Assignment 3.3 AI ASSISTED CODING

Htno:2303a51288

Btno:05

Task 1: AI-Generated Logic for Reading Consumer Details .

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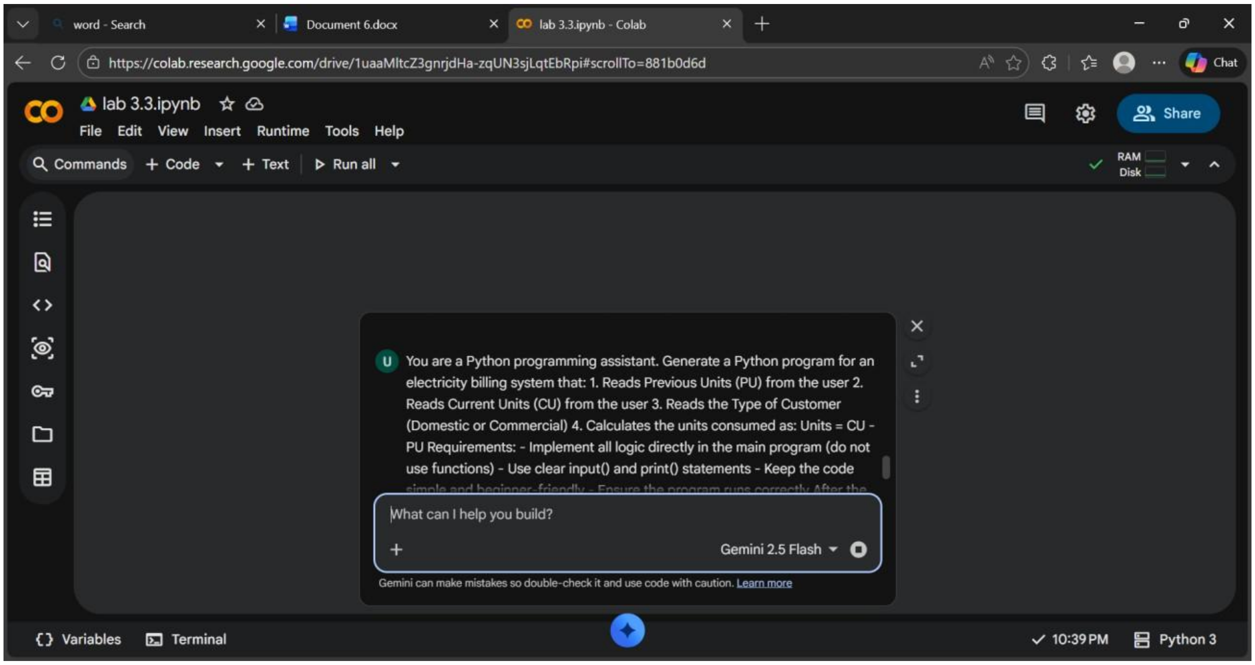

You are a Python programming assistant. Generate a Python program for an electricity billing system that: 1. Reads Previous Units (PU) from the user 2. Reads Current Units (CU) from the user 3. Reads the Type of Customer (Domestic or Commercial) 4. Calculates the units consumed as: Units = CU - PU Requirements: - Implement all logic directly in the main program (do not use functions) - Use clear input() and print() statements - Keep the code simple and beginner-friendly - Ensure the program runs correctly After the

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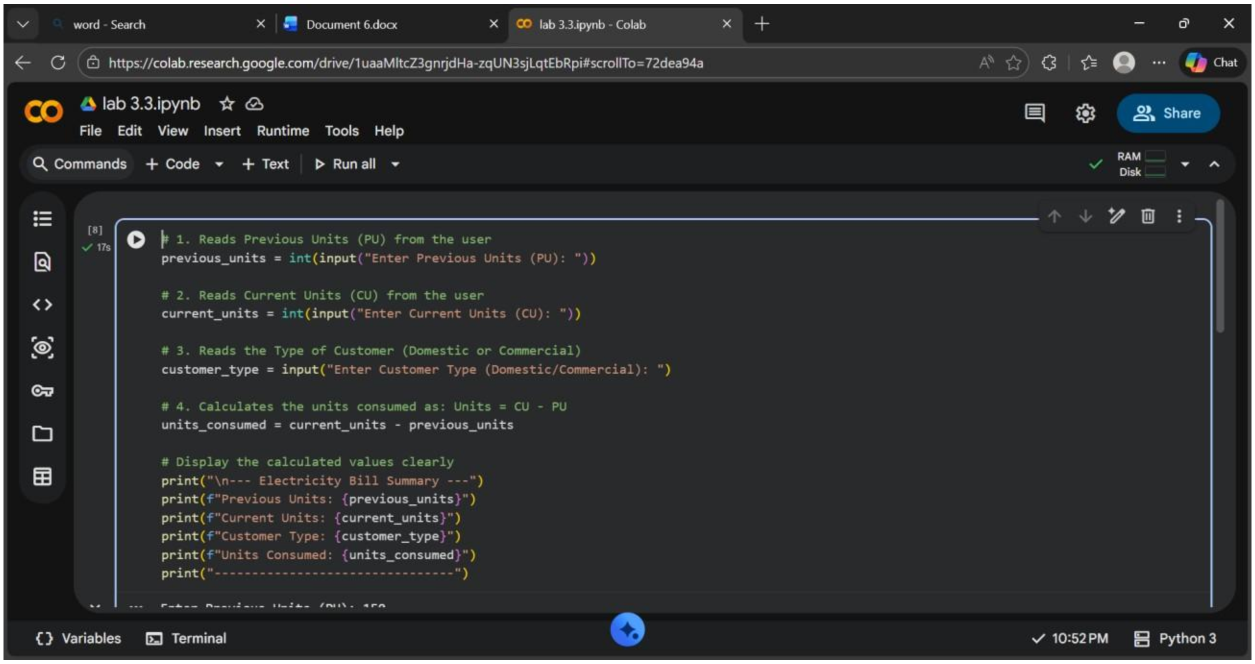
Code: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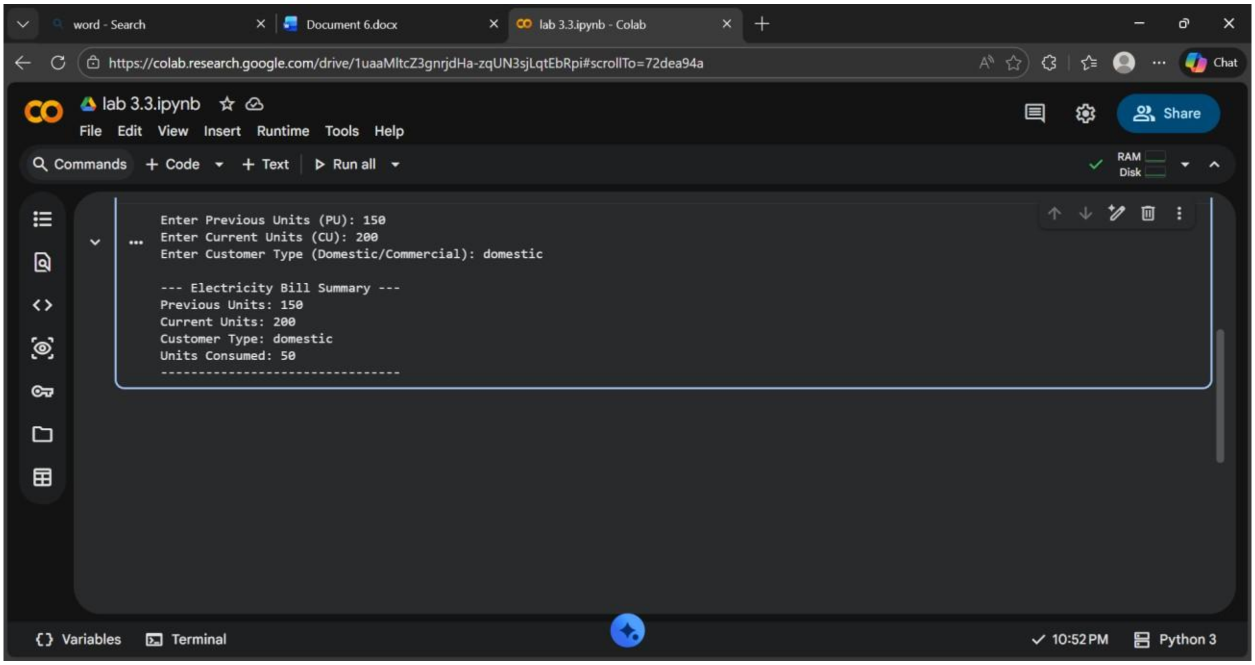
```python
# 1. Reads Previous Units (PU) from the user
previous_units = int(input("Enter Previous Units (PU): "))

# 2. Reads Current Units (CU) from the user
current_units = int(input("Enter Current Units (CU): "))

# 3. Reads the Type of Customer (Domestic or Commercial)
customer_type = input("Enter Customer Type (Domestic/Commercial): ")

# 4. Calculates the units consumed as: Units = CU - PU
units_consumed = current_units - previous_units

# Display the calculated values clearly
print("\n--- Electricity Bill Summary ---")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Customer Type: {customer_type}")
print(f"Units Consumed: {units_consumed}")
print("--------------------------------")
```

Output: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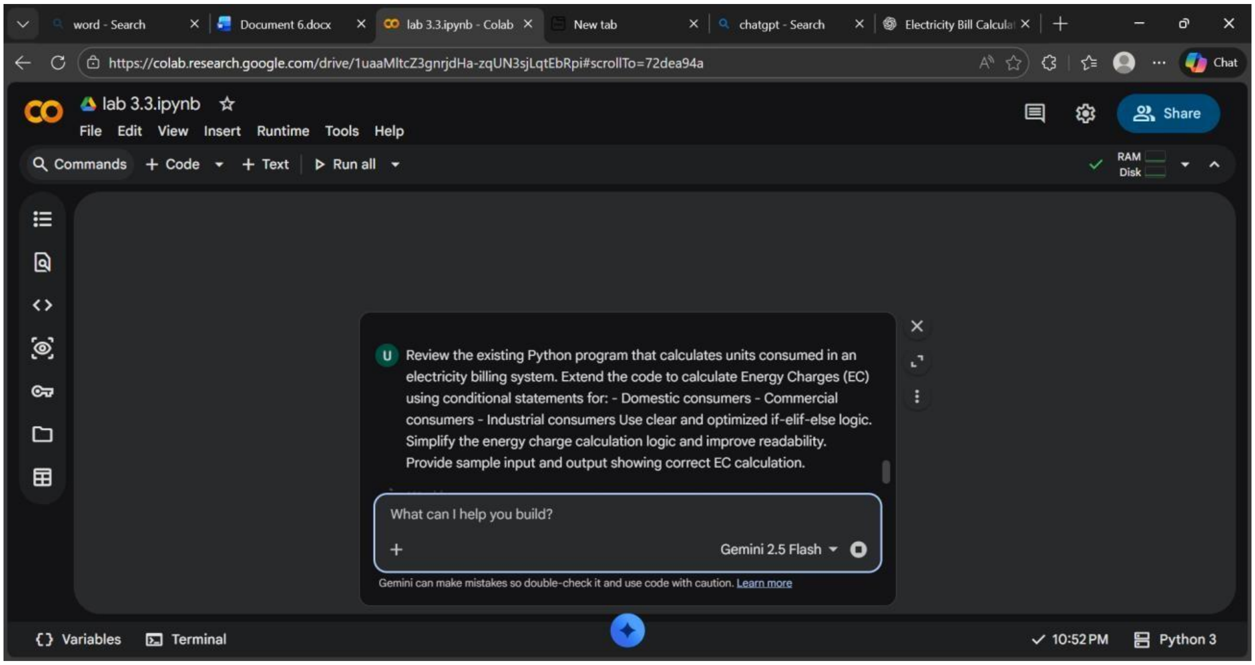
```
Enter Previous Units (PU): 150
Enter Current Units (CU): 200
Enter Customer Type (Domestic/Commercial): domestic

--- Electricity Bill Summary ---
Previous Units: 150
Current Units: 200
Customer Type: domestic
Units Consumed: 50
--------------------------------
```

Explanation: The program reads previous units, current units, and customer type from the user. It calculates **units consumed** by subtracting previous units from current units (200 − 150 = 50). Finally, it displays a clear electricity bill summary with all entered details and the calculated consumption.

