Robotics process & Automation

wt is RPA?

Robotic process automation it is a technology that uses software Robots (bots) to automate repetative, Rule based tasks performad by humans on computers.

RPA s/w bot doing human computer work automatically

→ why RPA is Needed?

If any organization same tasks are repeated daily. Time is wasted, human error's occurs.

* RPA solves this by automatic tasks increasing speed reducing mistakes.

→ How RPA works?

RPA bots imitate human actions like clicking buttons, copy pasting and opening applications.

Ex: flow

login

↓

Enter data

↓

Submit

↓

Save Report

Key characteristics of RPA:

- Rule based follow instructions
- Works 24/7
- No coding
- low coding required.

Examples of RPA:

- Data entry in Excel
- Email automation
- Invoice processing
- Report generation.

RPA Tools:

Popular Tools include

- UI path
- Automation Anywhere
- Blue prism.

Advantages of RPA:

- Saves Time
- Reduce thuman errors
- Improves productivity
- Cost effective
- Scalable.

limitations of RPA:

- Works only with Rule based tasks
- Cannot Make decisions
- Need Maintainance.

Scope of RPA:

- Banking & Finance

RPA is heavily used in banking operations.

* Account opening
* loan processing
* fraud detection
* Transaction verification.

Ex:

If loan amount is high → Sent for approval else not Approved.

- Health Care:

RPA helps manage large amount patient data.

- Patient records Management
- Billing systems
- Appointment Schedoling
- Automatically update patient details in systems,
- Manufactoring:

Used for production & quality control.

- Assembly line automation
- Quality checking
- Supply chain mgmt.
- Costomer support / BBO

Ex: ChatBots, email/filteling, email responses, ticket processing

- Education :

RPA used in colleges & Universities.

- Attendance Mgmt
- Result processing
- Admission systems
- Information Technology:

Software automation testing.

Data processing.

Ex: UI path boards Handling Repetative tasks.

- Education:

* Online Exams
* Attendance System
* Grading

Ex: Learning Mgmt System

Transportation (Traffic Control, self driving vehicles) Ex: GPS based Navigation

* Automation is used in almost every field to increase speed, accuracy & productivity.
* It is fixed.

* Techniques of Automation :

Design for a specific task

- High production Rate, But less flexibility
- Assembly line mechanisms

* Programmable Automation :

Machine: Can be reprogrammable for different tasks operations can be changed by moditing the program

* Sustainable for Batch production

Ex: CNC (Computer Numerical Control)

* Flexible Automation :

Can easily switch between different task (or) products.

Ex: Industrial Robots.

* Industrial Automation :

Uses machines & control systems.

Etc. Reduce human efforts & increase efficiency

Ex: Power plants & Manufacturing Industrial products or Industries..

RPA Components / Core Components :

1) Bot (Robot)
2) Studio (UI path Studio) (Development tool)
3) Orchestrator (Controller)
4) Process → Workflows
5) Queues → List of tasks.

* Bot :
The worker that perform tasks.
Ex: filling forms, Copying data

* Studio :
It is a development tool. there we create automation
Ex: UI path studio.

* Orchestrator (Controller) :
It manages bots, schedule tasks, Monitors performance

* Process (Workflows) :
Step by step instruction for bots

* Queus (Task Manager) :
Stores task for bots to complete

Example: College Attendance System

* Studio creates automation
* Bot enter attendance data
* Orchestrator schedules daily updates
* Workflow step to login update (process)
* Queue is list of tasks

* Bot perform tasks
* Studio does automation
* Orchestrator control tasks
* Process does workflows
* Queues are list of tasks

RPA Platforms:

Top RPA platforms

1. UI path - * Market leader in RPA
   * Easy Drag and drop
   * interface
   * Supports AIML and automative workflows
   *

2. Automation Anywhere:
* Cloud-based RPA platform
* Strong AI + NLP capabilities

3. Blue prism:
* One of the oldest RPA tool
* Highly secure and reliable
* Used in banking & finance sectors

4. Microsoft power automator:
* Part of microsoft ecosystem
* Integrates with excel outlook share point
* low code automation

5. SAP

System Applications and products in Data Processing.
* Designed for SAP environments
* Best for SAP based companies
* Work fusion:

Combines RPA + AI, focus on Banking (K.Y.C - Automation). Best for finance automation.

