Modeling a Caste System

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Executive Summary

Our original plan for this year's Supercomputing project was to create a model of a society influenced by eugenics. After the Kick Off at Glorieta, though, we decided to re-examine our plan and decided upon a new topic while still retaining a few of our original themes and concepts of our initial project: modeling a caste system. As freshman we had learned about the ancient roots of perhaps the most famous example of such a system, or India, and it was this that sparked our interest in trying to model a caste system. Our new topic in place, we proceeded to try and find information on our chosen area of research, using all of our available resources. One of our team members began to use StarLogo to create a basic model, including five distinct classes based on the research we had gathered about India's castes. As of interim, team twenty-three had a basic, agent-based model, capable of showing the five castes intermingling, breeding however not dying. From there, we continued to work on this model and add variables including death which mirrored what would happen in a real-world scenario. Now, our model is able to simulate disasters as well as "Romeo and Juliet" situations, or cases when breeding occurs between two subjects of different classes. While it is virtually impossible to include all of the numerous variables of life which make the world interesting, our model has definitely covered a few of these scenarios.

Introduction

Project Description

The premise of our project is very simple: we wanted to model a caste system, like that of India. To do this, we created an agent-based model in StarLogo which is capable of simulating certain aspects of our real-world problem, as we will discuss later.

Purpose

As previously stated, we became interested in the Indian caste system during freshman year history class. It is something so unlike what we here in the United States are used to; here, we are raised to believe that no matter one's socio-economic status, he or she has the ability to rise above this and achieve great things. In India, however, the caste system has, historically, prevented such ideas from finding root within the society. People of lower castes are typically forgotten and mistreated, facing violence and hostility. In short, our purpose was to look at a society which is founded on different ideas from the ones we here in the United States are used to and try to find out if this culture can survive and thrive. While our project does not directly appear to affect us, it is important to keep in mind that India is the largest democracy in the world and, as recent history proves, is a country attempting to gain standing in the global community by making nuclear weaponry. India is an important player in our futures and we felt it was important to investigate into its history.

Background Information

Our project, modeling a caste system like that found in India, is one which has its roots in the centuries old religion of Hinduism. The model we have made includes five castes, taken directly from the traditional classes, or *varnas*. The highest group, called

Brahmins, is customarily the priests and scholars, responsible for teaching the lower castes and instructing them in religious dogma. They are the smallest group on our pyramid, being the best educated and having the least amount of children. The next tier down is a group called the *Kshatriyas*, or the warrior class, who are responsible for not only protecting people, but living a life unattached to material possessions. This group is slightly larger than the *Brahmins*, but also well educated and with rather low reproductive rates. The third group is again slightly larger and consists of the *Vaishyas*, or common people, responsible for farming and commerce. The last group included on the pyramid is the largest of the five and is another, lower group of commoners called *Shudras*, meaning "conquered people." Historically, it is thought that this group is the remnants of the Indus civilization, the society present before the entrance of the Aryans who brought with them this caste system.

The final group, considered too lowly to even be included on the caste pyramid, has two names: *Pariahs* and *Dalits*. The former is a more traditional term while the latter is used in contemporary times. They both have the same meaning, though: "untouchable." These people are, traditionally, considered to be sub-human. They do the unglamorous jobs such as being butchers, street cleaners, and brick makers. Basically, they are slaves, unable to gain social status and escape the grasp of their debts which hold them in this "untouchable" caste. In our model, this group is not a direct reflection of reality; we chose to include a hybrid caste, the direct results of the "Romeo and Juliet" scenario, or when subjects breed outside their class.

In India, 80% of the population follows Hinduism and believes in some form of this caste system. While the castes are not as clearly defined in this modern day as they

were when the Aryans first entered India with this new form of organization, the stereotypes of each group lingers. The *Dalits* continue to struggle, fighting for recognition politically, as well as forming underground groups comparable to the Black Panthers in ideology, all in the hopes of being recognized as human beings. Many people still try to perform some of the traditional responsibilities of their class because the caste system is tied directly to their religious beliefs. In order to achieve the end goal of total liberation from body and caste, or *moksha*, a person must perform the duties of each caste perfectly and move up the pyramid. Violating one of the duties of your caste implies that you will be spending your next life in the same social status, or, if the offense is really bad, in a lower class. In short, while the caste system may have faded some from the power hold it previously had over the lives of Indians; it does still hold meaning for the pious.

Description

Our desired conception of the model was a simple model in StarLogo which modeled simple factors of a caste society, inbreeding, the hybrid caste, and population levels amongst the castes. Most of the factors that we wished to model are still there however due to the coding and modeling limitations of StarLogo we had to leave out the factor inbreeding. The factors that we have included are as follows, age, food, health, generation, disasters, caste and within that the inclusion of the hybrid caste.

