AIDS in South Africa

New Mexico Adventures in Supercomputing Challenge

Final Report

April 6, 2005

Team 12
Of
Bosque School

Sponsoring Teacher:
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Sponsoring Mentor:
Mr. David Edwards of Duke University

Team Members:
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And
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Project Statement: To model the spread of AIDS in the country of South Africa through the use of the program Star Logo, research extracted from the world wide web, and articles collected from books and magazines.

Executive Summary: In short, it has been an interesting experience for the members of team twelve, all of whom have never before participated in the New Mexico Supercomputing Challenge. We have worked incredibly hard for the past few months, attempting to find information, contacting mentors and meeting most deadlines. It has been difficult, to say the least, but none the less, an enriching experience. To compact the last few months into a summary shorter than a page is easy: work, work, work. We started out this process by looking at a general idea—AIDS in Africa. After the meeting at Glorietta, we came to the realization of how titanic an undertaking that would be, so we decided to narrow our topic. We chose South Africa because over the past few decades, this nation has ignored the epidemic to the point that AIDS qualifies as a pandemic. Many articles in National Geographic and Smithsonian have been written about AIDS epidemic in South Africa and its devastating consequences. From these articles, we began to research death and birth rates in South Africa and looked at the how applications of the Star Logo program could be used to model the changes in birth and death rates. One of our team began to take the numbers from our research and put them in a math model. Another student started to try and transfer this math model into the Star Logo program. By the time of interim, we had created a working program that modeled an area in South Africa which our research indicated was the main transportation route and travel route for the male trucking population and was where many of these men first contracted the AIDS virus. Our team presented our model to judges who offered many practical ideas for revision of our final report. Once more, we went back to the drawing board, and reworked both our math and Star Logo models. At this point in time, we have a model that works beautifully and now feel more enlightened on this world problem. We knew at the start of this project how massive a problem AIDS was, but now we understand what can, and most likely will, happen in the future of the nation of South Africa.

Our Method: Our method is simple to describe. After many weeks of research into the South African problem with the spread of AIDS, we began to try and take the

numbers we discovered on the internet about the birth and death rates of this nation, and put them in a math model. At the time, we had one team member familiarizing himself with the possibilities of the turtles in Star Logo. Once our math model was sufficiently developed, we tried to transfer it into the computer program. Within weeks, we had turtles that could model the basic idea of the spread of AIDS in the turtle population. After a certain amount of time elapsed (granted, as we read this now, we see how morally wrong it seems to make turtles die from AIDS), we saw the turtle population decrease significantly. We have, over the past months, revised our model and have made it more accurate in displaying our problem.

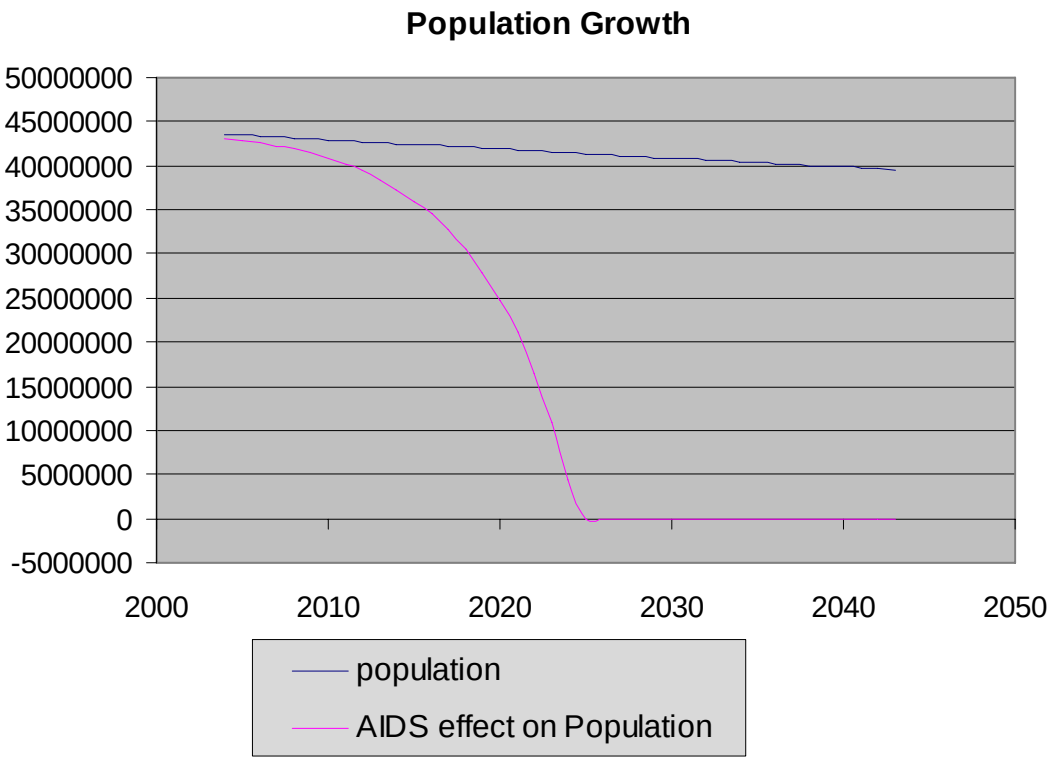
Our Results: Our results are grave for South Africa. Our math model has shown that the entire population of this land will be dead by the year 2025, only twenty years away. In our math model, the prevalence of AIDS is now randomized, meaning that it more accurately shows what would happen in the real world. This random function used in the math model adds between .01-1% more to the prevalence rate per year. What this seems to indicate, is that despite the continual growth of population in South Africa, more children are being born with the virus and daily more people die of the disease.

