Homework A

In the data file perturbations.dat, we have recorded a series of perturbations (y) from three different environments (stable, neutral, and transient). Assume a learner that estimates the perturbation using the following equations:

$$\hat{y}^{(n+1)} = \hat{y}^{(n)} + \eta e^{(n)}$$

$$e^{(n)} = y^{(n)} - \hat{y}^{(n)}$$

Plot the response of the learner ($\hat{y}$ on each trial) for each environment. Plot "learning from error" (ηe) as a function of error magnitude after exposure of a naïve learner to each of the environments.

You can assume that the naïve error sensitivity is 10% (i.e. $\eta = 0.1$)

Homework B

Using the environments from A (perturbations.dat), Assume a learner that updates it's error-sensitivity according to the following rules:

$$\hat{y}^{(n+1)} = \hat{y}^{(n)} + \eta^{(n)} e^{(n)}$$
$$e^{(n)} = y^{(n)} - \hat{y}^{(n)}$$

$$\eta\left(e^{(n)}\right) = \sum_i w_i g_i\left(e^{(n)}\right)$$

$$g_i\left(e^{(n)}\right) = \exp\frac{-\left(e^{(n)} - \breve{e}_i\right)^2}{2\sigma^2}$$

$$\mathbf{w}^{(n+1)} = \mathbf{w}^{(n)} + \beta\,\mathrm{sign}(e^{(n-1)}e^{(n)})\frac{\mathbf{g}\left(e^{(n-1)}\right)}{\mathbf{g}^T\left(e^{(n-1)}\right)\mathbf{g}\left(e^{(n-1)}\right)}$$

The objective is to estimate the amount of learning across error magnitudes. Plot "learning from error" (ηe) as a function of error magnitude after exposure of a naïve learner to each of the environments. Additionally, plot the response of the learner ($\hat{y}$ on each trial) for each environment.

You can assume that the naïve error sensitivity is 10% across all error magnitudes, and that the SD of the underlying Gaussian basis set is 0.5. Additionally assume that learners update their weights with a beta value of 0.001 (i.e. $\beta = 0.001; \sigma = 0.5$). Make sure you assign enough bases to adequately cover the error space.

Why are these curves nearly symmetric about an error of 0 when the perturbations are strictly positive?