Group Affinity and Fashion Scene

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Abstract/Problem Description

- People can be a part of the group in different ways based on appearance.
- Different behaviors, people adapt and react differently to others
- If you like some part of the appearance, you would want to adapt it and make some changes to your appearance.
- System of Differential equations were made, and matrices were made with the values given to their appearance which were compared and interaction were measured.

Assumptions

1. People can influence each other styles.

2. Interaction were measured comparing the appearance value using vectors.

3. Person can pull together to be more similar or push the person style far away.

4. People were divided into three groups which were conformist, non-conformist and an average person.

5. The amount a person is influenced by someone else is a function of difference between the styles of two people.

Model

$$\mathbf{v}_i(n+1) = \mathbf{v}_i(n) + \sum_{\mathbf{w}(n) \in V \setminus \{\mathbf{v}_i(n)\}} g_i\left(||\mathbf{w}(n) - \mathbf{v}_i(n)||\right)\left(\mathbf{w}(n) - \mathbf{v}_i(n)\right)$$

Model

$$\mathbf{v}_i(n+1) = \mathbf{v}_i(n) + \sum_{\mathbf{w}(n)\in V\setminus\{\mathbf{v}_i(n)\}} g_i\left(||\mathbf{w}(n) - \mathbf{v}_i(n)||\right)\left(\mathbf{w}(n) - \mathbf{v}_i(n)\right)$$

$$\mathbf{v}_i(n+1) - \mathbf{v}_i(n) = \sum_{\mathbf{w}(n)\in V\setminus\{\mathbf{v}_i(n)\}} g_i\left(||\mathbf{w}(n) - \mathbf{v}_i(n)||\right)\left(\mathbf{w}(n) - \mathbf{v}_i(n)\right)$$

$$\mathbf{v}_i(t+\Delta t) - \mathbf{v}_i(t) = \left(\sum_{\mathbf{w}(t)\in V\setminus\{\mathbf{v}_i(t)\}} g_i\left(||\mathbf{w}(t) - \mathbf{v}_i(t)||\right)\left(\mathbf{w}(t) - \mathbf{v}_i(t)\right)\right)\Delta t$$

$$\lim_{\Delta t\to 0}\frac{\mathbf{v}_i(t+\Delta t) - \mathbf{v}_i(t)}{\Delta t} = \sum_{\mathbf{w}(t)\in V\setminus\{\mathbf{v}_i(t)\}} g_i\left(||\mathbf{w}(t) - \mathbf{v}_i(t)||\right)\left(\mathbf{w}(t) - \mathbf{v}_i(t)\right)$$

$$\frac{d(\mathbf{v}_i(t))}{dt} = \sum_{\mathbf{w}(t)\in V\setminus\{\mathbf{v}_i(t)\}} g_i\left(||\mathbf{w}(t) - \mathbf{v}_i(t)||\right)\left(\mathbf{w}(t) - \mathbf{v}_i(t)\right)$$

Model

$$g_i\left(||\mathbf{v}_j(t) - \mathbf{v}_i(t)||\right) = g_{i,j}$$

$$A = \begin{bmatrix} -\sum_{m=2}^{k} g_{1,m} & g_{1,2} & g_{1,3} & \cdots & g_{1,k} \\ g_{2,1} & -g_{2,1} - \sum_{m=3}^{k} g_{2,m} & g_{2,3} & \cdots & g_{2,k} \\ g_{3,1} & g_{3,2} & -\sum_{m=1}^{2} g_{3,m} - \sum_{m=4}^{k} g_{3,m} & \cdots & g_{3,k} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ g_{k,1} & g_{k,2} & g_{k,3} & \cdots & -\sum_{m=1}^{k-1} g_{k,m} \end{bmatrix}$$

$$W = \begin{bmatrix} \mathbf{v}_1(t) \\ \vdots \\ \mathbf{v}_k(t) \end{bmatrix}$$

Model

$$A \times W = W'$$

Analysis of Symmetric Case

$$g_1 = g_2 = \cdots = g_k$$

$$\begin{aligned}
||\mathbf{v}_j(t) - \mathbf{v}_i(t)|| &= ||\mathbf{v}_i(t) - \mathbf{v}_j(t)|| \\
g_i\left(||\mathbf{v}_j(t) - \mathbf{v}_i(t)||\right) &= g_j\left(||\mathbf{v}_i(t) - \mathbf{v}_j(t)||\right) \\
g_{i,j} &= g_{j,i},
\end{aligned}$$

$$A = LDL^T = L\sqrt{D}\sqrt{D}L^T = \left(L\sqrt{D}\right)\left(L\sqrt{D}\right)^T$$

$$\mathrm{null}\left(\left(L\sqrt{D}\right)^T\right) = \mathrm{null}\left(\left(L\sqrt{D}\right)\left(L\sqrt{D}\right)^T\right) = \mathrm{null}(A)$$

