Project Scheduling

Scheduling

Scheduling the project tasks is an important project planning activity. Once a schedule has been worked out and the project gets underway, the project manager monitors the timely completion of the tasks and takes any corrective action that may be necessary whenever there is a chance of schedule slippage. In order to schedule the project activities, a software project manager needs to do the following:

1. Identify all the major activities that need to be carried out to complete the project.
2. Break down each activity into tasks.
3. Determine the dependency among different tasks.
4. Establish the estimates for the time durations necessary to complete the tasks.
5. Represent the information in the form of an activity network.
6. Determine task starting and ending dates from the information represented in the activity network.
7. Determine the *critical path*. A critical path is a chain of tasks that determines the duration of the project.
8. Allocate resources to tasks.

Work Breakdown Structure

- *Work breakdown structure* (WBS) is used to recursively decompose a given set of activities into smaller activities.
- WBS provides a notation for representing the activities, sub-activities, and tasks needed to be carried out in order to solve a problem. Each of these is represented using a rectangle.
- The root of the tree is labelled by the project name. Each node of the tree is broken down into smaller activities that are made the children of the node.
- To decompose an activity to a sub-activity, a good knowledge of the activity can be useful.
- The figure given in the next slide represents the WBS of a management information system (MIS) software.

Work Breakdown Structure

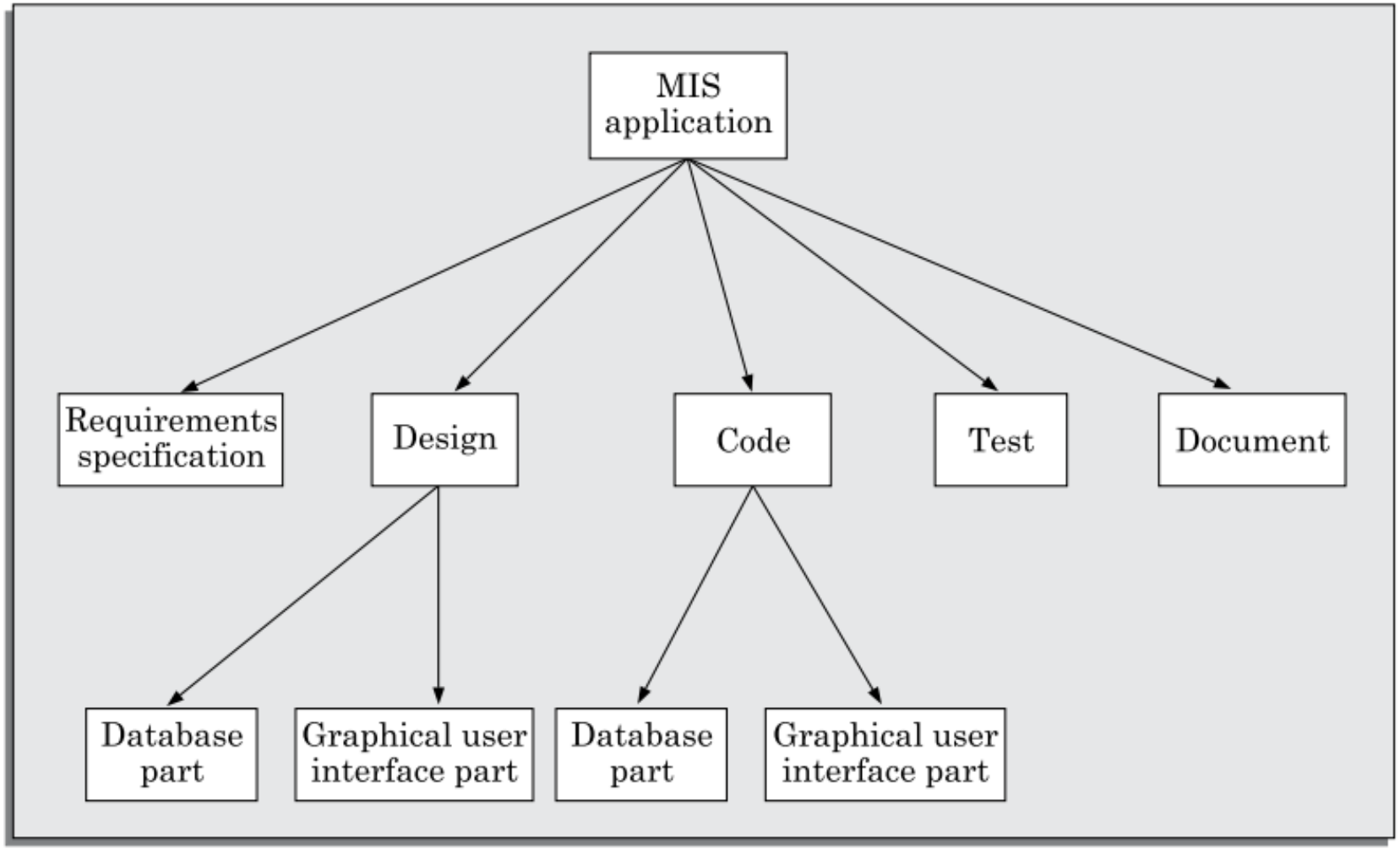

FIGURE: Work breakdown structure of an MIS problem.

Work Breakdown Structure

How long to decompose?

- The decomposition of the activities is carried out until any of the following is satisfied:
