CS470 Homework Assignment 5

Due date: ________________

General info: Turn in all code on both paper and by email (to dbahr@regis.edu with “CS470 Homework” in the subject line). Use old-fashion paper for everything else. For calculations, please show all your work.

Problem #1: Consider reversible rules (for example, 0R through 255R). How many of these rules will be class I rules? More importantly, why?

Hint: Try experimenting with the CA explorer if you are unsure.

Problem #2: Using the CA Explorer, create a rule that acts as an edge filter in all directions. In other words, your rule should find all of the “outlines” or edges in an image. The edges it finds should be oriented in any and all directions (vertical, and horizontal, and diagonal, etc.).

Turn in your “.java”, and please also email me a “.class”. Also turn in two pictures showing a before and after with your filter. (Please don’t email me gigantic jpegs. A hardcopy is fine.)

Problem #3: Run your edge filter rule for many time steps. Is your filter a member of class I, II, III, or IV? Briefly explain why.

Soon we’ll do a proof that the Game of Life rule is capable of universal computation. Woohoo! That complex proof is based on Turing machines and logic gates. But once somebody has shown that a particular rule (like rule 110) is universal, then it is easy to show that other similar rules are universal.

Problem #4: Matthew Cook has proved that rule 110 is capable of universal computation. Without knowing anything more, prove that rule 137 is capable of universal computation.

Hint: You know rule 110 is capable of universal computation, so your job is done if you can show that rule 137 is essentially equivalent to rule 110. Try writing the rule as 000-> 0, 001-> 1, etc. Now, think about what would happen if you switched the roles of 0 and 1 on both sides. Please be as specific as possible. And be careful, or you might think I made a typo with 137 (I haven’t).