AI Assisted Coding

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Batch no:05

Task-01

Prompt : To generate a Python program that Reads: Previous Units (PU), Current Units (CU),Type of Customer, Calculates units consumed, Implements logic directly in the main program (no functions).

Code:

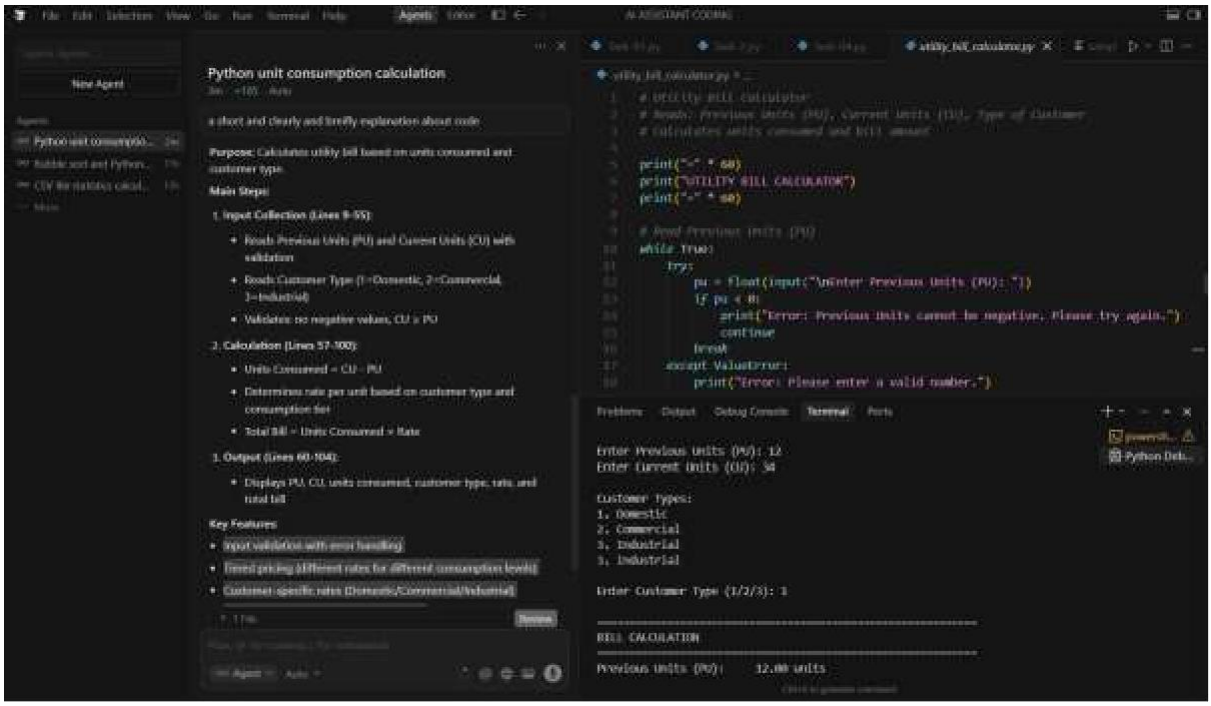
```
# Utility Bill Calculator
# Reads: Previous Units (PU), Current Units (CU), Type of Customer
# Calculates units consumed and bill amount
print("=" * 60)
print("UTILITY BILL CALCULATOR")
print("=" * 60)
# Read Previous Units (PU)
while True:
    try:
        pu = float(input("\nEnter Previous Units (PU): "))
        if pu < 0:
            print("Error: Previous Units cannot be negative. Please try again.")
            continue
        break
    except ValueError:
        print("Error: Please enter a valid number.")
# Read Current Units (CU)
while True:
    try:
        cu = float(input("Enter Current Units (CU): "))
```

```
        if cu < 0:
            print("Error: Current Units cannot be negative. Please try again.")
            continue
        if cu < pu:
            print("Error: Current Units cannot be less than Previous Units. Please try again.")
            continue
        break
    except ValueError:
        print("Error: Please enter a valid number.")
# Read Type of Customer
print("\nCustomer Types:")
print("1. Domestic")
print("2. Commercial")
print("3. Industrial")
while True:
    try:
        customer_type_choice = input("\nEnter Customer Type (1/2/3): ").strip()
        if customer_type_choice == "1":
            customer_type = "Domestic"
            break
        elif customer_type_choice == "2":
            customer_type = "Commercial"
            break
        elif customer_type_choice == "3":
            customer_type = "Industrial"
            break
        else:
            print("Error: Please enter 1, 2, or 3.")
    except:
        print("Error: Invalid input. Please try again.")
# Calculate units consumed
```

```
units_consumed = cu - pu
# Display results
print("\n" + "=" * 60)
print("BILL CALCULATION")
print("=" * 60)
print(f"Previous Units (PU):    {pu:.2f} units")
print(f"Current Units (CU):     {cu:.2f} units")
print(f"Units Consumed:         {units_consumed:.2f} units")
print(f"Customer Type:          {customer_type}")
# Calculate bill based on customer type and units consumed
# Rate structure (example rates - can be modified)
if customer_type == "Domestic":
    if units_consumed <= 100:
        rate = 3.50
    elif units_consumed <= 200:
        rate = 4.50
    elif units_consumed <= 300:
        rate = 5.50
    else:
        rate = 6.50
elif customer_type == "Commercial":
    if units_consumed <= 100:
        rate = 5.00
    elif units_consumed <= 200:
        rate = 6.00
    elif units_consumed <= 300:
        rate = 7.00
    else:
        rate = 8.00
else:  # Industrial
    if units_consumed <= 100:
```

```
        rate = 6.00
    elif units_consumed <= 200:
        rate = 7.50
    elif units_consumed <= 300:
        rate = 9.00
    else:
        rate = 10.50
# Calculate total bill
total_bill = units_consumed * rate
print(f"\nRate per unit:          ₹{rate:.2f}")
print(f"Total Bill Amount:      ₹{total_bill:.2f}")
print("=" * 60)
```

Output:



Enter Previous Units (PU): 12

Enter Current Units (CU): 34

Customer Types:

1. Domestic

2. Commercial

3. Industrial

3. Industrial

Enter Customer Type (1/2/3): 1

==========

BILL CALCULATION

==========

Previous Units (PU): 12.00 units

Current Units (CU): 34.00 units

Units Consumed: 22.00 units

Customer Type: Domestic

Rate per unit: ₹3.50

Total Bill Amount: ₹77.00

Explanation:

Purpose: Calculates utility bill based on units consumed and customer type.**Main Steps:**

1. **Input Collection (Lines 9-55):**

- Reads Previous Units (PU) and Current Units (CU) with validation
- Reads Customer Type (1=Domestic, 2=Commercial, 3=Industrial)
- Validates: no negative values, CU ≥ PU

2. **Calculation (Lines 57-100):**

- Units Consumed = CU - PU
- Determines rate per unit based on customer type and consumption tier
- Total Bill = Units Consumed × Rate

