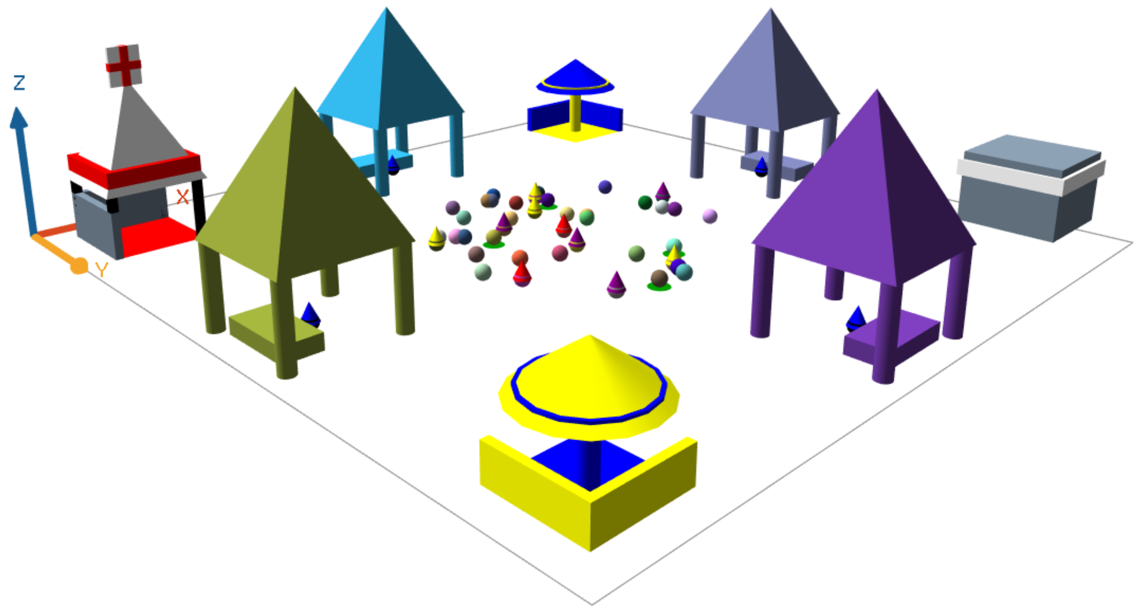
DAIIA – Final Project

23/12/2019 – Madis Lemsalu and Sean Deloddere



Main classes/species

FestivalGuest:

- guest (RL)
- star
- journalist
- doctor

Researcher (BDI)

Hospital

ResearchCenter

Restaurant

Bar

Stage

Introduction

So for our final project we started off with a bit of a typical festival and put a spin on it. Half of the people there are the sorts of people you would expect at a festival, like normal guests, (music) stars and journalists. However, luckily, as we'll find out in a second, there are also doctors and researchers at the festival. This is very fortunate because aside from all the normal interactions these people will have, there will also be an illness spreading that has to be treated. This illness is our creative part, but it is so heavily interwoven into the project that it is hard to discuss it as a separate thing at the end of the report, so we'll start off with it. A certain amount of people start out sick when the simulation is launched. These people can then, during interactions with others, infect them so they also become sick. A doctor however can take these sick people to the hospital and has a chance to cure them. Sometimes straight up curing is too difficult and some new technique has to be developed. This is where the researchers come in. The doctor goes out to find a researcher and this one develops a cure, bringing it back to the doctor when it's done. How these interactions, and a lot more others, exactly happen we'll discuss later. We'll split the interaction in two parts, the ones that have nothing to do with the spreading sickness, and the ones that do.

Approach

We started with a standard festival, using the components we made in the previous assignments, like the stages and the restaurant and bar. We started off by simply adding guests that use these facilities and interact with each other, becoming more or less happy depending on how similar their interests are. Later we added the stars. Then came the creative idea of the sickness, which we implemented already when we only had the normal guests and stars yet. Soon followed the doctors and a bit later the researchers, and then eventually we added the journalists as well. We opted to make all the types of guests the same species, since, despite their different ways of interacting with each other, have a ton of shared behaviour, such as going to concerts, restaurants and bars. For the researcher we used a different species since it makes use of bdi.

