

Understand CPM and run examples in CompuCell3D

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October 2016

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1 Problem Statement

Here is an excellent tutorial to go through to understand the theory of the Cellular Potts Model and its implementation in [Introduction To CompuCell3D](#)

In this assignment, you are to go through the tutorial, download, install compu-cell 3D and run the example systems. Specifically, run the cell sorting instance

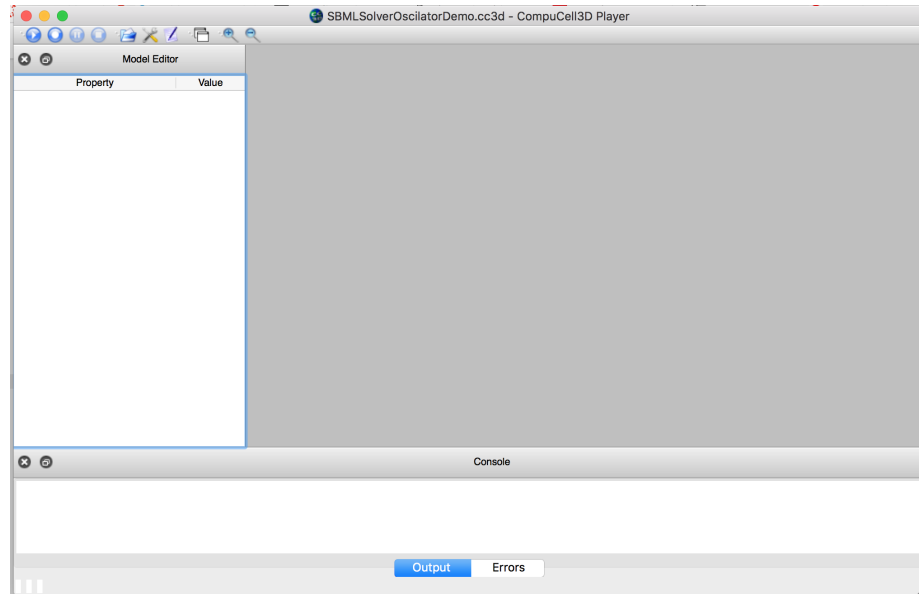
and understand the relationship between the different values of cell type adhesion and the resulting cellular morphology.

Write a short report that describes your experiments modifying the values of adhesion and provide examples of the final cellular patterns.

2 Installing and Running CompuCell 3D

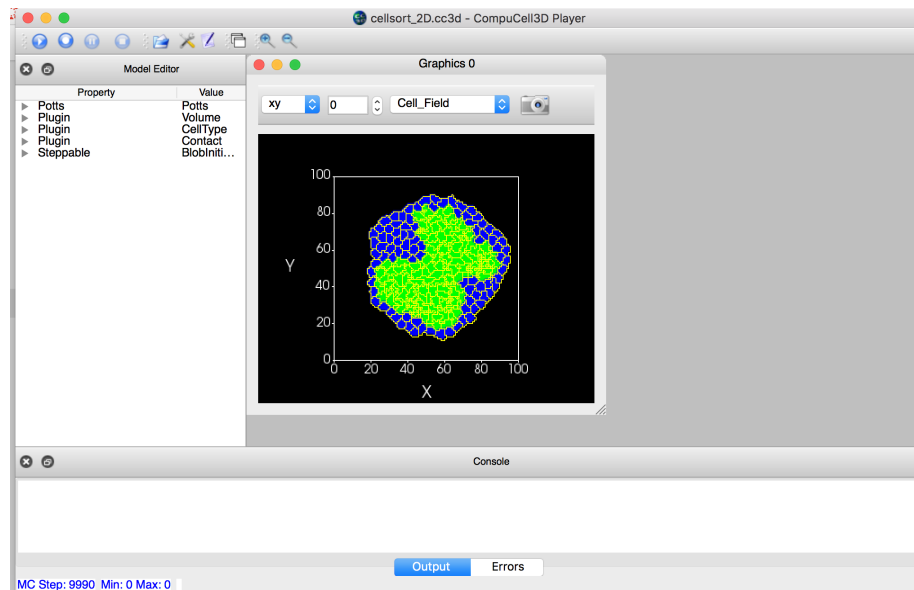
To install CompuCell 3D on Mac 10.11.x follow this link [CompuCell3D Download](#)

Unzip the resultant download. Inside the unzipped directory run a file called **compuCell3d.command**. This will open up compucell3d.