About UI path:
* UI path is a leading in RPA.
* It is used to automate repetative business task like data entry, email automation, SAP automation, report generation.
* It helps companies reduce manual works and improve accuracy

1. UI path stack | components:

Used to design automation work flows. Drag and drop interface. Developers create bots here.

2. UI path robot:

Executes the automation process. Runs tasks automatically.

Types: Attended Robot
Unattended Robot.

3. UI path orchestrator:

Web based Mgmt platform. Control and monitor robots.
* Scheduling & Deployment.

1. UI path assistance:
User friendly interface to run bots. Helps employees start automation easily.

5. UI path AI center:
Integrates AI & ML with RPA

6. UI path test suite:
Used for automation testing

Advantages:
* Saves time
* Reduce human errors
* Increase productivity
* Easy integration with SAP & excel webapps

* UI path studio projects:

1. Process projects:
Used to automate complete business processes
features:
* End to end automation
* Most commonly used projects
Ex: Attendance automation, Email automation

2. library projects:
Used to create reusable work flows and components
features:
* Reusable in multiple projects
* Reduce repeated work
* Easy maintainance
Ex: login workflows, Excel Utility Package, Email Sending components.

3. Test Automation projects:
Used to s/w and application testing
features:
* Automated test execution
* Test report generation
* Supports QA testing
Ex: Website testing, login page testing, application validation

4. Reframework projects:
(Robotic enterprice framework)
→ predefined framework in UI path used for large enterprize automation
features:
* Exception handling
* Retry mechanism
* Traisaction processing

* Types of RPA projects:
→ student attendance automation: Read attendance from excel, calculate attendance generate report automatically
→ Automatic email center: Read email Id from excel, send bulk emails Automatically
→ PDf data extraction: Extract ~~text~~ data from pdf doaments.

~~* Web Scrapping projects~~

UI (User Interface):

A user interface is the place where user interact with a computer, software, mobile app or machine.

* UI in UI path studio:

The UI of UI path studio contains

1. Ribbon
2. Activities panel
3. Designer panel
4. Properties panel
5. Output panel
6. Project panel

*This components helps users create automation workflows easily

Types of UI:

1. GUI (Graphical User Interface):

* Uses:
→ Buttons
→ Icons
→ Menus
→ Windows

Ex: Windows OS, mobile apps, UI path studio

2. CLI (Command line Interface):

Users type commands using keyboard.

3. Menu driven interface:

User select options from menus

Ex: ATM machine, Restaurant ordering system, Touch user interface (Interaction through touch screens): Smart phones, Tablets.

Advantages of UI:

* Easy to use
* Saves times
* Improves productivity
* User friendly
* Reduce errors

UI path task recorders:

* These are the tools

*Task recorders are tools in UI path studio
* Used to record mouse clicks, key board actions
* and user activities automatically to create automation work flows.

Types of task records:

Basic Recorder:

Used for simple & single activities

features:

* Records one activity ~~any~~ at a time.
* Suitable for small task

Ex: Click button, type text.

2. Desktop Recorder:

Used for desktop applications.

features:

1. faster recording
2. Generate full selectors
3. Suitable for desktop software

Ex: Notepad automation, Calculator automation, ms word automation

3. Web Application Recorder:

Used for web applications

4 Browsers

features:

1. Records browser activities
2. Handles web elements easily
3. login automation

Ex: Web Scrapping, Online form filling

4. Citrics Recorder:

Used for virtual or remote environments.

features:

1. Works on Virtual Machine
2. Uses image based automation

Ex: Remote desktop automation, Critics based application

* Advanced UI interactions:

Advanced UI interactions are the techniques used in automation tools like UI path studio to interact with complex applications, web pages, virtual environments, desktop applications.

1. Input methods:

Input methods are used to send data or actions from the robot to an application

Common input methods:

* Click → Used to create buttons, links, menu etc
* Typeinto → Enters text into text boxes, send ~~hotkey~~ hot key, send keyboard shortcuts (control c, control v), ~~select items~~

Select items: choose an option from drop down.

* Check → Used for checkboxes
* Drag & Drop → Moves files or objects

* Types of i/p modes in UI path

1. Default i/p:

Works like normal keyboard & mouse actions. Visible on screen. Slower compared to others.