Interactions independent of sickness

A few of the types of guests don't interact with the sickness directly. While they can of course still get sick, the interactions they have between each other and others have nothing to do with the sickness, so we'll discuss these first. We won't talk about the normal guests here, since we implemented their interactions using reinforcement learning, so we'll talk about them in that chapter.

For the stars we gave them four attributes to determine how they interact with the others. The first one is their social battery, this is a float value that will gradually decrease from having social interactions, and will need some time to replenish once it is empty. The second on is a boolean, openToConversation, that will determine if the star wants to interact with people. If the social battery was empty this goes to false, once the battery is back up to 200 this is set to true again. The stars also have an ego, that increases the more people and especially journalists talk to them. The higher their ego the less they will want to interact though. The amount this ego increases each time is according to the fourth attribute, the ego increase.

Third type that acts mostly independent of the sickness are the journalists. Their primary focus is interviewing stars and spreading the news to guests. They have 4 attributes. The first attribute is jobScore, this is a score that shows how well the journalist is performing his job, and also increases the chance that the star will want to interact with them. If they successfully interview a star or spread the story to a guest this score will increase. If they get rejected for an interview it will decrease. Second attribute is respect, this is the amount of respect the journalist shows to the star and also impacts how likely the star is to interact with them. Third attribute is hasStory, this is a boolean that get's set to true if the journalist successfully interviews a star. Once this is set to true, the journalist can interact with guests to sell/tell the story. The amount of times the journalist can tell the story before they need a new one depends on the fourth attribute, storyTold. The location also plays a role in these interactions. Stars are less likely to tolerate an interview when they are at a restaurant or bar and would prefer to be left alone.

Interactions relating to the sickness

Most of the interactions in our project are relating to the creative part, a spreading sickness in the festival. A certain amount of guests start off sick, and this sickness van spread to other guests during interactions. There are 3 attributes that define an agent's sickness: infectivity, sickness and curability, all three are float values. Infectivity is random and determines the chance to infect another agent upon interacting with them. Sickness get's worse gradually over time, and when it reaches 100 the agent dies. Curability is also random and determines how hard it is to be cured.

If a doctor encounters a sick agent, there is a chance that this doctor might help to try and cure this agent. This chance depends on the doctor's empathy, a float value. If the empathy check is succesfull, the doctor will escort the agent to the hospital. Once arrived at the hospital, the treatment can begin. When the treatment finished, there is a chance for it to be succesfull or not. This chance depends on both the doctors intelligence and experience, as well as the sick agent's curability. If the curability is below a certain value, this means that it is easier to cure than a higher value, the doctor can attempt to cure the agent without external help. It then depends on his intelligence and experience. The intelligence is a value determined in the beginning and doesn't change during the simulation. The experience starts rather low, but goes up over time after treatments, more for successful treatments. If the doctor is successful in curing the agent the agent is no longer sick, and both can enjoy the festival again. If the curability of the agent is above a certain value though, the doctor can't cure the disease, new research is needed to find a cure. This is where our last type of agent comes in.

The researcher is an agent that will be informed by the doctor that a cure is needed. When this happens the researcher heads to the research center and attempts to make a cure. Since this agent was programmed using BDI we will discuss how it works in the next chapter.

Challenge 1: BDI

The researcher has been coded as a seperate species to make use of the belief-desire-intention framework. The agent starts off with an initial desire, which is just to enjoy the festival, making it wander around the different stages. When a researcher perceives a doctor that needs a researcher, it will store that doctor's name, and add a new belief, cure_is_needed. The range at which the researcher can perceive the doctor is dependent on their 'view' attribute. When the researcher has the belief cure_is_needed it will get a new desire, work_in_lab. This will cause the agent to start heading to the research center. Once arrived there the researcher has a chance to develop a cure, depending on their 'brains'. If they are unsuccessful, they will just forget about making a cure thinking it is too difficult for them, and continue enjoying the festival. If they are successful however they will still have to deliver the cure. The way they deliver the cure depends on if they have a phone or not. If they have a phone, they can send a fipa message to the doctor letting it know the cure. If not the researcher has to head to the hospital and inform them it has a cure for the doctor. Once that doctor goes back to that hospital it will receive the cure.

