

AI-ASSISTANT-CODING-LAB-3

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Task 1: AI-Generated Logic for Reading Consumer Details

Scenario

An electricity billing system must collect accurate consumer data.

Task Description

Use an AI tool (GitHub Copilot / Gemini) to generate a Python program that:

- Reads:
 - o Previous Units (PU)
 - o Current Units (CU)
 - o Type of Customer
- Calculates units consumed
- Implements logic directly in the main program (no functions)

PROMPT:

Generate a Python program (without using functions) to read:

- Previous Units (PU)
- Current Units (CU)
- Type of customer (Domestic / Commercial / Industrial)

Validate inputs and calculate units consumed as:

`units_consumed = CU - PU`

Print all inputs and the calculated units consumed with clear labels.

Add comments explaining each step.

CODE:

```
# =====
# ELECTRICITY BILLING SYSTEM - COMPLETE ASSIGNMENT (25 CUSTOMERS)
# =====

import random
import csv
print("\nELECTRICITY BILLING SYSTEM - 25 Customers\n")

# Store all customer data
customers_data = []

# Auto-generate 25 customers
names = ["Rajesh Kumar", "Priya Sharma", "Amit Patel", "Sneha Desai", "Vikram Singh",
         "Anjali Mehta", "Rohit Gupta", "Kavita Reddy", "Sanjay Joshi", "Neha Kapoor",
         "Arun Nair", "Deepika Iyer", "Manoj Verma", "Pooja Agarwal", "Ravi Chauhan",
         "Sunita Bansal", "Kiran Rao", "Vishal Malhotra", "Rekha Pillai", "Suresh Menon",
         "Geeta Kulkarni", "Harish Bhat", "Meera Sinha", "Ashok Pandey", "Divya Jain"]

cities = ["Mumbai", "Delhi", "Bangalore", "Chennai", "Kolkata", "Pune", "Hyderabad"]
for i in range(25):
    customer = {
        'name': names[i],
        'id': f"CUST{1001 + i}",
        'phone': f"{random.randint(7000000000, 9999999999)}",
        'email': f"{names[i].lower().replace(' ', '.')}@email.com",
        'address': f"{random.randint(1, 999)} MG Road, {random.choice(cities)}",
        'previous_units': random.randint(100, 500),
        'current_units': 0,
        'customer_type': str(random.randint(1, 3))
    }
    customer['current_units'] = customer['previous_units'] + random.randint(150, 400)
    customers_data.append(customer)

print(f"✓ Successfully generated data for {len(customers_data)} customers!")
```

```
# TASK 1: Extract customer data and calculate units
print("\n[TASK 1] Extracting Customer Data & Calculating Units Consumed")
print("-" * 80)
consumer_name = customer['name']
consumer_id = customer['id']
phone = customer['phone']
email = customer['email']
address = customer['address']
previous_units = customer['previous_units']
current_units = customer['current_units']
customer_type = customer['customer_type']

# Calculate units consumed (Task 1)
units_consumed = current_units - previous_units

# Map customer type name (Task 1)
if customer_type == '1':
    customer_type_name = "Domestic"
elif customer_type == '2':
    customer_type_name = "Commercial"
else:
    customer_type_name = "Industrial"

print(f"  Consumer ID      : {consumer_id}")
print(f"  Consumer Name    : {consumer_name}")
print(f"  Customer Type    : {customer_type_name}")
print(f"  Previous Reading  : {previous_units} units")
print(f"  Current Reading   : {current_units} units")
print(f"  Units Consumed    : {units_consumed} units")
print(f"  ✓ Task 1 Complete!")
```

OUTPUT:

```
=====
CUSTOMER 1/25: Rajesh Kumar
=====

[TASK 1] Extracting Customer Data & Calculating Units Consumed
-----
Consumer ID      : CUST1001
Consumer Name    : Rajesh Kumar
Customer Type    : Commercial
Previous Reading  : 141 units
Current Reading  : 358 units
Units Consumed   : 217 units
✓ Task 1 Complete!
```

JUSTIFICATION:

extract customer details (ID, name, type, readings) and calculate units consumed using $\text{Units} = \text{Current Reading} - \text{Previous Reading}$.

This is necessary because the units consumed decide the tariff slab and are the main input for generating the electricity bill.

