Using Complexity Theory to Measure and Define Social Change

Workshop on Complexity, Computing and the Humanities

Presentation

Complexity Science and Social Systems - Theory

Discrete System States Jim Hay - 20 minutes
Social Systems and d/c Cycles David Flynn - 20 minutes
Discussion - 20 minutes

Break

Complexity Science and Social Systems – Applications

Introduction to Art Cycles David Flynn - 10 minutes
Siting Bologna in the Region of Complexity
Madeline Lennon - 20 minutes
Illustrations of the Range of Applications
James Hay - 10 minutes
Discussion - 20 minutes

Discrete Systems

- **A discrete system consists of a collection of individuals interacting with each other more than with their surrounding environment**
- **We study the behavior of discrete systems over time**
- **Literally billions of abstract discrete systems have been studied**

- **<u>Social systems are discrete systems</u>**

The Only Possible States of Discrete Systems

Order Type 1	**Class 1**
Order Type 2	**Class 2**
Complex	**Class 4**
Chaotic	**Class 3**

Properties of Discrete Systems

The effect of small changes

- **Order Type 1 - no effect of change on outcome**
- **Order Type 2 - change is localized**
- **Complex - Information is moved across the system if it affects one of the structures that move arou the system. Otherwise it is localized**
- **Chaotic - Change spreads at a uniform rate eventually the whole system. Sensitivity to initial cond**

Characteristics of Discrete Systems

- **Very complicated structures can arise**

  from very simple interactions (rules)

- **In spite of increasingly complicated interactions (rules) the same four classes appear**

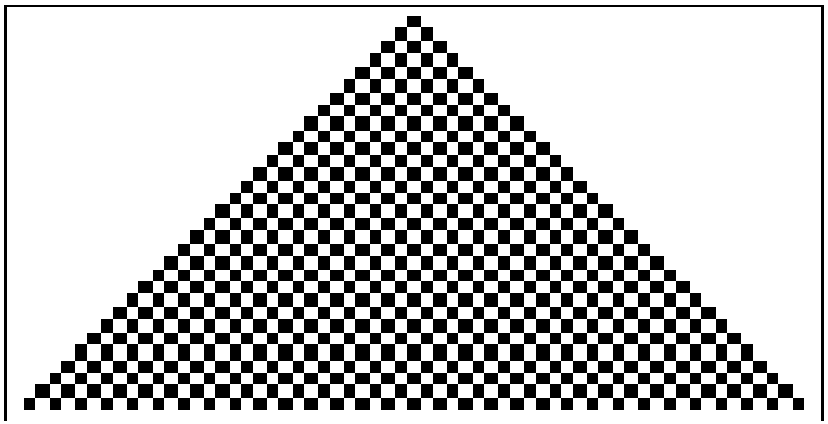
- **Wolfram and many others studied many discrete systems:**

Cellular Automata, mobile CAs (each cell changes immediately), Turing machines, substitution systems, tag systems (removin & adding blocks), cyclic tag systems, regist machines, symbolic systems, NT networks

ALL HAVE SAME FOUR STATES

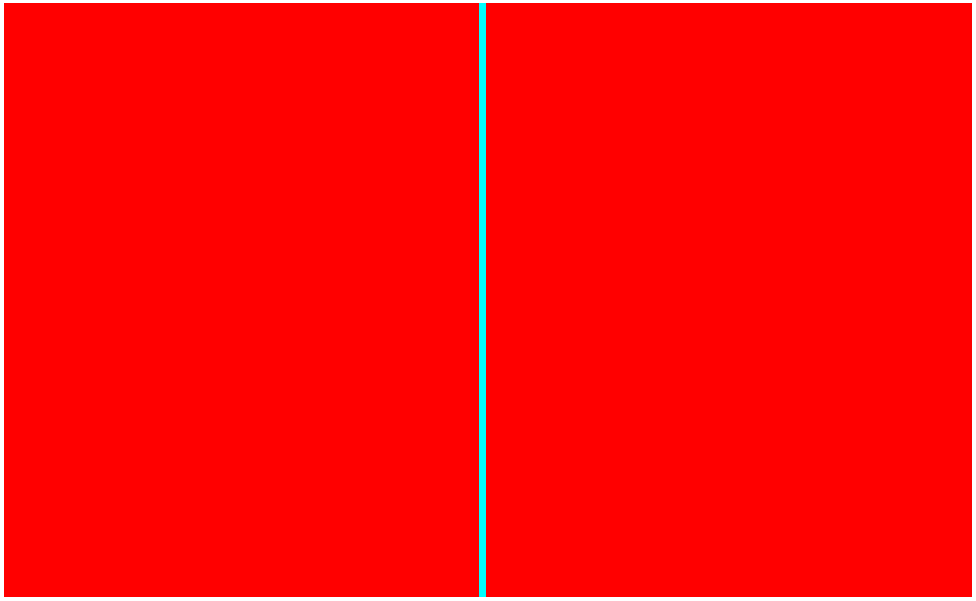
SOCIAL SYSTEMS HAVE ONLY THESE FOUR STATES