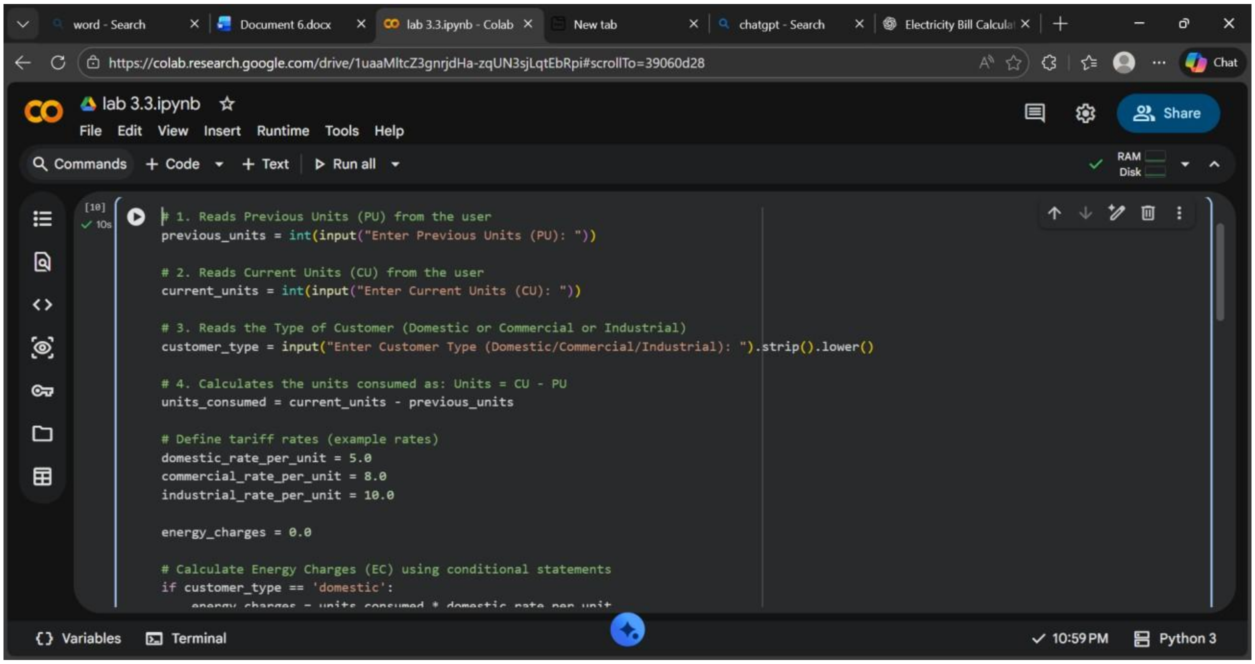
Task 2: Energy Charges Calculation Based on Units Consumed.

Prompt:

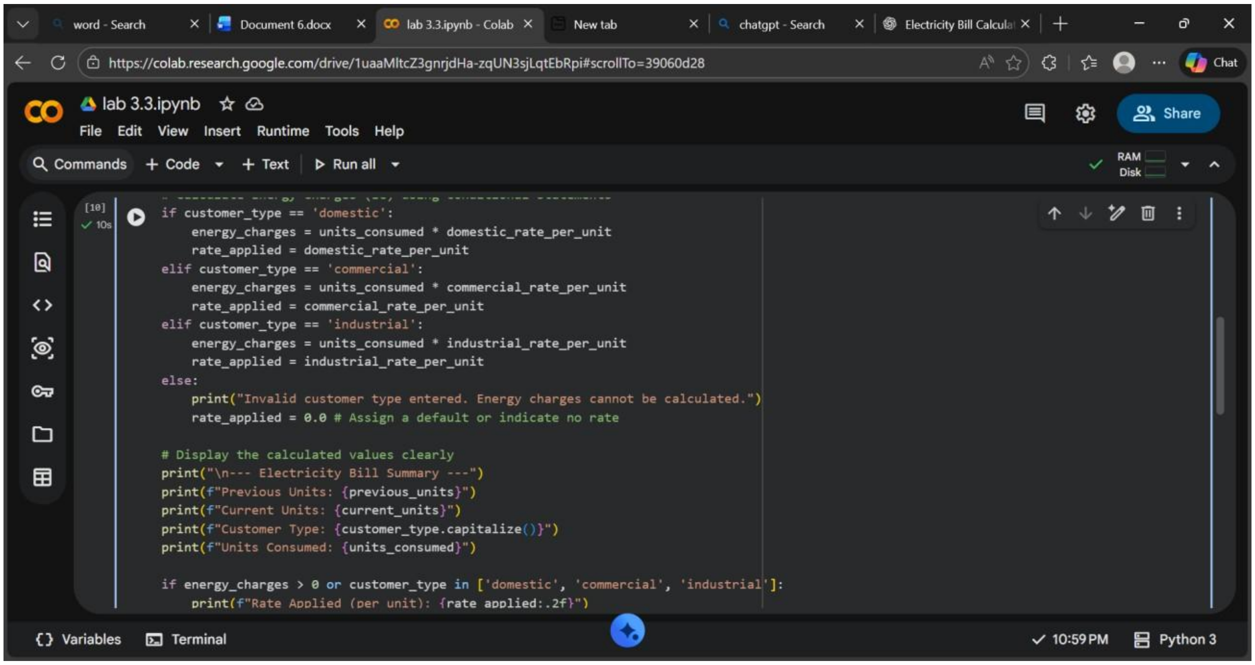


Review the existing Python program that calculates units consumed in an electricity billing system. Extend the code to calculate Energy Charges (EC) using conditional statements for: - Domestic consumers - Commercial consumers - Industrial consumers Use clear and optimized if-elif-else logic. Simplify the energy charge calculation logic and improve readability. Provide sample input and output showing correct EC calculation.

Code:

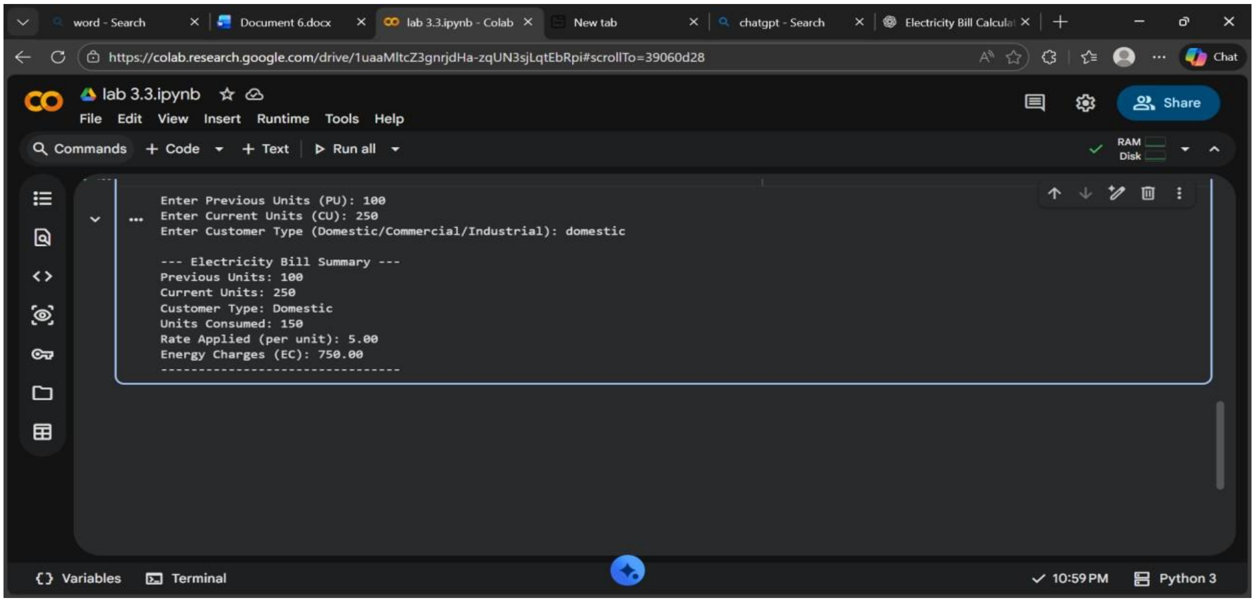


```python
# 1. Reads Previous Units (PU) from the user
previous_units = int(input("Enter Previous Units (PU): "))

# 2. Reads Current Units (CU) from the user
current_units = int(input("Enter Current Units (CU): "))

# 3. Reads the Type of Customer (Domestic or Commercial or Industrial)
customer_type = input("Enter Customer Type (Domestic/Commercial/Industrial): ").strip().lower()

# 4. Calculates the units consumed as: Units = CU - PU
units_consumed = current_units - previous_units

# Define tariff rates (example rates)
domestic_rate_per_unit = 5.0
commercial_rate_per_unit = 8.0
industrial_rate_per_unit = 10.0

energy_charges = 0.0

# Calculate Energy Charges (EC) using conditional statements
if customer_type == 'domestic':
    energy_charges = units_consumed * domestic_rate_per_unit
```



```python
# Calculate Energy Charges (EC) using conditional statements
if customer_type == 'domestic':
    energy_charges = units_consumed * domestic_rate_per_unit
    rate_applied = domestic_rate_per_unit
elif customer_type == 'commercial':
    energy_charges = units_consumed * commercial_rate_per_unit
    rate_applied = commercial_rate_per_unit
elif customer_type == 'industrial':
    energy_charges = units_consumed * industrial_rate_per_unit
    rate_applied = industrial_rate_per_unit
else:
    print("Invalid customer type entered. Energy charges cannot be calculated.")
    rate_applied = 0.0 # Assign a default or indicate no rate

# Display the calculated values clearly
print("\n--- Electricity Bill Summary ---")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Customer Type: {customer_type.capitalize()}")
print(f"Units Consumed: {units_consumed}")

if energy_charges > 0 or customer_type in ['domestic', 'commercial', 'industrial']:
    print(f"Rate Applied (per unit): {rate_applied:.2f}")
```

Output:



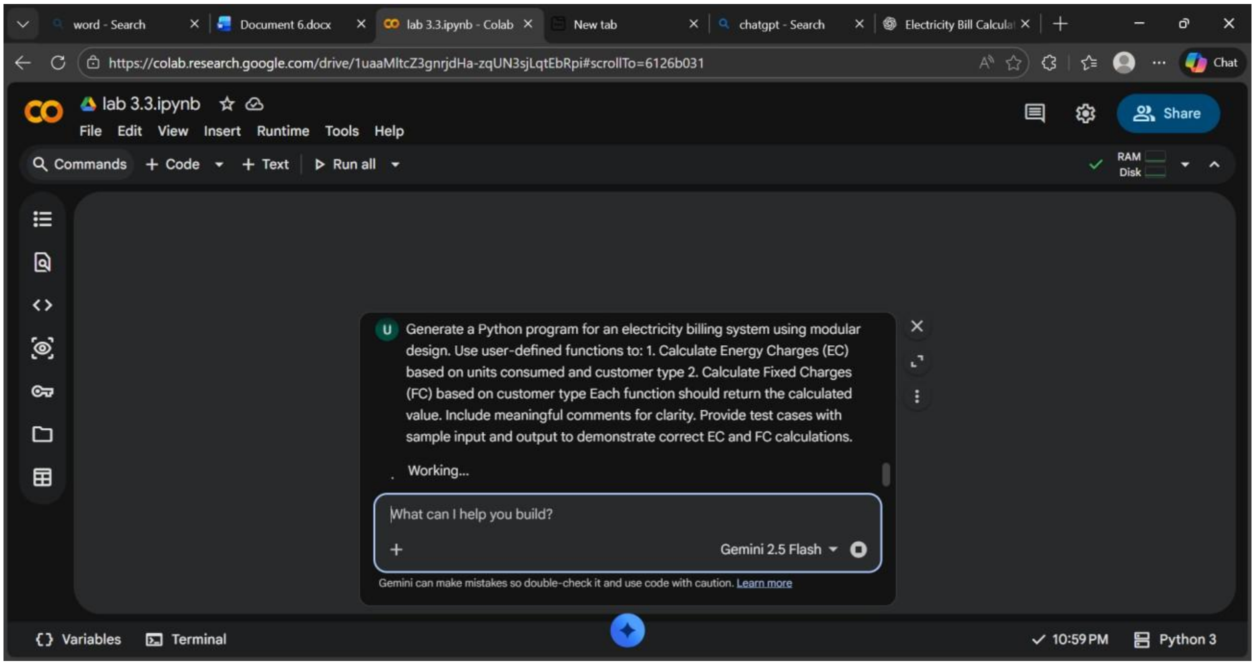
```
Enter Previous Units (PU): 100
Enter Current Units (CU): 250
Enter Customer Type (Domestic/Commercial/Industrial): domestic

--- Electricity Bill Summary ---
Previous Units: 100
Current Units: 250
Customer Type: Domestic
Units Consumed: 150
Rate Applied (per unit): 5.00
Energy Charges (EC): 750.00
--------------------------------
```

Expalantion: The extended program calculates **Energy Charges** based on units consumed and customer type using conditional statements.

Optimized `if-elif-else` logic improves readability and makes the billing rules easy to understand.

Task 3: Modular Design Using AI Assistance (Using Functions).

Prompt:



Generate a Python program for an electricity billing system using modular design. Use user-defined functions to: 1. Calculate Energy Charges (EC) based on units consumed and customer type 2. Calculate Fixed Charges (FC) based on customer type Each function should return the calculated value. Include meaningful comments for clarity. Provide test cases with sample input and output to demonstrate correct EC and FC calculations.

Working...

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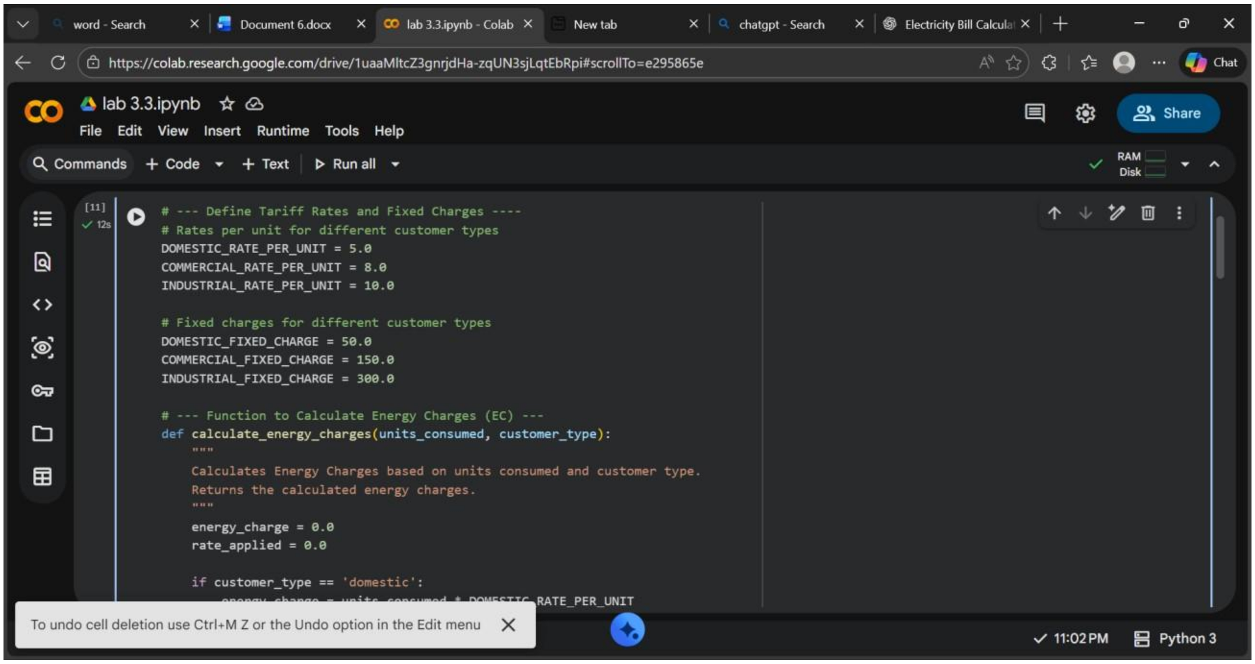
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```
# --- Define Tariff Rates and Fixed Charges ----
# Rates per unit for different customer types
DOMESTIC_RATE_PER_UNIT = 5.0
COMMERCIAL_RATE_PER_UNIT = 8.0
INDUSTRIAL_RATE_PER_UNIT = 10.0

# Fixed charges for different customer types
DOMESTIC_FIXED_CHARGE = 50.0
COMMERCIAL_FIXED_CHARGE = 150.0
INDUSTRIAL_FIXED_CHARGE = 300.0

# --- Function to Calculate Energy Charges (EC) ---
def calculate_energy_charges(units_consumed, customer_type):
    """
    Calculates Energy Charges based on units consumed and customer type.
    Returns the calculated energy charges.
    """
    energy_charge = 0.0
    rate_applied = 0.0

    if customer_type == 'domestic':
        energy_charge = units_consumed * DOMESTIC_RATE_PER_UNIT
```

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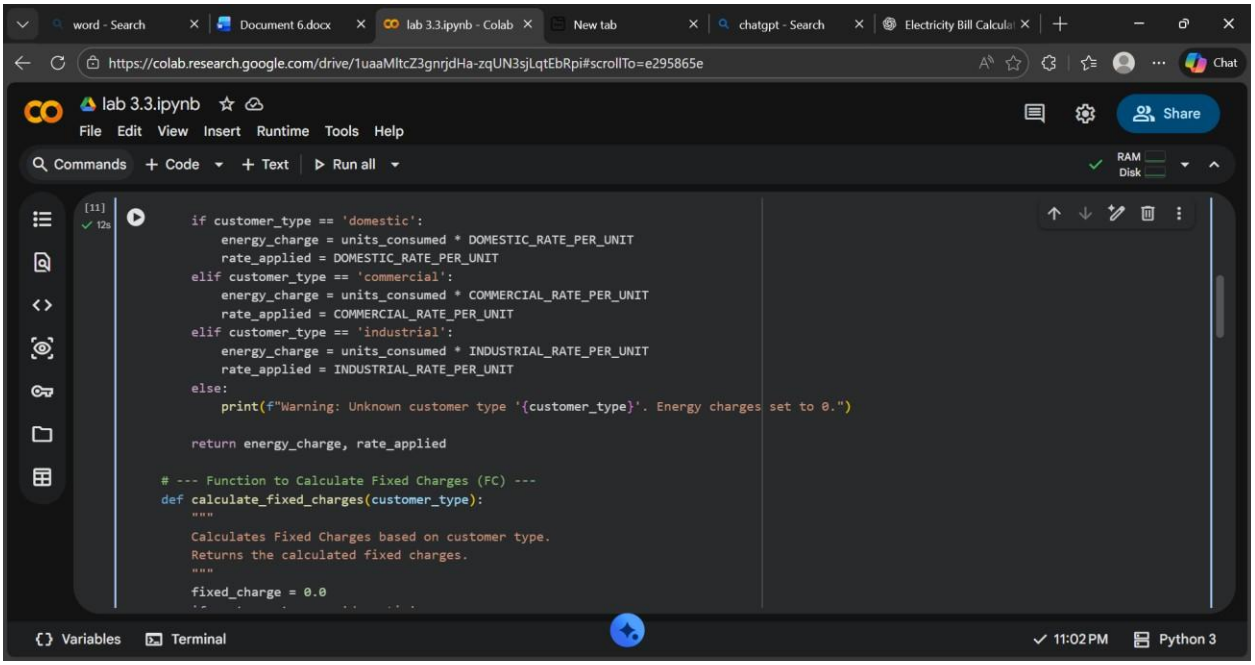
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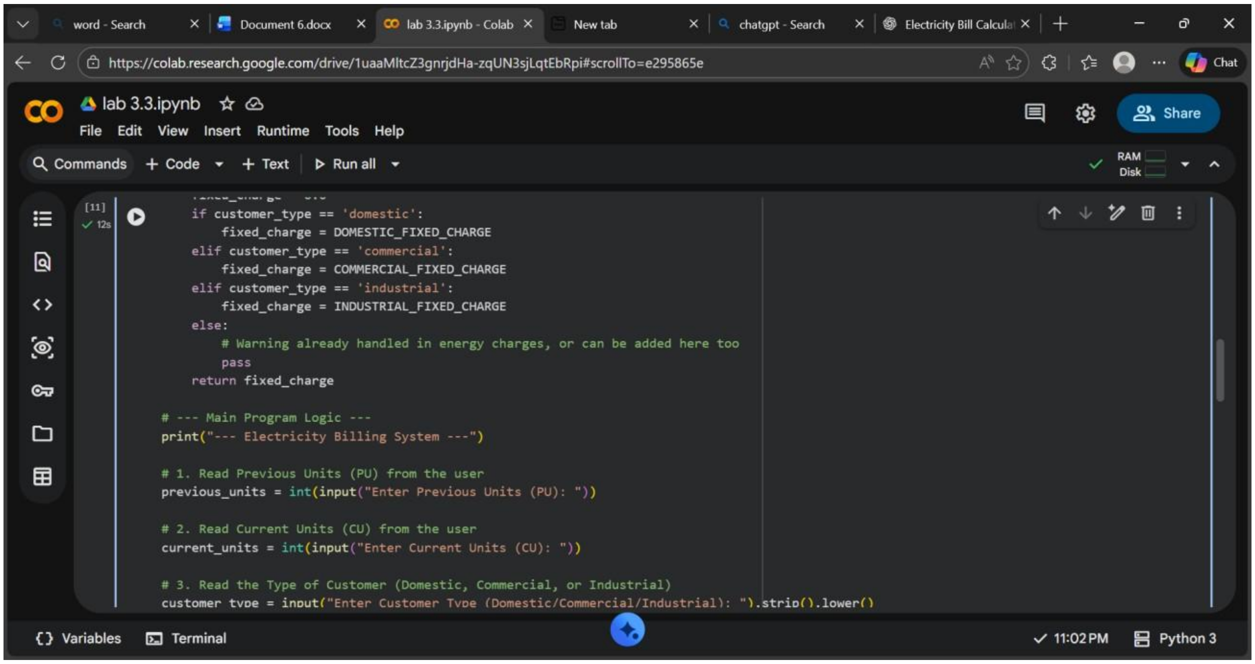
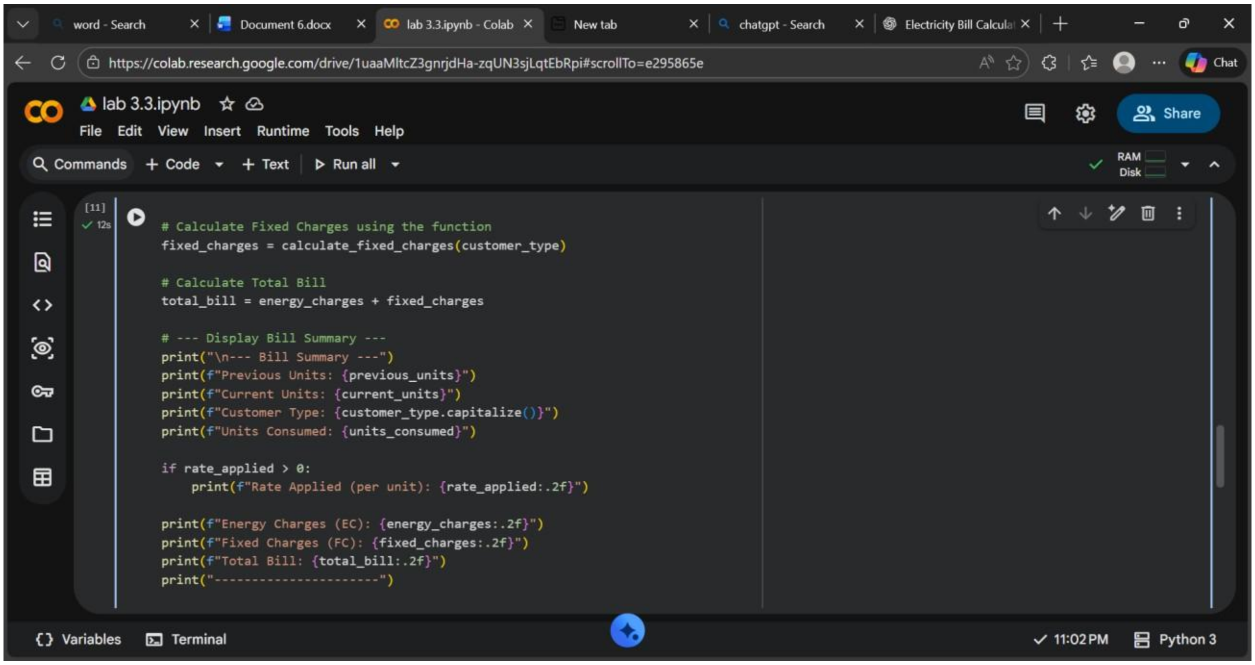
```
    if customer_type == 'domestic':
        energy_charge = units_consumed * DOMESTIC_RATE_PER_UNIT
        rate_applied = DOMESTIC_RATE_PER_UNIT
    elif customer_type == 'commercial':
        energy_charge = units_consumed * COMMERCIAL_RATE_PER_UNIT
        rate_applied = COMMERCIAL_RATE_PER_UNIT
    elif customer_type == 'industrial':
        energy_charge = units_consumed * INDUSTRIAL_RATE_PER_UNIT
        rate_applied = INDUSTRIAL_RATE_PER_UNIT
    else:
        print(f"Warning: Unknown customer type '{customer_type}'. Energy charges set to 0.")