3. **Output (Lines 60-104):**

- Displays PU, CU, units consumed, customer type, rate, and total bill

Key Features:

- Input validation with error handling
- Tiered pricing (different rates for different consumption levels)
- Customer-specific rates (Domestic/Commercial/Industrial)
- All logic in main program (no functions)

Example: If PU=100, CU=250, Type=Domestic → Units=150 → Rate=₹4.50 → Bill=₹675.00

Task-02

Prompt: Add Energy Charge (EC) calculation with optimized conditional logic for Domestic, Commercial, and Industrial consumers. Simplify and improve code readability

Code:

```
class UtilityBillCalculator:
    RATE_STRUCTURE = {
        "Domestic": [
            (0, 100, 3.50),
            (101, 200, 4.50),
            (201, 300, 5.50),
            (301, float('inf'), 6.50)
        ],
        "Commercial": [
            (0, 100, 5.00),
            (101, 200, 6.00),
            (201, 300, 7.00),
            (301, float('inf'), 8.00)
        ],
        "Industrial": [
            (0, 100, 6.00),
            (101, 200, 7.50),
            (201, 300, 9.00),
            (301, float('inf'), 10.50)
        ]
    }
```

```
def __init__(self, previous_units: float, current_units: float, customer_type: str):
    """
    Initialize the calculator with meter readings and customer type.
    Args:
        previous_units: Previous meter reading (PU)
        current_units: Current meter reading (CU)
        customer_type: Type of customer (Domestic, Commercial, Industrial)
    """
    self.previous_units = previous_units
    self.current_units = current_units
    self.customer_type = customer_type
    self.units_consumed = current_units - previous_units
    # Validate inputs
    self._validate_inputs()
def _validate_inputs(self):
    """Validate that inputs are logical and valid."""
    if self.previous_units < 0:
        raise ValueError("Previous Units cannot be negative")
    if self.current_units < 0:
        raise ValueError("Current Units cannot be negative")
    if self.current_units < self.previous_units:
        raise ValueError("Current Units cannot be less than Previous Units")
    if self.customer_type not in self.RATE_STRUCTURE:
        raise ValueError(f"Invalid customer type: {self.customer_type}")
def get_rate_per_unit(self) -> float:
    """
    Get the applicable rate per unit based on units consumed and customer type.
    Optimized conditional logic using slab-based lookup.
    Returns:
```

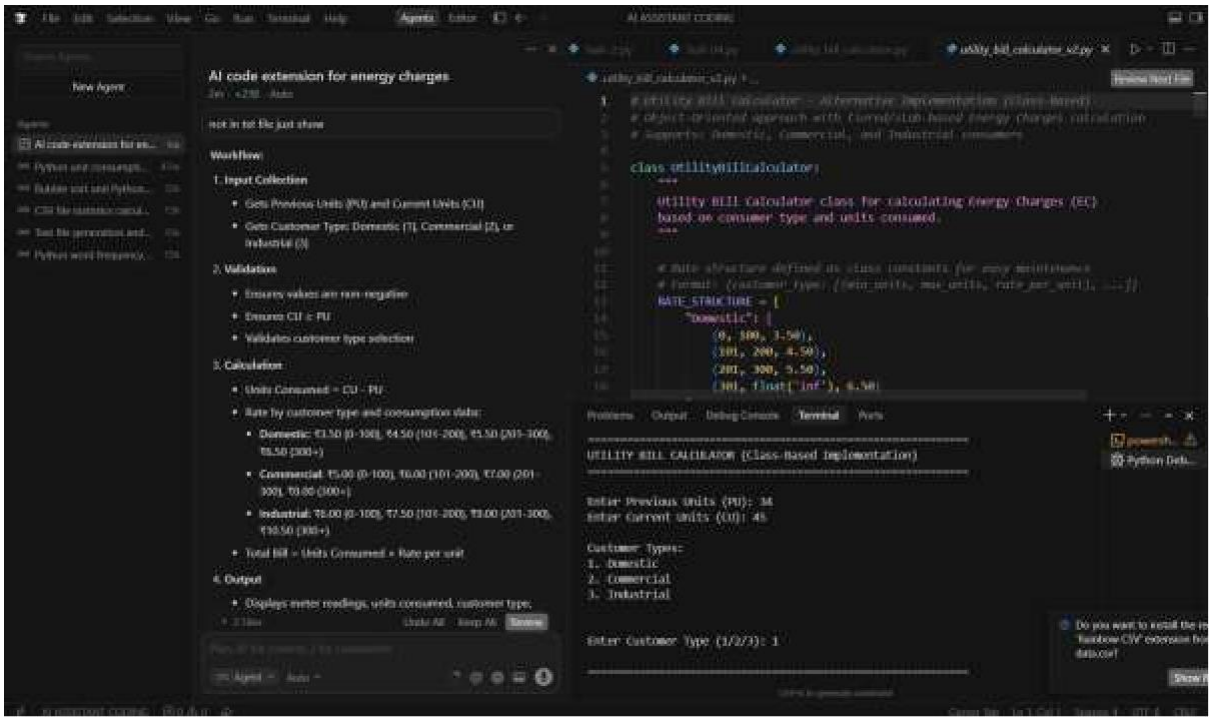
```
        Rate per unit in rupees
    """
    rate_slabs = self.RATE_STRUCTURE[self.customer_type]
    # Optimized: Direct lookup based on units consumed
    for min_units, max_units, rate in rate_slabs:
        if min_units <= self.units_consumed <= max_units:
            return rate
    # Fallback (should not reach here with proper structure)
    return rate_slabs[-1][2]
def calculate_energy_charges(self) -> float:
    rate_per_unit = self.get_rate_per_unit()
    energy_charges = self.units_consumed * rate_per_unit
    return energy_charges
def get_bill_details(self) -> dict:
    rate_per_unit = self.get_rate_per_unit()
    energy_charges = self.calculate_energy_charges()
    return {
        "previous_units": self.previous_units,
        "current_units": self.current_units,
        "units_consumed": self.units_consumed,
        "customer_type": self.customer_type,
        "rate_per_unit": rate_per_unit,
        "energy_charges": energy_charges,
        "total_bill": energy_charges
    }
def display_bill(self):
    """Display the bill in a formatted manner."""
    details = self.get_bill_details()
    print("\n" + "=" * 60)
```

```
        print("BILL CALCULATION")
        print("=" * 60)
        print(f"Previous Units (PU):     {details['previous_units']:.2f} units")
        print(f"Current Units (CU):      {details['current_units']:.2f} units")
        print(f"Units Consumed:          {details['units_consumed']:.2f} units")
        print(f"Customer Type:           {details['customer_type']}")
        print(f"\nRate per unit:          ₹{details['rate_per_unit']:.2f}")
        print(f"Energy Charges (EC):     ₹{details['energy_charges']:.2f}")
        print(f"Total Bill Amount:       ₹{details['total_bill']:.2f}")
        print("=" * 60)
def get_user_input() -> tuple[float, float, str]:
    print("=" * 60)
    print("UTILITY BILL CALCULATOR (Class-Based Implementation)")
    print("=" * 60)
    # Get Previous Units
    while True:
        try:
            pu = float(input("\nEnter Previous Units (PU): "))
            if pu < 0:
                print("Error: Previous Units cannot be negative. Please try again.")
                continue
            break
        except ValueError:
            print("Error: Please enter a valid number.")
    # Get Current Units
    while True:
        try:
            cu = float(input("Enter Current Units (CU): "))
            if cu < 0:
```

```
            print("Error: Current Units cannot be negative. Please try again.")
            continue
        if cu < pu:
            print("Error: Current Units cannot be less than Previous Units. Please try again.")
            continue
        break
    except ValueError:
        print("Error: Please enter a valid number.")
# Get Customer Type
print("\nCustomer Types:")
print("1. Domestic")
print("2. Commercial")
print("3. Industrial")
customer_types = {"1": "Domestic", "2": "Commercial", "3": "Industrial"}
while True:
    choice = input("\nEnter Customer Type (1/2/3): ").strip()
    if choice in customer_types:
        return pu, cu, customer_types[choice]
    print("Error: Please enter 1, 2, or 3.")
def main():
"""Main program entry point."""
try:
    # Get user input
    pu, cu, customer_type = get_user_input()
    # Create calculator instance
    calculator = UtilityBillCalculator(pu, cu, customer_type)
    # Display bill
    calculator.display_bill()
except ValueError as e:
```

```
        print(f"\nError: {e}")
    except Exception as e:
        print(f"\nUnexpected error: {e}")
if __name___== "__main__":
    main()
```

