The Intelligent Data Analysis Group

Dr Allan Tucker
Department of Computer Science, Brunel University London.

IDA
Research

Brunel
University
London

Intelligent Data Analytics at Brunel

- Founded in 1995 at Birkbeck College
- IDA focuses on combination of algorithm / experts and users
- Applications in Environment, Health, Bioinformatics, Software Engineering, Education, Design
- Funded by many sources, nationally and internationally

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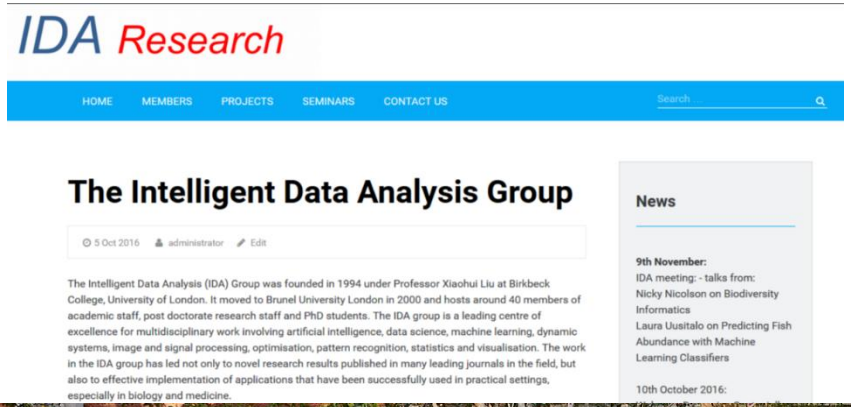
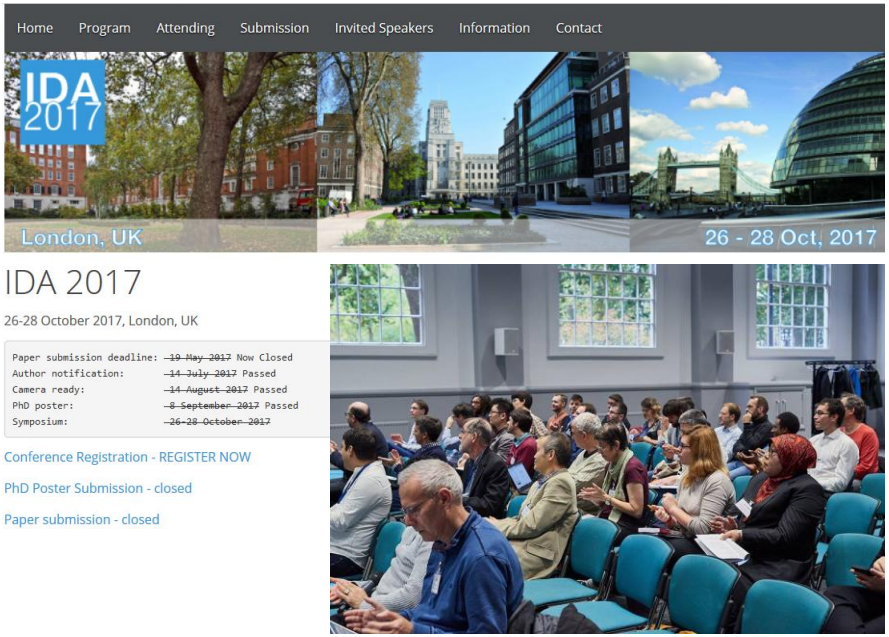
IDA
Research

Intelligent Data Analytics at Brunel

- *ida-research.net*: Hosted at Brunel
- International Symposia
- 20 years old last year (London)

