9. Riots, ethnocentrism and sugar

Modelling Social Interaction in Information systems

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Granovetta's riot model

- Mark Granovetta introduced a model related to riots (1978)
- Makes it clear that it is a general model related to any kind of behaviour in which
  - Individuals have to make a binary decision
  - Base that decision on what others decide
  - Have internal (often different) thresholds that determine their actions

Granovetter (1978) "Threshold models of collective behaviour", American Journal of Sociology, vol 83, No. 6, 1420-1443

Granovetta's riot model

- Hence it could apply to the spread of:
  - Innovation
  - Opinion
  - Fashion
  - Revolution
  - Internet craze

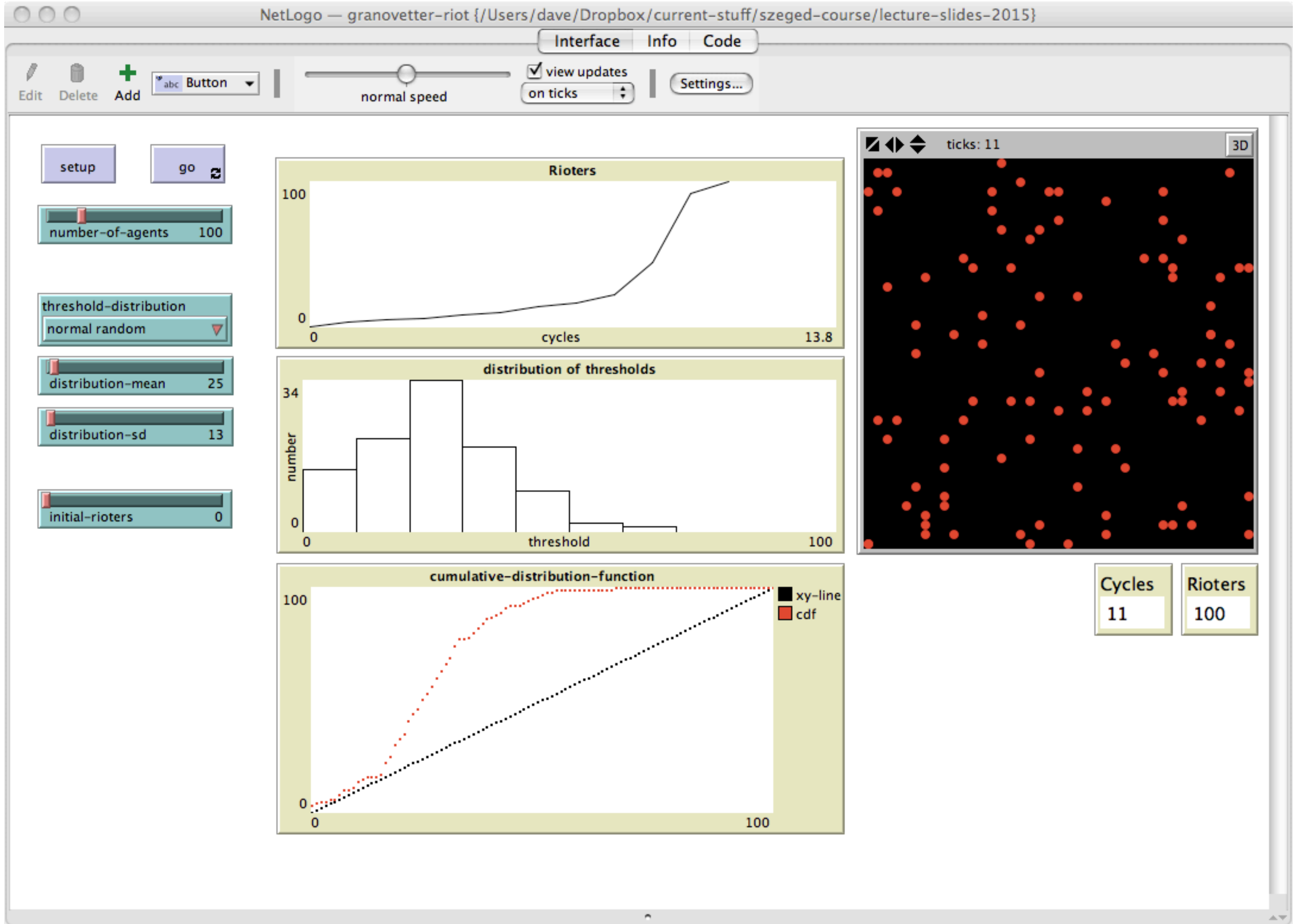
How it works

- Each agent has some fixed threshold T
- Periodically each agent:
  - Decides to join the riot if the current number of other agents rioting is >= T
- This continues until either all agents are rioting or an equilibrium number of rioters is produced
- What will happen with different distributions of thresholds in the population?

An example

- Suppose there are 100 agents:
  - One has T=0, another T=1, so on up to T=99
- What will happen?
- If we modify the distribution of T such that:
  - The agent with T=3 is set to T=4
- What will happen?
- Can we say in general what will happen if we initialise agents with randomly drawn values from 0..100 ?

Netlogo model



http://davidhales.com/msiis/netlogo/granovetta-riot.nlogo

Normally distributed T

- If we distribute T normally about a mean
- And vary the standard deviation (s.d)
- A sudden jump occurs in the final number of rioters at some critical s.d. value
- Why do you think this happens?

From Granovetta (1978)

One way to understand what is going on is to look at the cumulative distribution function of the thresholds in the population.

