Sampling from the Gaussian mixture (GM) density is a ubiquitous problem. Alongside the random samples (iid, independent identically distributed), there are deterministic samples, where sample positions are chosen as homogeneously as possible, yielding superior convergence properties. State of art deterministic sampling methods for GMs are however too slow for real-time application. Instead, low-quality samples (that can be generated fast) can easily be reduced to fewer high-quality samples. GMs play an important role in state estimation and control, representing multimodal estimates, and in machine learning, representing clusters.

Task 1: Implement different ways of fast low-quality GM sampling and combine them with different methods of sample reduction, respectively.

Task 2: Perform a comprehensive evaluation. Find out, for example, how many reference samples should be used.

Task 3: Publish a repository that can be used by other researchers in the future who need high-quality GM samples.

What to do
- Understand and check mathematical derivations
- Implement in Julia
- Optimize and publish the repository


Requirements:
Students with a background in computer science, mathematics, electrical engineering, or other engineering majors. Pre-knowledge in Julia is welcome. Strong self-motivation, reliability, mathematical skills, and critical mind are expected.

Emphasis:

<table>
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<tr>
<th>Theoretical Study</th>
<th>Software Implementation</th>
<th>Hardware Implementation</th>
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