Java Capstone Project

Compact Programming Course - Java

Group#10

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Agenda

Problem Statement and Tasks

Requirements to the system

Class Diagram

Component Diagram

Project Overview

Management I/O in the system

User interfaces

Concurrency

Results of the Unit Test of the System

Smart House: Simulation of the Energy supply and consumption

Tasks

- Simulation of the Smart Objects
- Simulation of the Energy Sources
- Management system for the house consumption
- Design of the User Interface for the Managing Smart Objects
- Design of the User Interface for Managing Energy Sources

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System Requirements

Hardware Requirements

•**Processor**: Dual-core processor (e.g., Intel Core i3 or AMD equivalent).

•**RAM**: 4 GB.

•**Storage**: 2 GB of free disk space (for Java Development Kit (JDK), Integrated Development Environment (IDE), and project files).

•**Graphics**: Basic integrated graphics (no special GPU needed for Java programs).

Software Requirements

Operating System: Windows, macOS

Java Development Kit (JDK)

Integrated Development Environment (IDE): IntelliJ IDEA, Eclipse, or NetBeans

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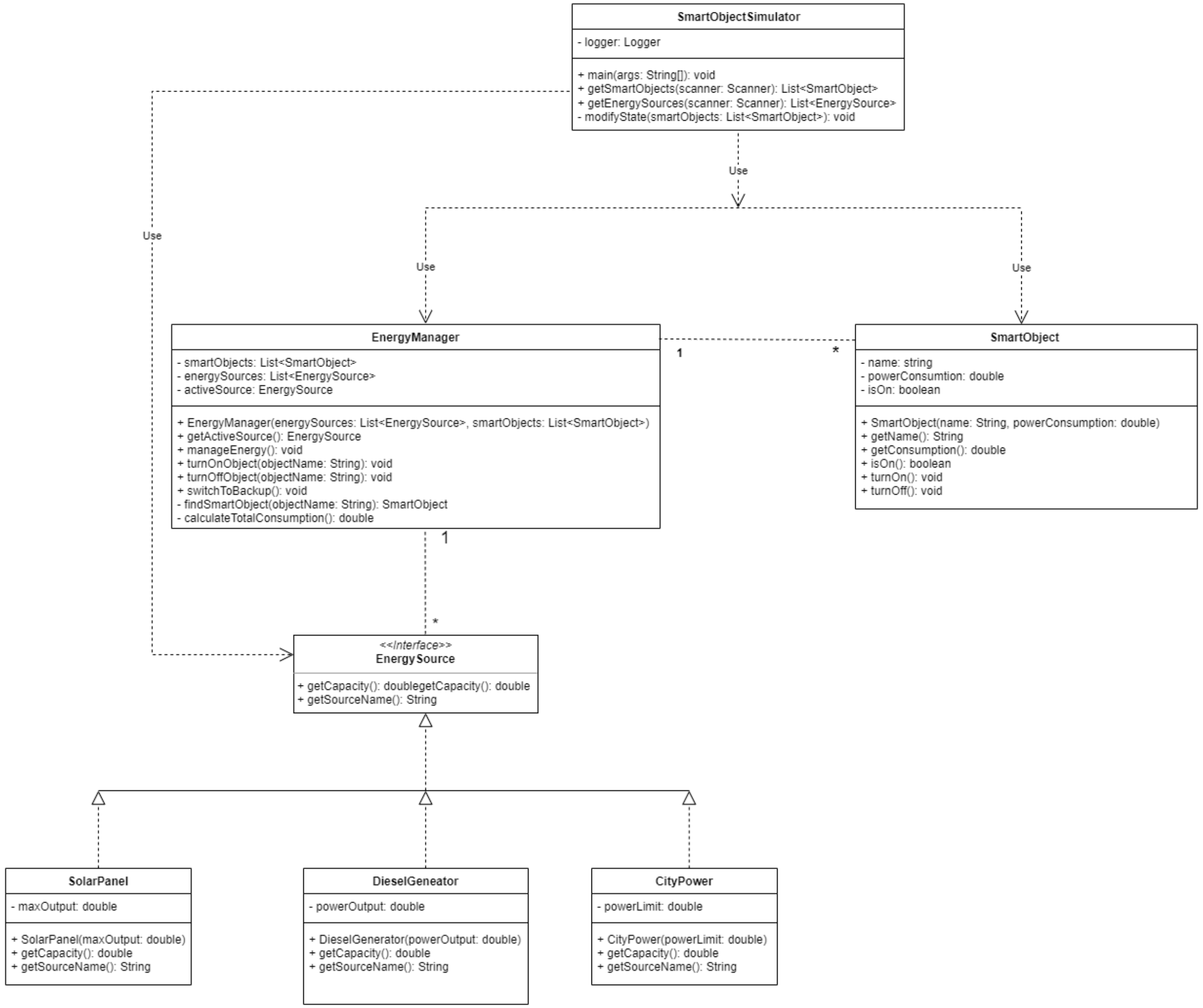
SmartHouseSimulation