Task 2: Energy Charges Calculation Based on Units Consumed

Scenario

Energy charges depend on the number of units consumed and customer type.

Task Description

Review the AI-generated code from Task 1 and extend it to:

- Calculate Energy Charges (EC)
- Use conditional statements based on:
 - o Domestic
 - o Commercial
 - o Industrial consumers
- Improve readability using AI prompts such as:
 - o “Simplify energy charge calculation logic”
 - o “Optimize conditional statements”

PROMPT:

Extend the existing Python program to calculate Energy Charges (EC) using conditional statements:

Domestic:

- First 100 units: ₹1.5/unit
- Above 100 units: ₹2.5/unit

Commercial:

- Flat rate ₹4.0/unit

Industrial:

- Flat rate ₹6.0/unit

Use if-elif-else statements and print the calculated EC.
Add meaningful comments.
For logic optimization:
Simplify and optimize the energy charge calculation logic to improve readability.
Ensure the conditional structure is clean and easy for students to understand.

CODE:

```
# TASK 2 & 3: Calculate energy charges using function
print("\n[TASK 2] Calculating Energy Charges (Slab-based)")
print("-" * 80)
ec = calculate_energy_charges(units_consumed, customer_type)
print(f"  Energy Charges (EC) : ₹{ec:.2f}")
print(f"  ✓ Task 2 Complete!")
```

OUTPUT:

```
[TASK 2] Calculating Energy Charges (Slab-based)
-----
  Energy Charges (EC) : ₹1452.00
  ✓ Task 2 Complete!
```

JUSTIFICATION:

performed to calculate the Energy Charges (EC) using slab-based tariff rates based on the units consumed and customer type. This ensures the bill is fair and accurate, since different customers (Domestic/Commercial/Industrial) have different rates and slabs.

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

Scenario

Billing logic must be reusable for multiple consumers.

Task Description

Use AI assistance to generate a Python program that:

- Uses user-defined functions to:
 - o Calculate Energy Charges
 - o Calculate Fixed Charges
- Returns calculated values
- Includes meaningful comments

PROMPT:

(Function for Energy Charges)

Rewrite the program using user-defined functions.

Create a function named `calculate_energy_charges(units, customer_type)`

that returns the energy charges based on tariff rules.

Call the function from the main program.

Add proper comments and sample output printing.

Add Fixed Charges Function)

Add another user-defined function named `calculate_fixed_charges(customer_type)` with the following logic:

Domestic: ₹50

Commercial: ₹100

Industrial: ₹150

Return the fixed charges and display them in the main program.

Include comments explaining function usage.

CODE:

```
# TASK 3: Calculate fixed charges using function
print("\n[TASK 3] Calculating Fixed Charges using Function")
print("-" * 80)
fc = calculate_fixed_charges(customer_type)
print(f"  Fixed Charges (FC)   : ₹{fc:.2f}")
print(f"  ✓ Task 3 Complete!")
```

OUTPUT:

```
[TASK 3] Calculating Fixed Charges using Function
-----
  Fixed Charges (FC)   : ₹150.00
  ✓ Task 3 Complete!
```

JUSTIFICATION:

to calculate the **Fixed Charges (FC)** based on the **customer type**. Fixed charges are added to every bill as a **mandatory service/maintenance cost**, regardless of units consumed, ensuring correct total bill computation.

Task 4: Calculation of Additional Charges

Scenario

Electricity bills include multiple additional charges.

Task Description

Extend the program to calculate:

- FC – Fixed Charges
- CC – Customer Charges
- ED – Electricity Duty (percentage of EC)

Use AI prompts like:

- “Add electricity duty calculation”
- “Improve billing accuracy

Prompt

Add Extra Charges)

Extend the function-based electricity billing program to calculate:

- Customer Charges (CC) = ₹30 for all consumers
- Electricity Duty (ED) = 5% of Energy Charges (EC)

Print EC, FC, CC, and ED separately with proper formatting.

Add comments for billing accuracy.

Improve billing accuracy by formatting all monetary values to two decimal places.

Ensure calculations are clear and correct.

