# Simulating the Festival

Digital Urban Visualization. People as Flows.

14.11.2016

iA
zuend@arch.ethz.ch
treyer@arch.ethz.ch
chirkin@arch.ethz.ch

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

DARCH

iA Chair of Information Architecture

# Crowds at the Festival


image: zvv.ch

# Crowds at the Festival


image: zvv.ch


Legende

- Bar
- Food & Getränke
- Food
- Waren / Info
- Kühlwagen
- Musik ab Tonträger
- mit DJ / Live
- Gas
- Fluchtwege 4 m
- Sanität
- Meeting Point
- Eingang
- WC/Pissoir
- Pressmulden
- Container

20 YEARS LATIN MUSIC FESTIVAL

# CALIENTE!

3 - 5 JULIO 2015

WWW.CALIENTE.CH

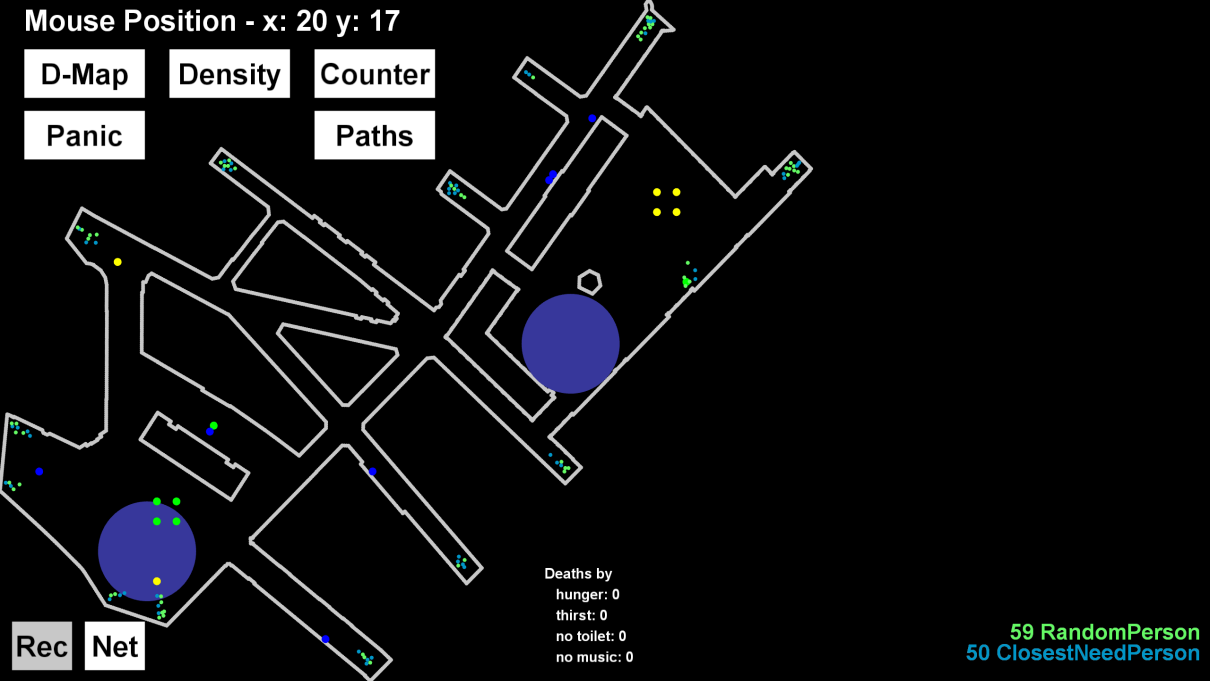
LANGSTRASSE

WC PISSOIR

VOLKSHAUS

Tische

Tische


Mouse Position - x: 20 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
59 RandomPerson
50 ClosestNeedPerson


Mouse Position - x: 20 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
934 RandomPerson
932 ClosestNeedPerson

# Framework

## what does it do?

The framework is able to simulate any kind of crowd simulations. We set it up to simulate the Caliente Festival in Zürich.

The simulation consists of different people types walking around. They have some needs to fulfill or otherwise they will die.

# Framework

## what does it do?

Currently, the people in the simulation have four needs, eating, drinking, going to the toilet, and listening to music.