SmartObjectSimulator

- logger: Logger

+ main(args: String[]): void
+ getSmartObjects(scanner: Scanner): List<SmartObject>
+ getEnergySources(scanner: Scanner): List<EnergySource>
- modifyState(smartObjects: List<SmartObject>): void

EnergyManager

- smartObjects: List<SmartObject>
- energySources: List<EnergySource>
- activeSource: EnergySource

+ EnergyManager(energySources: List<EnergySource>, smartObjects: List<SmartObject>)
+ getActiveSource(): EnergySource
+ manageEnergy(): void
+ turnOnObject(objectName: String): void
+ turnOffObject(objectName: String): void
+ switchToBackup(): void
- findSmartObject(objectName: String): SmartObject
- calculateTotalConsumption(): double

SmartObject

- name: string
- powerConsumtion: double
- isOn: boolean

+ SmartObject(name: String, powerConsumption: double)
+ getName(): String
+ getConsumption(): double
+ isOn(): boolean
+ turnOn(): void
+ turnOff(): void

<<Interface>>
EnergySource

+ getCapacity(): doublegetCapacity(): double
+ getSourceName(): String

SolarPanel

- maxOutput: double

+ SolarPanel(maxOutput: double)
+ getCapacity(): double
+ getSourceName(): String

DieselGeneator

- powerOutput: double

+ DieselGenerator(powerOutput: double)
+ getCapacity(): double
+ getSourceName(): String

CityPower

- powerLimit: double

+ CityPower(powerLimit: double)
+ getCapacity(): double
+ getSourceName(): String

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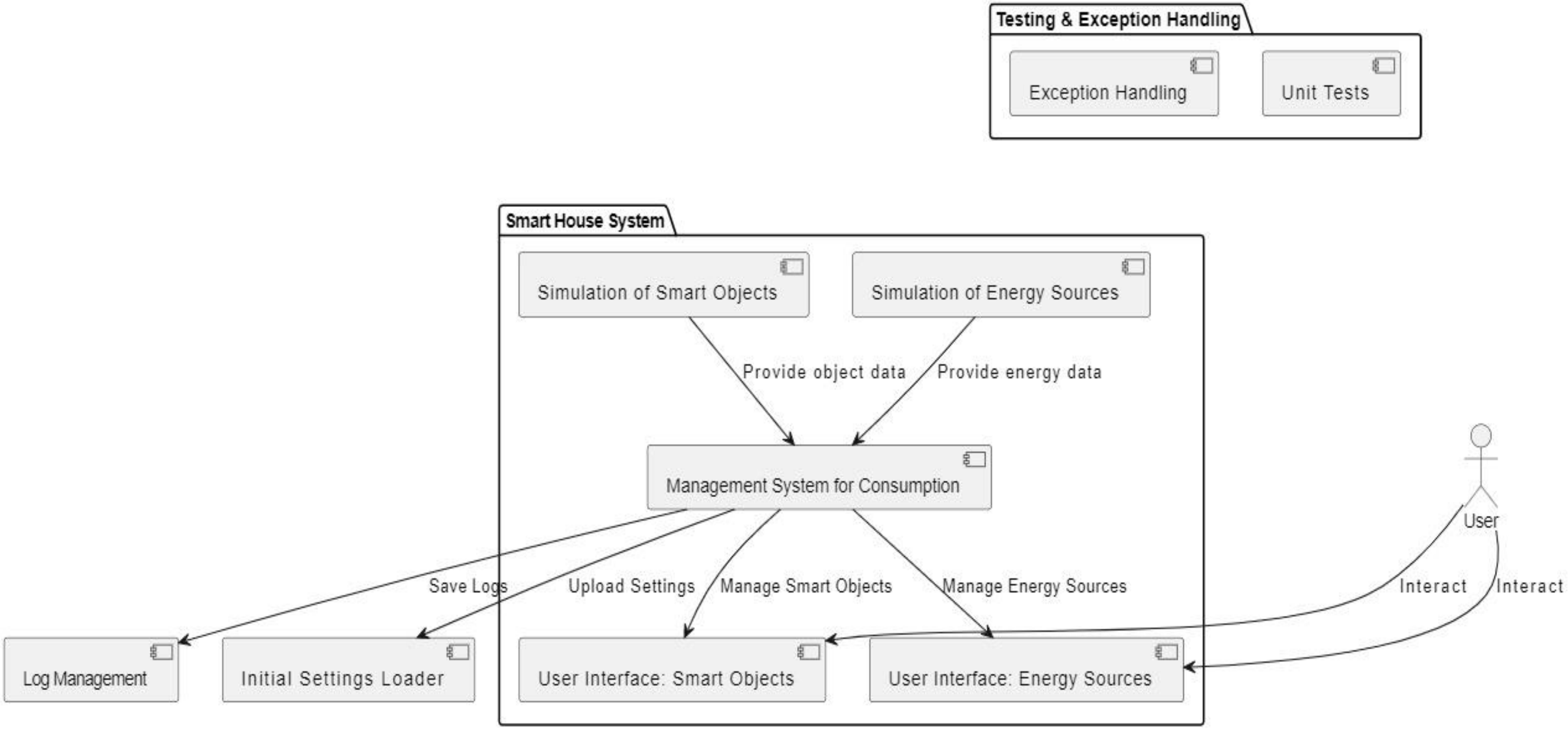
Component Diagram for Smart House Simulation



