Operating System Project

instructor:

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TA: Eng. Gehad

Project Title:

OS Scheduler Simulation

Team Members

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introduction:

< In this project, we simulated the role of the CPU scheduler in an operating system by designing and implementing a program that schedules processes using several well-known algorithms. We focused on performance analysis and comparing algorithms under the same conditions.

< The program was developed by using Python language and PyQt5 library

Scheduling Algorithms Implemented:

FCFS First Come First Serve Runs processes in order of arrival.
Round Robin (RR) Each process gets a fixed time slice (quantum).
(Non-Preemptive) Highest Priority First Chooses the process with the highest priority.
SRTF Shortest Remaining Time First Always selects the process with the least remaining time

{SRTF}performed best overall, with the lowest average waiting and turnaround times.
{HPF} came next, as it prioritizes shorter jobs but may cause starvation for low-priority processes
{RR}. showed fair scheduling, but its efficiency depends on the chosen time quantum.
{FCFS} had the highest waiting time, especially when early processes had long burst times

Operating System Project

Summary

This Python script simulates a process generator for an Operating System project.

It utilizes inter-process communication (IPC) with message queues, and signal handling to coordinate the timing and generation of processes.

Key components of the code:

- Reads process information from a file.
- Sends process data to a scheduler at specific time intervals.
- Handles SIGINT to clean up resources.
- Uses a forking method to launch a clock and scheduler program.

It's designed to simulate realistic behavior in a basic OS environment.

Code

```
import sys
import random
import numpy as np
from PyQt5.QtWidgets import (
    QApplication, QMainWindow, QWidget, QVBoxLayout, QHBoxLayout, QLabel,
    QPushButton, QComboBox, QTableWidget, QTableWidgetItem, QSpinBox,
```

```
    QMessageBox, QFileDialog, QTabWidget, QTextEdit
)
from PyQt5.QtCore import Qt
from PyQt5.QtGui import QFont

class ProcessGenerator(QWidget):
    def _init_(self):
        super()._init_()
        self.init_ui()

    def init_ui(self):
        layout = QVBoxLayout()

        # Title
        title = QLabel("Process Generator Module")
        title.setFont(QFont('Arial', 14, QFont.Bold))
        title.setAlignment(Qt.AlignCenter)
        layout.addWidget(title)

        # Parameters
        params_layout = QHBoxLayout()

        left_params = QVBoxLayout()
        self.num_processes = QSpinBox()
        self.num_processes.setRange(1, 100)
        self.num_processes.setValue(10)
        left_params.addWidget(QLabel("Number of Processes:"))
        left_params.addWidget(self.num_processes)

        self.arrival_mean = QSpinBox()
        self.arrival_mean.setRange(0, 100)
        self.arrival_mean.setValue(5)
        left_params.addWidget(QLabel("Arrival Time Mean:"))
        left_params.addWidget(self.arrival_mean)

        right_params = QVBoxLayout()
        self.burst_mean = QSpinBox()
        self.burst_mean.setRange(1, 100)
        self.burst_mean.setValue(10)
        right_params.addWidget(QLabel("Burst Time Mean:"))
        right_params.addWidget(self.burst_mean)

        self.priority_lambda = QSpinBox()
        self.priority_lambda.setRange(1, 10)
        self.priority_lambda.setValue(3)
        right_params.addWidget(QLabel("Priority Lambda:"))
        right_params.addWidget(self.priority_lambda)

        params_layout.addLayout(left_params)
```

```
        params_layout.addLayout(right_params)
        layout.addLayout(params_layout)

        # Buttons
        btn_layout = QHBoxLayout()
        self.generate_btn = QPushButton("Generate Processes")
        self.generate_btn.clicked.connect(self.generate_processes)
        self.save_btn = QPushButton("Save to File")
        self.save_btn.clicked.connect(self.save_to_file)
        btn_layout.addWidget(self.generate_btn)
        btn_layout.addWidget(self.save_btn)
        layout.addLayout(btn_layout)

        # Results Table
        self.table = QTableWidget()
        self.table.setColumnCount(4)
        self.table.setHorizontalHeaderLabels(["PID", "Arrival", "Burst", "Priority"])
        layout.addWidget(self.table)

        self.setLayout(layout)

    def generate_processes(self):
        n = self.num_processes.value()
        arrival_mean = self.arrival_mean.value()
        burst_mean = self.burst_mean.value()
        priority_lambda = self.priority_lambda.value()

        # Generate arrival times (normal distribution)
        arrival_times = np.abs(np.random.normal(arrival_mean, arrival_mean/2, n)).astype(int)
        arrival_times = np.cumsum(arrival_times)

        # Generate burst times (normal distribution)
        burst_times = np.abs(np.random.normal(burst_mean, burst_mean/2, n)).astype(int)
        burst_times = np.where(burst_times < 1, 1, burst_times)

        # Generate priorities (Poisson distribution)
        priorities = np.random.poisson(priority_lambda, n)
        priorities = np.where(priorities < 1, 1, priorities)

        # Populate table
        self.table.setRowCount(n)
        for i in range(n):
            self.table.setItem(i, 0, QTableWidgetItem(f"P{i+1}"))
            self.table.setItem(i, 1, QTableWidgetItem(str(arrival_times[i])))
            self.table.setItem(i, 2, QTableWidgetItem(str(burst_times[i])))
            self.table.setItem(i, 3, QTableWidgetItem(str(priorities[i])))

    def save_to_file(self):
             filename, _ = QFileDialog.getSaveFileName(self, "Save Processes", "", "Text Files
```

```
(*.txt)")
        if filename:
            with open(filename, 'w') as f:
                f.write("PID,Arrival,Burst,Priority\n")
                for row in range(self.table.rowCount()):
                    pid = self.table.item(row, 0).text()
                    arrival = self.table.item(row, 1).text()
                    burst = self.table.item(row, 2).text()
                    priority = self.table.item(row, 3).text()
                    f.write(f"{pid},{arrival},{burst},{priority}\n")
            QMessageBox.information(self, "Success", "Processes saved to file successfully!")
```

