Geoawesomeness blog post 1

Modelling the dynamics of police demand and resourcing over space and time: an algorithmic solution.

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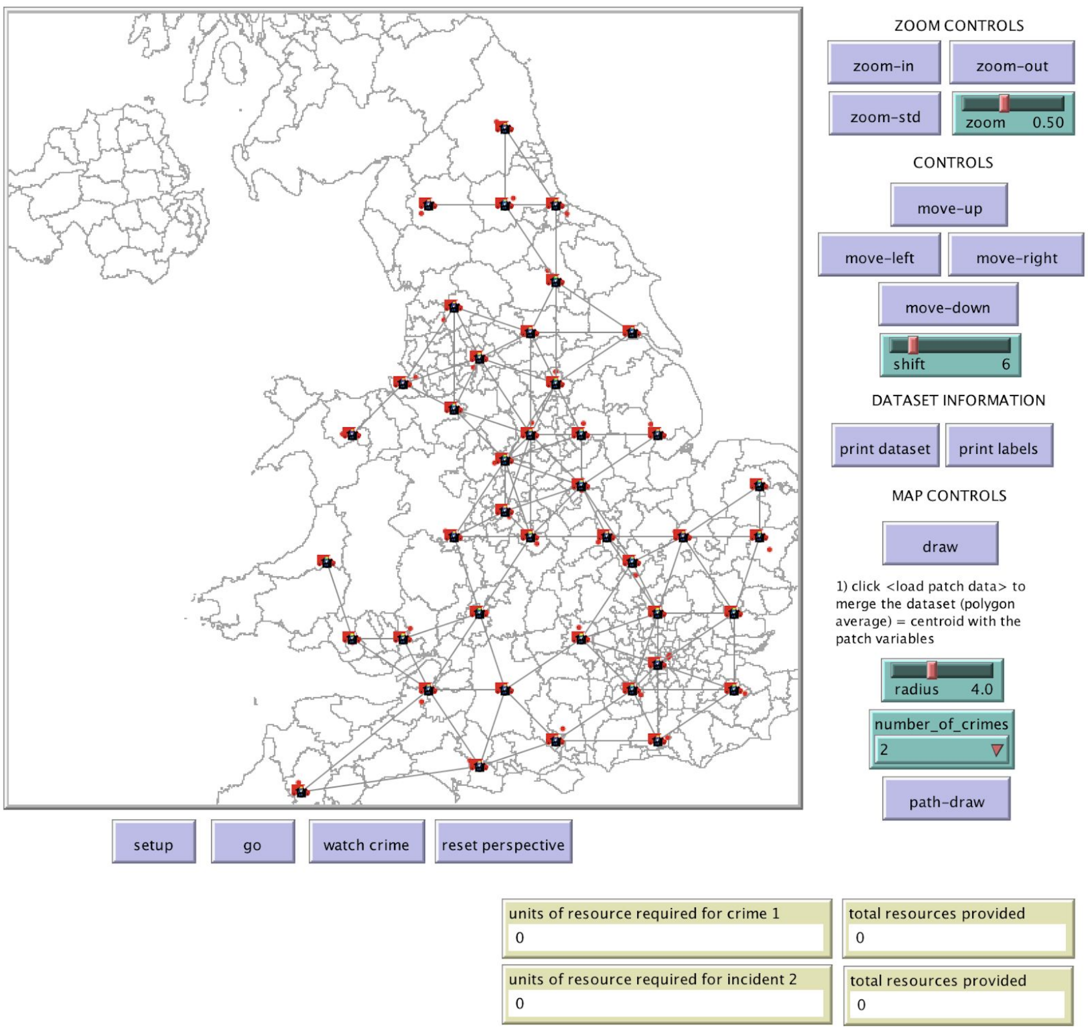
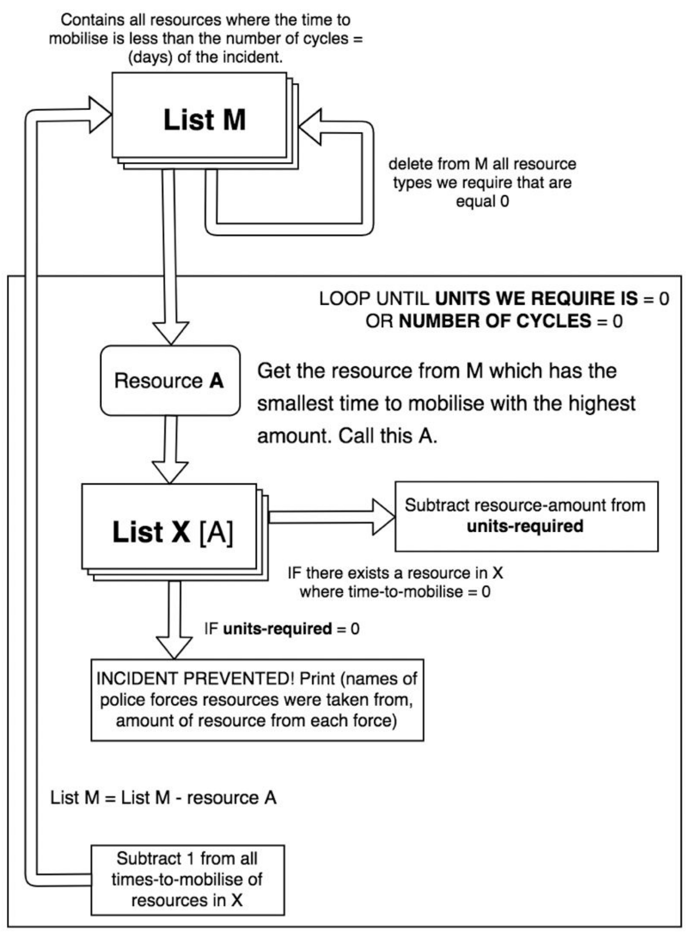
Understanding when and where resources should be distributed in response to dynamic spatio-temporal processes is a complex task. One example of this problem is understanding how to best deploy police resources in response to calls for service. Police agencies have finite numbers of resources that must be allocated to events occurring in a particular locality in real-time. These events can be diverse in nature, require varying levels of resources and represent different levels of importance to the responder (police artificial intelligence transparency). Moreover, they are often interdependent, both at the event level and in terms of opportunity costs when responding to one event is prioritised over another. Understanding this problem is particularly important in the 21st century where the police are being asked to deal with increasingly diverse problems, often with relatively restricted resources. This complexity dictates that traditional analytical approaches often struggle to provide adequate solutions to resourcing and demand problems.