These are provided by different types of need-providers: bars, food stalls, toilets, and stages.

During the simulation, people go to these locations, thus walk around.

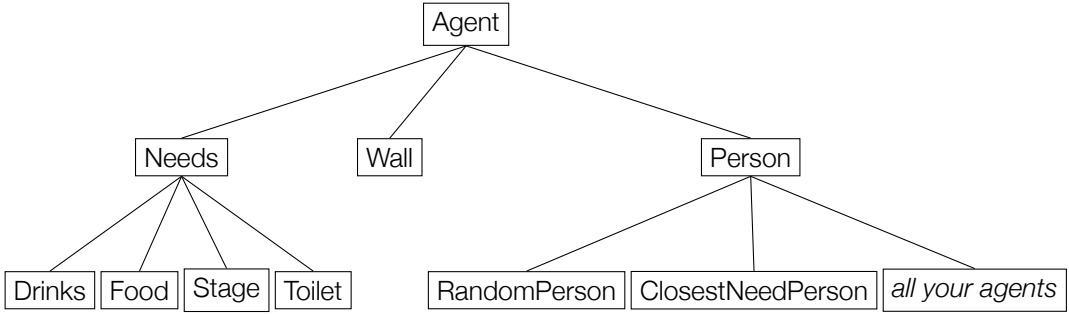
# Types in the Framework

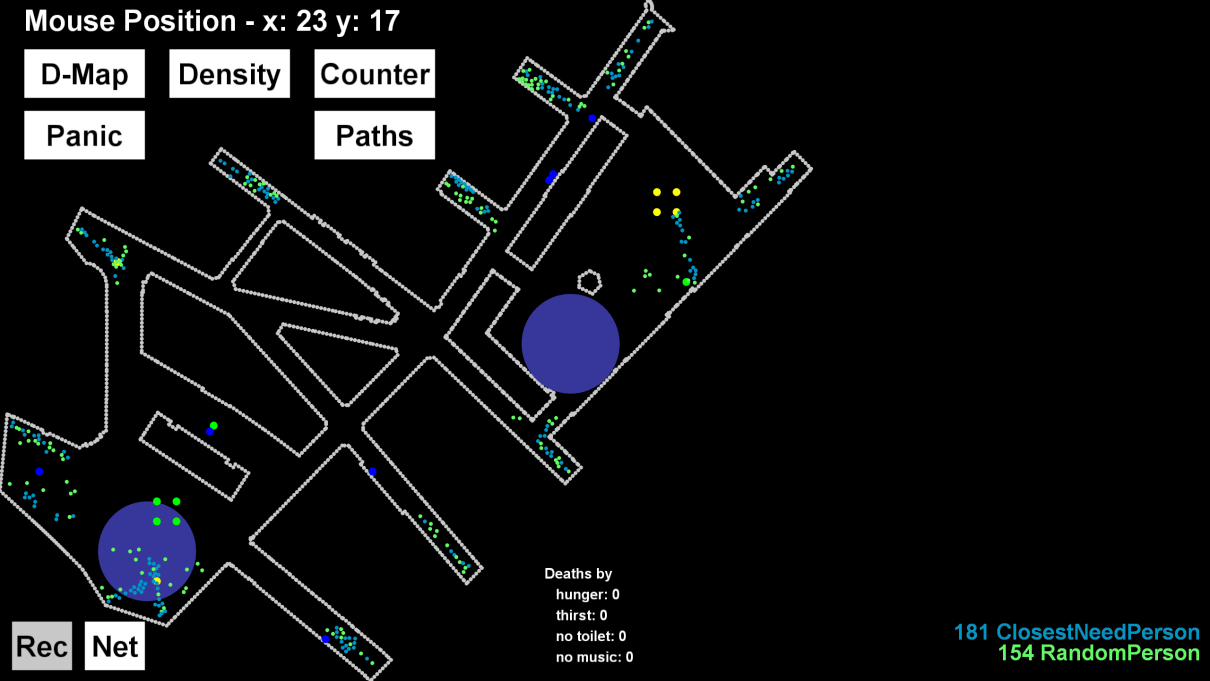
## everything is agents

All actors in the simulation are so called agents. The following main types are all subclasses of the type *Agent*:

**Needs:** All the stalls in the simulation. Food stalls, bars, toilets, and stages inherit from this class.
**Person:** All the people in the simulation are a subtype of *Person*. They are the objects that move around.
**Wall:** The walls of the simulated area consist of agents of the class *Wall*.

# Type Hierarchy




Mouse Position - x: 23 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
181 ClosestNeedPerson
154 RandomPerson

# Types

## agent type

This is the super-type of all actors in the simulation. It provides the basic interface of the minimal functionalities an actor has to provide.

It defines that an agent must have a **color** for when it is displayed and a **radius** of interaction with other agents. It also defines that all agents must have a **force field** and that it must be possible to get **their position**. Additionally an agent must have a function called **step** which changes the state of the agent for the next iteration.

# Types

## needs type

This is the super-type of all the different locations people can satisfy their needs.

In the current case, we have four different *Needs* types, food stalls, bars, toilets and stages.

They all have a certain range of interaction. This means that if an agent is close enough, he can fill up with, e.g., drinks.

# Types

## wall type

Their only job is to repel moving agents, thus keeping them in the area.

# Types

## person type

This is the super-type of all moving things, they have many additional state variables and also additional functions. For example they have to calculate the next location they want to go, as well the path to that location.

Objects of type *Person* are initialized with a certain value for the amount of thirst and hunger, and need for music and to go to the toilet. In every step they make, all the values decrease a little bit.

# Where to go?

## force fields

To have quasi-realistic behavior of the crowd, it is important that they cannot walk through each other. In our framework we use force fields to accomplish that.

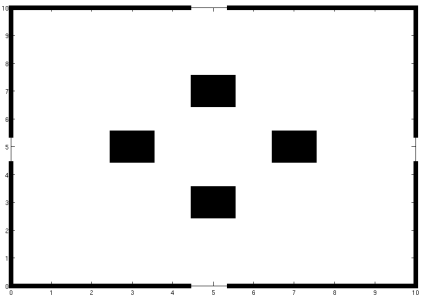
The force field is described by the distance of agents to each other, the closer they get, the more they are repelled from each other.

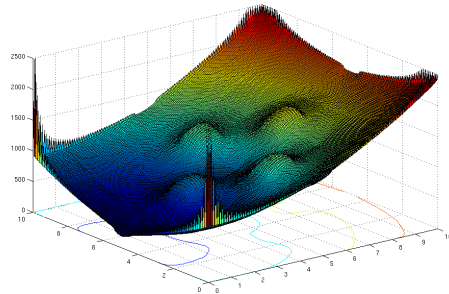
The opposite accounts for the location the agent decided to go to. He is attracted to that location.

Since we actually calculate the force field from potentials, the agent can be pictured as a ball rolling down a landscape.

# Where to go?

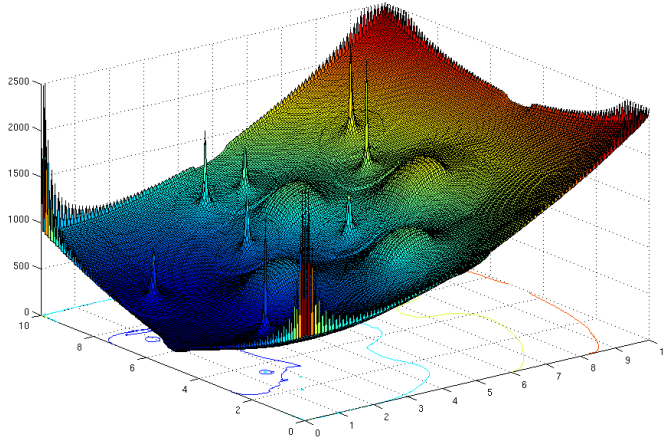
potential landscape



# Where to go?

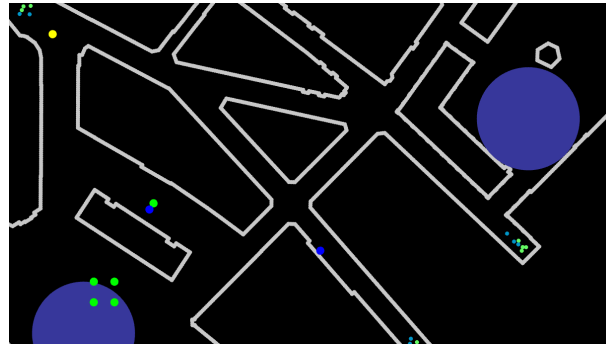
potential landscape



# Where to go?

## walking along a graph

If a person would take the direct path to the desired location, he/she might get stuck in certain situations.