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Management I/O in the system

The System handles I/p and O/p for various operations across different methods, enabling user interactions like adding or removing Smart Objects and managing Energy Sources.

1.Energy Manager

➔ User mange energy resources.

➔ List Energy sources is displayed.

2. Smart Objects

➔ Users can add new smart objects and as well remove.

➔ List of smart objects is displayed

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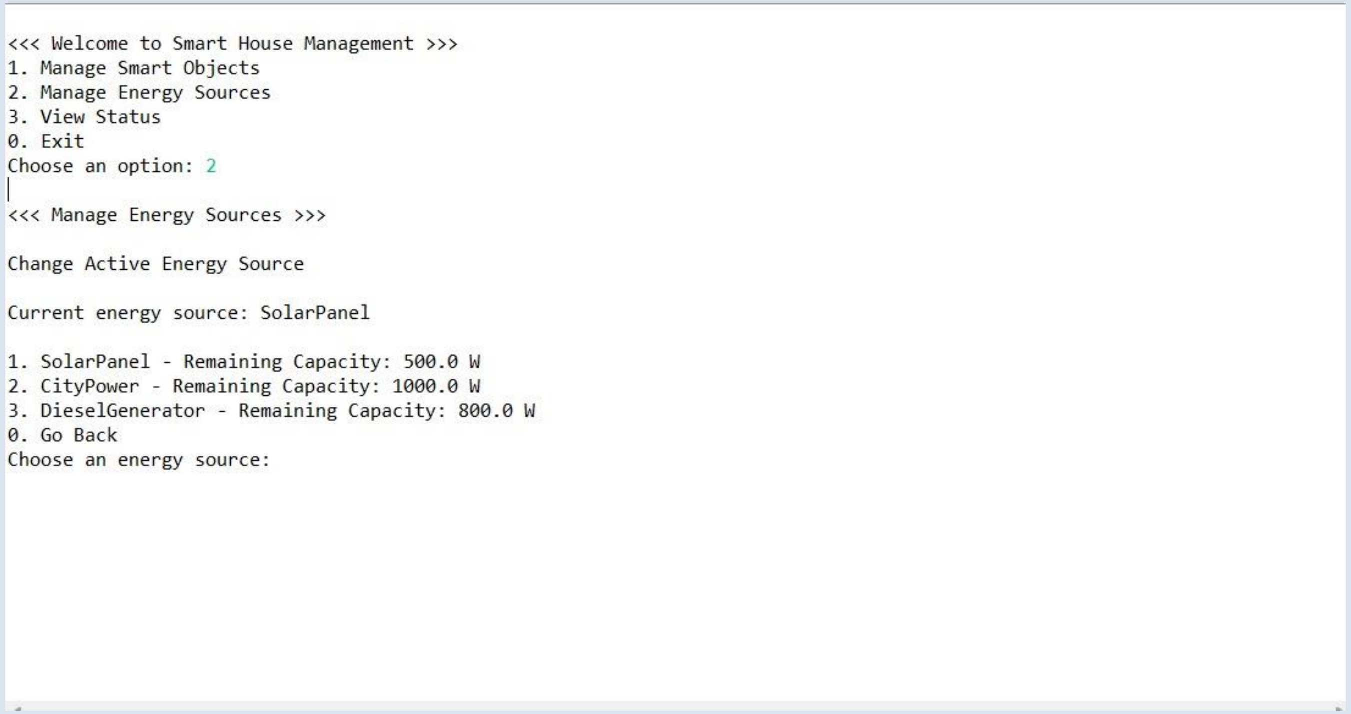
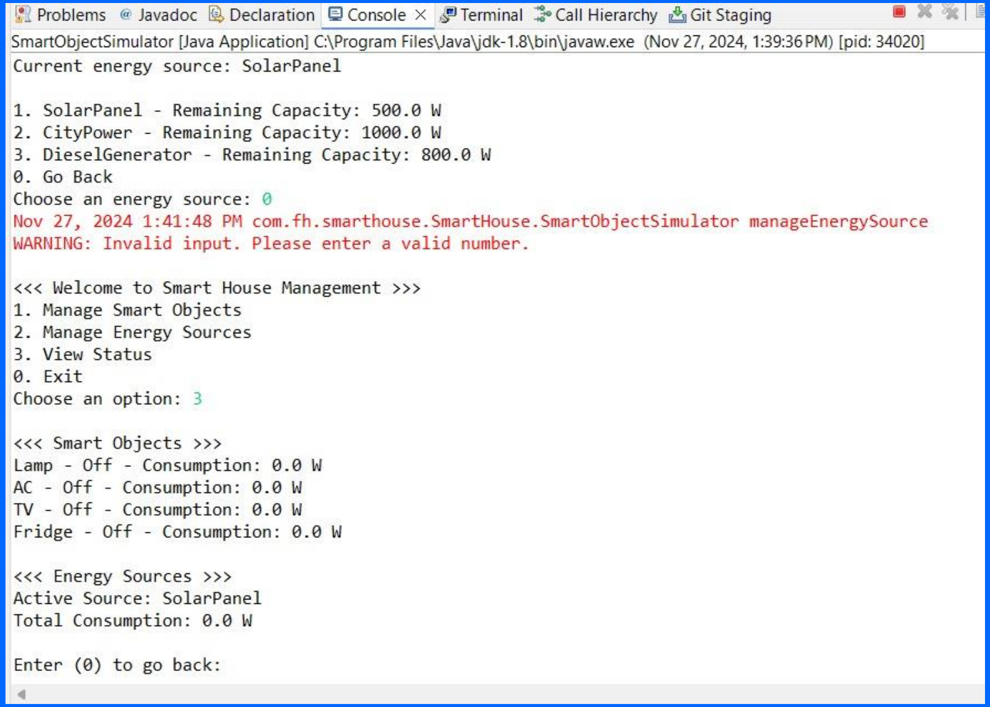
Available Energy Sources