Analysis of Symmetric Case

$$D_j = B_{j,j} - \sum_{m=1}^{j-1} L_{j,m}^2$$

$$L_{i,j} = \frac{1}{L_{j,j}} \left(B_{i,j} - \sum_{m=1}^{j-1} L_{j,m} L_{i,m} d_m \right), \text{ for } i > j$$

Analysis of Asymmetric Case

- Can qualitatively describe certain equilibria
- Exhaustive quantitative description of all equilibria exceeds the scope of this project

Different Behavior Functions

$$g(x) = \begin{cases} 1x - .5 & 0 < x \leq 1 \\ -1x + 1.5 & 1 < x \leq 1.5 \\ 0 & 1.5 < x, \end{cases}$$

Regular people

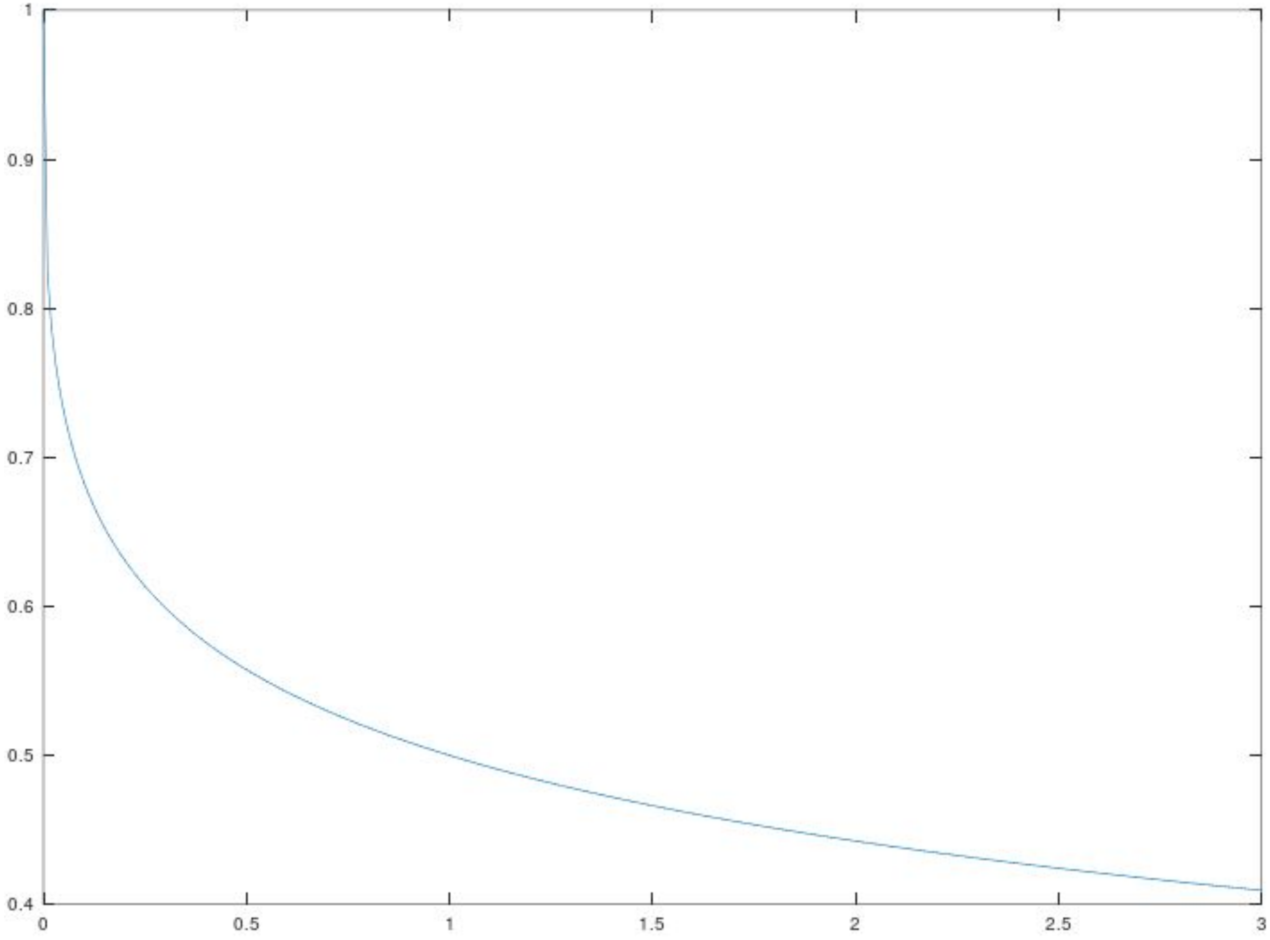
$$f(x) = \begin{cases} \frac{4}{3}x - 2 & 0 < x \leq 1.5 \\ 0 & 1.5 < x; \end{cases}$$

