# Learning to see.

## Competition details:

- Ultrasound Nerve Segmentation competition, 2016
- 923 competitors during the competition and many more afterwards
- 5636 training images with masks
- 5508 test images
- Dice coefficient accuracy metric:

$$DSC \stackrel{\text{def}}{=} \frac{2|X \cup Y|}{|X|+|Y|}$$

- Best competition score: 0.732
- Baseline scores
  - Top-left pixel: 0.0
  - Empty submission: 0.534

## Kaggle competition:
## Ultrasound nerve segmentation

## Machine detection:

- Machine labels are more consistent
- It takes time for an expert to label many images
- Trained software can output new labels instantly
- Takes weeks to create a model and hours to train it
- Training machines on cloud platforms is cheap

## Nerve Detection required

## Human detection:

- Human labels suffer from inconsistency
- Human-labeled data contains noise, artefacts, and mistakes
- It takes a lot of time for an expert to label new images
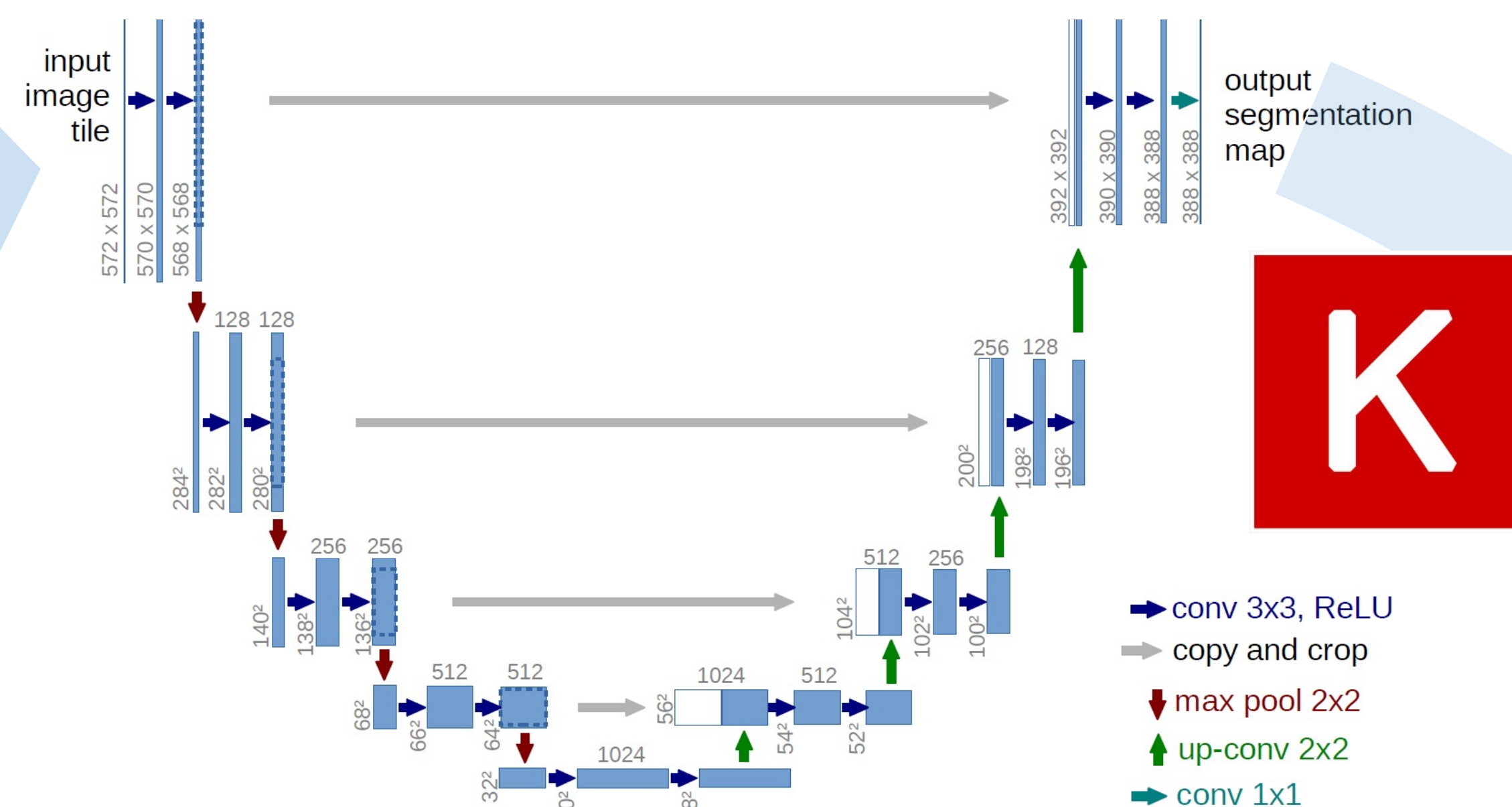- Takes years to teach a doctor
- It is expensive to train humans