Simple Cellular Automata



- Each row is made up of cells that can be black or white
- Each row represents an instance of time (time step)
- The color of each cell in the next time step depends upon its color and that of its immediate neighbors
- This dependency is set by a particular RULE
- We study the change over time

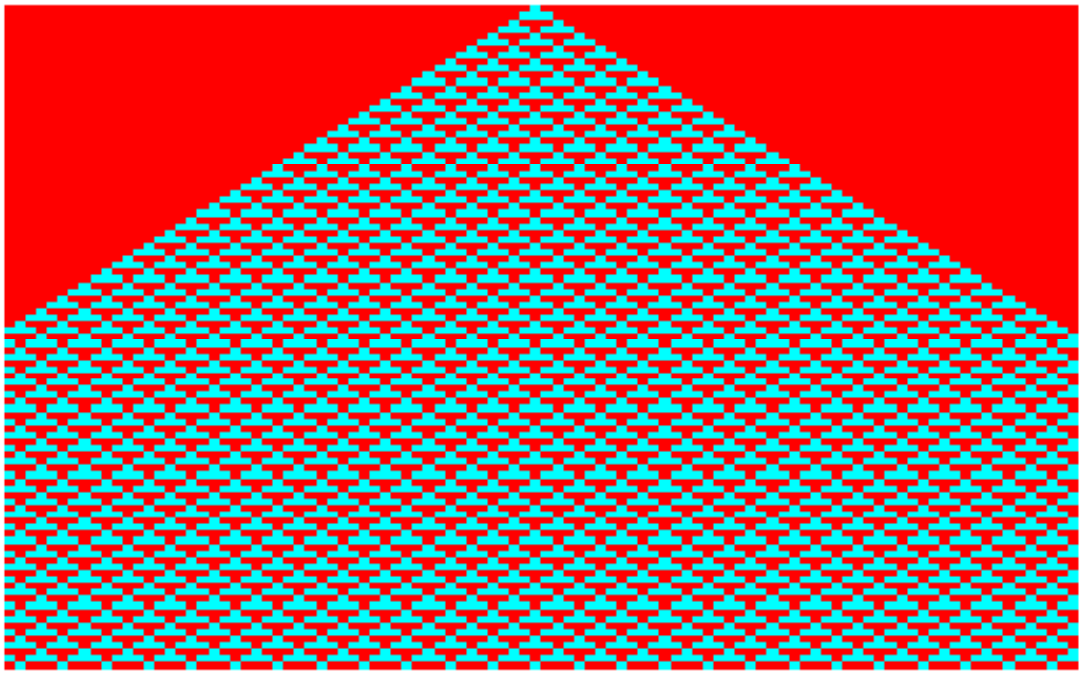
Order Type 1



Rule 4

- Outcome does not change with time
- No effect of a small change to one cell

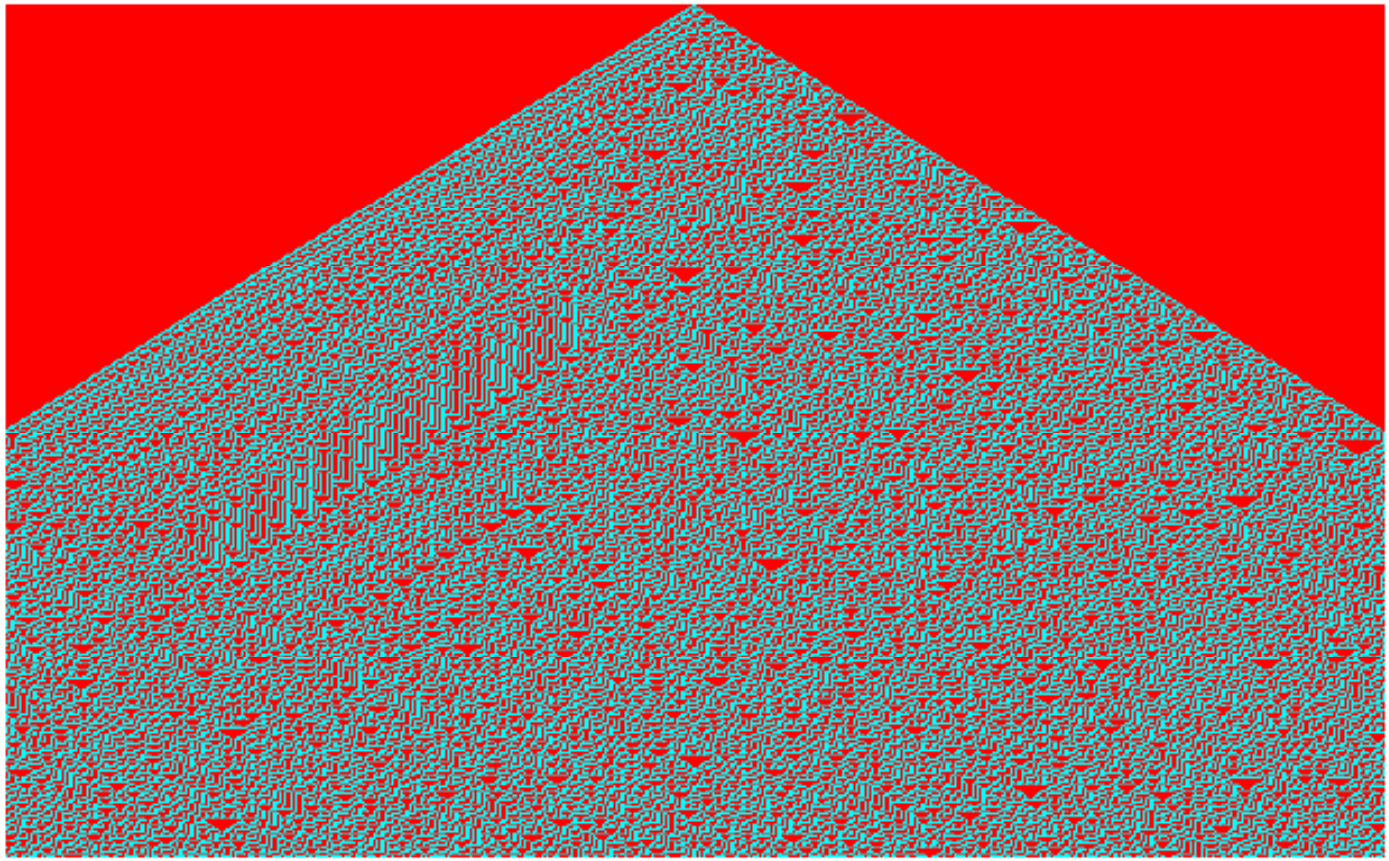
Order Type 2



Rule 50

- Repetitive
