SYSC 5104: **METHODOLOGIES FOR DISCRETE EVENT MODELLING AND SIMULATION**

Assignment II

### FIRE AND SMOKE

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**Brief Introduction**

There is no smoke without fire. So, wherever there is fire, it is expected that there will be smoke.

The aim of this assignment is to simulate the behavior of smoke when there is fire, seeing as fire always produces smoke.

The assignment follows the already established rules for fire behavior of the environmental Lab of the University of Course and then a different set of rules are generated for smoke behavior [smokebehaviour], which are dependent on the rules of fire behavior [FireBehavior].

**The Model.**

There are two layers in this model. The motion of smoke particles is such that it follows the migration pattern of evaporation i.e it gradually disappears in to the atmosphere from the bottom to the top. Therefore, a bottom layer (x,y,0) represents the fire layer while a top layer (x,y,1) represents the top layer.

The behaviour of smoke particle is completely random and no particularly defined motion. So, I have designed its behavior as a random function generation whose initial value is dependent on the value of the corresponding cell in the fire layer and an exponential operation of the average of the values of the cell neighbours.

The model structure is as follows:

#include(macros.inc)

[top]

components : ForestFire

[ForestFire]

type : cell

dim : (30,30,2)

delay : inertial

defaultDelayTime : 100

border : nowrapped

neighbors : ForestFire(-1,-1,0) ForestFire(-1,0,0) ForestFire(-1,1,0)

neighbors : ForestFire(0,-1,0) ForestFire(0,0,0) ForestFire(0,1,0)

neighbors : ForestFire(1,-1,0) ForestFire(1,0,0) ForestFire(1,1,0)

neighbors : ForestFire(0,0,-1)

initialvalue : 0

initialCellsValue : Fireandsmoke.val

localtransition : FireBehavior

zone : smokebehaviour { (0,0,1)..(29,29,1) }

[FireBehavior]

rule : {(0,0,0)} 100 { (0,0,0) = (-9999) } % check if border

rule : {(1,-1,0)+(21.552615/17.967136)} {(21.552615/17.967136)\*600} {(0,0,0)=0 and (1,-1,0)>0}

rule : {(1,0,0)+(15.24/5.106976)} {(15.24/5.106976)\*600} {(0,0,0)=0 and 0<(1,0,0)}

rule : {(0,-1,0)+(15.24/5.106976)} {(15.24/5.106976)\*600} {(0,0,0)=0 and 0<(0,-1,0)}

rule : {(-1,-1,0)+(21.552615/1.872060)} {(21.552615/1.872060)\*600} {(0,0,0)=0 and 0<(-1,-1,0)}

rule : {(1,1,0)+(21.552615/1.872060)} {(21.552615/1.872060)\*600} {(0,0,0)=0 and 0<(1,1,0)}

rule : {(-1,0,0)+(15.24/1.146091)} {(15.24/1.146091)\*600} {(0,0,0)=0 and 0<(-1,0,0)}

rule : {(0,1,0)+(15.24/1.146091)} {(15.24/1.146091)\*600} {(0,0,0)=0 and 0<(0,1,0)}

rule : {(-1,1,0)+(21.552615/0.987474)} {(21.552615/0.987474)\*600} {(0,0,0)=0 and 0<(-1,1,0)}

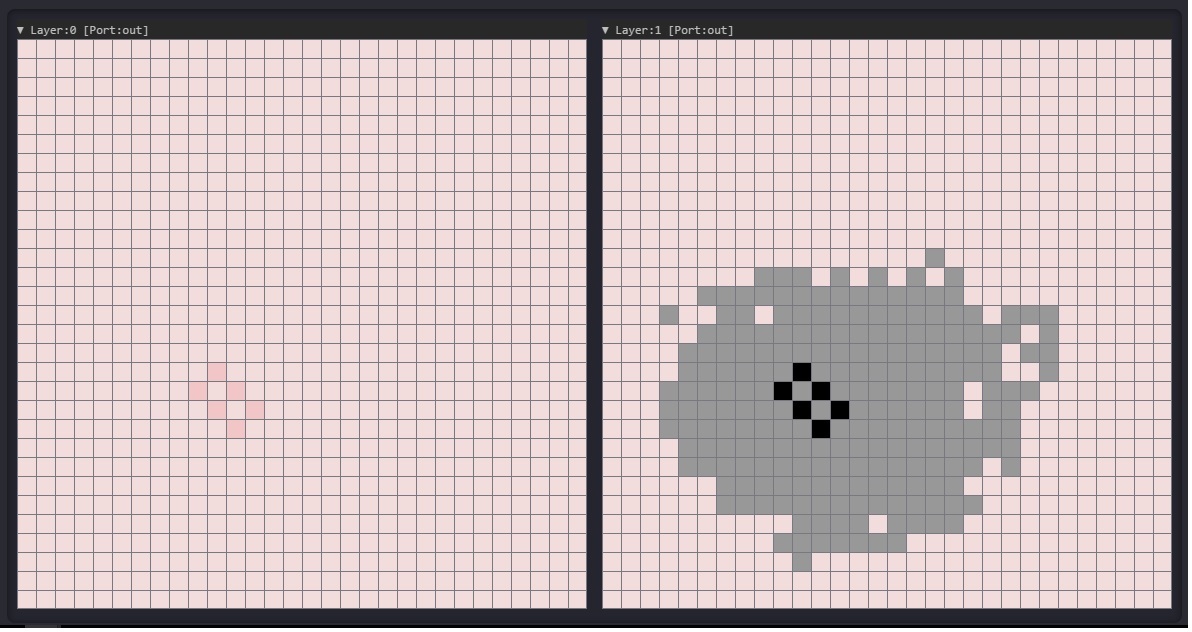
rule : {(0,0,0)} 100 { t }

[smokebehaviour]

