CSC-40045

Distributed Intelligent Systems

Practical 5:

Self-Organisation and Emergent Behaviour in NetLogo

Coursework Part 1.4

Q4. Choose two complex models (e.g., Wolf Sheep Predation) and discuss briefly how each model works - focusing particularly on how the agents and their interactions lead to complex emergent behaviour. Comment on how each model can be extended to achieve a particular dominant behaviour such as "wolves don't diminish and actively chase sheep?". In addition, identify any constraints or limitations of the model.

Ans:

1. Rabbits Grass Weeds
    - This model illustrates a simple ecosystem consisting of rabbits, grass, and weeds. In the ecosystem, rabbits wander randomly, and they will encounter grass or weeds. Then they will consume them, gain energy, and reproduce themselves. If they do not gain sufficient energy, they will die. By varying the growth rates of grass and weeds we can control the reproductive rates of rabbits.
    - Initially, there was not much grass and weeds, many rabbits died due to food scarcity. The shortage of rabbits allowed the grass and weeds to grow back more, then the remaining rabbits consume it and overpopulate and in turn, leads to food scarcity again. This depicts the predator-prey life cycle system.
    - If we increase the grass or weed energy to the maximum, the reproductive count of the rabbit can be enhanced without losing the equilibrium. Because rabbits do not need to consume more grass or weeds to achieve targeted energy for reproduction
    - There is one limitation in this model, If the rabbit population ever hits zero, then it cannot revive even though weeds or grass exists in the ecosystem.

2. Virus
    - This model simulates the rate of transmission of viruses in the human population.
    - In this model, we will consider the total population as 150 and the infected count as 10. People will move randomly across the world, and we categorize them into 3 states:
        - Healthy
        - Sick and infectious
        - Immune
    - When an infectious person meets a healthy person, he will also get infected. Sometimes the person will become immune to it, otherwise, he will die. A person can die to the old

age factor too. Healthy people can reproduce healthy offspring and maintain the population.

- If we increase the percentage of the immune factor and decrease the infectious parameter, then soon the entire population will become healthy.
- The limitation of this model: Immune people are not getting infected again. Because gradually, the virus will get mutation and immune people can also get infected again. So, we need to consider this parameter also in the future models

References

[1] Wilensky, U. (2001). NetLogo Rabbits Grass Weeds model. http://ccl.northwestern.edu/netlogo/models/RabbitsGrassWeeds. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL

[2] Wilensky, U. (1998). NetLogo Virus model. http://ccl.northwestern.edu/netlogo/models/Virus. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL

[3] Wilensky, U. (1999). NetLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL