AI Agent for Sepsis EHR Analysis

Objective: The project seeks to develop an AI-powered agent to help physicians analyze electronic healthcare records (EHR). The AI agent should be able to accurately predict mortality outcomes and generate clear interpretable explanations for its predictions.

Dataset: Each training sample contain EHR features and a class label (**mortality_90d)**. Each test sample only contains input features. The features are listed as the following table.

Special Notes:

1. Each icustayid may have several records, but only one mortality label. Therefore, treat the records of the same icustayid as a time series in the order of charttime and predict its 90-day mortality.
2. There are several entries with a value of 0. Determine whether these zeros represent actual values or if they indicate missing data. If they indicate missing data, please implement a corresponding method to address this.

Variable	Description
bloc	The order of entry of icu stay.
icustayid	Unique identifier for a patient's ICU stay
charttime	Timestamp when the data was recorded (charting time)
gender	Patient's gender
age	Patient's age in days
elixhauser	Elixhauser comorbidity score, summarizing the burden of chronic diseases
mortality_90d	Mortality status within 90 days of admission or discharge. **This is the class label.**
Weight_kg	Patient weight in kilograms
GCS	Glasgow Coma Scale score, a measure of consciousness
HR	Heart rate (beats per minute)
SysBP	Systolic blood pressure
MeanBP	Mean arterial blood pressure
DiaBP	Diastolic blood pressure
RR	Respiratory rate (breaths per minute)
SpO2	Peripheral capillary oxygen saturation (%)
Temp_C	Body temperature in degrees Celsius
FiO2_1	Fraction of inspired oxygen (FiO2) provided
Potassium	Serum potassium level

Sodium	Serum sodium level
Chloride	Serum chloride level
Glucose	Blood glucose level
BUN	Blood urea nitrogen level
Creatinine	Serum creatinine level
Magnesium	Serum magnesium level
Calcium	Serum calcium level
Ionised_Ca	Ionized calcium level
CO2_mEqL	Carbon dioxide content measured in mEq/L
SGOT	Aspartate aminotransferase (AST) level
SGPT	Alanine aminotransferase (ALT) level
Total_bili	Total bilirubin level
Albumin	Serum albumin level
Hb	Hemoglobin concentration
WBC_count	White blood cell count
Platelets_count	Platelet count
PTT	Partial thromboplastin time, assessing blood clotting
PT	Prothrombin time, another measure of clotting function
INR	International Normalized Ratio, standardizing PT results
Arterial_pH	pH of arterial blood
paO2	Partial pressure of oxygen in arterial blood
paCO2	Partial pressure of carbon dioxide in arterial blood
Arterial_BE	Arterial base excess, indicating metabolic balance
HCO3	Bicarbonate concentration in the blood
Arterial_lactate	Lactate level in arterial blood (marker for tissue hypoxia)
mechvent	Indicator of whether the patient was mechanically ventilated
Shock_Index	Index of shock evaluation.
PaO2_FiO2	Ratio of paO2 to FiO2, used to assess lung oxygenation efficiency
median_dose_vaso	Median dose of vasopressors administered during ICU stay
max_dose_vaso	Maximum dose of vasopressors administered
input_total	Total volume of fluids administered
input_4hourly	Fluid input measured over each 4-hour period

output_total	Total urine output (losses) recorded
output_4hourly	Urine output measured over each 4-hour period
cumulated_balance	Cumulative account balance
SOFA	Sequential Organ Failure Assessment score, indicating severity of organ dysfunction
SIRS	Systemic Inflammatory Response Syndrome criteria or score, indicating inflammatory state

Key objectives:

1. **Missing Feature Detection and Imputation:** Some records have missing features. When a feature is not measured for a patient, we call it a missing feature. The AI agent needs to identify missing features, assess their potential impacts, and impute them if necessary.
2. **Mortality Prediction Model:** Train a machine learning model to predict mortality based on the available data. The model will take the features of a patient and return a mortality prediction. This model may be hosted as an API endpoint, which the AI agent can call to obtain predictions.
3. **Interpretable Predictions:** The AI agent should be able to generate human-understandable explanations for the mortality predictions, which include
   - **Classification Results:** Clear statements about the prediction outcome (e.g., survived or dead in 90 days).
   - **Impact of Missing Data:** Insights into whether missing features influenced the prediction and how crucial the missing data was to the model's decision-making process.
   - **Impact of Imputation:** An evaluation of whether imputing missing data can affect the prediction uncertainty, including an analysis of how the imputation might affect the final outcome.

Tips:

- **Data Preprocessing:** The initial step involves cleaning and processing the input data, ensuring that all relevant features for mortality prediction are correctly structured. Missing features will be identified and flagged for evaluation.
- **Explanation Generation:** Explainable AI (XAI) techniques (e.g., SHAP) can be used to produce "importance" of features for generating a prediction, which can be translated into human-understandable languages.
- **Missing Feature Assessment:** Assess the impact of missing feature imputation on the model's prediction. Consider adding a small amount of noise to an imputed value and observing its effect on the model's prediction.

Evaluation Criteria:

1. F1 score of mortality prediction on test samples.

2. Feature importance justification.
3. Missingness impact explanation, including how you detect missingness, how you deal with it, and how it impacts the model performance.
4. The readability of the explanations generated by AI agents, measured by Flesch–Kincaid readability test
5. The AI agent needs to be working.