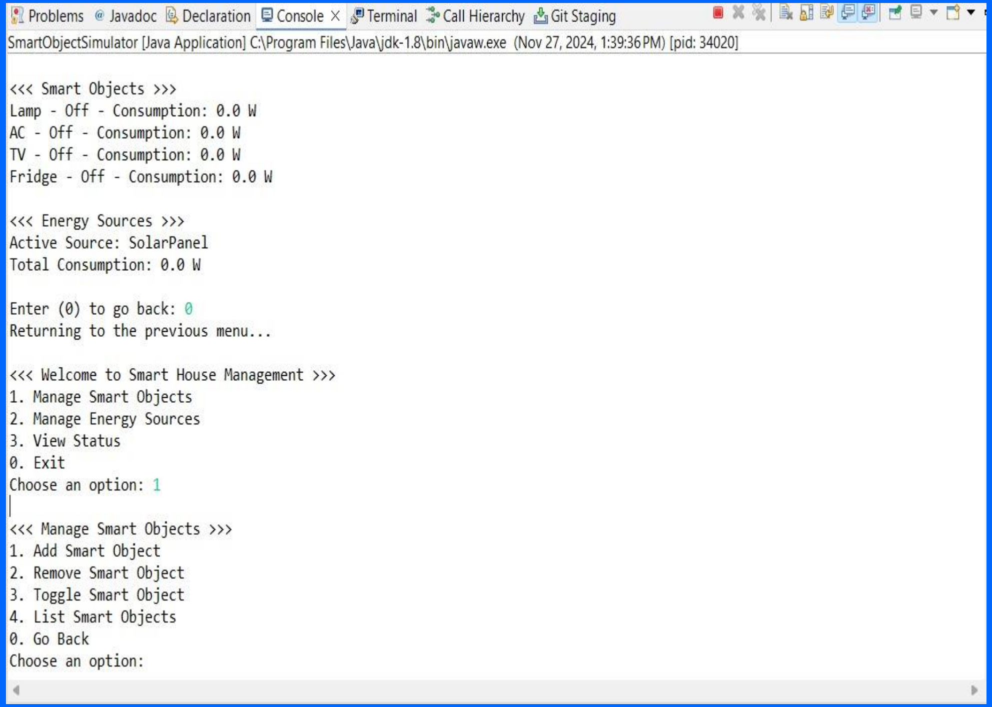


```
<<< Welcome to Smart House Management >>>
1. Manage Smart Objects
2. Manage Energy Sources
3. View Status
0. Exit
Choose an option: 2

<<< Manage Energy Sources >>>

Change Active Energy Source

Current energy source: SolarPanel

1. SolarPanel - Remaining Capacity: 500.0 W
2. CityPower - Remaining Capacity: 1000.0 W
3. DieselGenerator - Remaining Capacity: 800.0 W
0. Go Back
Choose an energy source:
```

