



DHL WAREHOUSE AUTOMATION SYSTEM



ROLES DISTRIBUTION

- > **BERNARD WIDJAJA**
 - RESOURCE (BOX,AGV)
 - STORAGEAREA
 - UI
- > **MEGHANA HEMESH KUMAR**
 - LOG MANAGER
 - PROCESS (STORING AND RETRIEVING)
- > **RAJDEEP SHAW**
 - CHARGING STATION
 - BATTERY
 - STORAGE SYSTEM



DESCRIPTION OF THE DOMAIN

DOMAIN:
AUTOMATED WAREHOUSE MANAGEMENT

DESCRIPTION:

- **HANDLING STORAGE AND RETRIEVAL OF BOXES EFFICIENTLY**
- **MANAGING AUTONOMOUS GUIDED VEHICLES (AGVS)**
- **MAINTAINING LOGS FOR AUDITING AND MONITORING**
- **ENSURING SAFE AND CONCURRENT OPERATIONS**
- **CHARGING THE AGVS WHEN THE BATTERY IS LOW**



REQUIREMENTS TO THE SYSTEM

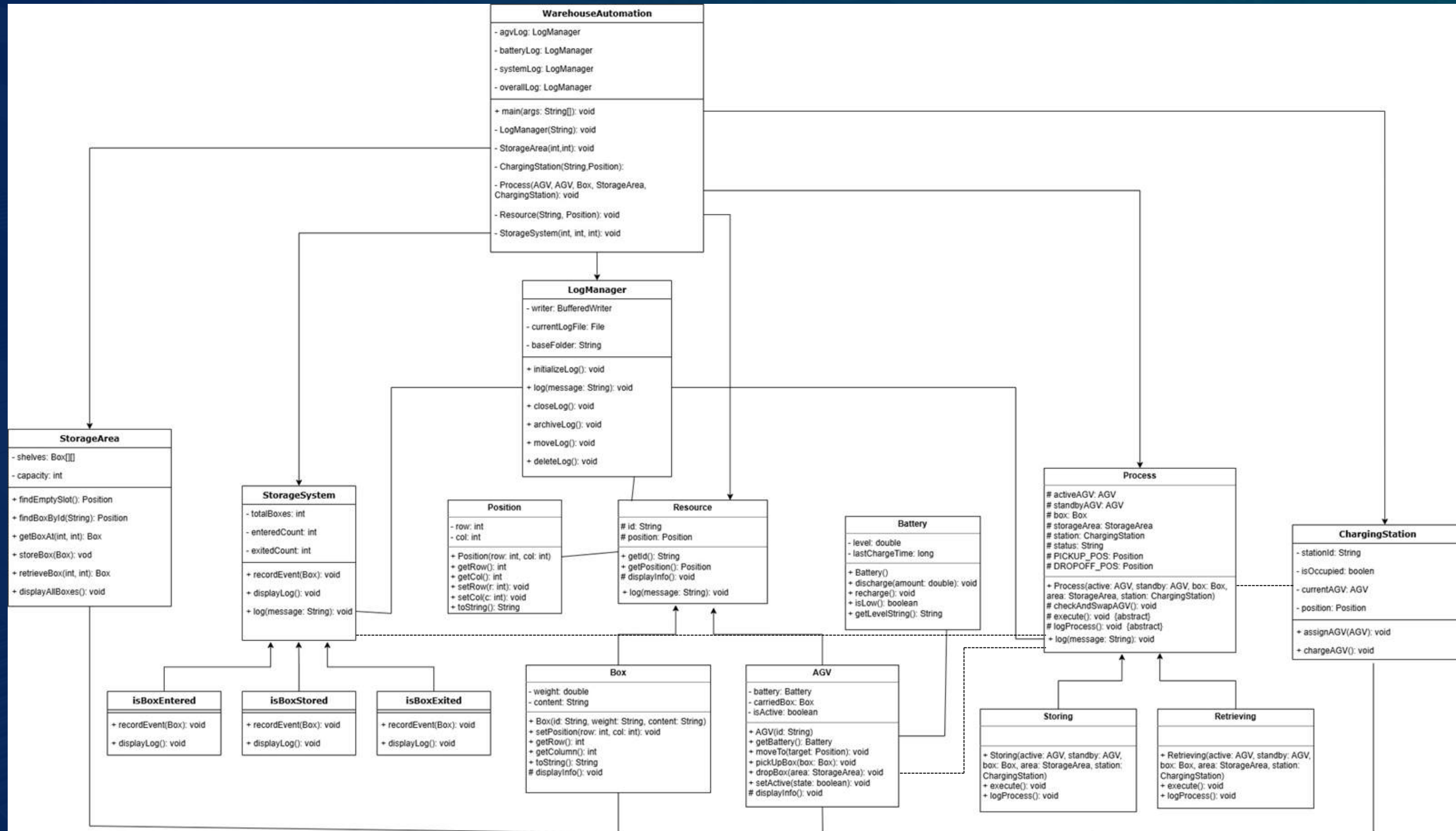


FUNCTIONAL REQUIREMENTS:

- THE SYSTEM MUST ALLOW STORING AND RETRIEVING BOXES.
- AGVS SHOULD MOVE TO PICKUP AND DROP POSITIONS.
- EACH AGV MUST MONITOR ITS BATTERY LEVEL.
- CHARGING STATIONS MUST HANDLE THE AGV CHARGING PROCESS.
- IF A STATION IS UNAVAILABLE, THE AGV MUST EITHER WAIT OR THROW AN EXCEPTION AFTER TIMEOUT.
- THE SYSTEM SHOULD LOG IMPORTANT EVENTS.
- THE UI MUST ALLOW THE USER TO INTERACT WITH THE SYSTEM.

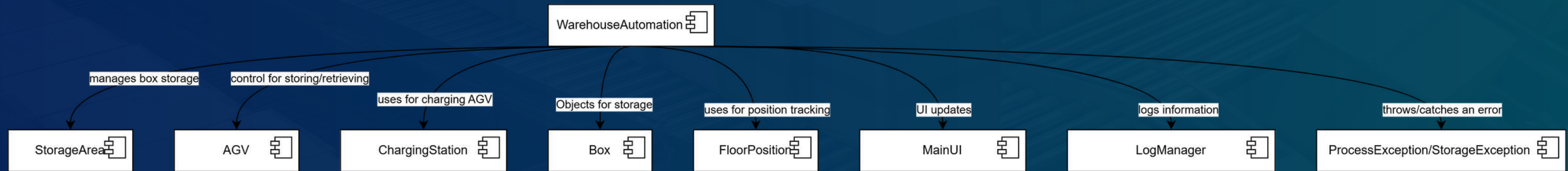


UML CLASS DIAGRAM

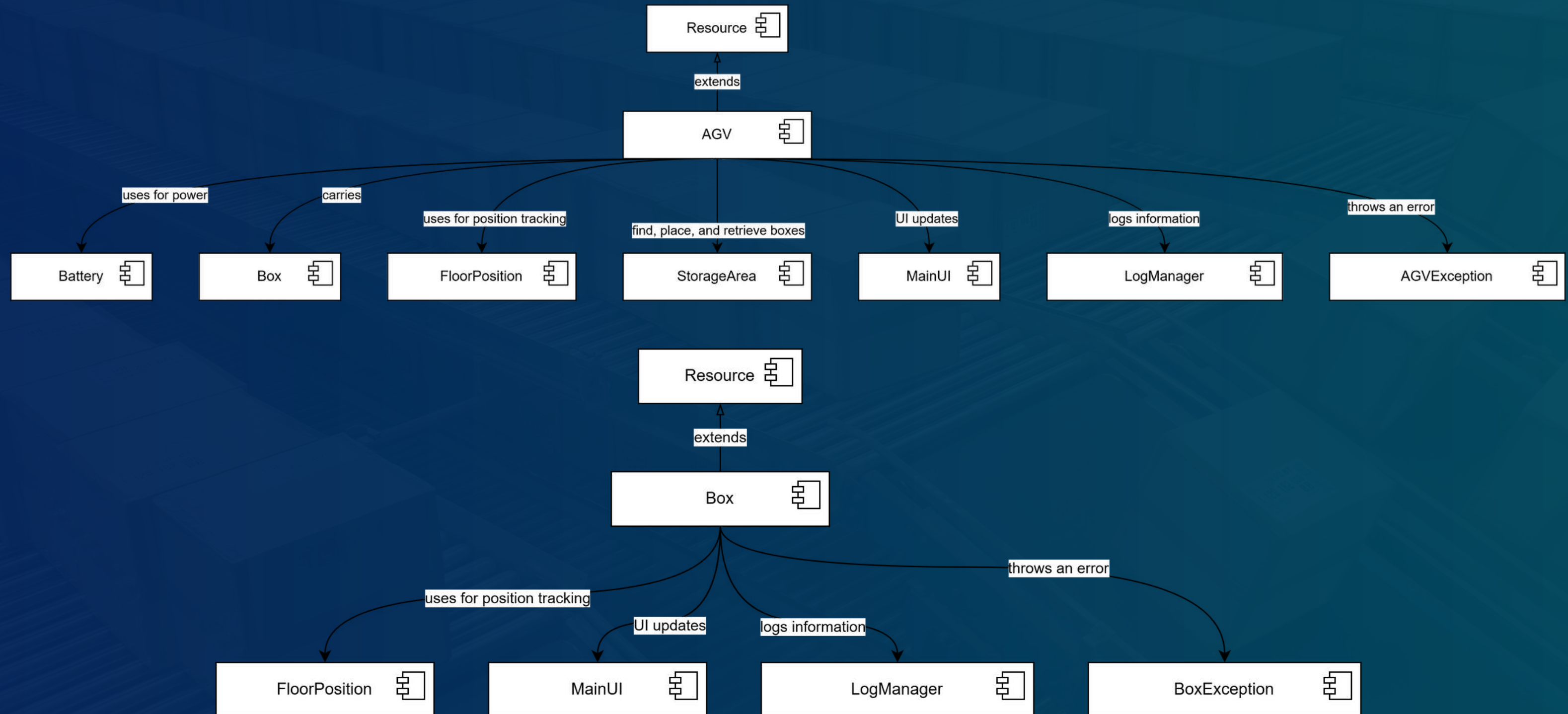




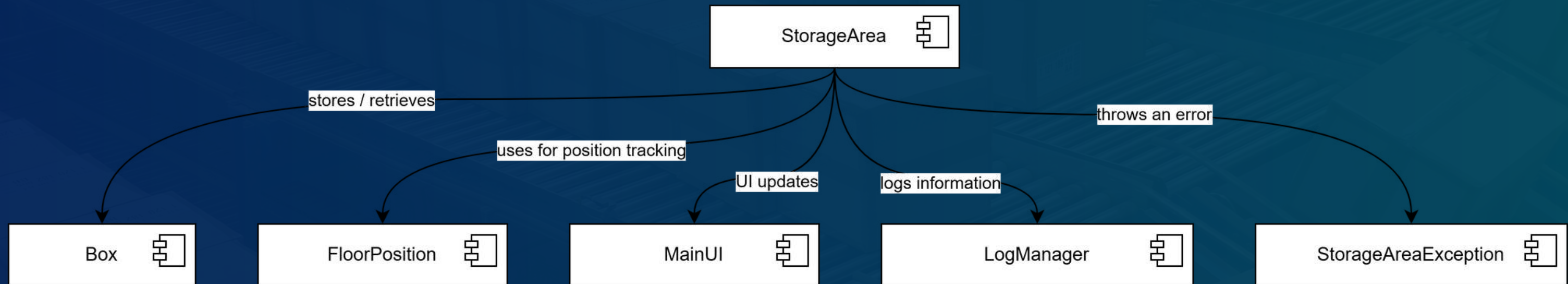
WAREHOUSE AUTOMATION COMPONENT DIAGRAM



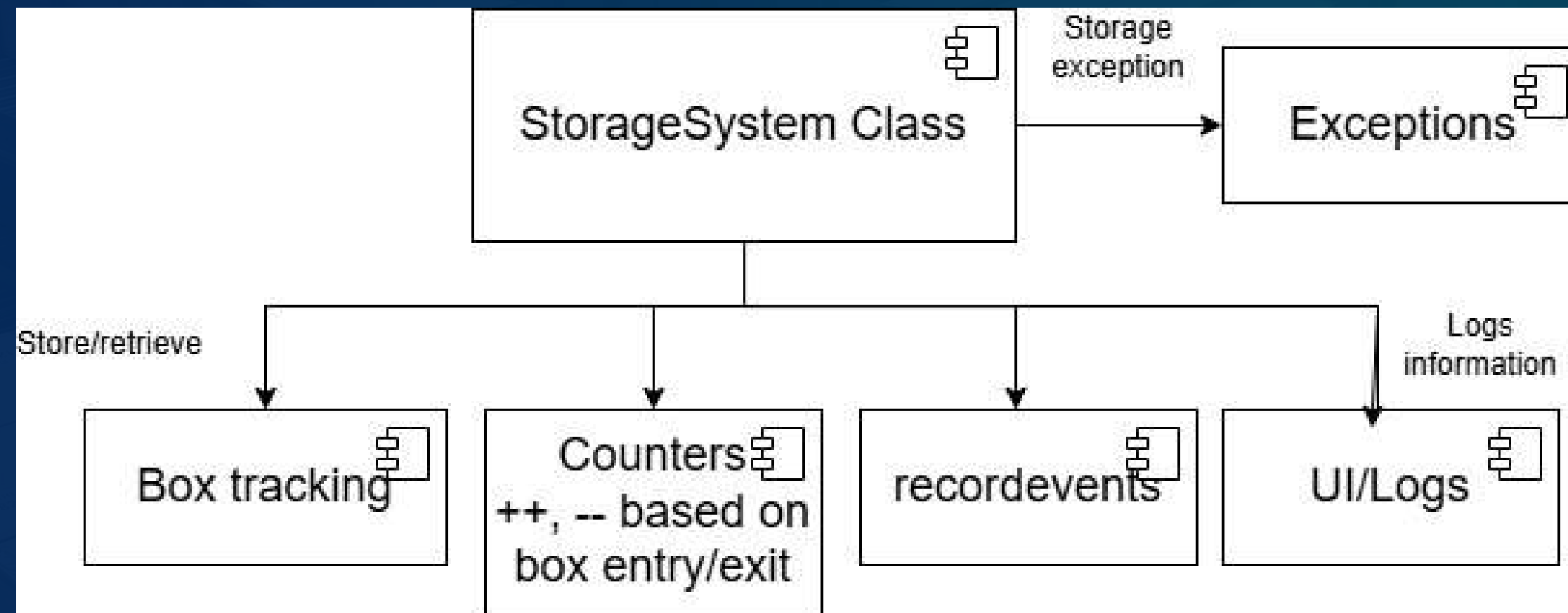
AGV & BOX COMPONENT DIAGRAM



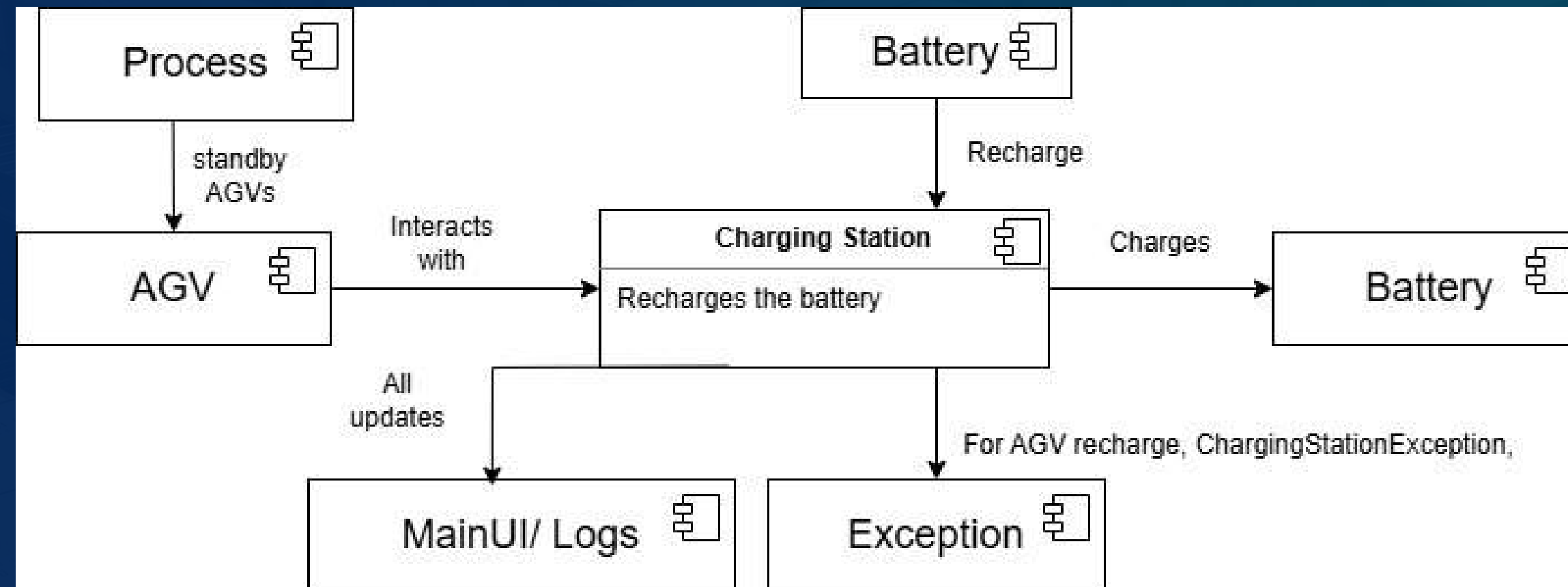
STORAGEAREA COMPONENT DIAGRAM



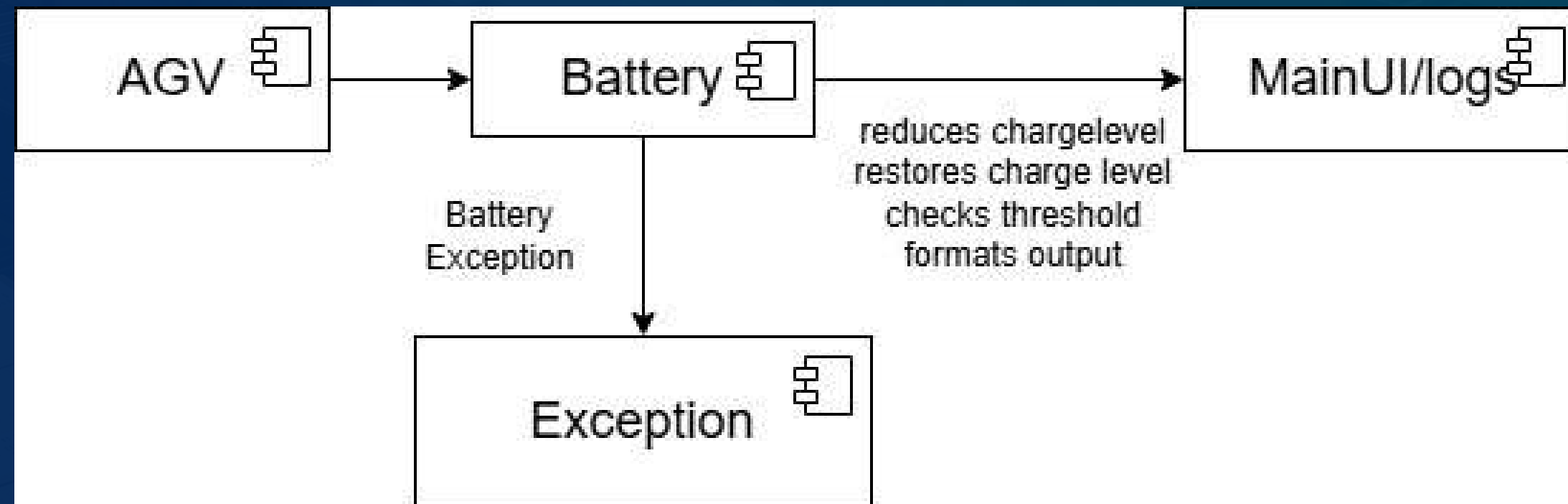
STORAGE SYSTEM COMPONENT DIAGRAM



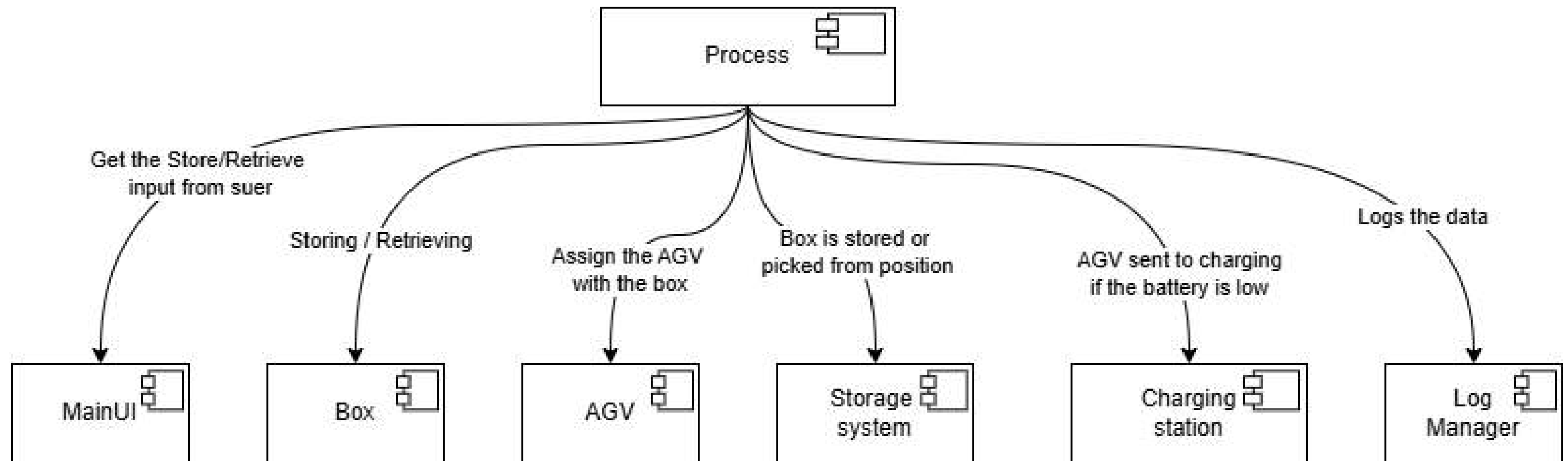
CHARGING STATION COMPONENT DIAGRAM



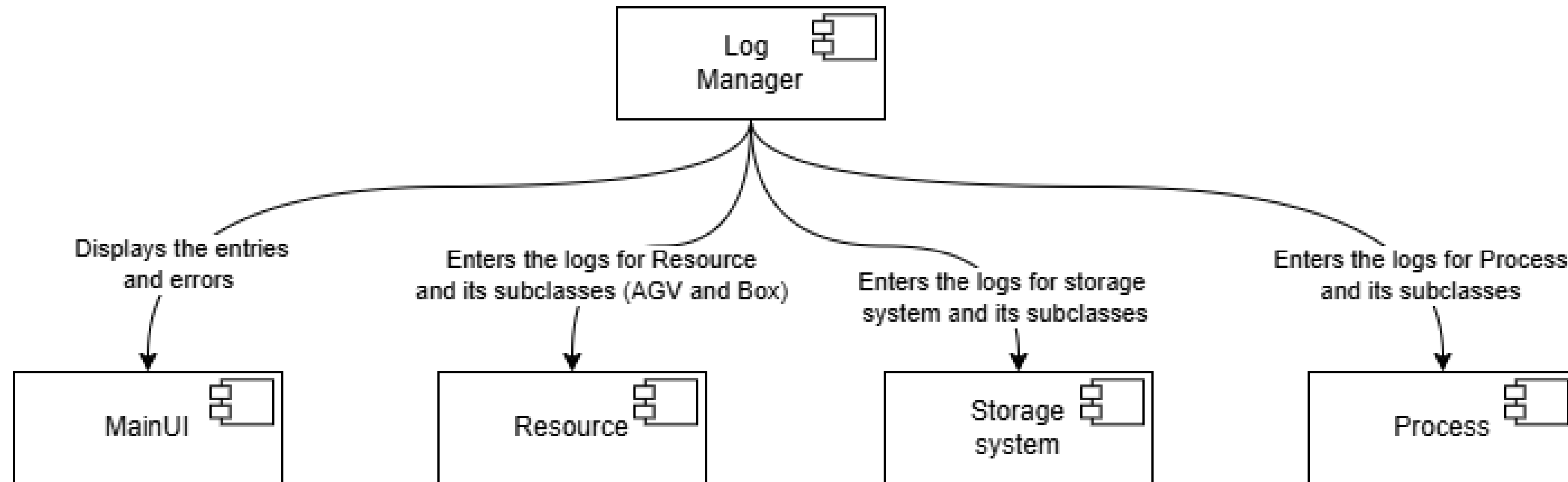
BATTERY COMPONENT DIAGRAM



PROCESS COMPONENT DIAGRAM



LOG MANAGER COMPONENT DIAGRAM



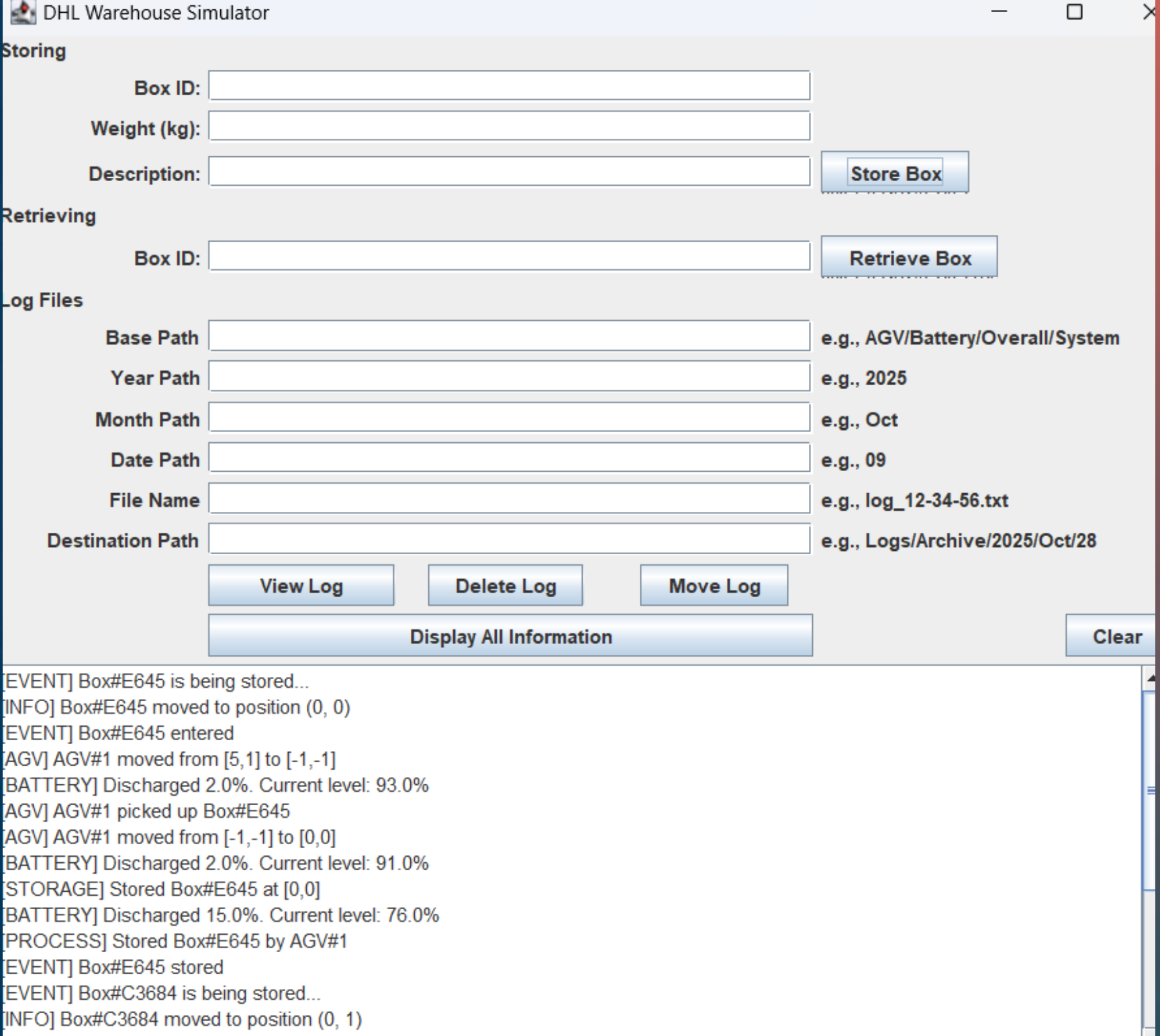
MANAGEMENT I/O IN THE SYSTEM

INPUTS:

- **STORING: BOX ID, WEIGHT, DESCRIPTION**
- **RETRIEVING: BOX ID**
- **LOG FILES: BASE PATH, YEAR, MONTH, DATE AND FILE NAME**
- **VIEW LOG, DELETE LOG, MOVE LOG**
- **DISPLAY ALL INFORMATION AND CLEAR**

OUTPUTS:

- **MAINUI LOGS FOR USER**
- **SYSTEM LOGS FOR AUDITING (AGV, BATTERY, OVERALL, SYSTEM)**



The screenshot displays the DHL Warehouse Simulator interface. It features three main input sections: 'Storing' with fields for