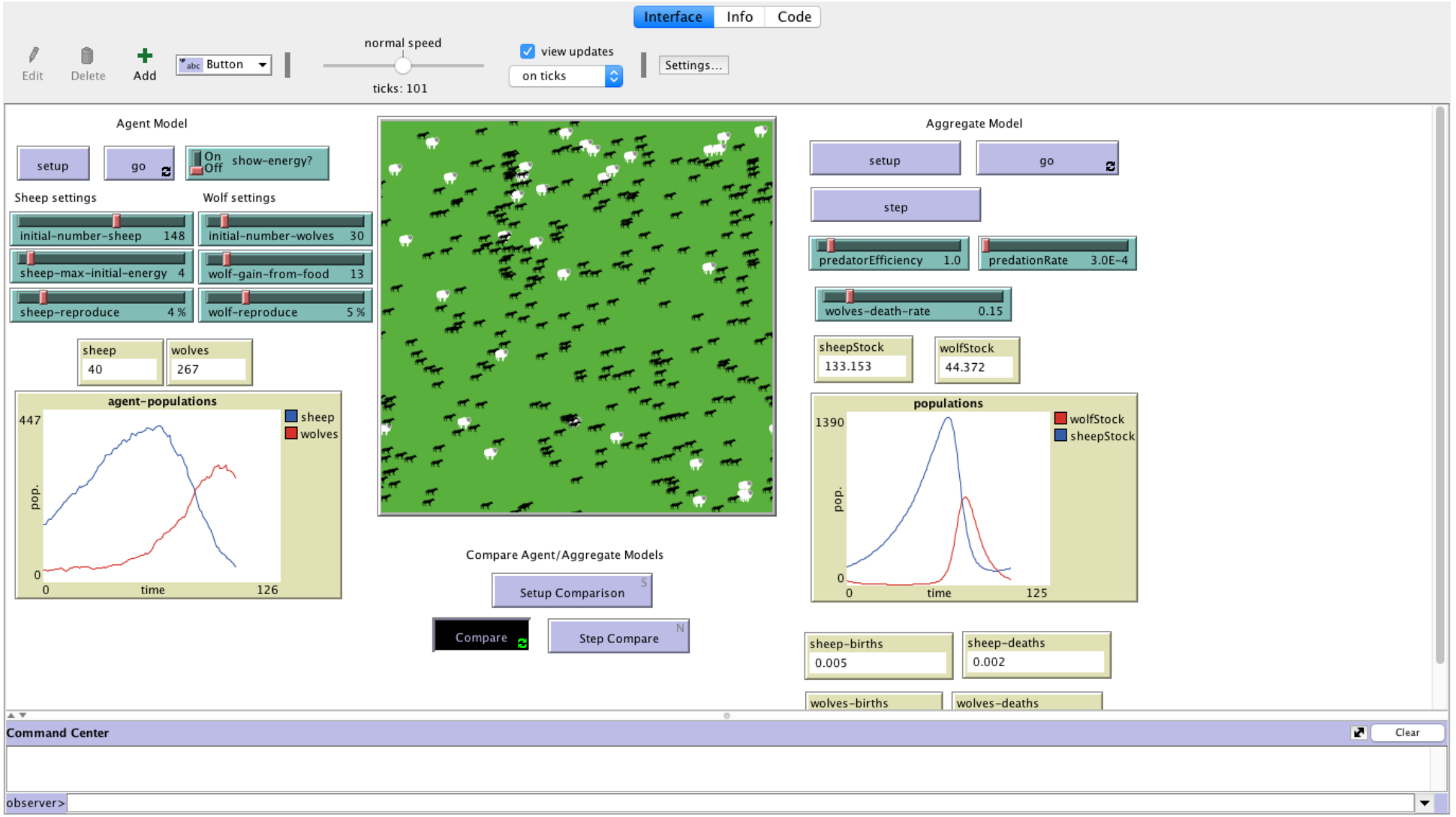
神經與行為模型建構
(Neural & Behavioral Modeling)

課號：Psy7277　　教室： 北 206
識別碼：227M9280　　時間： 五 234


今天模型要往下降一個尺度
！

Predator-Prey Model

NetLogo: Models Library→System Dynamics→Wolf Sheep Predation (Hybrid)




Overview
Cellular Automata Models
Agent-Based Models

社會科學模型建構：特色

單位是處在一個格點環境的人

具有某些基本的特質 (性別、記憶容量、容忍度)
互動的對象或有的資訊是臨近的人 / 環境 (locality)

變異與隨機性

人常有個體差異
環境可有一些隨機元素

互動 / 演化規則

簡單規則能衍生出相當複雜的穩定態

社會科學模型建構：實做

物件導向程式設計 (OOP)