Where it crosses the 45-degree line from above you get an equilibrium

In fact if it lies exactly on the line then that is an equilibrium

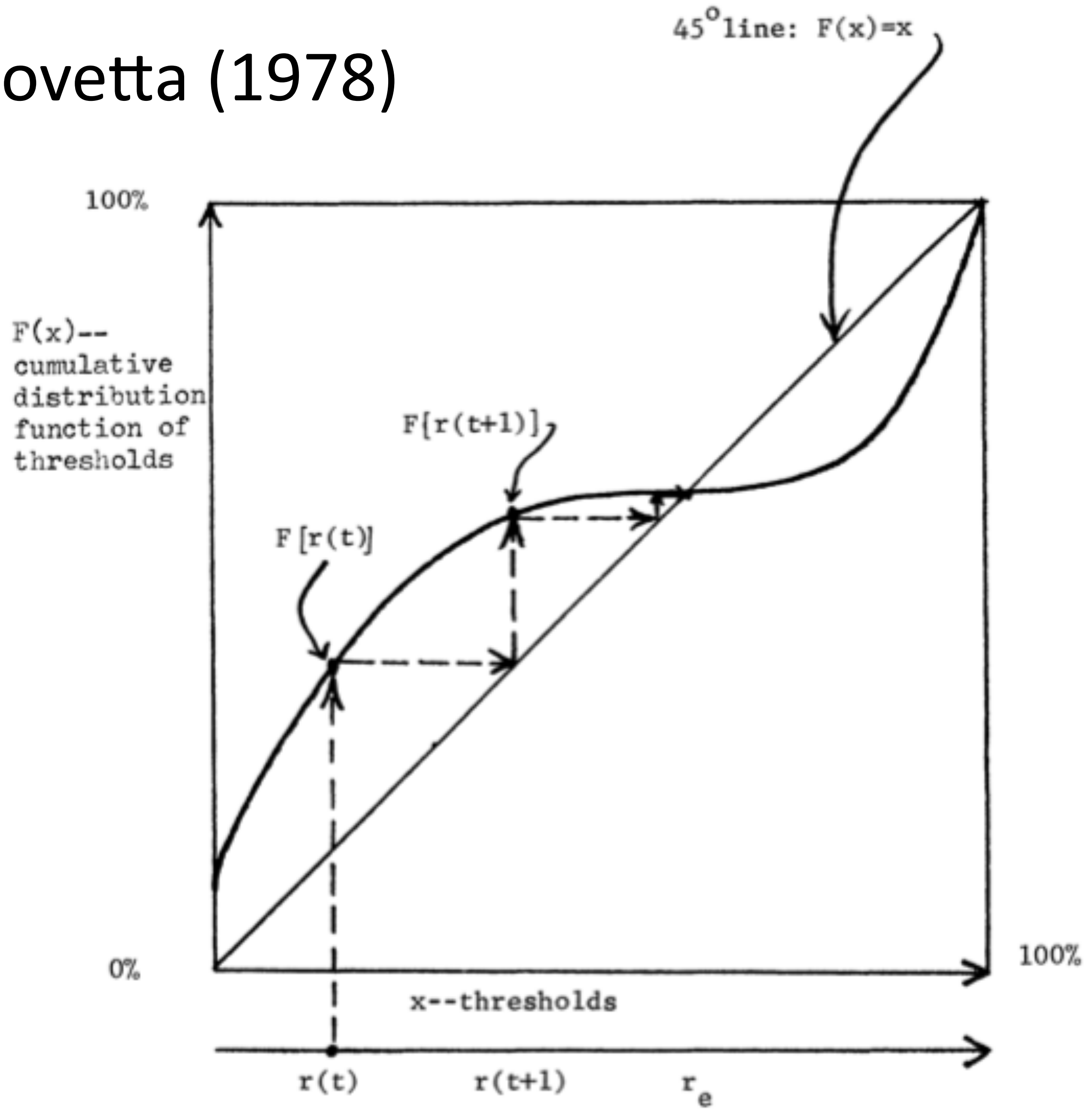


FIG. 1.—Graphical method of finding the equilibrium point of a threshold distribution. $r(t)$ = proportion having rioted by time t.

From Granovetta (1978)

