

HONG KONG INSTITUTE OF VOCATIONAL EDUCATION
DEPARTMENT OF INFORMATION TECHNOLOGY
HIGHER DIPLOMA IN SOFTWARE ENGINEERING (IT114105)

Module Name: Contemporary Topics in Software Engineering

Module Code: ITP4507

Assignment Number: One

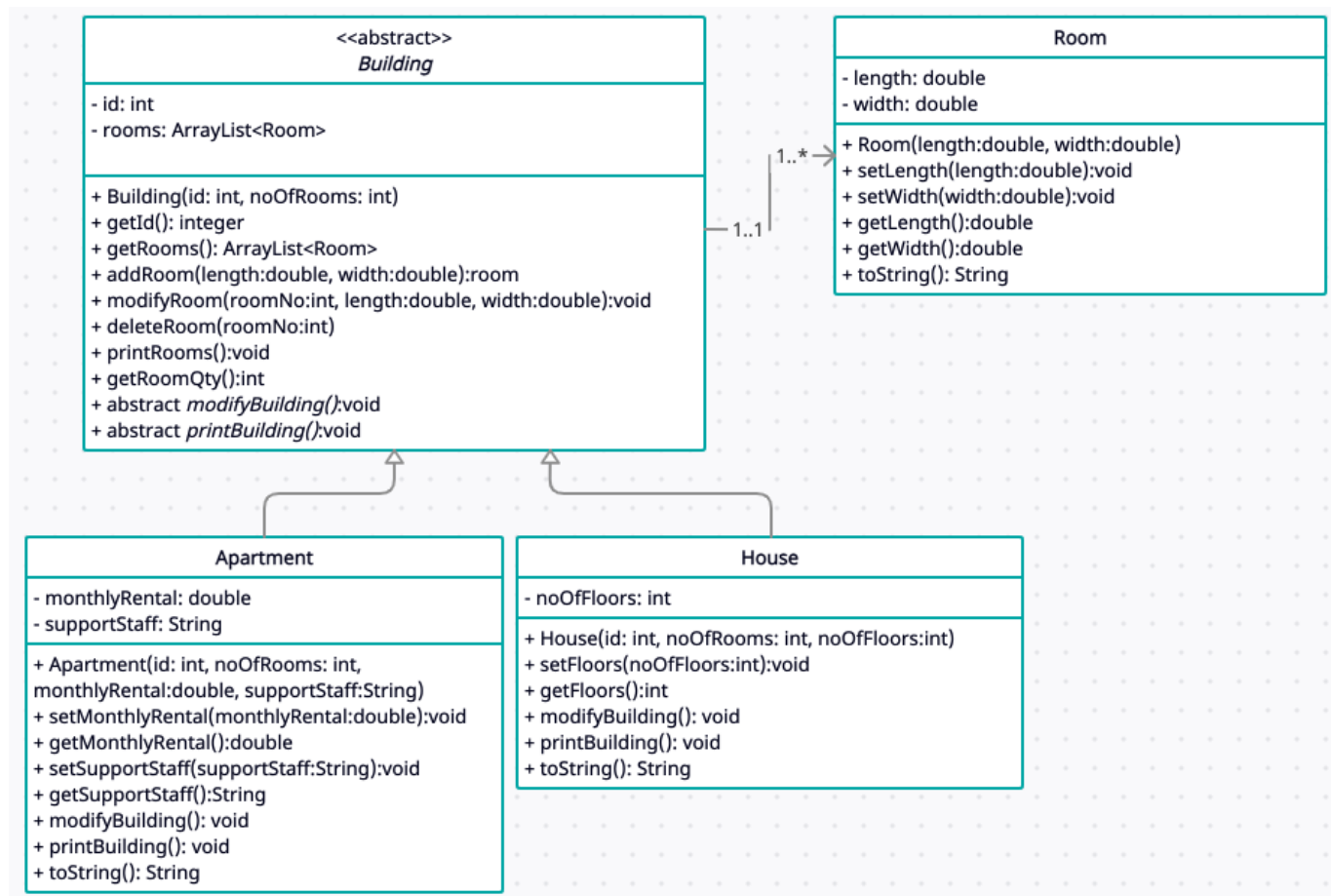
Hand-in: **18 November, 2022**
(On or before 4:30 PM to Moodle)

