COEN 239 HW 5 - Justin Li

Seeds Chosen: A: 933,588,178 S: 209,208,115

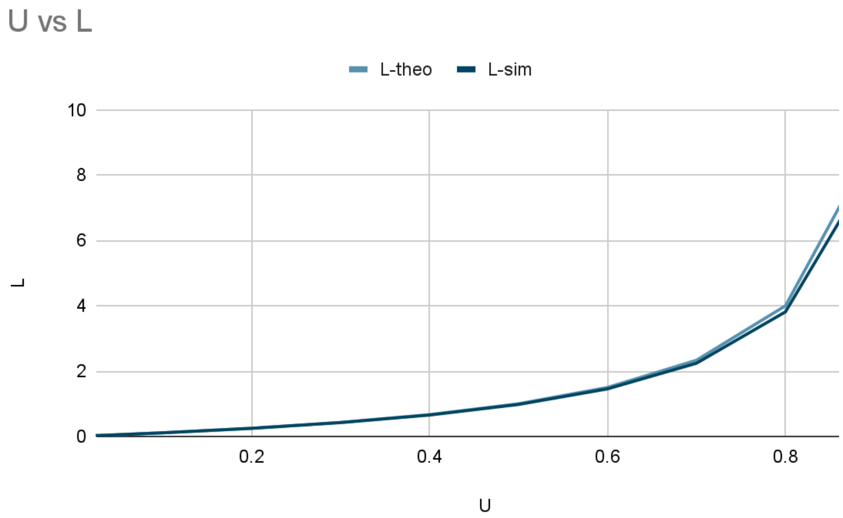
Theoretical				
te	x	u	l	w
100	0.005	0.5	1	200
1000	0.005	0.5	1	200
10000	0.005	0.5	1	200
100000	0.005	0.5	1	200
1000000	0.005	0.5	1	200
10000000	0.005	0.5	1	200

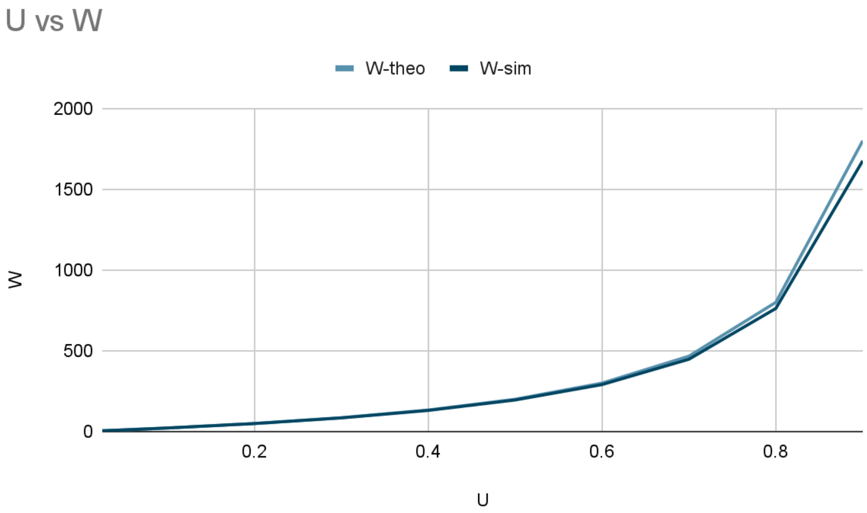
Theoretical				
Ts	x	u	l	w
5	0.005	0.025	0.025641026	5.128205128
10	0.005	0.05	0.052631579	10.52631579
20	0.005	0.1	0.111111111	22.22222222
40	0.005	0.2	0.25	50
60	0.005	0.3	0.428571429	85.71428571
80	0.005	0.4	0.666666667	133.3333333
100	0.005	0.5	1	200
120	0.005	0.6	1.5	300
140	0.005	0.7	2.333333333	466.6666667
160	0.005	0.8	4	800
180	0.005	0.9	9	1800

Simulation				
te	x	u	l	w
100	0	0	1	0DivError
1000	0.005	0.623776898	0.4433053951	88.6610790272
10000	0.0049924894	0.4738420026	0.8973069673	179.731370665
100000	0.00478	0.471186646	0.94616621575	197.94272296
1000000	0.0047967	0.489915	0.98570835	205.496042285
10000000	0.0050054	0.4970931552	0.97823635433	195.43619977