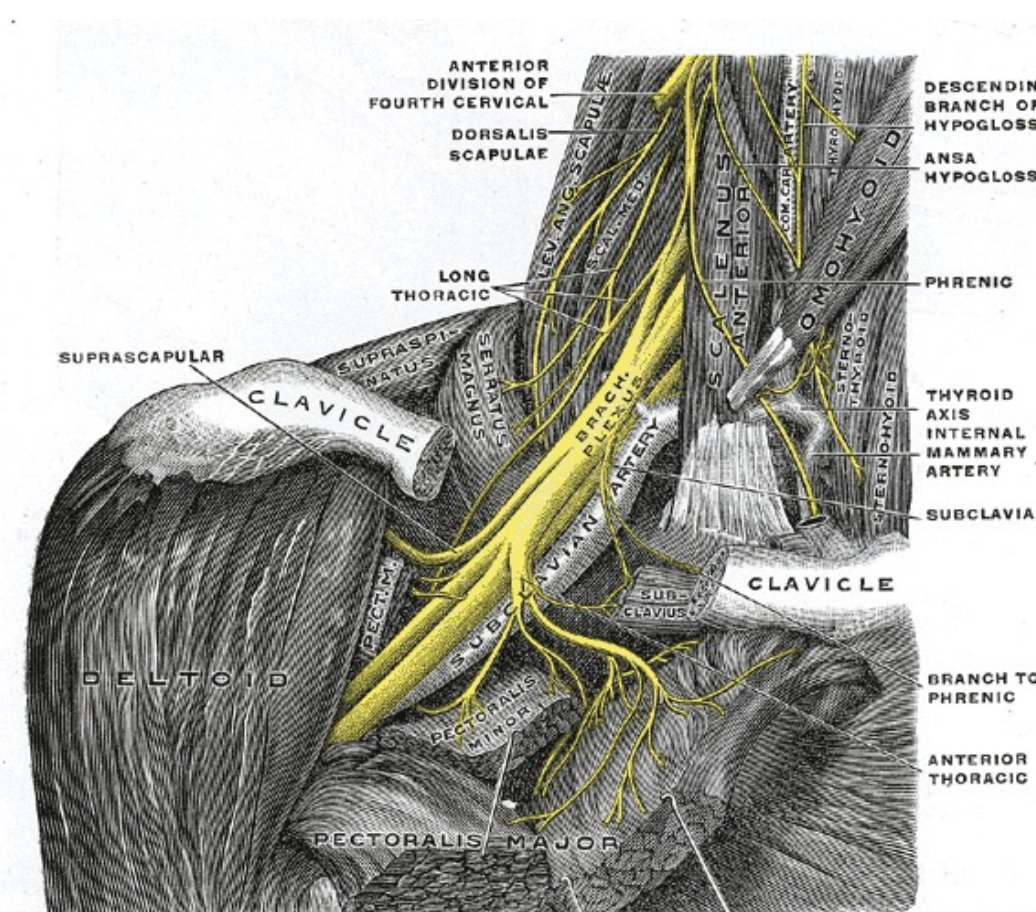*Figure 1: U-net architecture from original paper*
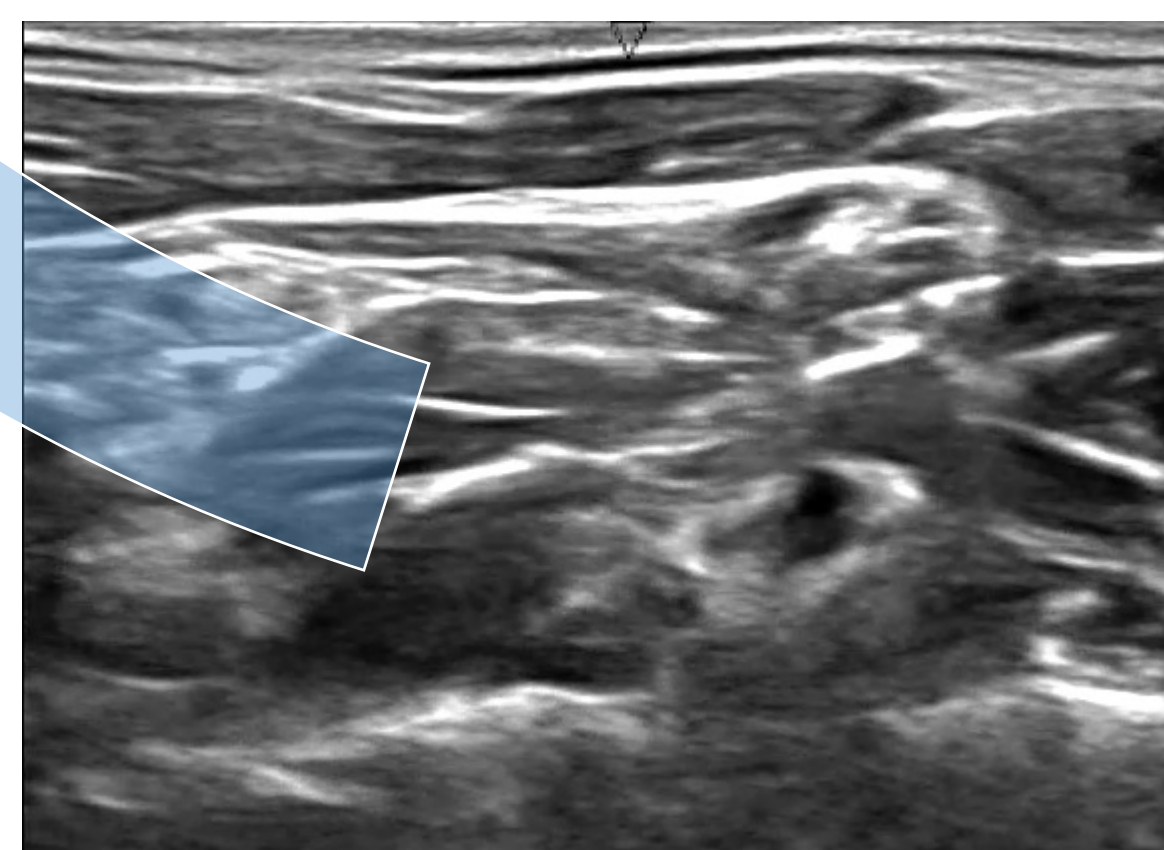


