Potential functions

In this assignment we will look at the potential function used in the study of Tuller, Case, Ding and Kelso (1994). Perform the following steps:

Open an Excel worksheet on your pc. Be sure to check the following settings! Probably, the ‘comma’ is the decimal sign, like in the text below. If not, be sure to change everything in the text to the ‘point’. (Remember the assignment of Meeting 2, and look back at the instructions there for help.)

1. Try to construct and plot the potential function these researchers used to explain their results. This potential function has the following form:

   $V(x) = kx - x^2/2 + x^4/4$.

   The parameter k is the control parameter in the model. To start, take k = 0.

   Tips: Use a range for x from –2 to +2 and a range for V from –2 to +2.
   This is not an iterative function!

2. Now plot at the potential function for different values of the parameter k. Try (at least) the values k = -1 → -0.5 → -0.25 → 0 → 0.25 → 0.5 → 1. Look closely at what happens to the shape of the function. What does this mean for the stable patterns of the system that ‘behaves’ according to this potential function?

   Tip: Start with a ball in the right well… What happened to the ball?

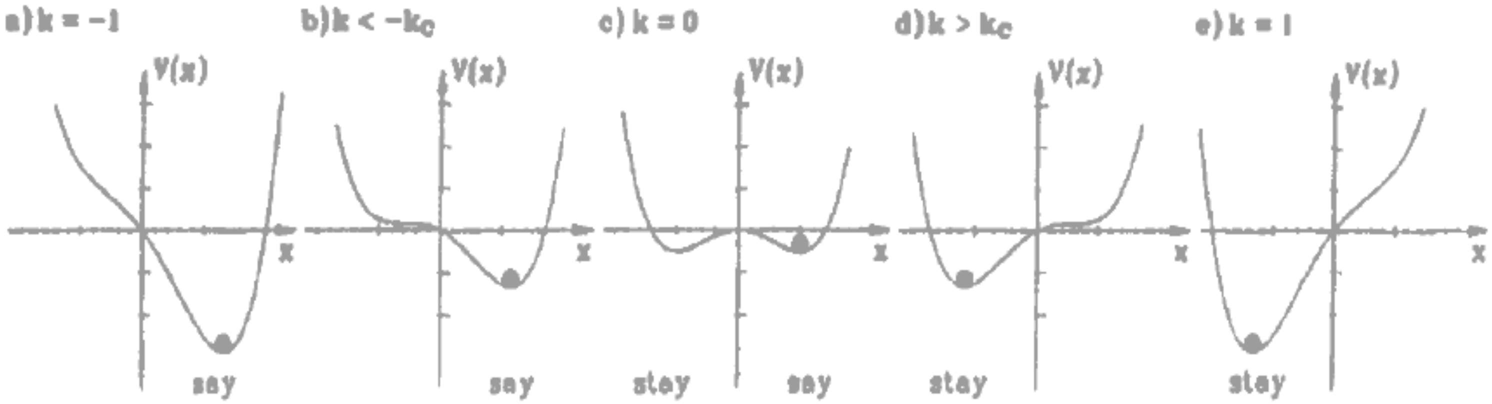

Fig. 5. Hypothetical potential-landscape illustrating the varying perception of “say” vs. “stay” as the parameter *k* changes. [From Case, P., Tuller, B., Mingzhou, D., & Kelso, J.A.S. (1995)

3. Potential function in MATLAB (or R)
   As we have shown earlier the equation for the potential function is: $\frac{dx}{dt} = -\frac{dV(x)}{dx}$

   V is described by: $V(x) = kx - \frac{x^2}{2} + \frac{x^4}{4}$

Where k is the control parameter.

a. Open an editor window in MATLAB (file -> new -> m-file)
b. First we give the k-parameter a value, write **k = -1;**
c. Then we decide a range for values of x, write **x = [-2:0.1:2];**
   If you run this, it will create a vector in MATLAB with values ranging from -2 to 2 in increments of 0.1.
d. Now we have to write down the formula. Try this yourself (if it doesn't work check the answer). Start with **V =** and write the formula after the equal sign.
e. Now we have to plot the formula. Remember we are plotting: $\frac{dV(x)}{dx}$
   So we plot V against x, by the command: **plot(x,V);**
f. Now we can run this script. Select all you have typed and press F9.
g. Note: You can check all the values in MATLABS workspace, double click a variable or a vector and you will see the array editor.
h. Play around with different values of the k-parameter, use -1; -0.5; 0; 0.5; 1