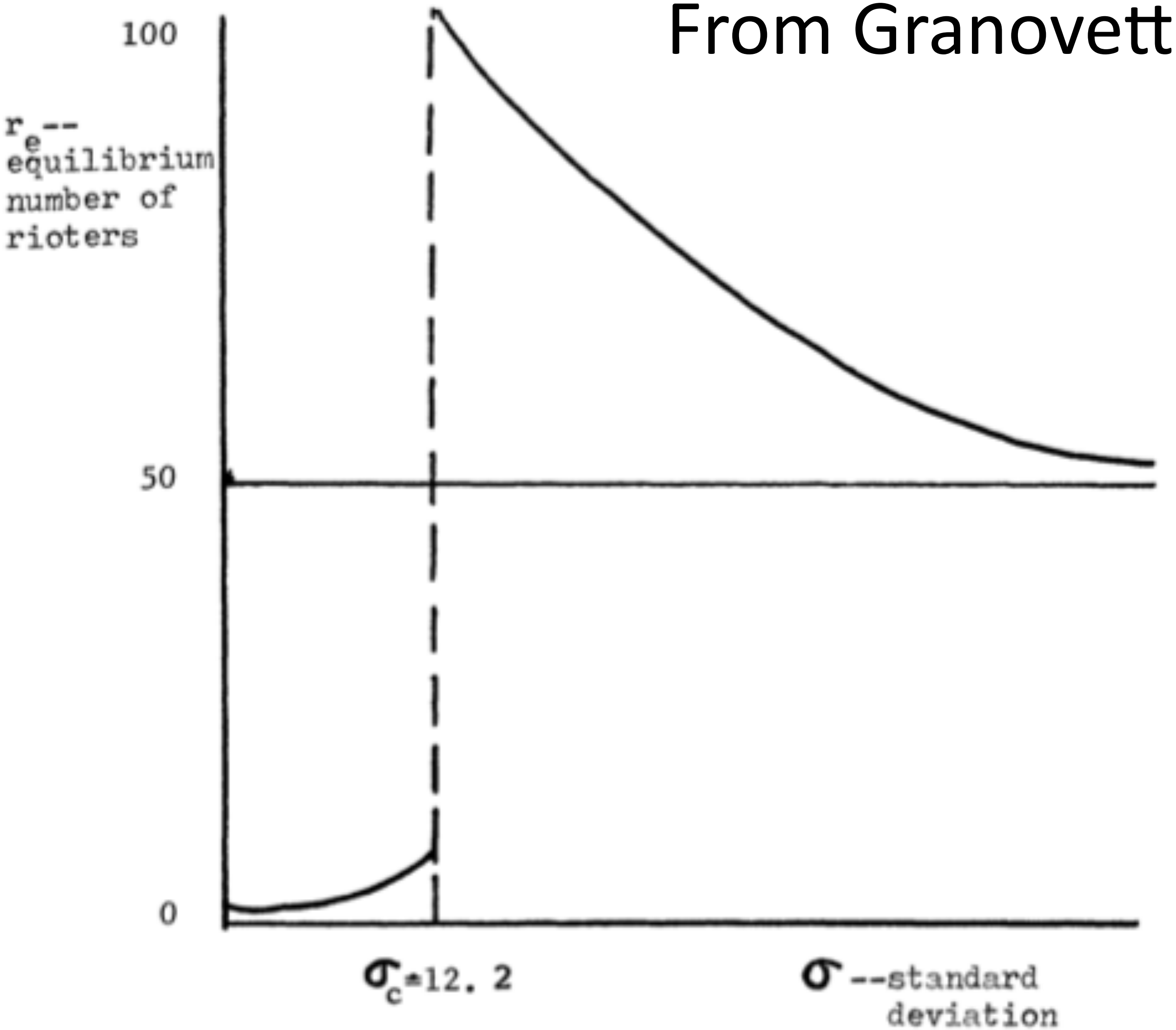


FIG. 2.—Equilibrium number of rioters plotted against standard deviation of normal distributions of thresholds with mean = 25, N = 100.

General insights

- Very small change in underlying distribution of T values can have dramatic effects
- small change at micro-level can have huge effects at macro-level
- A sudden cascade of collective action does not require a leader, a plan or “irrational forces” to be explained
- Granovetta says that thresholds could be highly rational for each individual (based on cost/benefit)
- In the real world looking at averages of individual preferences (“the representative agent”) may give little insight into collective behaviour

Granovetta on graphs

- Watts (2002) applied similar threshold model on graphs where:
  - Agents (nodes) only influenced by neighbours (those linked to)
  - T = proportion of neighbours rather than entire population
  - Various graph topologies / T distributions have been examined
- Granovetta's model can be considered as a fully connected graph

D.J. Watts (2002) A simple model of global cascades on random networks. Proc. Natl. Acad. Sci. USA 99 (2002) 5766

Watts and Dodds (2009) Threshold models of social influence. The Oxford Handbook of Analytical Sociology. Hedstrom & Bearman (eds), Oxford University Press. Chap 20.

Random graphs

- A node with k=1 will adopt even if T=100% and it's neighbour has adopted
- For a given T a node is vulnerable if one neighbour can make it adopt
- A node needs at least k=2 to spread adoption
- nodes with high k (hubs) are good at spreading but more resistant to adopting for given T
- Hence there is a "cascade window"
- relating degree of network (K) and thresholds T
- When K high T must be low for high adoption

From: Watts and Dodds (2009)