There were a range of methodologies at our disposal, however, agent-based modelling seemed to be the most resourceful (detailed project proposal). Individual entities can be designed and assigned attributes, they are then programmed to interact with the environment in which they reside. The environment is programmed by the developer and it can be dynamic or static (in this particular instance, we used ArcGIS to develop the maps and Netlogo to code the model). Entities also known as agents are then simulated and the behaviour enables the user to gain insights.



The model has three sets of buttons for loading data, running the model and navigating the environment . At the bottom right we have four views, on the left the number of resources needed to diffuse both incidents one and two and on the right the total number of resources the model was able to pull.

Clearly, there is some sort of computation going on in the background, we developed a recursive algorithm (an algorithm that loops a number of given times) to detect from which police forces resources can be pulled and the amount of resources.



The algorithm depicted above chooses a resource by checking all resources provided by police forces at the time that has the smallest time to mobilise. It then takes that resource and if the time to mobilise is 0 it then subtracts that resource from the units required (as the resource has reached the destination). The algorithm then checks if the units required is 0, if so we print "the incident has been prevented" and display the names of forces resources were pulled from and the amount of resource pulled. If units required is not 0 then we loop the algorithm again choosing another resource and so on.

The software model produced and discussed was developed to provide the police force with new decision support techniques. The model takes individual resource values for each region and provides you with a plan of where resources can be pulled if an incident occurs somewhere. This clearly means that the model can be extended to any domain that focuses on distribution of objects over space and time.

The software developed can be found on my Github repository:
https://github.com/SedarOlmez94/Agent_Based_Modelling_Projects/tree/master/Police%20project

Link to my academic research page:
https://www.turing.ac.uk/people/doctoral-students/sedar-olmez