

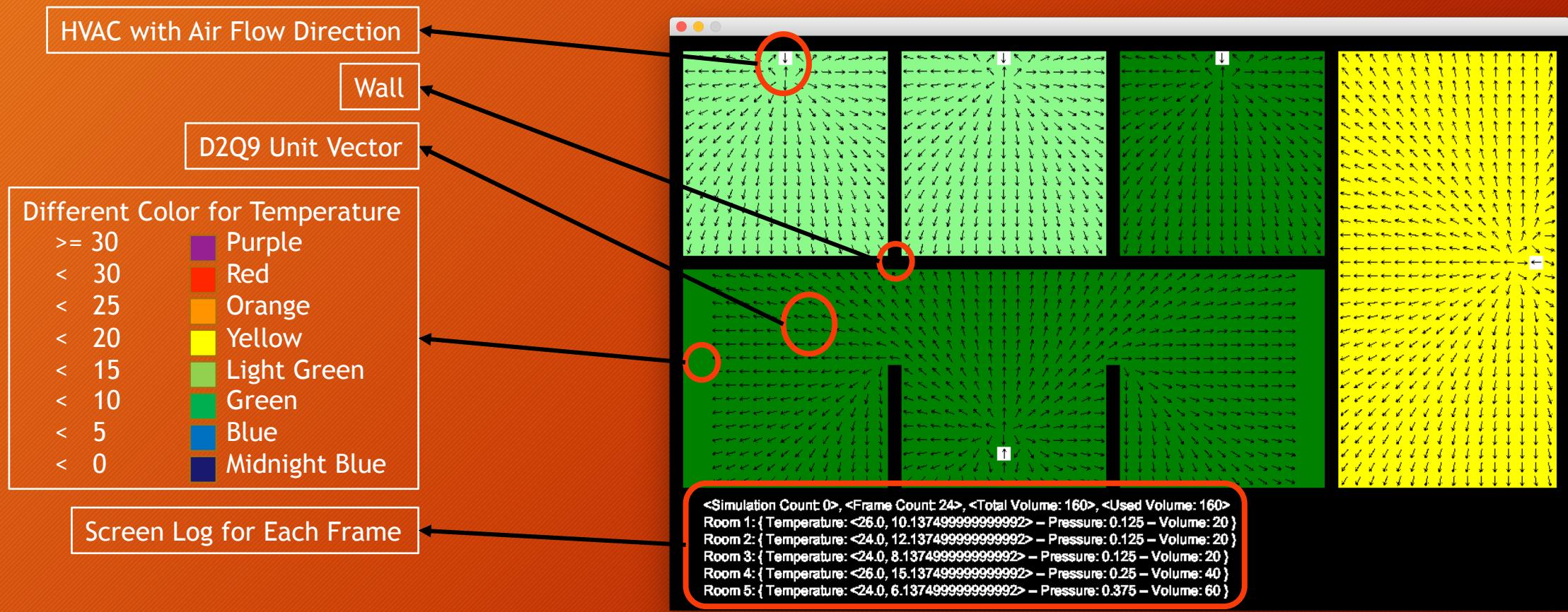
# SEBM Manual

Simplified Energy Building Model Manual

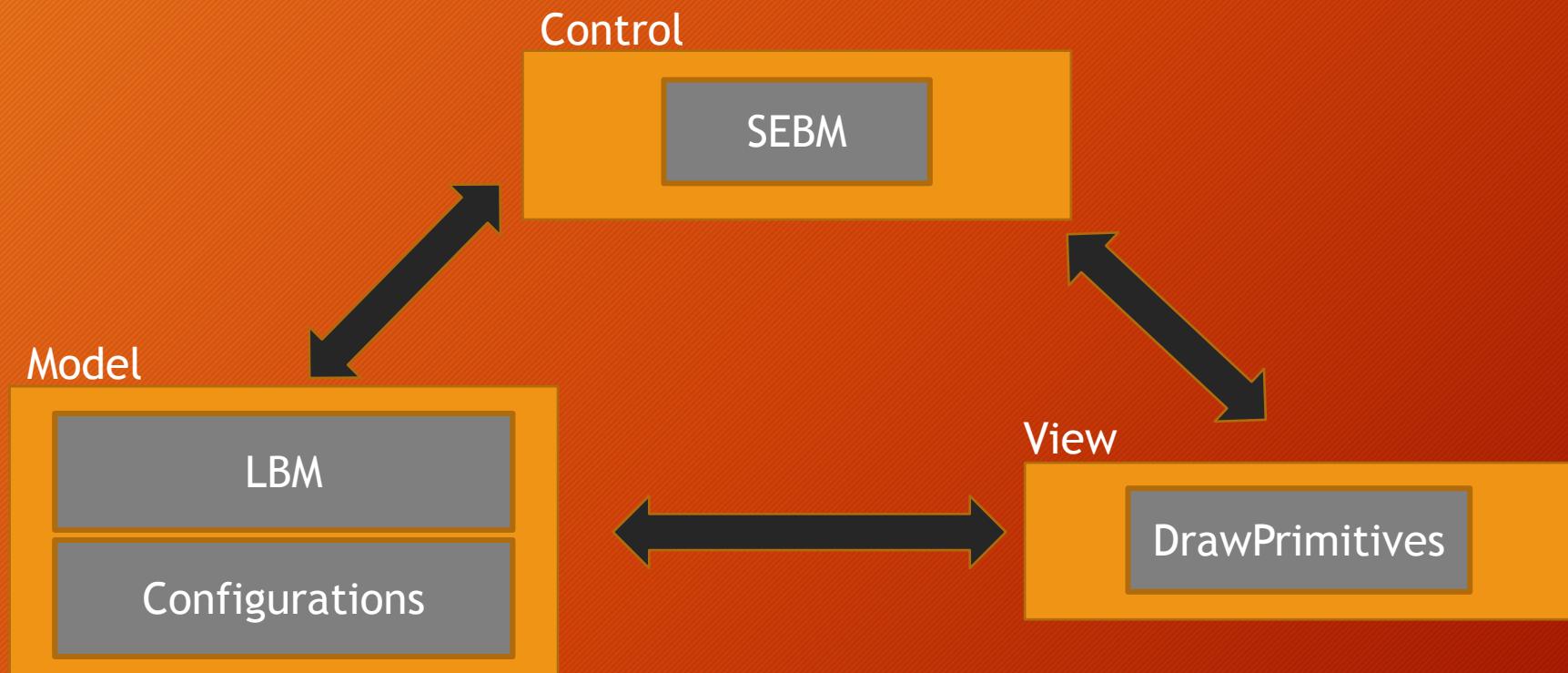
# Agenda

- Overview with Screen Layout
- Packages Overview (MVC)
- Classes
- Main Logic
- Configuration File and External Libraries
- Log Files and Format
- Run Simulator on Eclipse
- Run Simulator on Command Line
- Archive
- Appendix