Box ID, Weight (kg), and Description, and a 'Store Box' button; 'Retrieving' with a Box ID field and a 'Retrieve Box' button; and 'Log Files' with fields for Base Path, Year Path, Month Path, Date Path, File Name, and Destination Path, each with a corresponding example (e.g., AGV/Battery/Overall/System, 2025, Oct, 09, log_12-34-56.txt, Logs/Archive/2025/Oct/28). Below these are buttons for 'View Log', 'Delete Log', 'Move Log', 'Display All Information', and 'Clear'. The bottom section shows a log output area with text such as '[EVENT] Box#E645 is being stored...', '[INFO] Box#E645 moved to position (0, 0)', '[EVENT] Box#E645 entered', '[AGV] AGV#1 moved from [5,1] to [-1,-1]', '[BATTERY] Discharged 2.0%. Current level: 93.0%', '[AGV] AGV#1 picked up Box#E645', '[AGV] AGV#1 moved from [-1,-1] to [0,0]', '[BATTERY] Discharged 2.0%. Current level: 91.0%', '[STORAGE] Stored Box#E645 at [0,0]', '[BATTERY] Discharged 15.0%. Current level: 76.0%', '[PROCESS] Stored Box#E645 by AGV#1', '[EVENT] Box#E645 stored', '[EVENT] Box#C3684 is being stored...', '[INFO] Box#C3684 moved to position (0, 1)', and '[EVENT] Box#C3684 entered'.