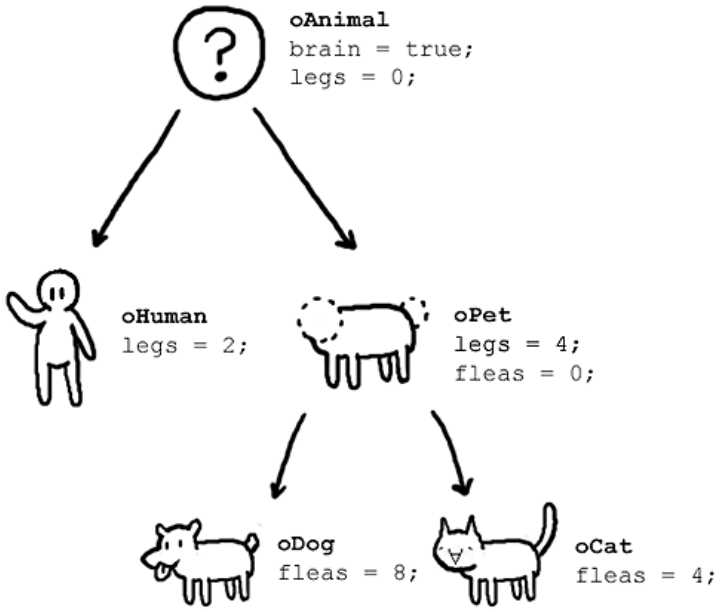
單一類別 (如男女) 下面可有不同的物件 (個人)
物件有其性質 (變數) 與特定動作 (函數)

實作語言

什麼語言都可以 (C, C++, Python, Matlab, etc.)
常用開源軟體 NetLogo

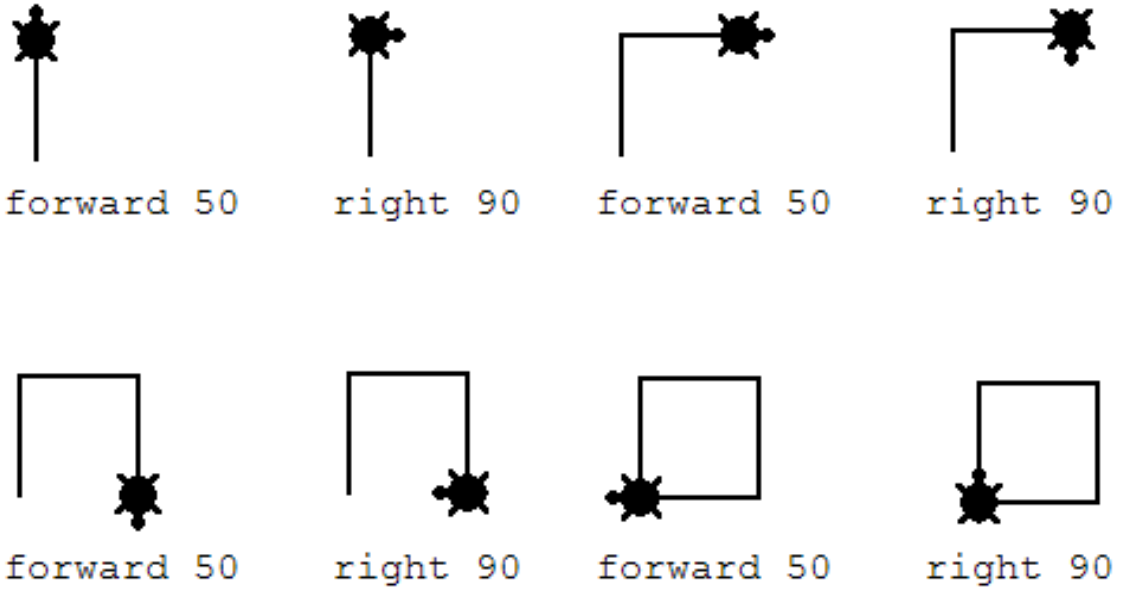
模型分類

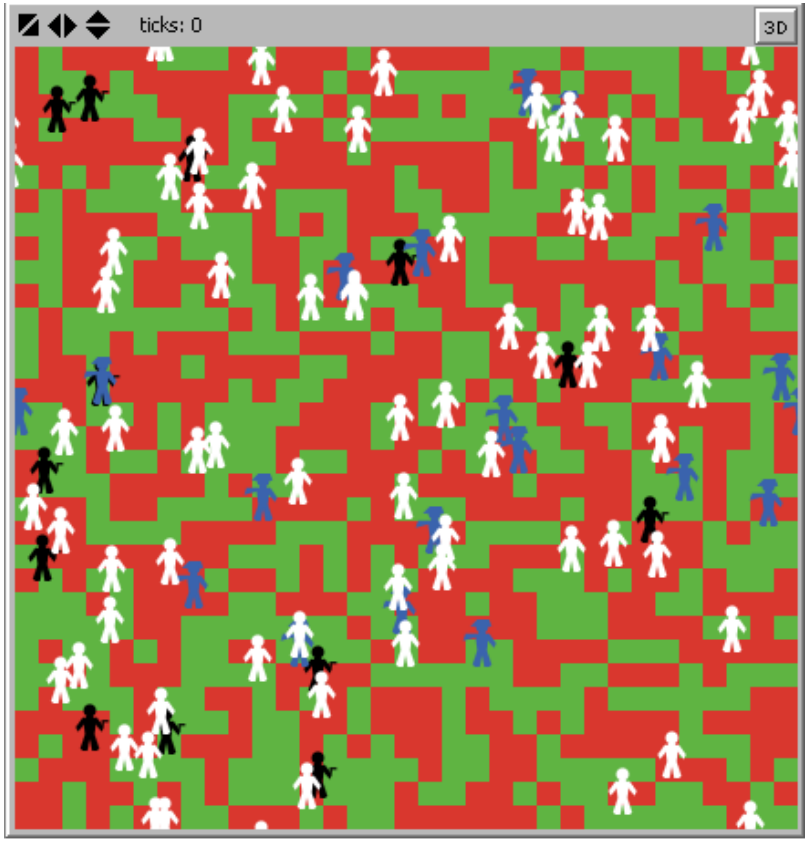
自動機 (人 = 格點)
代理人 (人≠格點)