Then under file → Open Simulation File (.cc3d) <command>O The demo files are under the Demos directory, open the Demos/Models/cellsort/cellsort_2D/cellsort_2D.cc3d

After clicking the play button or Simulation → Run <command>M and letting the simulation run for a minute or two, the simulation will stop on it's own after 9990 steps and produce this output.



3 Modifying Values of Adhesion

Inside the cc3d file used in the simulation shows this:

```
<Simulation version="3.6.1">
```

```
    <XMLScript Type="XMLScript">Simulation/cellsort_2D.xml</XMLScript>
```

```
</Simulation>
```

This points to another xml file which looks like this:

```
<CompuCell3D>
```

```
<Potts>
```

```
    <Dimensions x="100" y="100" z="1" />
```

```
    <Anneal>10</Anneal>
```

```
    <Steps>10000</Steps>
```

```
    <Temperature>10</Temperature>
```

```
    <Flip2DimRatio>1</Flip2DimRatio>
```

```
    <NeighborOrder>2</NeighborOrder>
```

```
</Potts>
```

```
<Plugin Name="Volume">
```

```
    <TargetVolume>25</TargetVolume>
```

```
    <LambdaVolume>2.0</LambdaVolume>
```

```
</Plugin>
```

```
<Plugin Name="CellType">
```

```
    <CellType TypeName="Medium" TypeId="0" />
```

```
    <CellType TypeName="Condensing" TypeId="1" />
```

```
    <CellType TypeName="NonCondensing" TypeId="2" />
```

```
</Plugin>
```

```
<Plugin Name="Contact">
```

```
    <Energy Type1="Medium" Type2="Medium">0</Energy><!--0-->
```

```
    <Energy Type1="NonCondensing" Type2="NonCondensing">16</Energy><!--16-->
```

```
    <Energy Type1="Condensing" Type2="Condensing">2</Energy><!--2-->
```

```
    <Energy Type1="NonCondensing" Type2="Condensing">11</Energy><!--11-->
```

```
    <Energy Type1="NonCondensing" Type2="Medium">1</Energy><!--16-->
```

```
    <Energy Type1="Condensing" Type2="Medium">1</Energy><!--16-->
```

```
    <NeighborOrder>2</NeighborOrder>
```

```
</Plugin>
```

```
<Steppable Type="BlobInitializer">
```

```
    <Region>
```

```

    <Center x=" 50" y=" 50" z=" 0" />
    <Radius>40</Radius>
    <Gap>0</Gap>
    <Width>5</Width>
    <Types>Condensing , NonCondensing</Types>
  </Region>
</Steppable>

```

```

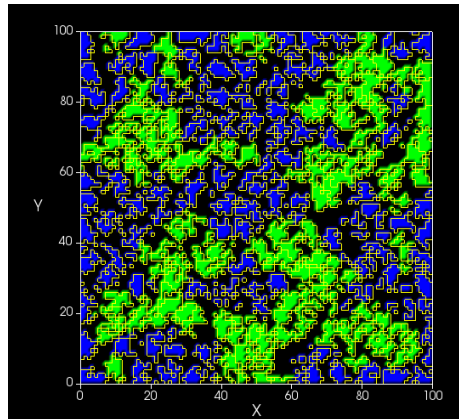
</CompuCell3D>

```

By modifying the Child elements of the Plugin Name=Contact tag and changing the tex quantity of each of the energy tags, different patterns will be constructed in the cell sorting simulation.

3.1 Changing Medium Energy

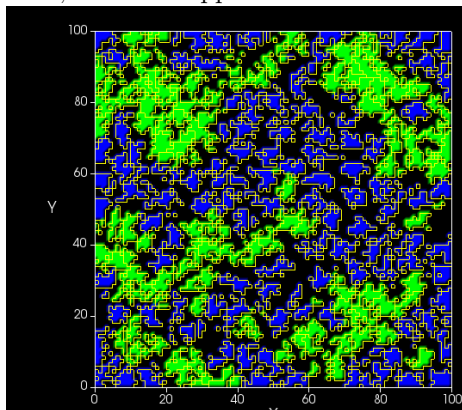
By changing all the Medium Energy to zero the overall structure seems to explode out. Next is an iteration of making most 0 and each list item value will



be set to 100 in the xml. This should show off any limiting behaviors.