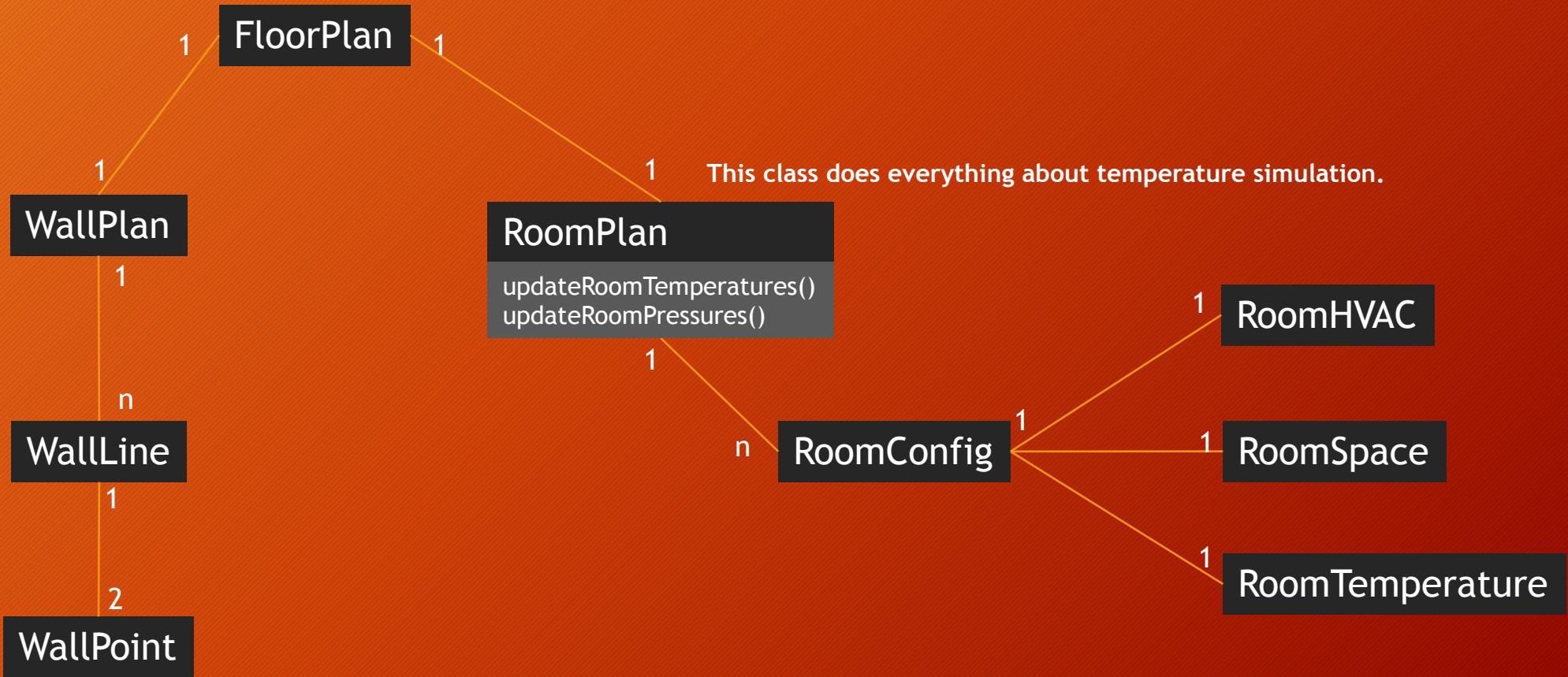
# Overview with Screen Layout



# Packages Overview (MVC)



# Classes - Configuration



# Classes - LBM (Lattice Boltzmann