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COBWEB Start-up Guide

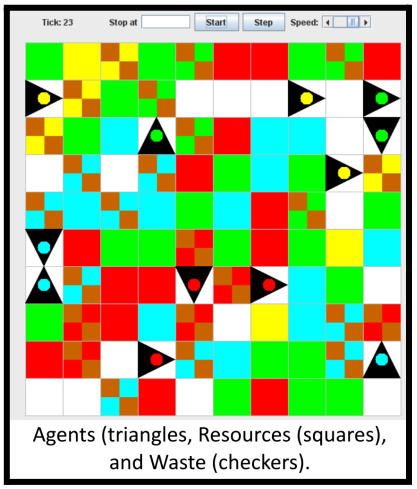
Adaptation to the Voluntary Extinction Group

Introduction

COBWEB is an agent-based software that allows simulations to be built and studies how behavioral changes lead to environmental changes. As this suggests, the main component of this software is the agents, which are allowed to interact with resources and each other through the different tabs COBWEB offers. It has a wide range of applications in fields like economics and biology, however, our focus will be on how it can be applied to demographic modeling and how zones, waste and aging can be tailored for this.

Agents

Agents are the main component of COBWEB and many aspects surrounding them may be altered in the Agents tab: Firstly, the total number of agents can be set to any non-negative number and the number of types of agents is set to 4 by default but it allows up to 64 different kinds, where each can have its parameter values. Furthermore, there is a range of characteristics that agents have, mainly regarding their energy and reproduction. In terms of energy, one can manipulate their 'Initial energy', how much of it they gain by consuming food ('Favorite/Other food energy'), the energy they need to move ('Step energy' and 'Turn energy') and also the energy they lose by bumping into other components of the model ('Agent/Rock bump energy'). COBWEB allows both sexual and asexual reproduction, but for demographic modeling, we will focus on the first case. In this case, the pregnancy period and chance of breeding can be modified.



Agents (triangles, Resources (squares), and Waste (checkers).

Resources

Another of COBWEB's fundamental tools is to generate resources. Resources are the primary energy source for the agents. Each agent has a default corresponding resource, but the consumption of resources by different agents can be modified in the Food Web tab.

There are many parameters that can manipulate resources, under the Resources tab. The number of resources and their generation and depletion can be changed. Also, there are multiple ways to use resources. In our project, resources represent government policies that raise fertility.

Waste

In the waste tab, 'Waste consumption energy' represents the change in energy when an agent consumes waste. By setting it to a positive value, the agent will gain energy after consuming the waste. This indicates that the waste provides energy to the agent consuming it and hence it can be regarded as good waste. On the contrary, negative values lead to an overall reduction in the agents' energy. 'Step waste energy loss' is a punishment parameter that represents the energy loss when an agent steps into waste. Additionally, there are waste gain and loss limits that represent the threshold values for the amount of energy needed to produce waste and the energy lost by producing waste respectively. 'Waste decay' reflects the rate at which unconsumed waste decays. In our model, waste represents the consequences of low birth rates. So, a negative 'Waste consumption energy' can be used to replicate this.

Specialty Features

Zones

The COBWEB simulation space can be divided into regions representing different environments. The Abiotic Factor Tab includes a wide range of dynamic and static patterns to choose from. Once a factor pattern is chosen, bands can be introduced into the environment by clicking on the patterns to add the active factors block and the number of bands can be amended. Each band has a designated value and bands with the same designated value have the same regional properties. Punishments can be implemented to restrict agents from venturing outside their designated band.

The Agent Abiotic tab can be used to tailor the behavior of agents in different bands. The preferred band for each type of agent can be assigned by inputting the band-designated value into the preference value section for each agent. To assign multiple preferred bands, we can insert a preference value range that represents the range of corresponding bands. Lastly, we can set a value for preference difference factor which represents the extent of punishment on the agent and choose a parameter of which punishment takes place. “Step energy” is the best punishment parameter if we want to observe a rapid effect based on the locations of the agents. In the Resources tab, we can do a similar tailoring procedure for food.

To simulate the urban-rural environment in our model, two agent types (urban/ rural residents) and two bands (urban/ rural area) will be introduced. Preference values for the agents should be set to align with the region they should be in. To prevent urban residents from venturing into a rural zone (or vice versa), we will check the punishment box for each band, set a non-zero preference difference factor, and select a punishment parameter for the agents.

Aging

Aging	☑
Age limit	300
Aging rate	100

Aging is one of COBWEB’s specialty features that can be applied to agents. Aging is found under the agents tab. As in the real world, it allows the hypothetically immortal agents to age.

1. Aging: First, select the aging checkbox to toggle on the feature. If it is not checked, then none of the aging settings will apply.
2. Age limit: agents will die after the time stamp reaches the indicated value. If aging is not used, agents could hypothetically live forever. Furthermore, each tick in time can be used to represent any unit of time such as hours, or years.
3. Aging rate: this controls the amount of energy extracted from food. Therefore, a higher aging rate will cause agents to die more quickly, as they will not intake nutrients efficiently. In general, this means that agents will have less energy to expend, whether for movement or reproduction.

Aging can be used in a range of situations. In our population decline project, elevated aging rates are one of the most typical consequences present. Even more, COBWEB allows a high aging rate to affect the ability of an agent to spend energy, and hence reproduce. As such, aging can be used to induce the decreasing birth rates of a population and to accurately represent the current situation in a country.