社會科學模型建構：NetLogo (1/2)

從小朋友畫畫用的語言 Logo 發展而來

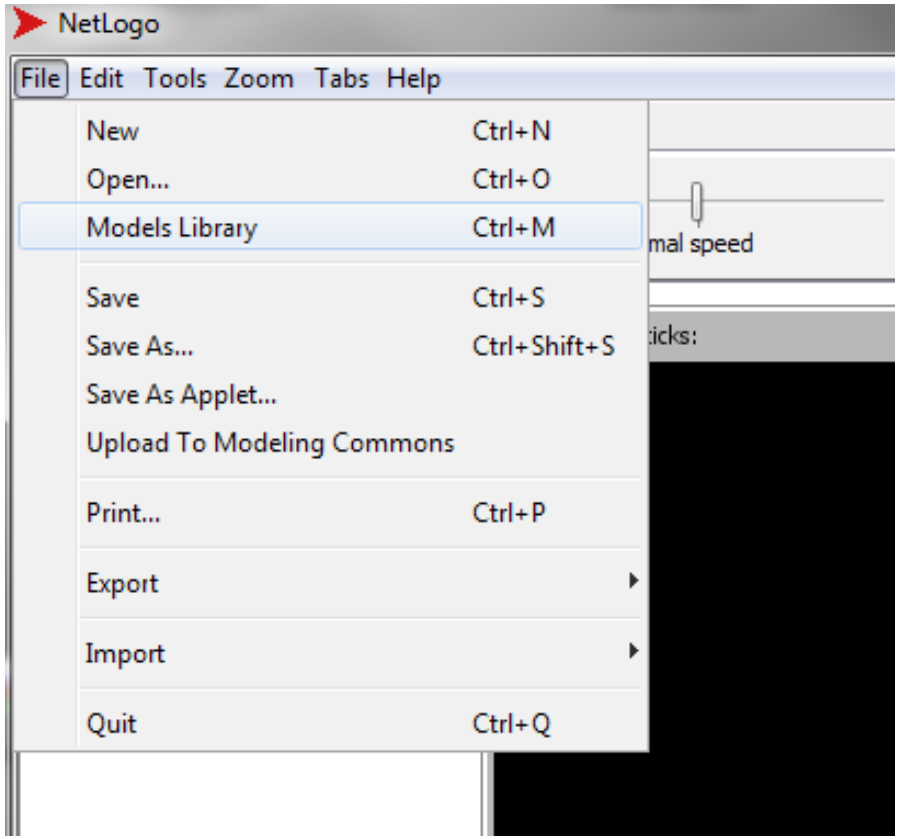


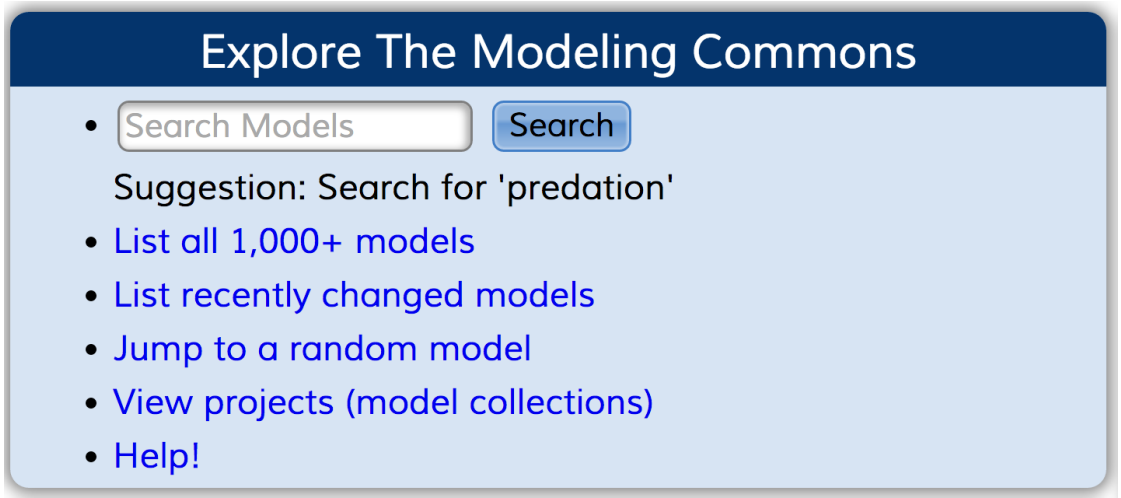


人 =turtle; 格點 =patch; 你 =observer

社會科學模型建構：NetLogo (2/2)

最好的入門方式是官網三個 tutorials





最好的進階學習是內建與官網上的 models library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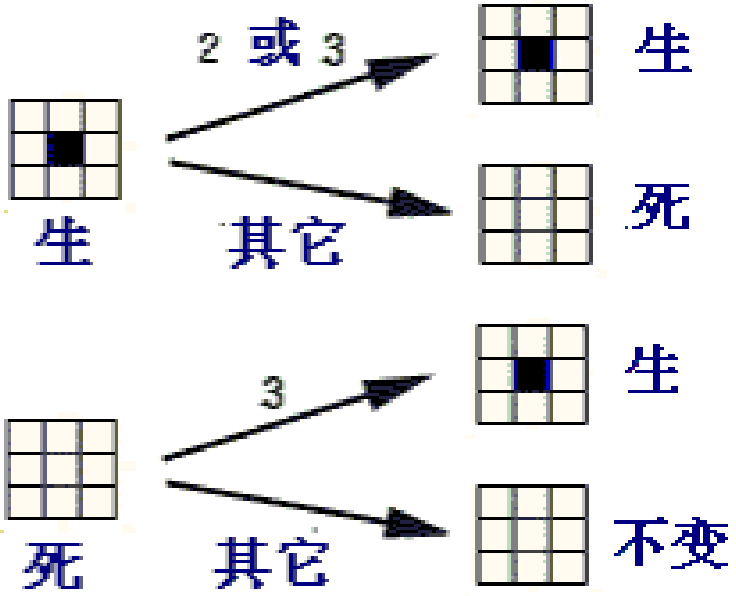
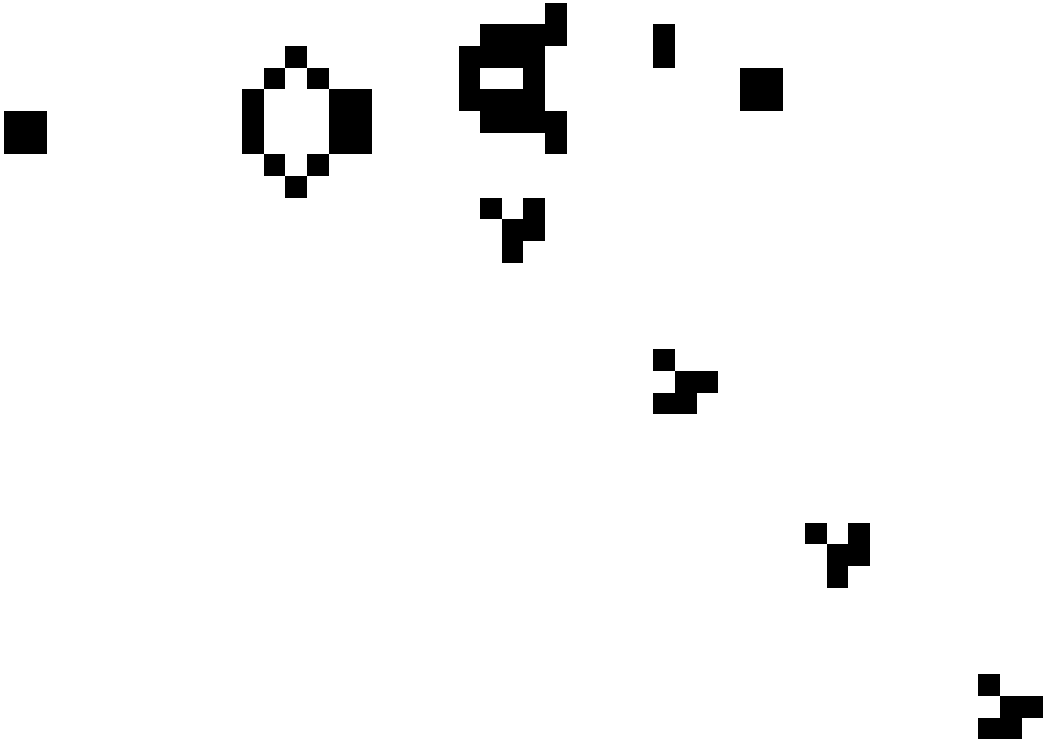
Conway's Game of Life

