

The background is a spiral-bound notebook with a white cover. A red pencil is positioned horizontally at the top, having just drawn a red line. In the bottom left corner, there is a row of colorful pencils. On the right side, there are two overlapping pieces of paper: one with a colorful abstract painting and another with a green and pink floral design.

# Project Scheduling

## Unit I

# What is Scheduling?

- ❖ Is an important part of project planning activity.
- ❖ It involves deciding which tasks would be taken up when.

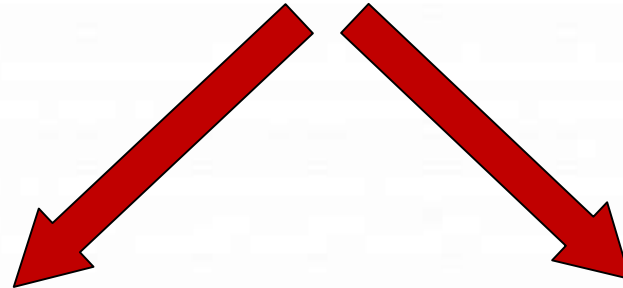
# Why Scheduling?

- ❖ The majority of projects are 'completed' late, if at all.
- ❖ A project schedule is required to ensure that required project commitments are met.
- ❖ A schedule is required to track progress toward achieving these commitments.

# Project Scheduling

- ◆ To schedule the project, a project manager must do the following:
  - ◆ Define all project tasks
  - ◆ Build a network that depicts their interdependence.
  - ◆ Identify the critical tasks
  - ◆ Track the progress of these tasks
  - ◆ Recognize the delay “one day at a time”

# Different Perspectives to View Scheduling



**End date for completion has been finalized**

**Only Rough time-frame is given**



# Basic Principles for S/W Project Scheduling

- ❖ Compartmentalization – define distinct tasks
- ❖ Interdependency- parallel and sequential tasks
- ❖ Time allocation - assigned person days, start time, ending time
- ❖ Effort validation - be sure resources are available
- ❖ Defined responsibilities — people must be assigned
- ❖ Defined Outcomes- each task must have an output
- ❖ Defined milestones - review for quality

# Scheduling

- ♦ To make a schedule, following tasks must be completed:
  - ♦ Identify all the tasks needed to complete the project
  - ♦ Break down large tasks into small activities.
  - ♦ Determine dependency among different activities.
  - ♦ Establish estimates for time durations to complete the activities.
  - ♦ Allocate resources to activities.
  - ♦ Plan starting and ending dates for activities.
  - ♦ Determine the **critical path** (chain of activities that determines the duration of the project)

# Scheduling

- ❖ The **first step** involves identifying all the tasks necessary to complete the project.
- ❖ This can be done when the manager has good knowledge about the intricacies of the project and development process.



# Scheduling

- ❖ In the **next step** large tasks are broken down into logical set of small activities which would be assigned to different developers.
- ❖ The **work breakdown structure (WBS)** helps the managers to do this systematically.

# Scheduling

- ❖ After the large tasks are broken down into small activities & a WBS is created, the manager has to find the dependency among the activities.
- ❖ Dependency determines the order in which different activities would be carried out.
- ❖ For example, if an activity A requires the results of activity B, then A must be scheduled after B.

# Scheduling

- Once the activity network representation has been done, resources are allocated to each activity.
- Resource allocation is typically done using **Gantt Chart**.

# Scheduling

- ❖ After resource allocation, a **PERT chart** representation is developed.
- ❖ **PERT** is suitable for project monitoring and control.
- ❖ The time frame when each activity has to be performed is also determined.
- ❖ The end of each activity is called as a **milestone.**