    return energy_charge, rate_applied

# --- Function to Calculate Fixed Charges (FC) ---
def calculate_fixed_charges(customer_type):
    """
    Calculates Fixed Charges based on customer type.
    Returns the calculated fixed charges.
    """
    fixed_charge = 0.0
```

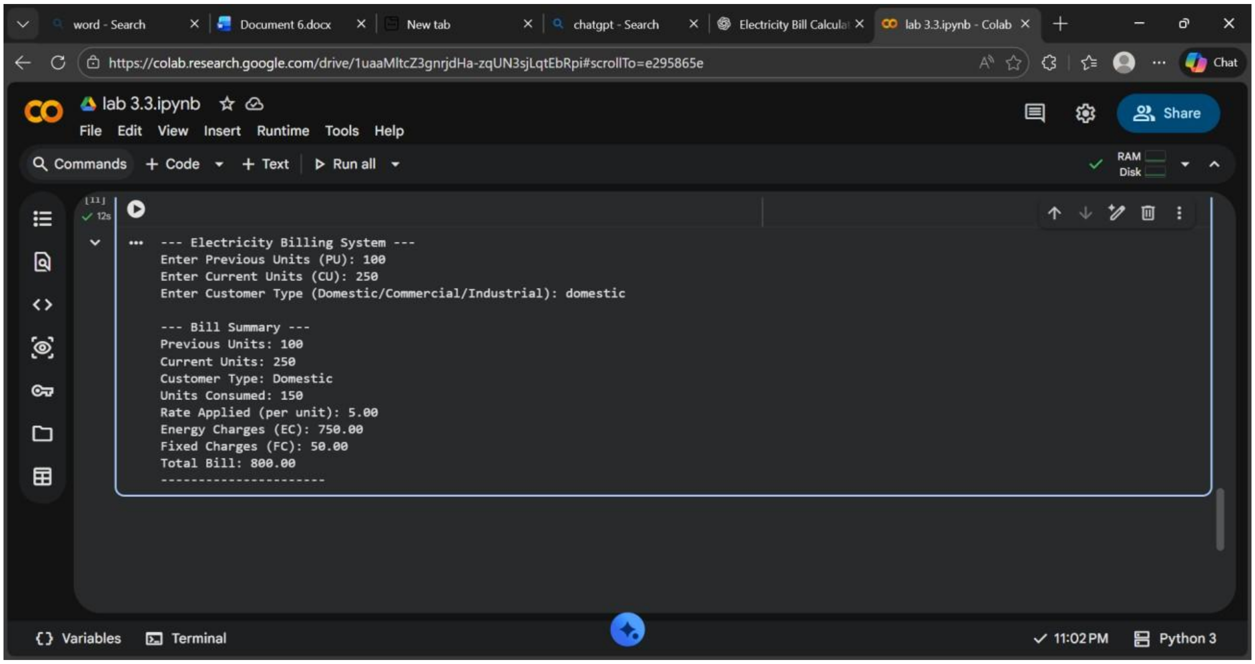


```
    if customer_type == 'domestic':
        fixed_charge = DOMESTIC_FIXED_CHARGE
    elif customer_type == 'commercial':
        fixed_charge = COMMERCIAL_FIXED_CHARGE
    elif customer_type == 'industrial':
        fixed_charge = INDUSTRIAL_FIXED_CHARGE
    else:
        # Warning already handled in energy charges, or can be added here too
        pass
    return fixed_charge

# --- Main Program Logic ---
print("--- Electricity Billing System ---")

# 1. Read Previous Units (PU) from the user
previous_units = int(input("Enter Previous Units (PU): "))

# 2. Read Current Units (CU) from the user
current_units = int(input("Enter Current Units (CU): "))

# 3. Read the Type of Customer (Domestic, Commercial, or Industrial)
customer_type = input("Enter Customer Type (Domestic/Commercial/Industrial): ").strip().lower()
```



```
# Calculate Fixed Charges using the function
fixed_charges = calculate_fixed_charges(customer_type)

# Calculate Total Bill
total_bill = energy_charges + fixed_charges

# --- Display Bill Summary ---
print("\n--- Bill Summary ---")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Customer Type: {customer_type.capitalize()}")
print(f"Units Consumed: {units_consumed}")

if rate_applied > 0:
    print(f"Rate Applied (per unit): {rate_applied:.2f}")

print(f"Energy Charges (EC): {energy_charges:.2f}")
print(f"Fixed Charges (FC): {fixed_charges:.2f}")
print(f"Total Bill: {total_bill:.2f}")
print("----------------------")
```

Output:



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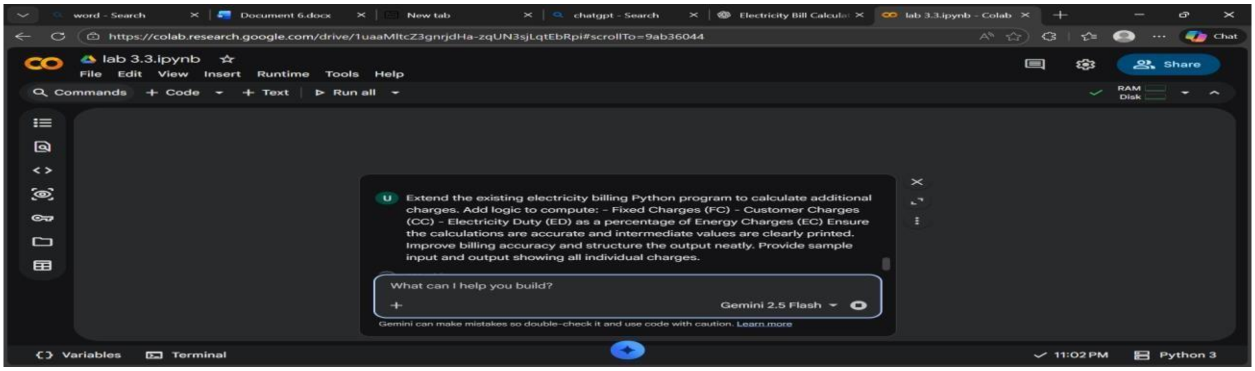
```
--- Electricity Billing System ---
Enter Previous Units (PU): 100
Enter Current Units (CU): 250
Enter Customer Type (Domestic/Commercial/Industrial): domestic