Challenge 2: RL

Our guests interact with each other when they meet each other at the festival. How good this interaction goes is measured in happiness, and is dependent on the shared interests of the guests. These interests are defined in 6 attributes, the same 6 that were used in assignment 3 to select which stage the guests would go to. When the guests interact, a difference in interests is calculated by summing the absolute of the subtraction of two agent's corresponding attributes. After some experimenting we found out that the mean difference is 2.0, so if the difference is smaller than 2.0 we count that as a positive interaction and the happiness will increase, if it is larger it is a negative interaction. Now where does the reinforcement learning part come in? We wanted our guests to learn which guests would be worth it to interact with and which wouldn't, to maximize their happiness. So how can a guest know if an interaction will be positive before the interaction happens? Well, each guest has a unique color. This color is calculated using their 6 attributes, the same 6 that are used to calculate the difference. Using their colors each agent is grouped into a color group, of which there are 7, namely: red, green, blue, redgreen, greenblue, bluered and neutral. These are calculated with a formula that looks at the rgb values and decides which catagorie fits best. Each agent also has a list of the size of the amount of colorgroups, 7, that contain the chance to interact with these color groups. These chances start out as 0.9 for every color group, and are increased every time the agent has a positive interaction with an agent of this color group, or decreased when an agent has a negative interaction with an agent of this group. Eventually the agent will have a much larger chance to interact with the color groups that on average increase their happiness, and a much lower chance to interact with the ones that decrease their happiness on average. Since we penalized a negative interaction more than we rewarded a positive interaction, we see a drop in happiness in the beginning, when the agent doesn't know yet which interactions are beneficial. However, when the agent starts to learn which agents to avoid, and which agents will yield a positive interaction, we can see the happiness climb steadily. When we compare the chances with their own color we can also clearly see that agents are more likely to interact with agents of a similar color. We refer to the experiments and results section for a demonstration of this.

Creative part

As mentioned throughout this report, for the creative part we implemented a sickness in the festival.