UI for EnergySources and SmartObjects



```
SmartObjectSimulator [Java Application] C:\Program Files\Java\jdk-1.8\bin\javaw.exe  (Nov 27, 2024, 1:39:36 PM) [pid: 34020]
Current energy source: SolarPanel

1. SolarPanel - Remaining Capacity: 500.0 W
2. CityPower - Remaining Capacity: 1000.0 W
3. DieselGenerator - Remaining Capacity: 800.0 W
0. Go Back
Choose an energy source: 0
Nov 27, 2024 1:41:48 PM com.fh.smarthouse.SmartHouse.SmartObjectSimulator manageEnergySource
WARNING: Invalid input. Please enter a valid number.

<<< Welcome to Smart House Management >>>
1. Manage Smart Objects
2. Manage Energy Sources
3. View Status
0. Exit
Choose an option: 3

<<< Smart Objects >>>
Lamp - Off - Consumption: 0.0 W
AC - Off - Consumption: 0.0 W
TV - Off - Consumption: 0.0 W
Fridge - Off - Consumption: 0.0 W

<<< Energy Sources >>>
Active Source: SolarPanel
Total Consumption: 0.0 W

Enter (0) to go back:
```



```
SmartObjectSimulator [Java Application] C:\Program Files\Java\jdk-1.8\bin\javaw.exe  (Nov 27, 2024, 1:39:36 PM) [pid: 34020]

<<< Smart Objects >>>
Lamp - Off - Consumption: 0.0 W
AC - Off - Consumption: 0.0 W
TV - Off - Consumption: 0.0 W
Fridge - Off - Consumption: 0.0 W

<<< Energy Sources >>>
Active Source: SolarPanel
Total Consumption: 0.0 W

Enter (0) to go back: 0
Returning to the previous menu...

<<< Welcome to Smart House Management >>>
1. Manage Smart Objects
2. Manage Energy Sources
3. View Status
0. Exit
Choose an option: 1

<<< Manage Smart Objects >>>
1. Add Smart Object
2. Remove Smart Object
3. Toggle Smart Object
4. List Smart Objects
0. Go Back
Choose an option:
```