Age limits how long the turtles can live; using a slider one can adjust the maximum age. Once the turtle reaches that maximum age it will die. Age also limits so that not every single turtle is reproducing, any turtles under the age of 14 cannot perform the “hatch” commands.

Food and health work hand in hand, if the turtle doesn't get enough food then their health will diminish and they will die, so they have to get enough to stay alive. Food is also worth different health values to the different castes. To the highest caste food is worth six, out of 10 maximum health this ensures that Caste 1 stays alive and healthy. To prevent caste 1's population from going totally haywire is that they have a low amount of children for this we set it to a random amount between zero and two. For the lowest caste food is worth two, we say two due to that because they are the lowest caste they would get the least amount of food, and what food they do get it wouldn't be very healthy. To keep them from totally dieing out we have them have a random amount between 0 and 6 children when ever they hatch. For the hybrid caste we set the food value to them being a random amount between 0 and 4. This represents that the hybrid caste either eats decently or not at all. To keep the population low the hybrid caste only hatches one turtle in the hatch command.

The factor of generation is merely thrown in to keep track of how much the castes are and have been breeding.

Disasters was a factor thrown in to keep populations controlled and to represent real world effects a disaster might have on a caste society. Due to the reason that an individual can only reproduce with another individual in the same caste then the highest castes get hit hardest by disasters occasionally getting rid of them entirely.

The caste and hybrid caste idea is the basis for our project. Everything depends on a turtle's caste. If they're high up in the social structure then they're rather healthy and will have fewer offspring. If they're lower in society then they won't be as healthy, however have many offspring. The hybrid caste is there to represent our “Romeo and Juliet”

scenarios where two individuals will breed outside of the caste system. The offspring is not of any caste, and thus is not as included in society; food is either worth a decent amount or nothing. When they do have the opportunity to breed with another they will only have one offspring. The amount and occurrence of the hybrid caste can be adjusted with a slider; this represents societies' strictness toward the random occurrence of an individual of the hybrid caste. In some cases if desired the hybrid caste occurrence slider can be adjusted at maximum which could represent a society free of the bonding laws of a caste society. The closer Hybrid occurrence is to 500 the more hybrids there will be.

Results

Thus far our model modestly represents the social behavior in a caste society; most significant of those behaviors is that individuals within a caste will only reproduce with others from that caste. Furthermore no matter what the starting numbers the social pyramid with highest caste having the smallest population, and the lowest caste having the highest caste, will lay itself out in time. Disaster Response is another modeled effect that emerged from our model, at the highest magnitude a disaster will occasionally eliminate multiple castes. The population graphs show that often the highest castes will be eliminated first due to their low populations, this happens despite their high health. After a disaster, if the color ahead of a turtle is purple it will clean it up and make the patch safe for other turtles to go on, only turtles caught in the path of destruction ever risk death.

Appendix B contains results in table form; our desired results were ones which portrayed the population levels among the different castes similar to the Indian caste system. The population levels we tested are incremented at 100, food levels are

incremented at 50, age levels are at 20 (although in results shown below maximum age was never adjusted). The hybrid occurrence was set at 10 so in this case with maximum hybrid occurrence being 500, there is a 1 in 50 chance that there will be a hybrid born. The results selected are taken from increments of 100 turtle-time up to 400. For each scenario we set up we ran 5 times over, all 5 from each scenario are shown.

Conclusions

We can draw numerous conclusions from our model and from the results shown in Appendix: B. For one, food in a caste society is vitally important in a caste society. As one can see from the results under 100 Starting, 50 Food, 40 Age, 10 Hybrid Occurrence, there was not enough food and often the population was at its peak when the program started out. After several changes and another 10 runs of the same model under different values of the variables, we finally got the conclusive results that we expected. After raising the initial population to 200 we found that the society was more stable, however, we still were not getting the numbers we predicted. After raising the food limit to 100, (200 Starting, 100 Food, 40 Age, 10 Hybrid), on the 2nd run of the model we got a conclusive result which, after 400 turtle time the numbers turned into a population of 28 of caste 1, 119 of caste 2, 309 of caste 3, 468 of caste 4, 646 for caste 5, and 19 hybrids; perfect results. We then became aware that food levels were important in causing the population to plateau. We proceeded to raise the food levels, this time making it equal to the initial population. This way the turtles of all castes could be sufficiently nourished and all 5 of the models were completely conclusive and put out numbers often exceeding 1000, with overall populations often exceeding 3000.