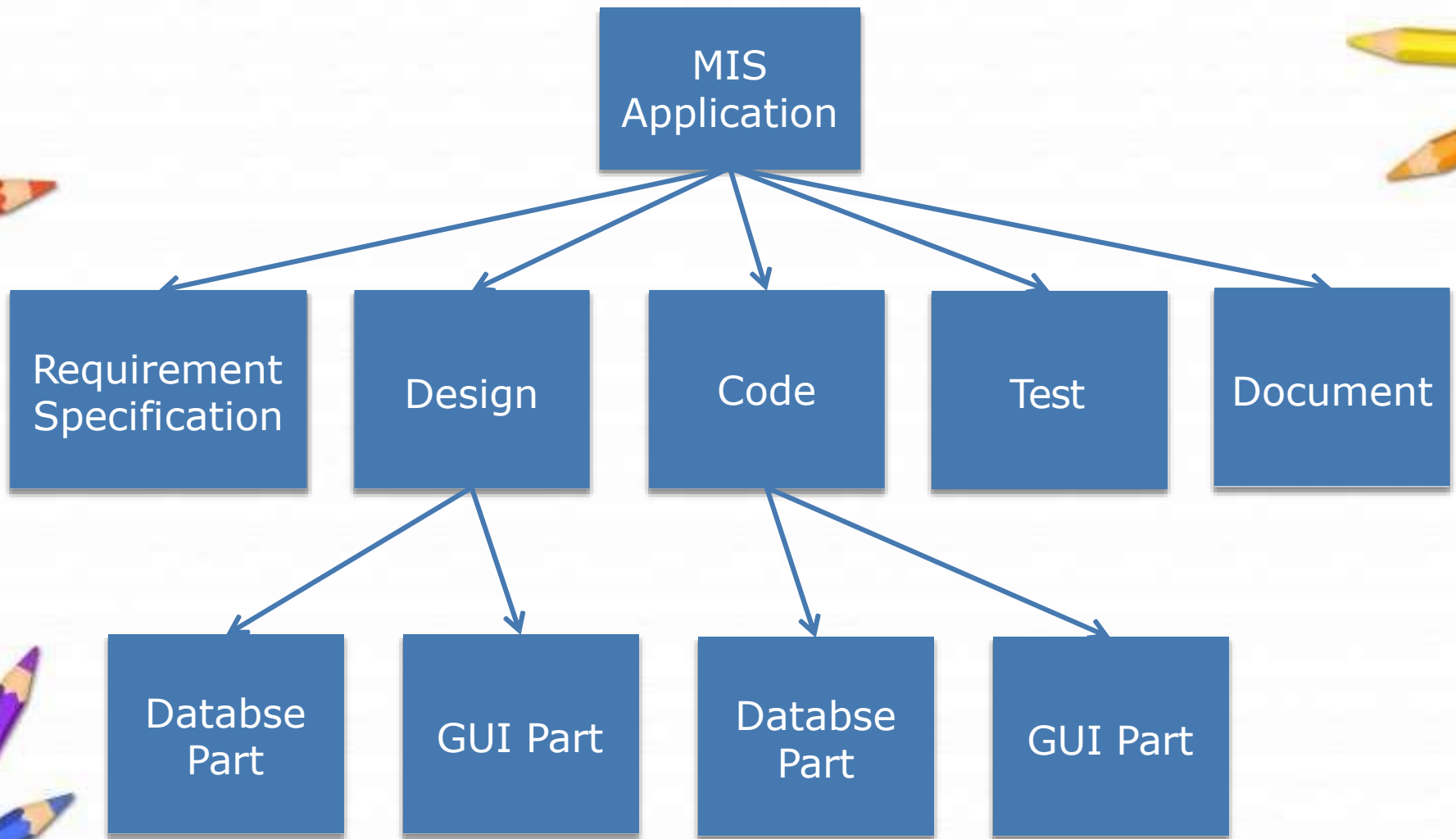
# Scheduling

- ❖ If the project manager observes that the milestones are getting delayed, he has to carefully control the activities so that the overall deadline can still be met.



# Work Breakdown Structure

- ❖ WBS is used to decompose a given task set recursively into small activities.
- ❖ It provides a notation for representing the major tasks needed to be carried out.
- ❖ The root of the tree is labelled by the problem name.
- ❖ Each node of the tree is broken down into smaller activities.
- ❖ Each activity is recursively decomposed into smaller sub activities, until at the leaf level, the activities require approximately 2 weeks to develop.



**WBS of an MIS application Problem**

# Activity Network

- ❖ WBS representation of a project is transformed into an activity network.
- ❖ And activity network shows
  - ❖ Different activities making up a project,
  - ❖ Their estimated durations, and
  - ❖ Interdependencies.
- ❖ Each activity is represented by a rectangular node and its duration is shown alongside each task.

