Stanford Papers

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1. DualCheXNet
- Chest radiograph interpretation
- Stanford CheXpert Dataset of frontal & lateral
- 14 classes, 65K patients → 223K radiographs
- 15% are lateral, 85% are frontal
- Trained separate DenseNet for frontal & lateral
- Averaged the output probabilities for both models
- AUCROC of 0.823, (There is scope)

X 2. Diagnosis of AD using MR
- 3D CNN
- ADNI-1 dataset & ADNI-2 dataset
- Both are T1-weighted structural MR
- 3 classes: NC, MCI, AD; Imbalanced
- Skull stripping algo using SPM, using BET
- Poor validation accuracy; few datapoints

X 3. DL for Congenital Lung using MRI
- 2D and 3D CNN
- binary class prediction - normal vs abnormal
- Fetal MRI scans. SSFSE dataset (T2 weighted)
- class imbalanced. 2D densenet & 3D resnet.
- Accuracy ~100

4. Brain Tumor segmentation UWMRCNN
- 1st method: Cascade of WNet and a UNet
- 2nd method: Mask R-CNN
- BraTS 2018 dataset
- Cascaded performed better
- 1st method: MRI scan $\xrightarrow{\text{WNet}}$ bounding box $\xrightarrow{\text{UNet}}$ segment
- 2nd ": i/p: slices & their masks
o/p: segmented image
- Huge dataset 330K train images
- They trained locally using only 10.5K images

5. Semantic segmentation Aortic Dissection U Link

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- CT scans
- segment into 3 regions: true lumen, false lumen & background
- 2D UNet and LinkNet comparison
- Dice-coefficient metric in loss function
- 24 CT aortogram from Stanford Medical
- Each CT made of 800 256x256 greyscale slices
- Less Data (very). UNet & LinkNet easily trainable.
- CCE loss + Dice loss
- 3D UNet. Dice scores of 0.85 +

X 6. Knee Osteo using radiograph
- Osteoarthritis (OA) is leading cause of disability in US.
- VGG-16; OAI dataset of X-ray of left & right knee
- Binary classification

X 7. ~~Predicting~~ seizures from EEG Recordings
- Data: Brain activity by electrodes in dogs (30 seconds)
- CNN and RNN, binary classification
= Presence of seizure in next 10 mins or absence
- Kaggle competition dataset. Leaderboard AUCROC to beat 0.84
- 4 American Epilepsy Seizure prediction
- Poor results; couldn't beat leaderboard at all

8. Instance UNet and watershed breast cancer
- Performs highly accurate cell segmentation & cell count.

Dataset they collected under microscope :(

- Region Proposal Networks to detect cells with bounding box
- Instance U-Net for segmentation
- Watershed algorithm to improve on net's output
- Beat SOTA. Very cool pipeline RPN + UNet + Watershed
- Identifies cells in images (issues: high density & bad illumination)
- Input: 40X fluorescent nucleus image 448x448
- RPN → bounding box ; UNet → segmentation

Watershed

↓

separates touching cells & gives mp + count
(like instance segmentation)

X 9. Automatic Brain Aneurysm segment CT
- Segments CT angiographs.
- Tries different ~~base~~ architecturs.
- Encoder: ResNet 50; Decoder: PPM & UPerNet
- Class imbalance [99.998%, 0.002%]
- Solved by randomly resampling scans of this cell.
- Stanford medical school dataset from Prof ☹

X 10. SomaNet - segment neurons forebrain
- segments neuron soma in 2D microscopy images
- Got dataset from Prof. UNet
- Pre-trained on non-neuron cell nucleus segmentation data from Kaggle Data Science Bowl
- Then employed TL, retrained last layers on few images.