Output:



UTILITY BILL CALCULATOR (Class-Based Implementation)

Enter Previous Units (PU): 34

Enter Current Units (CU): 45

Customer Types:

1. Domestic

2. Commercial

3. Industrial

Enter Customer Type (1/2/3): 1

BILL CALCULATION

Previous Units (PU): 34.00 units

Current Units (CU): 45.00 units

Units Consumed: 11.00 units

Customer Type: Domestic

Rate per unit: ₹3.50

Energy Charges (EC): ₹38.50

Total Bill Amount: ₹38.50

Explanation:

Purpose: Calculates electricity bill from meter readings and customer type.

Workflow:

1. **Input Collection**

- Gets Previous Units (PU) and Current Units (CU)
- Gets Customer Type: Domestic (1), Commercial (2), or Industrial (3)

2. **Validation**

- Ensures values are non-negative
- Ensures CU ≥ PU
- Validates customer type selection

3. **Calculation**

- Units Consumed = CU - PU
- Rate by customer type and consumption slabs:
- **Domestic**: ₹3.50 (0-100), ₹4.50 (101-200), ₹5.50 (201-300), ₹6.50 (300+)
- **Commercial**: ₹5.00 (0-100), ₹6.00 (101-200), ₹7.00 (201-300), ₹8.00 (300+)
- **Industrial**: ₹6.00 (0-100), ₹7.50 (101-200), ₹9.00 (201-300), ₹10.50 (300+)
- Total Bill = Units Consumed × Rate per unit

4. **Output**

- Displays meter readings, units consumed, customer type, rate, and total bill

Task-03

Prompt: Develop a Python program with user-defined functions for calculating Energy Charges and Fixed Charges. Functions should accept inputs, return results, use simple logic

Code:

```
def calculate_energy_charges(units_consumed, customer_type):
    rate_structure = {
        "Domestic": [
            (0, 100, 3.50),      # First 100 units at ₹3.50 per unit
            (101, 200, 4.50),    # Next 100 units (101-200) at ₹4.50 per unit
            (201, 300, 5.50),    # Next 100 units (201-300) at ₹5.50 per unit
            (301, float('inf'), 6.50)  # Above 300 units at ₹6.50 per unit
        ],
        "Commercial": [
            (0, 100, 5.00),      # First 100 units at ₹5.00 per unit
            (101, 200, 6.00),    # Next 100 units (101-200) at ₹6.00 per unit
            (201, 300, 7.00),    # Next 100 units (201-300) at ₹7.00 per unit
            (301, float('inf'), 8.00)  # Above 300 units at ₹8.00 per unit
        ],
        "Industrial": [
            (0, 100, 6.00),      # First 100 units at ₹6.00 per unit
            (101, 200, 7.50),    # Next 100 units (101-200) at ₹7.50 per unit
            (201, 300, 9.00),    # Next 100 units (201-300) at ₹9.00 per unit
            (301, float('inf'), 10.50)  # Above 300 units at ₹10.50 per unit
        ]
    }
    # Validate customer type
    if customer_type not in rate_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")
    # Get the applicable rate slabs for the customer type
    slabs = rate_structure[customer_type]
    # Find the applicable rate based on units consumed
    # The rate is determined by which consumption slab the total units fall into
    # All units are charged at the rate of the slab they fall into
```

```
    for min_units, max_units, rate_per_unit in slabs:
        if min_units <= units_consumed <= max_units:
            # Units fall within this slab, calculate charges at this rate
            energy_charges = units_consumed * rate_per_unit
            return energy_charges
    # Fallback: If consumption exceeds all defined slabs, use the highest rate
    # This handles cases where consumption is very high
    highest_rate = slabs[-1][2]
    return units_consumed * highest_rate
def calculate_fixed_charges(customer_type, units_consumed):
    fixed_charges_structure = {
        "Domestic": {
            "low": 50.00,      # For consumption up to 100 units
            "medium": 75.00,  # For consumption 101-200 units
            "high": 100.00,    # For consumption 201-300 units
            "very_high": 150.00  # For consumption above 300 units
        },
        "Commercial": {
            "low": 200.00,     # For consumption up to 100 units
            "medium": 300.00,  # For consumption 101-200 units
            "high": 400.00,    # For consumption 201-300 units
            "very_high": 500.00  # For consumption above 300 units
        },
        "Industrial": {
            "low": 500.00,     # For consumption up to 100 units
            "medium": 750.00,  # For consumption 101-200 units
            "high": 1000.00,  # For consumption 201-300 units
            "very_high": 1500.00  # For consumption above 300 units
        }
```

```
    }
    # Validate customer type
    if customer_type not in fixed_charges_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")
    # Determine consumption category based on units consumed
    if units_consumed <= 100:
        category = "low"
    elif units_consumed <= 200:
        category = "medium"
    elif units_consumed <= 300:
        category = "high"
    else:
        category = "very_high"
    # Get and return the fixed charges for this customer type and category
    fixed_charges = fixed_charges_structure[customer_type][category]
    return fixed_charges
def calculate_total_bill(previous_units, current_units, customer_type):
    # Validate inputs
    if previous_units < 0:
        raise ValueError("Previous Units cannot be negative")
    if current_units < 0:
        raise ValueError("Current Units cannot be negative")
    if current_units < previous_units:
        raise ValueError("Current Units cannot be less than Previous Units")
    # Calculate units consumed (difference between current and previous readings)
    units_consumed = current_units - previous_units
    # Calculate Energy Charges using the dedicated function
    energy_charges = calculate_energy_charges(units_consumed, customer_type)
    # Calculate Fixed Charges using the dedicated function
```

```
    fixed_charges = calculate_fixed_charges(customer_type, units_consumed)
    # Calculate total bill (Energy Charges + Fixed Charges)
    total_bill = energy_charges + fixed_charges
    # Return all calculated values as a dictionary
    return {
        "previous_units": previous_units,
        "current_units": current_units,
        "units_consumed": units_consumed,
        "customer_type": customer_type,
        "energy_charges": energy_charges,
        "fixed_charges": fixed_charges,
        "total_bill": total_bill
    }
def get_user_input():
    print("=" * 70)
    print("UTILITY BILL CALCULATOR - Function-Based Implementation")
    print("=" * 70)
    # Get Previous Units (PU) with validation
    while True:
        try:
            previous_units = float(input("\nEnter Previous Units (PU): "))
            if previous_units < 0:
                print("Error: Previous Units cannot be negative. Please try again.")
                continue
            break
        except ValueError:
            print("Error: Please enter a valid number.")
    # Get Current Units (CU) with validation
    while True:
```

```
        try:
            current_units = float(input("Enter Current Units (CU): "))
            if current_units < 0:
                print("Error: Current Units cannot be negative. Please try again.")
                continue
            if current_units < previous_units:
                print("Error: Current Units cannot be less than Previous Units. Please try again.")
                continue
            break
        except ValueError:
            print("Error: Please enter a valid number.")
    # Get Customer Type with validation
    print("\nCustomer Types:")
    print("1. Domestic")
    print("2. Commercial")
    print("3. Industrial")
    customer_types = {"1": "Domestic", "2": "Commercial", "3": "Industrial"}
    while True:
        choice = input("\nEnter Customer Type (1/2/3): ").strip()
        if choice in customer_types:
            customer_type = customer_types[choice]
            break
        print("Error: Please enter 1, 2, or 3.")
    return previous_units, current_units, customer_type
def display_bill(bill_details):
    print("\n" + "=" * 70)
    print("BILL CALCULATION RESULTS")
    print("=" * 70)
    print(f"Previous Units (PU):        {bill_details['previous_units']:.2f}  units")
```

```
    print(f"Current Units (CU):          {bill_details['current_units']:.2f}  units")
    print(f"Units Consumed:              {bill_details['units_consumed']:.2f} units")
    print(f"Customer Type:               {bill_details['customer_type']}")
    print("-" * 70)
    print(f"Energy Charges (EC):         ₹{bill_details['energy_charges']:.2f}")
    print(f"Fixed Charges (FC):          ₹{bill_details['fixed_charges']:.2f}")
    print("-" * 70)
    print(f"TOTAL BILL AMOUNT:           ₹{bill_details['total_bill']:.2f}")
    print("=" * 70)


def main():
    try:
        # Step 1: Get user input
        previous_units, current_units, customer_type = get_user_input()
        # Step 2: Calculate bill using the calculate_total_bill function
        # This function internally calls calculate_energy_charges and calculate_fixed_charges
        bill_details = calculate_total_bill(previous_units, current_units, customer_type)
        # Step 3: Display the calculated bill
        display_bill(bill_details)
    except ValueError as e:
        print(f"\nError: {e}")
    except Exception as e:
        print(f"\nUnexpected error: {e}")
# Program entry point
if __name___== "__main__":
    main()
```