--- Bill Summary ---
Previous Units: 100
Current Units: 250
Customer Type: Domestic
Units Consumed: 150
Rate Applied (per unit): 5.00
Energy Charges (EC): 750.00
Fixed Charges (FC): 50.00
Total Bill: 800.00
----------------------
```

Explanation: This program uses **functions** to make the billing logic reusable for multiple consumers.

Separating Energy Charges and Fixed Charges into functions improves clarity, modularity, and easy maintenance of the code.

Task 4: Calculation of Additional Charges.

Prompt:



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Extend the existing electricity billing Python program to calculate additional charges. Add logic to compute: - Fixed Charges (FC) - Customer Charges (CC) - Electricity Duty (ED) as a percentage of Energy Charges (EC) Ensure the calculations are accurate and intermediate values are clearly printed. Improve billing accuracy and structure the output neatly. Provide sample input and output showing all individual charges.

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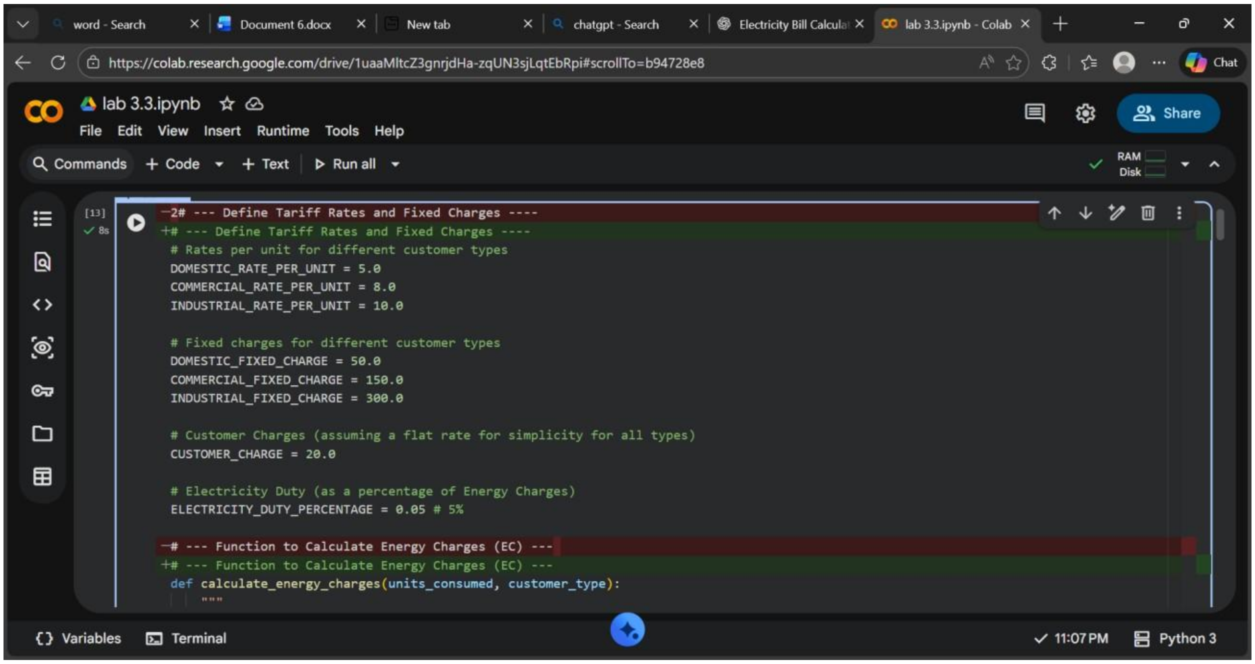
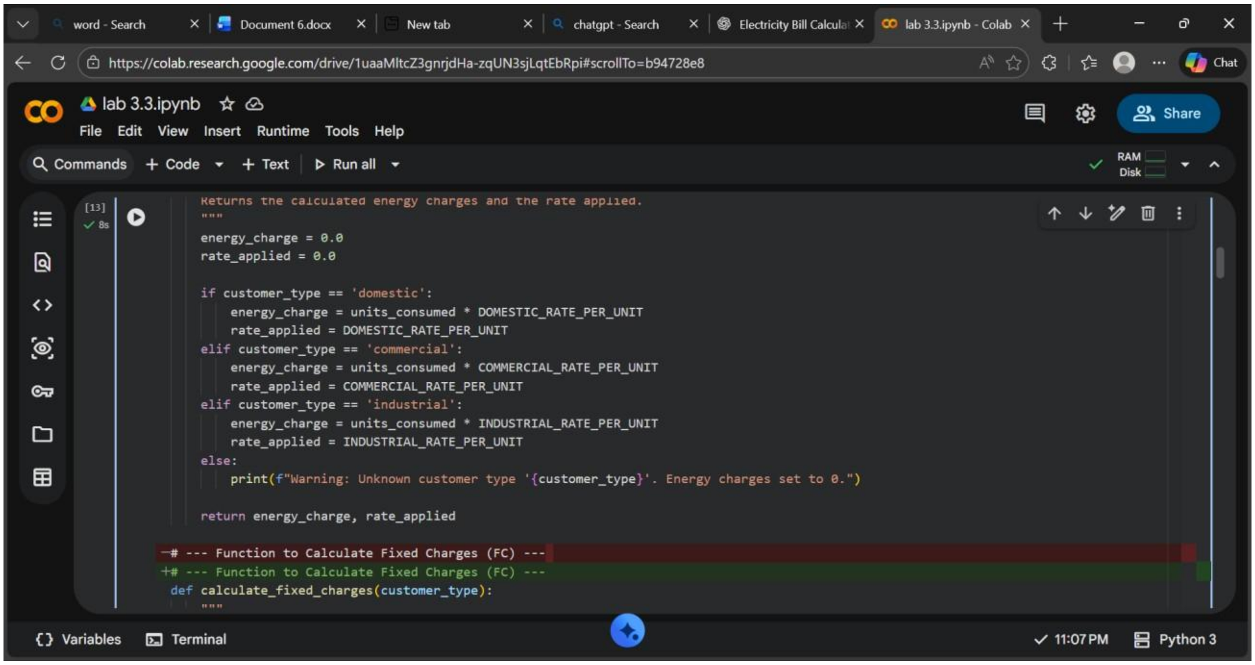
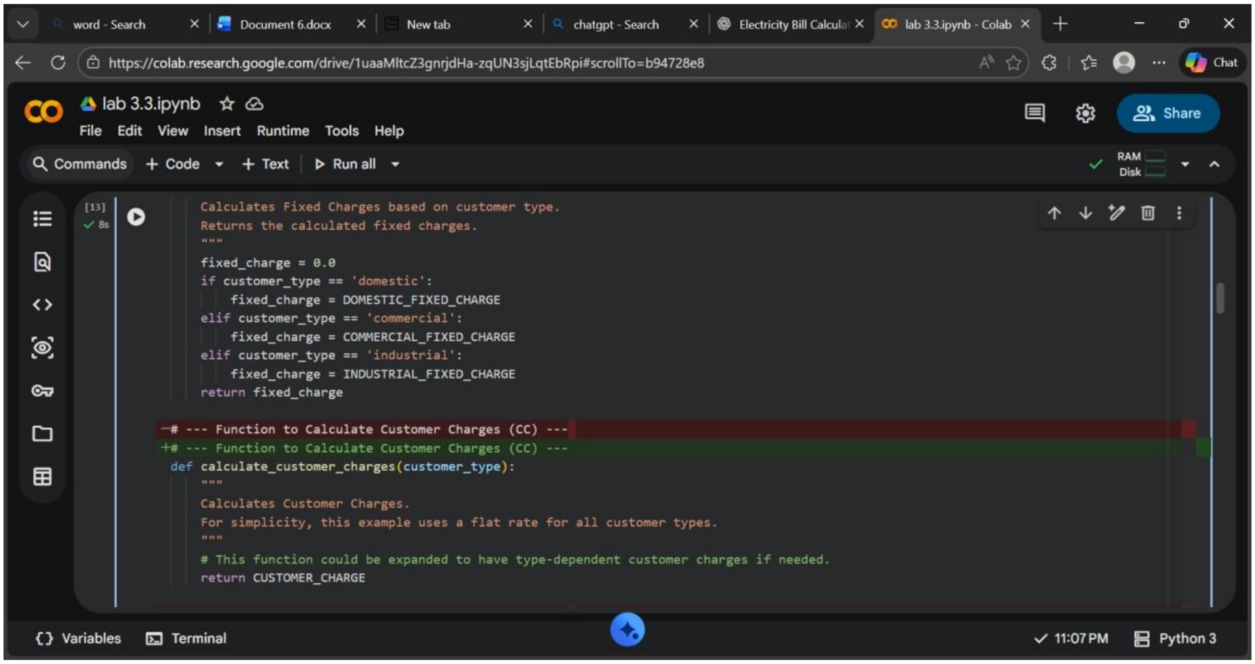
Code:



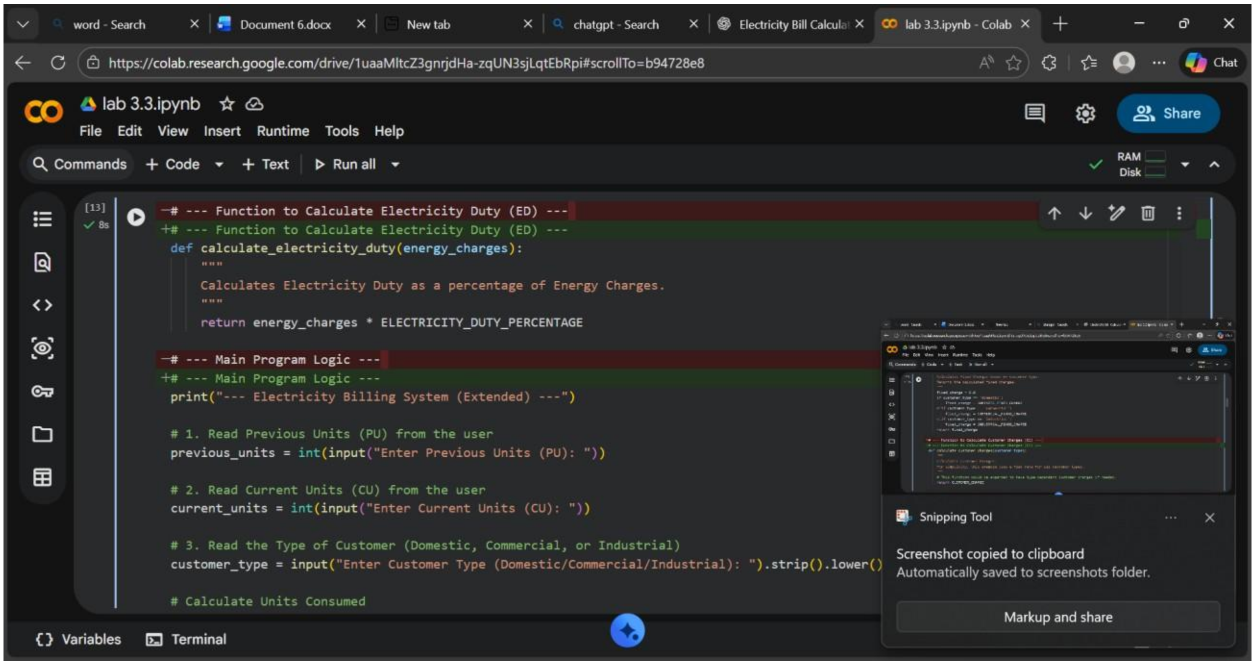
```
-2# --- Define Tariff Rates and Fixed Charges ----
+# --- Define Tariff Rates and Fixed Charges ----
 # Rates per unit for different customer types
 DOMESTIC_RATE_PER_UNIT = 5.0
 COMMERCIAL_RATE_PER_UNIT = 8.0
 INDUSTRIAL_RATE_PER_UNIT = 10.0

 # Fixed charges for different customer types
 DOMESTIC_FIXED_CHARGE = 50.0
 COMMERCIAL_FIXED_CHARGE = 150.0
 INDUSTRIAL_FIXED_CHARGE = 300.0

 # Customer Charges (assuming a flat rate for simplicity for all types)
 CUSTOMER_CHARGE = 20.0

 # Electricity Duty (as a percentage of Energy Charges)
 ELECTRICITY_DUTY_PERCENTAGE = 0.05 # 5%

-# --- Function to Calculate Energy Charges (EC) ---
+# --- Function to Calculate Energy Charges (EC) ---
 def calculate_energy_charges(units_consumed, customer_type):
     """
```



```
     Returns the calculated energy charges and the rate applied.
     """
     energy_charge = 0.0
     rate_applied = 0.0

     if customer_type == 'domestic':
         energy_charge = units_consumed * DOMESTIC_RATE_PER_UNIT
         rate_applied = DOMESTIC_RATE_PER_UNIT
     elif customer_type == 'commercial':
         energy_charge = units_consumed * COMMERCIAL_RATE_PER_UNIT
         rate_applied = COMMERCIAL_RATE_PER_UNIT
     elif customer_type == 'industrial':
         energy_charge = units_consumed * INDUSTRIAL_RATE_PER_UNIT
         rate_applied = INDUSTRIAL_RATE_PER_UNIT
     else:
         print(f"Warning: Unknown customer type '{customer_type}'. Energy charges set to 0.")

     return energy_charge, rate_applied

-# --- Function to Calculate Fixed Charges (FC) ---
+# --- Function to Calculate Fixed Charges (FC) ---
 def calculate_fixed_charges(customer_type):
     """
```



```
        Calculates Fixed Charges based on customer type.
        Returns the calculated fixed charges.
        """
        fixed_charge = 0.0
        if customer_type == 'domestic':
            fixed_charge = DOMESTIC_FIXED_CHARGE
        elif customer_type == 'commercial':
            fixed_charge = COMMERCIAL_FIXED_CHARGE
        elif customer_type == 'industrial':
            fixed_charge = INDUSTRIAL_FIXED_CHARGE
        return fixed_charge

-# --- Function to Calculate Customer Charges (CC) ---
+# --- Function to Calculate Customer Charges (CC) ---
 def calculate_customer_charges(customer_type):
        """
        Calculates Customer Charges.
        For simplicity, this example uses a flat rate for all customer types.
        """
        # This function could be expanded to have type-dependent customer charges if needed.
        return CUSTOMER_CHARGE
```



```
-# --- Function to Calculate Electricity Duty (ED) ---
+# --- Function to Calculate Electricity Duty (ED) ---
 def calculate_electricity_duty(energy_charges):
        """
        Calculates Electricity Duty as a percentage of Energy Charges.
        """
        return energy_charges * ELECTRICITY_DUTY_PERCENTAGE