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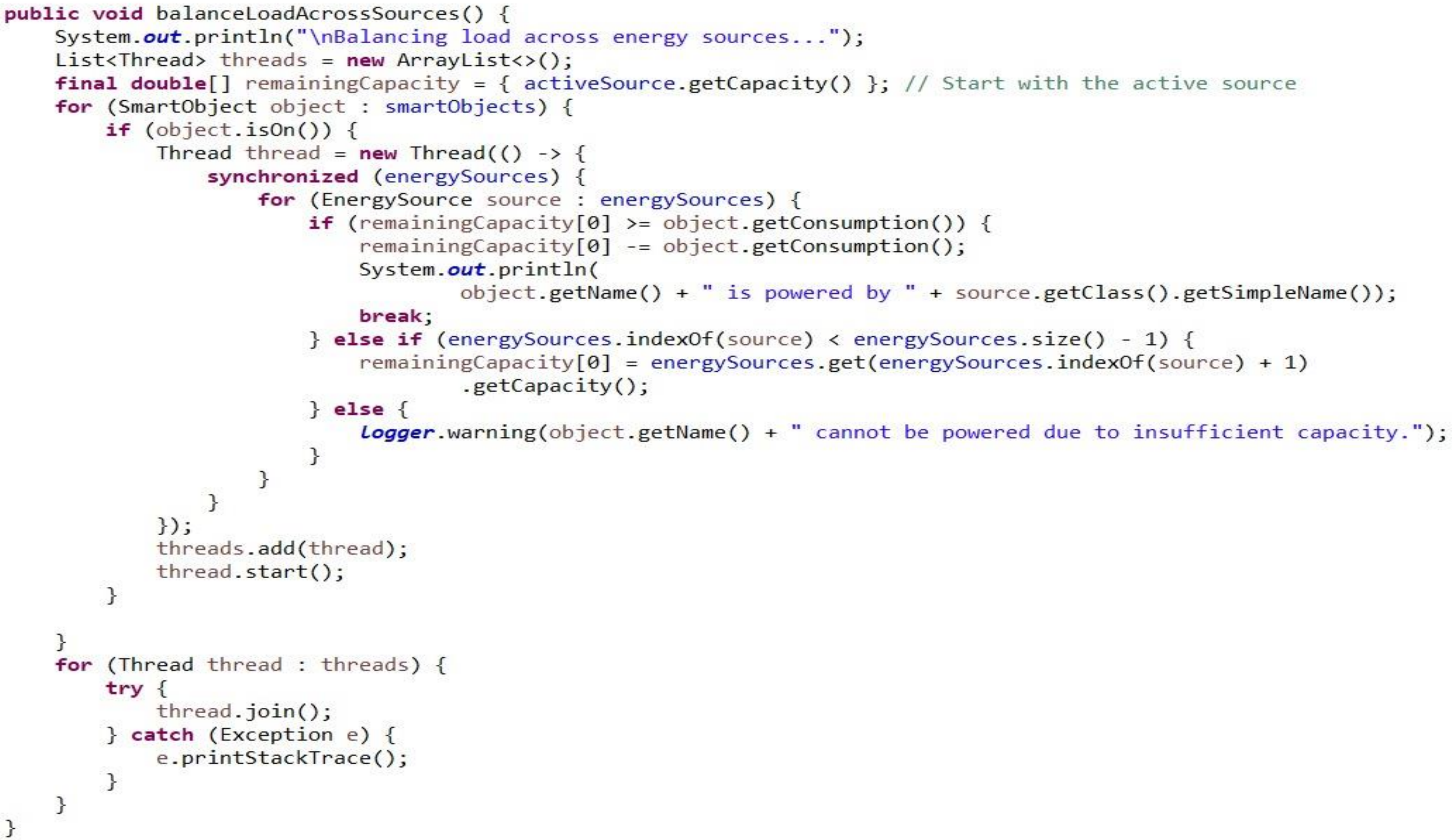

```
public void balanceLoadAcrossSources() {
    System.out.println("\nBalancing load across energy sources...");
    List<Thread> threads = new ArrayList<>();
    final double[] remainingCapacity = { activeSource.getCapacity() }; // Start with the active source
    for (SmartObject object : smartObjects) {
        if (object.isOn()) {
            Thread thread = new Thread(() -> {
                synchronized (energySources) {
                    for (EnergySource source : energySources) {
                        if (remainingCapacity[0] >= object.getConsumption()) {
                            remainingCapacity[0] -= object.getConsumption();
                            System.out.println(
                                    object.getName() + " is powered by " + source.getClass().getSimpleName());
                            break;