2. Simulate i/p:

Fatest method but works in background. Doesn't move mouse physically. Recommended for web applications. ~~Sent~~ Excel

3. Send window messages:
* Send actions directly to applications
* Faster than default.
* Useful for desktop apps

Output Method:

These are used to extract or capture data from applications

GetText → Extract normal visible text
GetFullText → Retrieves complete text quickly
Screen scraping → Extract data from UI screens.
Data scraping → Collect structured labelled data
getAttribute → Read properties of UI elements

Unit - II

Sequence:

- A linear workflow where activities execute one after another.
* Best for simple and state forward process.
* Easy to design and maintain

Ex: Start → Open App → login → Enable data → Save → End

Flow chart:

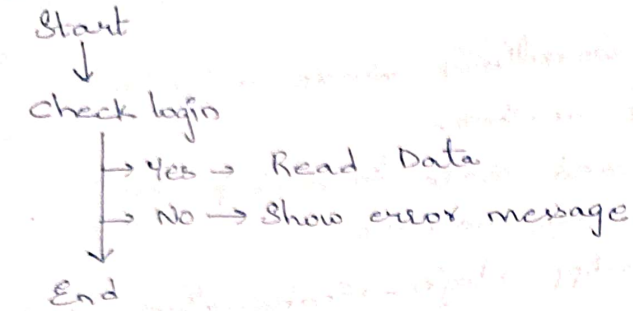
- A graphical workflow that shows the flow of execution using different path and decisions
* Suitable for complex process with multiple conditions.

Ex: Start → login → Credentials valid? → Yes → Open Dashboard → End
→ No → Show error message → End

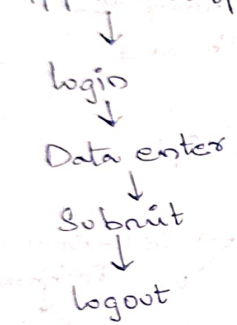
Control flow:

Defines the order in which activities are executed in a work flow.
* logic that determines how and when activities execute.
* Controls decisions, loops and branching.
* Used in both Sequence & flow chart.

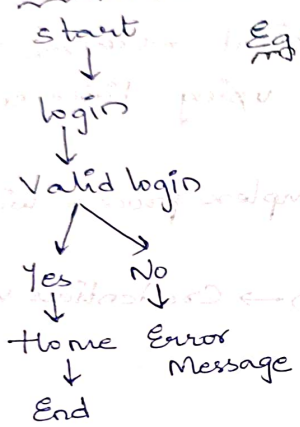
Ex:



Sequence

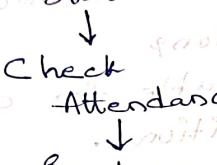


Flow Chart



Control Flow

Eg: for Each Statement



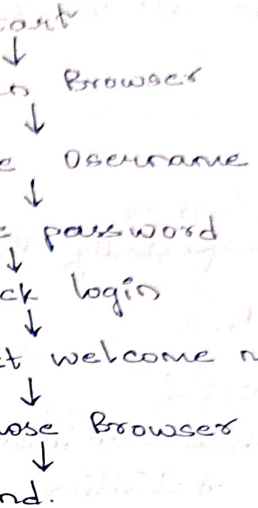
Ex: if
switch
while
Dowhile
Break

Control flows = Rules that control how the work flow runs.

Common Activities in RPA

Activities in Sequence Workflow:

1) Open App / Browser → Open Applications / Website
2) Type into → Enter text into a field
3) Click → clicks a button, link or control
4) Get text → Read text from the screen.
5) Message Box → Display message
6) Delay → Wait for a specified time
7) Close application



Various Types of loops:

Introduction to loops:

A loop is a control structure used to execute a set of activities repeatedly until a specified condition is met.

Why we use loops:

* To automate repeatative task.
* To process multiple records efficiently
* To reduce manual effort and coding complexity

Example:

Suppose an excel file contains 100 employees records instead of processing each record manually, a loop can process all records automatically

Types of loops in UI path:

1. While loop:

Set of activities repeatedly as long as the Specified conditions remains true.