# Critical Path Method (CPM)

- ❖ Critical path is the sequence of Critical Activities in a network.
- ❖ A network diagram may have more than one critical paths.
- ❖ It is the largest path in a network.
- ❖ Critical path gives the minimum time required to complete a project.
- ❖ The activities in the critical path are called critical activities.
- ❖ The nodes in the critical path are called critical nodes or events.
- ❖ If the critical activities are delayed, then the project is also delayed.

# Critical Path Method (CPM)

- From the network diagram, following analysis can be made:
  - Minimum Time (MT):** to complete the project is maximum of all paths from start to finish.
  - Earliest Start Time (ES):** is the maximum of all paths from start to this task.
  - Latest Start Time (LS):** is the difference between MT and maximum of all paths from this task to finish.
  - Earliest Finish Time (EF):** of a task is the sum of the ES of the task and its duration.
  - Latest Finish Time (LF):** of a task can be obtained by subtracting maximum of all paths from this task to finish from the MT.
  - Slag Time (ST):** is  $LS - ES$  and  $LF - EF$



# Critical Path Method: Example

From the above diagram:

MT= 285 days

Activity	ES	EF	LS	LF	ST
Specification	0	15	0	15	0
Design Database	15	60	15	60	0
Design GUI	15	45	90	120	75
Code Database	60	165	60	165	0
Code GUI	45	90	120	165	75
Integrate	165	285	165	285	0
Write User Manual	15	75	225	285	210

**Critical task is the one with slack time = 0**

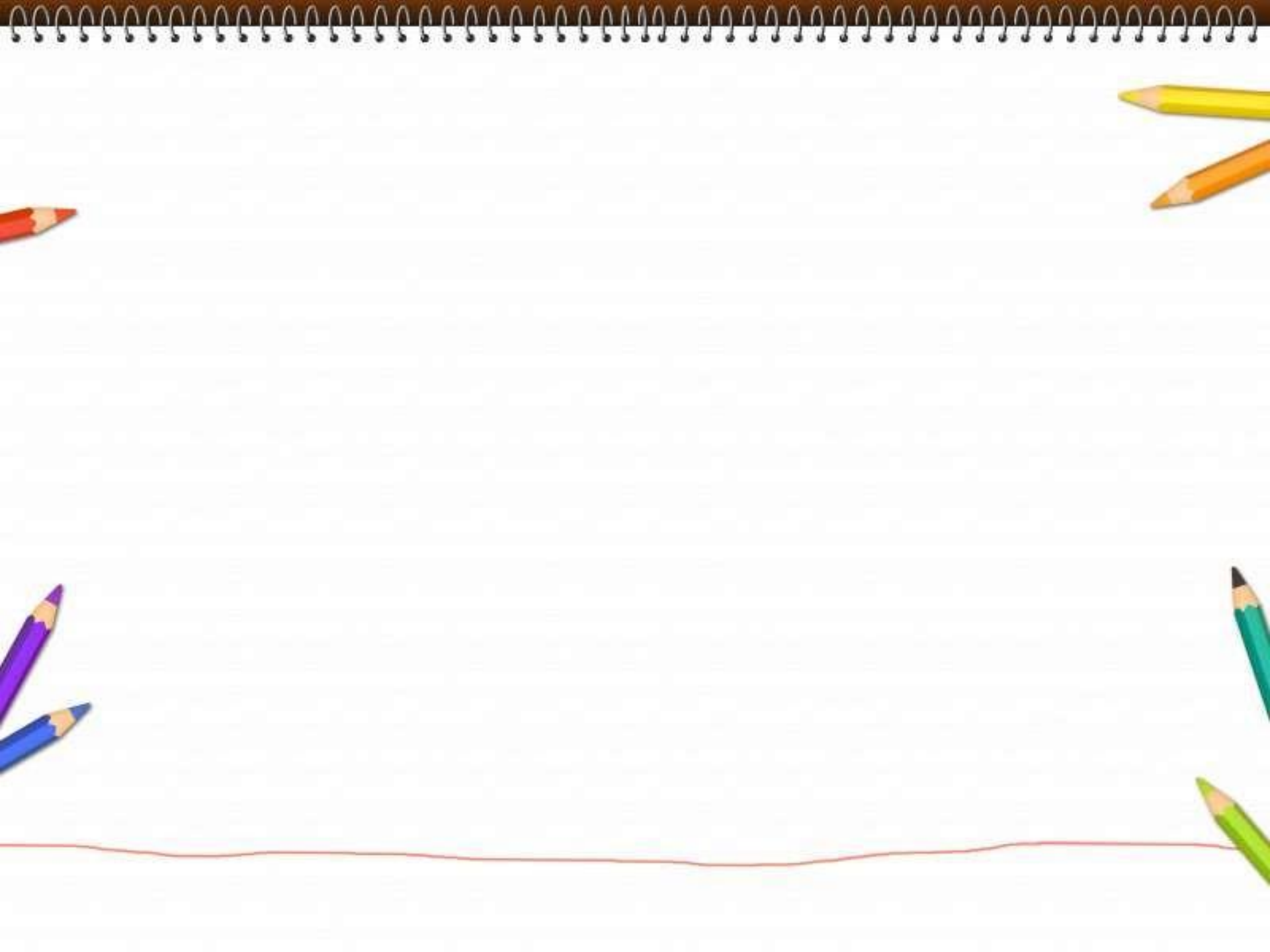
Critical path is indicated with **double lines**.

