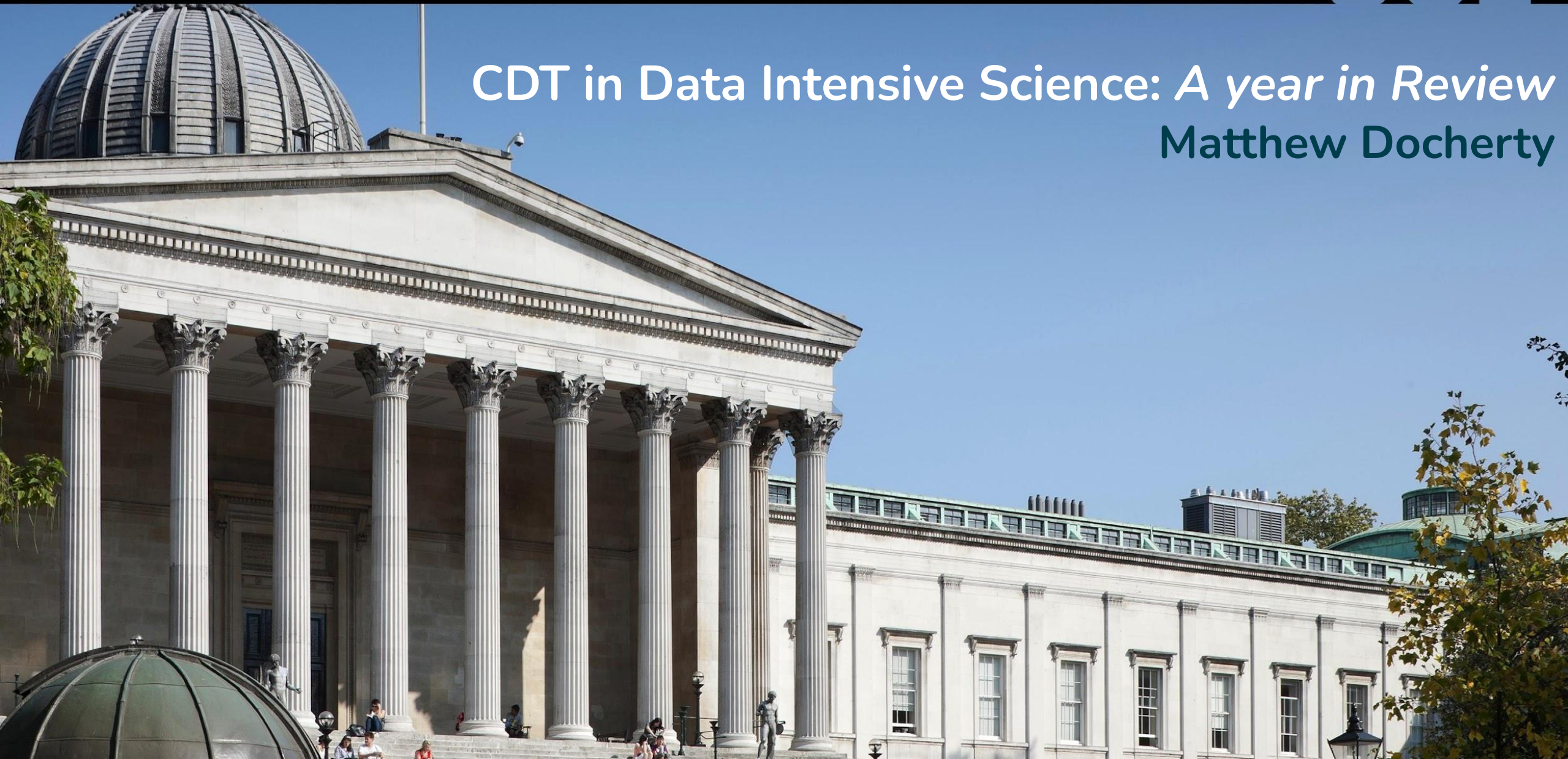
UCL

CDT in Data Intensive Science: *A year in Review*

Matthew Docherty



Who am I?