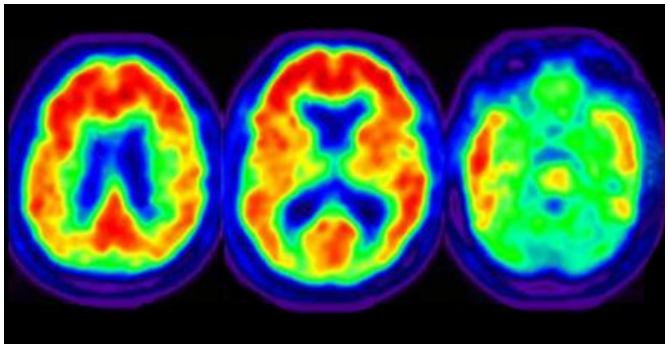


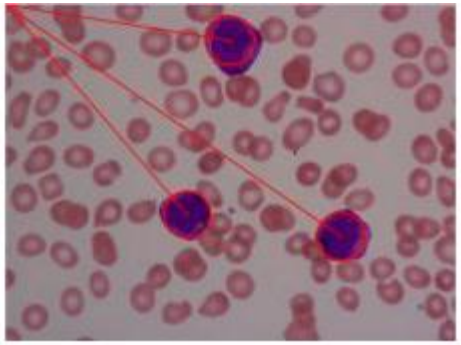


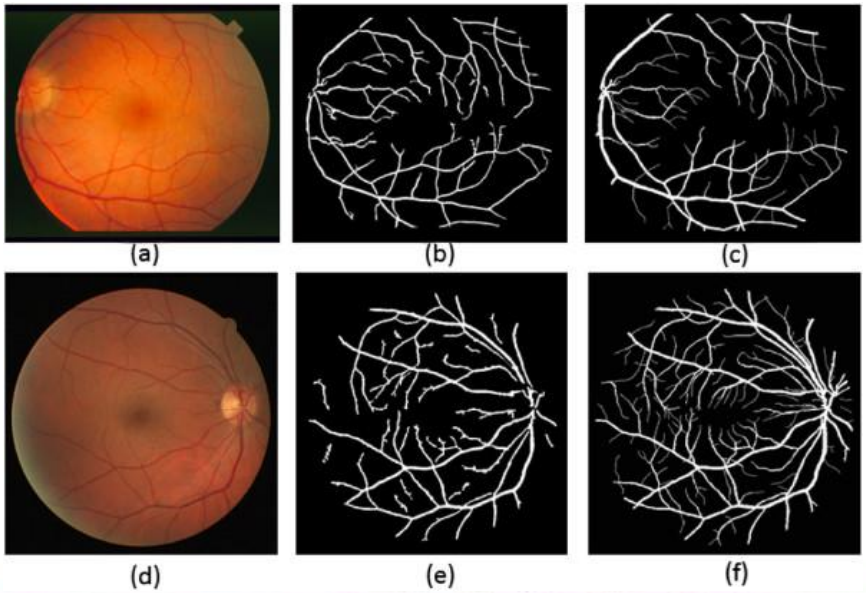
IDA
Research

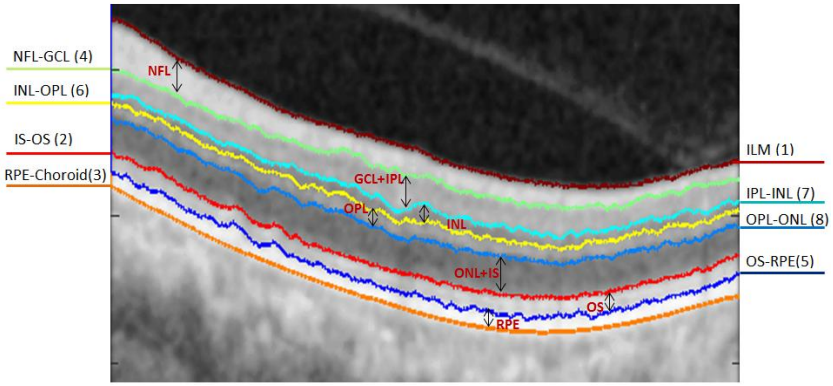
Medical Image Analysis

- Segmentation
- Classification
- Deep Learning





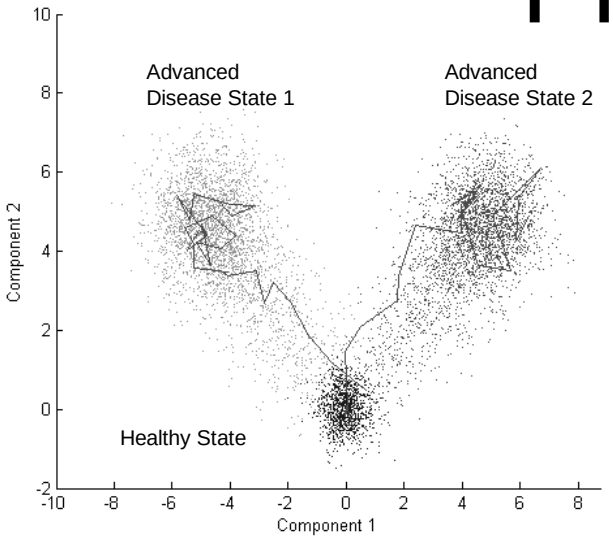


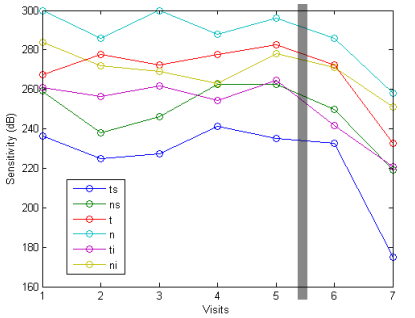