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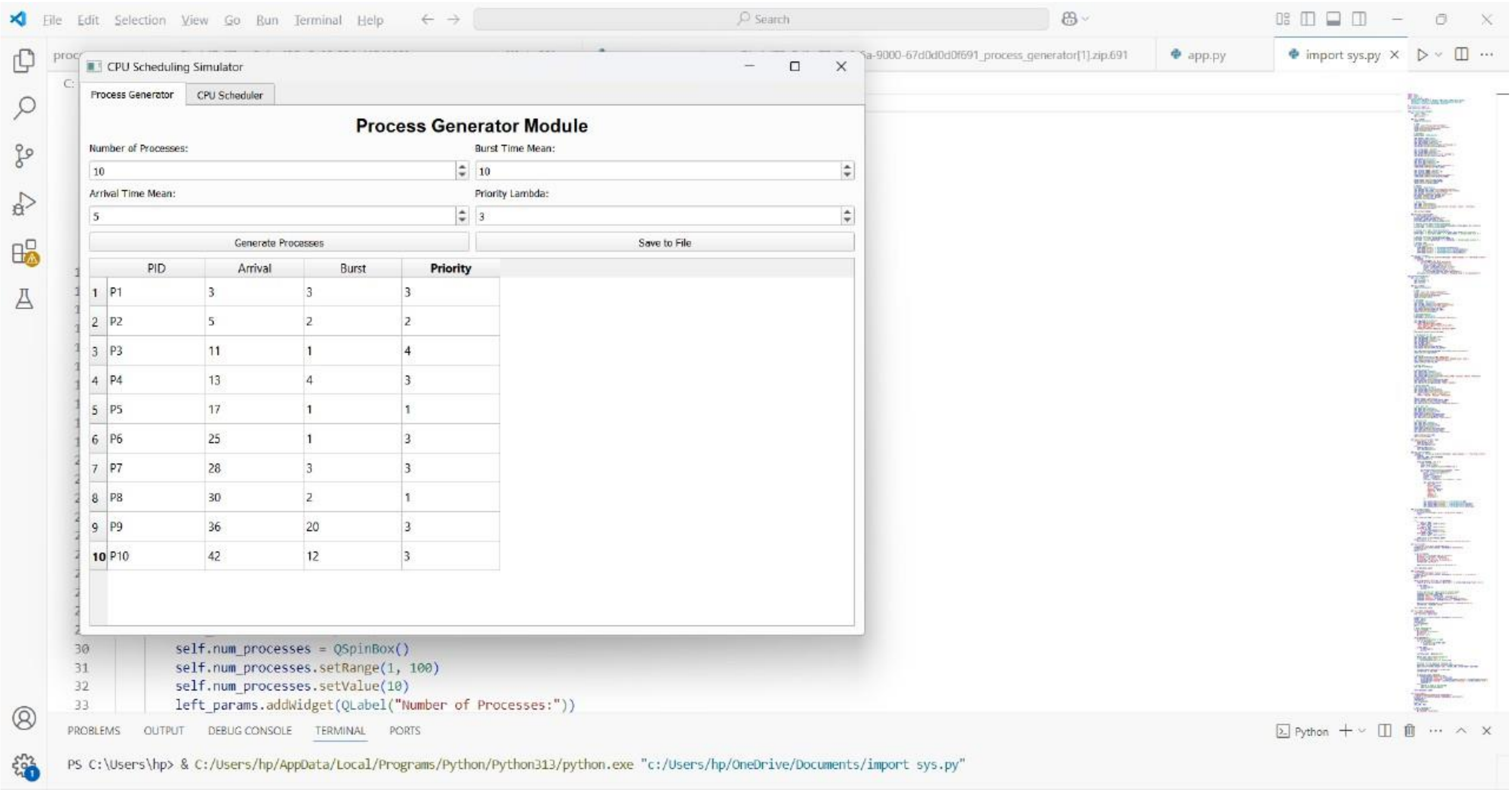

