TUGAS 1 – IMPLEMENTASI SIMULASI SISTEM ANTREAN

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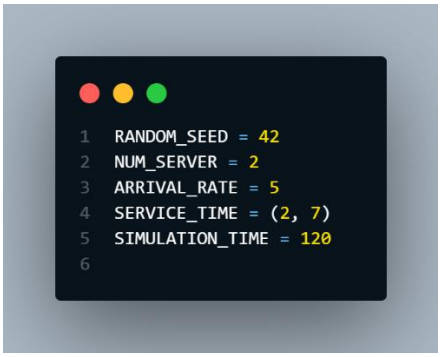
Permasalahan : "Implementasi Simulasi Sistem Antrean pada Pemrograman KRS Mahasiswa"
Skema :

Source Code :

1. **Pustaka Library**

```
import simpy
import random
import numpy as np
from tabulate import tabulate
```

2. **Parameter untuk mengukur Simulasi**



```
RANDOM_SEED = 42
NUM_SERVER = 2
ARRIVAL_RATE = 5
SERVICE_TIME = (2, 7)
SIMULATION_TIME = 120

```

3. **Variabel pendukung yang menyimpan nilai**

```
data = []
wait_times = []
idle_times = []
last_finish_time = 0

```

4. **Flow-Pemrosesan KRS**

```python
def student(env, name, server):
    global last_finish_time
    arrival_time = env.now
    with server.request() as request:
        yield request
        wait_time = env.now - arrival_time
        wait_times.append(wait_time)
        service_duration = random.uniform(*SERVICE_TIME)
        idle_time = max(0, arrival_time - last_finish_time)
        idle_times.append(idle_time)

        system_status = "Busy" if wait_time > 0 else "Idle"

        data.append([name, "\033[91mMengakses KRS\033[0m", f"{arrival_time:.2f} ms", "-", system_status])
        data.append([name, "\033[93mSistem Memproses\033[0m", f"{env.now:.2f} ms", f"{wait_time:.2f} ms", system_status])
        yield env.timeout(service_duration)
        data.append([name, "\033[92mKRS Selesai\033[0m", f"{env.now:.2f} ms", "-", "-"])

        last_finish_time = env.now

```

5. **Generator Mahasiswa untuk mengakses sistem secara acak**

```python
def student_generator(env, server):
    student_id = 0
    while True:
        yield env.timeout(random.expovariate(1.0 / ARRIVAL_RATE))
        student_id += 1
        env.process(student(env, f"Mahasiswa-{student_id}", server))

```

6. **Simulasi-Eksekusi**

```python
def run_simulation():
    random.seed(RANDOM_SEED)
    env = simpy.Environment()
    server = simpy.Resource(env, capacity=NUM_SERVER)
    env.process(student_generator(env, server))
    env.run(until=SIMULATION_TIME)

```

7. Analisis Waktu

```python
if wait_times:
    avg_wait = np.mean(wait_times)
    min_wait = np.min(wait_times)
    max_wait = np.max(wait_times)
    avg_idle = np.mean(idle_times) if idle_times else 0

    print(tabulate(data, headers=["Nama", "Kegiatan", "Waktu Akses", "Waktu Tunggu", "Status Server"], tablefmt="grid"))
    print(f"\nAnalisis Waktu Tunggu:")
    print(f"Rata-rata waktu tunggu: {avg_wait:.2f} ms")
    print(f"Waktu tunggu minimum: {min_wait:.2f} ms")
    print(f"Waktu tunggu maksimum: {max_wait:.2f} ms")
    print(f"Rata-rata idle server: {avg_idle:.2f} ms")
else:
    print("Tidak ada data waktu tunggu.")