Non-conformists

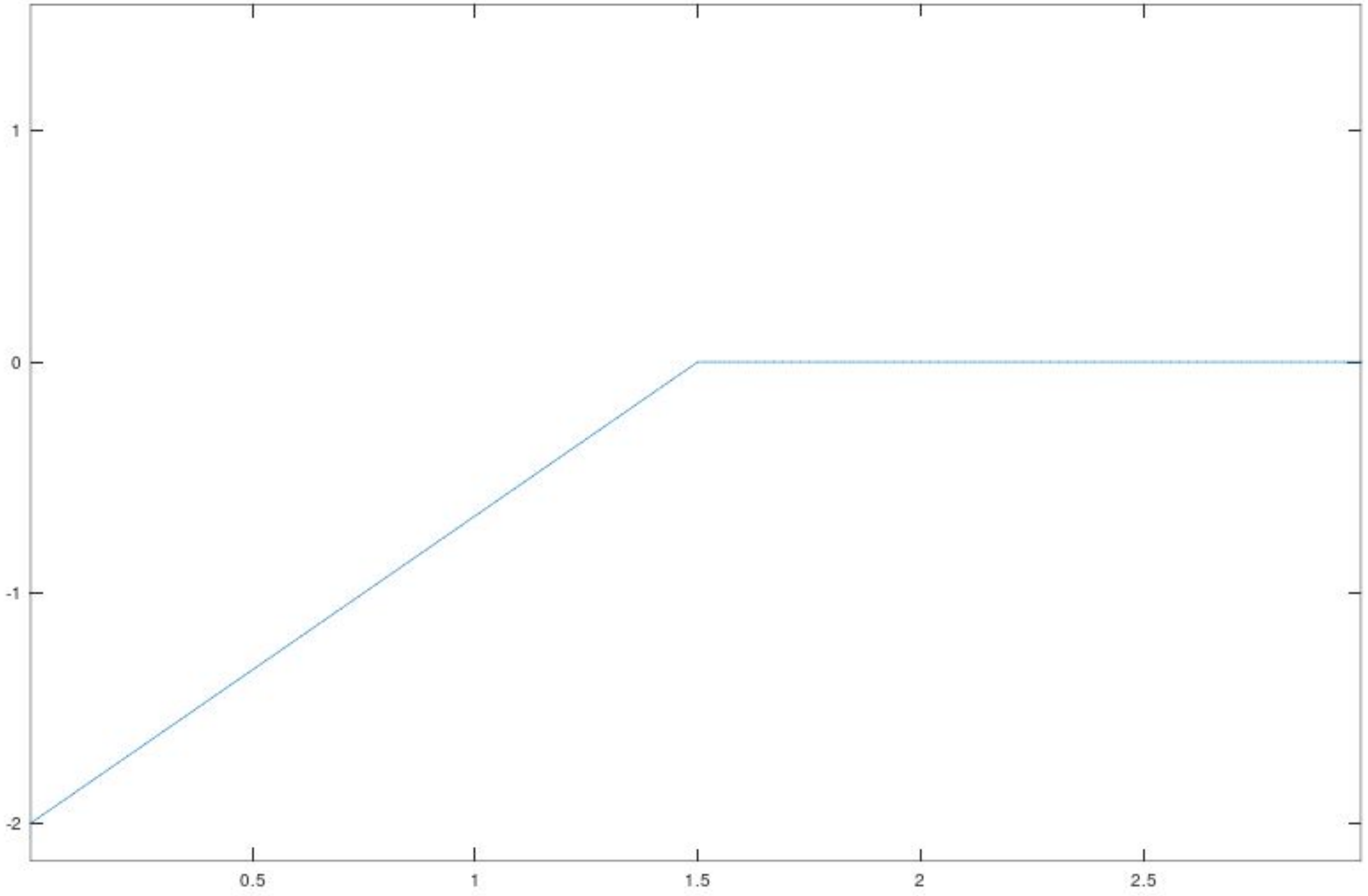
$$c(x) = \frac{1}{\sqrt[3]{x} + 1}$$

Conformists

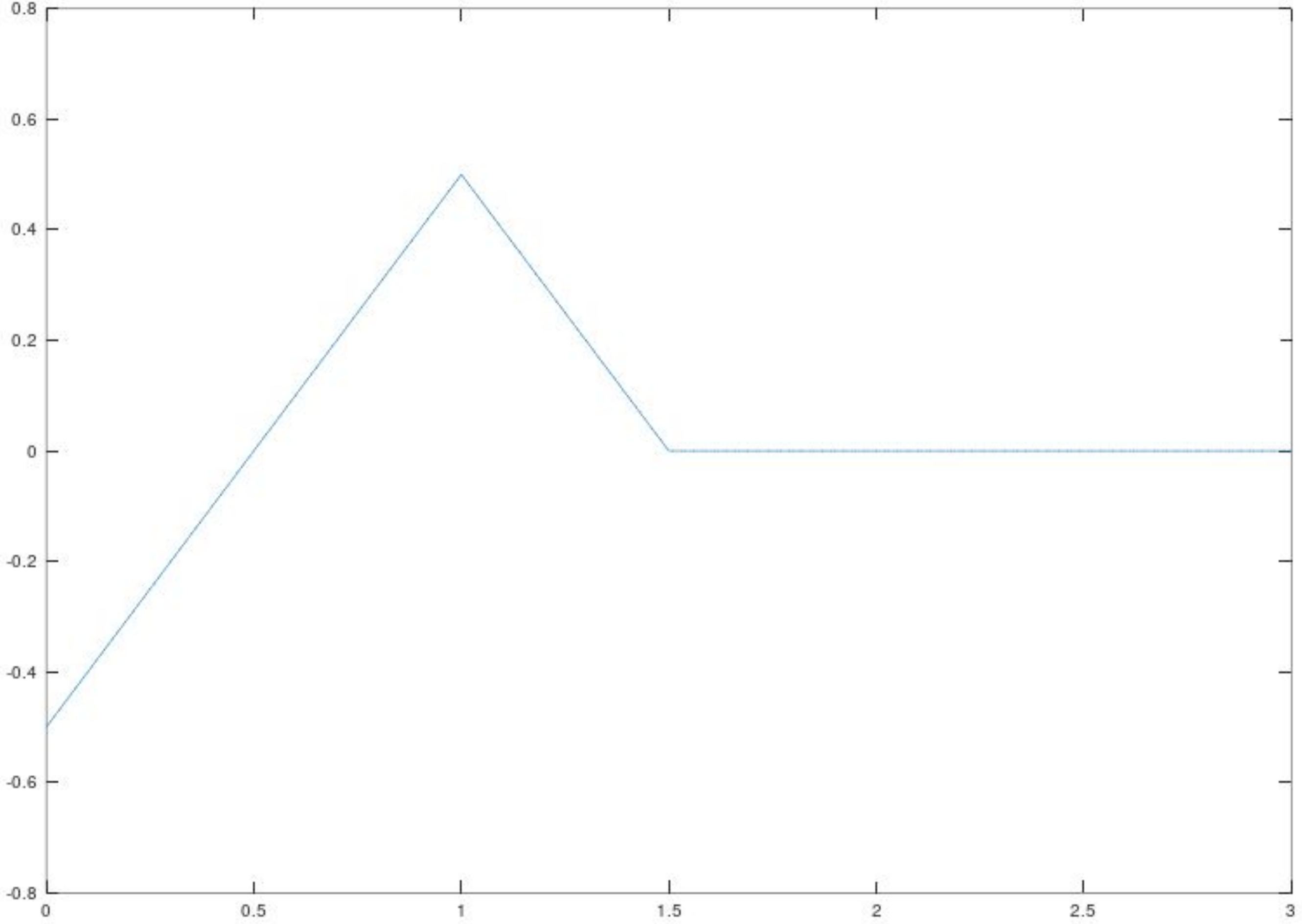
Behavior Function of Conformists



Behavior Function of Non-Conformists



Behavior Function of Regular People



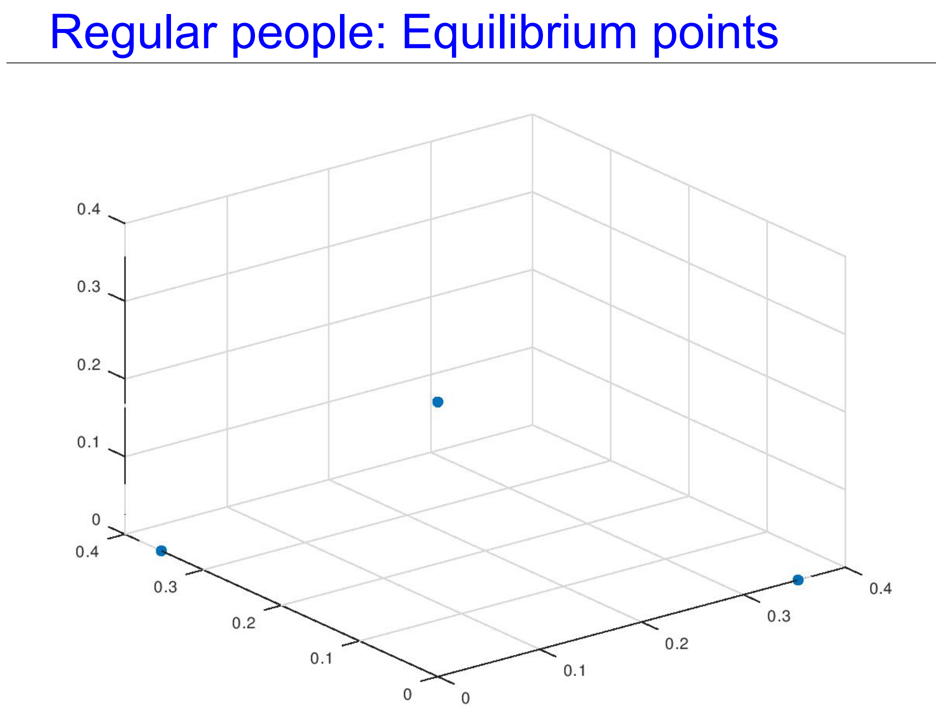
Code

```
function Wprime = matrixA (vectoroffunctions, sizeofA, W)
%this will be the matrix for my system of differential equations
% vector of functions will be a cell array of function handles, where the ith
% entry is the function by which the ith person reacts to those around them.
%  sizeofA is the number of people we wish to simulate, and will be equal to the
%  number of rows and columns of A
%   W is a cell array of the input vectors, the current styles of people, where
%   each cell contains the vector of the person.
