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# A deep learning approach to segmentation of the developing cortex in fetal brain MRI with minimal manual labeling

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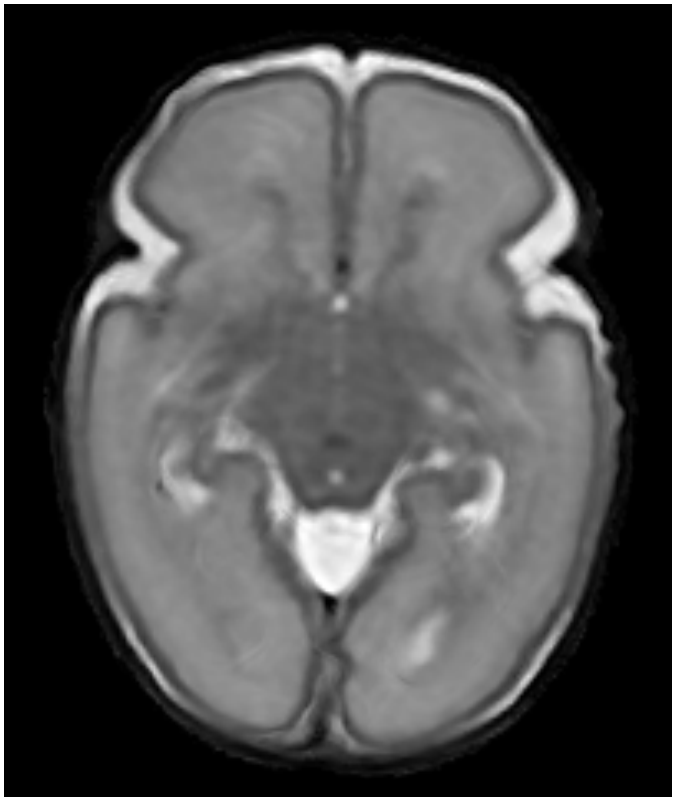
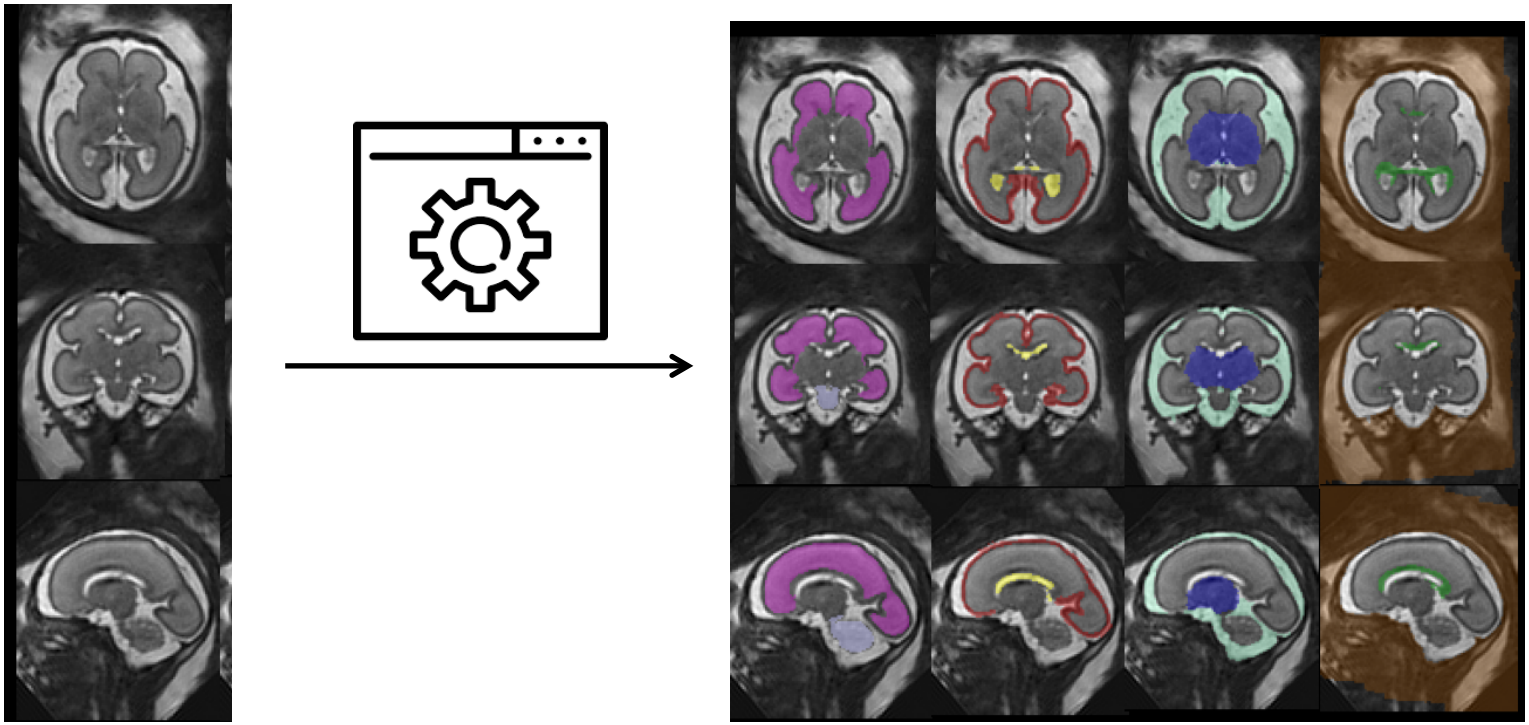
# Context – Developmental Brain Mapping