Model)

**LBMLattice**  
streamingLattice()  
propagateLattice()  
updateLattice()

1

**D2Q9**

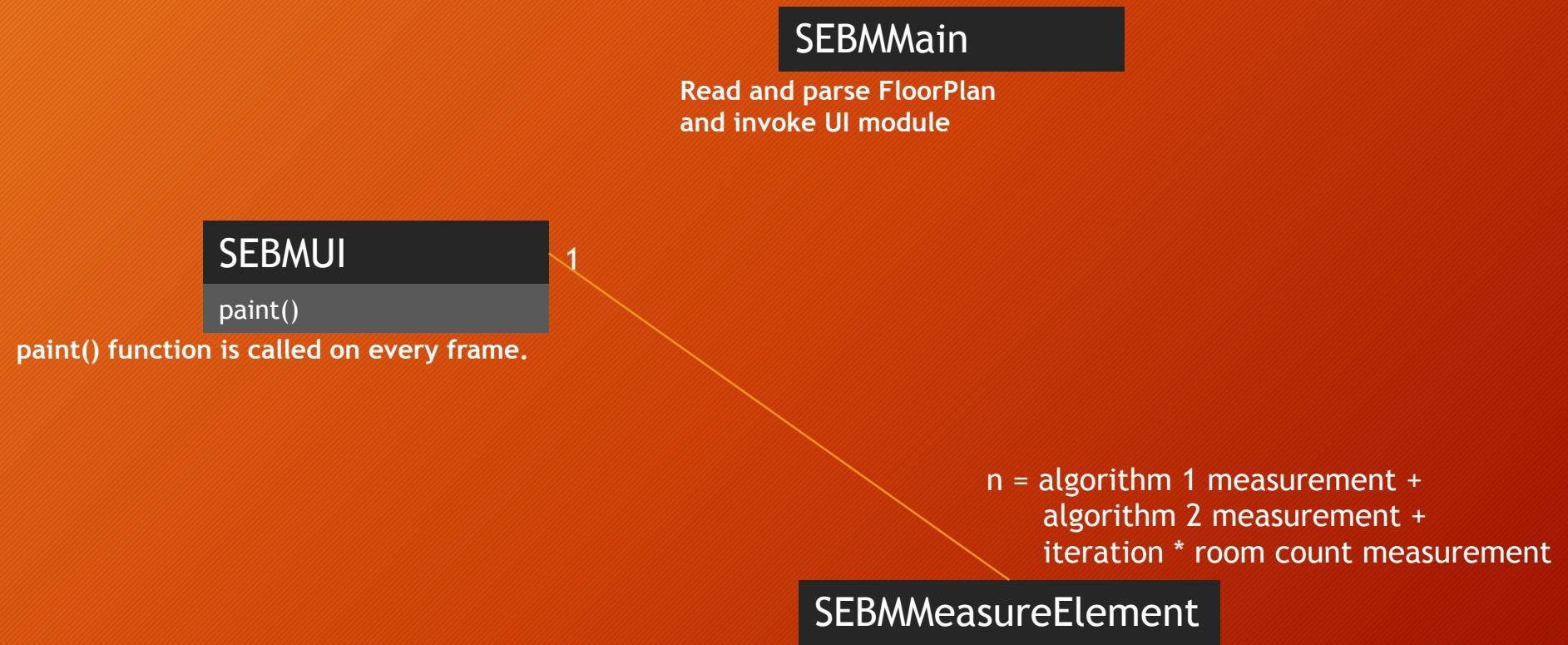
This class is a constant class.

