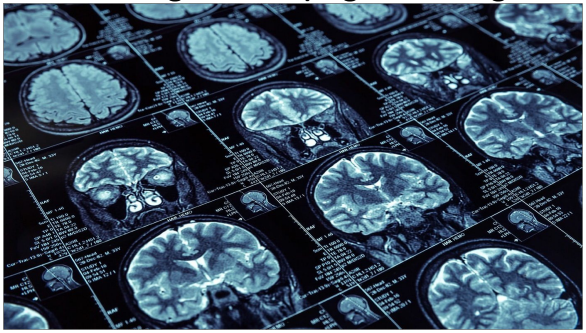
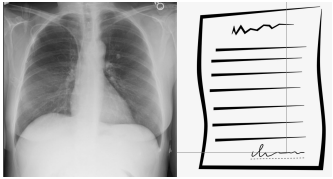
Accurate diagnosis and prognosis through ML



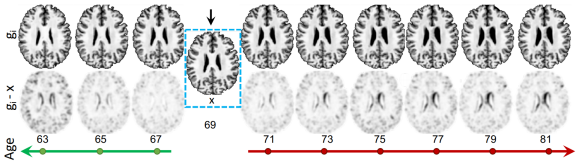
ML to augment doctors

Biological anatomy simulators

Multimodal modelling
images + text + structural data



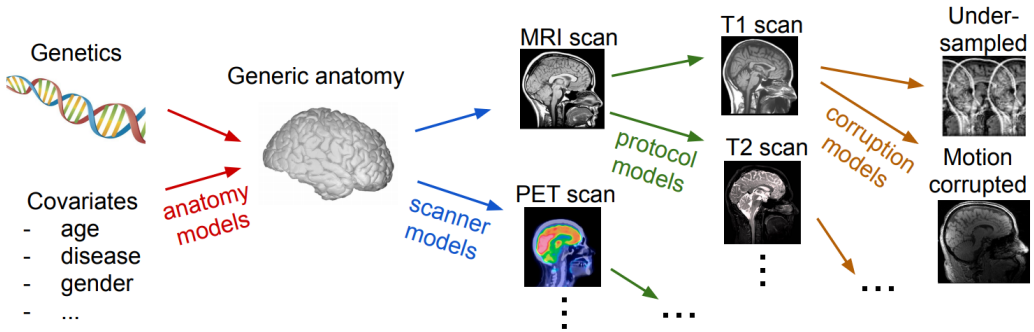
Disease Progression Modelling



Future work: Brain tissue and anatomy simulator

Simulator for brain anatomy from genetics:

- Using deep generative models
- Accounting for distributions shifts
- Following causal principles



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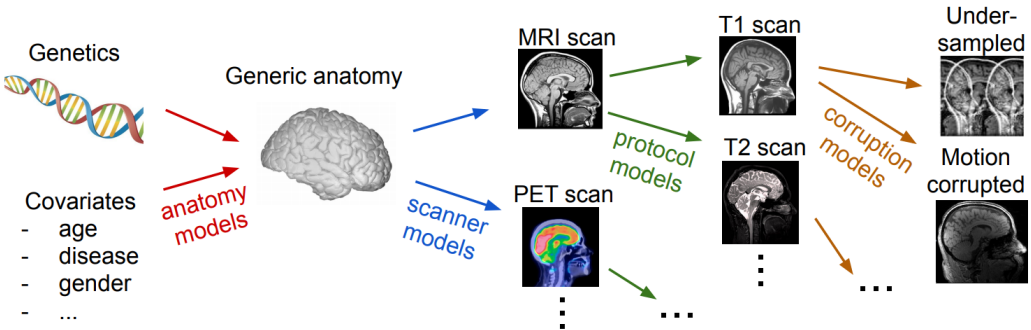

Can compute posterior over any variable, e.g. posterior over PET given motion corrupted (MOT) scan:

$$p(PET|MOT) = \sum_{GEN} p(GEN)p(PET|GEN) \sum_{MRI} p(MRI|GEN) \sum_{T1} p(T1|MRI)p(MOT|T1)$$

Multimodal modelling

- Extend models for multimodal generation: scan contrasts (T1/T2), Diffusion imaging, PET, diagnostic report, cognitive tests

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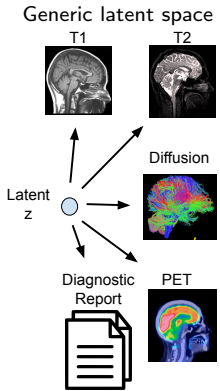

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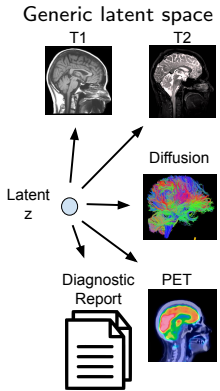
$$\min_G \max_D \mathbb{E}_{X,Y}[log\ D(X,Y)] + \mathbb{E}_z[log(1 - D(G_x(z), G_y(z)))]$$



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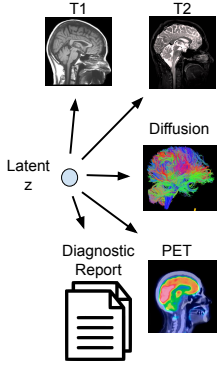
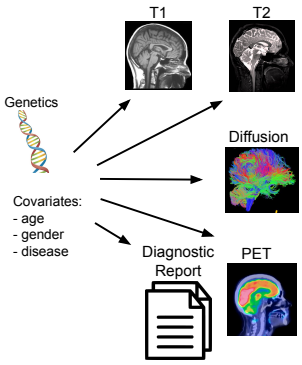
- Later on, replace latent with genetics and covariates

Generic latent space



Instantiated latent space



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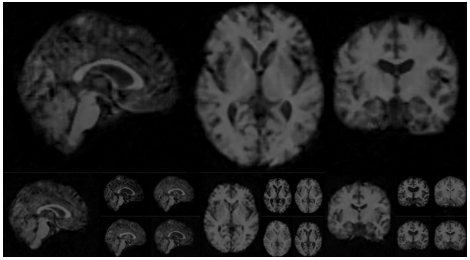
3D-StyleGAN



(submitted to MICCAI 2021)

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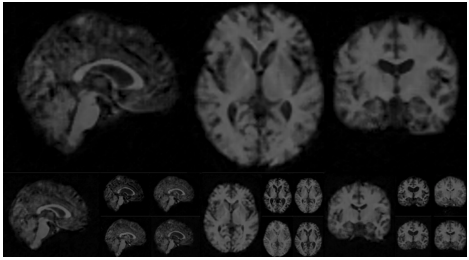
- Aim: model progression **directly in the space of 3D MRI scans**
  1. Build a good 3D brain MRI generator
  2. Estimate progression over time, e.g. through a conditional variable

$$\min_G \max_D \mathbb{E}_{X,a}[log\ D(X,a)] + \mathbb{E}_{z,a}[log(1 - D(G(z,a)))]$$

3D-StyleGAN



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Disease Progression Modelling