Conv. Network for Segmentation of Mixed Crops

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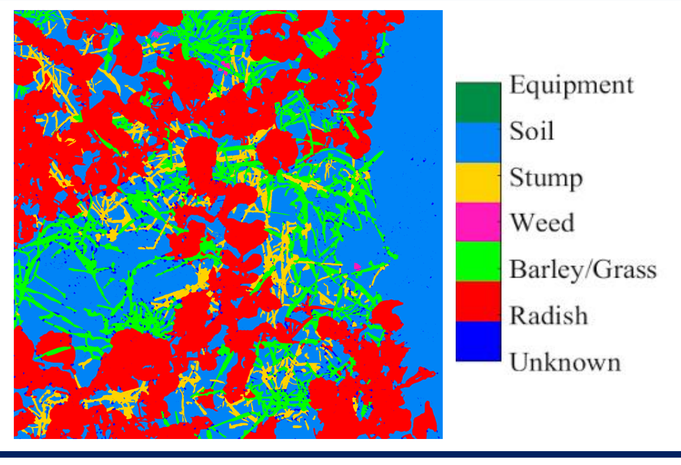
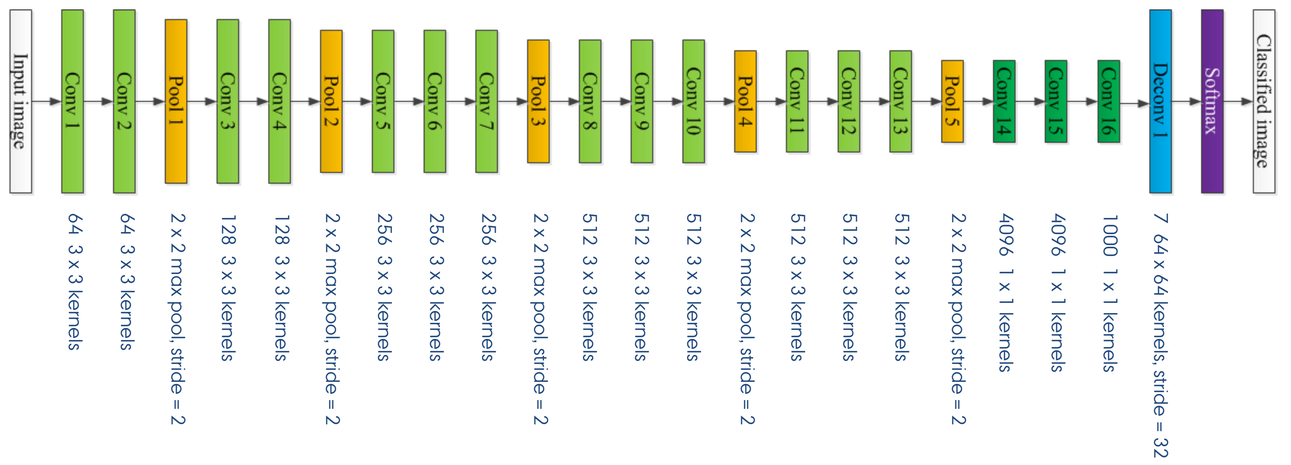
1. Problem:

- What?
  - Pixel-wise classification of top view images of mixed crops
- Why?
  - Yield estimation
  - Nitrogen-uptake estimation
  - Variable Nitrogen application to fields
  - Optimal harvest time



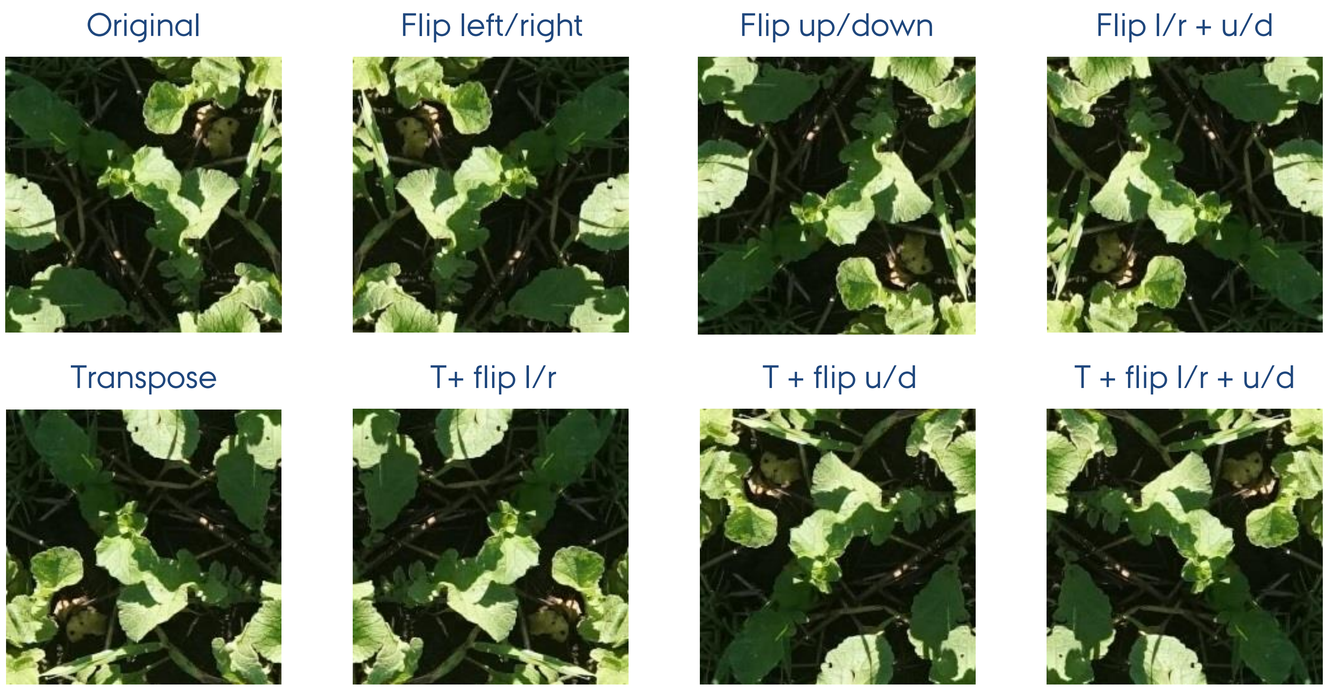
2. Method:

- Fine-tuning on a pre-trained Deep Convolutional Neural Network
  - Based on VGG-16D for image classification [1]
  - Adapted to pixel-wise classification [2]:
    - Convert fully connected layers to convolutional layers
    - Insert deconvolutional layer
  - First, fine-tuned on PASCAL-Context [2]
  - Then, fine-tuned on own data



- Data set
  - 48 images
  - 400 x 400 pixels
  - 75% used for training
  - 7 classes
    - Unknown, Radish, Barley/Grass, Weed, Stump, Soil Equipment
- Data argumentation to increase data set
  - Flip left/right, flip up/down and transpose

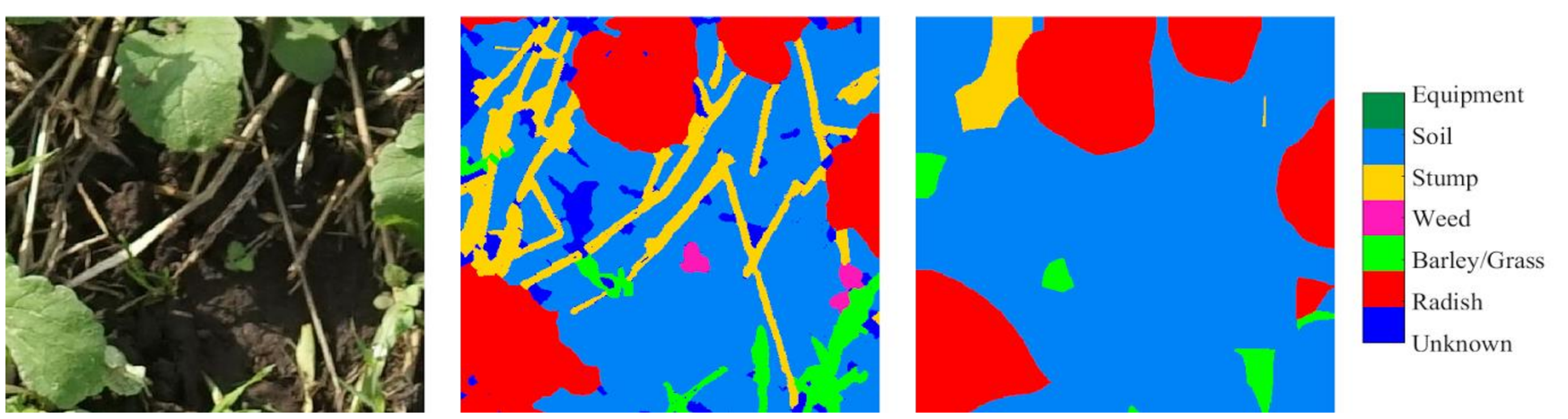
- Learning parameters
  - Learning rate: 10^{-9}
  - Per pixel learning rate: ~$1.6*10^{-4}$



3. Results:

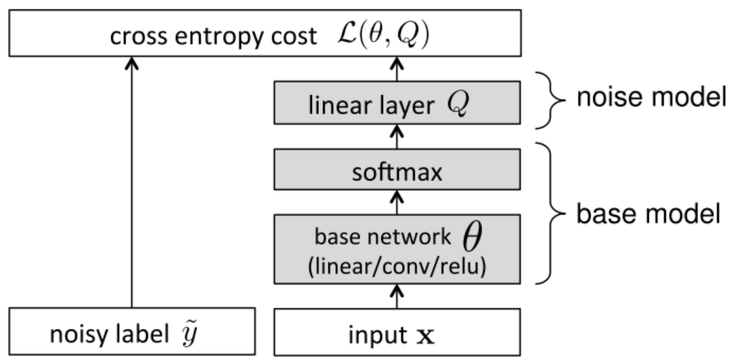
- Pixel-wise classification:
  - Pixel accuracy: 79 %
  - Frequency weighted IoU: 66%

- Ensemble classification
  - Pixel accuracy: 80 %
  - Frequency weighted IoU: 67%



4. Discussion and conclusion:

- Works relatively well, but only tested on small labelled data set
- Large un-labelled dataset + small lalelled dataset → semi-supervised learning?
  - How?
    - Auto-encoders?
    - Learning Noise model? [3]



Source: Sukhbaatar et al. 2014 [3]

5. References:

[1] Simonyan, K., & Zisserman, A. (2015). Very Deep Convolutional Networks for Large-Scale Image Recoginition. Intl. Conf. on Learning Representations (ICLR), 1–14.
[2] Long, J., Shelhamer, E., & Darrell, T. (2015). Fully Convolutional Networks for Semantic Segmentation. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 3431–3440.
[3] Sukhbaatar, S., Bruna, J., Paluri, M., Bourdev, L., & Fergus, R. (2014). Training Convolutional Networks with Noisy Labels, 1–10. Retrieved from http://arxiv.org/abs/1406.2080