# Where to go?

## walking along a graph

If a person would take the direct path to the desired location, he/she might get stuck in certain situations.

So we introduced a “walking”-network along which the people walk.

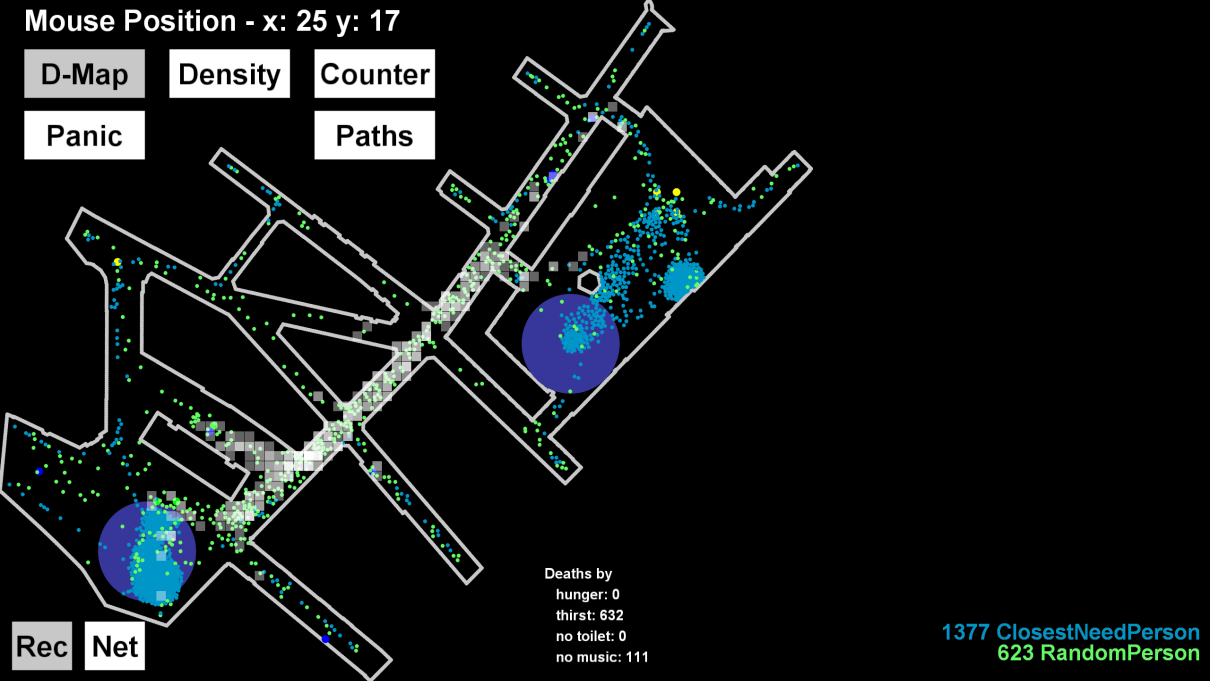
# Interface

## analysis helper

The interface has different helpers to analyse the current simulation. They are:

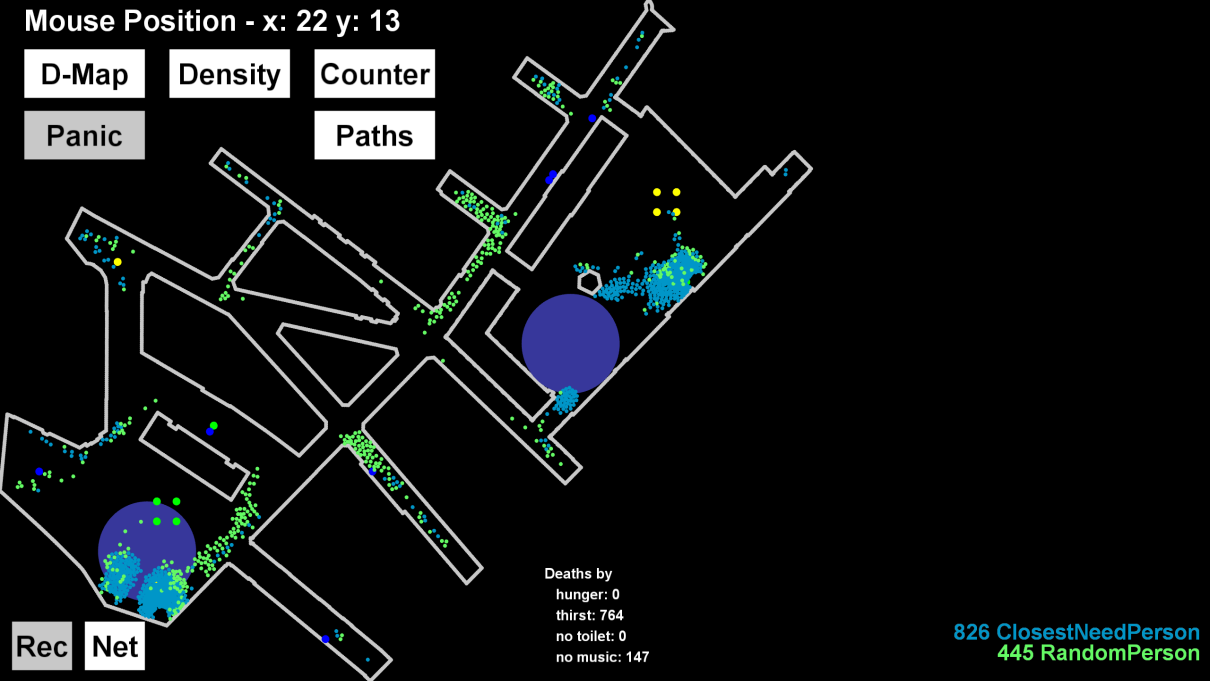
**Density:** draws a heatmap of the density per square meter, 5 and more people per $m^2$ is critical and fully red.
**D-Map:** draws a heatmap of the number of people who died inside that square.
**Counter:** shows the number of happy customers per needs-provider.
**Paths:** draws the last 50 locations of each visitor.
**Panic:** this button sets all people into panic mode and they try to exit at the closest exit as fast as possible.


Mouse Position - x: 23 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
1009 ClosestNeedPerson
991 RandomPerson


Mouse Position - x: 25 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 632
no toilet: 0
no music: 111
Rec
Net
1377 ClosestNeedPerson
623 RandomPerson


Mouse Position - x: 16 y: 11
D-Map
Density
Counter
Panic
Paths
16
13
2063
1403
31
205
161
11
21
17
4411
3443
423
453
13
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
1009 ClosestNeedPerson
991 RandomPerson


Mouse Position - x: 24 y: 20
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
1009 ClosestNeedPerson
991 RandomPerson


Mouse Position - x: 22 y: 13
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 764
no toilet: 0
no music: 147
826 ClosestNeedPerson
445 RandomPerson
Rec
Net

# Interface

## other information

The other two buttons in the bottom left corner are:

**Rec:** stores an image of the simulation every 25 iterations into the frames folder of your project.
**Net:** shows the graph along which people walk to their desired location.

At the bottom of the canvas are some minimal statistics of why visitors died.

At the right hand side are the sub-types of *Person* listed that are active in the current simulation, together with the number of them.


Mouse Position - x: 20 y: 17
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
934 RandomPerson
932 ClosestNeedPerson

# Exercise

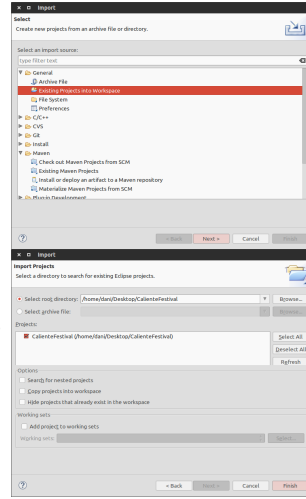
## import the project

Download the zip file “calienteCrowds.zip” from the website and extract it at your desired location.

