The goal of this homework is to get you familiar with the Shifting Expert Framework and Matlab. You are to implement some on-line learning algorithms in relation to the long-term memory effect and plot various performance curves.

Do one of the following three problems. The first one is the easiest. We sort of know what to expect and have lots of material to help you along. For the second one there is also basic and you have a paper to go by. The third one is newer to us and has more of a research flavor.

1 Diskspindown Problem

Base task:
Implement the disk idle time prediction algorithms given in original paper (see link for Lecture 2).
Plot the total energy usage of the master algorithm, the individual experts, and the optimal algorithm. For your master algorithm use the exponential update with the loss function given in the paper followed by one of the mixing updates.
Plot the weights of the experts over time.
Summarize your results in a short report. In particular, carefully describe your plots and the versions of the updates used.

Besides the base task you should do at least one of the following:

• Study the effects of using different sets of fixed time outs as experts and different learning rates
• Try different mixing updates (Fixed share to start vector / fixed share to uniform past / fixed share to decaying past / variable share updates).
• In the original paper each expert is a fixed time out strategy. Use other simple rules of thumbs as experts
• Make up artificial data sets (As in the [BW] paper) to study the effects of different share updates
• Any other idea you might have

Be sure to visualize your results and remember, presentation is what counts.
The data is accessible via a link of the webpage. Good parameter values can be gleaned from the talks and papers.
Begin by reading the original Spin Down paper and "Shifting Expert's" papers as much as possible.

2 Mixing updates

Base task:
Implement the some of the mixing updates algorithm given in the original long-term memory paper (paper, talk)
Roughly repeat the plots given in figures 2,3,4. Summarize your results in a short report. In particularly, carefully describe your plots.

Besides the base task you should do at least one of the following:

• Study the effects of different mixing schemes discussed in Section 5.2 of the paper (see also slide 22 of talk).
• Study "racheting". Does it work best if the overlayed experts are similar or different.
• What are the two regimes exhibited in Figure 8? What are the functions describing the two schemes?
• Any idea you might have re. the longterm memory effect.
  – How is it implemented in nature?
  – Does animal learning have a similar long-term memory effect?
  – What experiments would prove your conjectures.

Be sure to visualize your results and remember, presentation is what counts.
Begin by reading the original long-term memory paper and the associated talk.
3 Building a caching strategy from a number of base strategies

Implement the algorithms discussed in class. The setup is more involved. Only suggest this topic if you have some experience with implementing on-line algorithms in Matlab.

You can brainstorm with others but must do your own experiments and report.

My grad student Nie Jiazhong can help with implementation questions. He also has good data for the caching application.