Recommendations

We have a very good, functioning model which accurately mirrors some of the variables which occur in the real world situation of a caste system. If we were to continue this project into next year, though, we would continue to add in more variables in order to see how they affect our caste society. One of the variables we wanted to try and include this year but were unable to accomplish is that of inbreeding. Also, being able to keep the different castes completely separate from one another except for the occasional "Romeo and Juliet" scenario, is something else we feel would be interesting to include in our model.

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Appendix A: Code

-Observer commands

```
to setup
ca
crt numberofturtles + foodrate
ask-turtles [setup]
ask-patches [if (random 100) < 25 [setpc green]]
crt 100
ask-turtles [setup2]
clearplots
end

to total-humans
output count-turtles-with [species = human]
end
```

-Turtle Procedures

```
turtles-own [caste]
turtles-own [generation]
turtles-own [health age species [food human disaster]]

to setup
setxy random screen-width random screen-height
ifelse who < foodrate [setc black ht setspecies food]
        [setc white setspecies human setshape person-shape sethealth random 10
        setcaste random 5 setgeneration 1 setage random maximumlife setcaste random 5]
repeat 20 [grow]
if species = human [if caste = 0 [setc red]]
if caste = 1 [setc blue]
if caste = 2 [setc yellow]
if caste = 3 [setc magenta]
if caste = 4 [setc brown]
end

to setup2
if species not= human [ifelse species not= food [setc violet setspecies disaster setshape
shape-12 ht][stop]]
end

to go
if species = food [stop]
if species = disaster [stop]
wiggle
if pc-ahead-one-patch = violet [stamp-towards 0 1 black]
if species = human [if pc = violet [sethealth health - 10 stamp black]]
```

```
if health >= 7 [if age > 14 [repeat random 2 [if color = red [grab one-of-turtles-here
[hatch [set caste 0 setgeneration generation + 1 setage 1 wiggle]]]]]]
if health > 6 [if age > 14 [repeat random 3 [if color = blue [grab one-of-turtles-here [hatch
[set caste 1 setgeneration generation + 1 setage 1 wiggle]]]]]]
if health > 5 [if age > 14 [repeat random 4 [if color = yellow [grab one-of-turtles-here
[hatch [set caste 2 setgeneration generation + 1 setage 1 wiggle]]]]]]
if health > 4 [if age > 14 [repeat random 5 [if color = magenta [grab one-of-turtles-here
[hatch [set caste 3 setgeneration generation + 1 setage 1 wiggle]]]]]]
if health > 3 [if age > 14 [repeat random 6 [if color = brown [grab one-of-turtles-here
[hatch [set caste 4 setgeneration generation + 1 setage 1 wiggle]]]]]]
if age > 14 [if hybridcaste >= random 500 [grab one-of-turtles-here [hatch [setc white
setgeneration generation + 1 setage 1 setcaste 5 wiggle]]]]
if health > random 5 [if age > 14 [repeat 1 [if color = white [grab one-of-turtles-here
[hatch [set caste 5 setgeneration generation + 1 setage 1 wiggle]]]]]]
death
eatfood
end

to death
if species = food [stop]
if health < 0 [die]
if age > maximumlife [die]
end

to grow
if species = human [stop]
rt random 10 lt random 10
fd 1
if pc-ahead = green [stamp green]
end

to eatfood
if caste = 0 [if pc = green [stamp black sethealth health + 6]]
if caste = 1 [if pc = green [stamp black sethealth health + 5]]
if caste = 2 [if pc = green [stamp black sethealth health + 4]]
if caste = 3 [if pc = green [stamp black sethealth health + 3]]
if caste = 4 [if pc = green [stamp black sethealth health + 2]]
if caste = 5 [if pc = green [stamp black sethealth health + random 4]]
if health > 10 [sethealth 10]
end

to destruct
if species = food [stop]
if species = human [stop]
if species = disaster [st pd fd disastermagnitude pu ht stop]
end
```

```
to wiggle
fd 1
rt random 90
lt random 90
sethealth health - 0.75
setage age + 1
end
```

Appendix B: Results

100 Starting, 50 Food, 40 Age, 10 Hybrid Occurrence

1

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	20	19	17	20	24	/
@100	16	7	18	20	13	0
@200	14	4	32	104	40	1
@300	11	4	32	104	40	1
@400	12	8	76	261	99	4
Peaks	20	19	76	261	99	4

2

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	18	25	19	21	17	/
@100	11	13	19	12	15	0
@200	7	13	22	12	12	2
@300	7	10	33	27	25	1
@400	5	14	72	68	46	2
Peaks	18	25	72	68	46	2