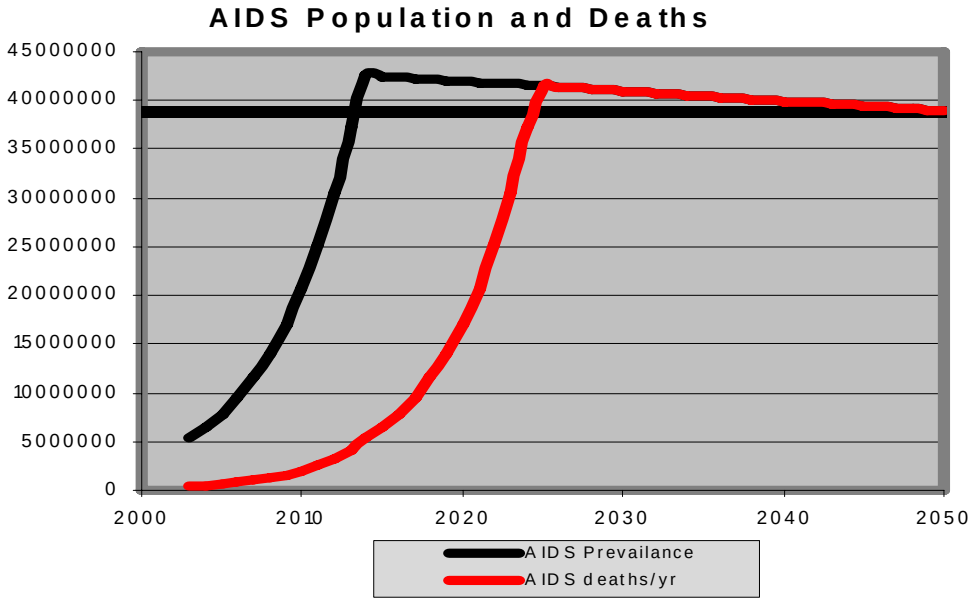
Our Conclusions: Our conclusions are grim, as we stated earlier. In only twenty years, the entire population of South Africa will die, if the country continues forward on this death march. A startling find for us of team twelve. This path is not inevitable. In the next twenty years South Africa could follow a different path, if the problem is recognized now as a major health issue. If the the South African government acts immediately, our team strongly feels that the situation of South Africa would greatly improve. Too many lives have been lost as a result of the lack of medical treatment for the virus and education about its spread. With the proper medication and education the effects of the virus can be slowed. Perhaps one day we will find a cure for AIDS, and we hope, after governments realize that an entire nation's population could die within twenty years, the search for a cure will be pushed forward and put in the limelight of the international community.

Our Big Achievement: We believe our biggest achievement to be our entire project. At the beginning of the year, our team was uneducated and ignorant about this problem and we had no idea how to accomplish our task. That may still be true on some level, but for the most part, we have worked incredibly hard to meet all of our deadlines,

