Pyro
for Deep Generative Models

Presented By
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Significance

- PPLs aim to reduce the difficulty of developing probabilistic models
- All PPLs offer some trade-off between key properties
  - Expressivity
  - Scalability
  - Flexibility
  - Minimality
- Pyro aims to offer an optimal trade-off

<table>
<thead>
<tr>
<th>System</th>
<th>Expressivity: Dynamic control</th>
<th>Scalability: Subsampling, AD</th>
<th>Flexibility: Flexible inference</th>
<th>Minimality: Host language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stan</td>
<td>Static control flow</td>
<td>Some, CPU</td>
<td>Automated</td>
<td>None</td>
</tr>
<tr>
<td>Church</td>
<td>Yes</td>
<td>No, None</td>
<td>Automated</td>
<td>Scheme</td>
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<td>Yes</td>
<td>None</td>
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<td>webPPL</td>
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<td>No, CPU</td>
<td>Some</td>
<td>JavaScript</td>
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<td>Edward</td>
<td>Static control flow</td>
<td>Yes, CPU/GPU</td>
<td>Yes</td>
<td>TensorFlow</td>
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<tr>
<td>Pyro</td>
<td>Yes</td>
<td>Yes, CPU/GPU</td>
<td>Yes</td>
<td>Python, PyTorch</td>
</tr>
</tbody>
</table>
Context: Deep Generative Modelling

• Exciting field, with rapid progress
• Fundamentally rooted in probabilistic ideas and inference
• Examples
  • GANs
  • VAEs
  • Normalising Flows
  • Diffusion
  • LLMs
Goals

• Investigate whether an optimal trade-off is achieved by Pyro
  • Specifically in the context of deep generative models
• Study the (under-)utilisation of Pyro for deep generative models
  • Experiment with my own code
  • Review existing literature that leverages Pyro
• Provide a comprehensive review of Pyro for deep generative models as a guide for researchers
• Compare Pyro to alternative PPLs, and other options, for deep generative modelling
Progress

• Completed:
  • Literature review of Pyro
  • Implementation of basic Bayesian inference in Pyro
  • Implementation of VAEs in Pyro

• In progress:
  • Learning how to use Pyro

• To do:
  • Implementations of other generative models in Pyro
  • Exploration of wider literature
  • Exploration of alternatives to Pyro
  • Writeup
Any questions?