3

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	18	22	18	24	18	/
@100	9	12	13	12	5	1
@200	9	9	14	20	7	0
@300	5	12	17	23	13	3
@400	4	13	22	63	29	5
Peaks	18	22	22	63	29	5

4

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	18	19	21	25	17	/
@100	6	11	28	8	9	1
@200	3	11	41	8	10	3
@300	1	12	69	17	10	6
@400	1	13	133	26	13	9
Peaks	18	19	133	26	17	9

5

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	17	22	17	15	29	/
@100	7	10	8	6	14	0
@200	5	7	6	9	8	0
@300	1	10	3	10	7	0
@400	3	12	3	20	15	0
Peaks	17	22	17	20	29	0

<u>200 Starting, 50 Food, 40 Age, 10 Hybrid</u>

1

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	36	35	45	45	39	/
@100	21	22	34	34	31	2
@200	15	21	34	50	29	3
@300	13	33	72	116	78	9
@400	8	37	116	270	174	30
Peaks	36	27	116	270	174	30

2

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	36	47	36	36	45	/
@100	17	47	24	37	63	5
@200	13	116	45	123	249	10
@300	13	192	68	282	559	28
@400	14	210	93	340	685	39
Peaks	36	210	93	340	685	39

3

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	37	35	43	47	38	/
2600	29	31	46	25	0	
@200	26	26	40	78	30	3
@300	25	45	54	132	46	5
@400	21	69	101	266	89	14
Peaks	37	69	101	266	89	14

4

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	34	43	46	30	47	/
@100	24	21	30	18	32	3
@200	16	19	48	30	62	4
@300	12	30	74	76	146	7
@400	9	48	144	197	359	17
Peaks	34	48	144	197	359	17

5

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	32	33	46	44	45	/
@100	25	21	33	47	19	1
@200	19	29	53	75	23	3
@300	11	54	69	156	36	2
@400	13	85	140	483	118	9
Peaks	32	85	140	483	118	9

200 Starting, 100 Food, 40 Age, 10 Hybrid

1

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	38	37	35	51	39	/
@100	23	27	37	63	35	1
@200	20	36	92	117	107	1
@300	24	59	200	285	216	12
@400	28	135	414	708	583	28
Peaks	38	135	414	708	583	28

2

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	28	57	43	32	35	/
@100	14	47	36	41	47	2
@200	15	54	70	93	77	0
@300	14	84	132	190	218	6
@400	11	119	309	468	646	19
Peaks	28	119	309	468	646	19

3

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	38	37	37	42	46	/
@100	18	33	48	58	37	2
@200	12	43	94	97	66	7
@300	14	77	243	289	226	14
@400	12	137	491	616	648	41
Peaks	12	137	491	646	648	41

4

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	42	51	35	35	37	/
@100	28	44	17	28	18	1
@200	28	52	24	61	25	2
@300	28	73	48	170	49	4
@400	32	131	126	492	182	18
Peaks	42	131	126	492	182	18

5

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	40	33	42	39	46	/
@100	24	21	44	28	49	0
@200	24	21	73	52	111	2
@300	25	48	146	146	336	15
@400	24	74	285	321	781	21
Peaks	40	74	285	321	781	21

200 Starting, 200 Food, 40 Age, 10 Hybrid

1

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
@100	36	33	25	70	68	1
@200	43	55	46	170	167	4
6100	61	129	108	498	618	11
@400	82	210	264	1289	1496	45
Peaks	82	210	264	1289	1496	45

2

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	37	44	34	44	41	/
@100	27	25	30	56	53	2
@200	28	34	73	150	203	5
@300	35	69	160	461	678	16
@400	39	119	377	1054	1565	61
Peaks	39	119	377	1054	1565	61

3

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	45	39	42	41	33	/
@100	29	35	42	70	20	1
@200	33	71	101	178	227	8
@300	51	146	268	499	712	24
@400	61	224	485	1082	1351	58
Peaks	61	224	485	1082	1351	58

4

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	51	35	42	32	40	/
@100	39	40	41	35	71	3
@200	46	47	61	35	71	3
@300	46	47	61	106	188	9
@400	63	120	146	326	714	22
Peaks	87	199	339	737	1658	51

5

	Caste 1	Caste 2	Caste 3	Caste 4	Caste 5	Caste 6
Starting values	37	41	35	36	51	/
@100	23	31	28	42	88	1
@200	19	46	40	77	268	6
@300	22	67	102	237	845	17
@400	24	114	188	595	2228	32
Peaks	37	114	188	595	2228	32