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**Lab 1 Report - CS420**

Introduction

This experiment's objective is to observe the class IV behavior of 1D cellular automata. 390 instances were recorded, observed, and classified. Only 25 of these showed class IV behavior. Some example images of this behavior are at the end of this report.

Calculations

	Lambda	Lambda_t	H	H_t
Average	0.7848571428	0.71703296703	1.94740430556	2.05682508264
Standard Deviation	0.1432893462	0.14832620864	0.20954319081	0.20212761691

The entropy of the totalistic rule table has the best standard deviation when compared to the average of the four values. This is because H_t standard deviation / average is the lowest when compared to the standard deviation / average of the other four. This means it had the lower distribution range during class for behavior. Therefore, it is the biggest indicator for class IV behavior. The graphs below actually visualize the distribution.

Graphs
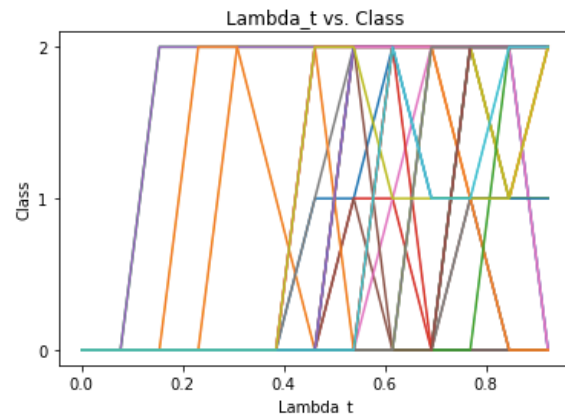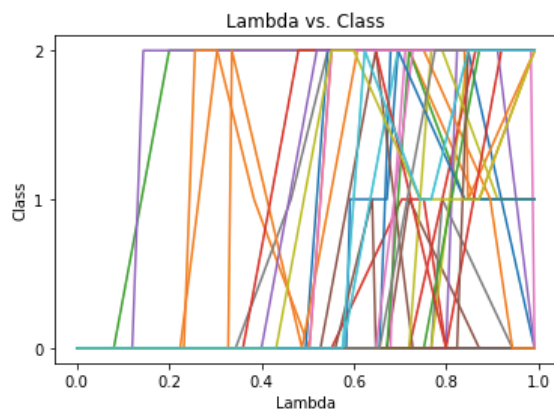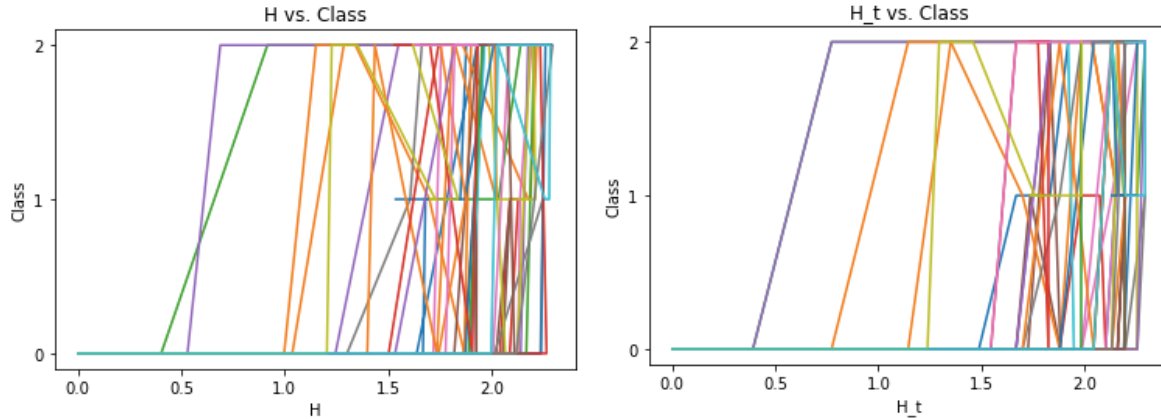
Each graph showed where lambda and entropy values needed to be for class IV behavior to show up in the automaton. Class IV behavior was only observed when the lambda was greater than 0.5 and the entropy was greater than 1.5. For the totalistic rule tables, the entropy was always greater than 1.6 while the lambda was greater than 0.4. The distribution of the entropy of the totalistic rule table was tighter than the other three values as indicated in the graphs above.

Some anomalies were also found. There were a lot of class I and II automata that had high entropy and lambda values despite these usually happening at lower values. Although no class I behaviors were observed during step 0 or 1 of any experiment. Class one behaviors were observed at around 0.6 lambda and 1.7 entropy. This occurrence was not very rare. One class I automaton had entropy as high as 2.1 while another had a lambda value of 0.8. These instances where class one behavior was observed at higher entropy/lambda values always had some movement near the top of the pattern. They were not completely blank aside from the first line of pixels.

Complex (class IV) behaviors were never observed at lower entropy/ lambda values. Class IV behaviors were consistent in this regard because a certain level of randomness (entropy) and consistency (lambda) seems to be necessary to produce these complex patterns. Only a couple instances were recorded featuring class III behaviors at low entropy values, but several instances were recorded at lower lambda values. This means that the level of entropy is

also a more consistent indicator for chaotic (class III) behavior. This would also be expected for instances with chaotic behavior. Below are some recorded examples of class IV behavior.