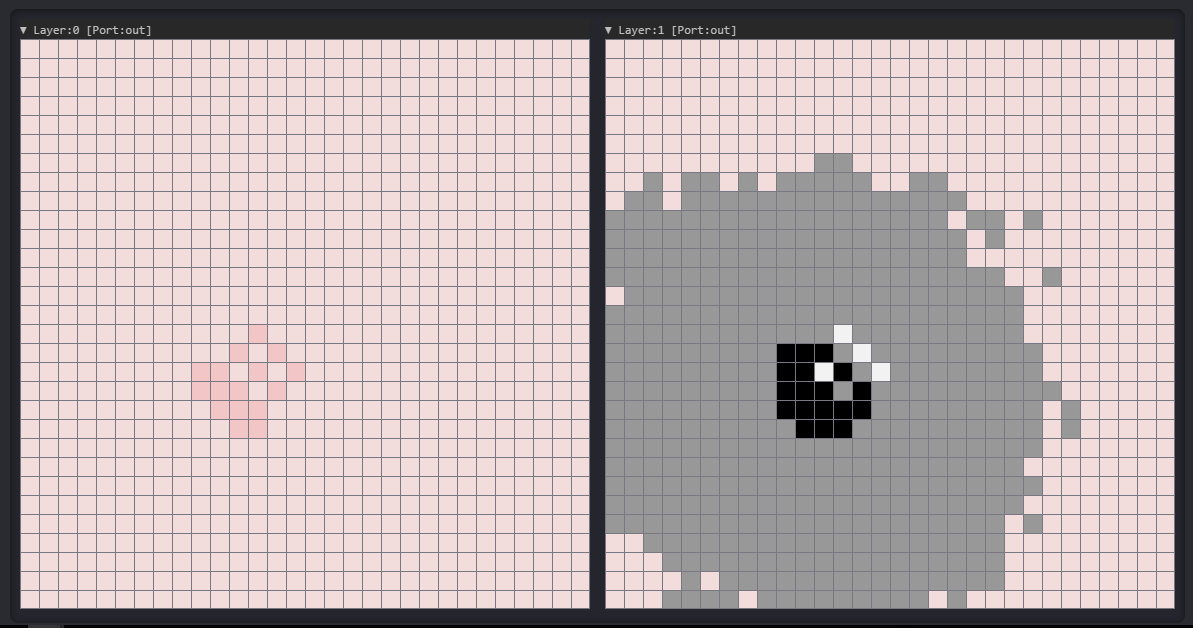
rule : {(-1) \* (0,0,-1)- 0.7385} 100 { (0,0,-1) > 0 }

**rule : {(-0.9) \* abs( ((-0.04)+exponential(0.623)) \* #macro(averageofneigbhors) ) } 100 { (0,0,-1) <= 0 }**

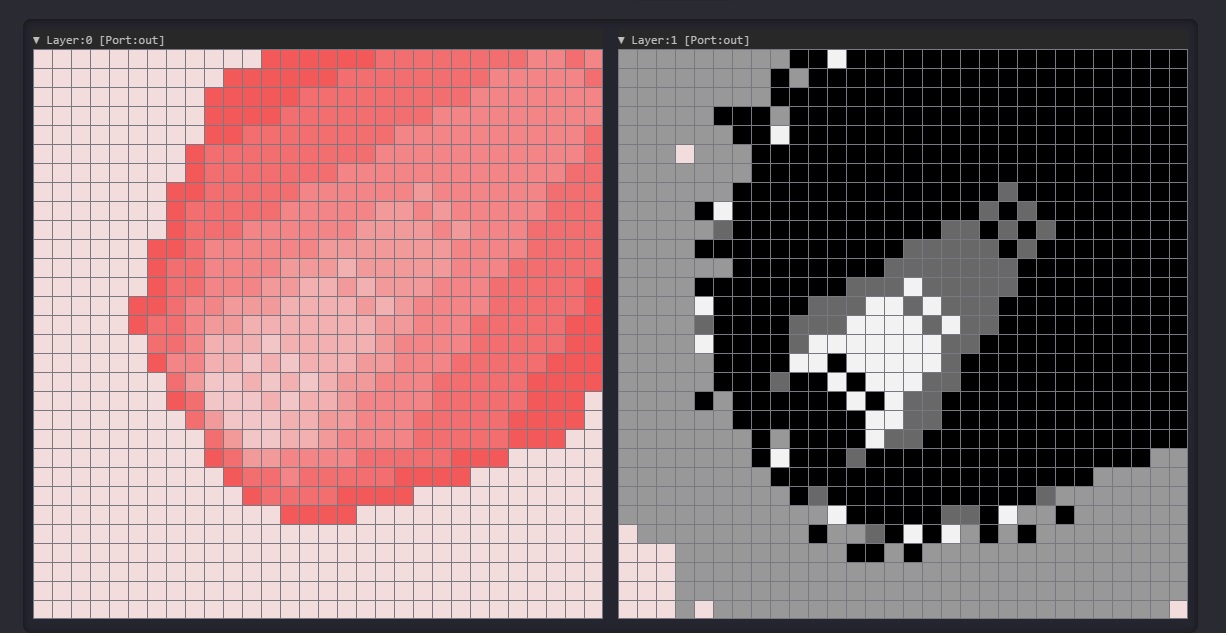
rule : {(0,0,0)} 100 { t }



Simulation at the beginning



Simulation after about 10s



At that end of simulation 30s

In the simulation one can see that there are thick black fumes(smoke) around the fire region and as the smoke particles migrate from the fire region to the surrounding cells, they become lighter and hence the colour grey.