CODE:

```
# TASK 4: Calculate additional charges
print("\n[TASK 4] Calculating Additional Charges")
print("-" * 80)
cc = 30.00 # Customer Charges

# Electricity Duty (percentage of EC)
if customer_type == '1':
    ed_rate = 0.05 # 5%
elif customer_type == '2':
    ed_rate = 0.08 # 8%
else:
    ed_rate = 0.10 # 10%

ed = ec * ed_rate # Electricity Duty calculation
print(f" Customer Charges      : ₹{cc:.2f}")
print(f" Electricity Duty       : ₹{ed:.2f} ({ed_rate*100:.0f}% of EC)")
print(f" ✓ Task 4 Complete!")
```

OUTPUT:

```
[TASK 4] Calculating Additional Charges
-----
Customer Charges      : ₹30.00
Electricity Duty     : ₹28.10 (5% of EC)
✓ Task 4 Complete!
```

JUSTIFICATION:

to calculate additional mandatory charges like Customer Charges (CC) and Electricity Duty (ED). These charges are required by billing rules, where ED is calculated as a percentage of Energy Charges based on customer type, ensuring the final bill amount is complete and accurate.

Task 5: Final Bill Generation and Output Analysis

Scenario

The final electricity bill must present all values clearly.

Task Description

Develop the final Python application to:

- Calculate total bill:
- Total Bill = EC + FC + CC + ED
- Display:
 - o Energy Charges (EC)
 - o Fixed Charges (FC)
 - o Customer Charges (CC)
 - o Electricity Duty (ED)
 - o Total Bill Amount
- Analyze the program based on:
 - o Accuracy
 - o Readability
 - o Real-world applicability

prompt:

Final Bill Calculation)

Generate the final electricity bill by calculating:

Total Bill = Energy Charges + Fixed Charges + Customer Charges + Electricity Duty

Display a neatly formatted electricity bill output similar to a real TGNPDCL bill.

Use clear headings and labels.

Analysis Paragraph for Report)

Write a short analysis paragraph evaluating the electricity billing program based on:

- Accuracy
- Readability
- Real-world applicability

Keep the explanation suitable for a laboratory record.

CODE:

```
# TASK 5: Calculate total bill
print("\n[TASK 5] Calculating Total Bill Amount")
print("-" * 80)
total_bill = ec + fc + cc + ed
total_revenue += total_bill
print(f"    Formula: Total = EC + FC + CC + ED")
print(f"    Total    = ₹{ec:.2f} + ₹{fc:.2f} + ₹{cc:.2f} + ₹{ed:.2f}")
print(f"    TOTAL BILL AMOUNT    : ₹{total_bill:.2f}")
print(f"    ✓ Task 5 Complete!")

# Store bill data
bill = {
    'customer': customer,
    'units_consumed': units_consumed,
    'customer_type_name': customer_type_name,
    'ec': ec,
    'fc': fc,
    'cc': cc,
    'ed': ed,
    'ed_rate': ed_rate,
    'total': total_bill
}
all_bills.append(bill)

print(f"\n/ Customer {idx} Bill Generated Successfully!")
```

```

# Add a pause for readability (optional - can be removed for faster execution)
if idx < 25:
    input("\nPress Enter to continue to next customer...")

print(f"\n{'='*80}")
print(f"ALL 25 CUSTOMERS PROCESSED SUCCESSFULLY!")
print(f"\n{'='*80}")
print(f"\nTOTAL REVENUE COLLECTED: ₹{total_revenue:.2f}\n")
print("="*80)
print("MAIN MENU")
print("="*80)
print("1. Summary | 2. Detailed Bill | 3. Statistics | 4. Export | 5. Exit")

while True:
    view_choice = input("\nEnter your choice (1-5): ").strip()

    if view_choice == '1':
        # Summary view
        print(f"\n{'No.':<5} {'Name':<20} {'ID':<12} {'Type':<12} {'Units':<10} {'Total':<15}")
        print("-" * 85)
        for idx, bill in enumerate(all_bills, 1):
            c = bill['customer']
            print(f"{idx:<5} {c['name']:<20} {c['id']:<12} {bill['customer_type_name']:<12} {bill['units_consumed']:<10} {bill['total_revenue']:<15}")
            print(f"\nTotal Revenue: ₹{total_revenue:.2f}")

    elif view_choice == '2':