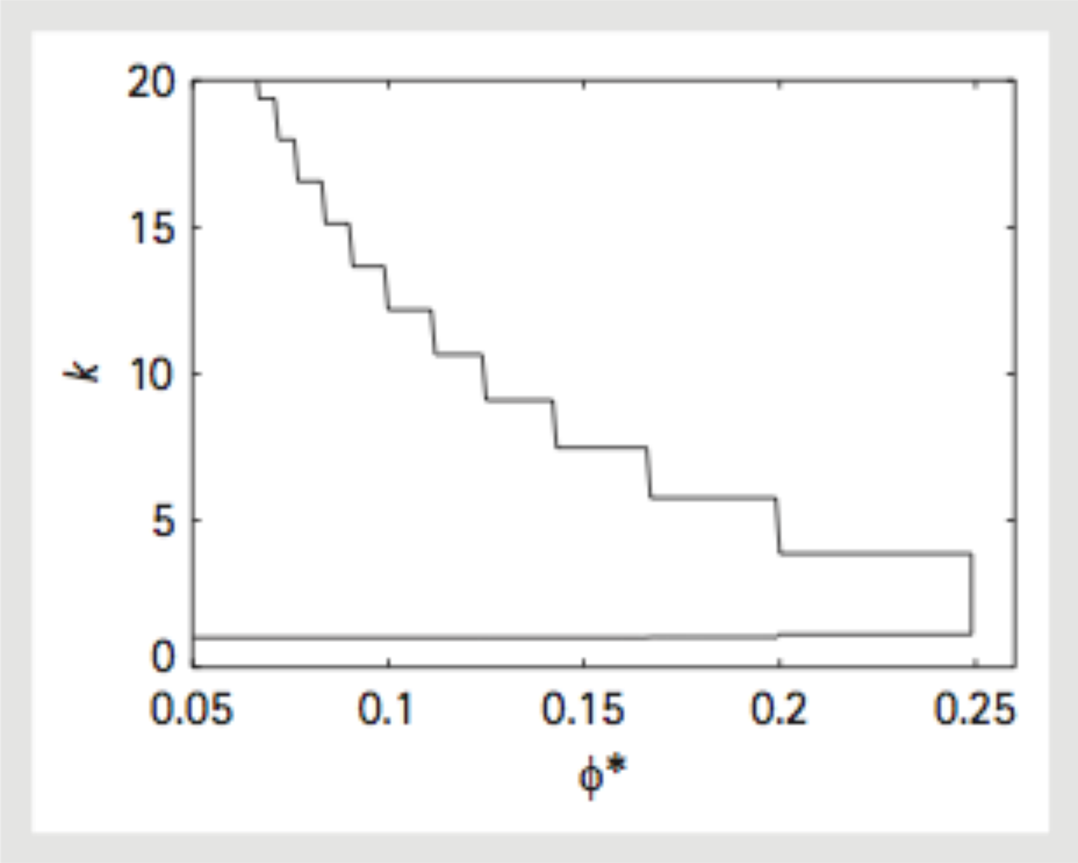


Fig. 20.2. The cascade window for random networks, where all members of the population have the same critical threshold ϕ^*, and k is the average degree of the influence network

From: Watts and Dodds (2009)