Weighting of This Assignment: 50% of the End of Module Assessment

This assignment must be done by individual only. Plagiarism will be treated seriously. Any assignments that are found involved wholly or partly in plagiarism (no matter the assignments are from the original authors or from the plagiarists) will score Zero mark. **Late submission will NOT be accepted.**

Task Specification

Imaginary Big Building Corporation is a property management company in Hong Kong. The company manages various kinds of buildings from overseas whose owners are people from Hong Kong. The company plans to develop a building management system (BMS) for maintaining different kinds of building records. The following is the simplified class diagram of existing data maintained by the company.



As a system analyst of the Company, you are required to design and develop BMS. You are reminded that the design of the existing classes: Building, Apartment, House and Room must be kept unchanged.

MS should provide the following functions:

1. Create a building record (Apartment, House or any new kind of Building in the coming future).
2. Modify a building record (Apartment, House or any new kind of Building in the coming future)
3. Display Building details (such as building id, corresponding attributes and rooms) by a given building id (input building id=* to display all building records)
4. Add, update or delete rooms in a building record
5. Undo last command
6. Redo the last undone command
7. Show undo/redo list

Your system design should conform to the Open Closed Principle so that your design should easily be extended to support new building (e.g. Warehouse or Shop).

You **MUST** apply the following design patterns for your new system

- **Command pattern** to provide the “add building”, “display buildings”, “modify building”, “add room”, “delete room”, “modify room”, “undo”, “redo” and “list undo/redo list” functions
- **Factory pattern or Abstract Factory Pattern** to create different kinds of Command objects and different kinds of Building objects (e.g. Apartment object, House object, etc.)
- **Memento pattern** to provide “Undo” and “Redo” functions on “modify building” and “modify room”.

Assignment Report

In addition to the system development, you are required to write up a **Short Report** covers the following sections:

1. **Assumptions regarding the problem context**
2. **Application design with class diagram**
3. **Discussion and explanation on each of the design patterns applied to the application**
4. **Test Plan and Test Cases**
5. **Well documented Source Code**

Mark Allocation

Your assignment work will be marked according to the following criteria.

Work	Mark Allocated
System Coding and Implementation	
a) Implementation of the system and coding style (Hard-coded output will result in zero mark.)	30%
b) Correctness of system functions * (Hard-coded output will result in zero mark.)	15%
c) Test Plan and Test Cases (Will be used in testing your own application.)	10%
System Analysis and Design, and Discussion	
d) Design of your system and correct use of design patterns	20%
e) Application design with class diagram	10%
f) Discussion and explanation on each of the design patterns applied to the application	15%
Total	100%

Note: * Please note that your source code will be recompiled and tested for the correctness of the system functions. Your implementation is required to support the 'Copy and Paste' method for testing which is described in page 12.

Submission of Assignment Work

1. The front page of your submission should include the programme title, module title, student identity number, and student name.
2. Submit your Java source codes and your report to <https://moodle2223.vtc.edu.hk> .
 - Well documented Source Code of your program.
 - Report for analysis, design, discussion, user guide, test plan and test cases of your following work.
 - A. The assumption made during analysis and design of the application
 - B. System design on your application with class diagram
 - C. Discussion on the design patterns that applied on your program
 - D. Test Plan with Test Cases (Design your own test plan and corresponding test cases for each function. For each test case, you should provide a SCREEN CAPTURE for test result).
3. Submit according to the guideline on the top part of cover page. **Late submission will NOT be accepted.**

Extra Reference

Testing Method

This sample run is served for reference only. You are free to design your own user interface. But to make the testing environment simple and to apply the "Copy and Paste" testing method described on page 11 easily, you are advised to accept user input at the command prompt as shown in the sample run below.