Output:

UTILITY BILL CALCULATOR - Function-Based Implementation

Enter Previous Units (PU): 45

Enter Current Units (CU): 56

Customer Types:

1. Domestic

2. Commercial

3. Industrial

Enter Customer Type (1/2/3): 2

BILL CALCULATION RESULTS

Previous Units (PU): 45.00 units

Current Units (CU): 56.00 units

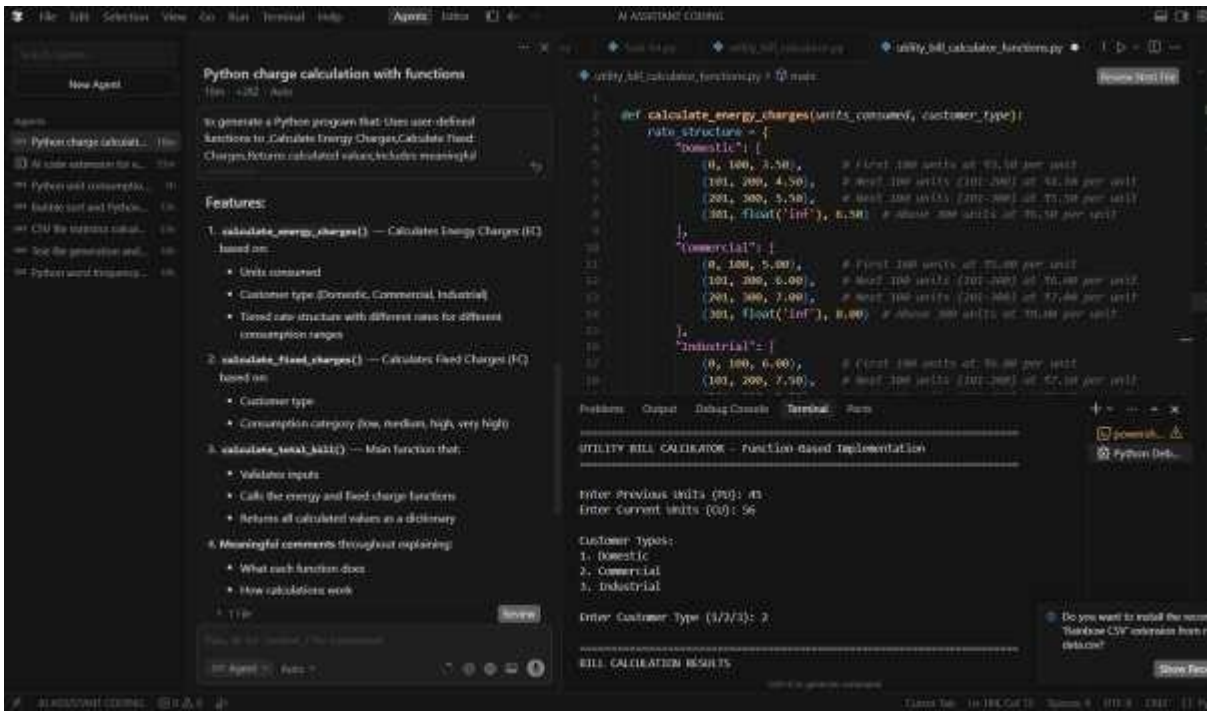
Units Consumed: 11.00 units

Customer Type: Commercial

Energy Charges (EC): ₹55.00

Fixed Charges (FC): ₹200.00 TOTAL

BILL AMOUNT: ₹255.00



Explanation:

1. User enters previous units, current units, and customer type
2. Program calculates units consumed = current - previous
3. Energy Charges = units × rate (based on consumption slab)
4. Fixed Charges = fixed amount (based on customer type and consumption category)
5. Total Bill = Energy Charges + Fixed Charges
6. Results are displayed

Task-04

Prompt:

Extend the program to calculate Fixed Charges (FC), Customer Charges (CC), and Electricity Duty. Add electricity duty calculation, improve billing accuracy, and keep the code simple and readable.