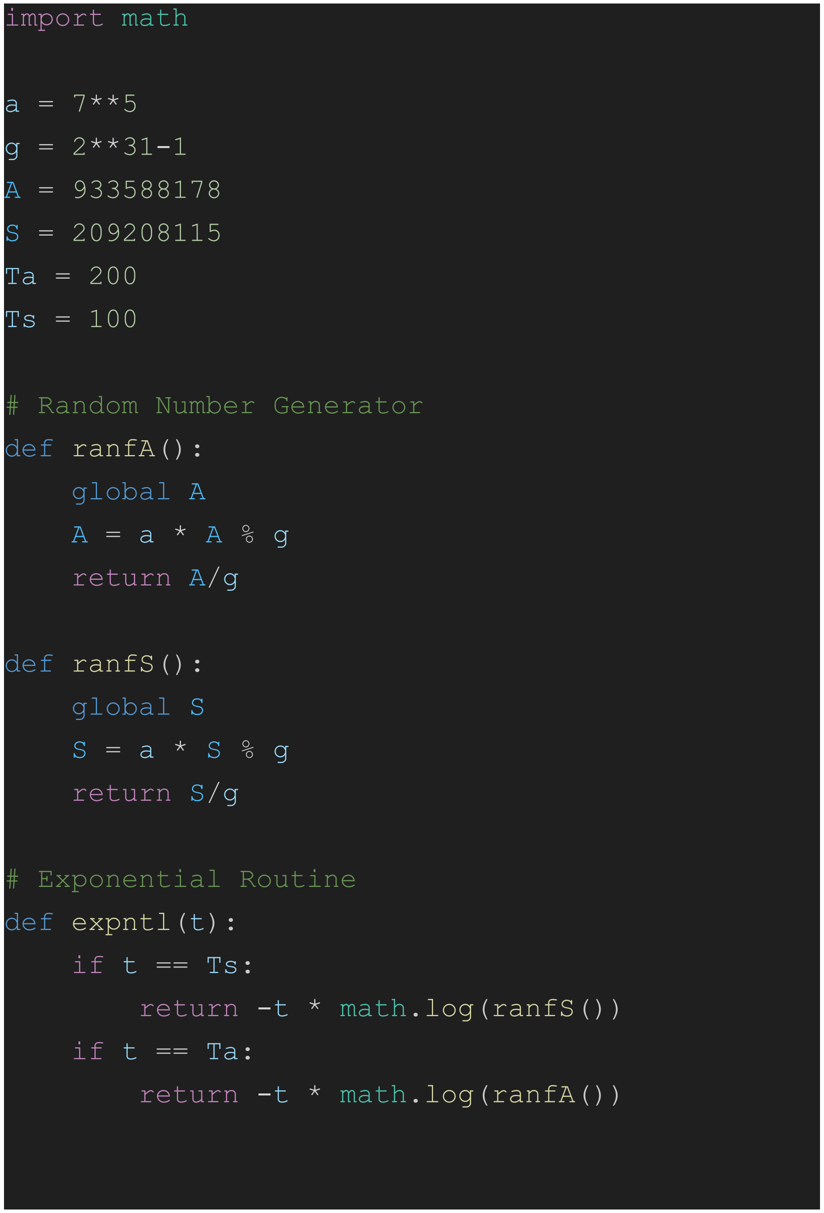
Simulation				
Ts	x	u	l	w
5	0.0050054	0.0248693	0.02550134634	5.09476692
10	0.0050054	0.049723185	0.05232676	10.4540615622
20	0.0050054	0.09943096	0.1103060604	22.037411676
40	0.0050054	0.1988465	0.247386878	49.4239977
60	0.0050054	0.298262	0.423441822	84.597
80	0.0050054	0.3976776	0.655021	130.8628937
100	0.0050054	0.497093155	0.97823635433	195.43619977
120	0.00500528834	0.5964919	1.4553	290.75
140	0.00500521574	0.695897	2.240749	447.6828
160	0.0050050386	0.79510318744	3.8142438942	762.0808
180	0.0050038836	0.89212332	8.387250977	1676.1483

Graphs:

