**Problem Statement**: To estimate the project metrics for a **Brain Disease Prediction** system using both **COCOMO** and **Halstead’s Complexity Metrics**

**1. COCOMO Model for Estimating Project Metrics**

**Objective**: Estimate the effort, development time, and personnel required for a Brain Disease Prediction project using COCOMO.

**Assumptions for Brain Disease Prediction System:**

* The Brain Disease Prediction system is assumed to involve **machine learning** techniques for disease prediction based on various medical data inputs (e.g., MRI scans, genetic data, etc.).
* The software system involves a **graphical user interface (GUI)** for medical professionals, integration with medical devices, and **data processing** to train and test predictive models.
* The estimated size of the software is **50 KDSI (Kilo Delivered Source Instructions)**, which is a reasonable estimate for such a system with its different components (GUI, backend, and data processing).

**Step 1: Classify the Project Type**

* **Project Type**: The Brain Disease Prediction system falls under the **Semi-detached** category, as it involves a moderately complex system with both experienced and less experienced team members, and the software involves some external systems (like medical devices).

**Step 2: Apply COCOMO’s Basic Formula**

For the **Semi-detached** project type, the constants are:

* **a = 3.0**
* **b = 1.12**
* **c = 0.35**

We now calculate the **effort (person-months)**, **development time (months)**, and **personnel required** using the following formulas:

* **Effort (PM)**:

Effort=a×(KDSI)b=3.0×(50)1.12=3.0×90.1≈270.3 person-months\text{Effort} = a \times (\text{KDSI})^b = 3.0 \times (50)^{1.12} = 3.0 \times 90.1 \approx 270.3 \text{ person-months}

* **Development Time (Tdev)**:

Tdev=2.5×(Effort)c=2.5×(270.3)0.35=2.5×17.4≈43.5 monthsTdev = 2.5 \times (\text{Effort})^c = 2.5 \times (270.3)^{0.35} = 2.5 \times 17.4 \approx 43.5 \text{ months}

* **Personnel Required**:

Personnel=EffortTdev=270.343.5≈6.2 people\text{Personnel} = \frac{\text{Effort}}{\text{Tdev}} = \frac{270.3}{43.5} \approx 6.2 \text{ people}

**Results from COCOMO (Semi-detached):**

* **Effort**: 270.3 person-months
* **Development Time (Tdev)**: 43.5 months
* **Personnel Required**: 6.2 people

**2. Halstead's Complexity Metrics for Estimating Program Complexity**

**Objective**: Estimate the program complexity of the Brain Disease Prediction system using **Halstead’s Complexity Metrics**.

**Assumptions:**

* The system uses **20 unique operators** (e.g., arithmetic operators, conditional statements, function calls) and **30 unique operands** (e.g., variables, constants, functions).
* The total number of **operators used (N1)** is **200**.
* The total number of **operands used (N2)** is **250**.

**Step 1: Calculate Program Length (N)**

N=N1+N2=200+250=450N = N1 + N2 = 200 + 250 = 450

**Step 2: Calculate Program Vocabulary (n)**

n=n1+n2=20+30=50n = n1 + n2 = 20 + 30 = 50

**Step 3: Calculate Volume (V)**

V=N×lg⁡(n)=450×lg⁡(50)≈450×5.64≈2538 bitsV = N \times \lg(n) = 450 \times \lg(50) \approx 450 \times 5.64 \approx 2538 \text{ bits}

**Step 4: Calculate Difficulty (D)**

D=(n1×N2)2×n2=(20×250)2×30=500060≈83.33D = \frac{(n1 \times N2)}{2 \times n2} = \frac{(20 \times 250)}{2 \times 30} = \frac{5000}{60} \approx 83.33

**Step 5: Calculate Effort (E)**

E=D×V=83.33×2538≈211,417 mental effort unitsE = D \times V = 83.33 \times 2538 \approx 211,417 \text{ mental effort units}

**Step 6: Calculate Time to Implement (T)**

T=E18=211,41718≈11,745 seconds≈3.26 hoursT = \frac{E}{18} = \frac{211,417}{18} \approx 11,745 \text{ seconds} \approx 3.26 \text{ hours}

**Summary of Project Metrics for Brain Disease Prediction**

**1. COCOMO Model (Semi-detached) Estimates:**

* **Effort**: 270.3 person-months
* **Development Time (Tdev)**: 43.5 months
* **Personnel Required**: 6.2 people

**2. Halstead's Complexity Metrics:**

* **Program Length (N)**: 450
* **Program Vocabulary (n)**: 50
* **Volume (V)**: 2538 bits
* **Difficulty (D)**: 83.33
* **Effort (E)**: 211,417 mental effort units
* **Time to Implement (T)**: 3.26 hours

**Conclusion:**

For the **Brain Disease Prediction** system, we used both **COCOMO** and **Halstead's Complexity Metrics** to estimate project metrics. The COCOMO model helps to estimate the **effort**, **time**, and **team size** required, while Halstead's metrics provide insights into the **program complexity** and **mental effort** involved. These metrics are essential for proper planning and understanding the scope and complexity of the software development process.