3.1.1 Medium, Medium

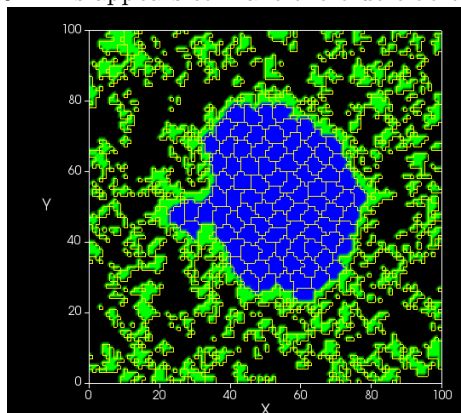
value = 100. Medium, Medium appears to not do much as far as the final



picture looks like.

3.1.2 Medium, NonCondensing

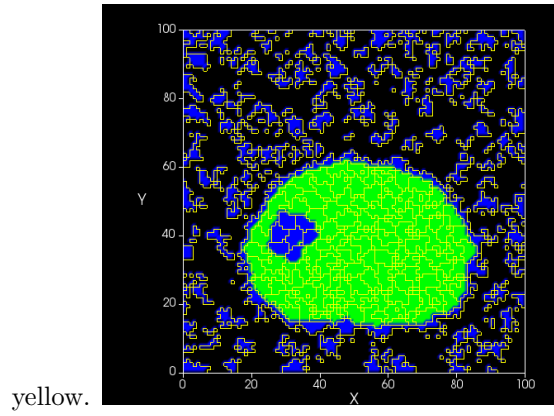
value = 100. This appears to make the blue clob together, but allow the yellow



to scatter.

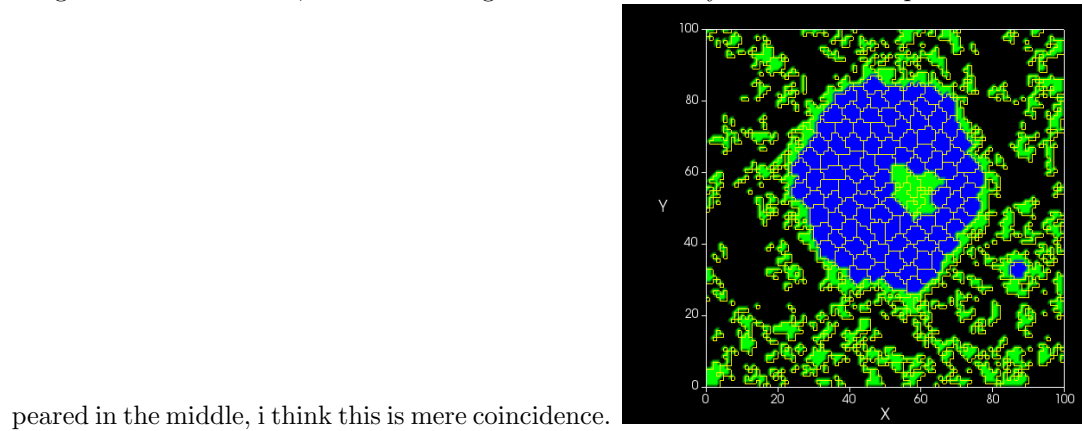
3.1.3 Medium, Condensing

value = 100. This has the opposite effect as above, the blue scatters but the yellow sticks together. Interesting that a blue clog has appeared inside the



