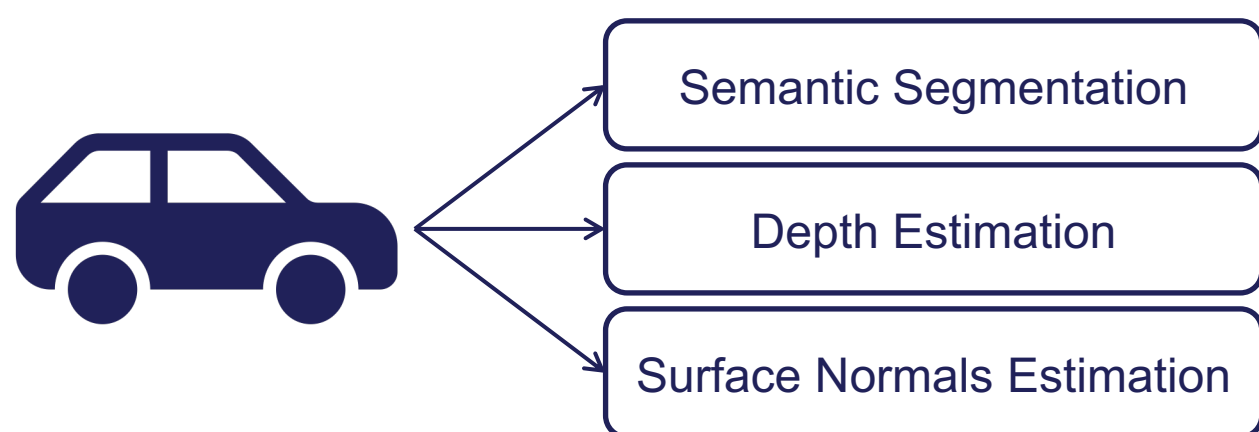


# Overparameterisation for Single and Multi-Task Learning

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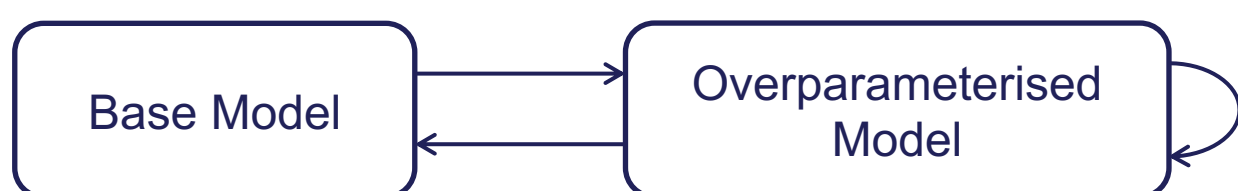
## BACKGROUND



Autonomous vehicles make use of computer vision techniques to make sense of their environments. Some constraints are:

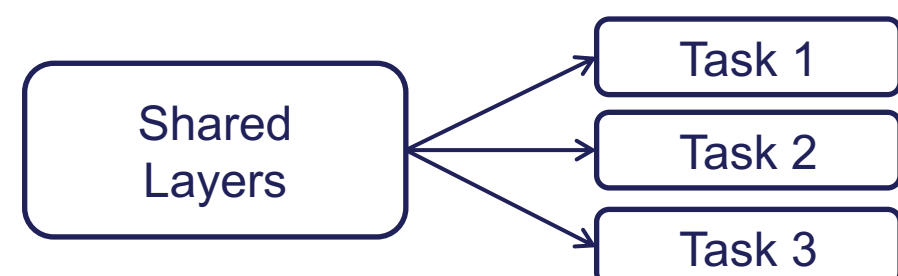
- Inference need to be performed at high performance within latency and hardware accelerator constraints
- Multiple tasks need to be solved at the same time

### Overparameterisation



*Overparameterisation* is a technique to improve model performance with equal parameter size at inference time (e.g. FNL<sup>1</sup>, RepVGG<sup>2</sup>).