-# --- Main Program Logic ---
+# --- Main Program Logic ---
 print("--- Electricity Billing System (Extended) ---")

 # 1. Read Previous Units (PU) from the user
 previous_units = int(input("Enter Previous Units (PU): "))

 # 2. Read Current Units (CU) from the user
 current_units = int(input("Enter Current Units (CU): "))

 # 3. Read the Type of Customer (Domestic, Commercial, or Industrial)
 customer_type = input("Enter Customer Type (Domestic/Commercial/Industrial): ").strip().lower()

 # Calculate Units Consumed
```

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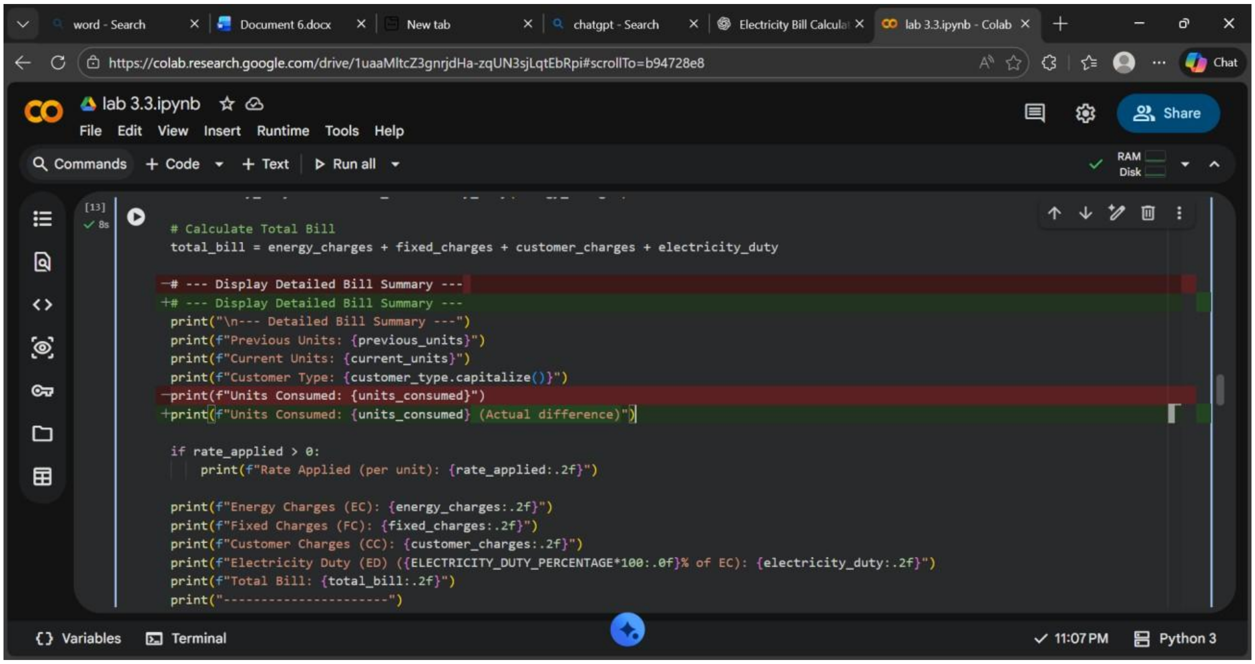
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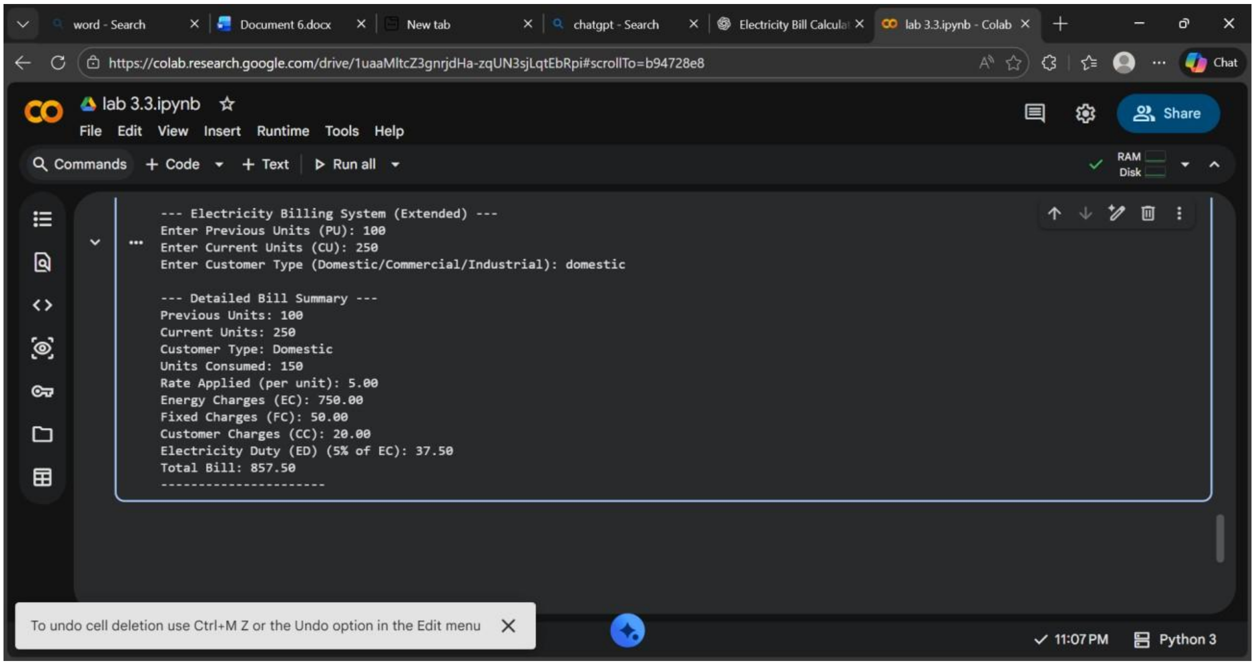
```
# Calculate Total Bill
total_bill = energy_charges + fixed_charges + customer_charges + electricity_duty

-# --- Display Detailed Bill Summary ---
+# --- Display Detailed Bill Summary ---
print("\n--- Detailed Bill Summary ---")
print(f"Previous Units: {previous_units}")
print(f"Current Units: {current_units}")
print(f"Customer Type: {customer_type.capitalize()}")
-print(f"Units Consumed: {units_consumed}")
+print(f"Units Consumed: {units_consumed} (Actual difference)")

if rate_applied > 0:
    print(f"Rate Applied (per unit): {rate_applied:.2f}")

print(f"Energy Charges (EC): {energy_charges:.2f}")
print(f"Fixed Charges (FC): {fixed_charges:.2f}")
print(f"Customer Charges (CC): {customer_charges:.2f}")
print(f"Electricity Duty (ED) ({ELECTRICITY_DUTY_PERCENTAGE*100:.0f}% of EC): {electricity_duty:.2f}")
print(f"Total Bill: {total_bill:.2f}")
print("--------------------")
```

Output: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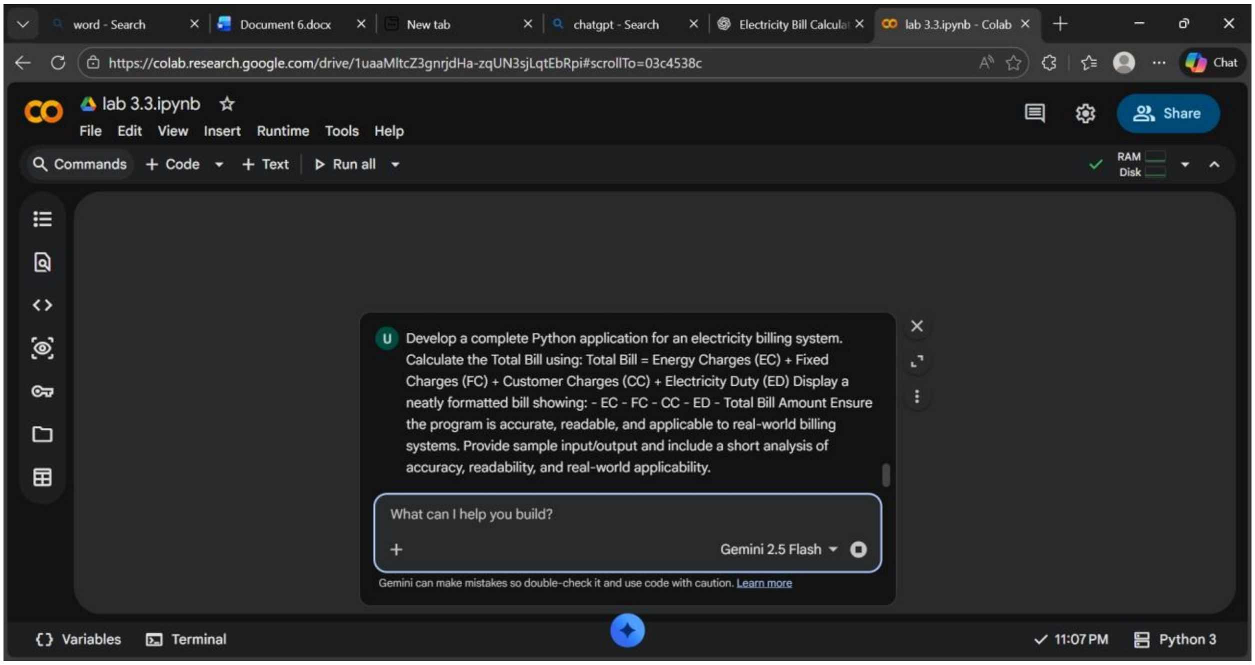
```
--- Electricity Billing System (Extended) ---
Enter Previous Units (PU): 100
Enter Current Units (CU): 250
Enter Customer Type (Domestic/Commercial/Industrial): domestic