$n = \text{width} * \text{height}$

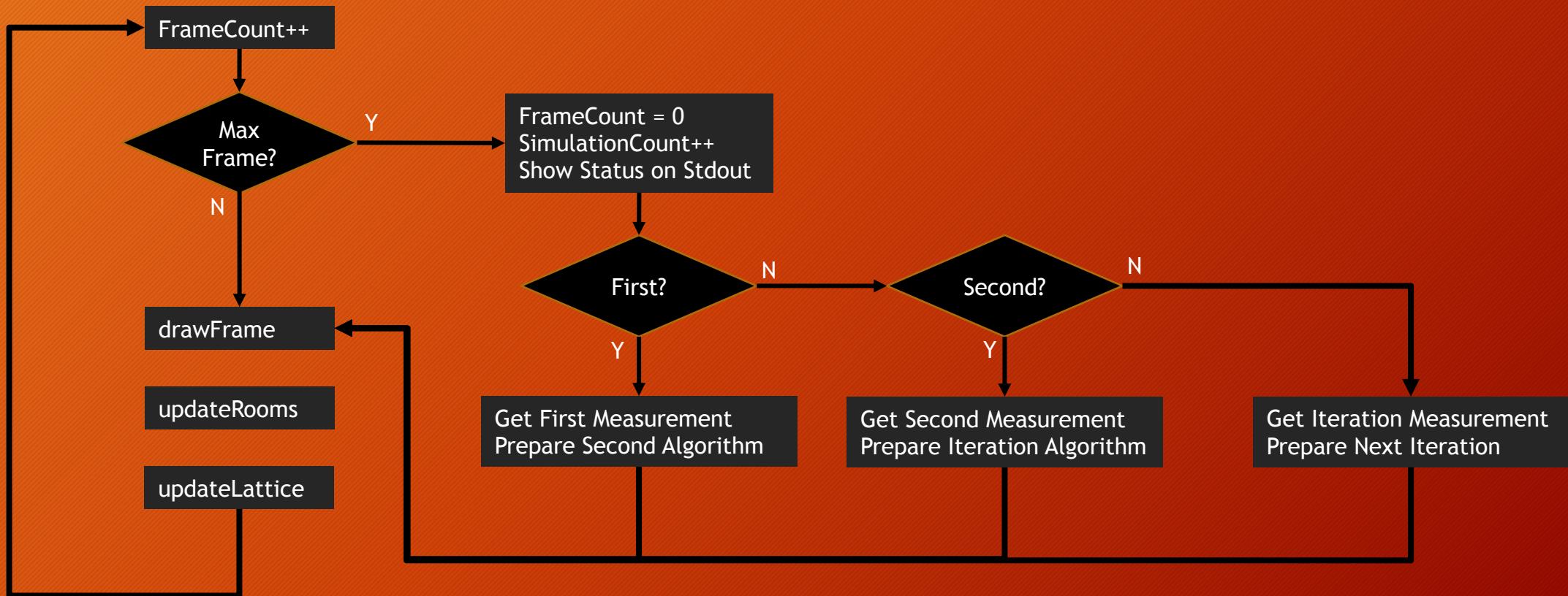
**LBMUnit**

step()

# Classes - SEBM



# Main Logic -paint() function of SEBMUI



# Configuration File and External Libraries

FloorPlan.json

```
"FLOOR": "EBMTest",
"WIDTH": 64,
"HEIGHT": 32,
"UNIT": 16,
"PAD": 1,
"DURATION": 5000,
"WALL": [
    {
        "START": [0, 0], "END": [65, 0],
        "START": [0, 33], "END": [65, 33],
        "START": [0, 0], "END": [0, 33],
        "START": [65, 0], "END": [65, 33],
        "START": [16, 0], "END": [16, 16],
        "START": [32, 0], "END": [32, 16],
        "START": [32, 24], "END": [32, 33],
        "START": [16, 24], "END": [16, 33],
        "START": [48, 0], "END": [48, 33],
        "START": [0, 16], "END": [48, 16]
    },
    "ROOM": [
        {
            "NUMBER": 1,
            "VOLUME": 20,
            "INITIAL": 10,
            "TARGET": 26,
            "DELTA": 5,
            "SPACE": [1, 1, 15, 15],
            "HVAC": [8, 1, 10, 2]
        },
        {
            "NUMBER": 2,
            "VOLUME": 20,
            "INITIAL": 12,
            "TARGET": 24,
            "DELTA": 6,
            "SPACE": [17, 1, 15, 15],
            "HVAC": [24, 1, 10, 2]
        }
    ]
},
```

WIDTH, HEIGHT : Lattice Size  
UNIT : Pixels per Lattice Unit  
PAD : Boundary Padding (by Lattice Unit)  
DURATION : Max Frame Count to Simulate

Each line describes wall line, and  
Wall line has two points, START and END.  
These points have coordinates based on Lattice Unit.

NUMBER : Room Number  
VOLUME : Room Volume  
INITIAL : Initial temperature of room  
TARGET : Target temperature of room  
DELTA : Temperature tolerance of room  
SPACE : Rectangular coordinate of room  
HVAC : HVAC (x, y, initial force, direction)  
direction 1 → East,  
2 → South,  
3 → West,  
4 → North

Only one external library is used:  
[json-simple-1.1.1.jar](#)

# Log Files and Format (Temperature Log)

File Name: SimLog(SimulationCount).log

```
1, 1, 26.0, 10.0
1, 2, 24.0, 12.0
1, 3, 24.0, 8.0
1, 4, 26.0, 15.0
1, 5, 24.0, 6.0
2, 1, 26.0, 10.00625
2, 2, 24.0, 12.00625
2, 3, 24.0, 8.00625
2, 4, 26.0, 15.00625
2, 5, 24.0, 6.00625
3, 1, 26.0, 10.0125
3, 2, 24.0, 12.0125
3, 3, 24.0, 8.0125
3, 4, 26.0, 15.0125
3, 5, 24.0, 6.012499999999999
4, 1, 26.0, 10.018749999999999
4, 2, 24.0, 12.018749999999999
4, 3, 24.0, 8.018749999999999
4, 4, 26.0, 15.018749999999999
4, 5, 24.0, 6.018749999999999
5, 1, 26.0, 10.024999999999999
5, 2, 24.0, 12.024999999999999
5, 3, 24.0, 8.024999999999999
5, 4, 26.0, 15.024999999999999
5, 5, 24.0, 6.024999999999999
```