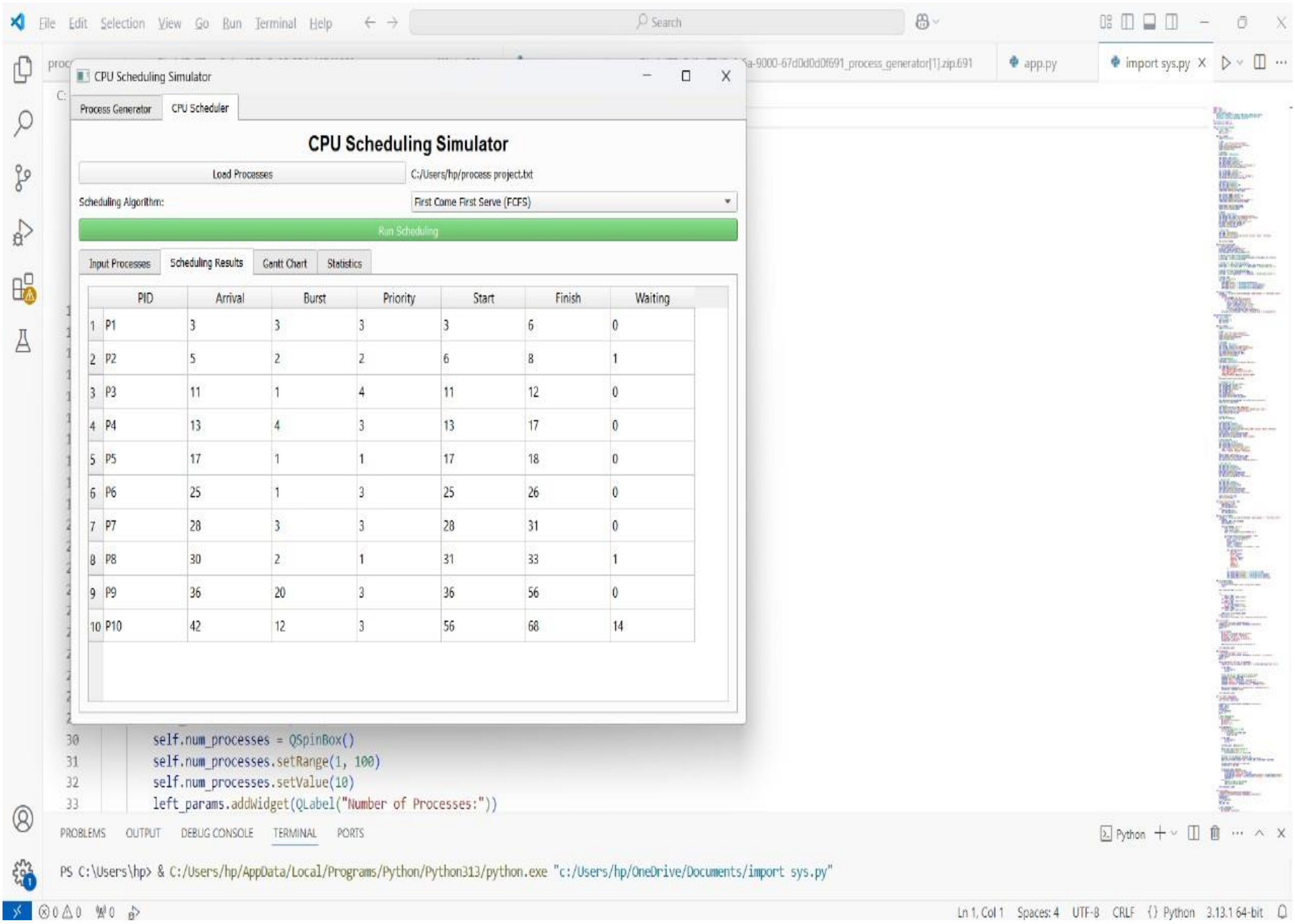

