Lab 2: Job Scheduling System in OCaml

CSI3120 - Programming Language Concepts
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How the system works

1. The user is asked how many jobs they want to schedule
2. For each job, the user provides the start time, duration, and priority
3. The user selects a scheduling strategy:
    a. No overlaps: schedules jobs ensuring no overlap in time
    b. Max priority: schedules jobs to maximize priority
    c. Minimize idle time: schedules jobs to minimize idle time
4. The program displays the schedule jobs accordingly

System Design

read_int: (string) -> int	This function takes a string prompt, prints it, and reads an integer from the user. If the input isn't an integer, it asks again.
time_to_minutes: (int * int) -> int	This function converts hours and minutes into total minutes since midnight.
read_job: (int) -> job	This function asks the user for a job's start time, duration, and priority, then returns a job record.
read_jobs: (int * int * job list) -> job list	This function reads multiple jobs from the user and stores them in a list.
schedule_jobs: job list -> job list	Schedules jobs with the "No Overlaps" strategy by sorting them by start time and removing overlaps.
schedule_jobs_max_priority: job list -> job list	Schedules jobs with the "Max Priority" strategy by sorting them based on priority, highest first.
schedule_jobs_min_idle: job list -> job list	Schedules jobs with the "Minimize Idle Time" strategy by sorting them by start time to reduce gaps.
print_schedule: job list -> unit	This function prints the scheduled jobs with their start time, duration, and priority.
main: unit -> unit	Asks how many jobs to schedule, collects job details, picks a strategy, schedules jobs, and prints the result.

Defining a type: job

- The job type is defined as a record with three fields: start_time, duration, and priority. This allows the program to create objects of type job that store all relevant information about a job.

Tests and Analysis

Test 1 - No Overlaps

```
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How many jobs do you want to schedule? 2
For job 1, please enter the following details:
- Start Time (hours): 9
- Start Time (minutes): 30
- Duration (minutes): 60
- Priority: 3
For job 2, please enter the following details:
- Start Time (hours): 11
- Start Time (minutes): 0
- Duration (minutes): 45
- Priority: 5
Choose a scheduling strategy (1 for No Overlaps, 2 for Max Priority, 3 for Minimize Idle Time): 1

Job scheduled: Start Time = 570 minutes, Duration = 60 minutes, Priority = 3
Job scheduled: Start Time = 660 minutes, Duration = 45 minutes, Priority = 5
```

Analysis

- In the No Overlaps strategy, jobs are scheduled to ensure no overlap in their start and end times. The jobs were sorted by their start time (9:30 for Job 1 and 11:00 for Job 2). Since Job 1 finishes at 10:30 (60 minutes after 9:30), there's no overlap with Job 2 (which starts at 11:00) so both jobs were scheduled successfully without any changes.

Test 2 - Max priority

```
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How many jobs do you want to schedule? 3
For job 3, please enter the following details:
- Start Time (hours): 8
- Start Time (minutes): 0
- Duration (minutes): 90
- Priority: 1
For job 2, please enter the following details:
- Start Time (hours): 9
- Start Time (minutes): 30
- Duration (minutes): 60
- Priority: 3
For job 1, please enter the following details:
- Start Time (hours): 11
- Start Time (minutes): 0
- Duration (minutes): 45
- Priority: 2
Choose a scheduling strategy (1 for No Overlaps, 2 for Max Priority, 3 for Minimize Idle Time): 2

Job scheduled: Start Time = 570 minutes, Duration = 60 minutes, Priority = 3
Job scheduled: Start Time = 660 minutes, Duration = 45 minutes, Priority = 2
Job scheduled: Start Time = 480 minutes, Duration = 90 minutes, Priority = 1
```

Analysis

- In the Max Priority strategy, jobs are sorted by priority instead of start time. Job 2, with the highest priority (3), was scheduled first, followed by Job 3 (priority 2), and finally Job 1 (priority 1), regardless of their start times. The start times are preserved from the input, but jobs are displayed in priority order (highest to lowest).