NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

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NAS-SpatialFlow: Neural Architecture Search for Panoptic Segmentation

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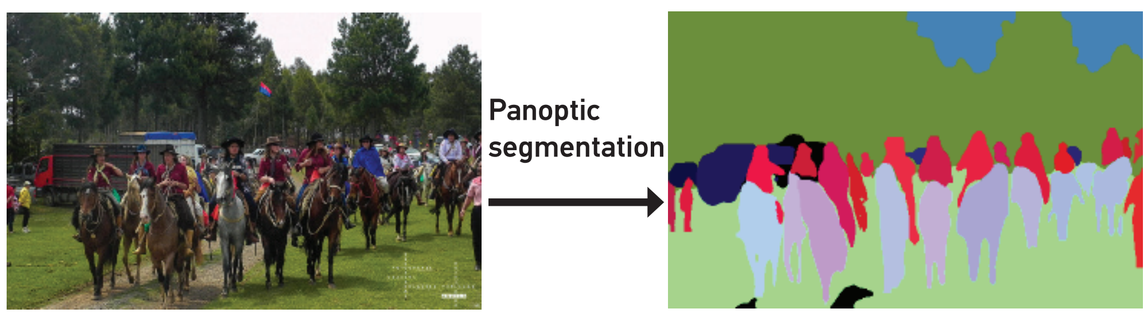
1. Objective

Neural architecture search (NAS) can automatically find an efficient neural network architecture. We apply a gradient-based NAS method called DARTS to search for a network structure to better fuse features between sub-networks based on SpatiaFlow, a unified neural network with four sub-networks for panoptic segmentation.



2. Approach

Algorithm 1: DARTS Algorithm

Result: The searched architecture α

1. Given a set of operations O as the search space $O = \{conv3 \times 3, identity, none\}$.
2. Define α as a vector with length $|O|$. Each operation $o \in O$ is associated with a parameter a_o, which is an element in α.
3. Define mixed operation as

$$o^{(i,j)}(x) = \sum_{o \in O} \frac{\exp(\alpha_o)}{\sum_{o' \in O} \exp(\alpha_{o'})} o(x) \quad (1)$$

4. Initialize the associated architecture parameter α

while *not converge* **do**
  1. update architecture α by gradient descending $\nabla_\alpha L_{val}(w - \varepsilon \nabla_w L_{train}(w, \alpha), \alpha)$
  2. update weights w by descending $\nabla_w L_{train}(w, \alpha)$

end

Table 1: **Panoptic segmentation:** panoptic quality (PQ) on COCO dataset

Model	Backbone	PQ	PQ^{th}	PQ^{st}
Panoptic FPN	ResNet50	39.0	45.9	28.7
AUNet	ResNet50	39.6	49.1	25.2
Baseline	ResNet50	39.3	45.1	30.5
NAS-SpatialFlow	ResNet50	39.7	45.6	30.8
SpatialFlow	ResNet50	40.5	46.7	31.1
Attention-guided SpatialFlow	ResNet50	**40.8**	**47.0**	**31.5**

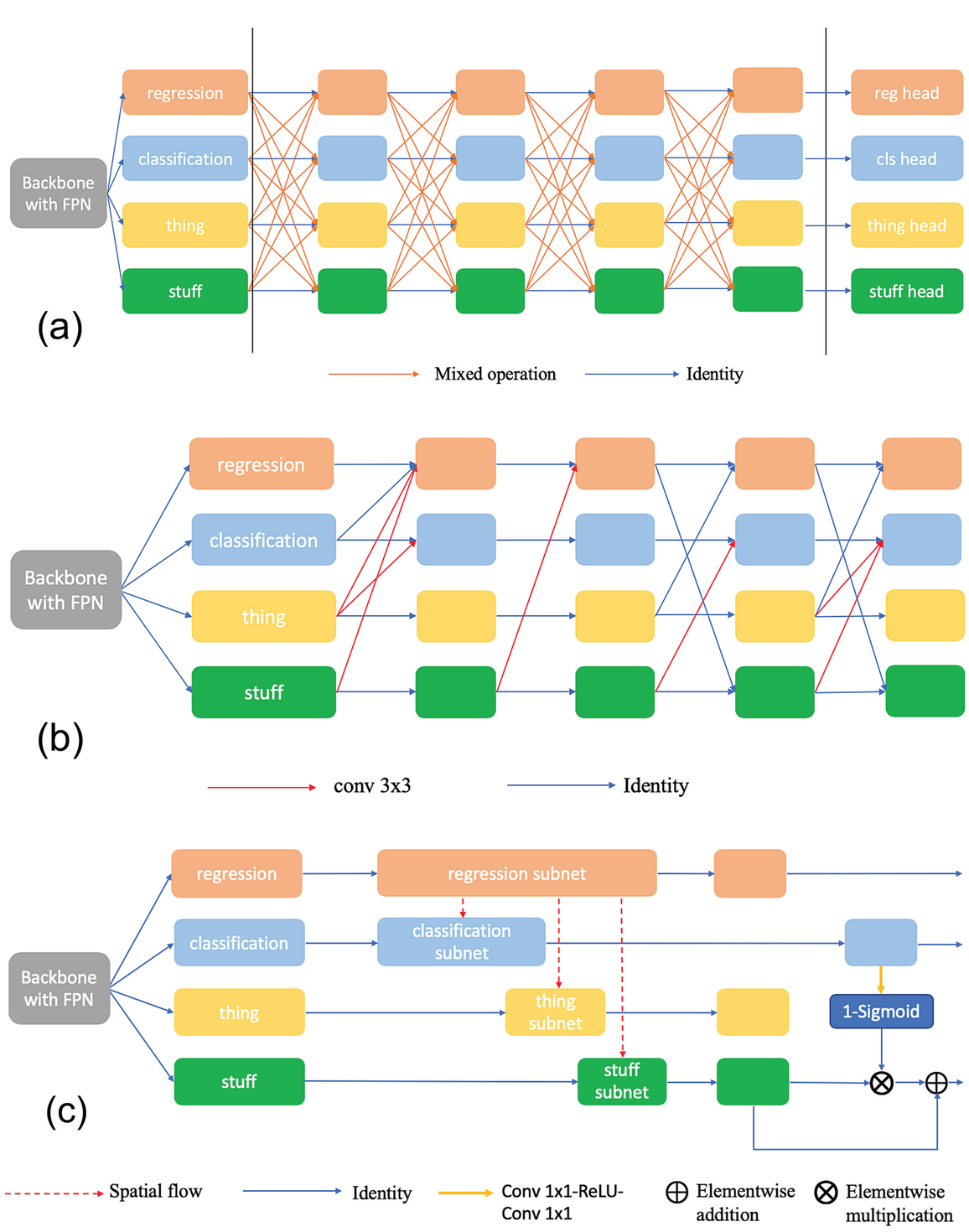


Figure 1: (a) Initial structure of NAS-SpatialFlow.
(b) The structure of NAS-SpatialFlow at the end of the search.
(c) Attention-guided SpatialFlow.

3. Conclusion

The current effective NAS methods used in image classification do not perform well in more complicated tasks like panoptic segmentation, as the searched NAS-SpatialFlow model is inferior to the human-designed SpatialFlow model. Moreover, the attention modules designed based on human-prior knowledge enhance the recognition of the background stuff of SpatialFlow.