- A leaf-level sub-activity (a task) requires approximately two weeks to develop.
- Hidden complexities are exposed, so that the job to be done is understood and can
- be assigned as a unit of work to one of the developers.
- Opportunities for reuse of existing software components is identified.

Activity Network

An activity network shows the different activities making up a project, their estimated durations, and their interdependencies. Two equivalent representations for activity networks are possible and are in use:

Activity on Node (AoN): In this representation, each activity is represented by a rectangular (some use circular) node and the duration of the activity is shown alongside each task in the node. The inter-task dependencies are shown using directional edges.

Activity on Edge (AoE): In this representation tasks are associated with the edges. The edges are also annotated with the task duration. The nodes in the graph represent project milestones.

Activity networks were originally represented using *activity on edge* (AoE) representation.

However, later *activity on node* (AoN) has become popular since this representation is easier to understand and revise.

Activity Network

PROBLEM: Determine the Activity network representation for the MIS development project for which the relevant data is given in Table given below. Assume that the manager has determined the tasks to be represented from the work breakdown structure of figure given earlier, and has determined the durations and dependencies for each task as shown in the table.

Task Number	*Task*	*Duration*	*Dependent on Tasks*
T1	Specification	15	-
T2	Design database	45	*T1*
T3	Design GUI	30	*T1*
T4	Code database	105	*T2*
T5	Code GUI part	45	*T3*
T6	Integrate and test	120	*T4* and *T5*
T7	Write user manual	60	*T1*

TABLE: Project Parameters Computed from Activity Network

Activity Network

SOLUTION:

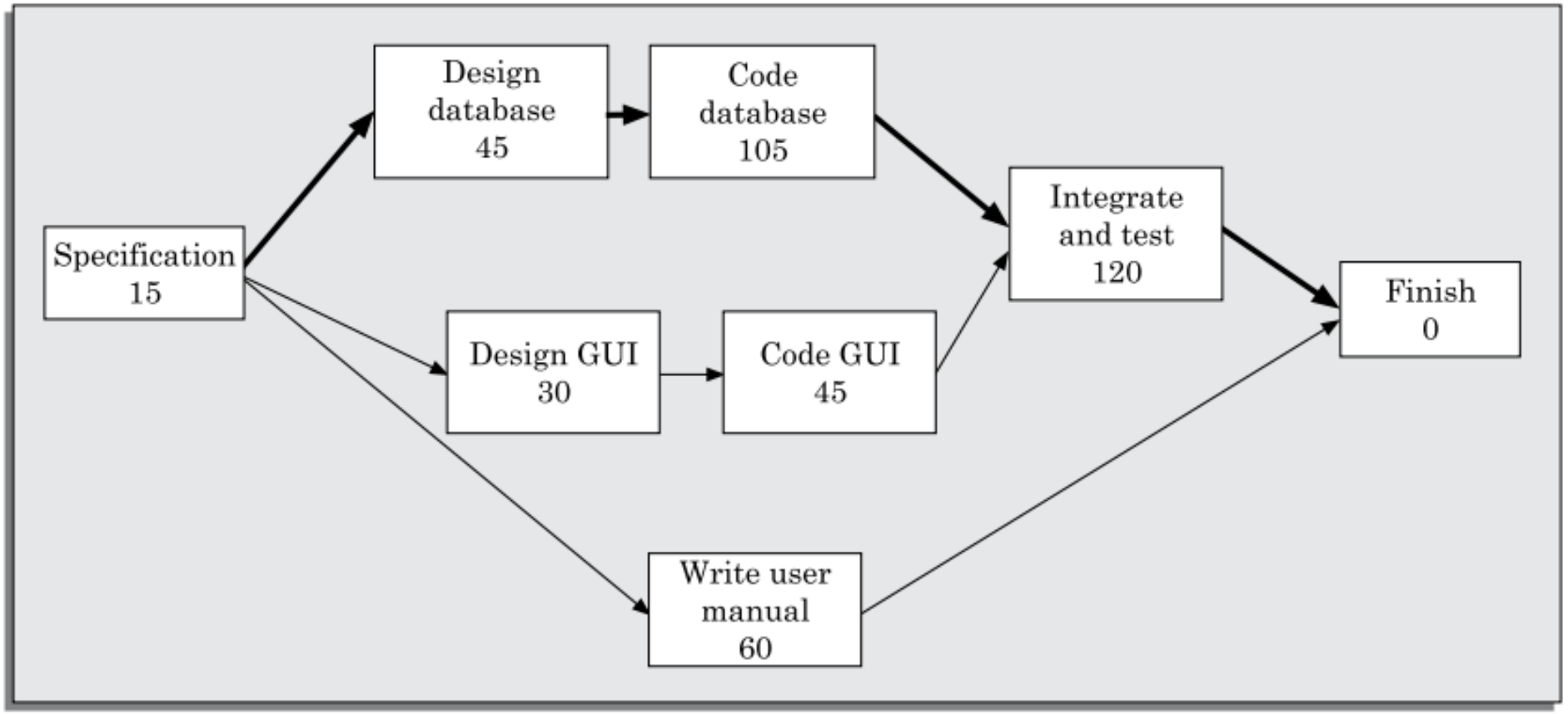

FIGURE: Activity network representation of the MIS problem.

Critical Path Method (CPM)

A path in the activity network graph is any set of consecutive nodes and edges in this graph from the starting node to the last node. A critical path consists of a set of dependent tasks that need to be performed in a sequence and which together take the longest time to complete.

CPM is an algorithmic approach to determine the critical paths and slack times for tasks not on the critical paths involves calculating the following quantities:

Minimum time (MT): It is the minimum time required to complete the project. It is computed by determining the maximum of all paths from start to finish.

Earliest start (ES): It is the time of a task is the maximum of all paths from the start to this task. The ES for a task is the ES of the previous task plus the duration of the preceding task.

Critical Path Method (CPM)

Latest start time (LST): It is the difference between MT and the maximum of all paths from this task to the finish. The LST can be computed by subtracting the duration of the subsequent task from the LST of the subsequent task.

Earliest finish time (EF): The EF for a task is the sum of the earliest start time of the task and the duration of the task.

Latest finish (LF): LF indicates the latest time by which a task can finish without affecting the final completion time of the project. A task completing beyond its LF would cause project delay. LF of a task can be obtained by subtracting maximum of all paths from this task to finish from MT.

Slack time (ST): The slack time (or float time) is the total time that a task may be delayed before it will affect the end time of the project. The slack time indicates the "flexibility" in starting and completion of tasks. ST for a task is LS-ES and can equivalently be written as LF-EF.

Critical Path Method (CPM)

PROBLEM: Use the Activity network of figure given earlier to determine the ES and EF for every task for the MIS problem.