  Wprime=cell(sizeofA,1);
  for i1=1:sizeofA
    B=zeros(1,length(W{1}));
    for i2=1:sizeofA
      B=B+vectoroffunctions{i1}(norm(W{i2}-W{i1}))*(W{i2}-W{i1});
    endfor
    Wprime{i1}=B;
  endfor
endfunction
```

Code

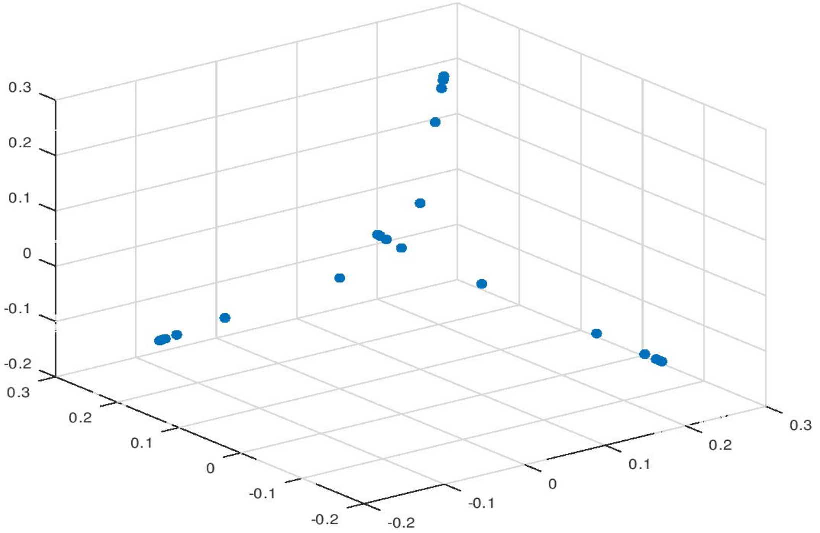
```
function outputW = rungekutta (steps, Length, initialW, matrixA, funcvec, sizeofA)
% the Runge-Kutta method (RK4), it can take and return vectors
  outputW=cell(sizeofA,steps+1);
  for i3=1:sizeofA
    outputW{i3,1}=initialW{i3};
  endfor
  H=Length/steps;
  %preallocating for speed
  inputW=cell(sizeofA,1);
  PreK1=cell(sizeofA,1);
  K1=cell(sizeofA,1);
  PreK2=cell(sizeofA,1);
  K2=cell(sizeofA,1);
  PreK3=cell(sizeofA,1);
  K3=cell(sizeofA,1);
  PreK4=cell(sizeofA,1);
  K4=cell(sizeofA,1);
  %actual method; I had to break things up because
  for i1=1:steps