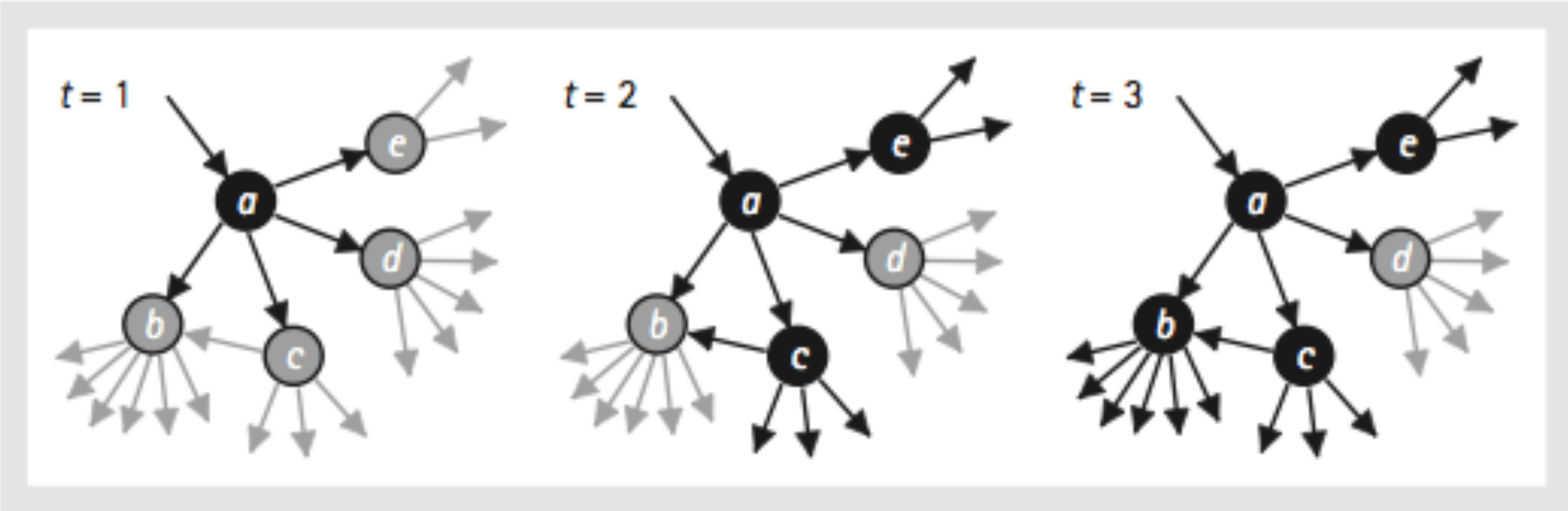


Fig. 20.3. Spread of influence throughout a network via vulnerable nodes. Black indicates a node or edge is active, and gray indicates inactive. All nodes in this example have a threshold $\phi^* = 0.18$, which means they are vulnerable if they have degree $k \leq 5$. At time $t = 1$ node *a* becomes active, as do its outgoing edges. At time $t = 2$ nodes *e* and *c* register that their thresholds have been exceeded and also become active. Node *b*, a nonvulnerable, switches on in time step $t = 3$, since now 2/8 = 25% of its neighbors are active

Group structured graphs

- Graphs with tightly connected clusters
- Similar to social networks
- Extend the cascade window:
  - Nodes in clusters reinforce each other
  - Hence T can be higher for given K

Threshold models

- Schelling's segregation model and Granovetter's riot model are termed:
  - Threshold models of collective action