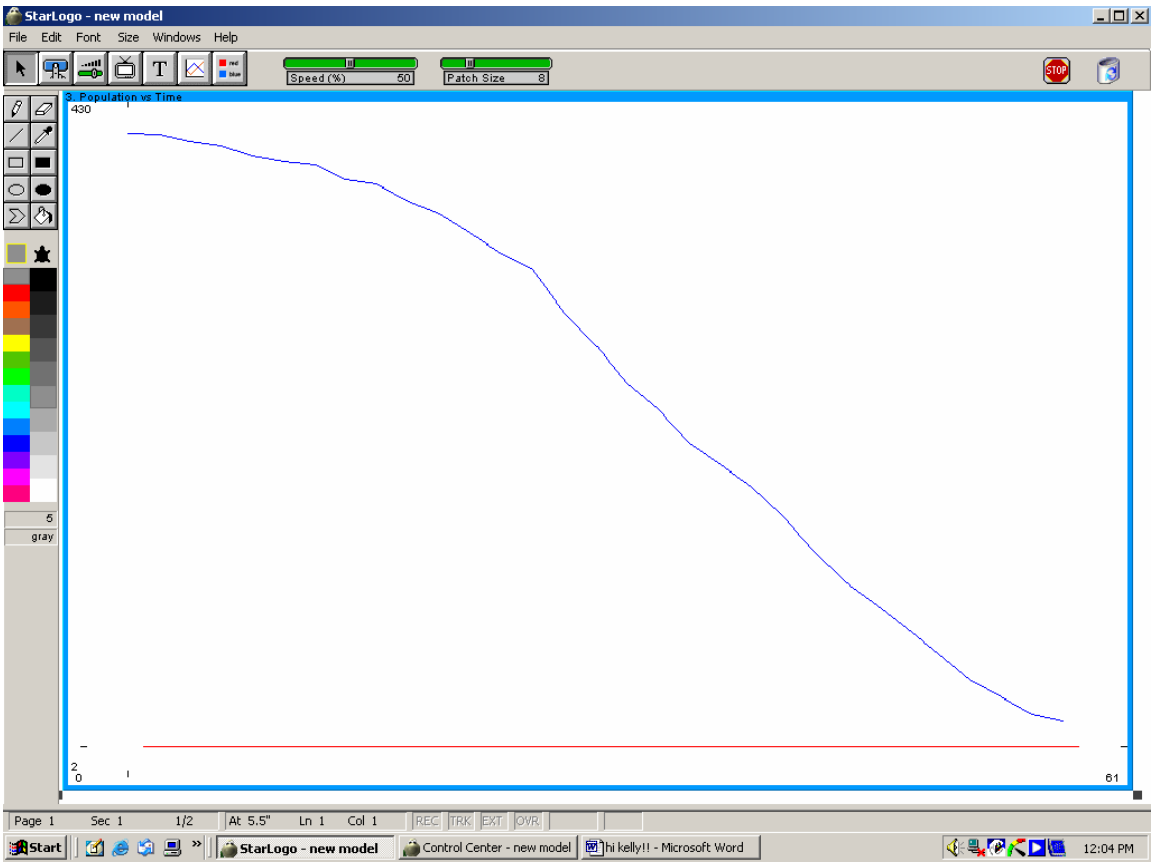
collect proper information and the numerous other parts involved in this process. We had to make presentations in front of people we did not know and complete written work to the best of our abilities. We had to make complex math models and try to transfer their results to the Star Logo program. We worked on a project that we knew was afflicting millions across the world and have come up with startling results that perhaps will bring more light to this topic.

Acknowledgment: Team twelve has a few people to thank for their enormous contributions to our project. To our fellow Supercomputers, for without them, there is a good chance most of our work would have been for nothing (mainly what we mean is that without them, we would have forgotten to save a lot of our work). Not to mention, they were always willing to help us if we reached a problem with our code and programing. To Mr. David Edwards of Duke University for being willing to try and help us with the massive under taking of trying to model the spread of AIDS in a country he knows well, South Africa. Finally, To Mr. Allen. He was always there to help and when times looked bleak, there was no doubt we could seek him out for assistance. Most of all, he gave us the chance to experience being part of a team.