Each row in temperature log is comprised of  
Frame Count, Room Number, Target Temperature, Current Temperature

First 5 rows of left image means

Frame Count = 1, Room Number = 1, Target = 26.0, Current = 10.0  
Frame Count = 1, Room Number = 2, Target = 24.0, Current = 12.0  
Frame Count = 1, Room Number = 3, Target = 24.0, Current = 8.0  
Frame Count = 1, Room Number = 4, Target = 26.0, Current = 15.0  
Frame Count = 1, Room Number = 5, Target = 24.0, Current = 6.0

# Log Files and Format (Time Frame Log)

File Name: SimResult.log

```
Simulation: 1 Round: 0 SubRound: 0 Weights: (0.1, 0.0)
Room1, 2560, 3469, 4378
Room2, 1920, 3009, 4098
Room3, 2560, 3469, 4378
Room4, 1760, 2565, 3370, 4175, 4980
Room5, 2880, 3544, 4208, 4871
Ratio: Unknown

Simulation: 2 Round: 0 SubRound: 0 Weights: (0.1, 0.0)
Room1, 2499, 3271, 3994, 4729
Room2, 1882, 2839, 3725, 4350
Room3, 2499, 3272, 3997, 4735
Room4, 1765, 2550, 3259, 3968, 4696
Room5, 2746, 3370, 4004, 4650
Ratio: 14.85278339914494

Simulation: 3 Round: 0 SubRound: 1 Weights: (0.1, 0.0)
Room1, 1423, 1966, 2505, 3001, 3536, 4047, 4509
Room2, 2293, 3369, 4292
Room3, 2946, 3693, 4559
Room4, 1927, 2760, 3494, 4267
Room5, 2904, 3559, 4223, 4882
Ratio: 13.351769934052202

Simulation: 4 Round: 0 SubRound: 2 Weights: (0.1, 0.0)
Room1, 2931, 3704, 4526
Room2, 1067, 1726, 2358, 2968, 3582, 4209, 4843
Room3, 2931, 3704, 4527
Room4, 1887, 2729, 3434, 4141, 4899
Room5, 2887, 3544, 4200, 4873
Ratio: 14.676699566448898

Simulation: 5 Round: 0 SubRound: 3 Weights: (0.1, 0.0)
Room1, 2948, 3695, 4561
Room2, 2293, 3367, 4295
Room3, 1423, 1967, 2505, 3002, 3538, 4047, 4510
Room4, 1933, 2765, 3498, 4271
Room5, 2909, 3564, 4227, 4887
Ratio: 13.339883708727243
```

This log writes frame count of each room when HVAC is going to off.  
This log appends every simulation result.

First section of log has

Simulation = 1, Round = 0, SubRound = 0, Weights = (0.1, 0.0)  
Room = 1, HVAC is off when frame count is 2560, 3469, 4378.  
...  
Ratio: Unknown (because there is no comparison)

Second section of log has

Simulation = 2, Round = 0, SubRound = 0, Weights = (0.1, 0.0)  
Room = 1, HVAC is off when frame count is 2499, 3271, 3994, 4729.  
...  
Ratio: 14.852 % better (comparison with first section)

Round = Iteration,  
SubRound = sub-iteration,  
Weights = (next W,  
current W).

Above 3 values are used  
in algorithm 3.

# Run Simulator on Eclipse

1. Import project into eclipse.
  1. Use project source in ./EBMSimulatorEclipse
2. Modify build path to add **json-simple-1.1.1.jar** .
3. Modify code described in below text box.
4. Place floorplan.json to proper directory.

**Simulator requires paths for 3 external files.**

1. SEBM.SEBMMain.java line 12  
it is a path to configuration file  
`tFloorPlan.readFloorPlan("/PathToConfiguration/FloorPlan.json");`

2. SEBM.SEBMUI.java line 119, openLogFile()  
it is a path to temperature log file  
`String strFilePath = "/PathToLog/SimLog" + (mSimulationCount + 1) + ".log";`

3. SEBM.SEBMUI.java line 120, openLogFile()  
it is a path to time frame log file  
`String strResultFilePath = "/PathToLog/SimResult.log";`

Simulator was implemented with **Java 1.8** on Eclipse IDE.  
Simulator was implemented with Pure Java with AWT.  
Simulator requires **json-simple-1.1.1.jar** on build path.