Code:

```
def calculate_energy_charges(units_consumed, customer_type):
    rate_structure = {
        "Domestic": [
            (0, 100, 3.50),      # First 100 units at ₹3.50 per unit
            (101, 200, 4.50),    # Next 100 units (101-200) at ₹4.50 per unit
            (201, 300, 5.50),    # Next 100 units (201-300) at ₹5.50 per unit
            (301, float('inf'), 6.50)  # Above 300 units at ₹6.50 per unit
        ],
        "Commercial": [
            (0, 100, 5.00),      # First 100 units at ₹5.00 per unit
            (101, 200, 6.00),    # Next 100 units (101-200) at ₹6.00 per unit
            (201, 300, 7.00),    # Next 100 units (201-300) at ₹7.00 per unit
            (301, float('inf'), 8.00)  # Above 300 units at ₹8.00 per unit
        ],
```

```
    "Industrial": [
        (0, 100, 6.00),      # First 100 units at ₹6.00 per unit
        (101, 200, 7.50),    # Next 100 units (101-200) at ₹7.50 per unit
        (201, 300, 9.00),    # Next 100 units (201-300) at ₹9.00 per unit
        (301, float('inf'), 10.50)  # Above 300 units at ₹10.50 per unit
    ]
}

# Validate customer type
if customer_type not in rate_structure:
    raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")

# Get the applicable rate slabs for the customer type
slabs = rate_structure[customer_type]

# Find the applicable rate based on units consumed
# The rate is determined by which consumption slab the total units fall into
# All units are charged at the rate of the slab they fall into
for min_units, max_units, rate_per_unit in slabs:
    if min_units <= units_consumed <= max_units:
        # Units fall within this slab, calculate charges at this rate
        energy_charges = units_consumed * rate_per_unit
        return energy_charges

# Fallback: If consumption exceeds all defined slabs, use the highest rate
# This handles cases where consumption is very high
highest_rate = slabs[-1][2]
return units_consumed * highest_rate
```

```
def calculate_fixed_charges(customer_type, units_consumed):
    # Define fixed charges structure
    # Fixed charges may vary by customer type and consumption category
    fixed_charges_structure = {
        "Domestic": {
            "low": 50.00,      # For consumption up to 100 units
            "medium": 75.00,   # For consumption 101-200 units
            "high": 100.00,    # For consumption 201-300 units
            "very_high": 150.00  # For consumption above 300 units
        },
        "Commercial": {
            "low": 200.00,     # For consumption up to 100 units
            "medium": 300.00,  # For consumption 101-200 units
            "high": 400.00,    # For consumption 201-300 units
            "very_high": 500.00  # For consumption above 300 units
        },
        "Industrial": {
            "low": 500.00,     # For consumption up to 100 units
            "medium": 750.00,  # For consumption 101-200 units
            "high": 1000.00,   # For consumption 201-300 units
            "very_high": 1500.00  # For consumption above 300 units
        }
    }

    # Validate customer type
    if customer_type not in fixed_charges_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic,
Commercial, or Industrial")

    # Determine consumption category based on units consumed
```

```
    if units_consumed <= 100:
        category = "low"
    elif units_consumed <= 200:
        category = "medium"
    elif units_consumed <= 300:
        category = "high"
    else:
        category = "very_high"

    # Get and return the fixed charges for this customer type and category
    fixed_charges = fixed_charges_structure[customer_type][category]
    return fixed_charges

def calculate_customer_charges(customer_type, units_consumed):
    # Define customer charges structure
    # Customer charges vary by customer type and consumption level
    customer_charges_structure = {
        "Domestic": {
            "low": 25.00,      # For consumption up to 100 units
            "medium": 35.00,   # For consumption 101-200 units
            "high": 50.00,     # For consumption 201-300 units
            "very_high": 75.00  # For consumption above 300 units
        },
        "Commercial": {
            "low": 100.00,     # For consumption up to 100 units
            "medium": 150.00,  # For consumption 101-200 units
            "high": 200.00,    # For consumption 201-300 units
            "very_high": 300.00  # For consumption above 300 units
        },
```

```
        "Industrial": {
            "low": 250.00,     # For consumption up to 100 units
            "medium": 400.00,  # For consumption 101-200 units
            "high": 600.00,    # For consumption 201-300 units
            "very_high": 900.00  # For consumption above 300 units
        }
    }

    # Validate customer type
    if customer_type not in customer_charges_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")

    # Determine consumption category based on units consumed
    if units_consumed <= 100:
        category = "low"
    elif units_consumed <= 200:
        category = "medium"
    elif units_consumed <= 300:
        category = "high"
    else:
        category = "very_high"

    # Get and return the customer charges for this customer type and category
    customer_charges = customer_charges_structure[customer_type][category]
    return customer_charges

def calculate_electricity_duty(energy_charges, customer_type):
    # Define electricity duty percentage by customer type
    # ED is calculated as a percentage of Energy Charges
```

```
    duty_percentage = {
        "Domestic": 5.0,      # 5% of EC for Domestic customers
        "Commercial": 8.0,    # 8% of EC for Commercial customers
        "Industrial": 10.0    # 10% of EC for Industrial customers
    }

    # Validate customer type
    if customer_type not in duty_percentage:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")

    # Validate energy charges
    if energy_charges < 0:
        raise ValueError("Energy Charges cannot be negative")

    # Calculate electricity duty as percentage of energy charges
    duty_percent = duty_percentage[customer_type]
    electricity_duty = energy_charges * (duty_percent / 100.0)

    return electricity_duty

def calculate_total_bill(previous_units, current_units, customer_type):
    # Validate inputs
    if previous_units < 0:
        raise ValueError("Previous Units cannot be negative")
    if current_units < 0:
        raise ValueError("Current Units cannot be negative")
    if current_units < previous_units:
        raise ValueError("Current Units cannot be less than Previous Units")
```

```
# Calculate units consumed (difference between current and previous readings)
units_consumed = current_units - previous_units

# Calculate Energy Charges using the dedicated function
energy_charges = calculate_energy_charges(units_consumed, customer_type)

# Calculate Fixed Charges using the dedicated function
fixed_charges = calculate_fixed_charges(customer_type, units_consumed)

# Calculate Customer Charges using the dedicated function
customer_charges = calculate_customer_charges(customer_type, units_consumed)

# Calculate Electricity Duty as percentage of Energy Charges
electricity_duty = calculate_electricity_duty(energy_charges, customer_type)

# Calculate total bill (EC + FC + CC + ED)
total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

# Return all calculated values as a dictionary
return {
    "previous_units": previous_units,
    "current_units": current_units,
    "units_consumed": units_consumed,
    "customer_type": customer_type,
    "energy_charges": energy_charges,
    "fixed_charges": fixed_charges,
    "customer_charges": customer_charges,
    "electricity_duty": electricity_duty,
    "total_bill": total_bill
```

```
    }

def get_user_input():
    print("=" * 70)
    print("UTILITY BILL CALCULATOR - Extended Version")
    print("Calculates: EC, FC, CC, and ED")
    print("=" * 70)

    # Get Previous Units (PU) with validation
    while True:
        try:
            previous_units = float(input("\nEnter Previous Units (PU): "))
            if previous_units < 0:
                print("Error: Previous Units cannot be negative. Please try again.")
                continue
            break
        except ValueError:
            print("Error: Please enter a valid number.")

    # Get Current Units (CU) with validation
    while True:
        try:
            current_units = float(input("Enter Current Units (CU): "))
            if current_units < 0:
                print("Error: Current Units cannot be negative. Please try again.")
                continue
            if current_units < previous_units:
                print("Error: Current Units cannot be less than Previous Units. Please try again.")
                continue
```

```
            break
        except ValueError:
            print("Error: Please enter a valid number.")

    # Get Customer Type with validation
    print("\nCustomer Types:")
    print("1. Domestic")
    print("2. Commercial")
    print("3. Industrial")

    customer_types = {"1": "Domestic", "2": "Commercial", "3": "Industrial"}

    while True:
        choice = input("\nEnter Customer Type (1/2/3): ").strip()
        if choice in customer_types:
            customer_type = customer_types[choice]
            break
        print("Error: Please enter 1, 2, or 3.")

    return previous_units, current_units, customer_type

def display_bill(bill_details):
    """
    Display the calculated bill in a formatted, user-friendly manner.

    Args:
        bill_details (dict): Dictionary containing bill calculation results
    """
    print("\n" + "=" * 70)
```

