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arXiv:2106.09685 (cs)

[Submitted on 17 Jun 2021 ([v1](https://arxiv.org/abs/2106.09685v1)), last revised 16 Oct 2021 (this version, v2)]

Title:LoRA: Low-Rank Adaptation of Large Language Models

Authors:[Edward J. Hu](https://arxiv.org/search/cs?searchtype=author&query=Hu,+E+J), [Yelong Shen](https://arxiv.org/search/cs?searchtype=author&query=Shen,+Y), [Phillip Wallis](https://arxiv.org/search/cs?searchtype=author&query=Wallis,+P), [Zeyuan Allen-Zhu](https://arxiv.org/search/cs?searchtype=author&query=Allen-

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> Abstract:An important paradigm of natural language processing consists of
> large-scale pre-training on general domain data and adaptation to particular
> tasks or domains. As we pre-train larger models, full fine-tuning, which
> retrains all model parameters, becomes less feasible. Using GPT-3 175B as an
> example -- deploying independent instances of fine-tuned models, each with
> 175B parameters, is prohibitively expensive. We propose Low-Rank Adaptation,
> or LoRA, which freezes the pre-trained model weights and injects trainable
> rank decomposition matrices into each layer of the Transformer architecture,
> greatly reducing the number of trainable parameters for downstream tasks.
> Compared to GPT-3 175B fine-tuned with Adam, LoRA can reduce the number of
> trainable parameters by 10,000 times and the GPU memory requirement by 3
> times. LoRA performs on-par or better than fine-tuning in model quality on
> RoBERTa, DeBERTa, GPT-2, and GPT-3, despite having fewer trainable
> parameters, a higher training throughput, and, unlike adapters, no
> additional inference latency. We also provide an empirical investigation
> into rank-deficiency in language model adaptation, which sheds light on the

> efficacy of LoRA. We release a package that facilitates the integration of
> LoRA with PyTorch models and provide our implementations and model
> checkpoints for RoBERTa, DeBERTa, and GPT-2 at [this https
> URL](https://github.com/microsoft/LoRA).

Comments: | Draft V2 includes better baselines, experiments on GLUE, and more on adapter latency

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Subjects: | Computation and Language (cs.CL); Artificial Intelligence (cs.AI); Machine Learning (cs.LG)

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