These charts show the basic idea of what is going to happen to South Africa, however, not all the random functions have been added in at this time, so it is not as accurate as it could be. We are still working on adding in all the random functions to these charts.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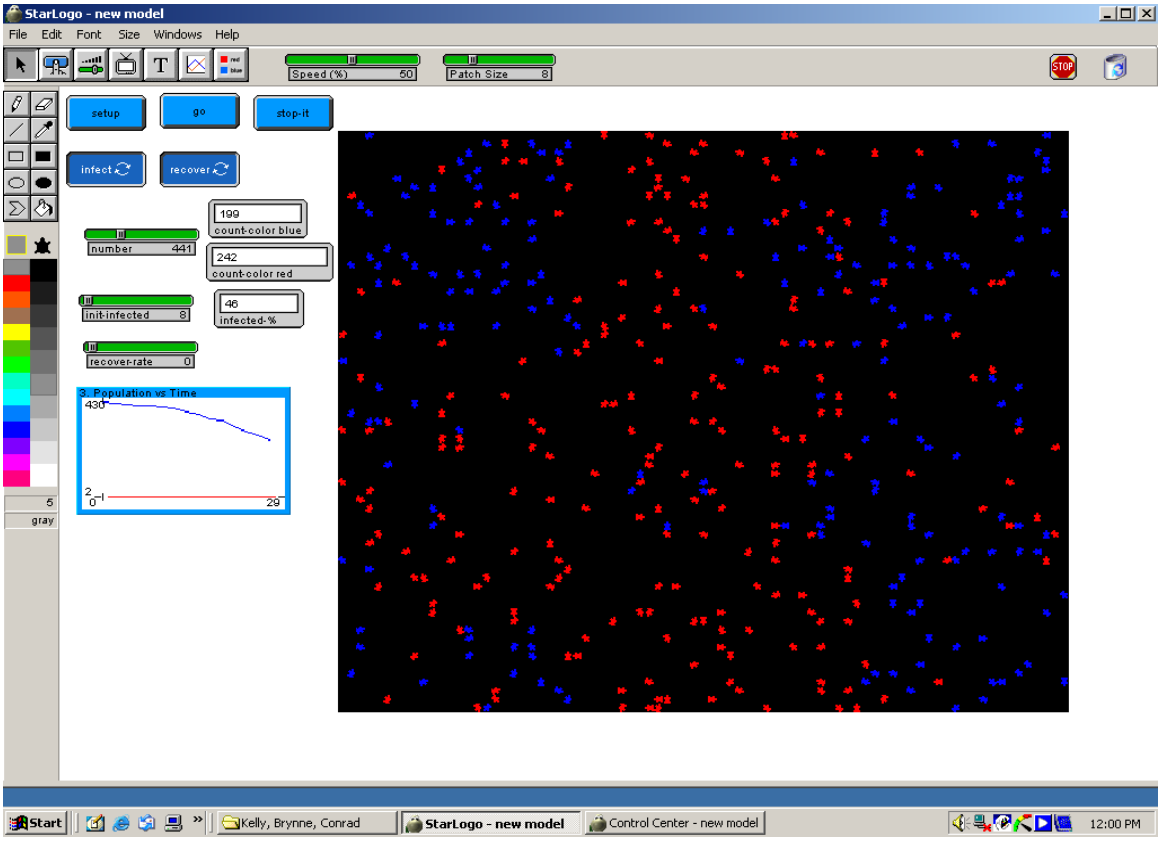
File Edit Font Size Windows Help
Speed (%) 50
Patch Size 8
3. Population vs Time
430
2
0
61
Page 1 Sec 1 1/2 At 5.5" Ln 1 Col 1
Start
StarLogo - new model
Control Center - new model
hi kelly!! - Microsoft Word
12:04 PM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Speed (%) 50
Patch Size 8
setup
go
stop-it
infect
recover
199
count-color blue
number 441
242
count-color red
init-infected 8
46
infected-%
recover-rate 0
3. Population vs Time
430
2
0
29
Start
Kelly, Brynne, Conrad
StarLogo - new model
Control Center - new model
12:00 PM

TURTLE COMANDS

```
turtles-own [sick?]

to infect
  rt random 100
  lt random 100
  fd 1
  if sick?       ;if you're sick, make all the other turtles on your patch sick
    [setsick?-at 0 0 true
    make-sick]
wiggle
end

to recover
  if sick?
    [if (random 100) < recover-rate      ;randomly recover based on the recover-rate slider
      [setsick? false
       make-healthy]]
if pc = green
          [setc red fd 1 wiggle]
end

to make-healthy
  setc red
end
```

OBSERVER COMANDS

```
to make-sick
  setc blue
end

if color = blue
          [wait 11[ die]]
end
to wiggle
  rt random 100
  lt random 100
end
to setup
  ca
  crt number
  ask-turtles
    [setxy random screen-width random screen-height
     setshape 0
     ifelse who < init-infected
       [make-sick
       setsick? true]
       [make-healthy
       setsick? false]]
  clearplots
end

to go
  startinfectbutton
  startrecoverbutton
end

to stop-it
  stopinfectbutton
  stoprecoverbutton
end

to infected-%
  output ((count-turtles-with [sick?]) / count-turtles) * 100
end

count-turtles

count-color red
```