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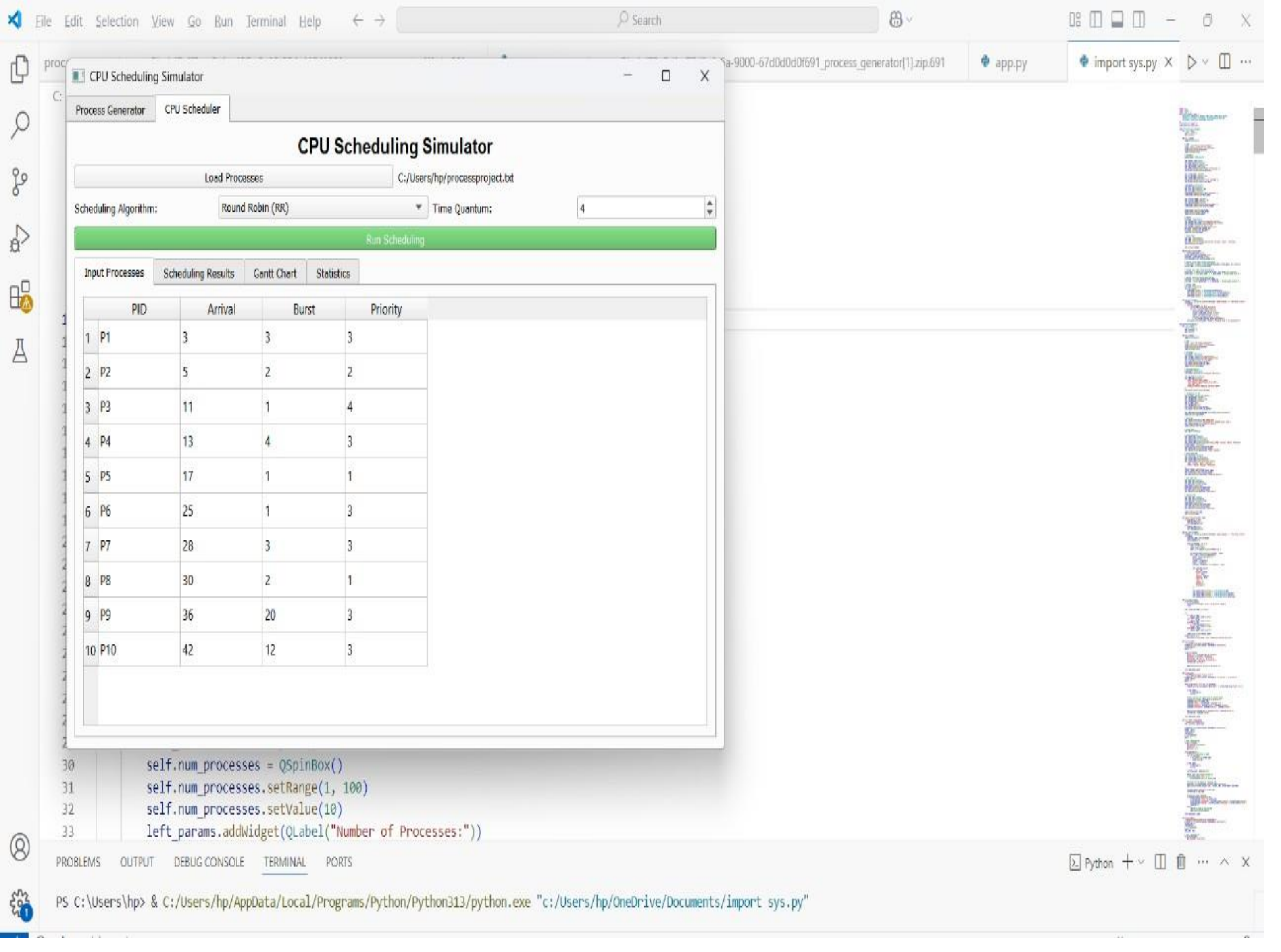