- Effect of change is localized

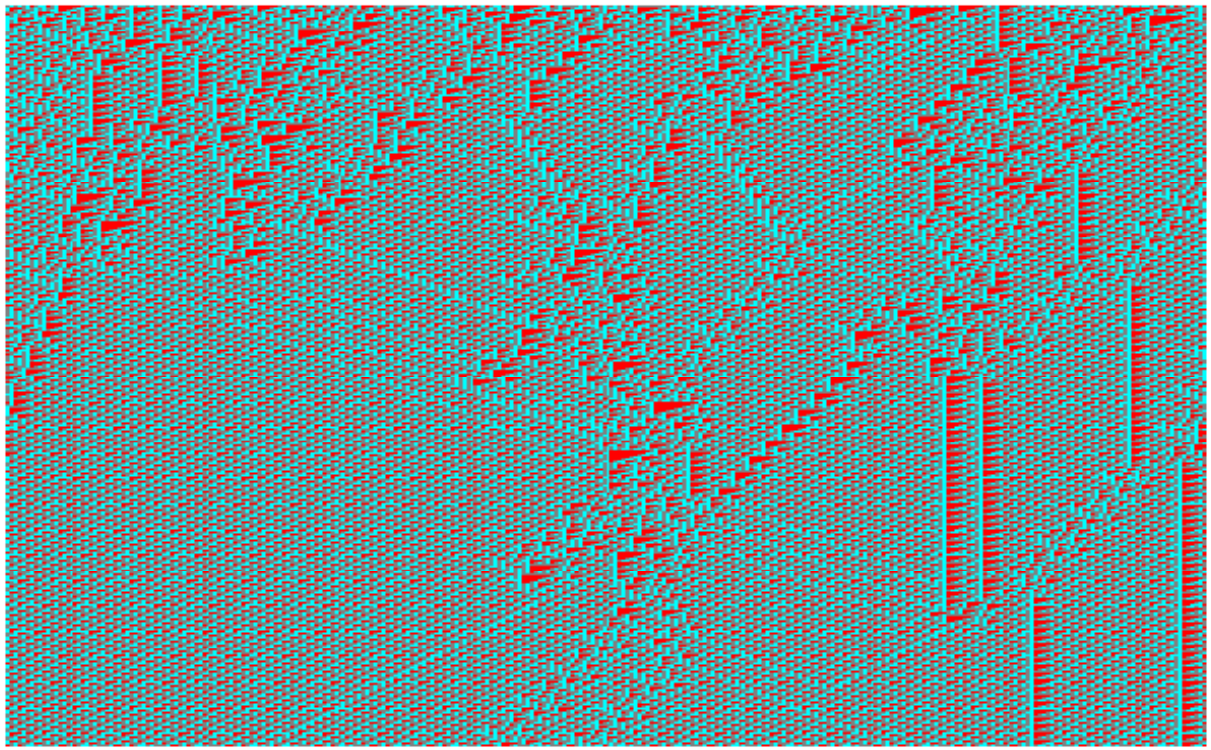
Chaotic



Rule 30

- Very complicated from a simple rule
- Change moves through whole system - sensitive to
  - initial conditions

Complex



Rule 110 - random starting condition

- Structures move and interact with each other
- Mix of order and chaos
- Effect of change depends on where it is introduced

The Causes of Change Between the Four States

- From the environment causing change
- Changing the initial conditions
- Change the rule - the interaction between ce