Ex: print numbers 1 to 5

```
count = 1
while count <=5
    print count
    Count =count+1
End while
```

Output: 1 2 3 4 5

Syntax:

```
while condition
    Activities
End.
```

Advantages of while loop:

* Suitable when the no. of iterations are Unknown.
* Checks the condition before execution

2. Do-while loop:

The do-while activity executes first and then checks the condition.

Syntax:

```
Do
  Activity
  loop while condition
```

Example:

```
Do
  print count
  count =count+1
  loop while condition
```

O/P: 1 2 3 4 5

Advantages:

* Executes atleast once even if condition is false

3. for Each loop:

Used to iterate through each item in collection

Ex for collection: Apple, Banana, Guava

Syntax:

```
for Each Item in collection
    print Item
End for each.
```

O/P: Apple
Banana
Guava

Uses:

* Reading file from folder
* Processing list item
* Reading Emails.

4. for each Row loop:

Used for specially data-tables

Ex:

→

Employee Table

ID	Name
101	Ram
102	Sita
103	John

Workflow:

```
for Each Row in Datatable
    print Row("Name")
End for Each Row
```

o/p: Ram
Sita
John.

Uses:

* Reading Excel data
* Processing Database records
* Data Manipulation:

Data manipulation in RPA is means modifing and organising, filtering and processing data within a RPA flows.

* Example: Reading data from excel
  filtering rows in a data table
  Sorting data
  Extracting specific value.

Variable: Variable is a container used to store data temporarily during workflow execution.

* Common variable types
1. int
2. double
3. float
4. char
5. string

Scope:

Scope defines where a variable can be accessed and used in the workflows.

i) local Scope:

A variable is available only within a specific activity or sequence or workflow.

* It cannot be accessed outside that scope.

Ex: Variable student name is created inside a sequence.

* It is can be used only within that sequence

ii) Global Scope:

A variable is available throughout the entire project or workflow. It can be accessed from multiple sequences and workflows.

Ex: Variable company name is declared globally. All workflows can accessed and use it.

Collections :

+ Collection is a group of multiple items stored under one variable.

Purpose :

* Store multiple values
* Easy iteration using loops.
* Better data organisation

Types:

1. Array :

+ A array is a collection of elements of same data types stored in continuous memory allocation.

Ex:

Accessing elements

Numbers (0) = 10
Numbers (1) = 20
Numbers (2) = 30.

Uses in RPA :

* Storing a fixed list of employee names
* Processing predefined data

2. list :

+ list is a dynamic collection that stores multiple elements of the same datatype in a single variable.

+ The size of list can be increased or decreased during program execution.

Features :

1. Dynamic size
2. stores multiple values
3. Elements are accessed using indexes
4. Items can be added or removed

Ex: New list (Strings) from
{"Ram", "Ravi", "Rajo"}

Uses in RPA :

* Storing employee names
+ Customer Records.

3. Queue :

Queue follows fifo. Used for managing tasks and transactions. Items are processed sequencely.

Uses :

* Invoice processing
* Customers request handling
* Order processing.

4. Stack :

* Elements are added using stack push operation
* Elements are removed " pop operation

Uses:

Undo operations
Browser navigation
workflow execution history

Dictionary:

Collection of key value pairs used for quick data retriever. Each key is unique. fast data retriever

Ex: 101 → Sita
102 → Shiva
103 → Ram

Uses:

* Employee Id and Employee name
* ~~Emp~~ product code & Name
* Configuration settings.

* Data table: table like

Data table is a structure used to store data in rows and columns. Similar to Excel sheet.

* It allows robots to process multiple records efficiently.

Excel file
↓
Read Range
↓
Data table (dt student)
↓
Process data (Check Attendance)
↓
Write Range
↓
Update Excel file

Student details:

	RollNo	Name	Attendance
Row1	101	Ravi	75% → process
Row2	102	Raju	85% → process
Row3	103	Ranu	90% → process

→ Steps:

1. The read range activity reads all data from excel sheet. It converts the excel data into a data table.
2. Data Table: The data is now stored in memory as a data table. It contains rows and columns just like excel. UI path can easily access and manipulate this data
3. Process Data: The for each row activity process one row at a time. It repeats until all rows are completed in a data table are processed.
5. Perform the required operations on each row check if attendance is less than 75%. Calculate total marks verify employee details filter duplicate records

Ravi 75% → Eligible
Raju 80% → Eligible
Ranu 90% → Eligible

6. Write Range:

After processing the updated data is written back to an excel file using the write range activity

RollNo	Name	Attendance	Status
101	Ravi	75%	Eligible
102	Raju	85%	
103	Ranu	90%	

Updated Excel file

CSV/Excel to data table in UI path:

CSV to data table:

Converts the data from a csv file into a data table.

