
vm3cpu = 1/8
```

```
In [41]: N = [10,100,1000]
```

```
In [42]: lamda = 0.9
```

```
In [43]: #Decide type of vm
def getTypeVM():
    vmRan=random.random()
    cpu = 0
    if(vmRan <= 1/3):
        cpu = 0.5
    elif(vmRan<=2/3):
        cpu = 0.25
    else:
        cpu = 0.125
    return cpu
```

```
In [44]: def getNumberVMs(n):
    vmno=0
    for i in range(n):
        if(random.random() <= lamda):
            vmno+=1
    return vmno
```

```
In [45]: def getDepartureTime(time, vmtype):  
    depatureTime=time  
    while(random.random()>vmtype):  
        depatureTime+=1  
    if(depatureTime==time):  
        depatureTime+=1  
    return depatureTime
```

```
In [46]: def checkdeparture(servers, time):  
    slen=len(servers)  
    while(slen>0):  
        qLen = len(servers[slen-1]['slot'])  
        if(len(servers[slen-1]['slot'])==0):  
            del servers[slen-1]  
        while(qLen > 0):  
            if(np.min(servers[slen-1]['slot'])<time):  
                break  
            elif(servers[slen-1]['slot'][qLen-1] <= time):  
                del servers[slen-1]['res'][qLen-1]  
                del servers[slen-1]['slot'][qLen-1]  
            qLen-=1  
        slen-=1
```

First Fit

```

In [47]: result=[]
         for n in N:
             servers =[]
             num_servers = []
             for i in range(10**3):
                 checkdeparture(servers, i)
                 numberVMs = getNumberVMs(n)
                 for vm in range(numberVMs):
                     vmType = getTypeVM()
                     depTime = getDepartureTime(i, vmType)
                     if(len(servers)==0):
                         servers.append({'res': [vmType], 'slot': [depTime]})
                     else:
                         found = False
                         for s in range(len(servers)):
                             if(np.sum(servers[s]['res'])+vmType<=1):
                                 servers[s]['res'].append(vmType)
                                 servers[s]['slot'].append(depTime)
                                 found = True
                                 break
                         if(not found):
                             servers.append({'res': [vmType], 'slot': [depTime]
})
                 num_servers.append(len(servers))
             result.append(np.mean(num_servers))

```

```

In [48]: result

```

```

Out[48]: [8.5280000000000005, 76.299000000000007, 742.50199999999995]

```

```

In [49]: servers

```

```

Out[49]: [{'res': [0.125, 0.125, 0.125, 0.125, 0.125, 0.25, 0.125],
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```

```

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```

```

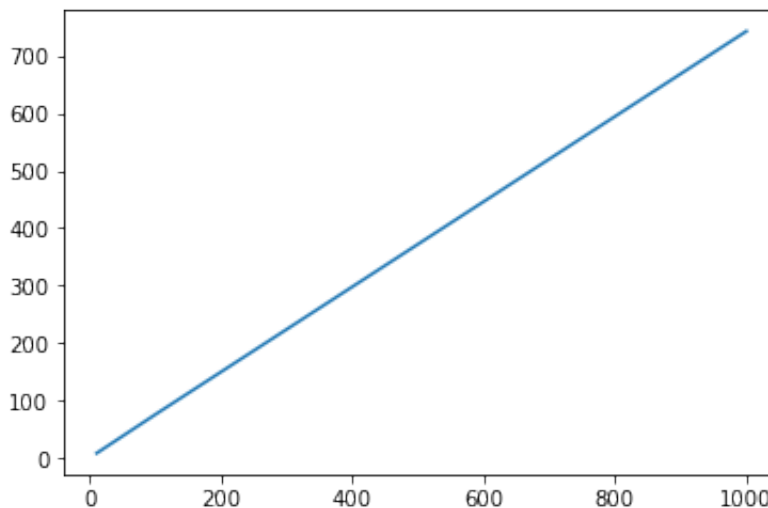
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{'res': [0.5], 'slot': [1000]}]

```

```
In [50]: plt.plot(N, result)
```

```
Out[50]: [<matplotlib.lines.Line2D at 0x11976d4e0>]
```

```
In [51]: plt.show()
```



Best Fit

```

In [52]: result2=[]
for n in N:
    servers =[]
    num_servers = []
    for i in range(10**3):
        checkdeparture(servers, i)
        numberVMs = getNumberVMs(n)
        for vm in range(numberVMs):
            vmType = getTypeVM()
            depTime = getDepartureTime(i, vmType)
            if (len(servers)==0):
                servers.append({'res': [vmType], 'slot': [depTime]})
            else:
                found = False
                found_fit = False
                holder=[]
                for s in range(len(servers)):
                    if (np.sum(servers[s]['res'])+vmType==1):
                        servers[s]['res'].append(vmType)
                        servers[s]['slot'].append(depTime)
                        found = True
                        break
                    if (np.sum(servers[s]['res'])+vmType<1):
                        found_fit = True
                        holder.append(s)
                if ((not found) and found_fit == True):
                    max_val=0
                    index_h=0
                    for h in holder:
                        if (max_val<(np.sum(servers[h]['res'])+vmType))
:
                                max_val = (np.sum(servers[h]['res'])+vmType)
e)
                                index_h = h
                                servers[index_h]['res'].append(vmType)
                                servers[index_h]['slot'].append(depTime)
                if (not found and found_fit == False):
                    servers.append({'res': [vmType], 'slot': [depTime]
}))
        num_servers.append(len(servers))
    result2.append(np.mean(num_servers))

```

```

In [53]: result2

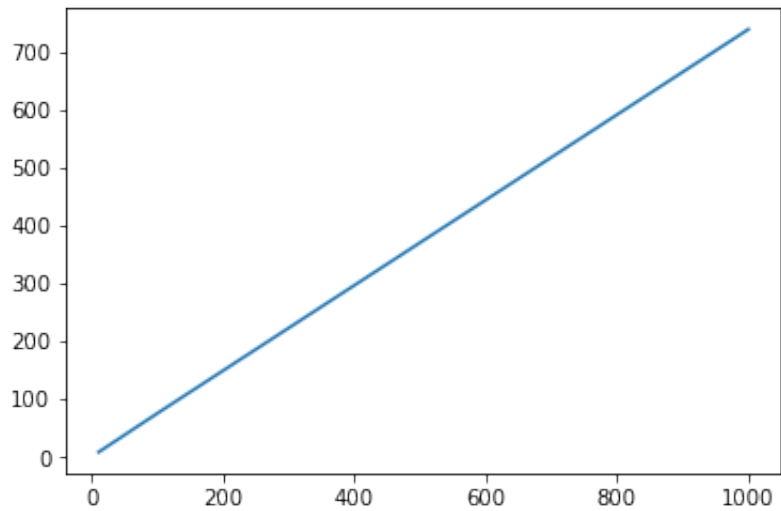
```

```

Out[53]: [8.5809999999999995, 75.85699999999999, 737.85799999999995]

```

```
In [54]: plt.plot(N, result2)
plt.show()
```



```
In [55]: plt.plot(N,result2)
plt.plot(N, result)
```

```
Out[55]: [<matplotlib.lines.Line2D at 0x1195e6780>]
```

```
In [56]: plt.show()
```