### Multi-Task Learning



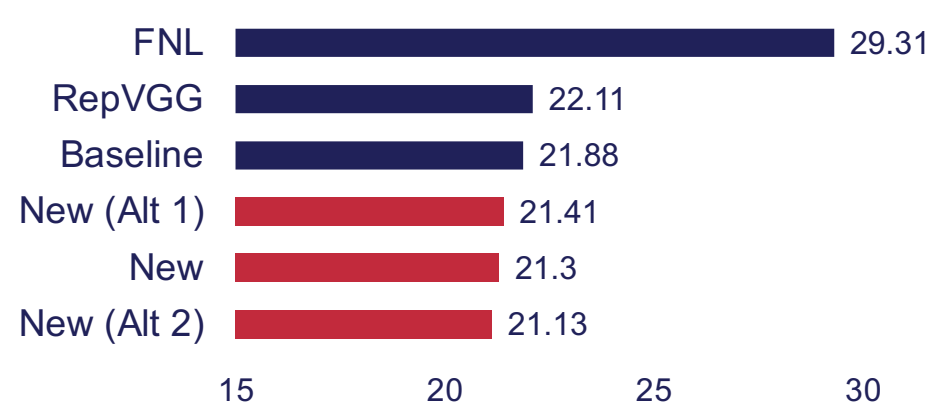
*Multi-task learning* attempts to solve multiple tasks simultaneously using a single model, such as through shared layers and task-specific layers<sup>3</sup>.

## PROJECT FINDINGS

We developed a new overparameterisation method with three alternative training routines for both single and multi-task learning. The performance is compared against the baseline and existing methods.

### CIFAR-100 Dataset (Single-Task)

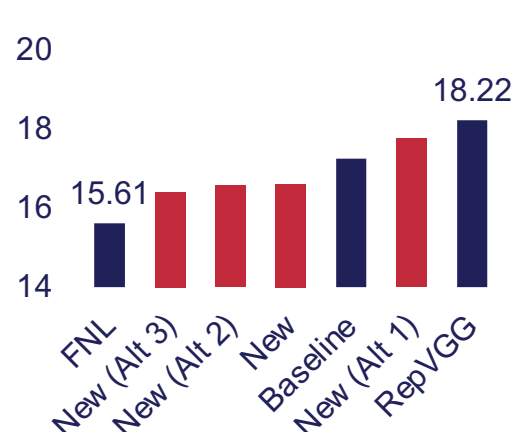
#### ResNet-50 Top-1 Errors (lower better)



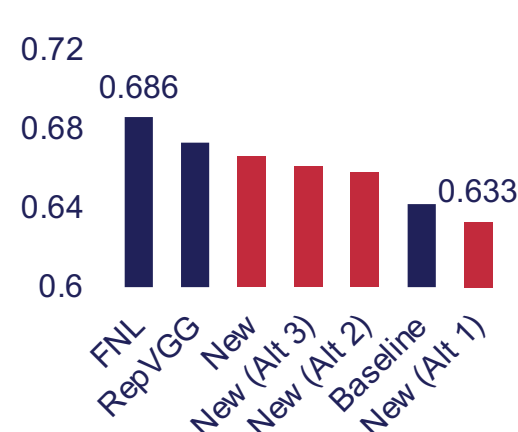
Our new method achieves exceptional performance with CIFAR-100, beating the baseline and existing methods, FNL and RepVGG.

### NYUv2 Dataset (Multi-Task)

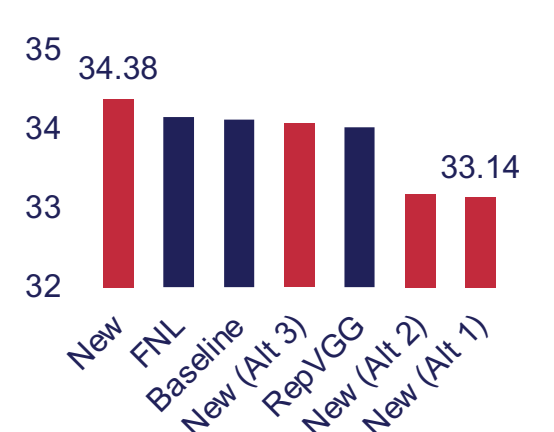
#### Semantic Segmentation Mean IoU (higher better)



#### Depth Absolute Error (lower better)



#### Normals Mean Error (lower better)



Our new method with alternative training routine 1 has achieved the best performance for depth estimation and surface normals estimation. However, RepVGG achieved a better performance in semantic segmentation, though our method still beats the baseline.

<sup>1</sup> Khodak, M., Tenenholz, N., Mackey, L., & Fusi, N. (2021). Initialization and regularization of factorized neural layers. arXiv preprint arXiv:2105.01029.

<sup>2</sup> Ding, X., Zhang, X., Ma, N., Han, J., Ding, G., & Sun, J. (2021). RepVGG: Making VGG-style ConvNets great again. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 13733-13742).

<sup>3</sup> Crawshaw, M. (2020). Multi-task learning with deep neural networks: A survey. arXiv preprint arXiv:2009.09796.