    for i4=1:sizeofA
      inputW{i4}=outputW{i4,i1};
    endfor
    PreK1=matrixA(funcvec, sizeofA, inputW);
    for i8=1:sizeofA
      K1{i8}=H*PreK1{i8};
    endfor
    for i5=1:sizeofA
      inputW{i5}=outputW{i5,i1}+K1{i5}*(1/2);
    endfor
    PreK2=matrixA(funcvec, sizeofA, inputW);
    for i9=1:sizeofA
      K2{i9}=H*PreK2{i9};
    endfor
    for i6=1:sizeofA
      inputW{i6}=outputW{i6,i1}+K2{i6}*(1/2);
    endfor
    PreK3=matrixA(funcvec, sizeofA, inputW);
    for i10=1:sizeofA
      K3{i10}=H*PreK3{i10};
    endfor
    for i7=1:sizeofA
      inputW{i7}=outputW{i7,i1}+K3{i7};
    endfor
    PreK4=matrixA(funcvec, sizeofA, inputW);
    for i11=1:sizeofA
      K4{i11}=H*PreK4{i11};
    endfor
    for i2=1:sizeofA
      outputW{i2,i1+1}=outputW{i2,i1}+(1/6)*(K1{i2}+2*K2{i2}+2*K3{i2}+K4{i2});
    endfor
  endfor
endfunction
```