NetLogo: Models Library→Computer Science→Cellular Automata→Life





Python 的版本也很簡單

其他用 CAM 的社會科學模擬

- Axelrod’s Tribute Model
- Bremer-Mihalka’s & Cusack-Stoll’s Realpolitik Models
- Hegselman’s Opinion Dynamics Model
- Parisi’s Model of the Neo-Assyrian Empire
- Sakoda’s Group Attitudinal Model
- Schelling’s Urban Racial Segregation Model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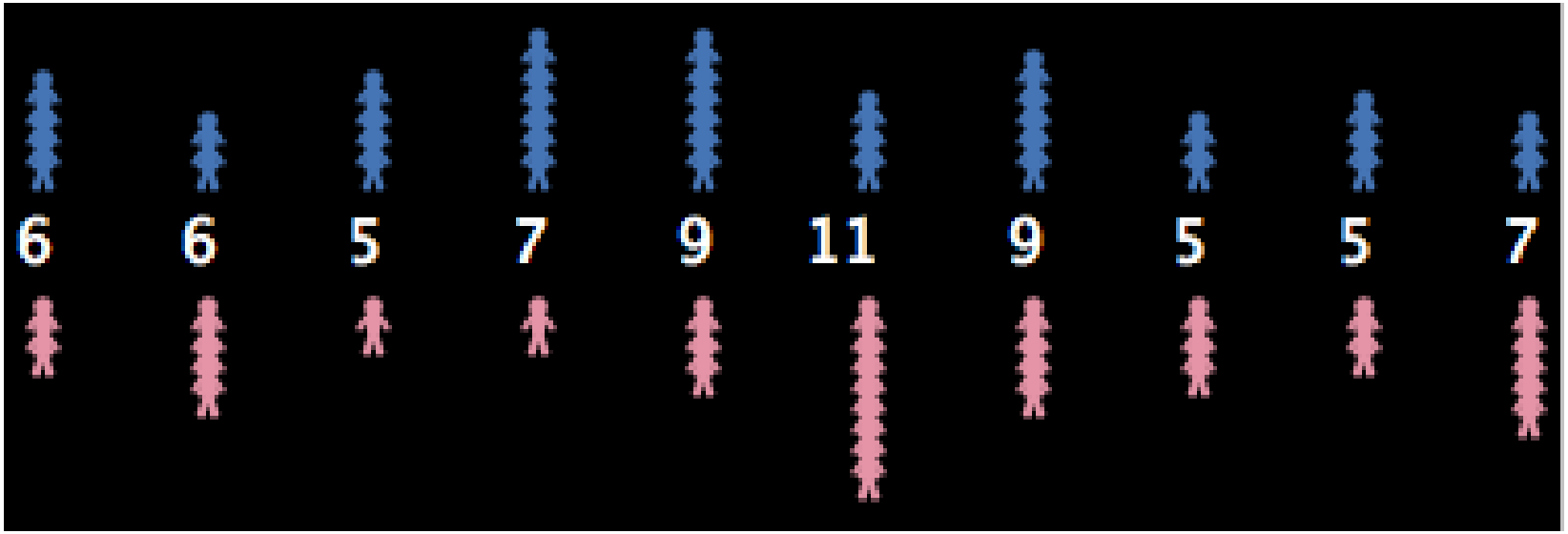
Party Dynamics