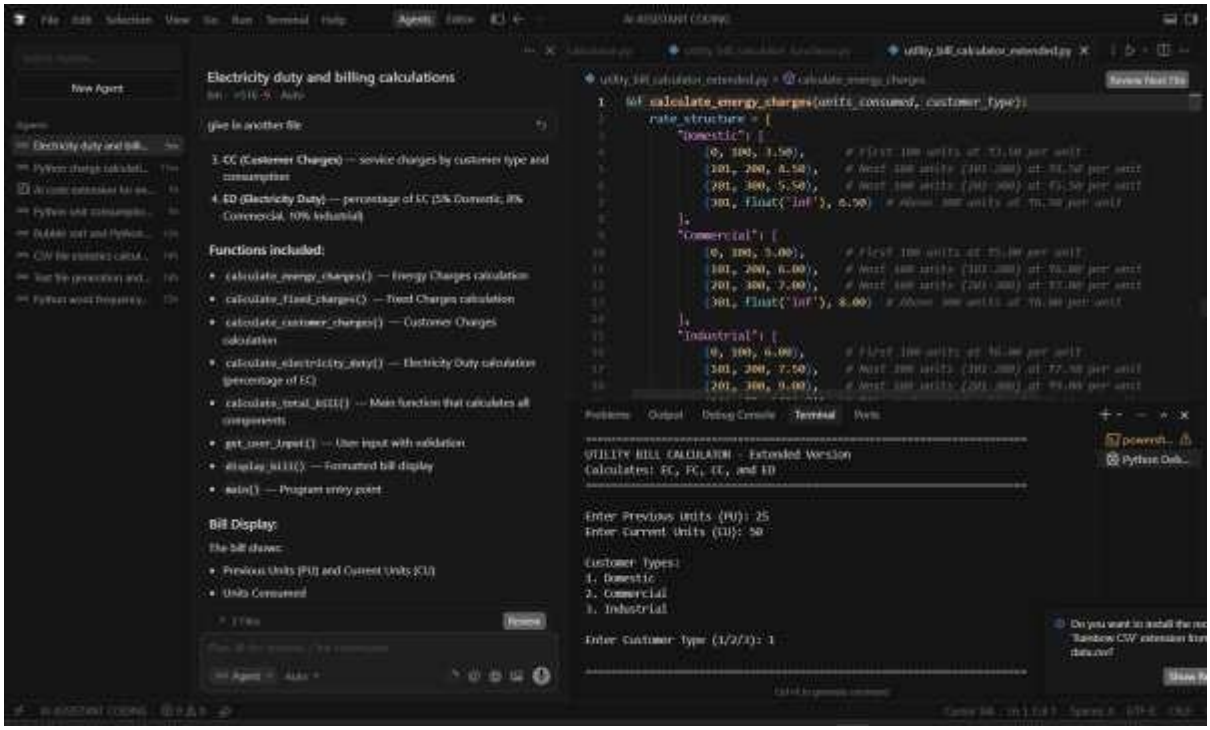
```
    print("BILL CALCULATION RESULTS")
    print("=" * 70)
    print(f"Previous Units (PU):       {bill_details['previous_units']:.2f} units")
    print(f"Current Units (CU):        {bill_details['current_units']:.2f} units")
    print(f"Units Consumed:            {bill_details['units_consumed']:.2f} units")
    print(f"Customer Type:             {bill_details['customer_type']}")
    print("-" * 70)
    print("CHARGE BREAKDOWN:")
    print(f"  Energy Charges (EC):     ₹{bill_details['energy_charges']:.2f}")
    print(f"  Fixed Charges (FC):      ₹{bill_details['fixed_charges']:.2f}")
    print(f"  Customer Charges (CC):   ₹{bill_details['customer_charges']:.2f}")
    print(f"  Electricity Duty (ED):   ₹{bill_details['electricity_duty']:.2f}")
    print("-" * 70)
    print(f"TOTAL BILL AMOUNT:         ₹{bill_details['total_bill']:.2f}")
    print("=" * 70)

def main():
    try:
        # Step 1: Get user input
        previous_units, current_units, customer_type = get_user_input()
        bill_details = calculate_total_bill(previous_units, current_units, customer_type)

        # Step 3: Display the calculated bill
        display_bill(bill_details)

    except ValueError as e:
        print(f"\nError: {e}")
    except Exception as e:
        print(f"\nUnexpected error: {e}")
```

 # Program entry point

if __name___== "__main__":

main()

Output:



UTILITY BILL CALCULATOR - Extended Version

Calculates: EC, FC, CC, and ED

Enter Previous Units (PU): 25

Enter Current Units (CU): 50

Customer Types:

1. Domestic

2. Commercial

3. Industrial

Enter Customer Type (1/2/3): 1

BILL CALCULATION RESULTS

Previous Units (PU): 25.00 units

Current Units (CU): 50.00 units

Units Consumed: 25.00 units

Customer Type: Domestic

CHARGE BREAKDOWN:

Energy Charges (EC): ₹87.50

Fixed Charges (FC): ₹50.00

Customer Charges (CC): ₹25.00

Electricity Duty (ED): ₹4.38

TOTAL BILL AMOUNT: ₹166.88

Explanation:

- calculate_energy_charges() — Energy Charges calculation
- calculate_fixed_charges() — Fixed Charges calculation
- calculate_customer_charges() — Customer Charges calculation
- calculate_electricity_duty() — Electricity Duty calculation (percentage of EC)
- calculate_total_bill() — Main function that calculates all components
- get_user_input() — User input with validation
- display_bill() — Formatted bill display
- main() — Program entry point

Task-05

Prompt: Develop a Python application to calculate and display Energy Charges (EC), Fixed Charges (FC), Customer Charges (CC), Electricity Duty (ED), and the Total Bill (EC + FC + CC + ED).