The Developing Human Connectome Project (DHCP) aims to make major scientific progress by creating the first 4D connectome map of early life.



# Segmentation – Ultimate Goal

Develop a 3D structural segmentation pipeline for fetal brain MRI to support connectomics research.



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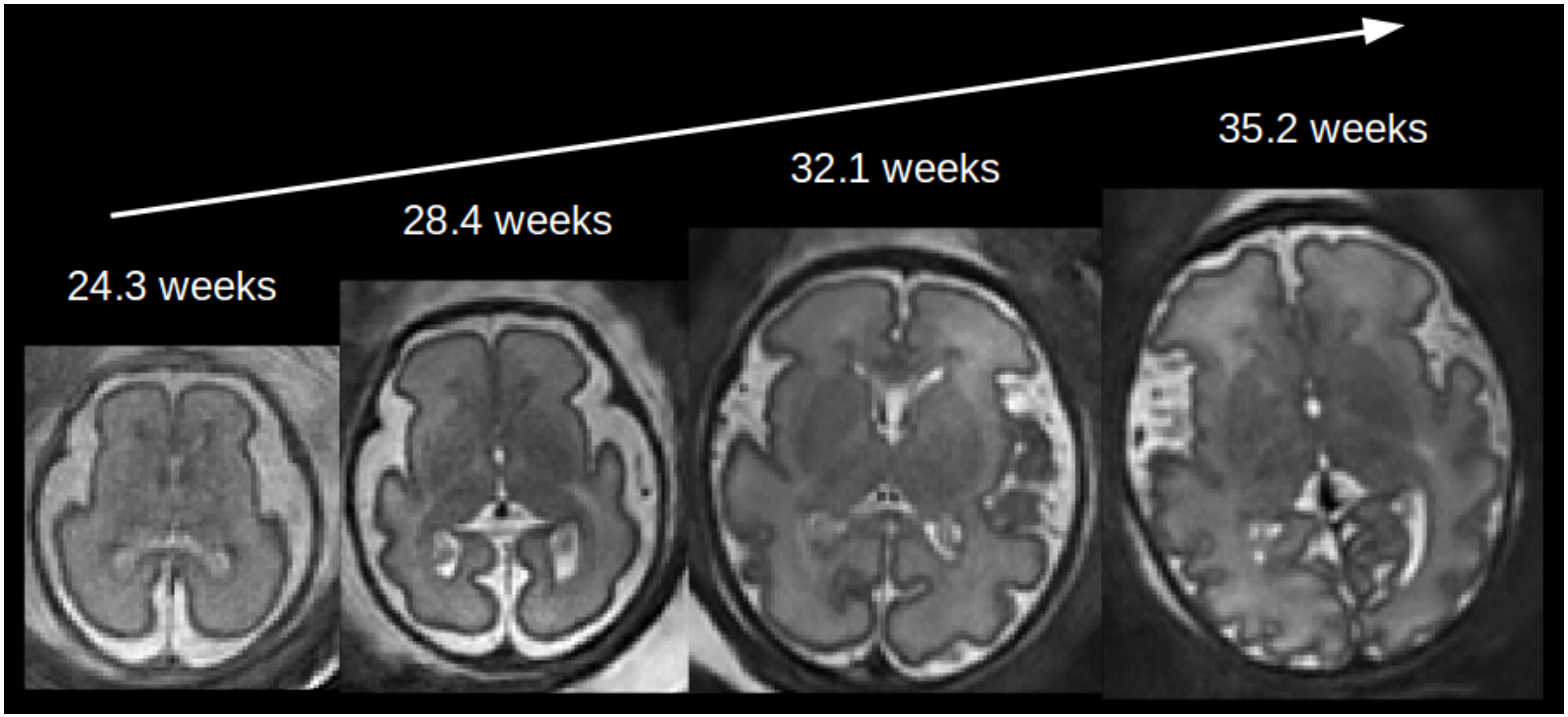
# Segmentation - Challenges