```

- ## Full Code :

```python
import simpy
import random
import numpy as np
from tabulate import tabulate

# Parameter simulasi
RANDOM_SEED = 42  # Untuk hasil yang reproducible
NUM_SERVER = 2    # Jumlah server KRS tersedia
ARRIVAL_RATE = 5   # Rata-rata mahasiswa datang per menit (Poisson Process)
SERVICE_TIME = (2, 7)  # Waktu layanan dalam rentang (min, max) menit
SIMULATION_TIME = 120  # Total waktu simulasi dalam menit

# List untuk menyimpan hasil simulasi
data = []
wait_times = []
idle_times = []
last_finish_time = 0

def student(env, name, server):
    global last_finish_time
    arrival_time = env.now
    with server.request() as request:
        yield request
        wait_time = env.now - arrival_time
        wait_times.append(wait_time)
        service_duration = random.uniform(*SERVICE_TIME)
        idle_time = max(0, arrival_time - last_finish_time)
        idle_times.append(idle_time)

        system_status = "Busy" if wait_time > 0 else "Idle"

        data.append([name, "\033[91mMengakses KRS\033[0m", f"{arrival_time:.2f} ms", "-", system_status])
        data.append([name, "\033[93mSistem Memproses\033[0m", f"{env.now:.2f} ms", f"{wait_time:.2f} ms", system_status])
        yield env.timeout(service_duration)
        data.append([name, "\033[92mKRS Selesai\033[0m", f"{env.now:.2f} ms", "-", "-"])

        last_finish_time = env.now

def student_generator(env, server):
    student_id = 0
    while True:
        yield env.timeout(random.expovariate(1.0 / ARRIVAL_RATE))
        student_id += 1
        env.process(student(env, f"Mahasiswa-{student_id}", server))

# Setup dan jalankan simulasi
def run_simulation():
    random.seed(RANDOM_SEED)
    env = simpy.Environment()
    server = simpy.Resource(env, capacity=NUM_SERVER)
    env.process(student_generator(env, server))
    env.run(until=SIMULATION_TIME)

    # Analisis waktu tunggu
    if wait_times:
        avg_wait = np.mean(wait_times)
        min_wait = np.min(wait_times)
        max_wait = np.max(wait_times)
        avg_idle = np.mean(idle_times) if idle_times else 0

        print(tabulate(data, headers=["Nama", "Kegiatan", "Waktu Akses", "Waktu Tunggu", "Status Server"], tablefmt="grid"))
        print(f"\nAnalisis Waktu Tunggu:")
        print(f"Rata-rata waktu tunggu: {avg_wait:.2f} ms")
        print(f"Waktu tunggu minimum: {min_wait:.2f} ms")
        print(f"Waktu tunggu maksimum: {max_wait:.2f} ms")
        print(f"Rata-rata idle server: {avg_idle:.2f} ms")
    else:
        print("Tidak ada data waktu tunggu.")

if __name__ == "__main__":
    run_simulation()
```

Output:

Nama	Kegiatan	Waktu Akses	Waktu Tunggu	Status Server
Mahasiswa-1	Mengakses KRS	5.10 ms	-	Idle
Mahasiswa-1	Sistem Memproses	5.10 ms	0.00 ms	Idle
Mahasiswa-2	Mengakses KRS	5.23 ms	-	Idle
Mahasiswa-2	Sistem Memproses	5.23 ms	0.00 ms	Idle
Mahasiswa-1	KRS Selesai	8.48 ms	-	-
Mahasiswa-3	Mengakses KRS	6.49 ms	-	Busy
Mahasiswa-3	Sistem Memproses	8.48 ms	1.99 ms	Busy
Mahasiswa-2	KRS Selesai	10.91 ms	-	-
Mahasiswa-4	Mengakses KRS	12.14 ms	-	Idle
Mahasiswa-4	Sistem Memproses	12.14 ms	0.00 ms	Idle
Mahasiswa-3	KRS Selesai	14.94 ms	-	-
Mahasiswa-5	Mengakses KRS	12.59 ms	-	Busy
Mahasiswa-5	Sistem Memproses	14.94 ms	2.35 ms	Busy
Mahasiswa-4	KRS Selesai	16.25 ms	-	-
Mahasiswa-6	Mengakses KRS	12.74 ms	-	Busy
Mahasiswa-6	Sistem Memproses	16.25 ms	3.50 ms	Busy
Mahasiswa-5	KRS Selesai	17.07 ms	-	-
Mahasiswa-7	Mengakses KRS	13.98 ms	-	Busy
Mahasiswa-7	Sistem Memproses	17.07 ms	3.09 ms	Busy
Mahasiswa-6	KRS Selesai	19.24 ms	-	-
Mahasiswa-8	Mengakses KRS	17.49 ms	-	Busy
Mahasiswa-8	Sistem Memproses	19.24 ms	1.74 ms	Busy
Mahasiswa-7	KRS Selesai	22.32 ms	-	-
Mahasiswa-9	Mengakses KRS	21.43 ms	-	Busy
Mahasiswa-9	Sistem Memproses	22.32 ms	0.89 ms	Busy

```
Analisis Waktu Tunggu:
Rata-rata waktu tunggu: 1.20 ms
Waktu tunggu minimum: 0.00 ms
Waktu tunggu maksimum: 4.84 ms
Rata-rata idle server: 2.17 ms
```

Link Source Code dan Dokumentasi : https://github.com/miegoyeng/Model-dan-Simulasi-Data