building_performance_analysis.py - C:\Users\user\Downloads\building_performance_analysis.py (3.13.2)

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```python
import random

class Building:
    def __init__(self, insulation_level, window_type, hvac_efficiency, area, external_temp):
        self.insulation_level = insulation_level  # 'poor', 'average', 'good'
        self.window_type = window_type  # 'single', 'double', 'triple'
        self.hvac_efficiency = hvac_efficiency  # 0.0 to 1.0
        self.area = area  # in square meters
        self.external_temp = external_temp  # average outdoor temperature
        self.indoor_temp = 22  # desired indoor temperature in Celsius

    def insulation_factor(self):
        factors = {'poor': 1.5, 'average': 1.0, 'good': 0.5}
        return factors.get(self.insulation_level, 1.0)

    def window_factor(self):
        factors = {'single': 1.8, 'double': 1.2, 'triple': 0.8}
        return factors.get(self.window_type, 1.2)

    def calculate_heat_loss(self):
        delta_temp = abs(self.indoor_temp - self.external_temp)
        heat_loss = delta_temp * self.area * self.insulation_factor() * self.window_factor()
        return heat_loss

    def energy_consumption(self):
        heat_loss = self.calculate_heat_loss()
        energy_needed = heat_loss / max(self.hvac_efficiency, 0.01)  # avoid divide-by-zero
        return energy_needed

    def performance_rating(self):
        energy = self.energy_consumption()
        if energy < 10000:
            return 'Excellent'
        elif energy < 20000:
            return 'Good'
        elif energy < 30000:
            return 'Average'
        else:
            return 'Poor'
```

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```
    def energy_consumption(self):
        heat_loss = self.calculate_heat_loss()
        energy_needed = heat_loss / max(self.hvac_efficiency, 0.01)  # avoid divide-by-zero
        return energy_needed

    def performance_rating(self):
        energy = self.energy_consumption()
        if energy < 10000:
            return 'Excellent'
        elif energy < 20000:
            return 'Good'
        elif energy < 30000:
            return 'Average'
        else:
            return 'Poor'

    def report(self):
        print("=== Building Performance Report ===")
        print(f"Insulation Level: {self.insulation_level}")
        print(f"Window Type: {self.window_type}")
        print(f"HVAC Efficiency: {self.hvac_efficiency}")
        print(f"Floor Area: {self.area} m²")
        print(f"External Temperature: {self.external_temp}°C")
        print(f"Heat Loss: {self.calculate_heat_loss():.2f} units")
        print(f"Estimated Energy Consumption: {self.energy_consumption():.2f} units")
        print(f"Performance Rating: {self.performance_rating()}")
        print("====================================")


# Utility to run multiple building scenarios
def simulate_buildings():
    insulation_options = ['poor', 'average', 'good']
    window_options = ['single', 'double', 'triple']

    print("Simulating 5 building scenarios...\n")
    for i in range(5):
        insulation = random.choice(insulation_options)
        windows = random.choice(window_options)
        hvac_eff = round(random.uniform(0.4, 0.95), 2)
        area = random.randint(80, 300)  # in square meters
        ext_temp = random.randint(-10, 35)
```

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```
        elif energy < 20000:
            return 'Good'
        elif energy < 30000:
            return 'Average'
        else:
            return 'Poor'

    def report(self):
        print("=== Building Performance Report ===")
        print(f"Insulation Level: {self.insulation_level}")
        print(f"Window Type: {self.window_type}")
        print(f"HVAC Efficiency: {self.hvac_efficiency}")
        print(f"Floor Area: {self.area} m²")
        print(f"External Temperature: {self.external_temp}°C")
        print(f"Heat Loss: {self.calculate_heat_loss():.2f} units")
        print(f"Estimated Energy Consumption: {self.energy_consumption():.2f} units")
        print(f"Performance Rating: {self.performance_rating()}")
        print("====================================")