Simulator has been tested on Ubuntu Linux 16.04.  
Simulator has been tested on macOS Mojave 10.14.1.

When it is run on Ubuntu Linux, it is blinking fast.  
When it is run on macOS, it does not blink.

# Run Simulator on Command Line

Same information can be found in READ.ME file.

Goto directory “./EBMSimulatorCmd”

Compile with

```
javac -sourcepath src -classpath bin:lib/json-simple-1.1.1.jar src/SEBM/SEBMMain.java -d bin
```

Run with

```
java -classpath bin:lib/json-simple-1.1.1.jar SEBM/SEBMMain
```



Left image shows directory hierarchy of “./EBMSimulatorCmd”.

./bin directory has \*.class files.

./config directory has FloorPlan.json.

./lib directory has json-simple-1.1.1.jar.

./log directory will have log files.

./src directory has simulator source code.

# Archive

Report will be zipped as one archive.

- ▶ EBMSimulatorCmd
- ▶ EBMSimulatorEclipse
- ▶ FloorPlan.json
- ▶ json-simple-1.1.1.jar
- ▶ LatestLogs
- ▶ RatioWithAlg3.xlsx
- ▶ READ.ME
- ▶ SEBM\_Manual.pptx
- ▶ Simulating HVAC Co...with Volume of Room

EBMSimulatorCmd directory contains Java Project for Command Line Execution.  
EBMSimulator directory contains Eclipse Java Project.  
Tested Floor Plan file.  
json-simple-1.1.1.jar is simple json library file.  
LatestLogs directory has latest logs.  
RatioWithAlg3.xlsx is an analysis document.  
READ.ME file has information on how to compile and run project in command line.  
SEBM\_Manual.pptx is the document you are looking at.  
Simulating HVAC ~ .docx is a report document.

# Appendix - Run Example Screen Capture

```
[Chois-MacBook-Pro:EBMSimulatorCmd TalyListen$ pwd
/Users/TalyListen/Desktop/ResearchReport/EBMSimulatorCmd
[Chois-MacBook-Pro:EBMSimulatorCmd TalyListen$ javac -sourcepath src -classpath bin:lib/json-simple-1.1.1.jar src/SEBM/SEBMMain.java -d bin
Chois-MacBook-Pro:EBMSimulatorCmd TalyListen$ java -classpath bin:lib/json-simple-1.1.1.jar SEBM/SEBMMain
[Floor: EBMTTest
Width: 64
Height: 32
Unit: 16
Padding: 1
[((0, 0)-(65, 0))]
[((0, 33)-(65, 33))]
[((0, 0)-(0, 33))]
[((65, 0)-(65, 33))]
[((16, 0)-(16, 16))]
[((32, 0)-(32, 16))]
[((32, 24)-(32, 33))]
[((16, 24)-(16, 33))]
[((48, 0)-(48, 33))]
[((0, 16)-(48, 16))]
{ NUMBER: 1, DELTA: 5, Temperature: <26.0, 10.0>Space: < (1, 1), (15, 15), (20) >HVAC: <(8, 1), (10), (2)> }
{ NUMBER: 2, DELTA: 6, Temperature: <24.0, 12.0>Space: < (17, 1), (15, 15), (20) >HVAC: <(24, 1), (10), (2)> }
{ NUMBER: 3, DELTA: 5, Temperature: <24.0, 8.0>Space: < (33, 1), (15, 15), (20) >HVAC: <(40, 1), (10), (2)> }
{ NUMBER: 4, DELTA: 4, Temperature: <26.0, 15.0>Space: < (49, 1), (16, 32), (40) >HVAC: <(63, 16), (10), (3)> }
{ NUMBER: 5, DELTA: 3, Temperature: <24.0, 6.0>Space: < (1, 17), (47, 32), (60) >HVAC: <(24, 30), (10), (4)> }
Chois-MacBook-Pro:EBMSimulatorCmd TalyListen$ ]
```