SCHOOL OF COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE		DEPARTMENT OF COMPUTER SCIENCE ENGINEERING	
Program Name: B. Tech		**Assignment Type:** Lab	**Academic Year:** 2025-26
Course Coordinator Name	Dr.Vairachilai Shenbagavel		
Instructor(s) Name	Srinivas Komakula		
Course Code	23CA201SE402	**Course Title**	Explainable AI (P)
Year/Sem	III/V	**Regulation**	R24
Date and Day of Assignment	28-07-2025	**Time(s)**	09:00AM -05:00PM
Duration	2 Hours	**Applicable to Batches**	**23CSBTB43**
Assignment Number: 01			

Q. No.	Question	Expected Time to complete
1	FreshSip – Juice Bar	

Context:

Fresh Sip offers free samples outside malls and observes their impact on the number of juice orders.

Free Sample Events (x)	Juice Orders (y)
1	45
2	70
3	90
1	48
2	72

Objective:

Analyze how free sample events affect juice orders using Linear Regression and SHAP values.

Instructions:

1. Perform Linear Regression

- Independent Variable (x): Number of Free Sample Events
- Dependent Variable (y): Juice Orders
- Find the regression equation:
  y^=a+b·x\hat{y} = a + b \cdot xy^=a+b·x

2. Calculate the Baseline Value

- Compute the average of all y-values (juice orders)

3. SHAP Value Calculation

- For each observation:
  SHAP Value=y^−Baseline\text{SHAP Value} = \hat{y} - \text{Baseline}SHAP Value=y^−Baseline
- Attribute SHAP to the input variable (x)

4. Prediction Table

x (Samples)	Actual y	Predicted y	Baseline	SHAP Value	Interpretation

5. Interpretation Points

- How did free sample events influence predicted juice orders?
- Over/underprediction comparison
- Any practical insights (e.g., effectiveness of 1 vs 3 events)

Expected Deliverables:

- Linear regression equation
- Baseline juice order
- Prediction + SHAP + interpretation table
- Final summary:
  - How well the model captures the trend
  - Practical insight for FreshSip's marketing strategy
  - Feature impact via SHAP

Q. No.	Question	Expected Time to complete
2	**echBytes – Webinar Attendance using Multiple Linear Regression and SHAP Analysis**	

Objective:
Evaluate how the number of reminder emails and topic relevance score impact webinar attendance using Multiple Linear Regression and interpret results through SHAP values.

Given Dataset:

Emails Sent (x_1)	Topic Score (x_2)	Attendance (y)
100	8	200
80	6	160
120	9	230
90	5	150
70	4	130

Tasks:

1. **Perform Multiple Linear Regression Analysis**
   - Independent variables: Emails Sent and Topic Score
   - Dependent variable: Attendance
2. **Compute the Baseline Value**
   - Use the average of the attendance values
3. **Calculate SHAP Values**
   - Calculate SHAP Value
   - Distribute SHAP contributions between Emails Sent and Topic Score
4. **Compute Model Predictions for Each Record**
   - Apply the regression equation
   - Validate the SHAP decomposition: Prediction = Baseline + SHAP(Emails) + SHAP(Topic Score)
5. **Interpret the SHAP Contributions**
   - For each row, explain the influence of each input
   - Compare actual vs predicted attendance
   - Indicate whether the model overestimated or underestimated and why

Q. No.	Question	Expected Time to complete
3	**Regression with Diabetes Dataset**	

Objective:
Understand how patient features influence disease progression using Multiple Linear Regression and SHAP value analysis.

Tasks

1. Perform Multiple Linear Regression Analysis

- Use all available features from the Diabetes dataset as independent variables.
- Fit a Multiple Linear Regression model to predict disease progression.

2. Calculate the Baseline Value

- Compute the **mean** of the target variable (disease progression scores) from the training

data.

- This will serve as the **baseline prediction**.

3. Calculate SHAP Values

- Apply SHAP to compute **feature contributions** to each prediction.
- Use model coefficients to proportionally attribute the difference from the baseline to each feature.

4. Compute Final Prediction for Each Record

- For every test record, verify that:

Prediction = Baseline + SHAP(Feature$_1$) + SHAP(Feature$_2$) + ... + SHAP(Feature$_n$)

5. Interpret the Results

- For each patient record:
  - Explain how each feature contributed to the predicted disease progression.
  - Compare the **predicted value** vs the **actual observed value**.
  - Comment on whether the model **overpredicted or underpredicted** and **why**, based on SHAP values.

Q. No.	Question	Expected Time to complete
4	**Regression with Student Performance Dataset**	

Objective:

Investigate how student background and behavior influence final exam scores using Multiple Linear Regression and SHAP value analysis.

Tasks

1. Perform Multiple Linear Regression Analysis

- Use all relevant student attributes (e.g., study time, parental education, absences, etc.) as independent variables.
- Fit a regression model to predict the **final exam score**.

2. Calculate the Baseline Value

- Compute the **mean of the final exam scores** from the training set.
- This serves as the **baseline prediction** (expected value).

3. Calculate SHAP Values

- Use SHAP to compute the contribution of each student attribute to the final exam score prediction.
- Distribute the prediction deviation from the baseline among the features.

4. Compute Final Prediction for Each Record

- For each student record, confirm:

Predicted Score = Baseline + SHAP(Feature$_1$) + SHAP(Feature$_2$) + ... + SHAP(Feature$_n$)

5. Interpret the Results

- For every prediction:
  - Explain how different features (e.g., study time, failures, health) impacted the exam score.
  - Compare predicted score to actual score.
  - Comment on overprediction or underprediction and possible reasons behind it.