# Utility to run multiple building scenarios
def simulate_buildings():
    insulation_options = ['poor', 'average', 'good']
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    print("Simulating 5 building scenarios...\n")
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        insulation = random.choice(insulation_options)
        windows = random.choice(window_options)
        hvac_eff = round(random.uniform(0.4, 0.95), 2)
        area = random.randint(80, 300)  # in square meters
        ext_temp = random.randint(-10, 35)

        building = Building(insulation, windows, hvac_eff, area, ext_temp)
        print(f"\n--- Scenario {i + 1} ---")
        building.report()


if __name__ == "__main__":
    simulate_buildings()
```

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IDLE Shell 3.13.2

File Edit Shell Debug Options Window Help

```
Python 3.13.2 (tags/v3.13.2:4f8bb39, Feb  4 2025, 15:23:48) [MSC v.1942 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
======= RESTART: C:\Users\user\Downloads\building_performance_analysis.py =======
Simulating 5 building scenarios...


--- Scenario 1 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: triple
HVAC Efficiency: 0.5
Floor Area: 147 m²
External Temperature: 34°C
Heat Loss: 705.60 units
Estimated Energy Consumption: 1411.20 units
Performance Rating: Excellent
====================================

--- Scenario 2 ---
=== Building Performance Report ===
Insulation Level: poor
Window Type: single
HVAC Efficiency: 0.63
Floor Area: 249 m²
External Temperature: 7°C
Heat Loss: 10084.50 units
Estimated Energy Consumption: 16007.14 units
Performance Rating: Good
====================================

--- Scenario 3 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: double
HVAC Efficiency: 0.69
Floor Area: 172 m²
External Temperature: 30°C
Heat Loss: 825.60 units
Estimated Energy Consumption: 1196.52 units
Performance Rating: Excellent
```

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IDLE Shell 3.13.2

File Edit Shell Debug Options Window Help

```
Estimated Energy Consumption: 1411.20 units
Performance Rating: Excellent
==================================

--- Scenario 2 ---
=== Building Performance Report ===
Insulation Level: poor
Window Type: single
HVAC Efficiency: 0.63
Floor Area: 249 m²
External Temperature: 7°C
Heat Loss: 10084.50 units
Estimated Energy Consumption: 16007.14 units
Performance Rating: Good
==================================

--- Scenario 3 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: double
HVAC Efficiency: 0.69
Floor Area: 172 m²
External Temperature: 30°C
Heat Loss: 825.60 units
Estimated Energy Consumption: 1196.52 units
Performance Rating: Excellent
==================================

--- Scenario 4 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: triple
HVAC Efficiency: 0.86
Floor Area: 100 m²
External Temperature: 22°C
Heat Loss: 0.00 units
Estimated Energy Consumption: 0.00 units
Performance Rating: Excellent
==================================

--- Scenario 5 ---
```

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IDLE Shell 3.13.2

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```
Heat Loss: 10084.50 units
Estimated Energy Consumption: 16007.14 units
Performance Rating: Good
==================================

--- Scenario 3 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: double
HVAC Efficiency: 0.69
Floor Area: 172 m²
External Temperature: 30°C
Heat Loss: 825.60 units
Estimated Energy Consumption: 1196.52 units
Performance Rating: Excellent
==================================

--- Scenario 4 ---
=== Building Performance Report ===
Insulation Level: good
Window Type: triple
HVAC Efficiency: 0.86
Floor Area: 100 m²
External Temperature: 22°C
Heat Loss: 0.00 units
Estimated Energy Consumption: 0.00 units
Performance Rating: Excellent
==================================

--- Scenario 5 ---
=== Building Performance Report ===
Insulation Level: average
Window Type: single
HVAC Efficiency: 0.81
Floor Area: 203 m²
External Temperature: 5°C
Heat Loss: 6211.80 units
Estimated Energy Consumption: 7668.89 units
Performance Rating: Excellent
==================================
>>>
```