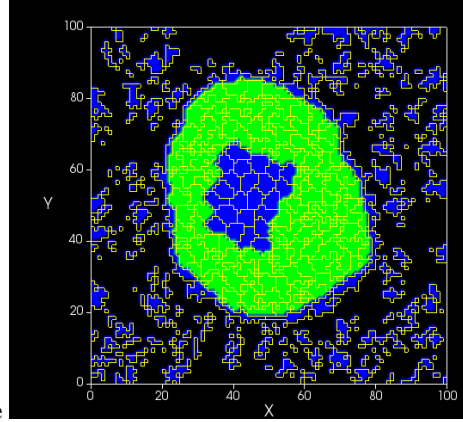
3.1.4 Medium, Medium and Medium, NonCondensing

value = 100. I stand by my claim that Medium,Medium doesn't do much as this image looks like Medium, NonCondensing alone. Granted a yellow blob has ap-



3.1.5 Medium, Medium and Medium, Condensing

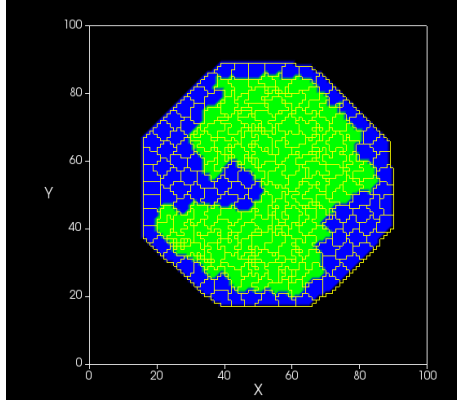
value = 100. I stand by my claim that Medium,Medium doesn't do much as this image looks like Medium, Condensing alone. However the blue blob is larger in the center. It is possible that the medium medium value determines how much of



a blob will appear in the center of the figure

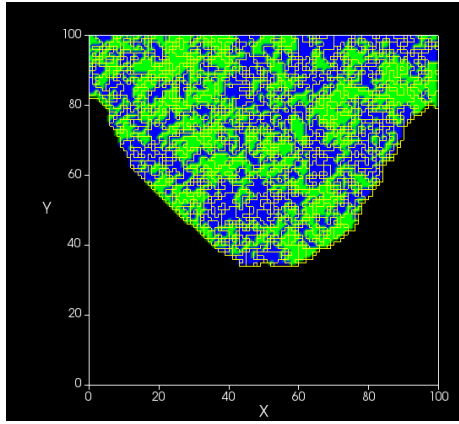
3.1.6 Medium, Medium, Medium, Condensing and Medium, Non-Condensing

value = 100. This looks identical to the default value. Likes like amplifying everything medium doesn't make a huge difference. However it appeared to converge to a stable state much quicker. This also created an octagonal pattern.



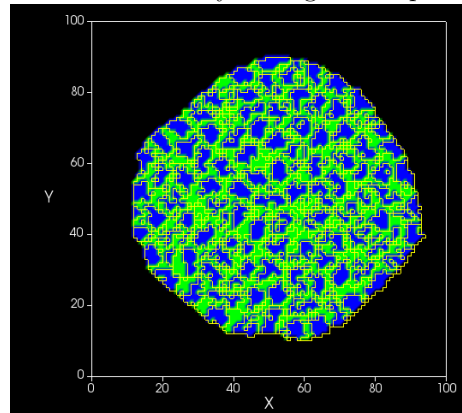
3.2 Changing Condensing NonCondensing Energy

Setting NonCondensing, NonCondensing,, Condensing, Condensing,, and Non-Condensing, Condensing to 0 and leaving everything else default results in this image. Oddly enough it appears to move up and out with these configurations. No sorting seemed to take place Next is an iteration of making most 0 and each list item value will be set to 100 in the xml. This should show off any limiting behaviors.



3.2.1 NonCondensing, NonCondensing

value = 100. This configuration appears to not allow any sorting to take place as

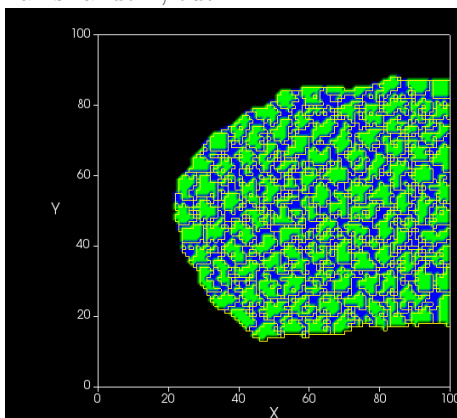


the final result appears very random.

