

Machine Learning

| Example – Heart Attack

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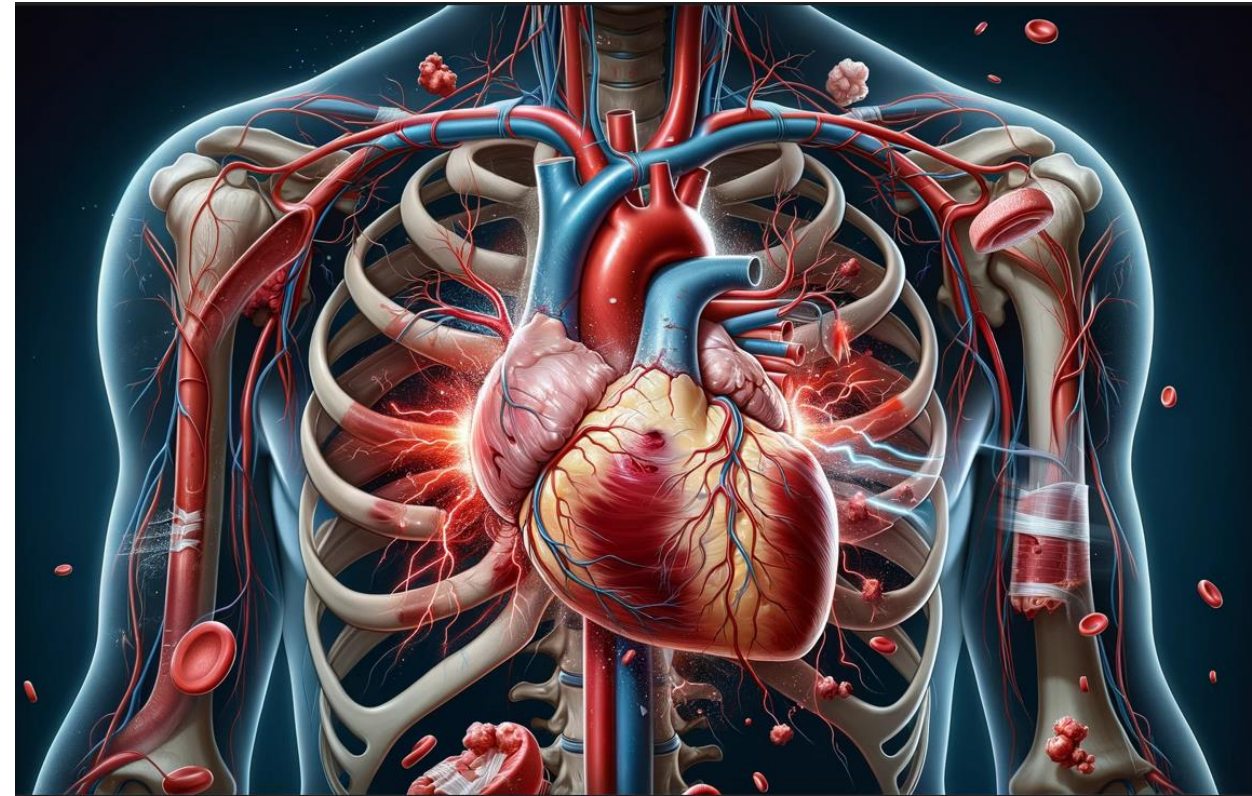


| Data

- We live in a world that is drowning in data
- Websites track every user's every click
- Your smartphone is building up a record of your location and speed every second of every day
- Smart cars – collect driving habits
- Smart homes – collect living habits
- Smart marketers collect purchasing habits
- Buried in these data are answers to countless questions that no one's ever thought to ask
- If Machine learning is the steam engine of this revolution, then data is its coal

| Heart Attack

- A heart attack, medically known as a myocardial infarction, occurs when the flow of blood to a part of the heart muscle gets blocked.
- This usually happens due to the buildup of fat, cholesterol, and other substances, which form a plaque in the coronary arteries that supply the heart with blood.



| Heart Attack

- When a plaque in a heart artery breaks, a blood clot forms around the plaque. This clot can block the blood flow through the heart muscle. When the heart muscle is starved of oxygen and nutrients (a condition called ischemia), it can cause damage or destruction to part of the heart muscle. This is what is referred to as a heart attack.
- Symptoms of a heart attack can include chest pain or discomfort, upper body pain (in the arms, back, neck, jaw, or stomach), shortness of breath, nausea, and lightheadedness, among others.
- Heart attacks are serious medical emergencies, and prompt treatment is crucial to minimize heart damage and potentially save lives. Treatment might include medications, lifestyle changes, and in some cases, surgical procedures.

