Efficient Biomedical Image Segmentation on EdgeTPUs

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Abstract. The U-Net architecture [1] is a state-of-the-art neural network
for semantic image segmentation that is widely used in biomedical re-
search. It is based on an encoder-decoder framework and its vanilla ver-
sion shows already high performance in terms of segmentation quality.
Due to its large parameter space, however, it has high computational
costs on both, CPUs and GPUs. In a research setting, inference time is
relevant, but not crucial for the results. However, especially in mobile,
clinical applications a light and fast variant would allow deep-learning
assisted, objective diagnosis at the point of care. In this work, we sug-
gest an optimized, tiny-weight U-Net for an inexpensive hardware accel-
erator. We first mined the U-Net architecture to reduce computational
complexity to increase runtime performance by simultaneously keeping
the accuracy on a high level. Using an open, biomedical dataset for high-
speed videoendoscopy (BAGLS, [2]), we show that we can dramatically
reduce the parameter space and computations by over 99.8% while keep-
ing the segmentation performance at 95% of our baseline. Using a cus-
tom upscaling routine, we further successfully deployed our optimized
U-Net to an EdgeTPU hardware accelerator to gain cost-effective speed
improvements on conventional computers and to showcase the applica-
bility of EdgeTPUs for biomedical imaging processing of large images
on portable devices. Combining the optimized architecture and the Ed-
geTPU, we gain a speedup of >79-times compared to our initial baseline
while keeping high accuracy. This combination allows to provide imme-
diate results to the clinician, especially in constrained computational
environments, and an objective diagnosis at the point of care. This work
has been previously published [3].

References

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