Sample Run of assignment

You may follow the design of user interface shown in this sample run in DOS command prompt.

For following examples, character(s) with underline is user's input.

1. Add building record (a)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

a

Enter Building Type (a=Apartment/h=House):

a

Building No.: 1001

Monthly Rental: 21000

Support Staff: Alan Po

Number of rooms: 2

Room No. 1 :

Length: 15

Width: 20

Room No. 2 :

Length: 10

Width: 20

New Building Added:

Building No: 1001

Support Staff: Alan Po

Monthly Rental: 21000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

a

Enter Building Type (a=Apartment/h=House):

a

Building No.: 1002

Monthly Rental: 24000

Support Staff: Peter Chan

Number of rooms: 1

Room No. 1 :

Length: 7

Width: 10

New Building Added:

Building No: 1002

Support Staff: Peter Chan

Monthly Rental: 24000.0

Room No.: 1, Length: 7.0, Width: 10.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

a

Enter Building Type (apr=Apartment/hou=House):

h

Building No.: 2001

No. of Floors: 2

Number of rooms: 3

Room No. 1 :

Length: 12

Width: 10

Room No. 2 :

Length: 20

Width: 10

Room No. 3 :

Length: 18

Width: 20

New Building Added:

Building No: 2001

No of Floors: 2

Room No.: 1, Length: 12.0, Width: 10.0

Room No.: 2, Length: 20.0, Width: 10.0

Room No.: 3, Length: 18.0, Width: 20.0

2. Display one Building record (d)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

1001

Building No: 1001

Support Staff: Alan Po

Monthly Rental: 21000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

2001

Building No: 2001

No of Floors: 2

Room No.: 1, Length: 12.0, Width: 10.0

Room No.: 2, Length: 20.0, Width: 10.0

Room No.: 3, Length: 18.0, Width: 20.0

Display all Building records

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

*

Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0

Building No.: 2001, No. of Floors: 2

3. Modify Building (m)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

m

Building No.: 1001

Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Modify Monthly Rental: 18000

Modify Support Staff: John Chan

Building is modified:

Building No.: 1001, Support Staff: John Chan, Monthly Rental: 18000.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

m

Building No.: 2001

Building No.: 2001, No. of Floors: 2

No. of Floors: 3

Building is modified:

Building No.: 2001, No. of Floors: 3

4. Edit rooms (e) and then add room (a)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

e

Building No.: 1001

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Please enter command: [a|d|m]

a = add room, d = delete room, m = modify room

a

Length: 12

Width: 14

Updated Building:

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Room No.: 3, Length: 12.0, Width: 14.0

5. Edit rooms (e) and then modify room (m)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

e

Building No.: 1001

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Room No.: 3, Length: 12.0, Width: 14.0

Please enter command: [a|d|m]

a = add room, d = delete room, m = modify room

m

Room No.:

2

Length: 9

Width: 18

Updated Building:

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 9.0, Width: 18.0

Room No.: 3, Length: 12.0, Width: 14.0

6. Edit rooms (e) and then delete room (d)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

e

Building No.: 1001

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 9.0, Width: 18.0

Room No.: 3, Length: 12.0, Width: 14.0

Please enter command: [a|d|m]

a = add room, d = delete room, m = modify room

d

Room No.:

1

Updated Building:

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 9.0, Width: 18.0

Room No.: 2, Length: 12.0, Width: 14.0

7. Display the Undo/Redo List (l)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

l

Undo List:

Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0

Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0

Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0

Modify Building: Building No. 2001, No. of Floor: 3

Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental: 18000.0

Add Building: Building No.: 2001, No. of Floor: 2

Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0

Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Redo List:

Nothing to Redo.