- Rapid changes in morphology over narrow time-scales.
- Changes in white/grey-matter intensities also take place.

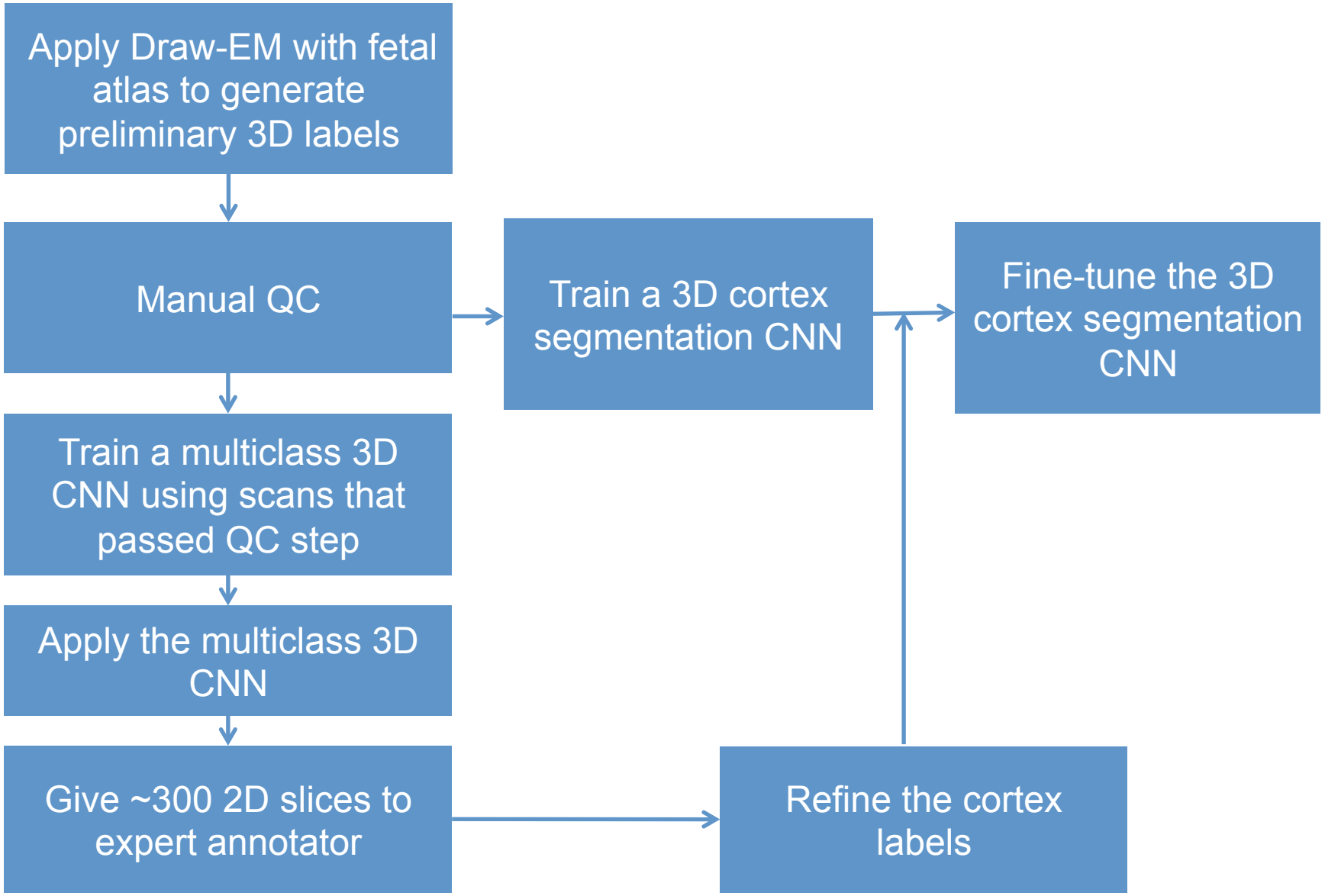


# Deep Learning?

Successful in other medical imaging applications

- However, main difficulty is in the need for large annotated ground-truth.
- Whilst large public datasets exist, they tend to mainly include adult brain scans e.g. UK Biobank.