In Eclipse, go to *File* → *Import…*

Under *General* choose *Existing Projects into Workspace*.

Next to *Select root directory:* click *Browse* and select the *CalienteFestival* where you have extracted it. Click *Finish*. The project should be imported now.



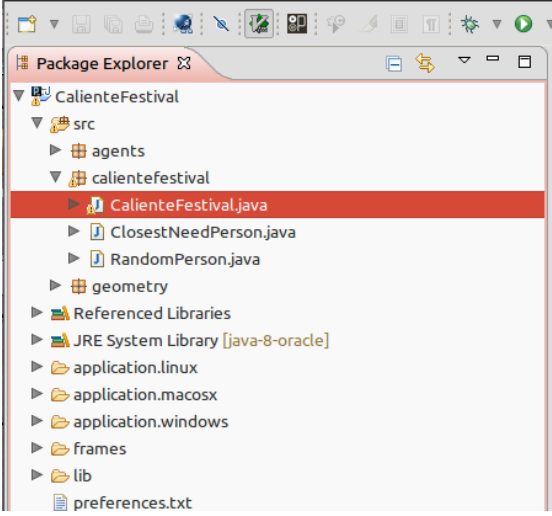
# Exercise

## start the simulation

To start the simulation, run the following file

in project *CalienteFestival* → *src* → *calientefestival* → *CalienteFestival.java*

with a right click and the *Run As* → *2 Java Application*.



