Motivation
Based on our experience as students and GSIs, disparate math backgrounds among incoming students
- May amplify existing inequities
- Significantly affect first-year PhD experience surrounding coursework
- Impacts learning in CHEM 220A / 221A

Low self-reported comfort in relevant topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Comfort</th>
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<th>Comfort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourier analysis</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Series expansions of functions</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Dirac notation</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>High-dimensional vector spaces</td>
<td>2</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Basis decomposition of vectors</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Solving differential equations</td>
<td>1</td>
<td>2</td>
<td>1</td>
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</tbody>
</table>

Mathematics intervention in a bootcamp format is known to positively impact knowledge and self-efficacy scores in short and long-term.

Pedagogical decisions for math bootcamp
- Flipped classroom
- Taught critical concepts for CHEM 220A / 221A
- Content builds on curated mathematical resources
- Emphasized growth mindset and inclusive practices
- Small groups worked directly with instructors
- In-person and fully remote course options

Content & structure

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration &amp; Differentiation</td>
<td>Coding in Python</td>
<td>Transformations</td>
<td>Fourier Analysis</td>
<td>Numerical Approaches to Diff. Eq.</td>
</tr>
<tr>
<td>Functions &amp; Approximations</td>
<td>Vectors &amp; Vector Spaces</td>
<td>Matrix Algebra</td>
<td>Analytic Approaches to Diff. Eq.</td>
<td>Probability &amp; Statistics</td>
</tr>
<tr>
<td>Calculus</td>
<td>Functions</td>
<td>Coding</td>
<td>Linear Algebra</td>
<td>Differential Equations</td>
</tr>
</tbody>
</table>

Student engagement
- Ten in-person instructional sessions across six subjects
- Students completed daily feedback forms for real-time course adjustments
- Significant time investment across all materials

Bootcamp by the numbers

50 students
110 pages of content
20 hours with students
100 problems
8+ discussion groups

Timeline
- Recruited assistant instructors
- Distributed bootcamp packet
- Bootcamp start
- Bootcamp end
- Final survey

Change in Confidence Levels

2021:
- Average pre survey value
- Average post survey value

2020:
- Confident in...

Qualitative feedback
- CHEM 220A/221A instructors indicate fewer math computation confusions, more group problem solving, remaining challenges translating between physics and math

Future goals & directions
1. Institutionalization of Math Bootcamp as part of CoC orientation
2. Engaging a broader range of students as Bootcamp instructors to reinforce relationships between cohorts and research groups
3. Incorporating more time for new students to build community
4. Securing funding to compensate instructors
5. Sharing content with students, departments, and other institutions

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