NetLogo: Models Library→Social Science→Party

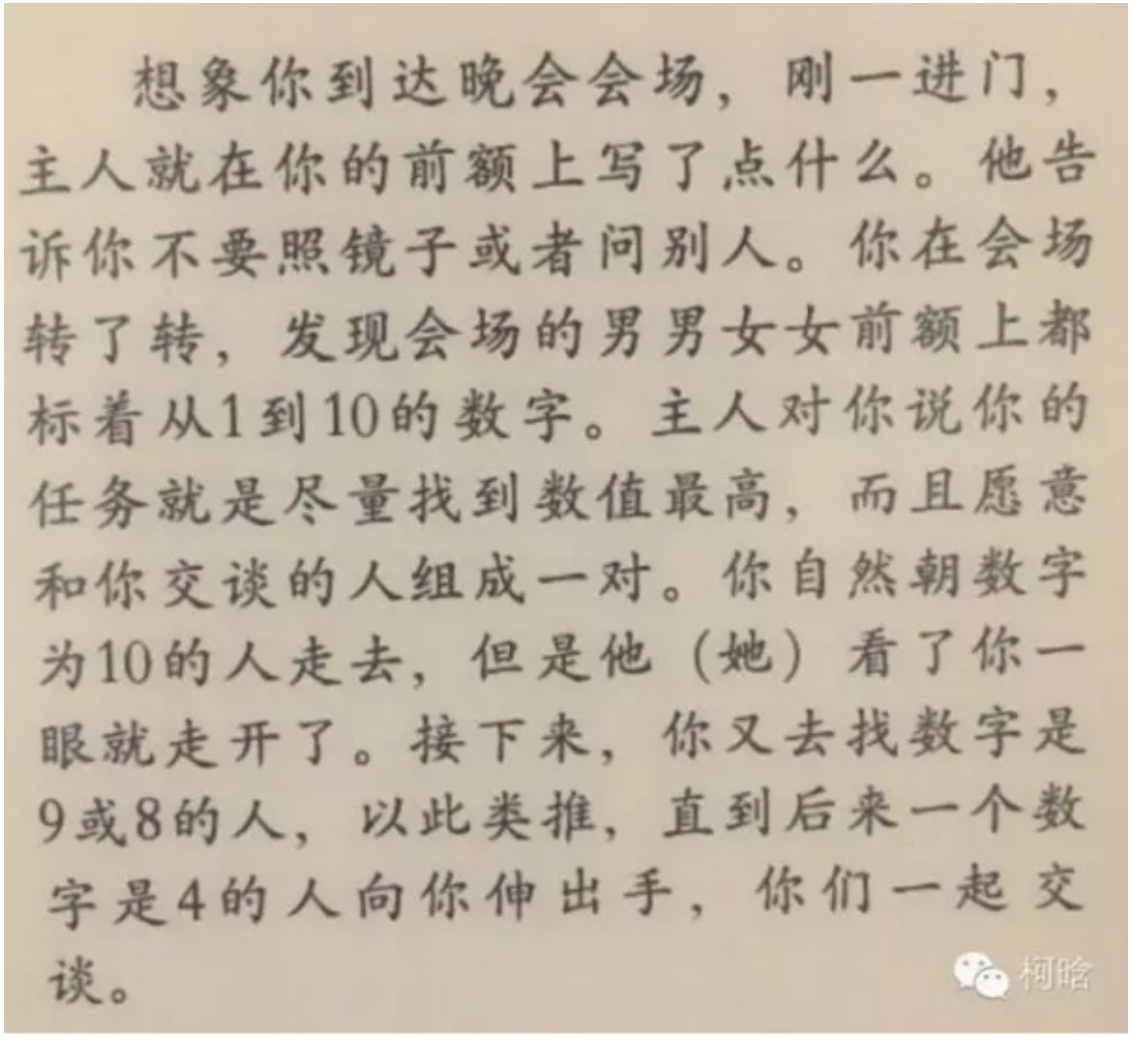
對異性比例的容忍度如何影響最後群聚的穩定態？



或許也可解釋意識形態族群 / 政黨的形成

MIT Matching Game

傳聞為 MIT 經濟學家 Dan Ariely 所做之實驗



後來被打臉說不存在

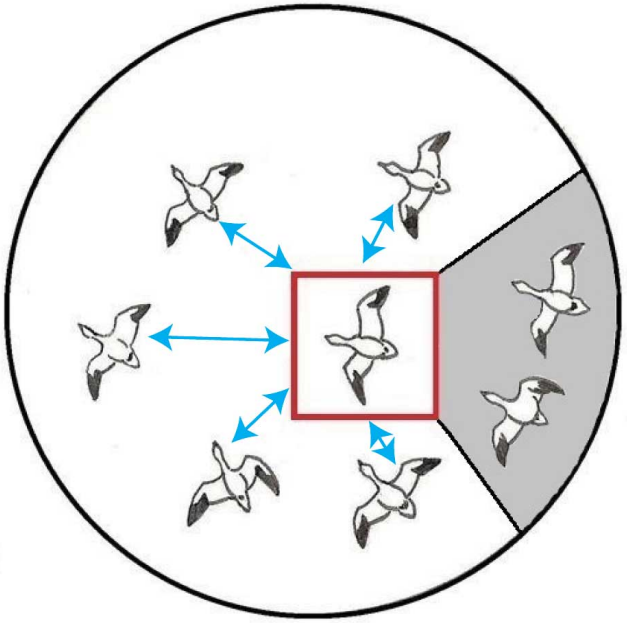
鳥的社群行為

個體如何得知群體接下來飛行的方向？

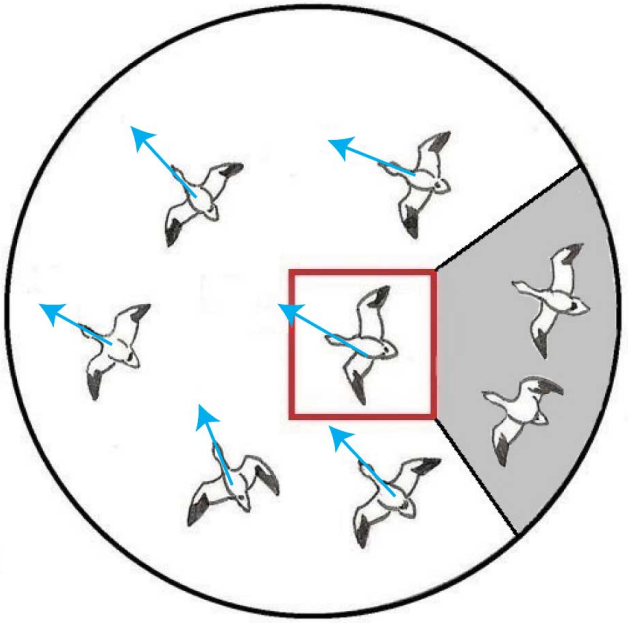
Boid Model

NetLogo: Models Library→Biology→Flocking

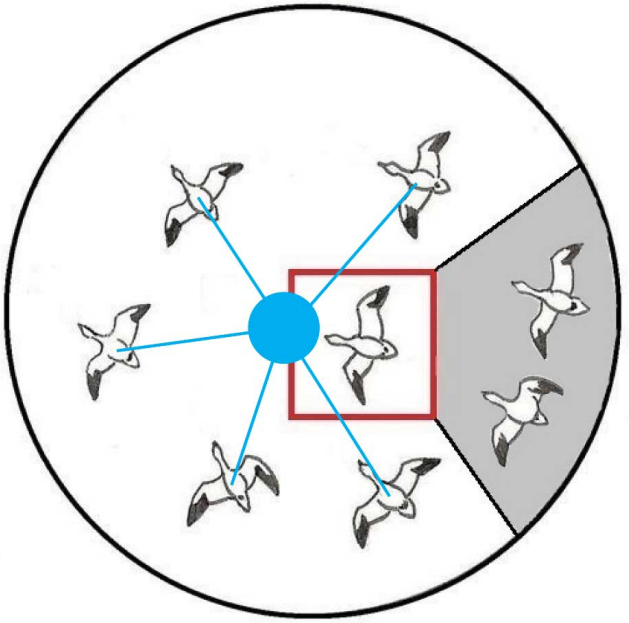
Separation



Alignment



Cohesion



Python 的版本其實也不難 (?)