Solution: The activity network with computed ES and EF values has been shown below:

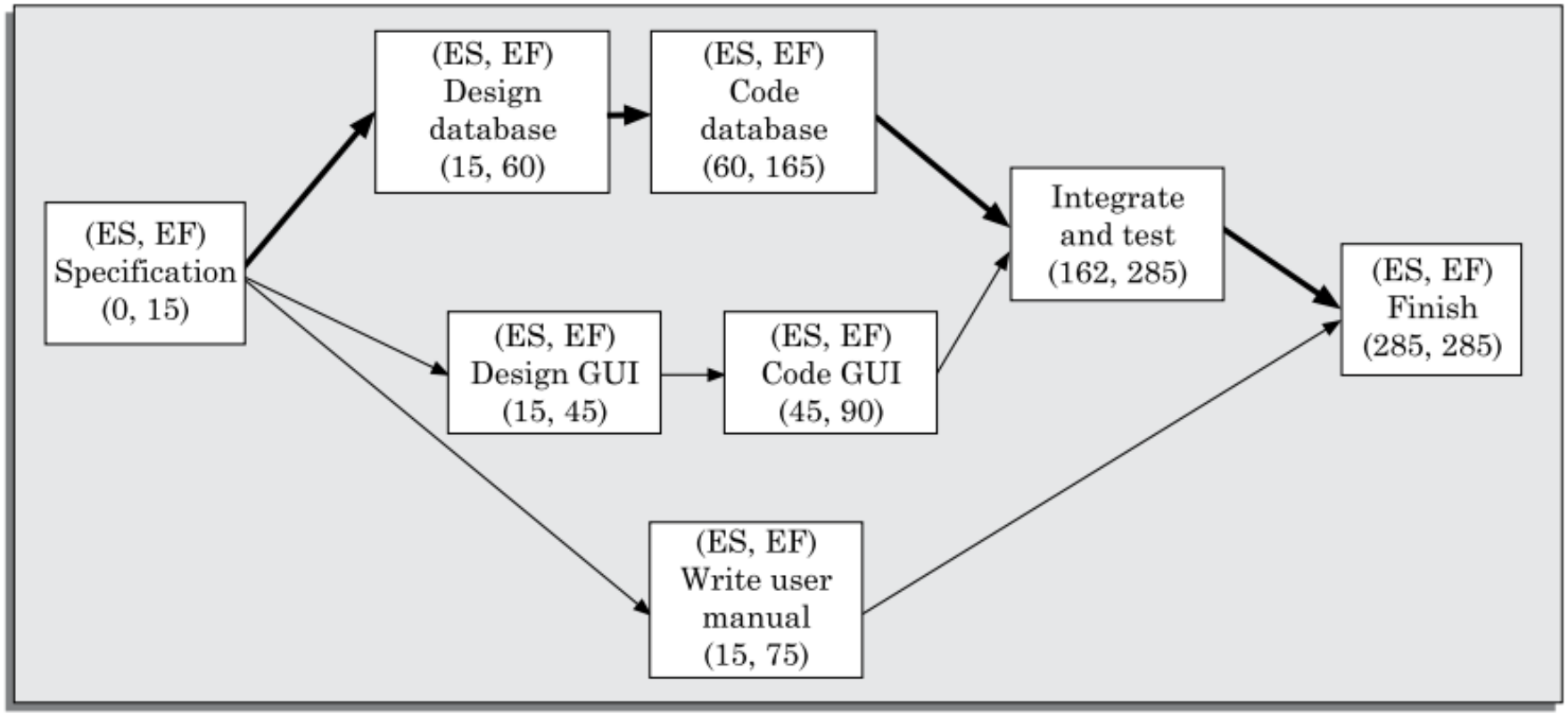

FIGURE: AoN for MIS problem with (ES, EF).

Critical Path Method (CPM)

PROBLEM 3.8 Use the Activity network given the previous problem to determine the LS and LF for every task for the MIS problem.