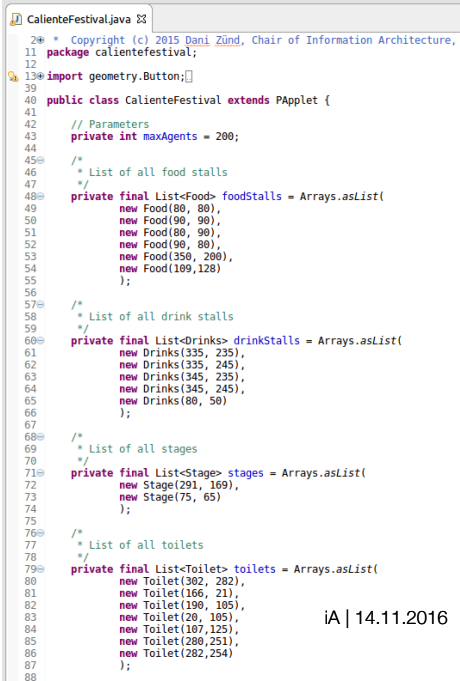
# Exercise

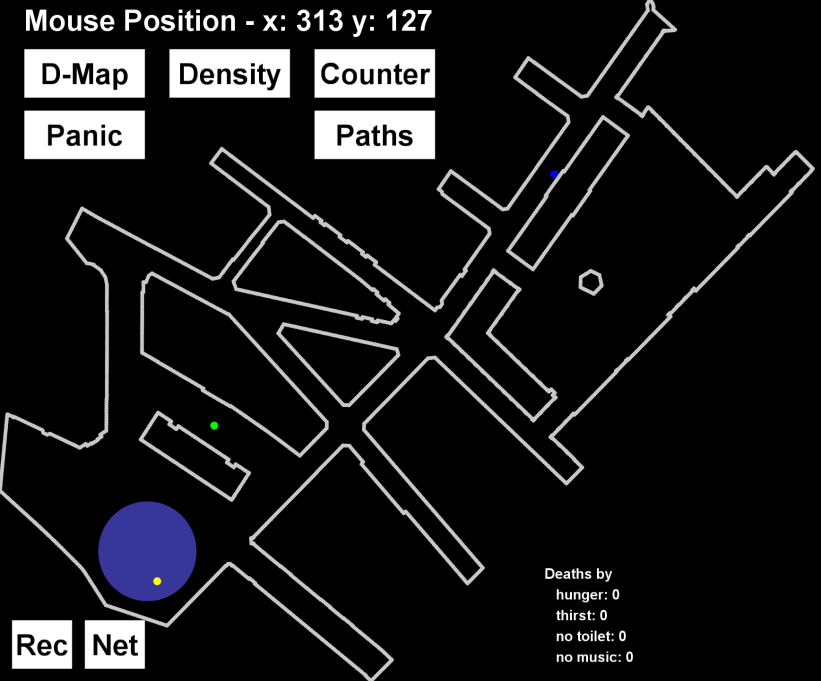
## basic setup and parameters

The basic parameters for the simulations are all within the first few lines of the *CalienteFestival.java* class.

The maximum number of agents can be set at line 43 with the private variable *maxAgents*.

The locations of the basic needs providers are defined right after this. They have to be defined as new objects of the specific type, having its coordinates as parameters.






```
40 public class CalienteFestival extends PApplet {
41
42     // Parameters
43     private int maxAgents = 0;
44
45     /*
46      * List of all food stalls
47      */
48     private final List<Food> foodStalls = Arrays.asList(
49             new Food(109,128)
50             );
51
52     /*
53      * List of all drink stalls
54      */
55     private final List<Drinks> drinkStalls = Arrays.asList(
56             new Drinks(80, 50)
57             );
58
59     /*
60      * List of all stages
61      */
62     private final List<Stage> stages = Arrays.asList(
63             new Stage(75, 65)
64             );
65
66     /*
67      * List of all toilets
68      */
69     private final List<Toilet> toilets = Arrays.asList(
70             new Toilet(282,254)
71             );
```

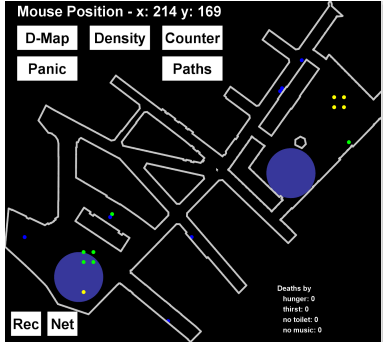
# Exercise

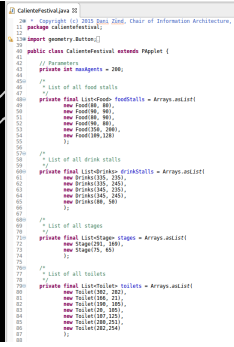
## place your stalls

Set up the layout you made last week.

To do this, you have to change the coordinates of the objects in the *CalienteFestival.java* class to your values and add additional objects of each type.

You can find out the coordinates of the stalls by starting the simulation and pointing the mouse at the desired location.



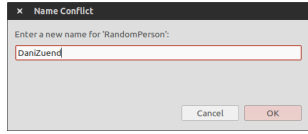
# Exercise

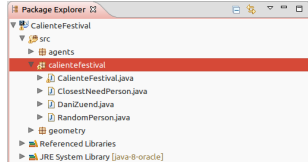
set up your own agent

The easiest way to start with your own agent is to copy and paste for example the *RandomPerson.java* file into the same package and then rename it.

Right click on *RandomPerson.java* → click *Copy*
Right click on the package *calientefestival* → click *Paste*
When the dialogue pops up, put in your name, without whitespaces.

After clicking *OK* there should be a class with your name in the *calientefestival* package.

# Exercise

## set up your own agent

To make your agent visually distinguishable from other agents, set up a unique color. This is done by opening your agent and set the *RGB* values for your agent in the *setColor* function.

```
@Override
protected void setColor() {
    this.r = 100;
    this.g = 250;
    this.b = 100;
}
```

To add the agent to the whole simulation, one last step has to be taken. You have to register the agent in the *CalienteFestival.java* class. Put the name of your class, e.g. *"DaniZuend"*, to the *classNames* list.

```
/*
 * List of all different person classes.
 */
private final List<String> classNames = Arrays.asList("ClosestNeedPerson", "RandomPerson");
```

→

```
/*
 * List of all different person classes.
 */
private final List<String> classNames = Arrays.asList("ClosestNeedPerson", "RandomPerson", "DaniZuend");
```