# Minimal Labeling Workflow

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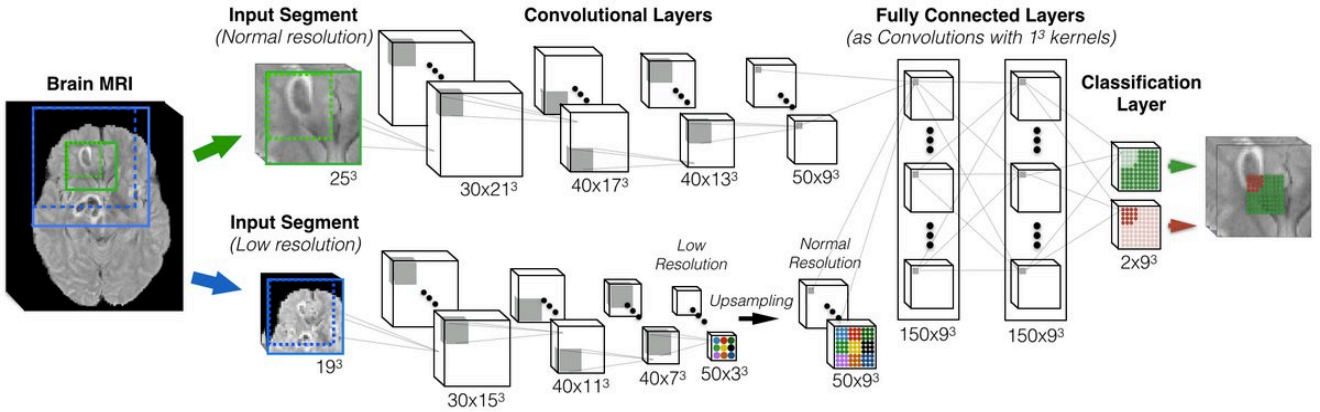
# CNN Architecture

- 3D modeling using DeepMedic




Kamnitsas et al. 2016

- Three parallel pathways:
  - normal resolution
  - downsampled by 3
  - downsampled by 5
- 8 layers per pathway
- Training batch size was set to 5
- Learning rate followed a pre-defined schedule.

