In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
```

Let a differential system be defined as

$$x_{n+1} = \frac{\sin(x_n)}{p}$$

with $p \in \mathbb{R}$.

Algorithm for finding fixed points

To create our bifurcation diagram, we simply iterate

$$x_{n+1} = f(x_n) = \frac{\sin(x_n)}{p}$$

for some x_0 and for different p's. Note that $x^* = 0$ is an attracting fixed point for $p > 1$, since

$$\left|\frac{df}{dx}\right|_{x^*=0} = \left|\frac{\cos(0)}{p}\right| = \left|\frac{1}{p}\right| < 1$$

and becomes a repelling fixed point for $p < 1$, since

$$\left|\frac{df}{dx}\right|_{x^*=0} = \left|\frac{\cos(0)}{p}\right| = \left|\frac{1}{p}\right| > 1$$

The code is in `strogatz-cont.py`.

Although initially there are simple bifurcations (going from right to left), there quickly appears some chaotic phases, followed by simple bifurcations "breaks" inbetween.

Just a side node: for each (p, x^*), I plotted its corresponding *pixel* in the plane. So when it's all blue, (basically) *all* single pixels are blue/are a fixed point.

Below is the Lyapunov exponents' plot, against p.