8. Undo the last command in the Undo List (u)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

l

Undo List:

Modify Building: Building No. 2001, No. of Floor: 3

Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental: 18000.0

Add Building: Building No.: 2001, No. of Floor: 2

Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0

Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Redo List:

Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0

Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0

Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

1001

Building No: 1001

Support Staff: John Chan

Monthly Rental: 18000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

u

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

l

Undo List:

Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental:
24000.0

Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental:
21000.0

Redo List:

Add Building: Building No.: 2001, No. of Floor: 2

Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental:
18000.0

Modify Building: Building No. 2001, No. of Floor: 3

Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0

Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0

Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

*

Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0

9. Redo the last command in the Redo List (r)

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

r

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

r

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

r

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

l

Undo List:

Modify Building: Building No. 2001, No. of Floor: 3

Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental:
18000.0

Add Building: Building No.: 2001, No. of Floor: 2

Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental:
24000.0

Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental:
21000.0

Redo List:

Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0

Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0

Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

d

Enter Building No. (* to display all):

*

Building No.: 1001, Support Staff: John Chan, Monthly Rental: 18000.0

Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0

Building No.: 2001, No. of Floors: 3

End of Sample Run

You can ease the testing by using the '**Copy and Paste**' method rather than inputting data manually. Prepare a text file, which includes all user inputs in a test run. By using the '**Copy and Paste**' method, you can automatically input in the command prompt window and then get the result automatically (without the input data echoed). The following is an example of the text file for user inputs.

Sample User Inputs for a Test Run

```
a
a
1001
21000
Alan Po
2
15
20
10
20
a
a
1002
24000
Peter Chan
1
7
10
d
1001
a
h
2001
2
3
12
10
20
10
18
20
d
*
m
1001
18000
John Chan
m
2001
3
e
1001
a
12
14
e
1001
m
2
9
18
e
1001
```

```
d
l
d
1001
l
u
u
u
l
d
1001
r
r
l
d
1001
X
```

Expected Output of the Test Run

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

Enter Building Type (a=Apartment/h=House):

Building No.: Monthly Rental: Support Staff: Number of rooms: Room No. 1 :

Length: Width: Room No. 2 :

Length: Width: New Building Added:

Building No: 1001

Support Staff: Alan Po

Monthly Rental: 21000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

Enter Building Type (a=Apartment/h=House):

Building No.: Monthly Rental: Support Staff: Number of rooms: Room No. 1 :

Length: Width: New Building Added:

Building No: 1002

Support Staff: Peter Chan

Monthly Rental: 24000.0

Room No.: 1, Length: 7.0, Width: 10.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

u = undo, r = redo, l = list undo/redo, x = exit system

Enter Building No. (* to display all):

Building No: 1001

Support Staff: Alan Po

Monthly Rental: 21000.0

Room No.: 1, Length: 15.0, Width: 20.0

Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)

Please enter command: [a|d|m|e|u|r|l|x]

a = add building, d = display buildings, m = modify building, e = edit rooms

```

u = undo, r = redo, l = list undo/redo, x = exit system
Enter Building Type (a=Apartment/h=House):
Building No.: No. of Floors: Number of rooms: Room No. 1 :
Length: Width: Room No. 2 :
Length: Width: Room No. 3 :
Length: Width: New Building Added:
Building No: 2001
No of Floors: 2
Room No.: 1, Length: 12.0, Width: 10.0
Room No.: 2, Length: 20.0, Width: 10.0
Room No.: 3, Length: 18.0, Width: 20.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Enter Building No. (* to display all):
Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0
Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0
Building No.: 2001, No. of Floors: 2

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Building No.: Building No.: 1001, Support Staff: Alan Po, Monthly Rental:
21000.0
Modify Monthly Rental: Modify Support Staff: Building is modified:
Building No.: 1001, Support Staff: John Chan, Monthly Rental: 18000.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Building No.: Building No.: 2001, No. of Floors: 2
No. of Floors: Building is modified:
Building No.: 2001, No. of Floors: 3

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Building No.: Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 10.0, Width: 20.0

Please enter command: [a|d|m]
a = add room, d = delete room, m = modify room
Length: Width: Updated Building:
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 10.0, Width: 20.0
Room No.: 3, Length: 12.0, Width: 14.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Building No.: Room No.: 1, Length: 15.0, Width: 20.0