  - Or just threshold models
- In general when you have threshold behaviour in agents which is influenced by (and influences) other agents then you can expect these highly non-linear macro outcomes

Ethnocentrism

- Ethnocentrism:
  - People +ve those within own ethnic group
  - Possibly –ve to those in other ethnic groups
- Observed in human society
- Observed in lab experiments
- Product of complex and historical phenomena
- Obviously politically sensitive area

Hammond ethnocentrism model

- Agents traits:
  - Ethnicity (a colour: 1..4)
  - In-group strategy (cooperate / defect)
  - Out-group strategy (cooperate / defect)
- Environment:
  - 2D grid (50x50) – initially empty
  - Agents added over time (immigration) into random empty locations

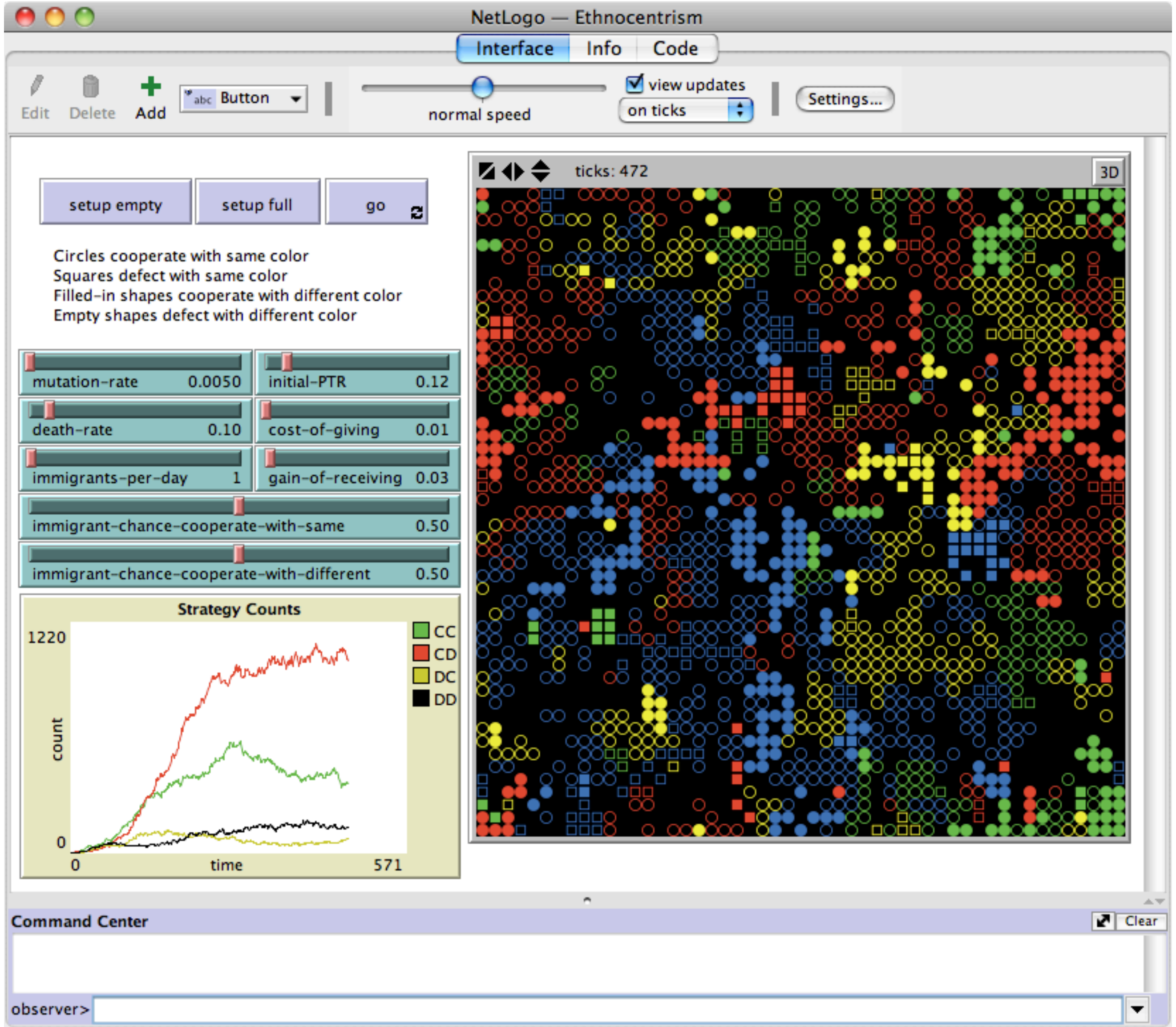
Hammond, R. & Axelrod, R. (2006). The Evolution of Ethnocentrism. Journal of Conflict Resolution, December 2006, 50: 926-936