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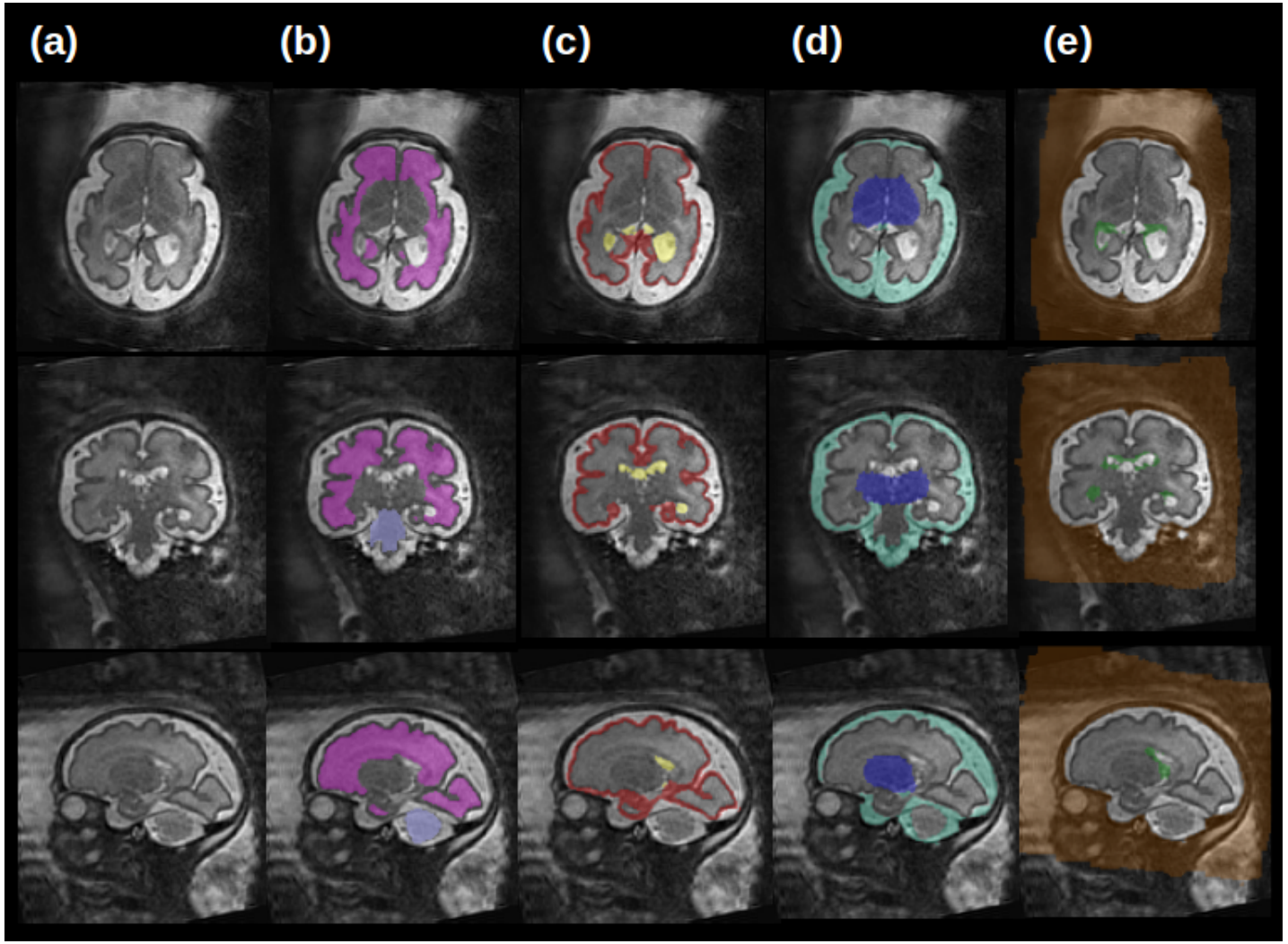
# Preliminary multiclass labels