Code:

```
def calculate_energy_charges(units_consumed, customer_type):
    rate_structure = {
        "Domestic": [
            (0, 100, 3.50),      # First 100 units at ₹3.50 per unit
            (101, 200, 4.50),    # Next 100 units (101-200) at ₹4.50 per unit
            (201, 300, 5.50),    # Next 100 units (201-300) at ₹5.50 per unit
            (301, float('inf'), 6.50)  # Above 300 units at ₹6.50 per unit
```

```
        ],
        "Commercial": [
            (0, 100, 5.00),      # First 100 units at ₹5.00 per unit
            (101, 200, 6.00),    # Next 100 units (101-200) at ₹6.00 per unit
            (201, 300, 7.00),    # Next 100 units (201-300) at ₹7.00 per unit
            (301, float('inf'), 8.00)  # Above 300 units at ₹8.00 per unit
        ],
        "Industrial": [
            (0, 100, 6.00),      # First 100 units at ₹6.00 per unit
            (101, 200, 7.50),    # Next 100 units (101-200) at ₹7.50 per unit
            (201, 300, 9.00),    # Next 100 units (201-300) at ₹9.00 per unit
            (301, float('inf'), 10.50)  # Above 300 units at ₹10.50 per unit
        ]
    }
    # Validate customer type
    if customer_type not in rate_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")
    # Validate units consumed
    if units_consumed < 0:
        raise ValueError("Units consumed cannot be negative")
    # Get the applicable rate slabs for the customer type
    slabs = rate_structure[customer_type]
    # Find the applicable rate based on units consumed
    for min_units, max_units, rate_per_unit in slabs:
        if min_units <= units_consumed <= max_units:
            # Units fall within this slab, calculate charges at this rate
            energy_charges = units_consumed * rate_per_unit
            return energy_charges
```

```
    # Fallback: If consumption exceeds all defined slabs, use the highest rate
    highest_rate = slabs[-1][2]
    return units_consumed * highest_rate
def calculate_fixed_charges(customer_type, units_consumed):
    fixed_charges_structure = {
        "Domestic": {
            "low": 50.00,      # For consumption up to 100 units
            "medium": 75.00,   # For consumption 101-200 units
            "high": 100.00,    # For consumption 201-300 units
            "very_high": 150.00  # For consumption above 300 units
        },
        "Commercial": {
            "low": 200.00,     # For consumption up to 100 units
            "medium": 300.00,  # For consumption 101-200 units
            "high": 400.00,    # For consumption 201-300 units
            "very_high": 500.00  # For consumption above 300 units
        },
        "Industrial": {
            "low": 500.00,     # For consumption up to 100 units
            "medium": 750.00,  # For consumption 101-200 units
            "high": 1000.00,   # For consumption 201-300 units
            "very_high": 1500.00  # For consumption above 300 units
        }
    }
    # Validate customer type
    if customer_type not in fixed_charges_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic,
Commercial, or Industrial")
    # Determine consumption category based on units consumed
    if units_consumed <= 100:
```

```
        category = "low"
    elif units_consumed <= 200:
        category = "medium"
    elif units_consumed <= 300:
        category = "high"
    else:
        category = "very_high"
    # Get and return the fixed charges for this customer type and category
    fixed_charges = fixed_charges_structure[customer_type][category]
    return fixed_charges
def calculate_customer_charges(customer_type, units_consumed):
    customer_charges_structure = {
        "Domestic": {
            "low": 25.00,      # For consumption up to 100 units
            "medium": 35.00,   # For consumption 101-200 units
            "high": 50.00,     # For consumption 201-300 units
            "very_high": 75.00  # For consumption above 300 units
        },
        "Commercial": {
            "low": 100.00,     # For consumption up to 100 units
            "medium": 150.00,  # For consumption 101-200 units
            "high": 200.00,    # For consumption 201-300 units
            "very_high": 300.00  # For consumption above 300 units
        },
        "Industrial": {
            "low": 250.00,     # For consumption up to 100 units
            "medium": 400.00,  # For consumption 101-200 units
            "high": 600.00,    # For consumption 201-300 units
            "very_high": 900.00  # For consumption above 300 units
```

```
        }
    }
    # Validate customer type
    if customer_type not in customer_charges_structure:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")
    # Determine consumption category based on units consumed
    if units_consumed <= 100:
        category = "low"
    elif units_consumed <= 200:
        category = "medium"
    elif units_consumed <= 300:
        category = "high"
    else:
        category = "very_high"
    # Get and return the customer charges for this customer type and category
    customer_charges = customer_charges_structure[customer_type][category]
    return customer_charges
def calculate_electricity_duty(energy_charges, customer_type):
    duty_percentage = {
        "Domestic": 5.0,      # 5% of EC for Domestic customers
        "Commercial": 8.0,    # 8% of EC for Commercial customers
        "Industrial": 10.0    # 10% of EC for Industrial customers
    }
    # Validate customer type
    if customer_type not in duty_percentage:
        raise ValueError(f"Invalid customer type: {customer_type}. Must be Domestic, Commercial, or Industrial")
    # Validate energy charges
    if energy_charges < 0:
```

```
        raise ValueError("Energy Charges cannot be negative")
    # Calculate electricity duty as percentage of energy charges
    duty_percent = duty_percentage[customer_type]
    electricity_duty = energy_charges * (duty_percent / 100.0)
    return electricity_duty
def calculate_total_bill(previous_units, current_units, customer_type):
    # Validate inputs
    if previous_units < 0:
        raise ValueError("Previous Units cannot be negative")
    if current_units < 0:
        raise ValueError("Current Units cannot be negative")
    if current_units < previous_units:
        raise ValueError("Current Units cannot be less than Previous Units")
    # Calculate units consumed (difference between current and previous readings)
    units_consumed = current_units - previous_units
    # Calculate Energy Charges (EC)
    energy_charges = calculate_energy_charges(units_consumed, customer_type)
    # Calculate Fixed Charges (FC)
    fixed_charges = calculate_fixed_charges(customer_type, units_consumed)
    # Calculate Customer Charges (CC)
    customer_charges = calculate_customer_charges(customer_type, units_consumed)
    # Calculate Electricity Duty (ED) as percentage of Energy Charges
    electricity_duty = calculate_electricity_duty(energy_charges, customer_type)
    # Calculate total bill (EC + FC + CC + ED)
    total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty
    # Return all calculated values as a dictionary
    return {
        "previous_units": previous_units,
        "current_units": current_units,
```

```
        "units_consumed": units_consumed,
        "customer_type": customer_type,
        "energy_charges": energy_charges,
        "fixed_charges": fixed_charges,
        "customer_charges": customer_charges,
        "electricity_duty": electricity_duty,
        "total_bill": total_bill
    }

def get_user_input():
    print("=" * 70)
    print("ELECTRICITY BILL CALCULATOR")
    print("Calculates: EC, FC, CC, ED, and Total Bill")
    print("=" * 70)
    # Get Previous Units (PU) with validation
    while True:
        try:
            previous_units = float(input("\nEnter Previous Units (PU): "))
            if previous_units < 0:
                print("Error: Previous Units cannot be negative. Please try again.")
                continue
            break
        except ValueError:
            print("Error: Please enter a valid number.")
    # Get Current Units (CU) with validation
    while True:
        try:
            current_units = float(input("Enter Current Units (CU): "))
            if current_units < 0:
```

```
            print("Error: Current Units cannot be negative. Please try again.")
            continue
        if current_units < previous_units:
            print("Error: Current Units cannot be less than Previous Units. Please try again.")
            continue
        break
    except ValueError:
        print("Error: Please enter a valid number.")
# Get Customer Type with validation
print("\nCustomer Types:")
print("1. Domestic")
print("2. Commercial")
print("3. Industrial")
customer_types = {"1": "Domestic", "2": "Commercial", "3": "Industrial"}
while True:
    choice = input("\nEnter Customer Type (1/2/3): ").strip()
    if choice in customer_types:
        customer_type = customer_types[choice]
        break
    print("Error: Please enter 1, 2, or 3.")
return previous_units, current_units, customer_type
def display_bill(bill_details):
print("\n" + "=" * 70)
print("ELECTRICITY BILL STATEMENT")
print("=" * 70)
print(f"Previous Units (PU):      {bill_details['previous_units']:.2f} units")
print(f"Current Units (CU):       {bill_details['current_units']:.2f} units")
print(f"Units Consumed:           {bill_details['units_consumed']:.2f} units")
print(f"Customer Type:            {bill_details['customer_type']}")
```

```
    print("-" * 70)
    print("CHARGE BREAKDOWN:")
    print(f"  Energy Charges (EC):       ₹{bill_details['energy_charges']:.2f}")
    print(f"  Fixed Charges (FC):        ₹{bill_details['fixed_charges']:.2f}")
    print(f"  Customer Charges (CC):     ₹{bill_details['customer_charges']:.2f}")
    print(f"  Electricity Duty (ED):     ₹{bill_details['electricity_duty']:.2f}")
    print("-" * 70)
    print(f"TOTAL BILL AMOUNT:         ₹{bill_details['total_bill']:.2f}")
    print("=" * 70)
def main():
    try:
        # Step 1: Get user input
        previous_units, current_units, customer_type = get_user_input()
        # Step 2: Calculate bill with all components
        bill_details = calculate_total_bill(previous_units, current_units, customer_type)
        # Step 3: Display the calculated bill
        display_bill(bill_details)
    except ValueError as e:
        print(f"\nError: {e}")
    except Exception as e:
        print(f"\nUnexpected error: {e}")
if __name___== "__main__":
    main()
```

