Song

写邮件来进行最近几天的学习汇报。

依据你的要求，我尽量使我的学习的路线与我们tutorial outline的内容相一致。例如Kalman Filter 和 Particle Filter都在outline上，而贝叶斯推断和HMM是书本Advanced Digital Signal Processing and Noise Reduction中的两个重要章节。

我最近的学习路线按照时间顺序如下：

1. 学习了2.5本基础的数学书（分别是 Elements-of-Mathematics, Power-of-Matrix, Essentials-of-Probability-and-Statistics）
2. 一些基础的算法的公式推导 LR，SVM，PCA
3. 贝叶斯推断 -> EM -> HMM -> Kalman Filter
4. 阅读书本ADSPNR 中的相关章节，并对书中缺失细节进行补充

以下是学习的一些收获：

1. 3本数学基础的书：

以可视化的方式积累了培养了一些数学直觉，比如梯度

熟悉了概率论和线性代数的融合，即高维度的概率表示

1. 一些基础的算法的公式推导，如LR，SVM，PCA：

积累了关于优化的入门知识，以及熟悉ML模型推导

1. 贝叶斯推断 -> EM -> GMM -> HMM -> Kalman Filter：

之所以这么个学习顺序，是因为他们之间有依赖关系。EM中广泛使用贝叶斯公式，GMM需要用EM的框架进行迭代求解，HMM中的一部分也依赖于EM进行求解，而Kalman Filter本质上和HMM都是Dynamic Model

1. 看你推荐的书本ADSPNR

从page 106 - 156， chapter5的所有，Chapter6中的一半内容，进行大量的缺失细节的补充，以及公式的推导。

关于这些书本阅读时的细节补充和笔记。以及我最近所有的学习内容资料和使用的时间统计表格，都放在了这个链接中：

在学习中遇到的问题

1. 那本书，太太太太理论化，符号和推导的复杂程度远超了一般的参考资料，逼近prml。以这本书作为主教材进行学习是非常困难的。同时，目前来看（前6个chapter）中的内容，不能够翻译成代码，然后在我们的SCG信号中进行尝试。
2. Tutorial Outline中的内容Particle Filter和HMM以及Kalman Filter本质上都是Dynamic Model，但是Particle Filter的原理突然变的过于困难了。需要搁置一下它的学习。
3. 之前在Signals and Systems上花费的时间过多，但学习的效果不太好。我下面几周会先画些时间学积分变换这门课，再接着Signals and Systems以及Digital Signal Processing这两门课程的学习

如果我的学习路线有什么问题，非常期待你能给出相关的指导。

非常感谢你的时间与指导。

Study Progress Report

Dear Prof Song,

I hope this email finds you well. I wanted to provide you with an update on my recent learning activities over the past few days.

In accordance with your guidance, I tried to align my study path with the outline of our tutorial. For instance, both Kalman Filter and Particle Filter are included in the outline, while Bayesian Inference and Hidden Markov Models (HMM) are two essential chapters from the book "Advanced Digital Signal Processing and Noise Reduction."

Here is a summary of my recent study progress in chronological order:

1. I have delved into 3 fundamental mathematics books, namely "Elements of Mathematics," "Power of Matrix," and "Essentials of Probability and Statistics."

2. I have derived formulas for some basic algorithms, including Linear Regression (LR), Support Vector Machine (SVM), and Principal Component Analysis (PCA).

3. I have progressed through the following sequence: Bayesian Inference -> Expectation-Maximization (EM) -> Hidden Markov Models (HMM) -> Kalman Filter.

4. I have read relevant chapters from the book "Advanced Digital Signal Processing and Noise Reduction", took notes and filled in any missing details from the book.

Here are some of the learning achievements:

1. Foundational Mathematics Books:

- I've developed an intuitive understanding of certain mathematical concepts, such as gradients, through visual representation.

- I've become familiar with the integration of probability theory and linear algebra, especially in the context of high-dimensional probability representations.

2. Derivation of Basic Algorithm Formulas (LR, SVM, PCA):

- I've accumulated introductory knowledge about optimization.

- I've gained proficiency in deriving formulas for machine learning models.

3. Sequential Learning Path (Bayesian Inference -> EM -> GMM -> HMM -> Kalman Filter):

- The reason for following this particular learning sequence is the interdependency among these topics. Bayesian Inference is extensively utilized in the EM algorithm. Gaussian Mixture Models (GMM) require an EM framework for iterative solving. Some aspects of Hidden Markov Models (HMM) also rely on EM for solving. Both Kalman Filter and HMM are fundamentally dynamic models, making their study sequence logically connected.

4. Study of the Book "Advanced Digital Signal Processing and Noise Reduction":

- I have thoroughly covered pages 106 to 156 of the book, including all of Chapter 5 and half of Chapter 6.

- During this process, I focused on supplementing missing details and conducting formula derivations.

I have compiled detailed notes and supplementary materials from the books I've been reading. I have also created a time log to track my study hours and progress. You can access all these resources through the following link: [Insert Link].

Here are some challenges I've faced:

1. Complexity of the Book: The book is exceptionally theoretical, with a level of complexity in symbols and derivations that exceeds typical reference materials. It is almost comparable to "Pattern Recognition and Machine Learning (PRML)." Using this book as the primary learning resource has been quite challenging. \*\* Furthermore, I have found that the content covered in the first six chapters may not be directly applicable to coding and experimentation within our SCG signal context. \*\*

2. Complexity of Particle Filter: While Particle Filter, Hidden Markov Models (HMM), and Kalman Filter all fall under the category of Dynamic Models, I have encountered unexpected difficulties in understanding the principles behind Particle Filters. Consequently, I want to temporarily postpone in-depth study of this algorithm.

3. Time Allocation for Courses: I realized that I may have devoted too much time to the "Signals and Systems" course without achieving the desired level of understanding. To address this, I plan to allocate some time in the coming weeks to study integral transformations. Afterward, I will resume my studies in "Signals and Systems" and "Digital Signal Processing."

If there are any issues with my learning path, I am very much looking forward to your guidance. Thank you very much for your time and guidance!

Best regards,

Jiayu Chen