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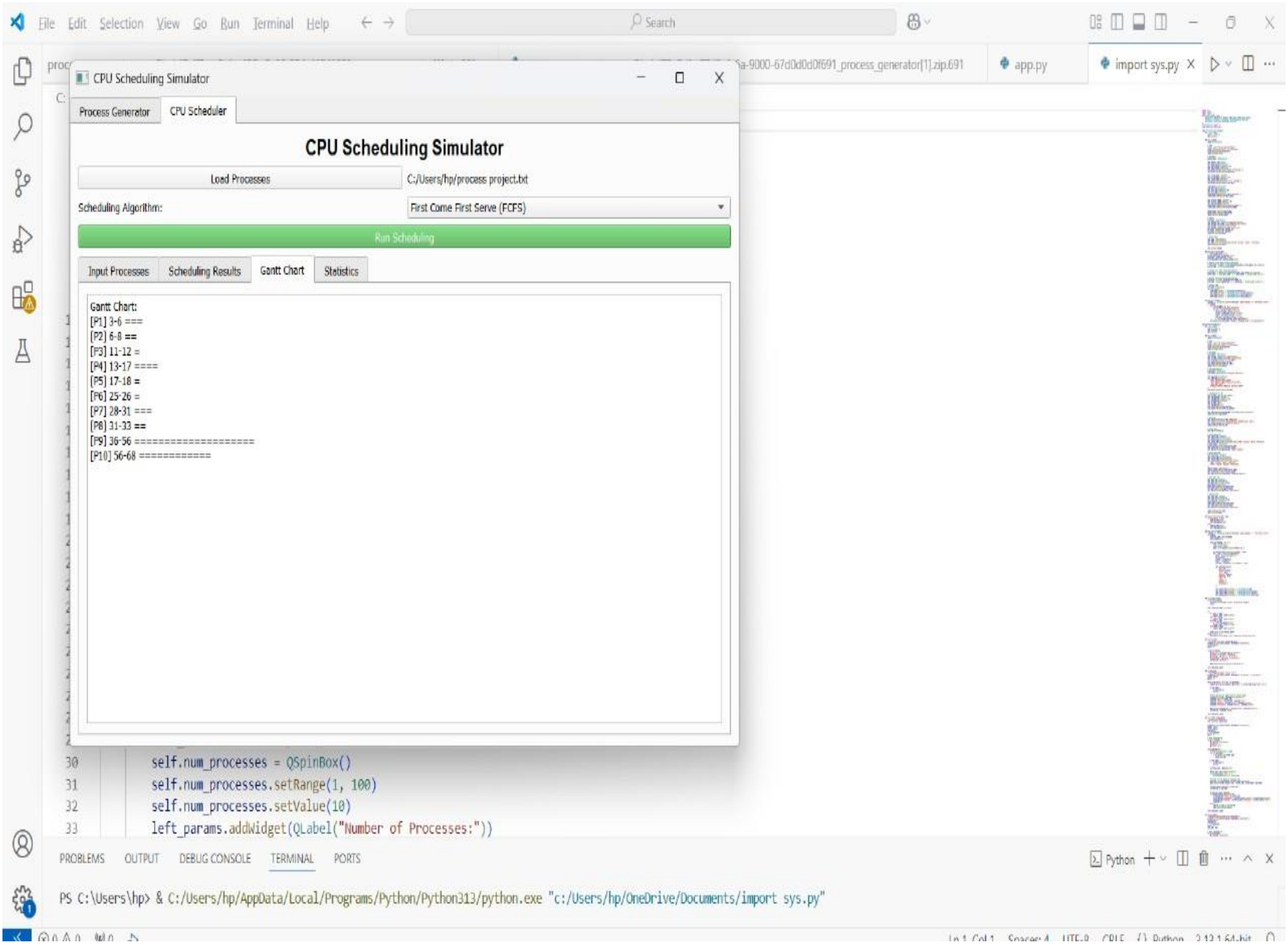

