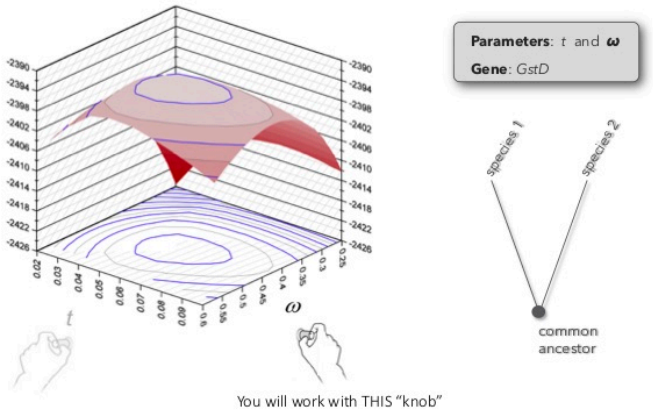
Exercise 1

The objective of this activity is to use CODEML to evaluate the likelihood of the *GstD1* sequences for a variety of ω values. Plot log-likelihood scores against the values of ω and determine the maximum likelihood estimate of ω. Check your finding by running CODEML's hill-climbing algorithm.



1. Find the input files for Exercise 1 (**ex1_codeml.ctl, seqfile.txt**) and familiarize yourself with them. Pay close attention to the contents of the modified control file called **ex1_codeml.ctl**.

2. Remember to create a directory where you want your results to go, and place all your files within it. Now open a terminal, move to the directory that contains your files. When you are ready to run CODEML, delete the **ex1**_ prefix (the control file must be called **codeml.ctl**). Now you can run CODEML.

3. Familiarize yourself with the results (see annotations in ex1_ HelpFile.pdf). If you have not edited the control file the results will be written to a file called **results.txt**. Identify the line within the results file that gives the likelihood score for the example dataset.

4. Now *change and save* the control file and re-run CODEML for a different fixed value of ω. The control file "quick guide" might be helpful here (quick guide). The objective is to compute the likelihood of the example dataset given a fixed value of ω. *Change the control file as follows*:

    - Change the name of your result file (via `outfile=` in the control file) or you will

overwrite your previous results!

- Change the fixed value for omega by changing the value for `omega=` in the control file. The values for this exercise are provided as comments at the bottom of the example control file that has been provided to you.

5. Repeat Step 4 for each value of ω according to the comments of the example control file (*e.g.*, ω = 0.005, 0.01, 0.05, 0.1, 0.2, 0.4, 0.8, 1.6, 2.0).

6. Use your favorite spread sheet or statistical package to plot the likelihood score (y-axis) against the fixed value for omega (x-axis). Use a logarithmic scale for the x-axis (do not transform ω). Your figure should look something like this: ex1 plot template.pdf (note: the data points have been intentionally omitted from this version of the plot; you need to generate the data for yourself).

    - For help plotting your results see the additional resources on this page.

7. From your plot, try to answer this question:

    - *What is the value of ω that will maximize the likelihood score (i.e., the MLE)*?

8. Now change the control file so that CODEML will use its hill-climbing algorithm to find the MLE; set `fix_omega=0` in the control file. Compare the result to your guess from Step 7.

    - *How good was your estimate of the MLE*?