# PERT

- ◆ Project Evaluation & Review Technique.
- ◆ Is a technique for estimating and planning a project.
- ◆ Similar to CPM,
  - ◆ a PERT chart consists of a network of boxes/circles and arrows.
  - ◆ The boxes/circles represent activities & arrows represent task dependencies.
- ◆ One of its most powerful concepts is that project management is the management of probabilities.
- ◆ It represents the statistical variations in the project estimates assuming a normal distribution.

# PERT

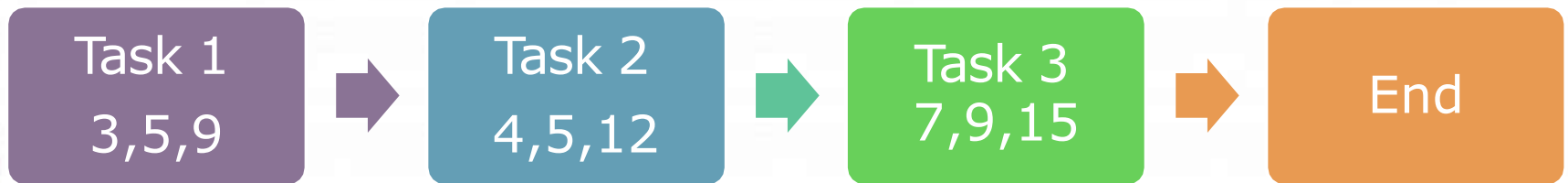
- ❖ Thus, in a PERT chart, instead of making a single estimate for each task, three estimates are made:
  - ❖ Optimistic,
  - ❖ Most Likely, and
  - ❖ Pessimistic.
- ❖ All of these estimates are written in the boxes/circles of the PERT chart.
- ❖ These three estimates are **combined** to calculate an **expected duration**.



# PERT

Expected Duration (E) = 
$$\frac{O + 4 * M + P}{6}$$

Consider a simple project of three tasks:



If the first task begins on day Zero, what day can we expect the third task to complete?



# PERT

Task	E
Task 1	$(3+5*4+9)/6 = 5.33$
Task 2	$(4+5*4+12)/6 = 6$
Task 3	$(7+9*4+15)/6 = 9.67$