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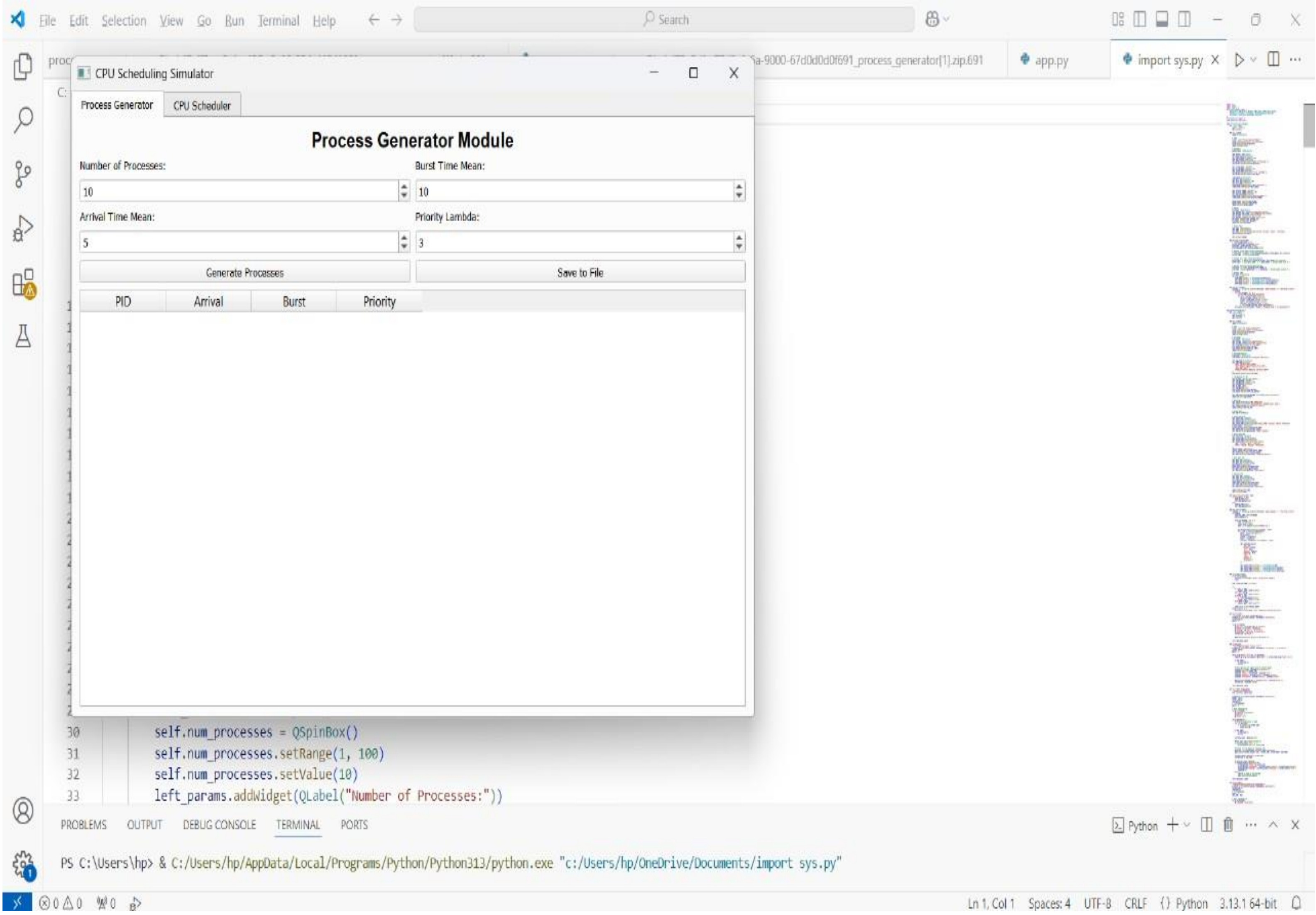