--- Detailed Bill Summary ---
Previous Units: 100
Current Units: 250
Customer Type: Domestic
Units Consumed: 150
Rate Applied (per unit): 5.00
Energy Charges (EC): 750.00
Fixed Charges (FC): 50.00
Customer Charges (CC): 20.00
Electricity Duty (ED) (5% of EC): 37.50
Total Bill: 857.50
--------------------
```

Explanation: The program is enhanced to include **additional billing components** like fixed charges, customer charges, and electricity duty.

Electricity Duty is calculated as a **percentage of Energy Charges**, and all values are displayed clearly for verification.

Task 5: Final Bill Generation and Output Analysis.

Prompt:



Develop a complete Python application for an electricity billing system. Calculate the Total Bill using: Total Bill = Energy Charges (EC) + Fixed Charges (FC) + Customer Charges (CC) + Electricity Duty (ED) Display a neatly formatted bill showing: - EC - FC - CC - ED - Total Bill Amount Ensure the program is accurate, readable, and applicable to real-world billing systems. Provide sample input/output and include a short analysis of accuracy, readability, and real-world applicability.

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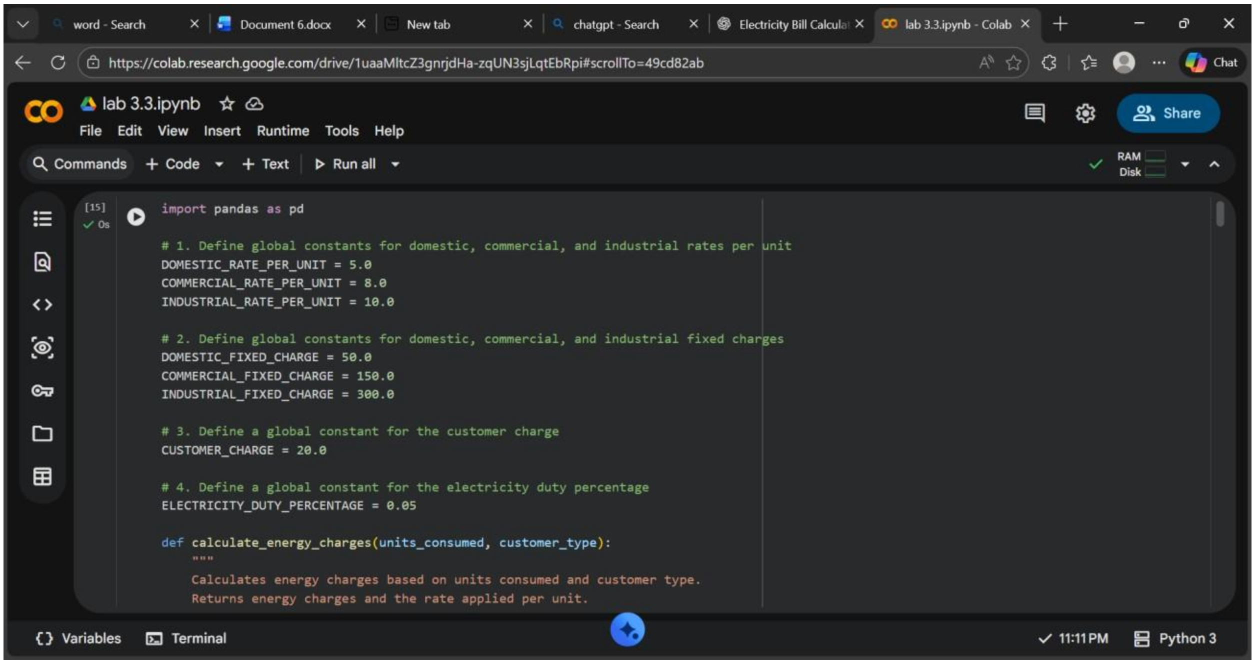

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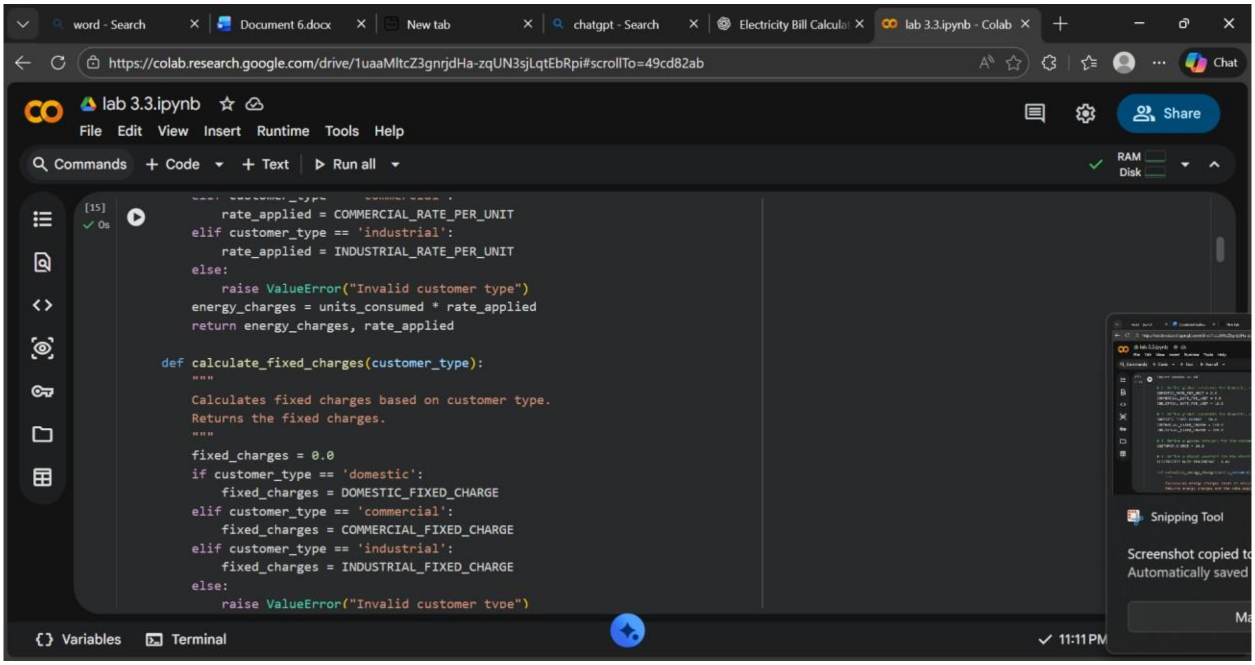
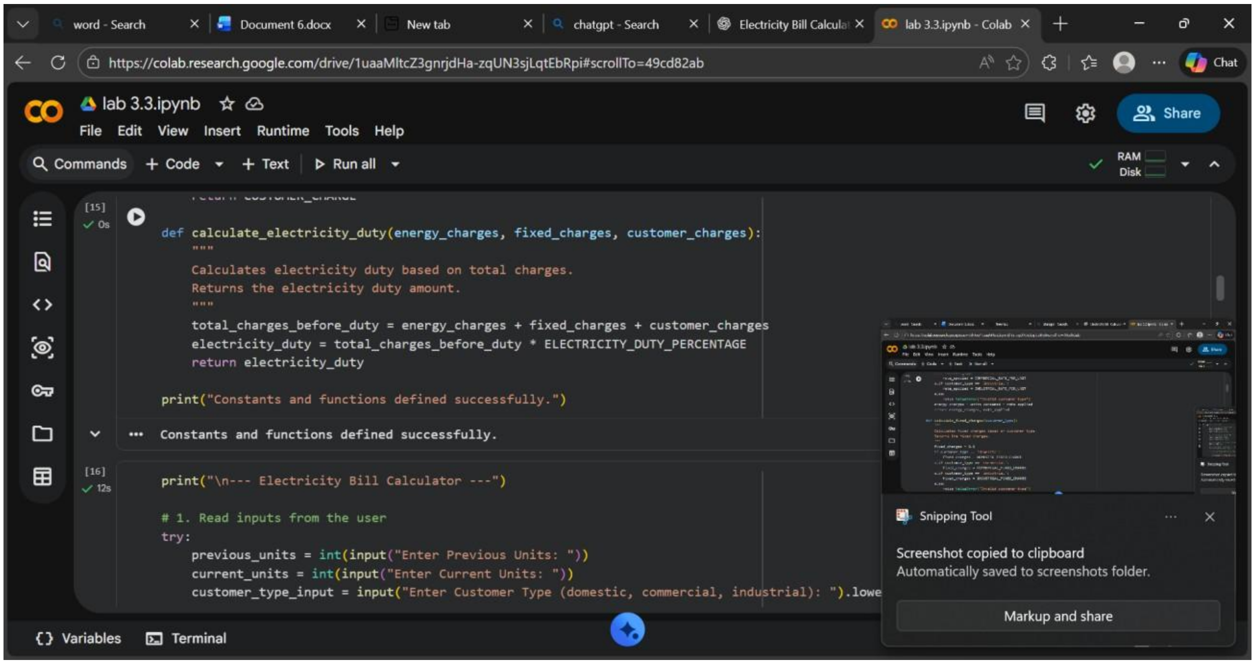
Python 3

```python
import pandas as pd

# 1. Define global constants for domestic, commercial, and industrial rates per unit
DOMESTIC_RATE_PER_UNIT = 5.0
COMMERCIAL_RATE_PER_UNIT = 8.0
INDUSTRIAL_RATE_PER_UNIT = 10.0

# 2. Define global constants for domestic, commercial, and industrial fixed charges
DOMESTIC_FIXED_CHARGE = 50.0
COMMERCIAL_FIXED_CHARGE = 150.0
INDUSTRIAL_FIXED_CHARGE = 300.0

# 3. Define a global constant for the customer charge
CUSTOMER_CHARGE = 20.0

# 4. Define a global constant for the electricity duty percentage
ELECTRICITY_DUTY_PERCENTAGE = 0.05

def calculate_energy_charges(units_consumed, customer_type):
    """
    Calculates energy charges based on units consumed and customer type.
    Returns energy charges and the rate applied per unit.
```



```python
        rate_applied = COMMERCIAL_RATE_PER_UNIT
    elif customer_type == 'industrial':
        rate_applied = INDUSTRIAL_RATE_PER_UNIT
    else:
        raise ValueError("Invalid customer type")
    energy_charges = units_consumed * rate_applied
    return energy_charges, rate_applied

def calculate_fixed_charges(customer_type):
    """
    Calculates fixed charges based on customer type.
    Returns the fixed charges.
    """
    fixed_charges = 0.0
    if customer_type == 'domestic':
        fixed_charges = DOMESTIC_FIXED_CHARGE
    elif customer_type == 'commercial':
        fixed_charges = COMMERCIAL_FIXED_CHARGE
    elif customer_type == 'industrial':
        fixed_charges = INDUSTRIAL_FIXED_CHARGE
    else:
        raise ValueError("Invalid customer type")
```



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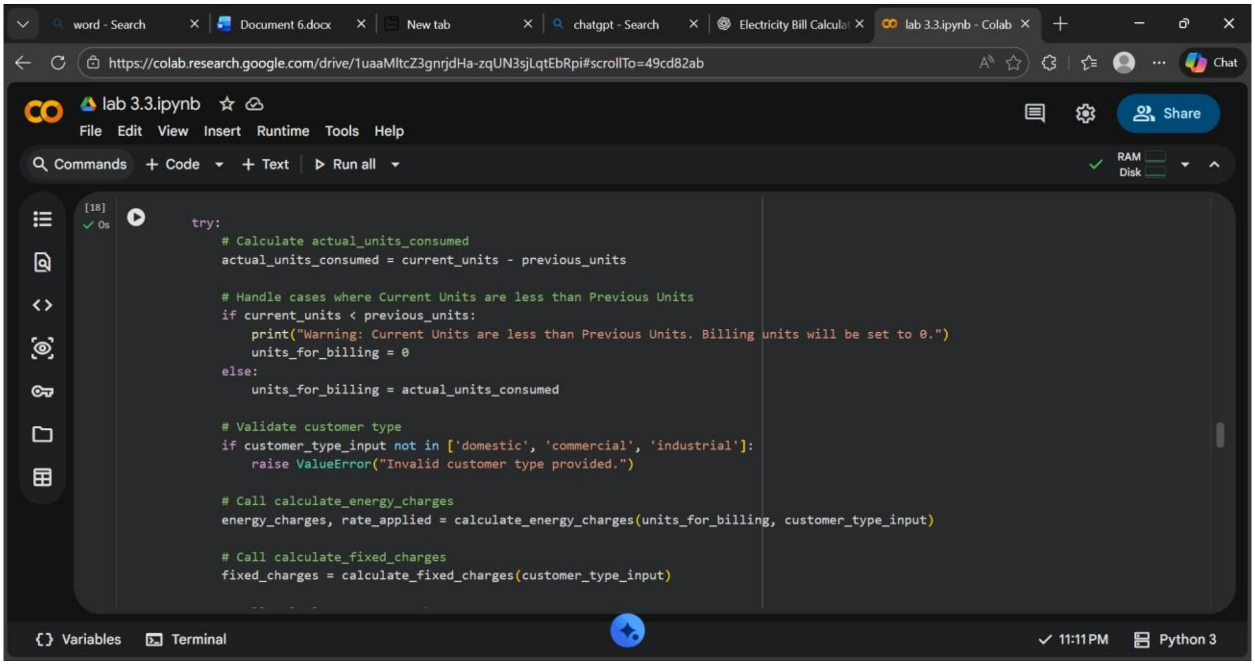
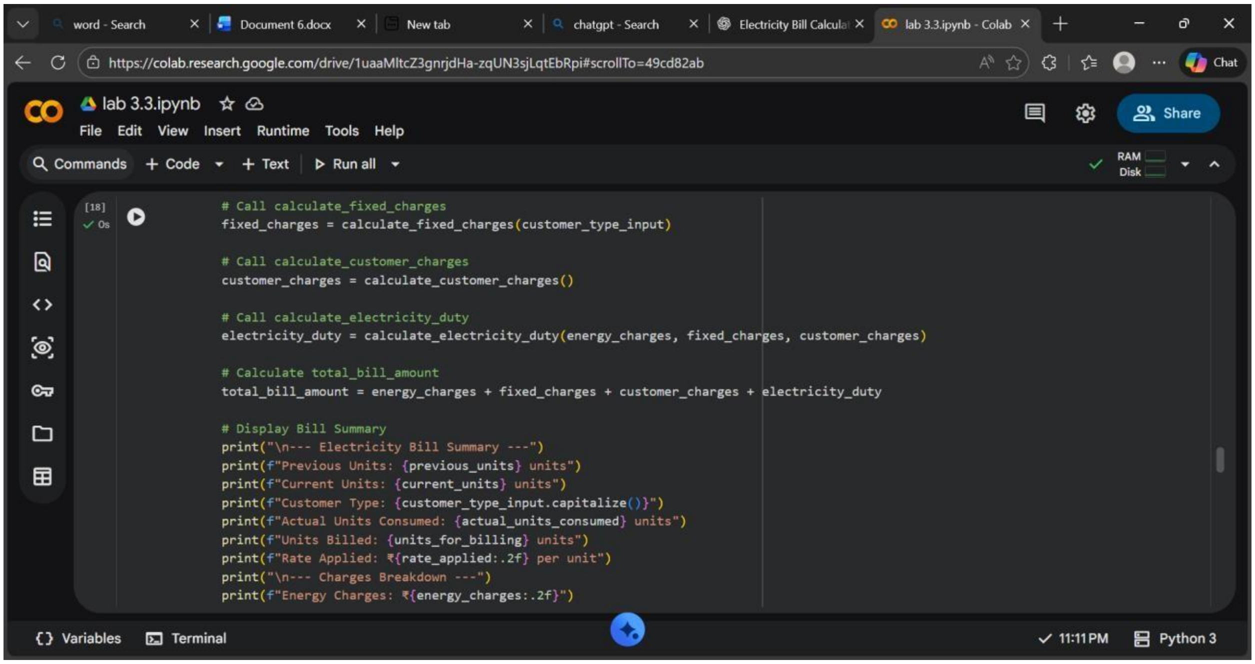
```
    return CUSTOMER_CHARGE

