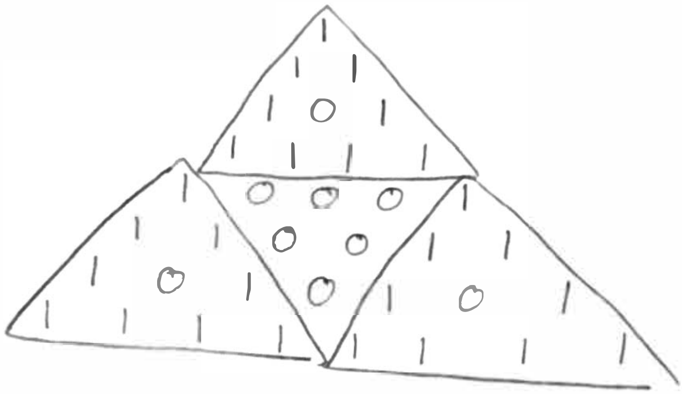
You may post

1)



Pascol's triangle mod 2 [8 rows]

The triangle we drew above is self similar. Since we can build the larger 8 row triangle recursively using the smaller 4 row triangle, it's a fractol In order words, the triangle above represents

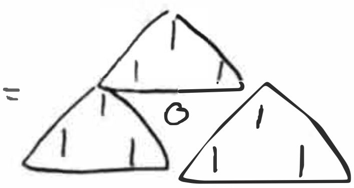
P(n) = P(n/2)
0
P(n/2) P(n/2)

where n is the # of rows in the triangle

We can see that

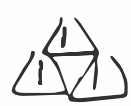
P(8) = P(4)
0
P(4) P(4)

where P(4) =



or P(2)
P(2) 0 P(2)

where P(2) =



or P(1)
P(1) 0 P(1)

where P(1) = 1

P(1) = Base

2) x_(n+1) - ax_n(1-x_n), x_0 = 0.5

(i) a = 1

Doesn't look like it's converging to any number.

First 10	last 10 from 1000
0.5	0.0010003251822699275
0.25	0.0009993245317996443
0.1875	0.0009983258822797876
0.15234375	0.000997329227712558
0.1291351318359375	0.0009963345621241083
0.11245924956165254	0.0009953418795644253
0.09981216674968249	0.0009943511741072105
0.08984969811841606	0.000993362439849762
0.08177672986644556	0.0009923756709128578
0.07508929631879595	0.0009913908614406382

(ii) a = 2.5

Tends towards a single number.
The limiting point seems to be 0.6

First 10	last 10 from 1000
0.5	0.6000000000000001
0.625	0.6
0.5859375	0.6000000000000001
0.606536865234375	0.6
0.5966247408650815	0.6000000000000001
0.6016591486318896	0.6
0.5991635437485985	0.6000000000000001
0.6004164789780495	0.6
0.5997913268741273	0.6000000000000001
0.6001042277017528	0.6

(iii) a = 3.1

Tends towards 2 numbers, the limiting points seems to cycle between (0.7645665...) and (0.558014...)

First 10	last 10 from 1000
0.5	0.7645665199585945
0.775	0.5580141252026958
0.5405625000000001	0.7645665199585945
0.769899519140625	0.5580141252026958
0.5491781736597441	0.7645665199585945
0.7675026724300255	0.5580141252026958
0.5531711927526629	0.7645665199585945
0.7662357552099034	0.5580141252026958
0.5552674202082185	0.7645665199585945
0.7655310880169375	0.5580141252026958

(iv) a = 3.5

Tends towards 4 numbers, the limiting points seem to be (0.50088...), (0.874997...), (0.382819...), (0.826940...)

First 10	last 10 from 1000
0.5	0.8269407065914387
0.875	0.5008842103072179
0.3828125	0.8749972636024641
0.826934814453125	0.38281968301732416
0.5008976948447526	0.8269407065914387
0.87499717950388	0.5008842103072179
0.3828199037744718	0.8749972636024641
0.826940887670016	0.38281968301732416
0.500883795893397	0.8269407065914387
0.8749972661668659	0.5008842103072179

~~2) $x_{n+1} = a x_n (1 - x_n)$~~

~~$x_0 = 0.5$~~

~~(i) $a = 1$~~

3) Define the Feigenbaum constant

We can see that when a is greater that 3 but less than 3.4494897, the period is 2. [period length is the number of unique values of x_n (when n is large) that it cycles]. Let a_n be the bifurcation parameter at which the period changes from 2^{n-1} to 2^n

Then $a_1 = 3$

$a_2 = 3.4494897$

$a_3 = 3.5440903$

$a_4 = 3.5644073$

$\vdots$

And the Feigenbaum constant is

$$\lim_{n \to \infty} \frac{a_{n-1} - a_{n-2}}{a_n - a_{n-1}}$$ which is equal to $\boxed{4.669201609}$