                        } else if (energySources.indexOf(source) < energySources.size() - 1) {
                            remainingCapacity[0] = energySources.get(energySources.indexOf(source) + 1)
                                    .getCapacity();
                        } else {
                            Logger.warning(object.getName() + " cannot be powered due to insufficient capacity.");
                        }
                    }
                }
            });
            threads.add(thread);
            thread.start();
        }

    }
    for (Thread thread : threads) {
        try {
            thread.join();
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```

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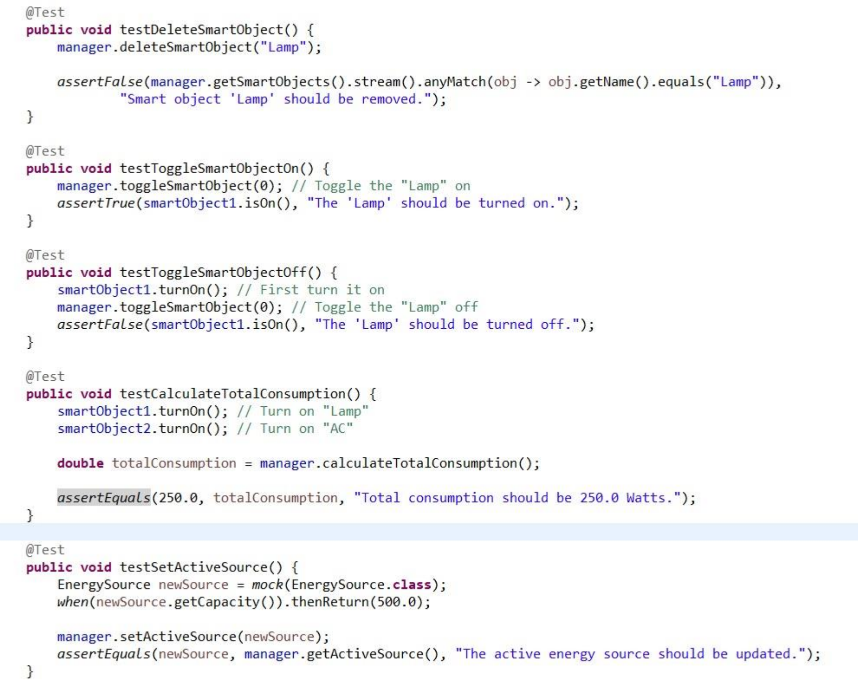
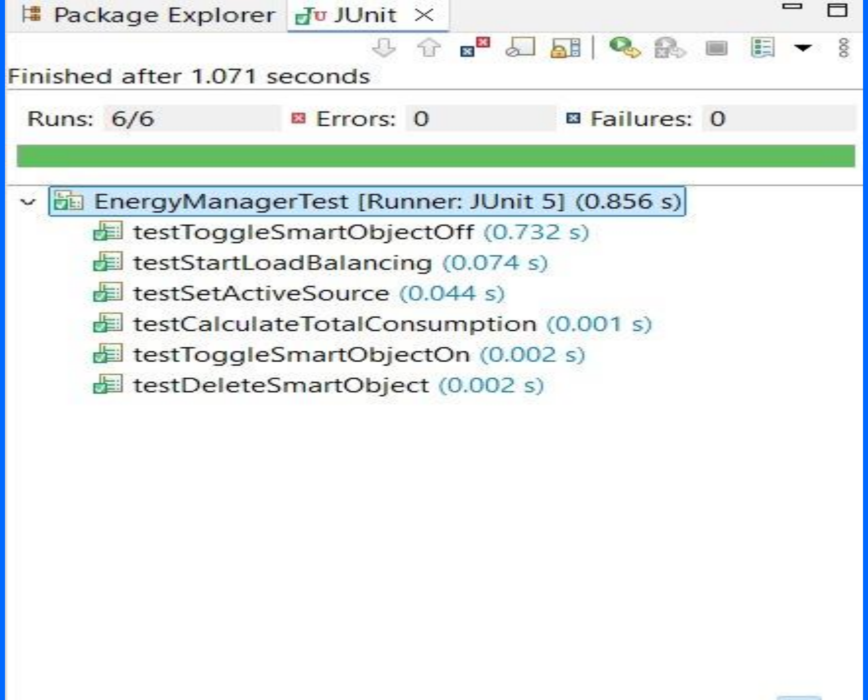
Results of the Unit Test of the System

Junit Test Case for EnergyManager

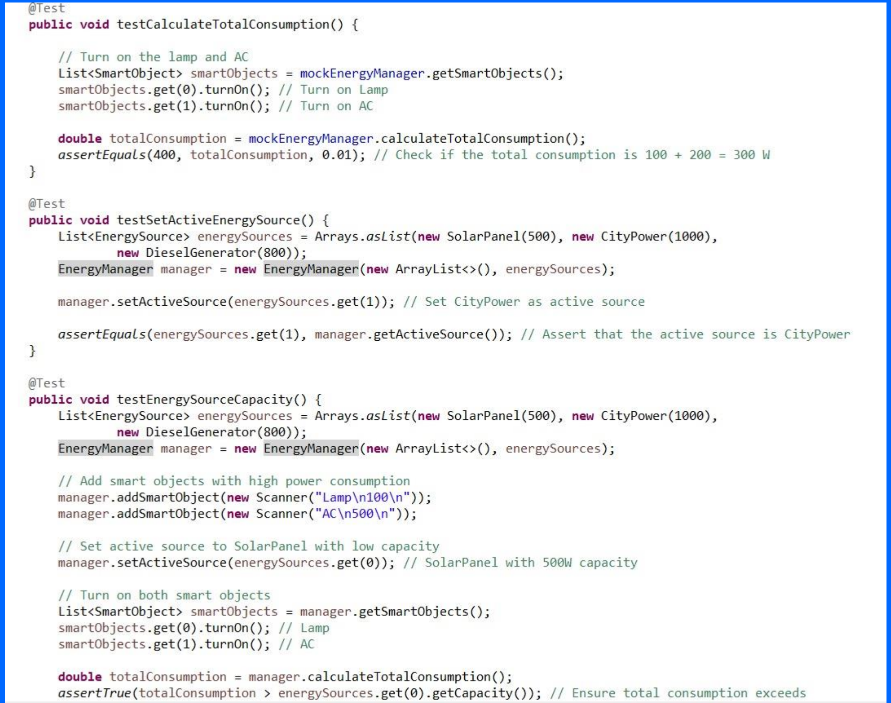