Solution: The activity network with computed LS and LF values has been shown in figure given below:

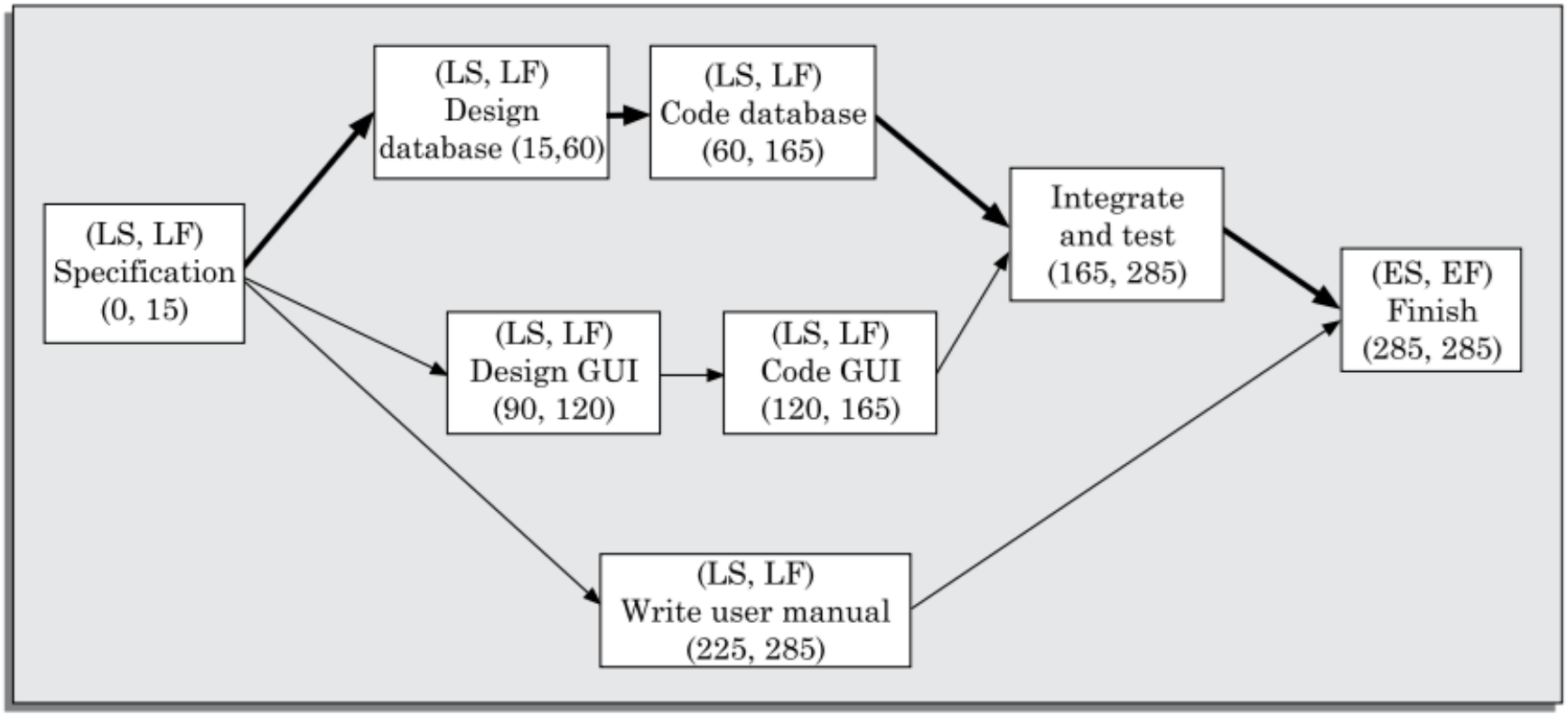

FIGURE: AoN of MIS problem with (LS, LF).

Critical Path Method (CPM)

The project parameters for different tasks for the MIS problem can be computed as follows:

- Compute ES and EF for each task.

  Use the rule: ES is equal to the largest EF the immediate predecessors

- Compute LS and LF for each task.

  Use the rule: LF is equal to the smallest LS of the immediate successors

- Compute ST for each task.

  Use the rule: ST=LF-EF

GANTT Charts

- A Gantt chart is a form of bar chart.
- The vertical axis lists all the tasks to be performed.
- The bars are drawn along the y-axis, one for each task.
- Gantt charts used in software project management are actually an enhanced version of the standard Gantt charts. In the Gantt charts used for software project management, each bar consists of an unshaded part and a shaded part.
- The shaded part of the bar shows the length of time each task is estimated to take. The unshaded part shows the *slack* time or lax time.
- The lax time represents the leeway or flexibility available in meeting the latest time by which a task must be finished.