| Heart Attack

- نوبة القلب أو الجلطة القلبية تحصل لما الدم ما يعرفش يوصل لجزء من عضلة القلب. ده بيكون عادة بسبب تراكم الدهون والكوليسترول في الشرايين اللي بتغذي القلب.
- لما الدهون دي بتتجمع وتسدها، بيتكون جلطة دم حوالينها وبتقطع تدفق الدم للقلب. ولما عضلة القلب ما تاخدش كفاية أكسجين وغذاء، بتبدأ تتأذي أو تموت في جزء منها. ده اللي بيسموه جلطة قلبية.
- أعراض الجلطة القلبية ممكن تشمل وجع في الصدر، وجع في الجسم من فوق زي الذراعين والظهر والرقبة والفك والمعدة، ضيق في التنفس، غثيان، ودوخة.
- الجلطة القلبية دي حالة خطيرة جداً ولازم تتعالج بسرعة علشان نقلل الضرر اللي ممكن يحصل للقلب وممكن كمان تنقذ حياة الإنسان. العلاج ممكن يكون بأدوية، تغيير في نمط الحياة، وأحياناً بعمليات جراحية

| Data Collection and Features

- Age: Older individuals generally have a higher risk of heart attacks.
- Sex: Gender can influence heart attack risk due to different lifestyle factors and biological differences.
- Blood Pressure: Both systolic and diastolic blood pressure readings. High blood pressure is a significant risk factor.
- Cholesterol Levels: Includes LDL (bad cholesterol), HDL (good cholesterol), and total cholesterol.
- Body Mass Index (BMI): Obesity is a known risk factor for heart disease.
- Blood Sugar Levels: To identify diabetes or pre-diabetic conditions, which are risk factors.
- Family History: Genetic predisposition plays a role in the likelihood of heart attacks.
- Smoking Status: Smoking is a major risk factor for heart disease.