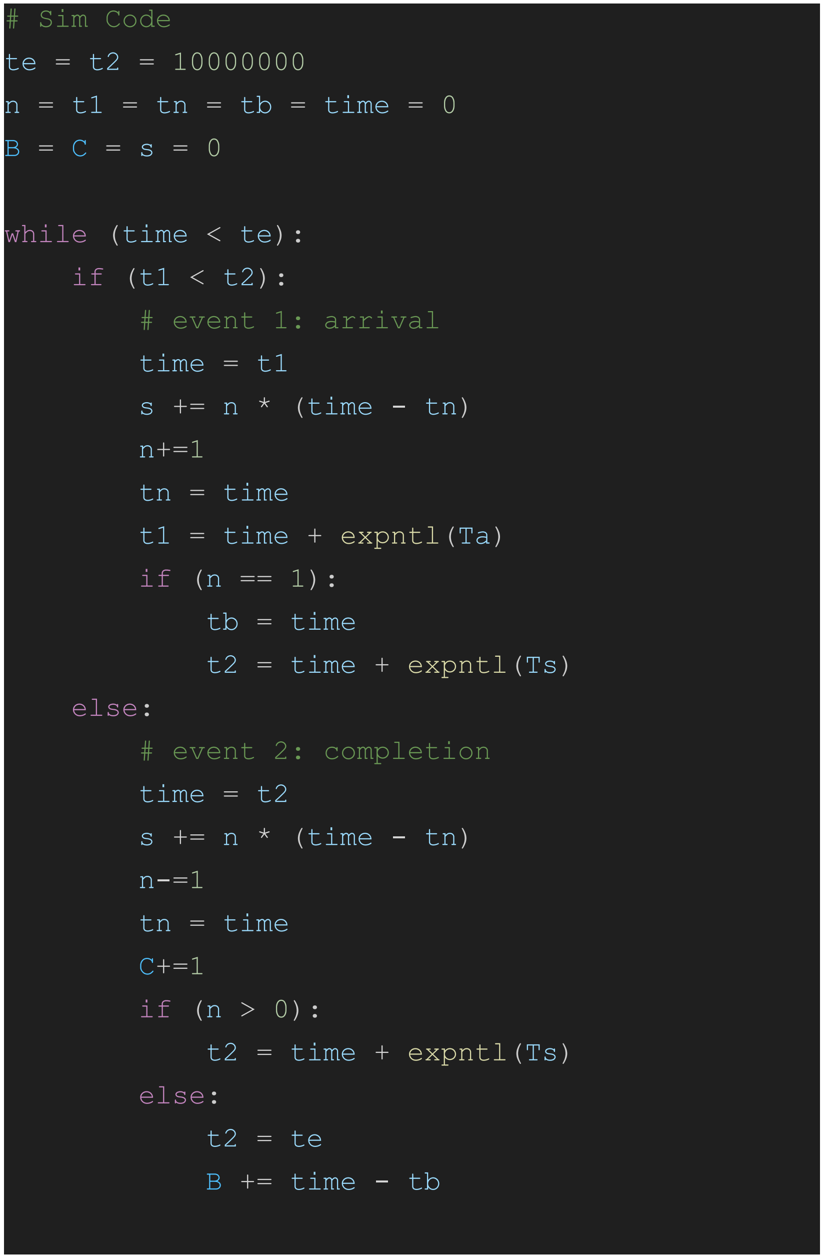

U vs L
L-theo
L-sim
10
8
6
4
2
0
L
0.2
0.4
0.6
0.8
U


U vs W
W-theo
W-sim
2000
1500
1000
500
0
W
0.2
0.4
0.6
0.8
U

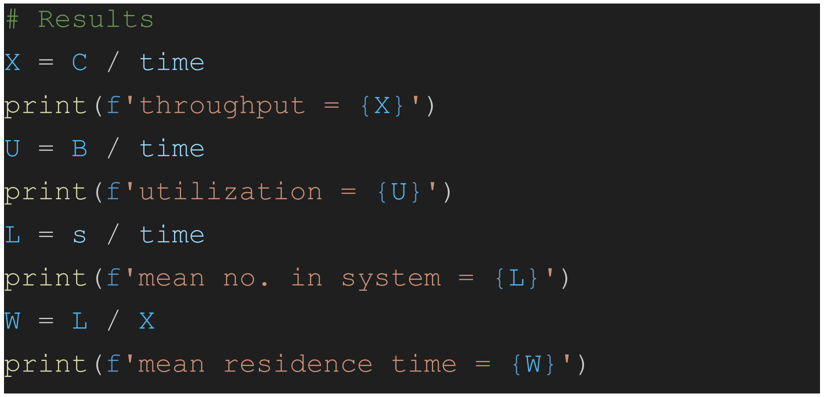
Code:



```
import math

a = 7**5
g = 2**31-1
A = 933588178
S = 209208115
Ta = 200
Ts = 100

# Random Number Generator
def ranfA():
    global A
    A = a * A % g
    return A/g

def ranfS():
    global S
    S = a * S % g
    return S/g

# Exponential Routine
def expntl(t):
    if t == Ts:
        return -t * math.log(ranfS())
    if t == Ta:
        return -t * math.log(ranfA())
```



```
# Sim Code
te = t2 = 10000000
n = t1 = tn = tb = time = 0
B = C = s = 0

while (time < te):
    if (t1 < t2):
        # event 1: arrival
        time = t1
        s += n * (time - tn)
        n+=1
        tn = time
        t1 = time + expntl(Ta)
        if (n == 1):
            tb = time
            t2 = time + expntl(Ts)
    else:
        # event 2: completion
        time = t2
        s += n * (time - tn)
        n-=1
        tn = time
        C+=1
        if (n > 0):
            t2 = time + expntl(Ts)
        else:
            t2 = te
            B += time - tb
```



```
# Results
X = C / time
print(f'throughput = {X}')
U = B / time
print(f'utilization = {U}')
L = s / time
print(f'mean no. in system = {L}')
W = L / X
print(f'mean residence time = {W}')
```