ASSIGNMENT 6 — ERROR-BASED LEARNING

For all questions below, provide all programming code and plots in the report.

One-State Model (6 Marks)

1. Let us assume a participant is performing a visuomotor rotation task. There are 50 baseline trials without rotation, then 50 adaptation trials with a $30°$ rotation, followed by 50 washout trials with no rotation.

   a. Assume only an adaptation rate ($B = 0.2$). Plot the adaptation and error curves. 3 marks.

   b. Now include a retention rate ($A = 0.98$; $B = 0.1$). Plot the adaptation and error curves. 1 mark.

2. A participant performs 25 baseline trials without rotation, then 75 trials with a $30°$ rotation, 10 trials with a $-30°$ rotation, followed by 40 washout trials with no perturbation. Assume $A = 0.98$; $B = 0.1$.

   a. Plot the adaptation and error curves. 1 mark.

   b. Assume the following are clamp trials: [27, 36, 45, 53, 62, 71, 80, 89, 98, 110-150]. Plot the adaptation and error curves. 1 mark.

Two-State Model (6 marks)

3. A participant performs 25 baseline trials without rotation, then 75 trials with a $30°$ rotation, 10 trials with a $-30°$ rotation, followed by 40 washout trials with no perturbation. Assume $A_s = 0.998$, $B_s = 0.049$, $A_f = 0.597$, $B_f = 0.227$.

   a. Plot the fast state (X_f), slow state (X_s), net adaptation (X_{net}), and error. 2 marks.

   b. Assume the following are clamp trials: [27, 36, 45, 53, 62, 71, 80, 89, 98, 110-150]. Plot X_f, X_s, X_{net}. 1 mark.

4. Fit the two-state model to X_{net} from **3b** above. Make your initial parameter guesses as follows: $A_s = 0.994$, $B_s = 0.025$, $A_f = 0.521$, $B_f = 0.268$ (**Graduate Only**):

   a. Plot X_f, X_s, X_{net} from the best-fit parameters, and list the best-fit parameters. 3 mark.

Additional Questions (3 marks)

5. What is a real-world example of generalization (other than the example in class)? 1 mark.

6. What type of error will the nervous system most likely store? 1 mark.

7. Why is motor variability more important in reinforcement learning than error learning? 1 mark.