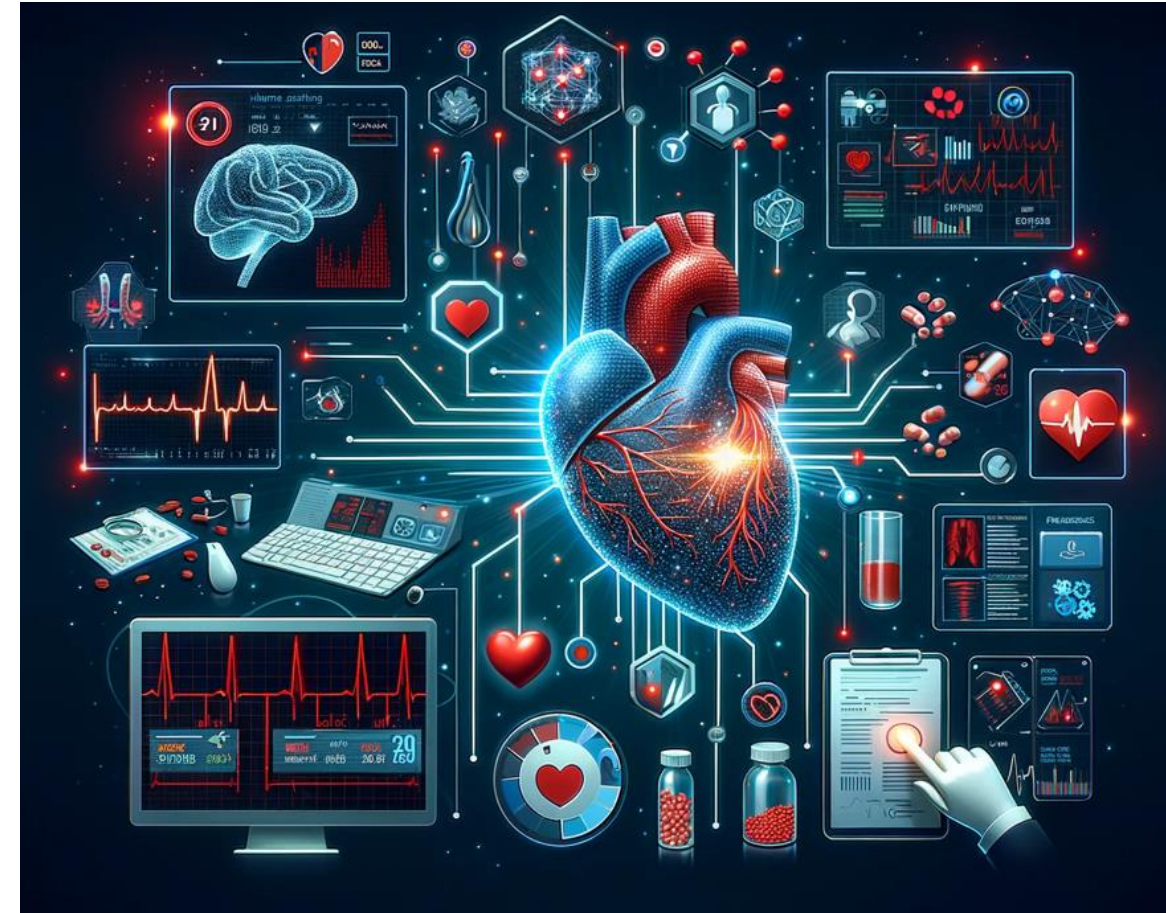
| Data Collection and Features

- Physical Activity Level: Sedentary lifestyle is a risk factor, while regular exercise reduces risk.
- Dietary Habits: A diet high in fats and sugars can increase the risk.
- Alcohol Consumption: Excessive alcohol intake can contribute to heart disease.
- Stress Level: Chronic stress is considered a contributing factor.
- Medical History: Previous heart conditions, strokes, or other related health issues.
- Medications: Some medications can influence heart attack risk.
- Resting Electrocardiogram (ECG) Results: To detect heart rhythm abnormalities..

| Heart Attack

Early Detection and Diagnosis

- **Pattern Recognition:** ML algorithms can identify patterns in large datasets that human clinicians might not easily notice. For example, subtle changes in ECG patterns or blood test results that could indicate an increased risk of a heart attack.
- **Predictive Modeling:** By analyzing historical health data, ML models can predict the likelihood of a patient having a heart attack. These models consider various risk factors such as age, blood pressure, cholesterol levels, and lifestyle habits..



| Heart Attack

Risk Assessment

- **Risk Stratification:** ML algorithms help in categorizing patients into different risk groups based on their health data. This stratification enables healthcare providers to prioritize care for individuals at higher risk.
- **Personalized Risk Scores:** ML models can generate personalized risk scores by analyzing an individual's unique health profile, offering a more tailored approach to prevention and treatment.

| Heart Attack

Integrating Diverse Data Sources

- **Combining Information:** ML can integrate and analyze data from various sources – ECG, blood tests, imaging, patient history – to form a comprehensive view of a patient's heart health.
- **Real-time Monitoring:** Wearable technology integrated with ML algorithms can monitor heart rate, blood pressure, and other vital signs in real-time, providing valuable data for ongoing assessment.

| Heart Attack

Enhancing Diagnostic Imaging

- Image Analysis: ML can be used to enhance the analysis of diagnostic imaging such as echocardiograms, MRIs, or CT scans, identifying signs of heart disease more accurately and quickly than traditional methods.

| Heart Attack

Treatment Planning and Management

- **Treatment Recommendations:** Based on the diagnosis, ML algorithms can suggest treatment plans tailored to the patient's specific condition and history.
- **Post-treatment Monitoring:** ML tools can also help in monitoring patients' recovery and response to treatment, alerting healthcare providers to any concerning changes.

| Heart Attack

Research and Development

- **Drug Discovery:** ML accelerates the discovery of new medications for heart disease by analyzing complex biochemical data and simulating drug interactions.
- **Clinical Trials:** ML aids in identifying suitable candidates for clinical trials based on the detailed analysis of patient data..

| Heart Attack - Workflow

- Data Processing

- The collected data must be cleaned and normalized. Missing values need to be handled, and categorical data should be encoded appropriately.

- Feature Selection

- Machine learning models can help identify which features are most predictive of a heart attack. Techniques like feature importance in decision trees or regularization in logistic regression can be used.

- Model Training

- The processed data is used to train a predictive model. Common ML models for such tasks include logistic regression, decision trees, random forests, and gradient boosting machines.

| Heart Attack - Workflow

- Model Evaluation

- The model's performance is evaluated using metrics like accuracy, precision, recall, and the AUC-ROC curve. It's crucial to have a balance between sensitivity (ability to detect heart attacks) and specificity (ability to correctly identify those without heart attacks).

- Deployment and Monitoring

- Once the model is deemed accurate and reliable, it can be deployed in a clinical setting. Continuous monitoring and updates are necessary to maintain its relevance and accuracy, considering new data and medical research.

| Heart Attack - Workflow

- Ethical Considerations and Limitations

- It's important to note that machine learning models can augment but not replace medical expertise. Ethical considerations, such as privacy and data security, must be addressed. Additionally, the model's limitations and potential biases should be clearly communicated to healthcare providers and patients.