X 11. Diabetic Retinopathy
- 5 class ; Densenet CNN.
- Input retina image from microscope.
- Class Imbalance : 73-7-15-3-2
- Modified loss function; gave different weights to missclassification of each class.
- Kaggle dataset ; 87.6% accuracy
- Class activation map ~~to~~ for model interpretability

X 12. Metastatic cancer
- 2019 Kaggle competition : Playground ☹
- Binary classification
- 4 layer CNN
- Looked at FP; FN; TP; TN (Error analysis)

X 13. Melanoma segmentation
= Two novel U-Net based models
- ISIC 2018 melanoma dataset
- Attention U-Net built on top of Bigger Leaky U-Net
- Top 10; Methodical testing of loss / hyperparameters etc. (good)

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X 14. Image Restoration low quality med images

- Denoising low resolution retinal images while retaining small features (like tiny blood vessels) in retina
- Try autoencoder vs DeepCNN vs GAN
  (9-days) (17-days)
- Metric for noisiness is PSNR & SSIM (higher → better)
- GAN was a pre-trained network for superresolution
- Dataset had high res images
- PSNR → realism; SSIM → reconstruction
- Final results are based on these two metrics.
- CNN did the best :(. So ~~good~~ cool things did not work well
- Good idea; but different technique should be tried

15. Boost MRI quality

- DL model to learn mapping from raw sensor data to image domain of MRI knee scans
- Signal-to-noise of 28.2; beats standard reconstruction methods. Input: K-space image in sensor domain
  Output: Reconstructed MRI image
- AUTOMAP SOTA image reconstruction model uses CNN
- Uses the primary architecture of AUTOMAP builds on top of it, for knee MRI.
- Risk of using GANs for medical images: realism. They use CNN & not GAN for that reason.
- DAGAN used for MRI reconstruction.
- fastMRI dataset by Facebook AI research
- Novel problem; easy to code; not sure of scope for improvement.
- The reconstruction from K-space input looks really good, compared to ground truth
- Pros: Good problem statement; nice outputs
  Con: Simple DL code; future scope

X 16. ElderNet: electroencephalography sleep stage scoring for elderly.

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- Dataset from Prof
- Too specific
- Time series ; spectograms ; wavelet coeffs
- Baseline + FC ; wavelets + RNN ; Spectrogram + CNN + RNN ; spectogram + CNN + Attention
- Alot of different architectures tried
- Too much domain knowledge required.

17. GAN translation between image modalities
- Translate between T1 & T2 modalities ~~of~~ on Brain MRI dataset from Human Connectome Project.
- UNIT network (Image to Image Translation)
- Improved by trying self-attention layers, spectral normalization, charbonnier penalty
- They have replicated the paper with same dataset and used as their baseline.
- MedGAN paper: PET ⟷ CT
  ↳ based on U-Net
- The ~~xxx~~ 1113 ~~xxx~~ patients, small dataset
- Pros: Cool network ; baseline paper ; simple PS
  Cons: Requires higher DL knowledge than segmentation. Purely DL based.
  Aim, to improve on baseline paper
- SSIM metric ; Couldn't beat baseline

FS.

X 18. Latent model for critical care using VAE
- Uses VAE to get latent representation of large patient data from EHR.
- Deep Patient, uses stacked denoising autoencoder to extract clinically relevant features from EHR
- Introduced a novel GM VAE (Gaussian mixture VAE) which incorporates cluster discovery into feature learning process

x 19. Semantic segmen of 3D protein
- Dataset not available
- High bio protein knowledge; author is protein researcher
- simple Network; complex preprocessing & later analysis. Work does not look parallelizable.

Final papers
Classification → 1. DualCheXNet
↦ Good dataset; easy to gauge progress
↦ Highly parallelizable work
↦ Simpler DL than other tasks
↦ Ongoing leaderboard by stanford KG.
↦ Cons: classification; Iterative

Segmentation → 4. Brain Tumour segmentation UWMRCNN
↦ Good BraTS dataset; easy to gauge progress
↦ Highly parallelizable work; Ongoing leaderboard
↦ Cons: Tougher DL; Just U-Net won't cut it.
Longer training time; can't iteratively improve because of long training; generic PS

8. Instance U-Net & watershed breast cancer
↦ Beautiful use of algorithms in sequential manner
↦ Beat SOTA; easy to gauge progress; Novel PS
↦ Cons: Dataset not available; PS not related to MR/CT/Xray. ~~At~~ Tougher DL (but slightly).
Biggest issue is dataset & fluorescence microscopy PS.

Image Translation : ~~better~~ 17. GAN between T_1 & T_2
↦ PS is cool; Baseline paper exists with code
↦ Easy to gauge progress; Dataset is available.
↦ Cons: DL knowledge; Beating paper baseline might not be possible; Purely DL based; high current advancement knowledge needed for testing & improving. Not parallelizable