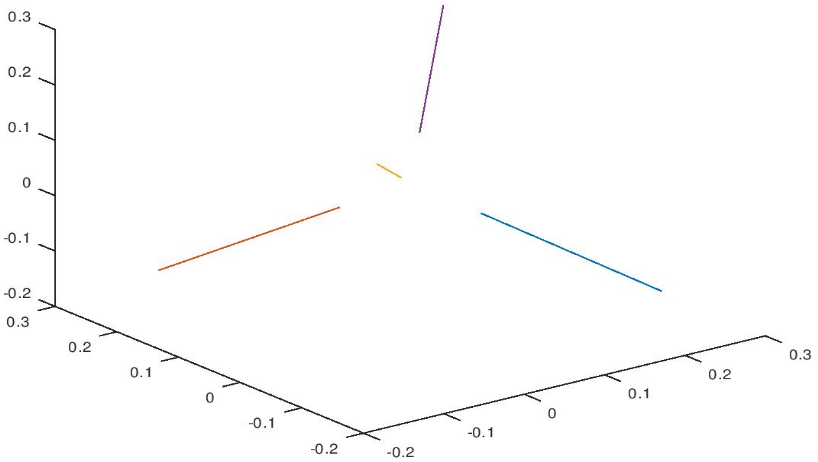
Simulations



Simulations

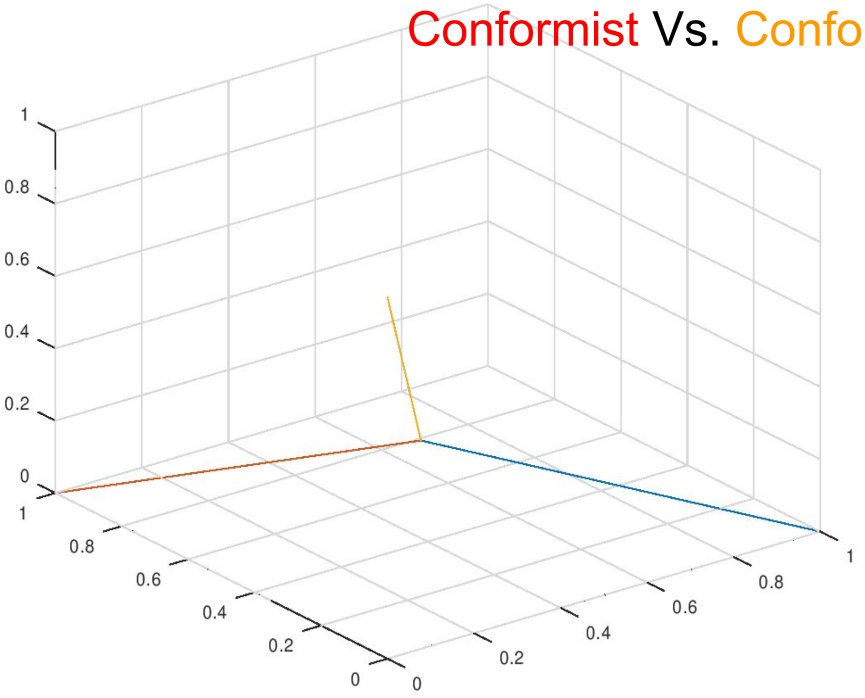
Regular Vs. Regular Vs. Regular Vs. Regular