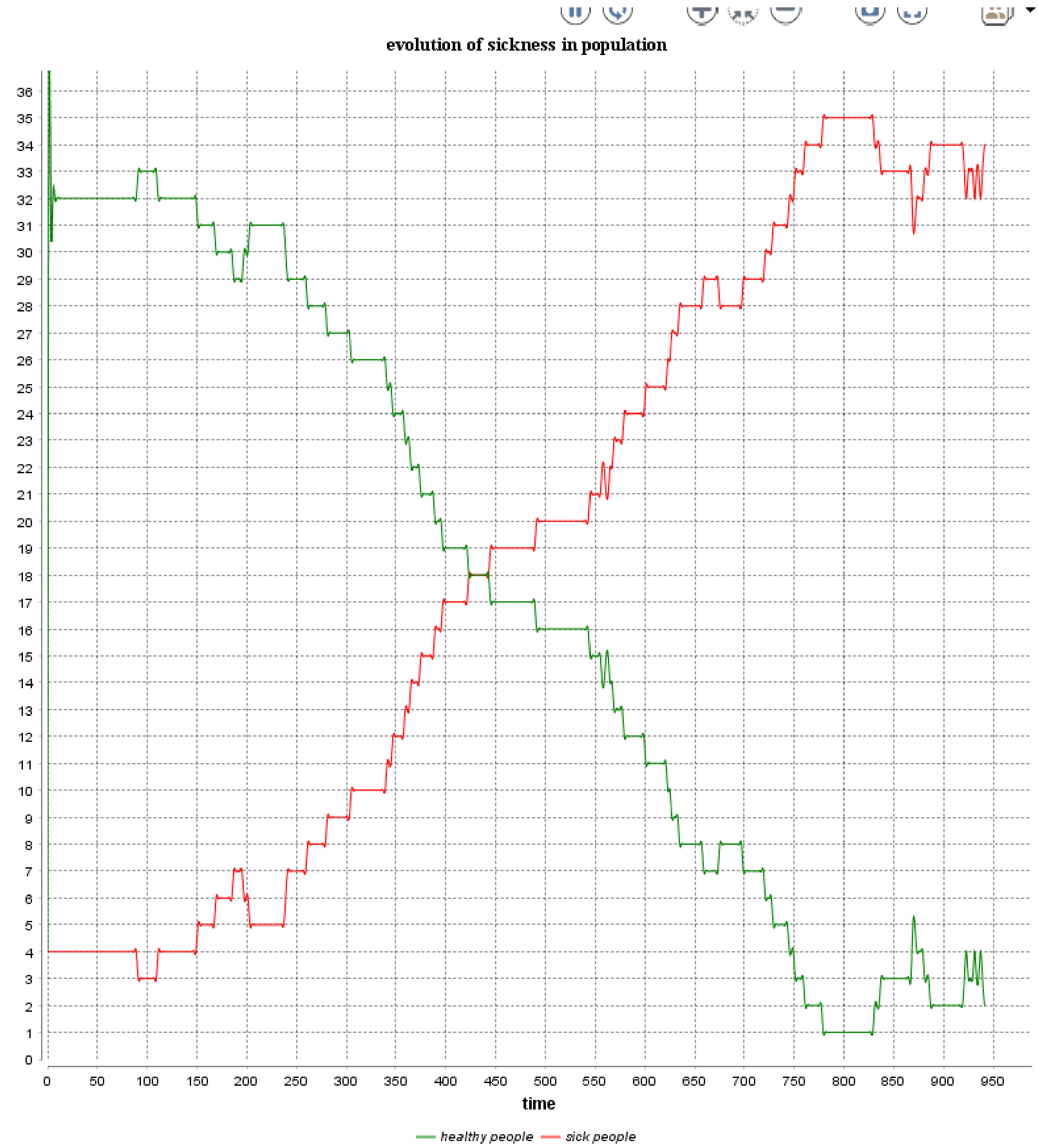
Experiments and results

infectivity

We did a couple of experiments with our simulation, of which we'll discuss two in the report. Firstly we'll take a look at how the sickness spreads throughout the population, and which factors influence it. We'll start off by a disclaimer, there are a ton of factors that influence the spread of the disease, namely: the initial amount of sick agents, the infectivity, the curability, the amount of doctors, their empathy, their intelligence, their initial experience, the amount of researchers, their brains, ... There are too much factors to make a graph for each and everyone of them, but it is pretty intuitive how the increase or decrease of each of these factors will influence how the disease can spread. So, we'll just demonstrate the difference when we change 1 factor, the infectivity, because this is the most obvious one that will result in the sickness spreading faster or slower.

High infectivity:

When we take a look at this graph, we can see a couple of things happening. We see that the doctors manage to cure a sick agent when time is a little before 100, but another agent gets sick quickly afterwards. Around 200 again a few agents get cured, but the other agents just get sick too quickly for the doctors to keep up. The more agents get sick the quicker the disease spreads. Near the end we notice that the graph starts going a bit into the other direction again. This can be explained fairly easily. Because almost all the guests are sick at this point, there are barely, if any, agents to infect. However the doctors can cure multiple agents at a time, and since there are so many that are sick of them around, the chance is pretty big that there will be small spurts where a bunch of agents get cured, before they quickly become sick again.



evolution of sickness for high infectivity

low infectivity:

In this experiment, we used infectivity of 1/10th of the infectivity in the high infectivity part. Keep in mind that the infectivity is still random, it is just in a lower interval now.

evolution of sickness for low infectivity

As we can see, if the infectivity is low, the doctors have time to cure the sick agents before the disease spreads too much, and the sickness will be eradicated.