Hammond model

- Dynamics (in each time step)
  - Place some number of randomly generated new agent in empty location (immigration rate)
  - Agents play PD game with v. neumann neighbours
  - Agents who obtain high fitness reproduce:
    - Create new agent into an empty neighbour location
    - Copy all traits apply low random mutation
  - Agents die with probability 10%

Netlogo model library / social science / ethnocentrism

Netlogo model:



Netlogo model library / social science / ethnocentrism

Hammond model results

- Clusters of homogenous ethnicities emerge
  - With in-group cooperation
  - Out-group defection
- Experiments conducted varying:
  - Num. of ethnicities (colours)
  - Immigration rate
  - Size of grid

Hammond model

- Combines a number of mechanisms we previously looked at:
  - Social dilemma
  - 2D grid mediated interaction
  - Evolution on the grid
  - Tags (observable markers
- If you understand these mechanisms you should not be too surprised at the result of the model

Artificial Societies

- In general when models combine several abstract mechanisms in this way they are termed Artificial Societies
- Like Alife they are more about construction than representation of real societies per se
- They encompass large numbers of assumptions (a large parameter space)
- Some argue it is dangerous to interpret them as relating to real societies (including me!)

The Sugarscape

- Entire book about it published in 1996
- Basic methodology is to "grow in the computer" complex social behaviours in order to understand them
- They are interested in the simplest rules that can lead to a phenomena of interest
- Creates a simple artificial world and experiments with different rules to explore phenomena such as:
  - Evolution
  - Simple trade
  - Formation of cultural groups
  - Social networks and trust relationships

Epstein, Joshua M.; Axtell, Robert (1996). Growing artificial societies: social science from the bottom up. Brookings Institution Press

Sugarscape

- Some simple parts of the model are included in NetLogo models library
- Essentially the model comprises:
  - 2D grid in which are placed resources called “sugar” in non-random arrangements (sugar peaks)
  - Agents move about on the grid and consume sugar to get energy (sugar grows back)
  - If agents run out of energy they die
  - Agents reproduce, form networks, trade, fight etc.