UCL

Hi, I'm Matthew

DEPARTMENT
1st year CDT Data Intensive Science student (2021 Cohort)

BACKGROUND
Masters in Astrophysics and Statistics specialising in GWs

RESEARCH GROUP
AstroInfo Team @ UCL group lead by *Prof. Jason McEwen* and co-supervised by *Dr Alessio Spurio Mancini* combining data science, machine learning and astrophysics

RESEARCH FOCUS
Likelihood-free Bayesian deep learning for probabilistic inference and model comparison for cosmology

CONTACT
For more info or to get my email to reach out, happy to chat all info you'll need

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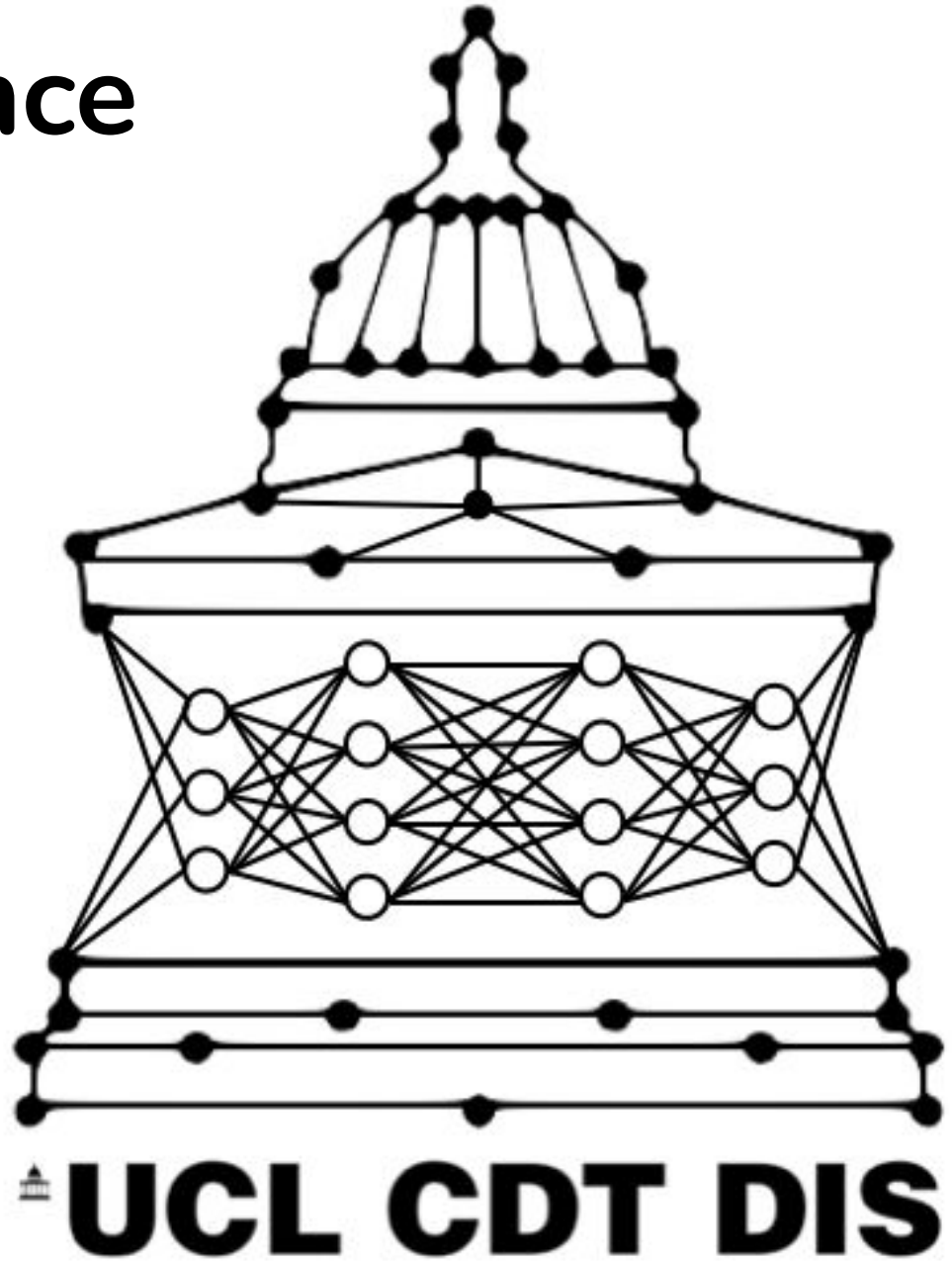
CDT in Data Intensive Science

What we do:

Applying cutting-edge data science techniques to solve problems in Astrophysics and High Energy Physics

Why I work here:

All standard PhD perks with many bespoke CDT-specific opportunities



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Great Network

- Strong ties to industry through our network of 20+ partner organisations

Exciting Collaborations

- Domestic and international collaborative projects help progress science

Positive Culture

- Supportive Management team
- Word-leading directors and supervisors who are approachable
- Positive and friendly work culture between all cohorts are other CDTs within the *MAPS* faculty

What does 1st year look like?