```

```

# Detailed bill for specific customer
try:
    cust_num = int(input(f"Enter customer number (1-25): "))
    if 1 <= cust_num <= 25:
        bill = all_bills[cust_num - 1]
        c = bill['customer']

        # TASK 5: Final Bill Display
        print("\n" + "=" * 58 + "\n")
        print("|" + " " * 15 + "ELECTRICITY BILL STATEMENT" + " " * 17 + "|")
        print("|" + "=" * 58 + "|")
        print(f"| Consumer Name       : {c['name']:<30} |")
        print(f"| Consumer ID        : {c['id']:<30} |")
        print(f"| Phone Number       : {c['phone']:<30} |")
        print(f"| Email              : {c['email']:<30} |")
        print(f"| Address            : {c['address']:<30} |")
        print("|" + "=" * 58 + "|")
        print(f"| Consumer Type      : {bill['customer_type_name']:<30} |")
        print(f"| Previous Reading   : {c['previous_units']:>10.2f} units" + " " * 17 + "|")
        print(f"| Current Reading    : {c['current_units']:>10.2f} units" + " " * 17 + "|")
        print(f"| Units Consumed     : {bill['units_consumed']:>10.2f} units" + " " * 17 + "|")
        print("|" + "=" * 58 + "|")
        print("CHARGES BREAKDOWN:" + " " * 39 + "|")
        print("|" + " " * 58 + "|")
        print(f"| Energy Charges (EC) : ₹{bill['ec']:>10.2f}" + " " * 22 + "|")
        print(f"| Fixed Charges (FC)  : ₹{bill['fc']:>10.2f}" + " " * 22 + "|")
        print(f"| Customer Charges (CC): ₹{bill['cc']:>10.2f}" + " " * 22 + "|")
        print(f"| Electricity Duty (ED): ₹{bill['ed']:>10.2f} ({bill['ed_rate']*100:.0f}%)" + " " * 16 + "|")
        print("|" + " " * 58 + "|")
        print("|" + "=" * 58 + "|")
        print(f"| TOTAL BILL AMOUNT   : ₹{bill['total']:>10.2f}" + " " * 22 + "|")
        print("|" + "=" * 58 + "|")

    else:
        print("Error: Customer number must be between 1 and 25!")
except ValueError:
    print("Error: Please enter a valid number!")

```



```

# =====
# EXPORT TO CSV FILE
# =====
csv_filename = "electricity_bills_data.csv"
with open(csv_filename, 'w', newline='', encoding='utf-8') as csvfile:
    fieldnames = ['Customer_ID', 'Name', 'Phone', 'Email', 'Address', 'Customer_Type',
                  'Previous_Units', 'Current_Units', 'Units_Consumed', 'Energy_Charges',
                  'Fixed_Charges', 'Customer_Charges', 'Electricity_Duty', 'Total_Bill']

    writer = csv.DictWriter(csvfile, fieldnames=fieldnames)
    writer.writeheader()

    for c, bill in zip(customers_data, all_bills):
        writer.writerow({
            'Customer_ID': c['id'],
            'Name': c['name'],
            'Phone': c['phone'],
            'Email': c['email'],
            'Address': c['address'],
            'Customer_Type': bill['customer_type_name'],
            'Previous_Units': c['previous_units'],
            'Current_Units': c['current_units'],
            'Units_Consumed': bill['units_consumed'],
            'Energy_Charges': f"{bill['ec']:.2f}",
            'Fixed_Charges': f"{bill['fc']:.2f}",
            'Customer_Charges': f"{bill['cc']:.2f}",
            'Electricity_Duty': f"{bill['ed']:.2f}",
            'Total_Bill': f"{bill['total']:.2f}"
        })

print(f"\n✓ Data exported to '{csv_filename}'")
print("\n✓ Program completed successfully!\n")

```

OUTPUT:

[TASK 5] Calculating Total Bill Amount

```

-----
Formula: Total = EC + FC + CC + ED
Total    = ₹562.00 + ₹50.00 + ₹30.00 + ₹28.10
Formula: Total = EC + FC + CC + ED
Total    = ₹562.00 + ₹50.00 + ₹30.00 + ₹28.10
Total    = ₹562.00 + ₹50.00 + ₹30.00 + ₹28.10
TOTAL BILL AMOUNT    : ₹670.10
✓ Task 5 Complete!

```

✓ Customer 1 Bill Generated Successfully!

JUSTIFICATION:

performed to calculate the final total bill amount by adding all charges:

Total Bill = EC + FC + CC + ED.

This ensures the customer receives a complete and accurate bill and also helps in computing the total revenue collected from all customers.