其他用 ABM 的社會科學模擬

Model name	Referent system and research questions	Empirical calibration	Source code	Bibliographic reference
RiftLand model	East African coupled socio-techno-natural system; hazards and disaster scenarios	High	MASON	Cioffi-Revilla et al. (2012)
Anasazi	Long House Valley, Arizona; population dynamics and carrying capacity	High	Ascape, NetLogo	Dean et al. (1999), Axtell et al. (2002)
Sugarscape	Theoretical system of agents; social consequences of agent rules	Medium	Ascape, NetLogo	Epstein and Axtell (1996)
RebeLand	Political stability in a country; insurgency and state-failure dynamics	Medium	MASON	Cioffi and Rouleau (2010)
GeoSim	Balance of power system; territorial change	Medium	Repast	Cederman (2003)
FEARLUS	Land-use and cover change; farming dynamics	Medium	Swarm	Gotts and Polhill (2010)
SIMPOP	Urban systems; growth dynamics	Medium	C++	Sanders et al. (1997)
Heatbugs	Abstract social system; agent happiness and social proximity	Low	Swarm	C.G. Langton, Swarm Development Group
Wetlands	Hunter-gatherers affected by weather; social effects of memory	Low	MASON	Cioffi et al. (2004)

從個體經濟學到總體經濟學

Prisoner's Dilemma → Economic units

Research Article

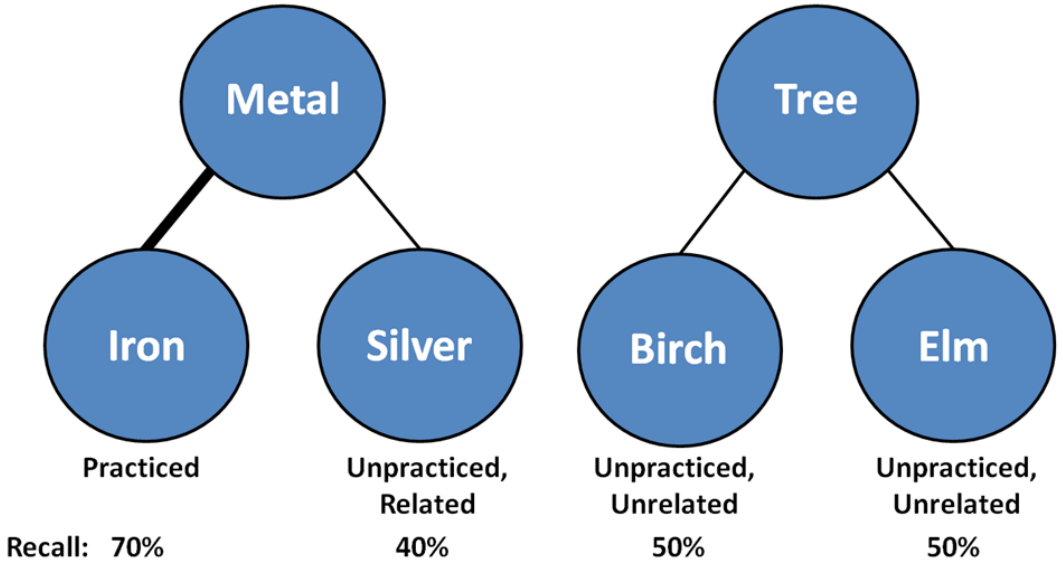
The Emergence of "Us and Them" in 80 Lines of Code: Modeling Group Genesis in Homogeneous Populations

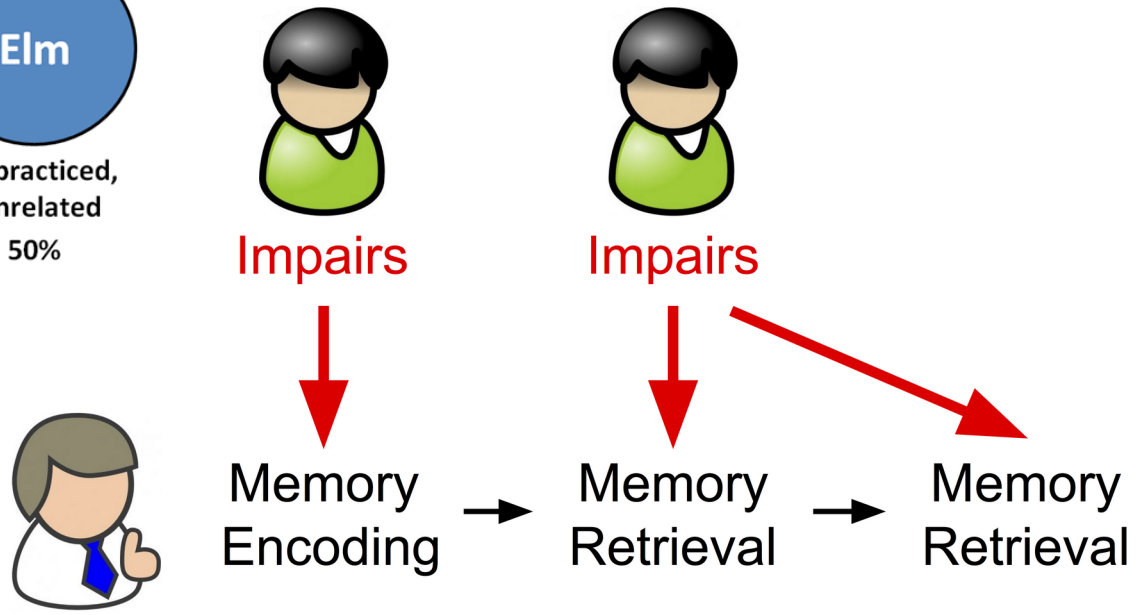
		Player 2: Cooperates	Player 2: Defects
Player 1	Cooperates	1/1	–3/3
Player 1	Defects	3/–3	–1/–1