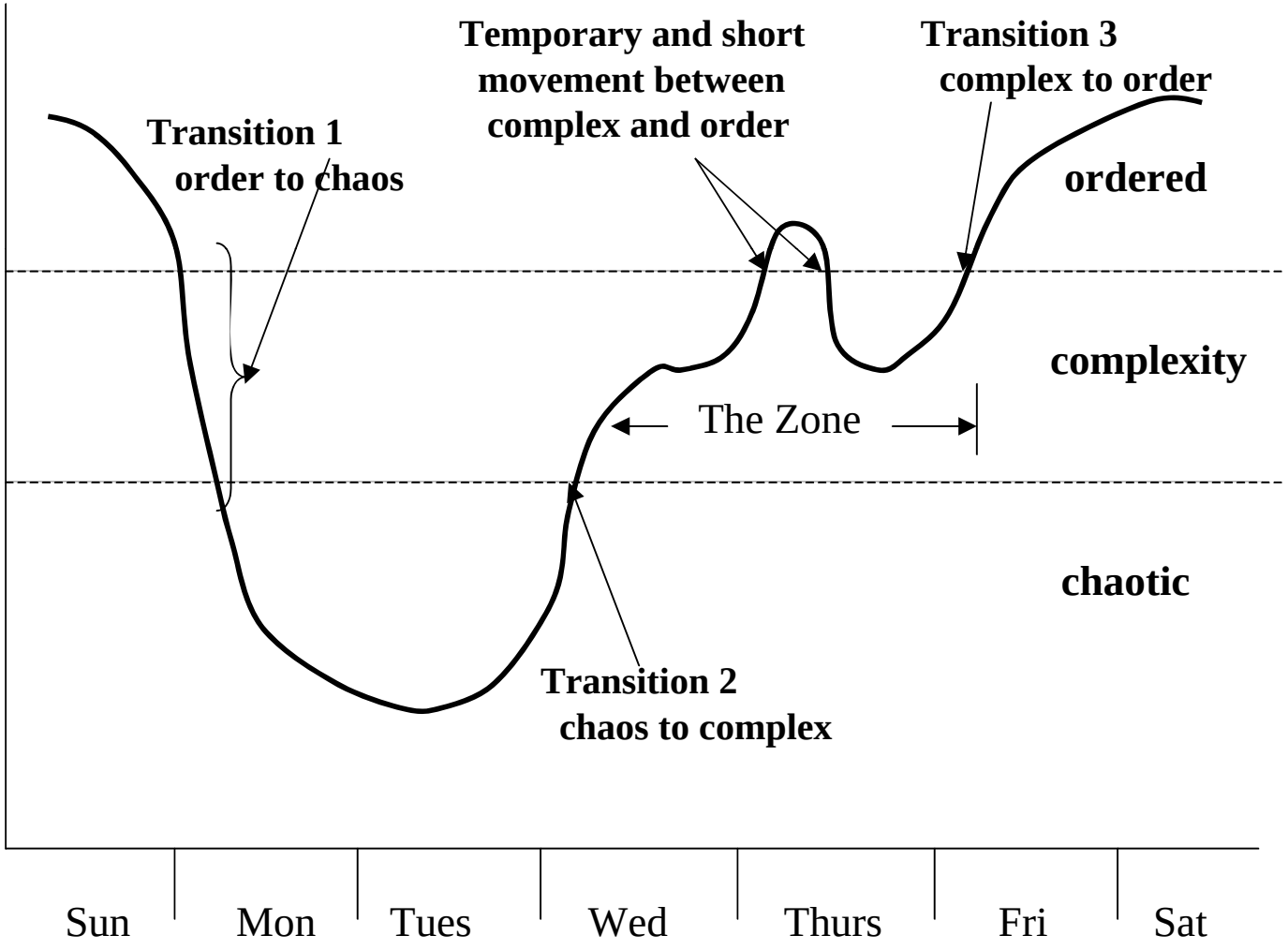
John Campbell's Small Groups

- **John Campbell led separate groups of about 20 people for a one week period over about 18 years beginning in 198**

- **Using the same techniques with each group he was able to change the behavior of the group over the week and provid a creative experience for the participants.**

- **The empirical techniques he used are explained by our ideas**

Group Transitions



From Chaos to Complexity

- **The group moves back into the ordered phase, but near the complex edge of chaos.**

- **Set guidelines and simple rules, small groups, establish “w**

- **The group becomes a complex system orderly enough to e stability yet full of flexibility and surprise.**

- **Group as a unit, heightened co-operation**

- **As the group performed at a very high level, a sense of beir part of a unique and special gathering.**

- **It was as if the group resonated as one.**

From complexity to order

- The handouts, ‘The Tool Kit’ and ‘Carrying New Ways of Be into One’s Community’ are discussed.

-These discussions and handouts have three purposes:

i) to outline the numerous environmental influences which may affect participants efforts to initiate change

ii) to provide information regarding positive ways to re-ente home, work, and community environments

iii) to emphasize the necessity of a participants developing daily program—a Tool Kit—unique to oneself,

Explaining How This Worked

John moved the group through a cycle of different discrete system states from order to order

Our theory explains how he accompanied th

This is developed in the next part of our presentation

Fractals

A fractal is similar at all levels of magnitude.
It is “scalable”.
We cannot tell the level of magnification.

Clouds, trees, mountains - we cannot tell scale by examining ther

We cannot tell the time period of a stock market chart (trace)
- a day looks like a week or a month

Fractals do not have the normal dimensions of 1 for a line, 2 for a square and 3 for a cube

The length we measure for the coastline of Britain depends on th measuring stick we use. It is a fractal line and its dimension is 1. rather then 1 that we expect for a line.

Cycles Occur in Social Systems

- John Campbell's groups
- Art Styles
- History of social interactions
- Corporate histories
- Economic systems

Such cycles are fractal

- the same cycles occur at all levels

The behavior of groups within an organization, the organization itself and the economic social system within which the organizatic is embedded, is scalable.

Each of these social systems cycle through the same social state