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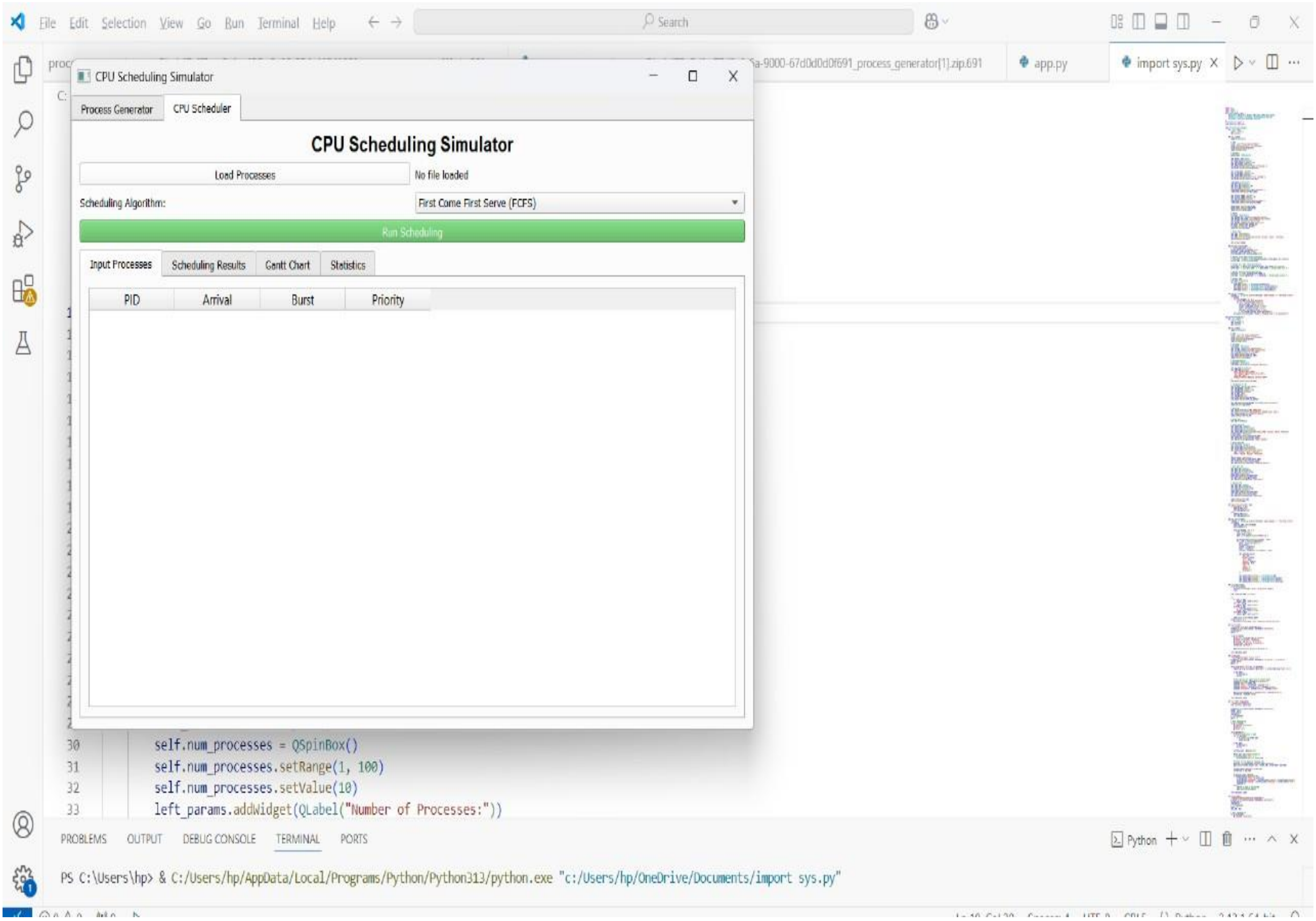