3.2.2 Condensing, Condensing

value = 100. This also seems to disallow sorting and it remains random, but in-

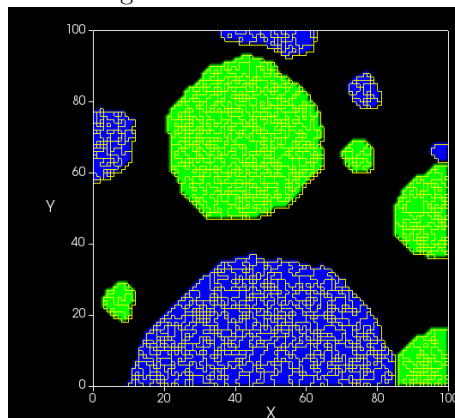
stead of staying in one place it appears to move to the right



3.2.3 NonCondensing, Condensing

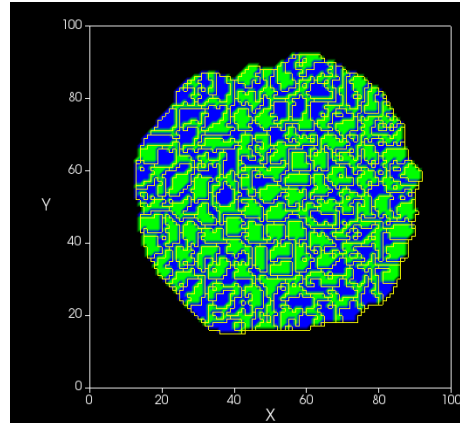
value = 100. This one forces the yellow to stick together and the blue to stick to-

gether, but to repel the different colors.



3.2.4 NonCondensing, NonCondensing, Condensing, Condensing

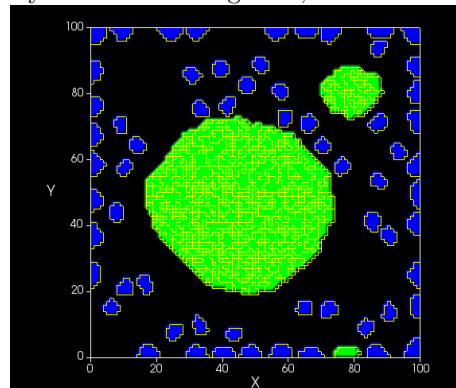
value = 100. This appears to not have done much to sort it. It seems to look very



similar to the individual state.

3.2.5 NonCondensing NonCondensing, NonCondensing Condensing

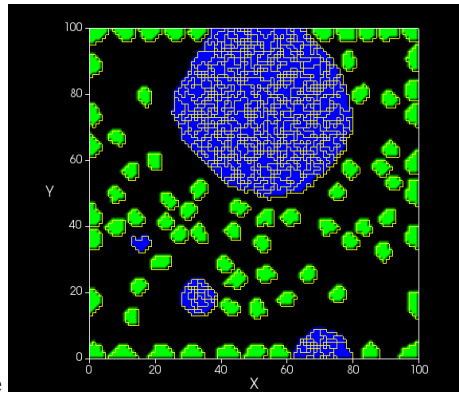
value = 100. This forces the yellow to stick together, but the blue seems to be



able to run off on it's own.

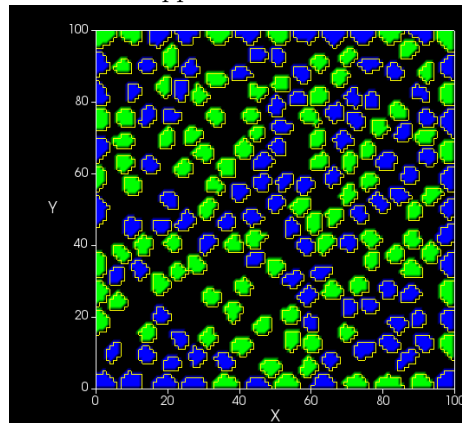
3.2.6 Condensing Condensing, NonCondensing Condensing

value = 100. From the above i can assume this will make the blue stick together and the yellow to be in small blobs of it's own. As you can see the assumption is



correct, inverted of the one above

Lastly every one of these to 100 looks like: This appears that the values are too



high to allow them to stick together.