# Surviving the Worst

New Mexico

Supercomputing Challenge

Final Report

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Team 98

Melrose

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# Executive Summary

**Proposal:** We plan to simulate what could happen to a rural town cut off from the rest of the world due to a national disaster such as terrorist attacks or war efforts. Put in this situation, the said town would have no outside sources of food, electricity, and other supplies. How long would the town last? Could local farms and water windmills sustain the population? Using either Net Logo or Star Logo, we intend to find out.

We will be dealing with variables such as food supplies in farms, how much water we will be able to access, and how much electricity local wind turbines will be able to produce. If nearby isolated towns are low on supplies, they may raid other towns. We intend to implement as many of these variables as we can into our model, as well as others.

If we find that the town cannot sustain itself, we plan to look for ways that the town can prolong supplies, protect itself from any local threats that may exist, and create general plans to protect the town from any problems it may encounter. This is an entirely realistic situation. If it happens, though we hope it does not, we need to know what to expect, how to act, and how to survive.

This situation is entirely possible, and a variety of things could trigger it, such as natural disasters, terrorist attacks, or war efforts. Having something planned out for such a situation is vital to our survival. Without planning, there would be rebellions and riots, reducing everything to a state of chaos.

# Problem Statement

The problem we are looking at deals with what would happen if our local area were to stop gaining supplies, primarily food, from outside sources. This may happen because of events such as natural disasters, terrorist attacks, or war efforts.

Our project is dealing with what would happen if a small rural town, based largely off of our own, were to be isolated from the rest of humanity. This isolation may happen because of natural disasters, terrorist attacks, war efforts, or other catastrophes. If this were to happen, this town would not have the usual supplies it gathers from the outside world. It would lose much of its supply of food, electricity, communications, and other things. Its collection of fields, pastures, towns, rivers, wind turbines, water mills and oil wells would become our only sources for all resources. How long could the town last? Could local farms and electricity generating windmills support the population? How would the nearby towns react? We intend to create a model in NetLogo to find out.

We came up with this idea after a similar theme was portrayed in numerous shows and books, Such as NBC's Jericho and Discovery Channel's The Colony, and wondered how events similar to those in the show might play out in real life in our area.

# Method Description

We decided to solve our problem with NetLogo, creating an agent based model to simulate the population of our designated area as they carry out the actions required to survive. Shown on the map are any supplies (crops, water, gas pumps, etc.) towns, and various landmarks. Each person is assigned a job, such as gathering food and water. If supplies run too low and people starve, they die. A balance between how many people gather different things is essential for the survival of the community. The major resources gathered are as follows:

•Grain/wheat- Used as the primary source of food. Agents gather this valuable resource and bring it back to their respective towns, where it is then shared and used by the rest of the population. Once a certain area in a field has been used to exhaustion, it becomes barren and begins to grow. In a few months' time, it will become usable yet again. A large stored supply of this is available from the beginning in grain elevators. Further food is obtained from various homes and supermarkets, adding to the food count.

•Water- Again, a very valuable tool. The function of this is very similar to that of the crops, with a few key differences. First of all, it is gathered primarily from the lake and, to a lesser extent, the windmills. This is due to the lake’s long term sustainability Furthermore, the source does not deplete as the crops do. Initially, there is a large supply of water from local water towers.

•Gasoline- This resource is used to power vehicles, which are used to transport goods at a faster pace and in greater quantities. It is obtained through gas wells in the south.

# Study Results

Once our agents began to act in an orderly fashion, it was interesting to see how they acted. They seemed to fall into their own little paths and trails on which they would travel going from one place to the next. This occurred much less frequently in the crops when they were set to die after a certain amount of time, but it was a recurring theme in the lake and windmills all the way through. Other than that, our results showed nothing extremely out of the ordinary. Agents behaved as they were expected to and performed their duties splendidly.

