9.520/6.860: Statistical Learning Theory and Applications

- Class: Tue, **Thu 11:00 am - 12:30 pm**, Zoom link available on Canvas
- Office Hours: **Friday 1:00 pm - 2:00 pm**, Zoom link available on Canvas

- Web: [https://cbmm.mit.edu/9-520](https://cbmm.mit.edu/9-520)
- Contact: [9.520@mit.edu](mailto:9.520@mit.edu)
- 9.520/6.860 will use Canvas: [https://canvas.mit.edu/courses/4639](https://canvas.mit.edu/courses/4639)
- Also check Canvas announcements for updates
Material

Slides— will be posted (for most lectures) on the website and Canvas

Videos— Recordings of Zoom lectures will be made available on Canvas

Notes—

L. Rosasco and T. Poggio, Machine Learning: a Regularization Approach, MIT-9.520 Lectures Notes, Manuscript, (will be provided)

For feedback on book (typos, errors, ...)
https://goo.gl/forms/pOcewnsAV3ICNoyr1
Faces

Instructors:
Faces

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  - Lorenzo Rosasco
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  - Tomaso Poggio
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  - Akshay Rangamani (head TA 1)
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  - Akshay Rangamani (also head TA 1?)
  - Andy Banburski (also head TA 2?)
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  • Akshay Rangamani (also head TA 1?)
  • Andy Banburski (also head TA 2?)

• TA:
  • Michael Lee
## Syllabus at a Glance

<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Title</th>
<th>Instructor(s)</th>
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<tbody>
<tr>
<td>Class 01</td>
<td>Tue Sep 01</td>
<td>The Course at a Glance</td>
<td>TP</td>
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<tr>
<td>Class 02</td>
<td>Thu Sep 03</td>
<td>Statistical Learning Setting</td>
<td>LR</td>
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<td><strong>Nov Sep 07 - Labor Day</strong></td>
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<tr>
<td>Class 03</td>
<td>Tue Sep 08</td>
<td>Regularized Least Squares</td>
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<td>Class 04</td>
<td>Thu Sep 10</td>
<td>Features and Kernels</td>
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<td>Class 05</td>
<td>Tue Sep 15</td>
<td>Logistic Regression and Support Vector Machines</td>
<td>LR</td>
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<td>Class 06</td>
<td>Thu Sep 17</td>
<td>Learning with Stochastic Gradients</td>
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<td>Class 07</td>
<td>Tue Sep 22</td>
<td>Implicit Regularization with linear networks</td>
<td>LR</td>
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<td>Class 08</td>
<td>Thu Sep 24</td>
<td>Learning with Random Features</td>
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<td>Class 09</td>
<td>Tue Sep 29</td>
<td>Approximation and Estimation Error</td>
<td>LR</td>
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<tr>
<td>Class 10</td>
<td>Thu Oct 01</td>
<td>Stability of Ridge Regression</td>
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<tr>
<td>Class 11</td>
<td>Tue Oct 06</td>
<td>Condition Number, Overparameterization, Puzzles, Stability of Ridge Regression</td>
<td>TP + AR</td>
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<tr>
<td>Class 12</td>
<td>Thu Oct 06</td>
<td>Introduction to Deep Networks</td>
<td>LR</td>
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<td><strong>Nov Oct 12 - Columbus Day</strong></td>
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<tr>
<td>Class 13</td>
<td>Thu Oct 16</td>
<td>Deep Learning Theory: Approximation</td>
<td>TP</td>
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<td>Class 14</td>
<td>Tue Oct 20</td>
<td>Deep Learning Theory: Dynamics of training</td>
<td>TP + AB</td>
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<td>Class 15</td>
<td>Thu Oct 22</td>
<td>Dynamics of training: square loss</td>
<td>TP</td>
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<td>Class 16</td>
<td>Tue Oct 27</td>
<td>Deep Learning Theory: Generalization puzzles</td>
<td>TP</td>
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<td>Class 17</td>
<td>Thu Oct 29</td>
<td>Neural Networks and the Brain</td>
<td>TP</td>
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<tr>
<td>Class 18</td>
<td>Tue Nov 03</td>
<td>Invariances in the visual pathway</td>
<td>TP + VH</td>
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<tr>
<td>Class 19</td>
<td>Thu Nov 05</td>
<td>Biophysics of neurons and synaptic plasticity</td>
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<td>Class 20</td>
<td>Tue Nov 10</td>
<td>Programming brain routines with recurrent networks</td>
<td>SU</td>
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<td><strong>Nov Nov 11 - Veteran's Day</strong></td>
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<td>Class 21</td>
<td>Thu Nov 12</td>
<td>Compression and generalization</td>
<td>SA</td>
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<td>Class 22</td>
<td>Tue Nov 17</td>
<td>Guest Lecture</td>
<td>TBD</td>
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<td>Class 23</td>
<td>Thu Nov 19</td>
<td>Guest Lecture - Bias, Fairness, Accountability</td>
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<td><strong>Sat Nov 21 - Sun Nov 29 - Thanksgiving Break</strong></td>
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<td>Class 24</td>
<td>Tue Dec 01</td>
<td>Guest Lecture - Neuronal Ensembles</td>
<td>CP + SV</td>
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<td>Class 25</td>
<td>Thu Dec 03</td>
<td>Guest Lecture - Adversarial Attacks, Robust Training</td>
<td>AM</td>
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<td>Class 26</td>
<td>Tue Dec 09</td>
<td>Guest Lecture</td>
<td>TBD</td>
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<td><strong>Wed Dec 09 - Project reports due</strong></td>
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Grading policies

**Problem sets (0.33)**
- 3 problem sets (0.11 each)
  - 2 - 3 questions (exercises and/or MATLAB)
  - Due in 10 days (out on a Thursday, and due on Sunday)
- Late policy on next slide
- typeset in LaTeX (template will be provided)
- Online submission on Canvas by due date

**Project (0.34)**
- See later

**Class Participation (0.33)**
- *Attending class lectures is required!*
- Discussions on Zoom during class - ask questions!
- Discussions on Canvas
- Students will be assigned a lecture to prepare a set of notes (typeset in a LaTeX template).
Problem sets

- Problem sets (0.33)
  - 3 problem sets (0.11 each)
    - 2 - 3 questions (demonstrations/exercises + short MATLAB)
    - 10 days due!
  - typeset in LaTeX (template provided)
  - online submission on Canvas by due date

Late policy

- All students have 6 free late days (to be used on psets and project proposal)
- You may use them as you see fit
- Beyond this, we will not accept assignments

- Dates (due times are 11:59 pm). Submission online (on Canvas).
  - Problem Set 1, out: Thu. Sep. 10, due: Sun. Sep. 20
  - Problem Set 2, out: Thu. Oct. 01, due: Sun., Oct. 11
  - Problem Set 3, out: Thu. Oct. 22, due: Sun., Nov. 01

- Collaboration policy: You may discuss with others but need to work out your own solution.
Students will be assigned groups of three and assigned a lecture to prepare lecture notes for.

- Use overleaf to collaborate!
- Students may use the lecture recordings, slides, and any other resources they deem appropriate to prepare the lecture notes.
- LaTeX template will be provided
- Online Submission through canvas within 2 weeks of the assigned lecture.
This is not a data science course, so we will not consider data preparation as contributing to the grade.

**Final Evaluation:**
- Presentation (for about 15 minutes)

**Dates**
- Abstract and title: Nov. 3
- Feedback and approval: Nov. 10
- Final Presentations: Dec. 9/10