Mathematica Problems on Recurrence Relations (RR) and Cellular Automata (CA) XII

1. You borrow 2500 dollars, at 12 percentage compounded monthly, to buy a computer. If the loan is to be paid back over two years, what is your monthly payment? Note you pay back same amount every month. Plot with command Plot the values of the debt a_n over the 2 years.

2. Consider the map $x_{n+1} = 2\ x_n \pmod 1$ for the starting value $x_0 = 11/24$. You have to modify the program with the new function $g(x) = 2x \pmod 1$. Use the If command when you define $g(x)$. Take away the second part with bifurcation diagram since there is no parameter for this map. Convert the x_n to base base 2. The command BaseForm will help you to do this. How can the iterations be described in base 2?

3. Consider rule 110 (1D CA) and start with one black cell. Run it up to 1000 iterations so let your string be 1000 cells. Note it evolves to the left only. The moving structures you observe are called spaceships and your task is to look at one of them. Try first the periodic sequence 00010011011111. It consists of 14 cells and repeat it 40 times so the string length should now be a multiple of 14. It is called the background. Finally put 0001110111 surrounded by the periodic sequence above. This string has length 10 so start with $14n + 10 + 14n$ cells where n is an integer. What happens? Illustrate with a figure. Useful commands here are: ConstantArray, Flatten, Insert. If you use a For-loop, use AppendTo command.

4. Consider rule 746 (2D CA) and start with the seed ■■■□■ . Plot the difference between 101 and 100 iterations, 102 and 101 iterations, 103 and 102 iterations, 104 and 103 iterations and finally 105 and 104 iterations. Describe what you see. CellularAutomaton produce lists and they can be added and subtracted as with numbers. With 0,1 and 2 in the lists you will get 3 colors, white, grey and black, respectively. **OP**