We have concluded that, provided everyone cooperates in this state of emergency, it shouldn't be too difficult to work our way through this situation. Provided everyone keeps a level head and avoids hoarding essential materials, there is easily enough to last for a significant amount of time.

```
globals [redFood blueFood greenFood allyFood redPop bluePop
greenPop otherPop day week month year rsustpop redFuel sday
redspop redWater today carCount redGas]
breed [reds redss]
turtles-own [id gfood gwater ggas civ job water getspotx getspoty
twn twnx twny food starv speed gas]
patches-own [energy dieday]

;COLORS
;water = 85.2
;food(crops) = 44.9

to setup
clear-all
 import-pcolors "Mapv3.png"
 create-reds 2600
  [set id (who + 1)]
  set redpop (count reds)
   set redfood 1000
   set redwater 1000
   set redgas (34 * 5000)
    set day 1
    set week 1
    set month 1
    set year 1
    ask reds [setjob
     set getspotx 0 set getspoty 0]
      ask patches [PatchPersonification]
      set today 1
      ask reds [set speed 0.25]
end
to setjob
set job random 7
 if job = 1 or job = 2
  [set gfood true]
 if job = 3 or job = 4
   [set gwater true]
 if job = 5
 [set civ true]
 if job = 6 or job = 7
 [set ggas true]
set twn random 3
 set twn (twn + 1)
if twn = 1
 [set twnx 76 set twny -20 setxy twnx twny]
if twn = 2
 [set twnx 159 set twny -28 setxy twnx twny]
if twn = 3
 [set twnx -79 set twny -46 setxy twnx twny]
end

to forever
if (redfood < 0)
 [set redfood 0]
if (redwater < 0)
 [set redwater 0]
if (redgas < 0)
 [set redgas 0]
 set redpop (count reds)
  set redspop (count reds with [starv = true])
  set rsustpop (redfood)  if round day != round today
   [set redfood (redfood - ((redpop - redspop) * 1))
   set redwater (redwater - (redpop * 1))
   set redgas (redgas - (carCount * 48))
   set today day]
```

←These are all the variables in our model. Notice that the model is set up so that it can separate different competing groups (sorted by color). This is something we hope to implement in the future.

←NetLogo recognizes colors by numbers. This key shows what colors represent certain key items.

←The setup sets all the default variables, then assigns each agent a home town and job at random.

←Forever is a set of repeating commands. This includes (in order shown) preventing values from going negative, killing agents that have been without food for too long, subtracting food that was eaten each day, keeping track of what day it currently is, counting the number of people allowed to drive cars based on available gas, and growing crops over a period of time.

```
 set day round (day + 0.01)
    set week ((day / 7) + 1)
     set month ((day / 32) + 1)
      set year ((day / 365) + 1)
set carCount (redgas / 35)
ask patches
[if energy < 1 and pcolor = 44.9
 [set pcolor brown set dieday day]
 if pcolor = brown and dieday + 90 = day
  [set pcolor 44.9 set energy 600]]
end


to starve
 ifelse id > rsustpop
  [set starv true]
  [set sday (day) set starv false]
  if (day - sday) > 14
  [die]
if redwater < 1
 [die]
end

to walk
forward speed
 left (random 90)
 right (random 90)
end

to work
 ifelse gwater = true
  [if water != true
   [ifelse getspotx = 0 and getspoty = 0
    [forward speed right random 90 left random 90 if pcolor = 85.2
[set getspotx xcor set getspoty ycor]]
   [set heading towardsxy getspotx getspoty
    forward speed]
    if pcolor = 85.2
     [set water true]]
  if water = true
   [set heading towardsxy twnx twny forward speed
    if pxcor = twnx and pycor = twny
     [set water false set redWater (redWater + 26)]]]

 [if gfood = true
  [if food != true
   [ifelse getspotx = 0 and getspoty = 0
    [forward speed right random 90 left random 90 if pcolor = 44.9
[set getspotx xcor set getspoty ycor]]
    [set heading towardsxy getspotx getspoty
     forward speed]
     if pcolor = 44.9
      [set food true ask patch-here [set energy energy - 26]]
     if pcolor = brown
     [set getspotx 0 set getspoty 0]]
    if food = true
     [set heading towardsxy twnx twny forward speed
      if pxcor = twnx and pycor = twny
       [set food false set redFood redFood + 26]]]]


if ggas = true
 [ifelse getspotx = 0 and getspoty = 0
```

←This counts the number of people that have not been able to eat. After a certain number of days, they die. Also, checks to see how much water is available. If there's not enough, people die.

←A basic wiggle command used when an agent doesn't know where to go to find perform the designated command.

←Tells each agent what to do for each assigned job.

```
[forward speed right random 90 left random 90 if pcolor = 44.9
[set getspotx round xcor set getspoty round ycor]]
  [set heading towardsxy getspotx getspoty
   forward speed]
   if pcolor = 22.6
    [set gas true]
   if gas = true
    [set heading towardsxy twnx twny forward speed
     if pxcor = twnx and pycor = twny
      [set gas false set redGas redGas + 26]]]
if xcor = twnx and ycor = twny
 [ifelse ID < carCount
   [set speed 1]
 [set speed 0.25]]
end

to PatchPersonification
if pcolor = 44.9
 [set energy 600]
end
```

←Sets energy for each patch in the fields. This happens in the setup.

# Original Achievements

Our model specifically deals with our area, where we live. The results we received deal specifically with this area and nowhere else. While other studies have been done on similar subjects, our experiment is unique in this way.

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