I. Rationale:
This course is an advance graduate course for senior graduate students who are interested in conducting research in spectral methods and reinforcement learning. We will have a mixture of lectures and paper presentations. The syllabus presented is tentative and might be adjusted during the semester accordingly.

II. Course Description:
This course will focus on advanced machine learning algorithms that have provable guarantees. In this course, we will focus on surveying various fundamental algorithms whose performance can be rigorously analyzed. Two major fields will be introduced: spectral methods and reinforcement learning. We will cover spectral methods related topics such as nonnegative matrix factorization, tensor decomposition, sparse coding, learning mixture models and matrix completion. Introductory materials in reinforcement learning such as Markov decision process, value iteration and regret bounds will also be covered.

III. Format and Procedures:
Multiple topics, as listed in the syllabus, will be covered in this course. The students are expected to take the initiative to read and present papers in groups after the instructor covers the basics of that topic, or scribing notes.

The most important part of this course is the course project. A list of projects will be suggested, but you are encouraged to come up with your own ideas. Therefore, it is a great idea to start thinking about your project since the first day of this course. You are free to either form groups of no larger than two or work on the project by your own.

IV. Course Requirements:
a. Prerequisite: Strong math background, completion of courses in probability, linear algebra, algorithms and theory of computation.

b. Class attendance and participation policy: You are required to attend all the sessions. In case of emergency, send the instructor an email note. There will be 27 sessions in total, and a maximum of 4 graceful sessions are allowed for unexpected emergencies.

c. Course readings: Before each session starts, presenters should be well prepared for the paper presentation. Attendees are also required to read the papers for efficient discussions.

V. Grading Procedures:
   a. Participation: 10%.
   b. Paper presentation: 30%.
   c. Course project: 40%. A report and a final presentation.
   d. Note scribning: 20%. There are 27 sessions in total. Each attendee is required to sign up for one session scribning.

VI. Tentative Course Schedule (May change to accommodate presenters & student needs)

Related papers are listed (not a complete list yet). Each presenter is encouraged to choose one and present.

<table>
<thead>
<tr>
<th>#</th>
<th>Topics</th>
<th>Detailed Schedule</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>1</td>
<td>August 29</td>
<td>Intro Nonnegative Matrix Factorization</td>
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<td>NNMF Intro Algebraic Algos</td>
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<td>2</td>
<td>August 31</td>
<td>Nonnegative Matrix Factorization</td>
<td>Algebraic Algos Stability and Separability</td>
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<td>3</td>
<td>September 5</td>
<td>Nonnegative Matrix Factorization</td>
<td>Stability and Separability Topic Models</td>
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<td>4</td>
<td>September 7</td>
<td>Tensor Methods</td>
<td>TBD</td>
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<td>September 12</td>
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<td>September 14</td>
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<td>September 19</td>
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<td>8</td>
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<td>Dictionary Learning</td>
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<td>Dictionary Learning</td>
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<tr>
<td>11</td>
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<td>Gaussian Mixture Models</td>
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<tr>
<td>12</td>
<td>October 5</td>
<td>Gaussian Mixture Models</td>
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NNMF Introduction

NNMF Algebraic Algorithms

**NNMF Stability and Separability**

**NNMF Topic Models**
VII. Academic Integrity
Each student in this course is expected to abide by the University of Maryland Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. For this course, collaboration is allowed in the instance of course project.

You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

VII. Accommodations for students with disabilities
In compliance with the University of Maryland policy and equal access laws, I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations.

VIII. Inclusivity Statement
We understand that our members represent a rich variety of backgrounds and perspectives. The computer science department is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we must learn from each other in this community
- value each other’s opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- use this opportunity together to discuss ways in which we can create an inclusive environment in this course and across the UMD community