Reinforcement learning

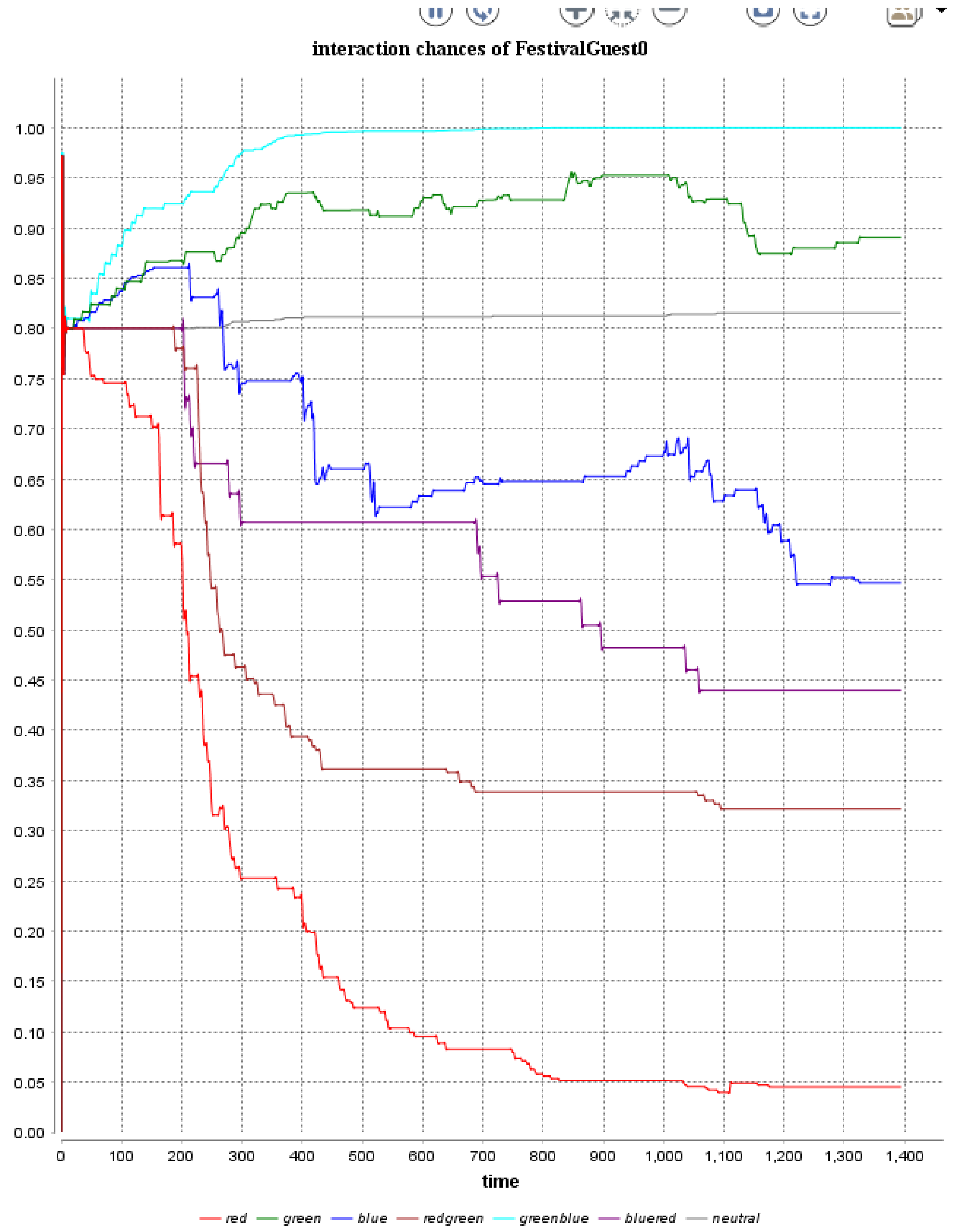
Another experiment we did was look at the reinforcement learning and how the chances for interaction changed over time, and how this influenced the happiness.

We looked at how FestivalGuest0 ‘s chances in particular changes. First we looked at FestivalGuest0’s color values. This should give an indication of its interests and we could predict that the interaction chances with similar colors should be high, while the interaction chances of differing colors should be low.

```
FestivalGuest0: my color: [82.875||197.625||178.5]
FestivalGuest0: my colors: false,true,true
FestivalGuest0: my colorCode: 4
```