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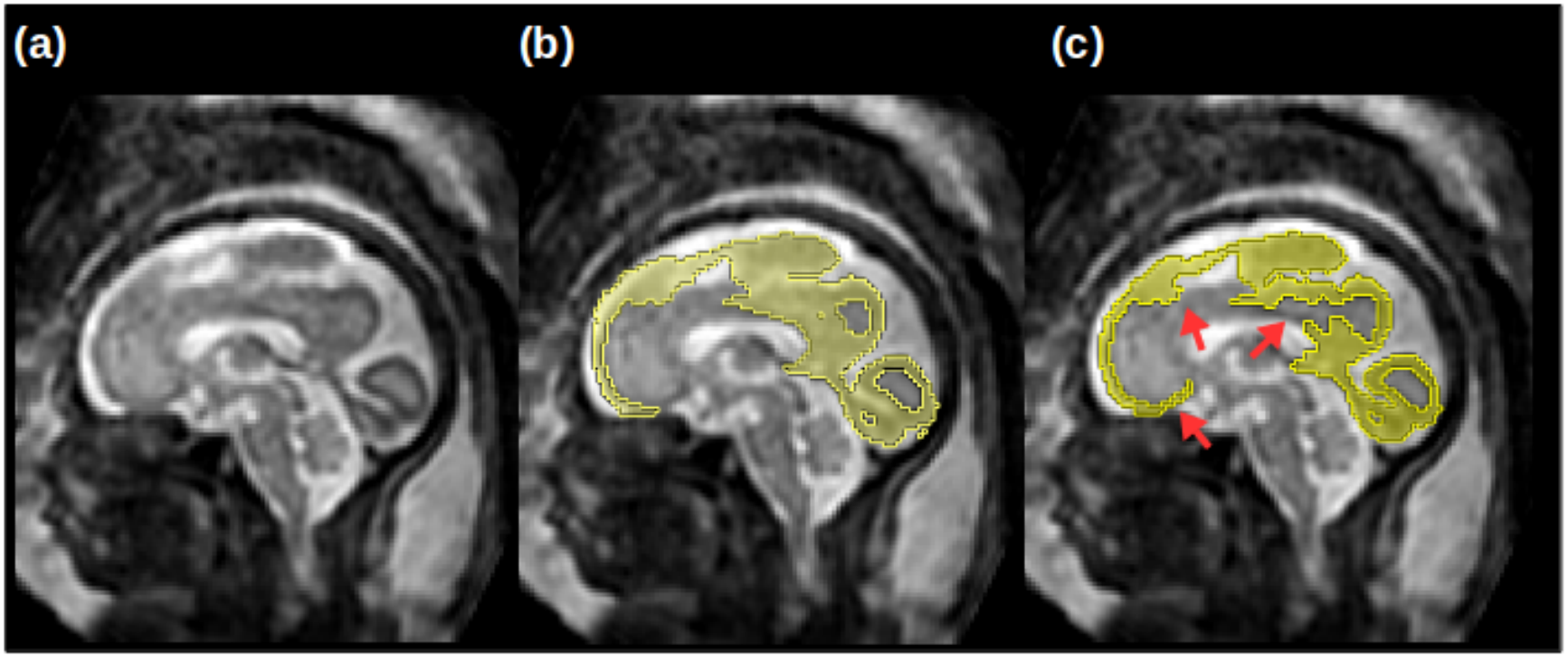
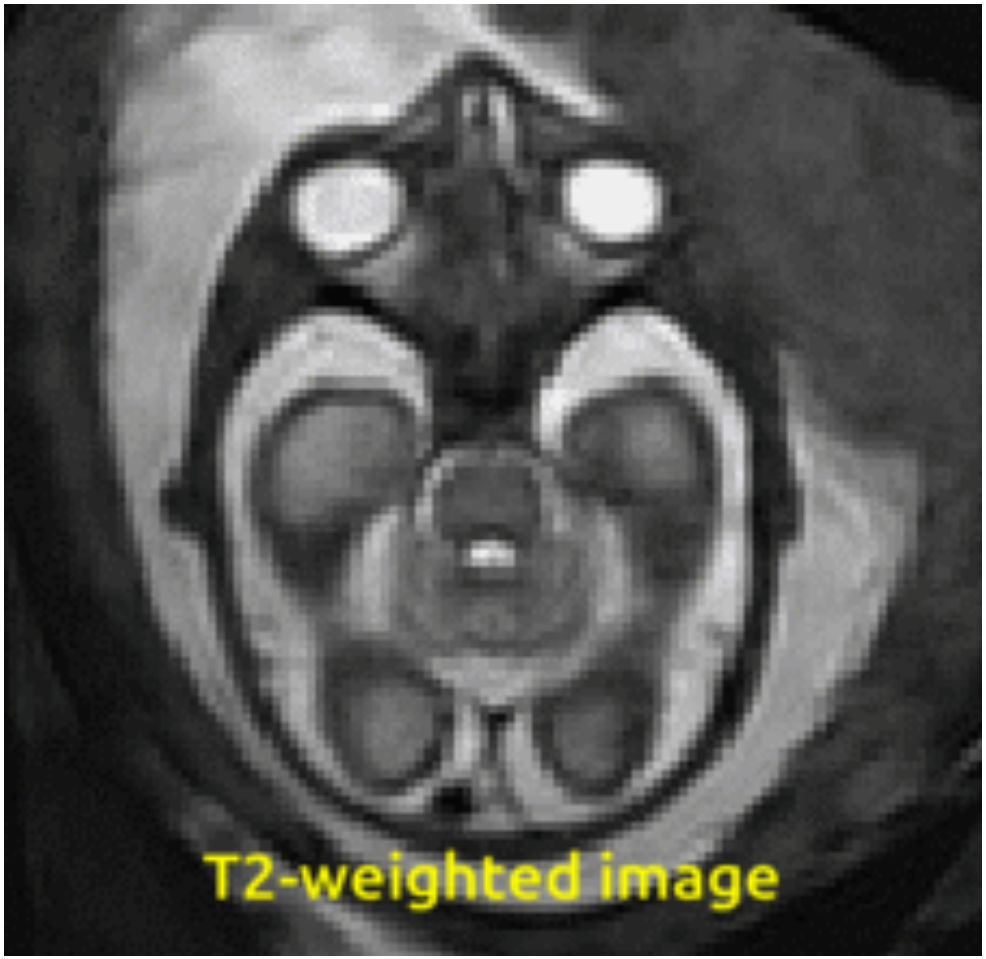
# Example cortex refinement




Gestational age: 27.5 weeks

# Example cortex segmentation




Gestational age: 28 weeks

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# Thank you!
# Questions?

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