Payoff: Player 1/Player 2

從認知心理學到社會心理學

Retrieval-induced Forgetting → Socially-shared Retrieval-induced Forgetting





SSRIF 的 agent-based models: 1, 2, 3

更多相關的心理學研究

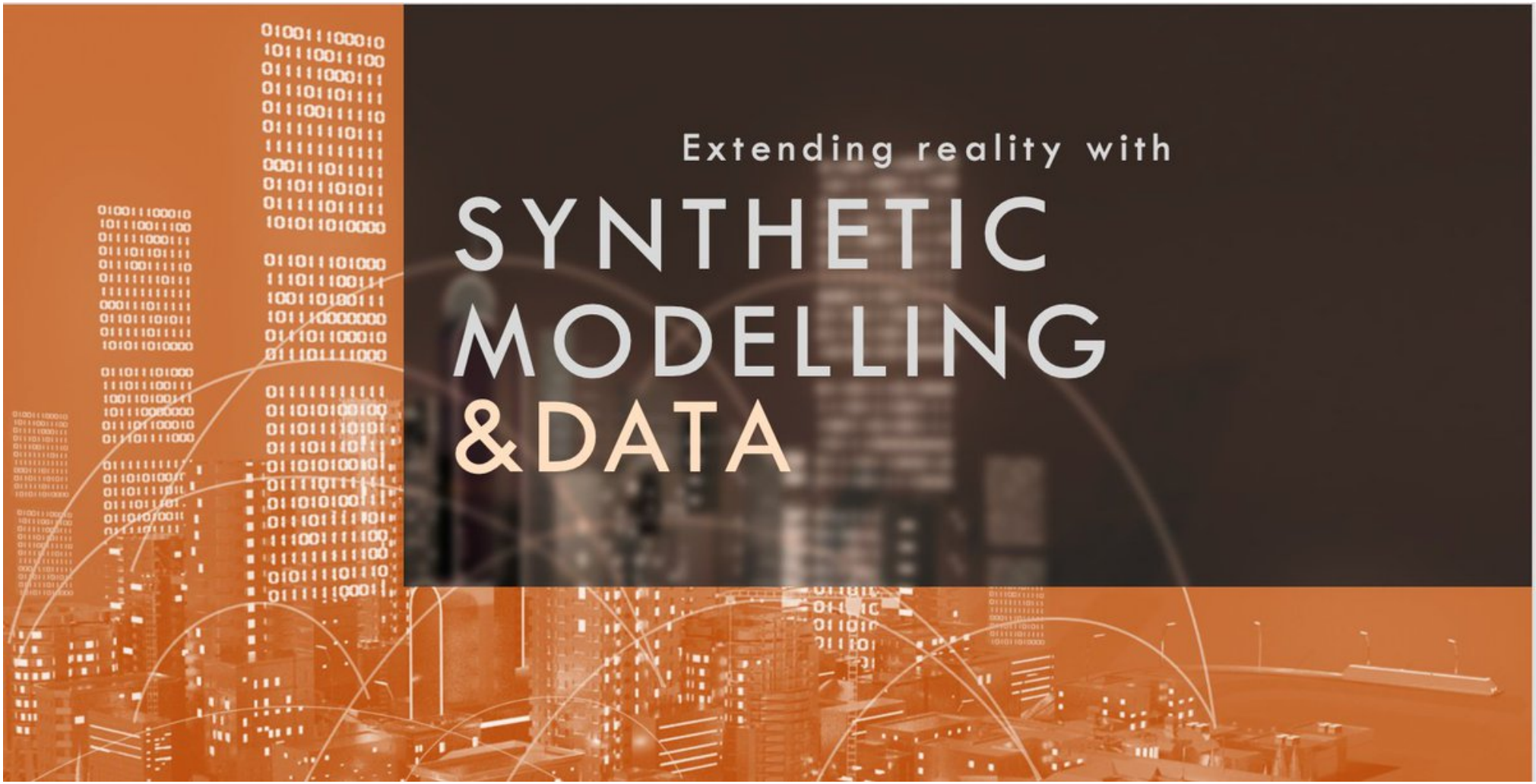
- Kalick, S. M., & Hamilton, T. E. (1986). The matching hypothesis reexamined. *Journal of Personality and Social Psychology, 51*(4), 673.

- Jackson, J. C., Rand, D., Lewis, K., Norton, M. I., & Gray, K. (2017). Agent-based modeling: A guide for social psychologists. *Social Psychological and Personality Science, 8*(4), 387-395.

- Henriques, G. J., Simon, B., Ispolatov, Y., & Doebeli, M. (2019). Acculturation drives the evolution of intergroup conflict. *Proceedings of the National Academy of Sciences, 116*(28), 14089-14097.

ABM 走到極端

可以 (開公司) 模擬 / 預測真實世界的運作



Game Over