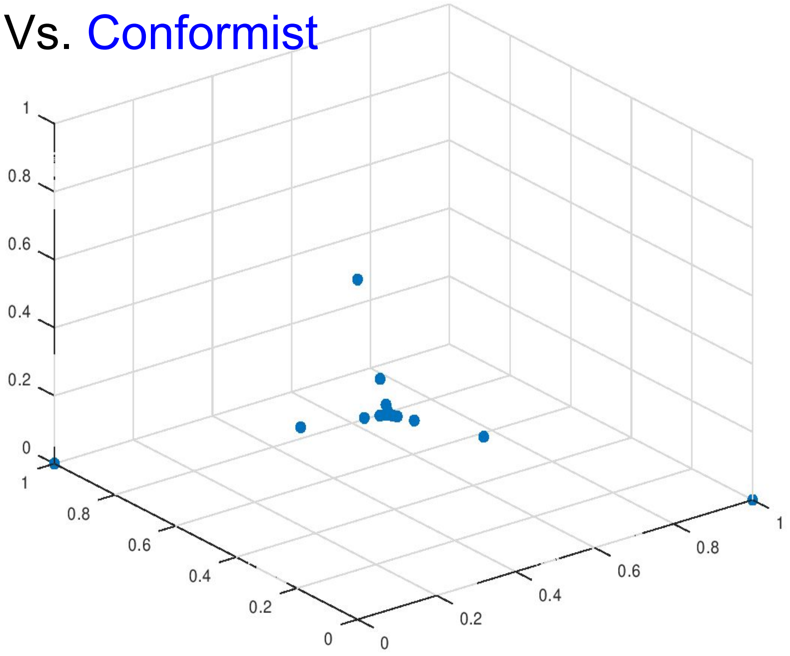




Simulations

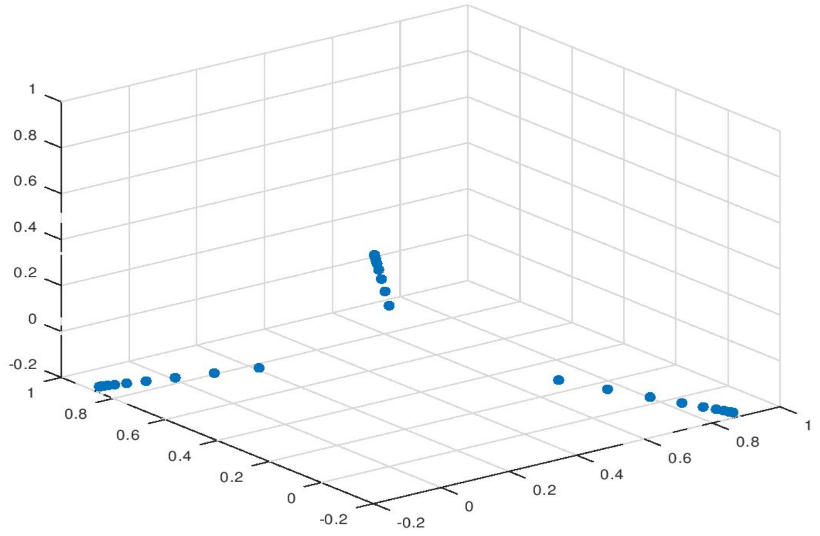
Conformist Vs. Conformist Vs. Conformist