```java
@Test
public void testDeleteSmartObject() {
    manager.deleteSmartObject("Lamp");

    assertFalse(manager.getSmartObjects().stream().anyMatch(obj -> obj.getName().equals("Lamp")),
            "Smart object 'Lamp' should be removed.");
}

@Test
public void testToggleSmartObjectOn() {
    manager.toggleSmartObject(0); // Toggle the "Lamp" on
    assertTrue(smartObject1.isOn(), "The 'Lamp' should be turned on.");
}

@Test
public void testToggleSmartObjectOff() {
    smartObject1.turnOn(); // First turn it on
    manager.toggleSmartObject(0); // Toggle the "Lamp" off
    assertFalse(smartObject1.isOn(), "The 'Lamp' should be turned off.");
}

@Test
public void testCalculateTotalConsumption() {
    smartObject1.turnOn(); // Turn on "Lamp"
    smartObject2.turnOn(); // Turn on "AC"

    double totalConsumption = manager.calculateTotalConsumption();

    assertEquals(250.0, totalConsumption, "Total consumption should be 250.0 Watts.");
}

@Test
public void testSetActiveSource() {
    EnergySource newSource = mock(EnergySource.class);
    when(newSource.getCapacity()).thenReturn(500.0);

    manager.setActiveSource(newSource);
    assertEquals(newSource, manager.getActiveSource(), "The active energy source should be updated.");
}
```

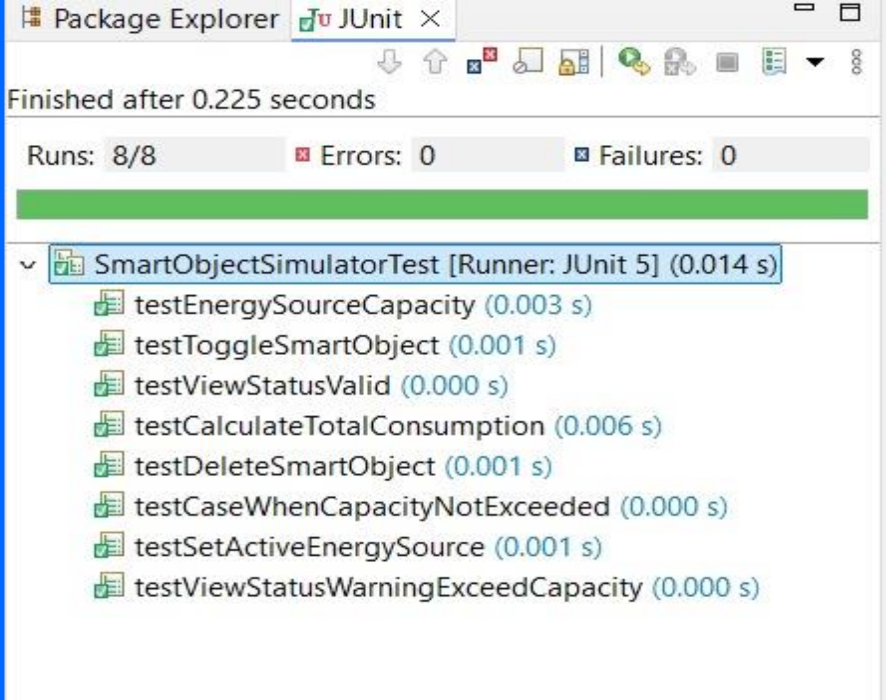


```
Finished after 1.071 seconds

Runs: 6/6    Errors: 0    Failures: 0

EnergyManagerTest [Runner: JUnit 5] (0.856 s)
    testToggleSmartObjectOff (0.732 s)
    testStartLoadBalancing (0.074 s)
    testSetActiveSource (0.044 s)
    testCalculateTotalConsumption (0.001 s)
    testToggleSmartObjectOn (0.002 s)
    testDeleteSmartObject (0.002 s)
```

Junit Test Case for SmartObjectSimulator



```
@Test
public void testCalculateTotalConsumption() {

    // Turn on the lamp and AC
    List<SmartObject> smartObjects = mockEnergyManager.getSmartObjects();
    smartObjects.get(0).turnOn(); // Turn on Lamp
    smartObjects.get(1).turnOn(); // Turn on AC

    double totalConsumption = mockEnergyManager.calculateTotalConsumption();
    assertEquals(400, totalConsumption, 0.01); // Check if the total consumption is 100 + 200 = 300 W
}

@Test
public void testSetActiveEnergySource() {
    List<EnergySource> energySources = Arrays.asList(new SolarPanel(500), new CityPower(1000),
            new DieselGenerator(800));
    EnergyManager manager = new EnergyManager(new ArrayList<>(), energySources);

    manager.setActiveSource(energySources.get(1)); // Set CityPower as active source

    assertEquals(energySources.get(1), manager.getActiveSource()); // Assert that the active source is CityPower
}

@Test
public void testEnergySourceCapacity() {
    List<EnergySource> energySources = Arrays.asList(new SolarPanel(500), new CityPower(1000),
            new DieselGenerator(800));
    EnergyManager manager = new EnergyManager(new ArrayList<>(), energySources);

    // Add smart objects with high power consumption
    manager.addSmartObject(new Scanner("Lamp\n100\n"));
    manager.addSmartObject(new Scanner("AC\n500\n"));

    // Set active source to SolarPanel with low capacity
    manager.setActiveSource(energySources.get(0)); // SolarPanel with 500W capacity

    // Turn on both smart objects
    List<SmartObject> smartObjects = manager.getSmartObjects();
    smartObjects.get(0).turnOn(); // Lamp
    smartObjects.get(1).turnOn(); // AC

    double totalConsumption = manager.calculateTotalConsumption();
    assertTrue(totalConsumption > energySources.get(0).getCapacity()); // Ensure total consumption exceeds
```



Finished after 0.225 seconds

Runs: 8/8 Errors: 0 Failures: 0

```
SmartObjectSimulatorTest [Runner: JUnit 5] (0.014 s)
    testEnergySourceCapacity (0.003 s)
    testToggleSmartObject (0.001 s)
    testViewStatusValid (0.000 s)
    testCalculateTotalConsumption (0.006 s)
    testDeleteSmartObject (0.001 s)
    testCaseWhenCapacityNotExceeded (0.000 s)
    testSetActiveEnergySource (0.001 s)
    testViewStatusWarningExceedCapacity (0.000 s)
```

Thank you