Different for everyone, but 3 main opportunities for progression in 1st year:

1. **Learning *(Training & Teaching)***
2. **Primary Research**
3. **Industry Group Project**

Remainder of talk is an overview of my journey through these 3 opportunities

Training

Chose *STEM* courses to develop my hard skills in:

- Software
- Deep Learning
- Statistics
- Numerical optimisation
- Cosmology

Provides base skill set required for cutting-edge interdisciplinary research

Teaching

Opportunities to teach and demonstrate, courses I've TA'd on:

- NSCI0010
- NSCI0007
- SPCE0038
- PHAS0021

Opportunities for ad-hoc teaching for short courses throughout year

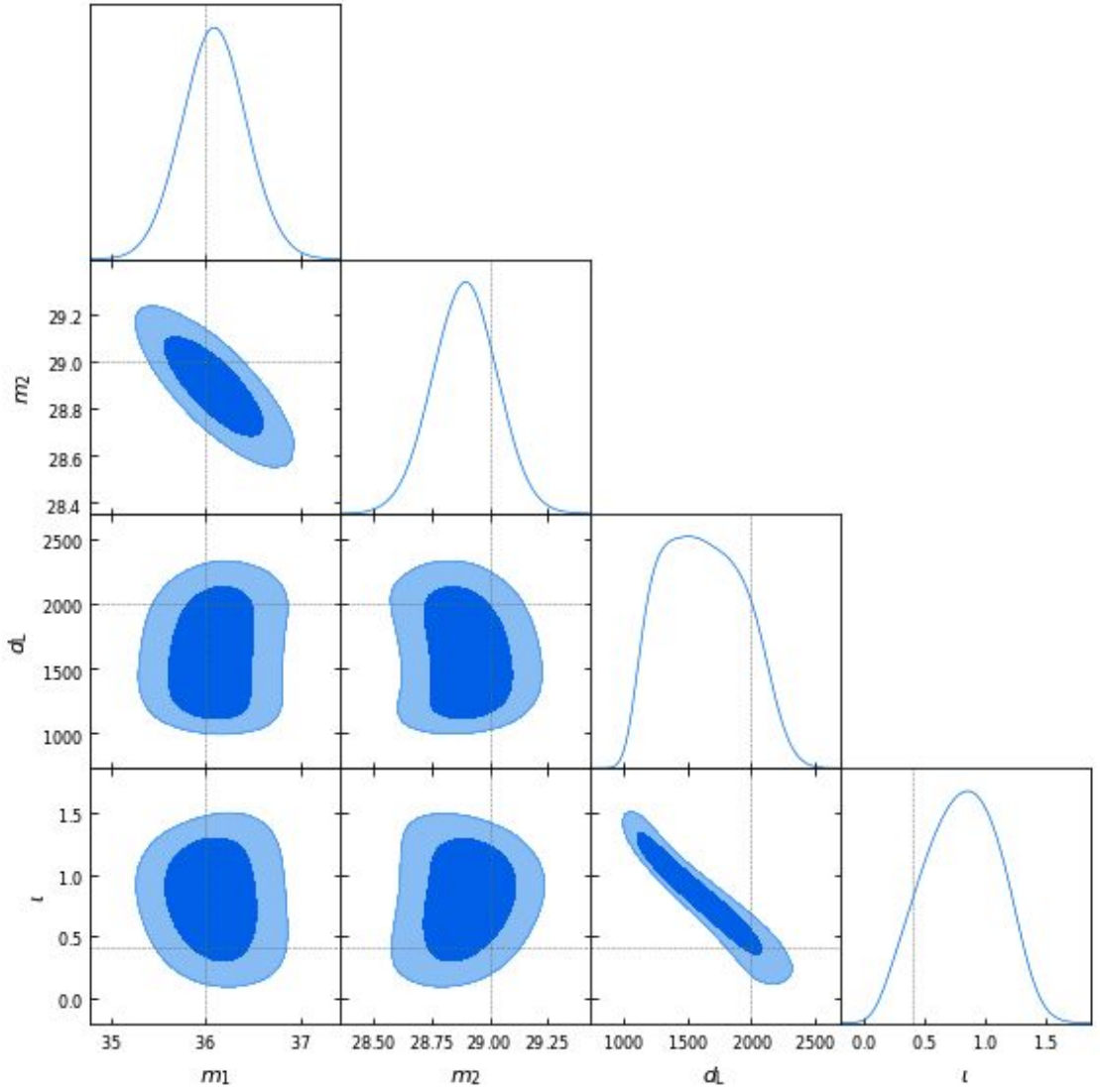
Research Overview and Group

RESEARCH FOCUS

- Bayesian model comparison for cosmology and gravitational waves using neural nets

