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FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY
DEPARTMENT OF COMPUTING AND TECHNOLOGY
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Personal Scheduling Assistant in Python
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Personal Scheduling Assistant

1. Overview

The Personal Scheduling Assistant is a Python-based application designed to help users organize tasks efficiently using dynamic programming techniques, sorting algorithms, and a visual representation of tasks using a Gantt chart. Built using **Tkinter** for the GUI and **Matplotlib** for task visualization, this project demonstrates the application of algorithm design principles.

2. System Architecture

2.1 Components

- **Task Class**: Represents individual tasks with attributes like name, category, priority, deadline, and duration.
- **Scheduler Class**: Handles task management operations such as adding, removing, and visualizing tasks.
- **SchedulerApp Class (GUI)**: Implements the user interface for interacting with the Scheduler.
- **Matplotlib Integration**: Generates a Gantt chart for tasks.

2.2 High-Level Workflow

1. User enters task details via the GUI.
2. The **Task** object is created and stored in the **Scheduler** class.
3. Tasks are sorted and visualized based on deadlines using optimized sorting algorithms (e.g., merge sort).
4. A Gantt chart displays task schedules visually.

3. Features and Functional Requirements

3.1 Features

- Add, remove, and view tasks categorized as **Personal** or **Academic**.

- Assign priorities and deadlines to tasks.
- Generate Gantt charts to display scheduled tasks.
- Sort tasks dynamically based on priority and deadlines.

3.2 Functional Requirements

- Input validation for task attributes.
- Deadlines must follow the format YYYY-MM-DD HH:MM.
- Efficient scheduling using dynamic programming and optimized sorting.
- Handle conflicts where tasks overlap or deadlines are missed.

4. Algorithm Design

4.1 Sorting Tasks by Deadline (Merge Sort)

- **Purpose**: To ensure tasks are scheduled in chronological order.
- **Complexity**: O(nlogn)

  .

Pseudocode:

```
function merge_sort(tasks):
    if length(tasks) ≤ 1:
        return tasks
    mid = length(tasks) // 2
    left = merge_sort(tasks[0:mid])
    right = merge_sort(tasks[mid:])
    return merge(left, right)

function merge(left, right):
    sorted_tasks = []
    while left and right:
        if left[0].deadline < right[0].deadline:
            sorted_tasks.append(left.pop(0))
        else:
            sorted_tasks.append(right.pop(0))
```

```
    return sorted_tasks + left + right
```

4.2 Dynamic Programming for Task Scheduling

- **Purpose**: Optimize task scheduling to minimize deadline conflicts.
- **Approach**: Use dynamic programming to calculate the maximum number of tasks that can be scheduled within their deadlines.

Pseudocode:

```
function schedule_tasks(tasks):
    sort tasks by deadline
    dp = [0] * (n + 1)
    for i from 1 to n:
        for j from i - 1 to 0:
            if tasks[i].deadline >= tasks[j].deadline + tasks[j].duration:
                dp[i] = max(dp[i], dp[j] + 1)
    return dp[n]
```

5. Technical Design

5.1 Task Class

Attributes:

- name: Task name.
- category: Task type (Personal/Academic).
- priority: Task importance (1-3).
- deadline: Task deadline as a datetime object.
- duration: Task duration in hours.

Pseudocode:

```
class Task:
    attributes: name, category, priority, deadline, duration
    function __init__(name, category, priority, deadline, duration):
        initialize attributes
```

5.2 Scheduler Class

Methods:

- add_task(task): Adds a task to the list.
- remove_task(task_name): Removes a task by name.
- display_gantt_chart(): Visualizes tasks using Matplotlib.

Pseudocode:

```
class Scheduler:
    attributes: tasks = []

    function add_task(task):
        append task to tasks list

    function remove_task(task_name):
        filter tasks list to exclude task_name

    function display_gantt_chart():
        sort tasks by deadline using mergeSort
        generate Gantt chart with task durations
```

5.3 SchedulerApp Class

Methods:

- add_task(): Collects inputs, validates them, and adds tasks.
- remove_task(): Removes selected task from the scheduler.
- refresh_task_list(): Updates the GUI task list display.
- show_gantt_chart(): Displays the Gantt chart.

Pseudocode:

```
class SchedulerApp:
    attributes: root, scheduler, GUI elements

    function add_task():
        collect inputs
        validate inputs
```

```
    create Task object
    call scheduler.add_task(task)
    refresh task list display

function remove_task():
    get selected task
    call scheduler.remove_task(task_name)
    refresh task list display

function refresh_task_list():
    clear GUI list
    display updated tasks

function show_gantt_chart():
    call scheduler.display_gantt_chart()
```

6. Gantt Chart Visualization

The display_gantt_chart method uses Matplotlib to create horizontal bar plots for tasks, showing their start and end times on a timeline. Tasks are labeled by name for clarity.