def calculate_electricity_duty(energy_charges, fixed_charges, customer_charges):
    """
    Calculates electricity duty based on total charges.
    Returns the electricity duty amount.
    """
    total_charges_before_duty = energy_charges + fixed_charges + customer_charges
    electricity_duty = total_charges_before_duty * ELECTRICITY_DUTY_PERCENTAGE
    return electricity_duty

print("Constants and functions defined successfully.")
```

```
Constants and functions defined successfully.
```

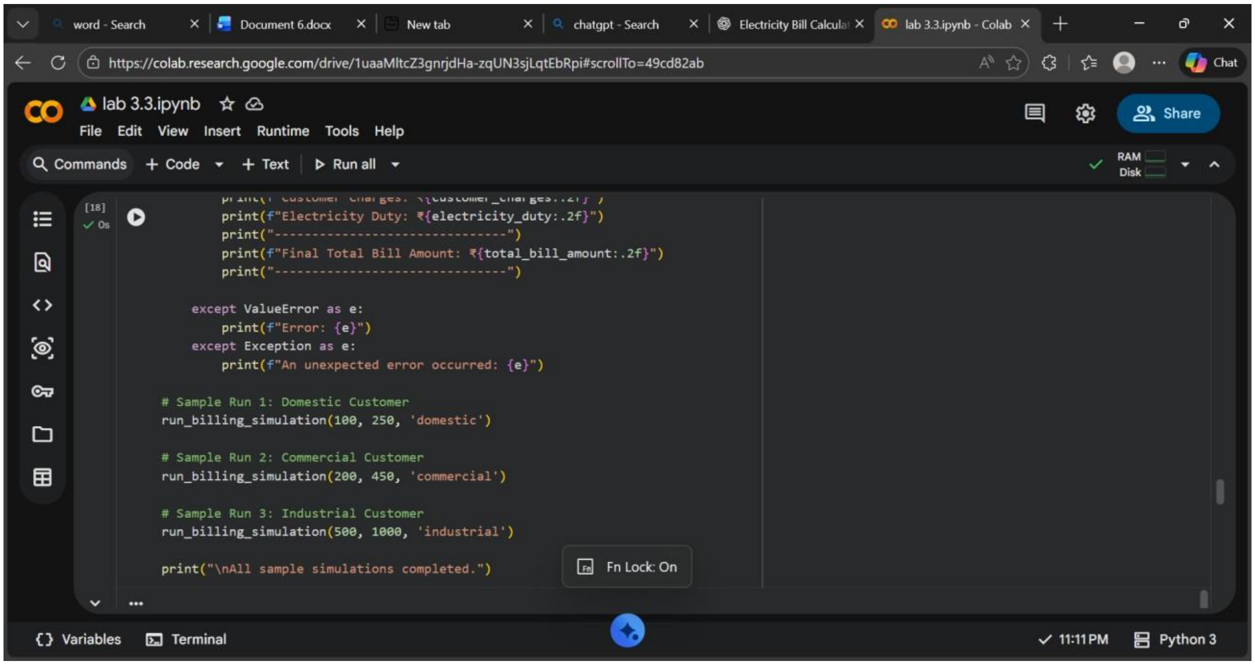
```
print("\n--- Electricity Bill Calculator ---")

# 1. Read inputs from the user
try:
    previous_units = int(input("Enter Previous Units: "))
    current_units = int(input("Enter Current Units: "))
    customer_type_input = input("Enter Customer Type (domestic, commercial, industrial): ").lowe
```



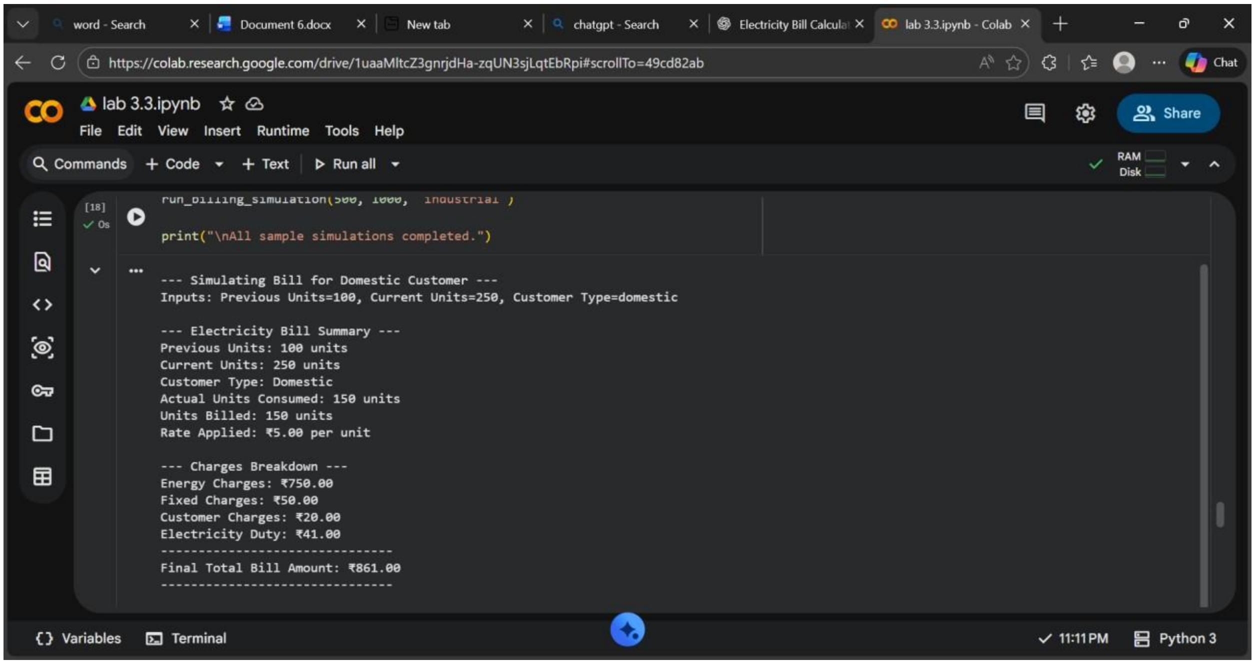
```
    try:
        # Calculate actual_units_consumed
        actual_units_consumed = current_units - previous_units

        # Handle cases where Current Units are less than Previous Units
        if current_units < previous_units:
            print("Warning: Current Units are less than Previous Units. Billing units will be set to 0.")
            units_for_billing = 0
        else:
            units_for_billing = actual_units_consumed

        # Validate customer type
        if customer_type_input not in ['domestic', 'commercial', 'industrial']:
            raise ValueError("Invalid customer type provided.")

        # Call calculate_energy_charges
        energy_charges, rate_applied = calculate_energy_charges(units_for_billing, customer_type_input)

        # Call calculate_fixed_charges
        fixed_charges = calculate_fixed_charges(customer_type_input)
```



```
        # Call calculate_fixed_charges
        fixed_charges = calculate_fixed_charges(customer_type_input)

        # Call calculate_customer_charges
        customer_charges = calculate_customer_charges()

        # Call calculate_electricity_duty
        electricity_duty = calculate_electricity_duty(energy_charges, fixed_charges, customer_charges)

        # Calculate total_bill_amount
        total_bill_amount = energy_charges + fixed_charges + customer_charges + electricity_duty

        # Display Bill Summary
        print("\n--- Electricity Bill Summary ---")
        print(f"Previous Units: {previous_units} units")
        print(f"Current Units: {current_units} units")
        print(f"Customer Type: {customer_type_input.capitalize()}")
        print(f"Actual Units Consumed: {actual_units_consumed} units")
        print(f"Units Billed: {units_for_billing} units")
        print(f"Rate Applied: ₹{rate_applied:.2f} per unit")
        print("\n--- Charges Breakdown ---")
        print(f"Energy Charges: ₹{energy_charges:.2f}")
```



```
        print(f"Customer Charges: ₹{customer_charges:.2f}")
        print(f"Electricity Duty: ₹{electricity_duty:.2f}")
        print("------------------------------")
        print(f"Final Total Bill Amount: ₹{total_bill_amount:.2f}")
        print("------------------------------")

    except ValueError as e:
        print(f"Error: {e}")
    except Exception as e:
        print(f"An unexpected error occurred: {e}")

# Sample Run 1: Domestic Customer
run_billing_simulation(100, 250, 'domestic')

# Sample Run 2: Commercial Customer
run_billing_simulation(200, 450, 'commercial')

# Sample Run 3: Industrial Customer
run_billing_simulation(500, 1000, 'industrial')

print("\nAll sample simulations completed.")
```



```
run_billing_simulation(500, 1000, 'industrial')

print("\nAll sample simulations completed.")
```

```
--- Simulating Bill for Domestic Customer ---
Inputs: Previous Units=100, Current Units=250, Customer Type=domestic

--- Electricity Bill Summary ---
Previous Units: 100 units
Current Units: 250 units
Customer Type: Domestic
Actual Units Consumed: 150 units
Units Billed: 150 units
Rate Applied: ₹5.00 per unit

--- Charges Breakdown ---
Energy Charges: ₹750.00
Fixed Charges: ₹50.00
Customer Charges: ₹20.00
Electricity Duty: ₹41.00
-------------------------------
Final Total Bill Amount: ₹861.00
-------------------------------
```

Output:

Explanation: he final program accurately computes all billing components and presents them in a clear, structured format.

Its readable logic and modular design make it suitable for real-world electricity billing applications and easy future enhancements.