Mouse Position - x: 12 y: 174
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 0
thirst: 0
no toilet: 0
no music: 0
Rec
Net
674 ClosestNeedPerson
666 RandomPerson
660 DaniZuend

# Exercise

## preview last exercise

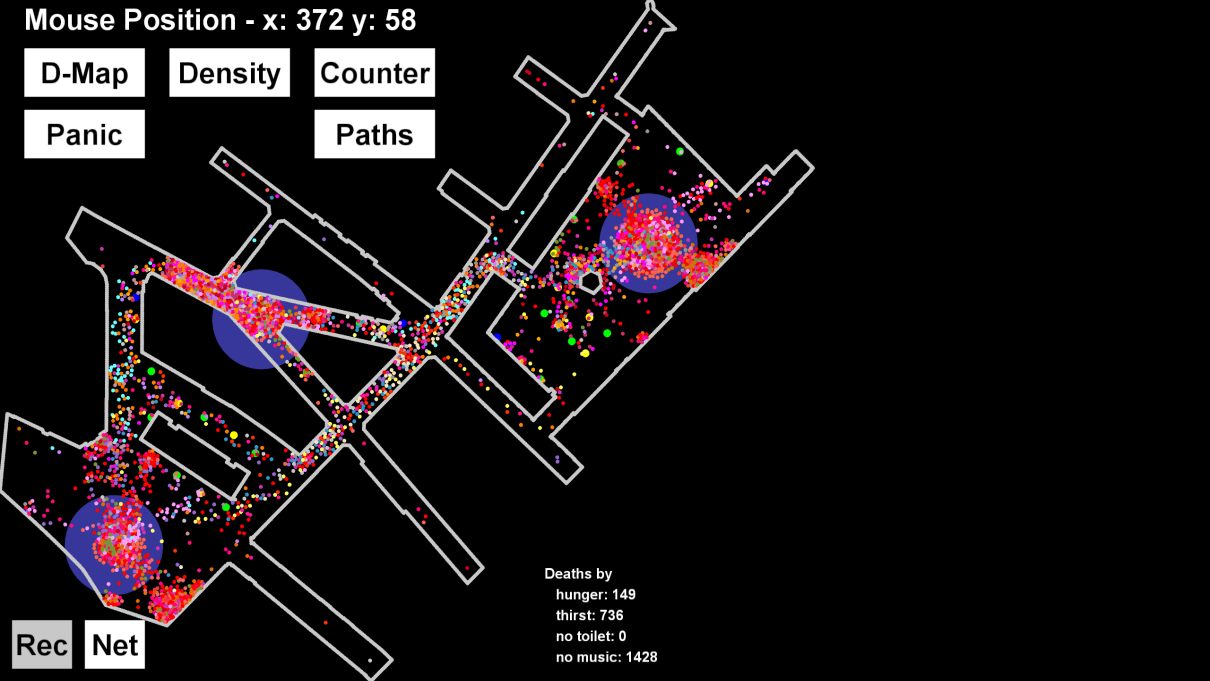
In the next exercise, you will have to implement the location choice function of your agent.

We will then run all the different implementations together to see who programmed the most persistent behavior.

The winner will win a price!!

CalienteFestival.java | Agent.java | Person.java | Rando

```
1  package calientefestival;
2
3  import java.util.ArrayList;
8
9  public class DaniZuend extends Person {
10
11     public DaniZuend(Agent curr) {
12         super(curr);
13         this.setColor();
14     }
15
16
17     public DaniZuend(double x, double y) {
18         super(x,y);
19         this.setColor();
20     }
21
22     @Override
23     protected Needs locationChoice(ArrayList<Agent> others) {
24         Needs n;
25         ArrayList<Needs> needs = this.getNeeds(others);
26         n = needs.get(rGen.nextInt(needs.size()));
27         return n;
28     }
29
30
31     @Override
32     protected void setColor() {
33         this.r = 200;
34         this.g = 200;
35         this.b = 100;
36     }
37
38 }
39
```


Mouse Position - x: 372 y: 58
D-Map
Density
Counter
Panic
Paths
Deaths by
hunger: 149
thirst: 736
no toilet: 0
no music: 1428
Rec
Net