Sugarscape

- The basic methodology in the book:
  - start with simple behaviour (e.g. moving randomly to find sugar)
  - Examine the emergent behaviour
  - Progressively add more complex rules to see how they change things
  - The rules are added to explore different kinds of social phenomena
- Consequently the Sugarscape is not a single model but rather a set of models

Sugarscape

- We will only consider a few results from the model in overview
- If you wish to understand the detail you will need to look at the book
- We will look at some general results from:
  - Chapter 3 - Sex, Culture and Conflict: The Emergence of History
  - Chapter 4 – Sugar and Spice: Trade Comes to the Sugarscape

Sugarscape – chapter 3

- Wish to "grow" a "caricature" of history. **Start with** "a social story":

"In the beginning there is a small population of agents, randomly distributed both in space and with respect to their genetic characteristics. Over time spatial agglomeration into two groups occurs as each agent – guided by the primal sugar drive – migrates to one of the two sugar peaks. There, in the midst of plenty, the pioneer agents interact sexually, producing children, who in turn beget children, and so on. All the while processes of cultural evolution are operating within each group producing culturally distinct "tribes" of agents on the two mountains. Ultimately, as population pressures mount from overexploitation of the sugar resources, each tribe spreads down into the central sugar lowlands between the two mountains. When the two tribes ultimately collide, processes of assimilation occur and feed back on the reproductive and cultural activities of the tribes, yielding complex social evolutions"

And state: Our goal, as always, is to grow this history "from the bottom up." Can the entire social history – along with all sorts of variants – be made to emerge from the interaction of agents operating under simple local rules?

Sugarscape – evolution and inheritance

- Simple rules for reproduction and death creating variable sized populations
- Genetic traits for “vision” and “metabolism”
- Various experiments on the evolution of different “population regimes”
- Explore how “inheritance” of sugar wealth changes the society
- Reduces the effectiveness of evolution and increases Gini equality measure (as would be expected)

Sugarscape – cultural processes

- Agents store "cultural tags" which is a fixed length bit string
- Each bit represents the presence or absence of some culturally learnable trait
- Agents interact locally by copying randomly chosen bits between neighbours
- Cultural groups: Agents are defined as "blue" when the string has more 0's than 1's or "red" otherwise
- They explore various "cultural dynamics" of how groups and tags form and spread
- They note the overtime all agents tend to converge to the same tag string – hence become part of the same cultural group

Sugarscape - combat

- They consider results of a combat rule based on the idea that one agent may kill another and take it’s resources:
  - If it is a member of another tribe and,
  - If the attacking agent has more wealth (sugar) than the victim and,
  - If there are no other wealthy agents from the other tribe near by (that could retaliate)

Sugarscape - combat

- They find that if cultural transmission is turned off (with equal red and blue fixed tribe membership) then one tribe often dominates
- Although this is not the case when agents only get rewarded by a fixed amount for winning a battle (rather than full wealth of killed agent)
- Neither is it the case if cultural transmission is turned on – due to a wealthy victor becoming assimilated into the other tribe

Chapter 4 – trade

- add another resource (called spice)
- Agents need sugar *and* spice to survive
- can trade them directly between neighbours (barter pairs) – there is no central auction or clearing system
- Agents use a rather complex trade rule based on neoclassical microeconomic theory (we will touch on these issues in a future lecture)
- Suffice to say, agents attempt to:
  - maximise their individual welfare through calculating how valuable sugar is to spice
  - Then bargain a price which is only accepted if this results in a Pareto improvement

Sugarscape - trade

- They show that in such a decentralised market the predictions of neoclassical theory do not entirely hold
- Essentially it does not converge to an efficient equilibrium promoting optimal agent welfare
- However trade:
  - Increases carrying capacity (i.e. supports larger population of agents)
  - Increases inequality (higher Gini)

Readings and Questions

- Readings
  - Hedstrom & Bearman (2009) The Oxford Handbook of Analytical Sociology., Chap 20. Threshold models of social influence
  - Epstein, Joshua M.; Axtell, Robert (1996). Growing artificial societies: social science from the bottom up. Brookings Institution Press
- Questions
  - Can you think of a way ideas from the these models could be useful in engineering or computer science?
  - Do you think the ethnocentrism model tells us anything about real ethnocentrism?
  - Why do you think some social scientists are interested in Artificial Societies?