*Figure 2: Brachial plexus*



*Figure 3: Doctors during operation*

**Warning! Approaching nerves!**
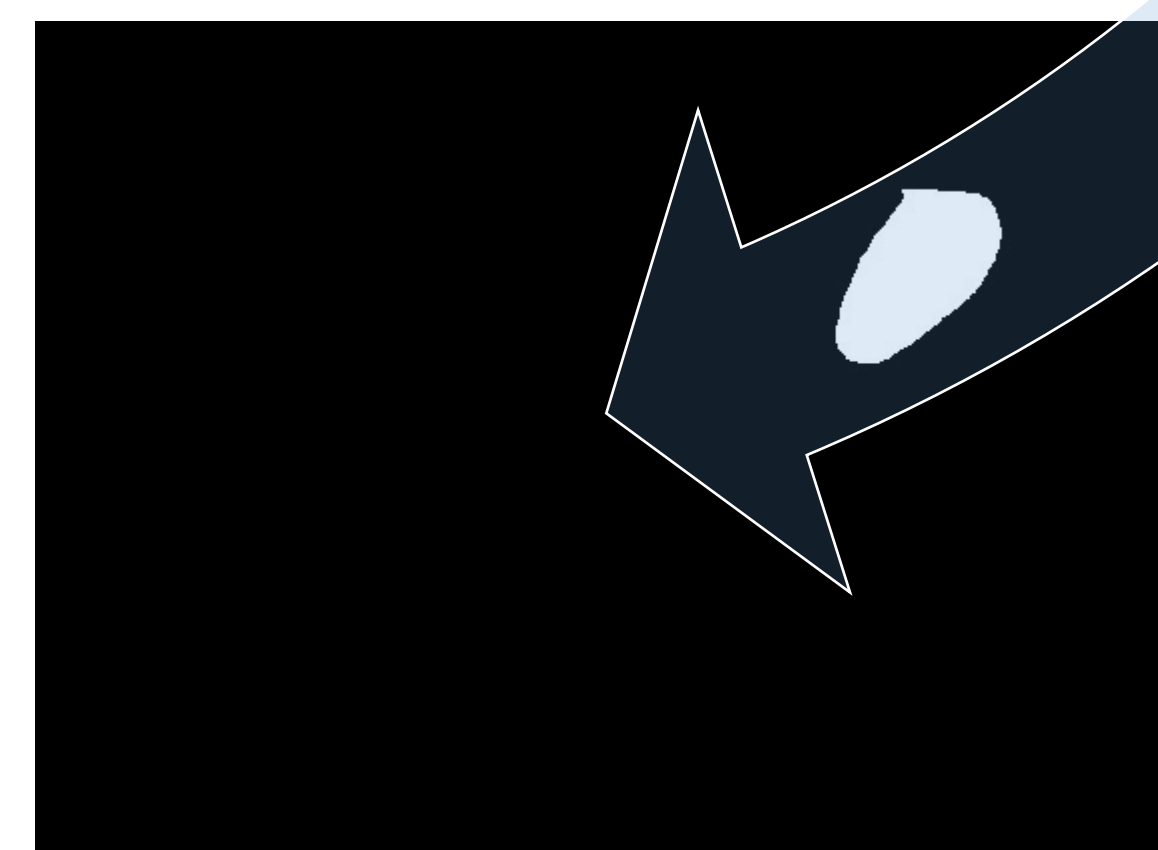


*Figure 4: Ultrasound scan (example)*
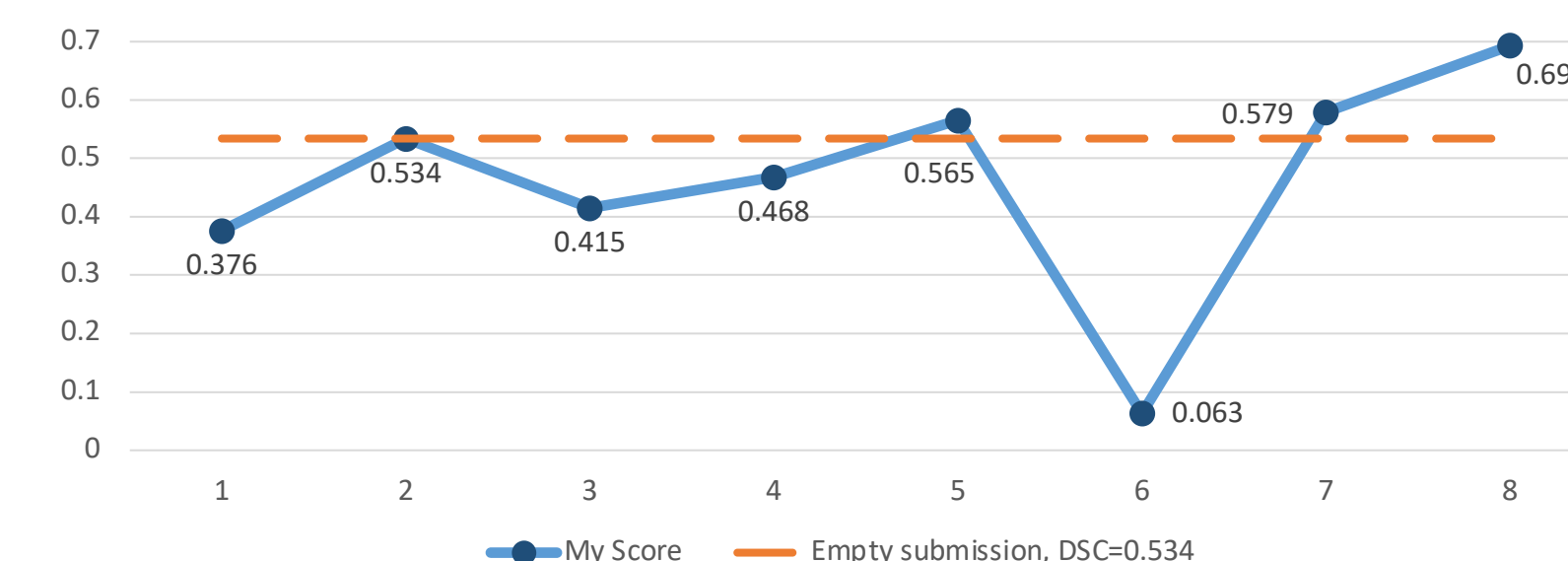


*Figure 5: Labelled Ultrasound scan*

## Warning:

- The final result is very dependent on the learning rate optimizer - the only difference between submissions 6 and 7. This shows, how sensitive Machine Learning models can be.

## Results:

- My best score: 0.693
- Score's percentile: top 6%
- Training time on Kaggle GPU: 11 minutes
- Kaggle: https://www.kaggle.com/gbatchkala
- GitHub: https://github.com/GeorgeBatch

### Score progression over submissions



My Score — Empty submission, DSC=0.534

## Contributors:

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## Based on:

- Marco Jocic's work: https://github.com/jocicmarko/ultrasound-nerve-segmentation
- Edward Tyantov's work: https://github.com/EdwardTyantov/ultrasound-nerve-segmentation

## References:

- Data, https://www.kaggle.com/c/ultrasound-nerve-segmentation/overview
- Dice coefficient, https://en.wikipedia.org/wiki/S%C3%B8rensen%E2%80%93Dice_coefficient
- Original U-net paper, https://arxiv.org/abs/1505.04597