GANTT Charts

A Gantt chart representation for the MIS problem of shown in figure given below:

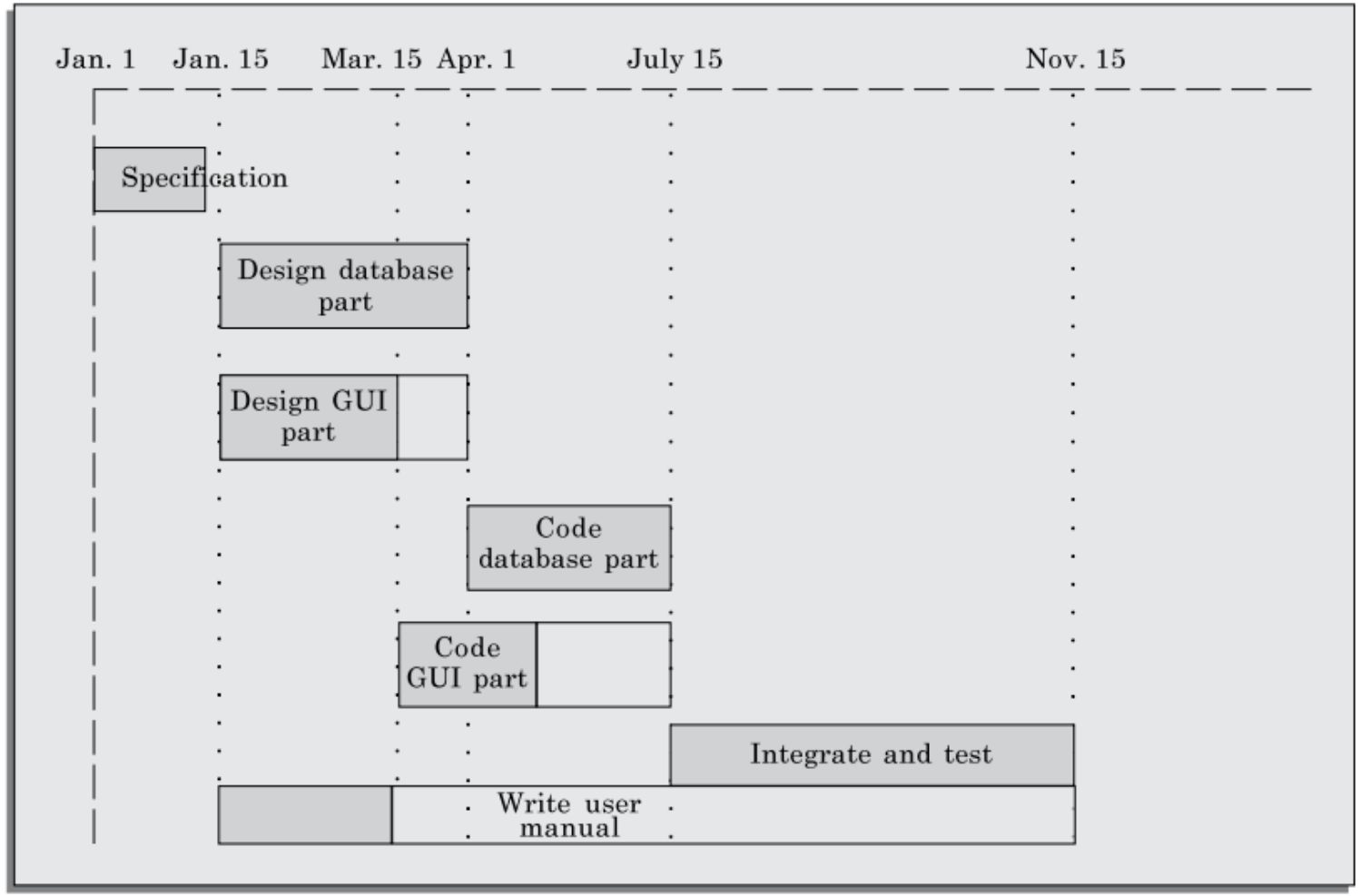

FIGURE: Gantt chart representation of the MIS problem.