USER INTERFACE

- DEVELOPED USING JAVA SWING FOR USER-FRIENDLY INTERACTION.
- ALLOWS THE USER TO STORE AND RETRIEVE BOXES WITH UNIQUE IDS.
- PROVIDES FIELDS FOR BOX ID, WEIGHT, DESCRIPTION, AND LOG MANAGEMENT
- INCLUDES FEATURES TO:
 - STORE / RETRIEVE BOXES
 - VIEW, DELETE, MOVE LOGS
 - DISPLAY ALL INFORMATION
 - CLEAR TEXT AREA
- DISPLAYS REAL-TIME SYSTEM EVENTS IN THE OUTPUT AREA — INCLUDING AGV MOVEMENT, STORAGE PROCESS, AND BATTERY UPDATES.

The screenshot shows a Java Swing window titled "DHL Warehouse Simulator". The interface is divided into several sections:

- Storing:** Contains input fields for "Box ID:", "Weight (kg):", and "Description:". A "Store Box" button is located to the right of the "Description" field.
- Retrieving:** Contains an input field for "Box ID:" and a "Retrieve Box" button to its right.
- Log Files:** Contains input fields for "Base Path", "Year Path", "Month Path", "Date Path", "File Name", and "Destination Path". To the right of each field is a text label providing an example: "e.g., AGV/Battery/Overall/System", "e.g., 2025", "e.g., Oct", "e.g., 09", "e.g., log_12-34-56.txt", and "e.g., Logs/Archive/2025/Oct/28".
- Buttons:** Below the "Log Files" section are three buttons: "View Log", "Delete Log", and "Move Log". At the bottom of this section is a wide "Display All Information" button.
- Clear:** A "Clear" button is located at the bottom right of the window.
- Output Area:** A text area at the bottom of the window displays real-time system events. The visible text includes:
 - [EVENT] Box#E645 is being stored...
 - [INFO] Box#E645 moved to position (0, 0)
 - [EVENT] Box#E645 entered
 - [AGV] AGV#1 moved from [5,1] to [-1,-1]
 - [BATTERY] Discharged 2.0%. Current level: 93.0%
 - [AGV] AGV#1 picked up Box#E645
 - [AGV] AGV#1 moved from [-1,-1] to [0,0]
 - [BATTERY] Discharged 2.0%. Current level: 91.0%
 - [STORAGE] Stored Box#E645 at [0,0]
 - [BATTERY] Discharged 15.0%. Current level: 76.0%
 - [PROCESS] Stored Box#E645 by AGV#1
 - [EVENT] Box#E645 stored
 - [EVENT] Box#C3684 is being stored...
 - [INFO] Box#C3684 moved to position (0, 1)
 - [EVENT] Box#C3684 entered

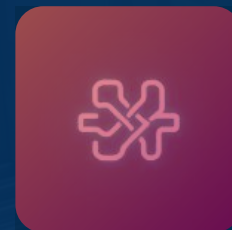


THREADS IMPLEMENTATION



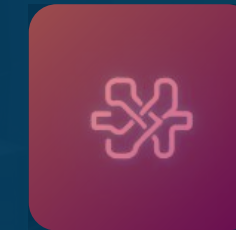
AGV ASSIGNMENT TO CHARGING STATION

- When multiple AGVs want to charge, only one should get the station at a time.
- Code uses synchronization to ensure fair access.



SWAP LOGIC WHEN BATTERY IS LOW

- If AGV1 is charging and AGV2's battery becomes low, AGV2 waits for 15 mins.
- This is controlled by threads and timers — a good example of concurrent behavior.



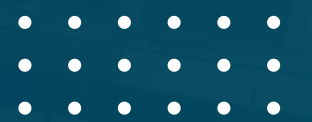
STORING AND RETRIEVING SYNCHRONIZED

- The storeBox() and retrieveBox() methods are synchronized to perform at the same time.





RESULTS OF THE UNIT TEST CASES



TESTCASES FOR BATTERY:

1. NEW BATTERY INITIALISATION
2. DISCHARGING BATTERY WHEN AGV IS PERFORMING TASK
3. INDICATE LOW BATTERY (WHEN HEAVILY DISCHARGED)
4. CHARGE VALUE SHOULD NOT BE NEGATIVE
5. PROPER FORMATTING FOR BATTERY UPDATES
6. RECHARGING AFTER DRAINING BATTERY SHOULD NOT CAUSE ERROR.

```
[INFO] Running BatteryTest
[BATTERY ERROR] Discharge amount cannot be negative!
[BATTERY] Discharged 10.0%. Current level: 86.4%
[BATTERY] Discharged 50.0%. Current level: 40.7%
[BATTERY] Charging started...
[BATTERY] Battery level: 60.7%
[BATTERY] Battery level: 80.7%
[BATTERY] Battery level: 100.0%
[BATTERY] Battery fully charged!
[BATTERY] Discharged 90.0%. Current level: 8.7%
[INFO] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 6.077 s -- in BatteryTest
```




RESULTS OF THE UNIT TEST CASES



TESTCASES FOR CHARGING STATION:

1. TEST THAT A CHARGINGSTATION OBJECT CAN BE CREATED WITHOUT ERRORS
2. MAKING SURE ASSIGNING AGV MOVES IT TO THE STATION'S COORDINATES
3. THE STATION ONLY ACCEPTS ONE AGV AT A TIME; OTHER AGV STAYS PUT
4. CHARGING AN AGV AT THE STATION SHOULD NEARLY FIL THE BATTERY
5. BOTH AGVS SHOULD GET FULLY CHARGED WHEN ASSIGNED AND CHARGED OEN AFTER ANOTHER

```
[INFO] Running ChargingStationTest
[AGV] AGV#AGV-1 moved from [0,0] to [1,1]
[BATTERY] Discharged 2.0%. Current level: 92.0%
[AGV] AGV#AGV-1 assigned to Charging Station#CS-02
[AGV] AGV#AGV-1 moved from [0,0] to [4,4]
[BATTERY] Discharged 2.0%. Current level: 91.0%
[AGV] AGV#AGV-1 assigned to Charging Station#CS-05
[BATTERY] Charging started...
[BATTERY] Battery level: 100.0%
[BATTERY] Battery fully charged!
[AGV] AGV#AGV-1 fully charged at Station#CS-05
[AGV] AGV#AGV-2 moved from [0,0] to [4,4]
[BATTERY] Discharged 2.0%. Current level: 92.5%
[AGV] AGV#AGV-2 assigned to Charging Station#CS-05
[BATTERY] Charging started...
[BATTERY] Battery level: 100.0%
[BATTERY] Battery fully charged!
[AGV] AGV#AGV-2 fully charged at Station#CS-05
[AGV] AGV#AGV-1 moved from [0,0] to [2,3]
[BATTERY] Discharged 2.0%. Current level: 92.5%
[AGV] AGV#AGV-1 assigned to Charging Station#CS-03
[BATTERY] Charging started...
[BATTERY] Battery level: 100.0%
[BATTERY] Battery fully charged!
[AGV] AGV#AGV-1 fully charged at Station#CS-03
[AGV] AGV#AGV-1 moved from [0,0] to [3,3]
[BATTERY] Discharged 2.0%. Current level: 89.7%
[AGV] AGV#AGV-1 assigned to Charging Station#CS-04
[BATTERY] Charging started...
[BATTERY] Battery level: 100.0%
[BATTERY] Battery fully charged!
[AGV] AGV#AGV-1 fully charged at Station#CS-04
[INFO] Tests run: 5, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 10.58 s -- in ChargingStationTest
```




RESULTS OF THE UNIT TEST CASES



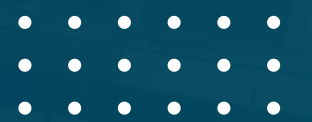
TESTCASES FOR STORAGESYSTEM:

1. EVERY BOX ENTRY SHOULD INCREASE BOTH COUNTERS BY 1
2. TWO BOX ENTRIES SHOULD PRODUCE COUNTS OF 2
3. RECORDING A 'STORED' EVENT SHOULD NOT CHANGE BOX COUNTS
4. BOX EXIT SHOULD DECREASE TOTAL BOXES AND INCREASE EXITED COUNT
5. DISPLAYING LOGS SHOULD NOT THROW ANY ERROS

```
[INFO] Running StorageSystemTest
[EVENT] Box#B1 exited
Test 4 Passed: Exiting updates counters properly
[EVENT] Box#B1 entered
[EVENT] Box#B2 entered
Test 2 Passed: Multiple entries tracked properly
[EVENT] Box#B1 stored
Test 3 Passed: Storing does not change counters
[INFO] Total boxes entered: 0
[INFO] Total boxes stored: 0
[INFO] Total boxes exited: 0
Test 5 Passed: displayLog() runs safely
[EVENT] Box#B1 entered
[EVENT] Box#B2 entered
[EVENT] Box#B1 stored
[EVENT] Box#B1 exited
[INFO] Total boxes entered: 2
[INFO] Total boxes stored: 1
[INFO] Total boxes exited: 1
[EVENT] Box#B1 entered
Test 1 Passed: Box entry updates counters properly
[INFO] Tests run: 6, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.066 s -- in StorageSystemTest
```




RESULTS OF THE UNIT TEST CASES



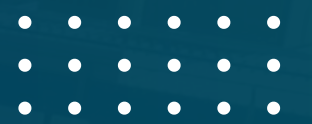
TESTCASES FOR PROCESS:

1. CHECK IF STORING BOX WORKS
2. CHECK IF STORING SAME BOX TWICE DOES NOT CRASH
3. CHECK RETRIEVE FUNCTION
4. TRY TO RETRIEVE WRONG BOX ID
5. SWAPPING AGV'S

```
[INFO] Running ProcessTest
Simulating storing box...
Test 1 Passed: Box stored successfully
Simulating AGV state swap...
Test 5 Passed: AGV swap simulated
Simulating storing box...
Simulating storing box...
Test 2 Passed: Duplicate handled
Simulating retrieving box...
Test 4 Passed: Handled missing box safely
Simulating retrieving box...
Test 3 Passed: Box retrieved properly
[INFO] Tests run: 5, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.022 s -- in ProcessTest
```




RESULTS OF THE UNIT TEST CASES



TESTCASES FOR LOG MANAGER:

1. CREATING A LOG IN VALID FOLDER SHOULD ACTUALLY CREATE A FILE
2. TRYING TO LOG TO AN INVALID PATH SHOULD NOT CRASH THE SYSTEM
3. LOGGING FILE CAN BE CLOSED SAFELY, EVEN IF ALREADY CLOSED
4. AFTER CLOSING A LOG, ITS FILE CAN BE MOVED TO ANOTHER LOCATION
5. LOGGING BEFORE CALLING INIT SHOULD NOT CRASH ANYTHING

```
[INFO] Running LogManagerTest
[LOG] Created folders: Logs/test_logs/513681090407900//2025/Nov/14
[LOG] Log file created: C:\Users\RAJDEEP SHAW\Downloads\FH Compact Programming Course\14_11_2025_11.56_WarehouseAutomation\WarehouseAutomation\Logs\test_logs\513681090407900\2025\Nov\14\log_12-28-44.txt
[LOG] Created folders: Logs/test_logs/513681115465500//2025/Nov/14
[LOG] Log file created: C:\Users\RAJDEEP SHAW\Downloads\FH Compact Programming Course\14_11_2025_11.56_WarehouseAutomation\WarehouseAutomation\Logs\test_logs\513681115465500\2025\Nov\14\log_12-28-44.txt
[LOG] Log file created: C:\Users\RAJDEEP SHAW\Downloads\FH Compact Programming Course\14_11_2025_11.56_WarehouseAutomation\WarehouseAutomation\Logs\test_logs\2025\Nov\14\log_12-28-44.txt
[LOG] Created folders: Logs/test_logs/513681654818300//2025/Nov/14
[LOG] Log file created: C:\Users\RAJDEEP SHAW\Downloads\FH Compact Programming Course\14_11_2025_11.56_WarehouseAutomation\WarehouseAutomation\Logs\test_logs\513681654818300\2025\Nov\14\log_12-28-44.txt
Error writing to log: Stream closed
[INFO] Tests run: 5, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.608 s -- in LogManagerTest
```