Activity used:

1. Read csv

follow: csv file → Read csv file → Datatable

Eg: student.csv

Name	RollNo
Sana	101
Sini	102

* After executing read csv, the data is stored in the data table ~~variable~~

* Excel to datatable:

Read data from a excel.

Activities used:

* Excel file → Read Range → Datatable

Ex: Read data from student.~~excel~~ xlsx

Datatable to CSV:

* Write the data from a data table into csv file

Activities used:

→ Write csv

Datatable to Excel:

* Writes the data from data table in excel xslx file

Activities:

→ Use excel file

→ Write Range

UNIT - IV

Handling User Events and Assistant Bots:

Assistant Bots:

Assistant bots are software bots that work with humans to perform tasks. They also called attended bots because they usually run when a user starts or interacts with them

Key features:

1. Human interaction - works alongside employee
2. User-triggered - can be started by clicking a button or performing an action
3. Task automation - Automates repetitive tasks such as data entry and Form filling
4. Improves productivity - Reduces manual work and saves time
5. Real-time assistant - provides quick support while the employee is working.

Examples:

- Generating reports from Excel data
- processing customer service requests
- checking and validating data

3) Exception handling Debugging (2)

Monitoring system Event Triggers:

System event triggers are mechanisms that monitor specific events occurring in a system and automatically start a bot when the required event happens

How it works:

System Event
↓
Trigger detects event
↓
RPA Bot starts
↓
Task is performed

Common system Event Triggers

1. File created: Bot starts when a new file is added to a folder
2. File modified - Bot runs when an existing file is changed
3. Email received - Bot starts when an email matching certain conditions arrives
4. Application Event - Bot responds when a specific application action occurs

Advantages:

- Reduces manual monitoring
- Provides quick response to events
- Save time and effort
- Reduces human errors

Monitoring Image and Element Triggers:

Monitoring image and element triggers means continuously checking a screen or application for a specific image, button, text, or UI element and automatically performing an action when it detected.

Image Trigger:

1. The bot monitors the screen for a particular image or visual pattern
2. when the image appears, the bot starts the required workflow.

Example:
Detecting a "Succes" icon after submitting a form

Element Trigger:

1. The bot monitors a specific UI element such as a button, textbox, or notification
2. when the element appears or changes, the bot performs an action

Example:
when a "Download" button becomes available, the bot automatically clicks it.

Advantages:

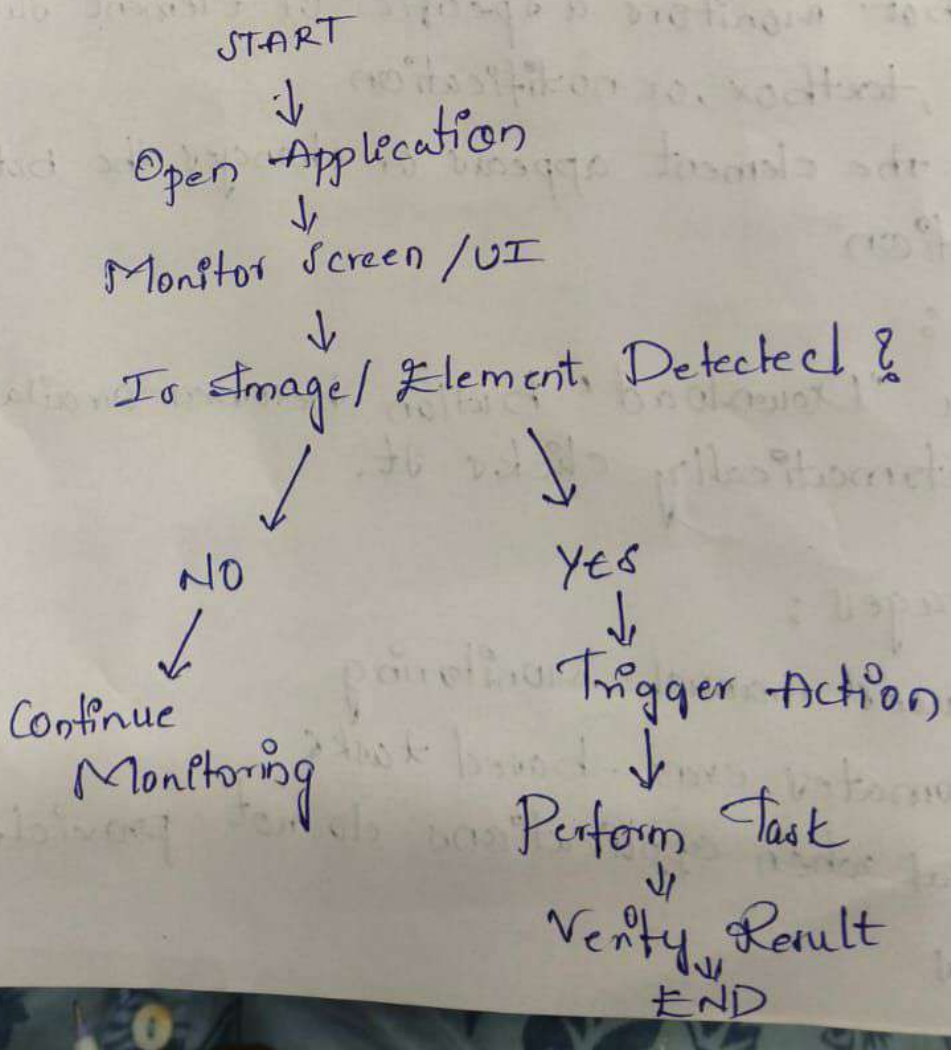
1. Reduces manual monitoring
2. Automates event-based tasks
3. Useful when applications do not provide direct API's

4. Improved speed and accu

Applications

1. Banking
   Detect payment confirmation and automatically update transaction records
2. E-commerce
   Detect Order confirmation and download invoices automatically
3. Health Care
   Detect patient information and update hospital records.
4. Data Entry
   Detects buttons or fields and automatically enter required Information.

Flow chart of Working:



3) Exception handling Debugging and logging:

Exception handling in RPA (Robotic process Automation) is the process of identifying, managing, and recovering from the errors that occur during automation, ensuring that bots continue to operate reliably without unnecessary interruptions.

Types of Exceptions

1. Business Exceptions (Excepted Exceptions)
   - Occur due to business rule violations.
   - Usually excepted and do not indicate a system failure.
   - Examples:
     - Invalid customer ID
     - Invoice amount exceeds the approved limit
     - Missing Mandatory Data
2. System Exceptions (Unexcepted Exceptions)
   - Occur because of technical or Environmental issues
   - Usually unexcepted.
   - Examples:
     - Network failure
     - Application crash
     - Database connection failure
     - Element not found on the screen.

Reusability of workflow

- Workflow reusability in RPA means Creating a workflow Once and using it multiple times in different automation processes instead of Creating the same workflow again.

Example:-

- Suppose an organisation has a Common task of sending an Email
- Instead of Creating the email-sending steps separately in every automation:

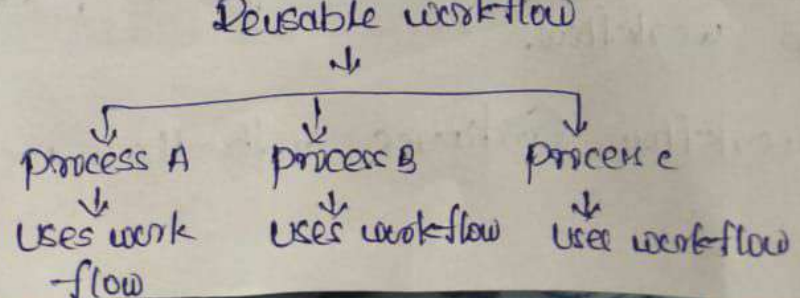
Workflow:

- Enter Email
- Enter recipient
- Enter Subject
- Enter message
- Send email

- This workflow Can be created once and reused in:

1) Employee onboarding
2) Invoice processing
3) Customer notifications
4) Report generation

How Reusability Works ?



(Common Exception and Ways to Handle them)

In RPA (Robotic process Automation), an exception is an unexpected error that occurs while a bot is executing a process. Exception handling helps the robot recover from errors, continue execution, or stop safely.