```

Room No.: 2, Length: 10.0, Width: 20.0
Room No.: 3, Length: 12.0, Width: 14.0

Please enter command: [a|d|m]
a = add room, d = delete room, m = modify room

Room No.:
Length: Width: Updated Building:
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 9.0, Width: 18.0
Room No.: 3, Length: 12.0, Width: 14.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Building No.: Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 9.0, Width: 18.0
Room No.: 3, Length: 12.0, Width: 14.0

Please enter command: [a|d|m]
a = add room, d = delete room, m = modify room

Room No.:
Updated Building:
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 9.0, Width: 18.0
Room No.: 2, Length: 12.0, Width: 14.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Enter Building No. (* to display all):
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 9.0, Width: 18.0
Room No.: 2, Length: 12.0, Width: 14.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Undo List:
Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0
Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0
Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0
Modify Building: Building No. 2001, No. of Floor: 3
Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental: 18000.0
Add Building: Building No.: 2001, No. of Floor: 2
Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental: 24000.0
Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental: 21000.0

Redo List:
Nothing to Redo.

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Undo List:
Modify Building: Building No. 2001, No. of Floor: 3
Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental:
18000.0
Add Building: Building No.: 2001, No. of Floor: 2
Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental:
24000.0
Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental:
21000.0

Redo List:
Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0
Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0
Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Enter Building Type (apr=Apartment/hou=House):
Enter Building No. (* to display all):
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 10.0, Width: 20.0

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system

Building Management System (BMS)

```
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Undo List:
Modify Room: Building No. 1001, Room No. 2, Length: 9.0, Width: 18.0
Add Room: Building No. 1001, Room No. 3, Length: 12.0, Width: 14.0
Modify Building: Building No. 2001, No. of Floor: 3
Modify Building: Building No. 1001, Support Staff: John Chan, Monthly Rental:
18000.0
Add Building: Building No.: 2001, No. of Floor: 2
Add Building: Building No.: 1002, Support Staff: Peter Chan, Monthly Rental:
24000.0
Add Building: Building No.: 1001, Support Staff: Alan Po, Monthly Rental:
21000.0

Redo List:
Delete Room: Building No. 1001, Room No. 1, Length: 15.0, Width: 20.0
```

```
Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
Enter Building Type (a=Apartment/h=House):
Enter Building No. (* to display all):
Building No: 1001
Support Staff: John Chan
Monthly Rental: 18000.0
Room No.: 1, Length: 15.0, Width: 20.0
Room No.: 2, Length: 9.0, Width: 18.0
Room No.: 3, Length: 12.0, Width: 14.0
```

```
Building Management System (BMS)
Please enter command: [a|d|m|e|u|r|l|x]
a = add building, d = display buildings, m = modify building, e = edit rooms
u = undo, r = redo, l = list undo/redo, x = exit system
```


Requirement for Scanner usage

Wrong Scanner usage (more than one object of Scanner is created for reading keyboard input):

```
// create new Scanner objects in loop
do {
    Scanner sc = new Scanner( System.in);
    choice = sc.nextInt();
} while (choice != 1);
```

Correct Scanner usage (only one Scanner object is created for reading keyword input):

Following is an example program to use a Global Scanner object or pass as a parameter to do the input.

```
import java.util.Scanner;

public class Test {
    //Global declaration for Scanner
    public static Scanner sc = new Scanner(System.in);

    public static void main(String args[]) {
        int x;
        System.out.print("Enter x:");
        x = sc.nextInt();
    }

    public static void method1() {
        int y;
        System.out.print("Enter y:");
        y = sc.nextInt();
    }

    public static void method2(Scanner sc) {
        int y;
        System.out.print("Enter y:");
        y = sc.nextInt();
    }
}
```

***** END *****