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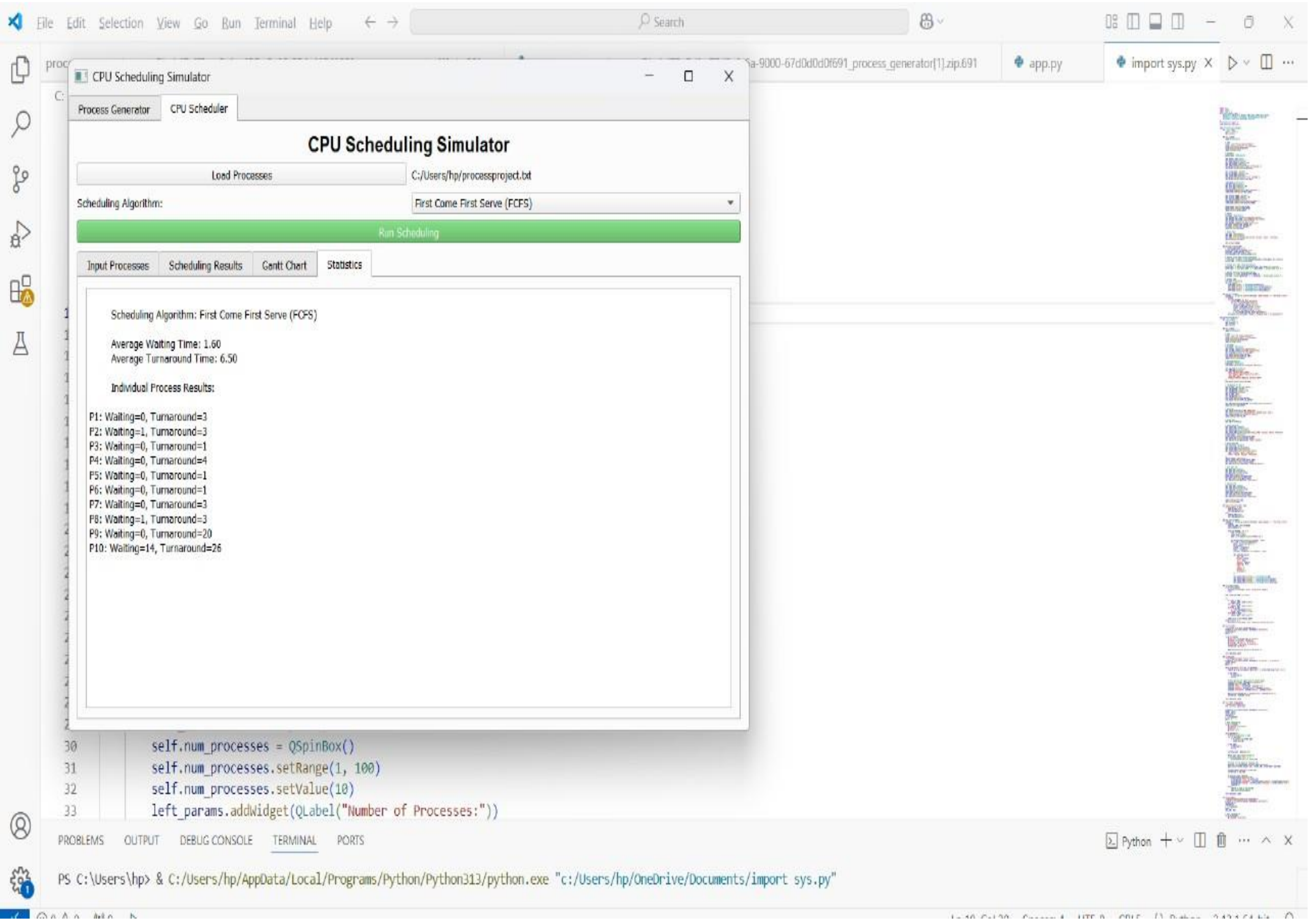

Conclusions

We successfully implemented and compared four scheduling algorithms. Each algorithm has strengths and weaknesses depending on the scenario. We learned how scheduling affects performance and user experience

References:

1. Course Lectures and Notes, Operating Systems, Spring 2025.
2. Project Specifications PDF, OS Scheduler.

Thanks