color values of FestivalGuest0

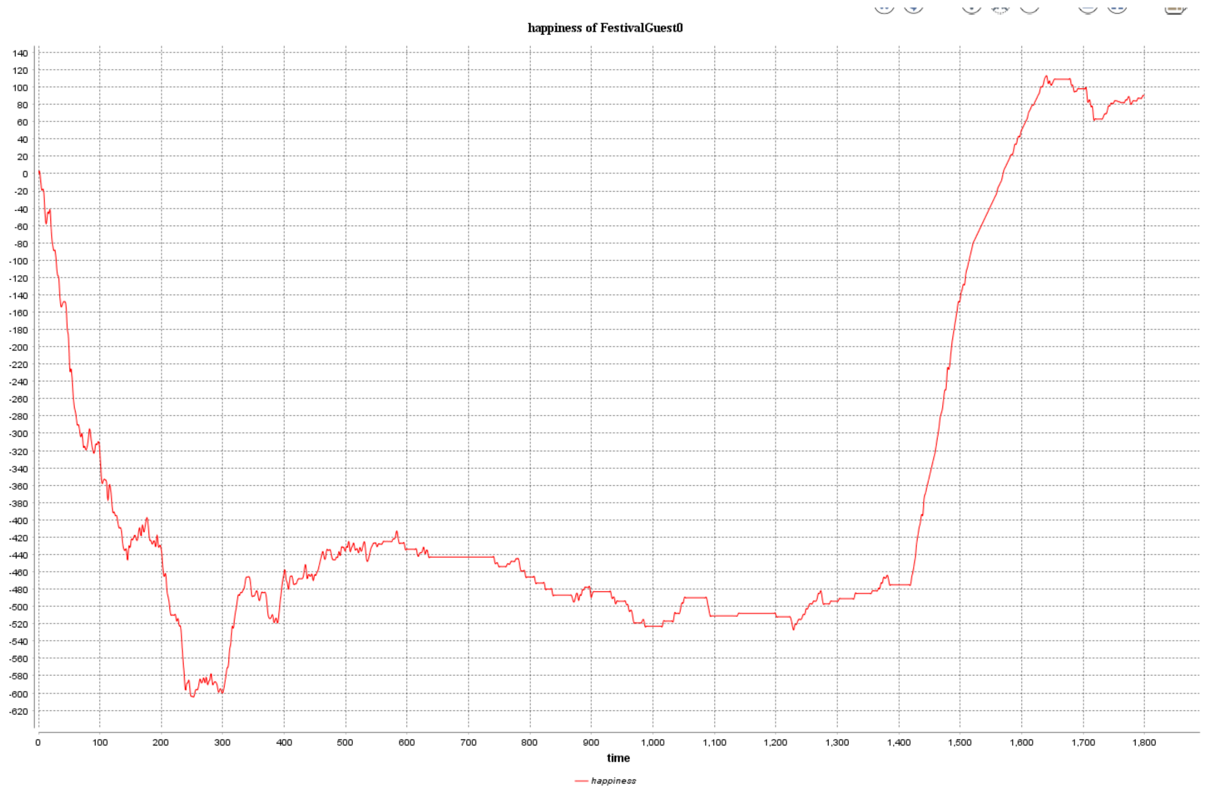
FestivalGuest0 get's a colorCode of 4, which means it will be grouped in the greenblue categorie. So, we can predict that it's interaction chances with other greenblue agents will be high. We also see a high green value, and a sort of high blue value, so the interaction with these agents should be high as well. We expect a low interaction change with red agents.



FestivalGuest0's chances of interacting with agents of these color categories

When we take a look at the results they are as we expected. Every agent with red or a color containing red will have a below half chance of interaction, while a green blue combination will have a very high chance.

Now we can also take a look at how the happiness of FestivalGuest0 evolved over time.



evolution of happiness of FestivalGuest0

We notice that the happiness heavily drops in the beginning, but eventually starts to steadily rise. One thing to keep in mind is that the concerts that are currently going on at the stages also play a role. If there is a concert going on that only similar agent go to, a positive interaction is very likely, and there will be a period of increase in happiness. If there is a concert that almost everyone goes to, interaction with different agents is more likely and we can expect a negative trend in happiness.

Conclusions

As predicted, increasing the infectivity will of course result in a faster spread of the disease. As for the second experiment, the results were what we expected, agents learn to interact with more similar colors to theirs, because that is a pretty good indication that there will be a small difference in their interests and the interaction will be positive. We also expected the happiness to drop in the beginning, because negative interactions get penalized more than positive interactions are rewarded, and the agent has no idea who to interact with in the beginning. However after a while we see the happiness climb back up, when the agent learns to avoid negative interactions and only go for ones that increase its happiness.