Output:

```
ELECTRICITY BILL STATEMENT
Previous Units (PU):    56.00 units
Current Units (CU):     56.00 units
Units Consumed:          0.00 units
Customer Type:           Domestic
```

CHARGE BREAKDOWN:

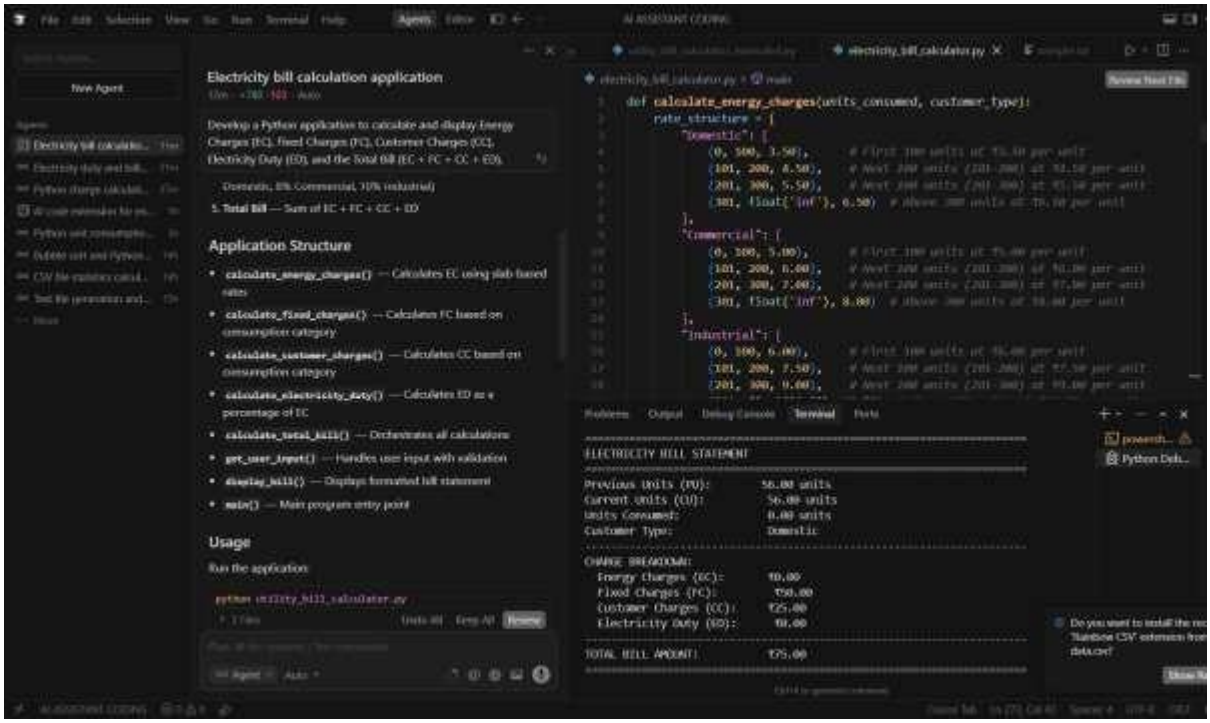
Energy Charges (EC): ₹0.00

Fixed Charges (FC): ₹50.00

Customer Charges (CC): ₹25.00

Electricity Duty (ED): ₹0.00

TOTAL BILL AMOUNT: ₹75.00



Explanation:

- calculate_energy_charges() — Calculates EC using slab-based rates
- calculate_fixed_charges() — Calculates FC based on consumption category
- calculate_customer_charges() — Calculates CC based on consumption category
- calculate_electricity_duty() — Calculates ED as a percentage of EC
- calculate_total_bill() — Orchestrates all calculations
- get_user_input() — Handles user input with validation
- display_bill() — Displays formatted bill statement
- main() — Main program entry point