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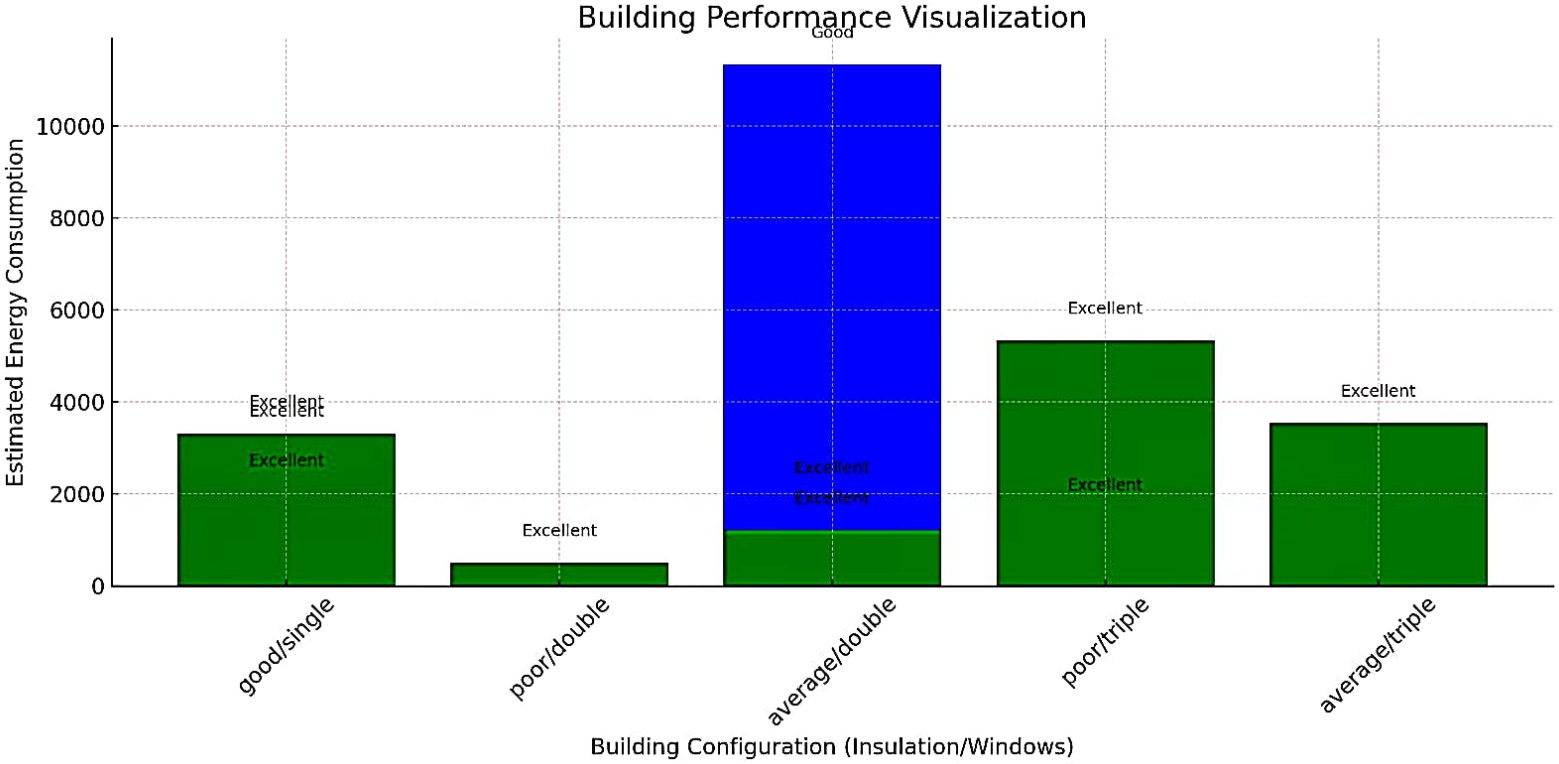
Building Performance Visualization
Estimated Energy Consumption
0
2000
4000
6000
8000
10000
Good
Excellent
Excellent
Excellent
Excellent
Excellent
Excellent
Excellent
Excellent
Excellent
good/single
poor/double
average/double
poor/triple
average/triple
Building Configuration (Insulation/Windows)