Erratum to "Mixed Hamiltonian Monte Carlo for Mixed Discrete and Continuous Variables"

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It has come to my attention[1] that there was a mistake in the proof of Lemma 4 in the supplementary of the paper [1], which led to an incorrect MH correction term in the presented M-HMC algorithm.

The incorrect MH correction term coincides with the correct one for random-walk proposals, and for modified Gibbs proposals on models with only binary discrete random variables. Due to a bug[2] in propagating the type of proposals in the code, all the numerical experiments in Section 3 of [1] were in fact run with a modified random-walk proposal instead of the intended modified Gibbs proposal. Some sanity check experiments on the 1D GMM were run with a modified Gibbs proposal, but in the considered 1D GMM, the 4 components are well-separated, which is a case that makes the incorrect MH correction term numerically indistinguishable from the correct one. As a result, the numerical experiments and the conclusions in the paper are still valid, although they were derived with a less efficient random-walk proposal.

I have updated the arXiv version of the paper[3] and the code on GitHub[4] with necessary changes:

- I updated Algorithm 1 in the main text and Algorithm 1 in the supplementary with the correct MH correction term, and fixed the code[5] accordingly.
- I fixed proof of Lemma 4 in supplementary and included detailed intermediate calculations.
- I updated the corresponding paragraph at the end of Section 2.2 to emphasize that using Gibbs updates for the discrete variables is in fact valid with the correct MH correction term.
- I conducted additional experiments on M-HMC with 3 different discrete proposals. See results in Section 5.3 in supplementary for comparison of performances. Gibbs proposals consistently outperform modified random-walk proposals and modified Gibbs proposals. As a result, I updated the results in Section 3 to use results with Gibbs proposals. For example, M-HMC with Gibbs proposals is 1.8 times more efficient than NUTS on the 24D GMM, and is almost 60 times more efficient than Gibbs/more than 8 times more efficient than HwG on CTMs, a further improvement upon the performance reported in the original paper.

I sincerely apologize for any inconveniences caused by this mistake.

Acknowledgments

I would like to thank Du Phan for the help in correcting the mistake in the MH correction term.

References

[1] Guangyao Zhou. Mixed hamiltonian monte carlo for mixed discrete and continuous variables. In H. Larochelle, M. Ranzato, R. Hadsell, M. F. Balcan, and H. Lin, editors, *Advances in Neural Information Processing Systems*, volume 33, pages 17094–17104. Curran Associates, Inc., 2020.

[1] See discussions at https://github.com/pyro-ppl/numpyro/pull/826 for more details.
[2] https://github.com/StannisZhou/mixed_hmc/commit/d0cdbbbce4276d58ee6f9953b8517f819e327a92
[3] https://arxiv.org/abs/1909.04852
[4] https://github.com/StannisZhou/mixed_hmc
[5] https://github.com/StannisZhou/mixed_hmc/commit/a788c77fa2f61f966e6a60340d4a6f0a0f9cb181