♦ So expected duration of the project =  
 $5.33+6+9.67 = 21$  days

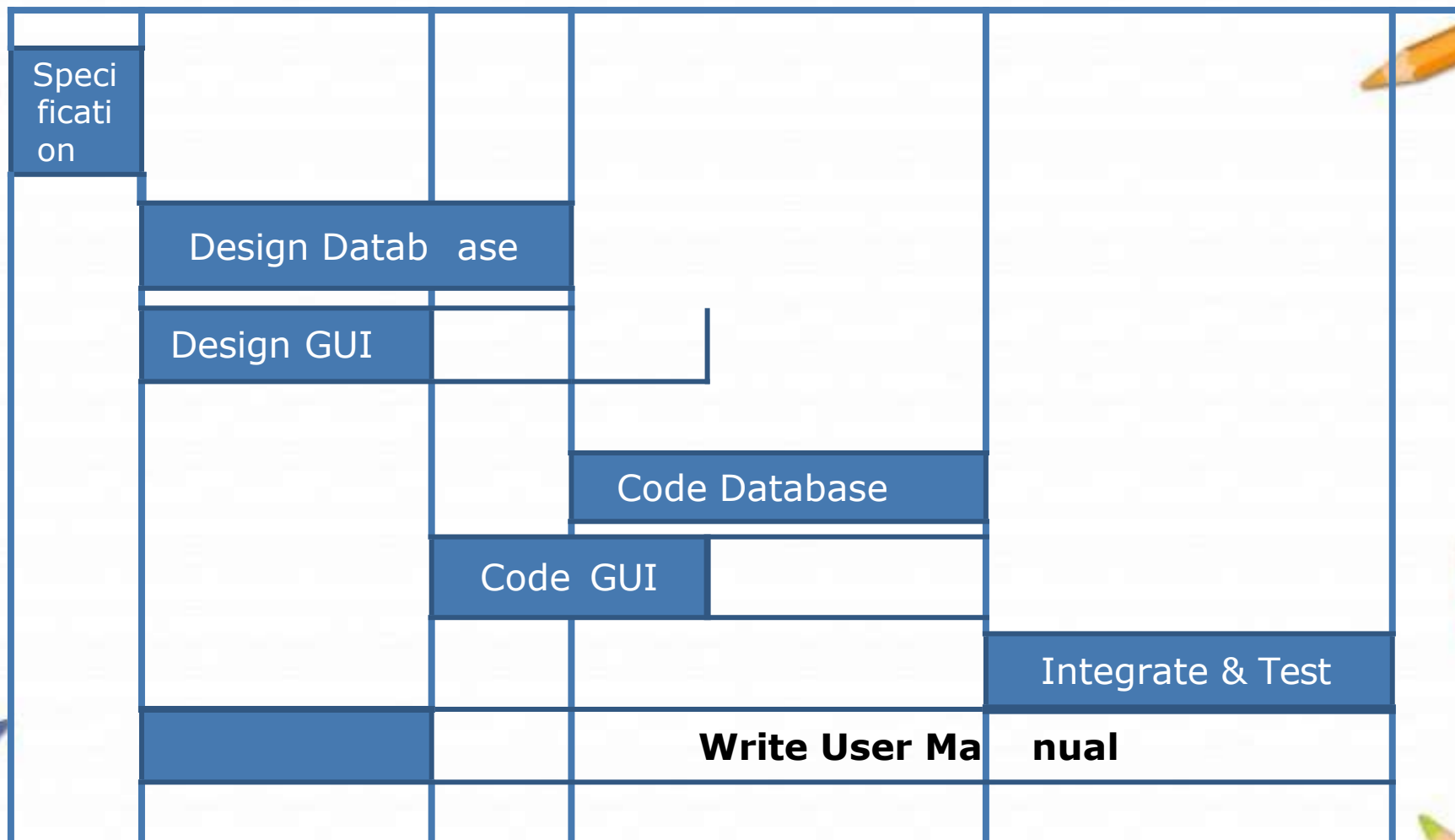
# Gantt Charts

- ◆ Gantt charts have been named after their developer Henry Gantt.
- ◆ They are mainly used to allocate resources to activities.
- ◆ The resources include:
  - ◆ Staff,
  - ◆ Hardware, and
  - ◆ Software.
- ◆ They are useful for resource planning.

# Gantt Charts

- ◆ A Gantt chart is a special type of bar chart where each bar represents an activity.
- ◆ The bars are drawn along a timeline.
- ◆ The length of each bar is proportional to the duration of time planned for that activity.
- ◆ Each bar consists of a shaded part and a white part.
- ◆ The shaded part shows the length of the time each task is estimated to take.
- ◆ The white part shows the slack time.

Jan 1      Jan 15      Mar 15      Apr 1      July 15      Nov 15



# Monitoring & Control

- Once a project starts, the project manager has to monitor the project continuously to ensure that it is progressing as per the plan.
- The project manager designates certain key events such as completion of some important activity as **milestones**.
- For example, a milestone can be the completion & review of SRS document.
- If any delay in reaching a milestone is predicted, then corrective actions might be taken.
- This may mean reworking all the schedules & producing a fresh schedule.
- PERT and CPM both help in determining a critical path, through which critical activities can be identified and monitored.