RESULTS OF THE UNIT TEST CASES



TESTCASES FOR AGV:

1. TEST AGV INITIALIZATION
2. TEST MOVE TO VALID POSITION
3. TEST MOVE TO NULL POSITION
4. TEST PICKUP VALID BOX
5. TEST DROPBOX INTO STORAGEAREA

```
AGVTest 2 sec 98 ms
  ✓ testAGVInitialization() 29 ms
  ✓ testMoveToValidPosition() 1 sec 3 ms
  ✓ testPickUpValidBox() 512 ms
  ✓ testDropBoxIntoStorageArea() 534 ms
  ✓ testMoveToNullPosition() 20 ms

5 tests passed 5 tests total, 2 sec 98 ms

"D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2.1\JDK\jdk-25\bin\java.exe" ...

Passed
[AGV] AGV#A1 moved from [10,10] to [20,30]
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
.1\IdeaProjects\WarehouseAutomation\Logs\AGV\2025\Nov\14\log_13-12-23.txt
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
.1\IdeaProjects\WarehouseAutomation\Logs\System\2025\Nov\14\log_13-12-23.txt
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
.1\IdeaProjects\WarehouseAutomation\Logs\Overall\2025\Nov\14\log_13-12-23.txt
[BATTERY] Discharged 2.0%. Current level: 93.5%
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2,
.1\IdeaProjects\WarehouseAutomation\Logs\Battery\2025\Nov\14\log_13-12-23.txt

Passed
[AGV] AGV#A1 picked up Box#B1

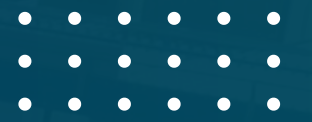
Passed
[INFO] Box#B1 moved to position (0, 0)
[AGV] AGV#A1 picked up Box#B1
[STORAGE] Stored Box#B1 at [0,0]

Passed
[ERROR] AGV#A1: Target position cannot be null!

Passed
```




RESULTS OF THE UNIT TEST CASES



TESTCASES FOR BOX:

1. TEST BOX INITIALIZATION
2. TEST SETPOSITION COORDINATES
3. TEST SETPOSITION NO THROW
4. TEST TOSTRING CONTAINS INFORMATION
5. TEST DISPLAYINFO RUNS WITHOUTERROR

```
✓ BoxTest 563 ms
  ✓ testSetPositionCoord() 529 ms
  ✓ testSetPositionNoThrow() 9 ms
  ✓ testToStringContainsInfo() 4 ms
  ✓ testBoxInit() 4 ms
  ✓ testDisplayInfoRunsWithoutError() 17 ms

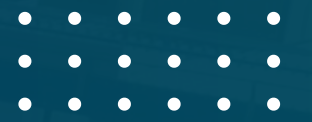
✓ 5 tests passed 5 tests total, 563 ms

"D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2.1\JDK\jdk-25\bin\java.exe"
[INFO] Box#B1 moved to position (5, 8)
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
      .1\IdeaProjects\WarehouseAutomation\Logs\System\2025\Nov\14\log_14-06-27.txt
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
      .1\IdeaProjects\WarehouseAutomation\Logs\Overall\2025\Nov\14\log_14-06-27.txt
testSetPositionCoord Passed
[INFO] Box#B1 moved to position (9, 9)
testSetPositionNoThrow Passed
testToStringContainsInfo Passed
testBoxInit Passed
[INFO] Box#B1 | TEST | Storage Pos: [-5,-5]
testDisplayInfoRunsWithoutError Passed

Process finished with exit code 0
```




RESULTS OF THE UNIT TEST CASES



TESTCASES FOR STORAGE AREA:

1. TEST FINDEMPTYSLOT
2. TEST STORE AND GET BOX
3. TEST FINDBOXBYID
4. TEST RETRIEVEBOX
5. TEST GETBOX AT OUT OF AREA

```
Run StorageAreaTest x
5 tests passed 5 tests total, 641 ms

"D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2.1\JDK\jdk-25\bin\java.exe" ...

[INFO] Box#B1 moved to position (1, 2)
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
      .1\IdeaProjects\WarehouseAutomation\Logs\System\2025\Nov\14\log_14-07-37.txt
[LOG] Log file created: D:\Bernard_App\JetBrains\IntelliJ IDEA 2025.2
      .1\IdeaProjects\WarehouseAutomation\Logs\Overall\2025\Nov\14\log_14-07-38.txt
[STORAGE] Stored Box#B1 at [1,2]
Passed
[ERROR] Invalid position [-1,0]
[ERROR] Invalid position [0,-1]
[ERROR] Invalid position [10,0]
[ERROR] Invalid position [0,10]
Passed
Passed
[INFO] Box#B1 moved to position (0, 0)
[STORAGE] Stored Box#B1 at [0,0]
Passed
[INFO] Box#B1 moved to position (1, 1)
[STORAGE] Stored Box#B1 at [1,1]
[RETRIEVE] Retrieved Box#B1 from [1,1]
Passed

Font size: 15pt Reset to 13pt
```


SIMULATION VIDEO

Stori...

Box ID:

Weight (kg):

Description:

Store Box

Retrievi...

Box ID:

Retrieve Box

Log Fil...

Base Path

Year Path

Month Path

Date Path

File Name

Destination Pa...

e.g., AGV/Battery/Overall/System

e.g., 2025

e.g., Oct

e.g., 09

e.g., log_12-34-56.txt

e.g., Logs/Archive/2025/Oct/28

View Log

Delete Log

Move Log

Display All Information

Clear

[EVENT] Box#1 is being stored...

[INFO] Box#1 moved to position (0, 0)

[EVENT] Box#1 entered

[AGV] AGV#1 moved from [5, 1] to [-1, -1]

[BATTERY] Discharged 2.0%. Current level: 92.0%

[AGV] AGV#1 picked up Box#1

[AGV] AGV#1 moved from [-1, -1] to [0, 0]

[BATTERY] Discharged 2.0%. Current level: 90.0%

[STORAGE] Stored Box#1 at [0, 0]

[BATTERY] Discharged 15.0%. Current level: 75.0%

[PROCESS] Stored Box#1 by AGV#1

[EVENT] Box#1 stored



THANK YOU