1. Application Exception

Occurs when an application does not respond correctly or a required UI element is missing.

Examples:
- Application is not opened.
- Button or text field is not found.
- Website is not responding.

How to handle:
- Use Try-catch.
- Use Element Exists before interacting with an element.
- Add Retry Scope.
- Restart the application if required

2. Business Rule Exception

Occurs when the input data does not satisfy a business rule.

Examples:
- Invoice amount is negative.
- Customer is not eligible for a loan.
- Required document is missing.

How to handle:
- Validate the data using If/Else conditions.
- Use Business Rule Exception.
- Log the reason for rejection

UNIT-5

Managing and maintaining the code

→ Project organization in RPA

Project organization in Robotic Process Automation (RPA) is the systematic arrangement of files, folders, and logic inside a design studio (like UiPath Studio). Proper structure uses modular components, clear folder hierarchies, and external configuration files to make bot maintenance, scaling, and debugging easier.

Core elements of RPA project structure:-

1) Root Directory:- Keep only the primary entry point file (like Main.xaml) at the root level.

2) Functional folders:- Group related workflow files into dedicated sub-folders (e.g Data_Input, SAP, Excel, UI_Interactions).

3) Config files:- Store environment URLs, credentials mapping, and global variables in an external Excel or JSON configuration file.

4) Frameworks:- Adopt established modular templates like the Re Framework (Robotic Enterprise framework) to handles states, retries, and exceptions seamlessly.

Best Practices for file management

1) Modular Design:- Break long processes into small, testable, and reusable sub-workflows rather than building a single massive sequence.

Naming Conventions:- :- Use clear, prefix-based naming rules (e.g., Init_AllApplications.xaml, Process_TransactionItem.xaml) to denote function and execution order.

Flowcharts vs Sequence:- Use flowcharts for high-level business Process navigation and decision blocks, reserving sequences for linear UI actions and data processing

6) Commenting Techniques

Commenting in RPA means adding notes or explanations to the workflow so that developers and other users can understand what the automation is doing.

Common commenting techniques are:-

i) Activity Comments:-
Add Comments to individual activities. Explain why an activity is used or what it does

ii) workflow annotations:-
Add visible notes inside the workflows. Add useful for explaining major sections of the process

iii) Variable Comments:-
Give Meaningful names to variables. Add descriptions explaining what each variable stores.

iv) Sequence/flow Comments:-
Add Comments before major steps such as:

→ Login
→ Data extraction
→ Data validation

State Machine

A state Machine in RPA is a workflow structure where a process is divided into different states and the automation moves from one state to another based on specific conditions / events.

Main Components :-

i) State :-
Represents a particular stage of the process.

ii) Transition :-
Defines how the robot moves from one state to another.

iii) Entry Action :-
Activities performed when entering a state

iv) Exit Action :-
Activities performed when leaving a state.

v) Final state :-
Indicates that the automation has completed.

Reusability of workflow

- Workflow reusability in RPA means creating a workflow once and using it multiple times in different automation processes instead of creating the same workflow again.

Example:-

- Suppose an organization has a common task of sending an Email
- Instead of creating the email-sending steps separately in every automation:

Workflow:

Enter Email
↓
Enter recipient
↓
Enter subject
↓
Enter message
↓
Send email

- This workflow can be created once and reused in:

1) Employee onboarding
2) Invoice processing
3) Customer notifications
4) Report generation

How Reusability Works ?

Reusable workflow
↓
Process A → Uses workflow
Process B → Uses workflow
Process C → Uses workflow

Nesting workflow :-

- Nesting workflow in RPA means placing one workflow or sequence of activities inside another workflow.

- The main workflow can call a sub-workflow to perform a specific task and then continue its execution.

Structure:

Main workflow
↓
Task 1
↓
Call Nested workflow
↓
[Nested workflow
Task A
Task B
Task C]
↓
Return to main workflow
↓
Task 2
↓
End

How it works ?

1) main workflow starts and performs the initial activities.
2) When a specific task is required, it invokes a nested/sub-workflow
3) The nested workflow performs its assigned activities.
4) After (workflow continues with) completion, control returns to the main workflow.
5) The main workflow continues with the remaining activities