RESEARCH PROGRESS

- 2 completed co-author projects
- Working on 1st first-author project



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My Research Journey *ii.* - *Project No.1*

McEwen, Wallis, Price & Docherty (2021)
[arXiv 2111.12720] *(Submitted STCO)*

PROJECT OVERVIEW

ML for Bayesian model comparison using Harmonic mean estimator:

$$\varphi(\theta) \overset{\text{ML}}{\simeq} \varphi^{\text{optimal}}(\theta) = \frac{\mathcal{L}(\theta)\pi(\theta)}{Z}$$

PERSONAL CONTRIBUTIONS

Developing codebase features and maintaining release dependencies

OPPORTUNITIES & OUTCOMES

Group trip to Paris to talk about paper and future work →

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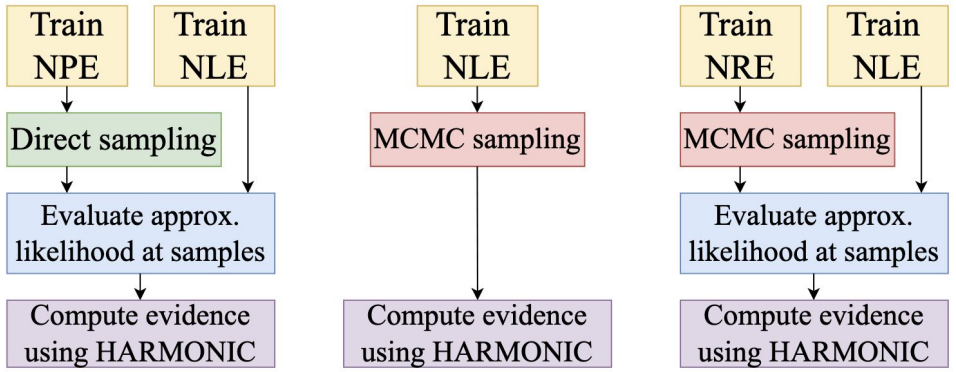
My Research Journey *iii.* - *Project No.2*

PROJECT OVERVIEW

Extending work to the likelihood-free setting using 3 neural pipelines:



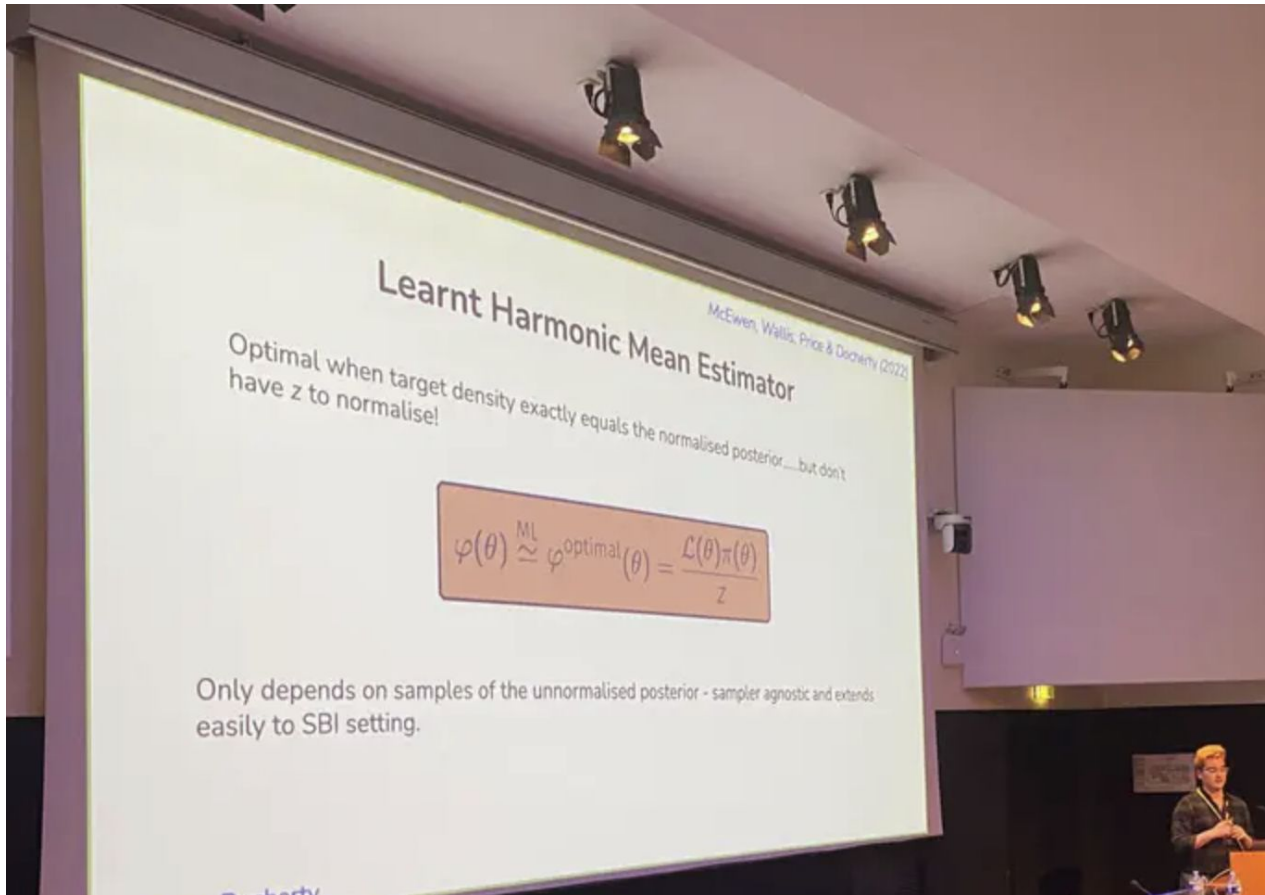
PERSONAL CONTRIBUTIONS

Significant work on data runs, paper writing and presenting

OPPORTUNITIES & OUTCOMES

Plenary talk at Paris conference in June planted seed for future collaborations

Spurio Mancini, Docherty, Price & McEwen (2022)
***[arXiv 2207.04037]** (Submitted RASTI)*



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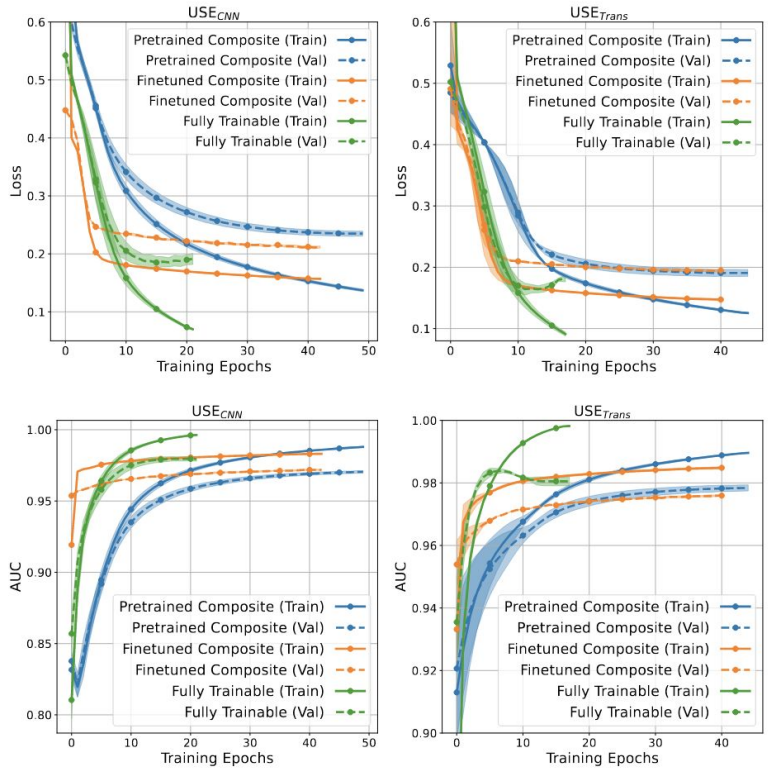
My Industry Group Project Journey

PROJECT OVERVIEW

Transformers applied to NLP to improve online search experience



OPPORTUNITIES & OUTCOMES

- In-person visits to ASOS HQ offices
- Result presentation at CDT event
- Continuing research for conference paper

Docherty, Duckett+ (2022)
(In prep. IEEE NLP workshop)

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A year in review

- Good targeted training
- Valuable teaching opportunities
- Strong research focus
- Unique industry experience
- Supportive department
- **Great year!**

Happy to answer any questions *now* or can reach me *here*

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