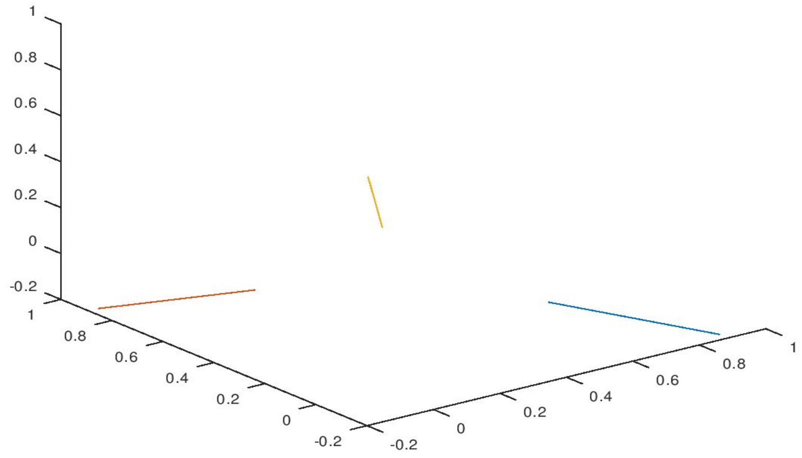




Simulations

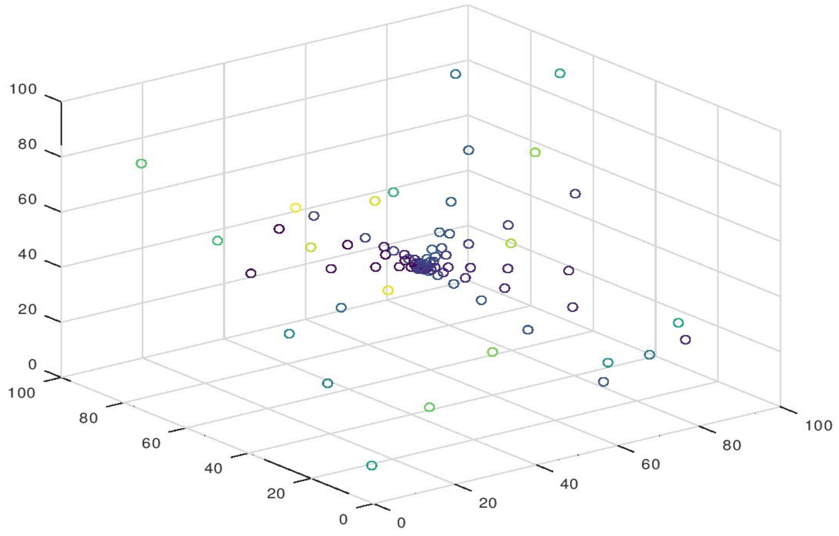
Non-Conformists Vs. Non-Conformists Vs. Non-Conformists

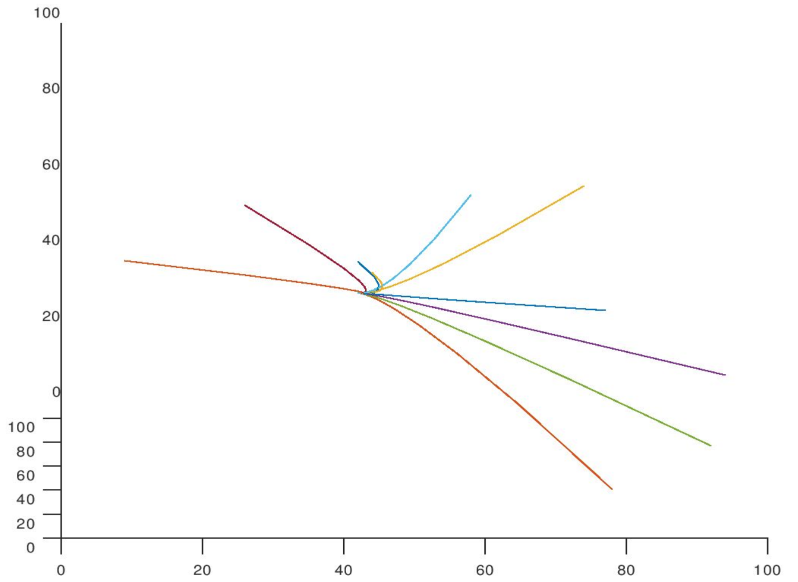




Simulations

10 Regular People Vs. 10 Conformists Vs. 10 Non-Conformists





Additional Issues

“2. The original statement asks you to model one aspect that is adopted within a group. How would your model change if you are required to model how two aspect

Flexibility, n-dimensional fashion space

Can model any number of aspects

$$W = \begin{bmatrix} \mathbf{v}_1(t) \\ \vdots \\ \mathbf{v}_i(t) \\ \mathbf{v}_{i+1}(t) \\ \vdots \\ \mathbf{v}_j(t) \\ \vdots \\ \mathbf{v}_l(t) \\ \vdots \\ \mathbf{v}_k(t) \end{bmatrix} \begin{array}{l} \left.\vphantom{\begin{array}{c} \mathbf{v}_1(t) \\ \vdots \\ \mathbf{v}_i(t) \end{array}}\right\} \text{Aspect 1} \\ \left.\vphantom{\begin{array}{c} \mathbf{v}_{i+1}(t) \\ \vdots \\ \mathbf{v}_j(t) \end{array}}\right\} \text{Aspect 2} \\ \qquad \vdots \\ \left.\vphantom{\begin{array}{c} \mathbf{v}_l(t) \\ \vdots \\ \mathbf{v}_k(t) \end{array}}\right\} \text{Aspect n} \end{array}$$

Future Considerations

More simulations with more people.

A person's style can mutate unpredictably.

Behavior is on a continuum from nonconformists to average people to conformists.

A person can move along the continuum and will do so sporadically.

Add additional behavior categories.

Allow people to react to different people in different ways based on their relationship with them.

We would like to thank SIMIODE for organizing this competition. We would also like to thank Prof. Pendleton, both for teaching us all of the math that we used in this project, and for pushing us to participate in this competition.