**Libraries and Tools Used in the Dashboard**

**1. Web Application Framework**

**Dash**

* **Library:** dash, dash\_core\_components, dash\_html\_components, dash.dependencies
* **Purpose:**
  + Build interactive web dashboards using Python.
  + dcc for graphs, dropdowns, and intervals.
  + html for page layout (headers, divs).
  + Input, Output, and callback\_context to manage user interactions.
* **Functions Used:**
  + Dash(): Initializes the app.
  + dcc.Graph(), dcc.Dropdown(), dcc.Interval()
  + html.H2(), html.Label()
  + Callback decorators (@app.callback)

**2. Dashboard Styling and Components**

**Dash Bootstrap Components (DBC)**

* **Library:** dash\_bootstrap\_components
* **Purpose:**
  + Provides responsive and visually appealing UI elements based on Bootstrap.
* **Components Used:**
  + dbc.Container, dbc.Row, dbc.Col: Layout structure
  + dbc.Card, dbc.CardBody: KPI blocks
  + dbc.Alert: Status messages
  + dbc.Button: Email trigger button

**3. Data Visualization**

**Plotly Express**

* **Library:** plotly.express (imported as px)
* **Purpose:**
  + Simplified syntax for creating complex charts.
* **Charts Used:**
  + px.pie(): Donut chart for Remote Work by Department
  + px.bar(): Bar chart for Projects by Job Title
  + px.line(): Line chart for Performance over Years
  + px.scatter(): Age vs Performance Score
  + px.box(): Box plot of Satisfaction by Department
  + px.density\_heatmap(): Heatmap of Performance vs Satisfaction
* **Theme:**
  + pio.templates.default = "plotly\_dark" for dark mode visuals

**4. Data Manipulation**

**Pandas**

* **Library:** pandas (imported as pd)
* **Purpose:**
  + Reading, cleaning, and manipulating tabular data (CSV file).
* **Functions Used:**
  + pd.read\_csv()
  + df.dropna(), df.drop()
  + df.groupby(), df.mean()
  + Date filtering using pd.to\_datetime() and conditional slicing

**5. Date and Time Handling**

**datetime**

* **Library:** datetime from Python Standard Library
* **Purpose:**
  + Handling and formatting dates for filtering and timestamps
* **Functions Used:**
  + datetime.now() for dashboard/email timestamps
  + datetime(year, month, day) for filtering by date range

**6. Email Alerts**

**smtplib & email.message**

* **Libraries:**
  + smtplib: For sending emails via Gmail SMTP
  + email.message.EmailMessage: For composing HTML/text-based emails
* **Purpose:**
  + Automatically send alerts about employees with high retention risk
* **Security Note:**
  + Uses **Gmail App Password** for secure SMTP login (instead of plain account password)

**7. File and OS Handling**

**os**

* **Library:** os
* **Purpose:**
  + Handles file paths and expands directories across different OS platforms
* **Functions Used:**
  + os.path.expanduser()
  + os.path.join()

**8. Miscellaneous**

**Global Variables**

* Used to store and display email and dashboard update status on UI:
  + email\_status, dashboard\_status

**Exception Handling**

* try-except blocks used in:
  + load\_data() to avoid crashes due to file or parsing errors
  + send\_email() to catch SMTP or formatting issues