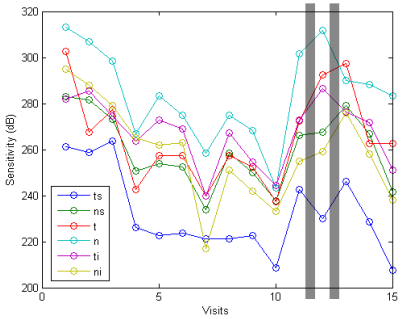
EPSRC
Engineering and Physical Sciences Research Council

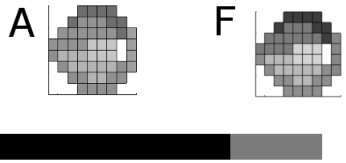
IDA
Research

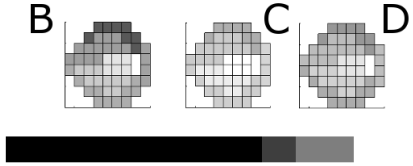
AI in Health: Disease Progression Modelling

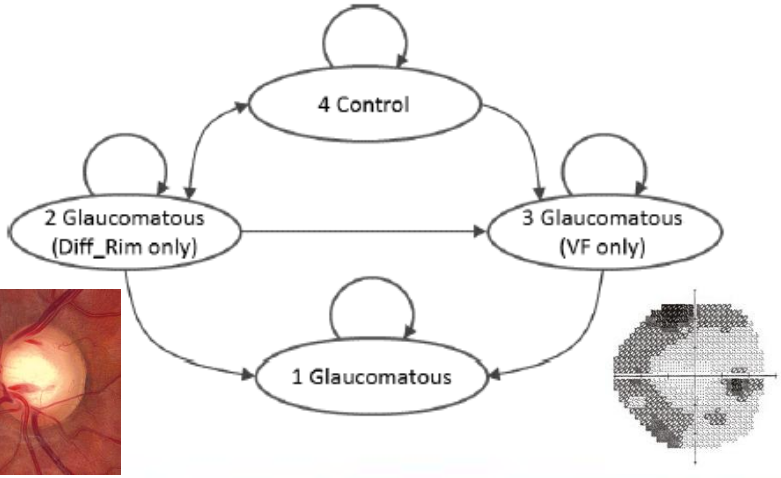












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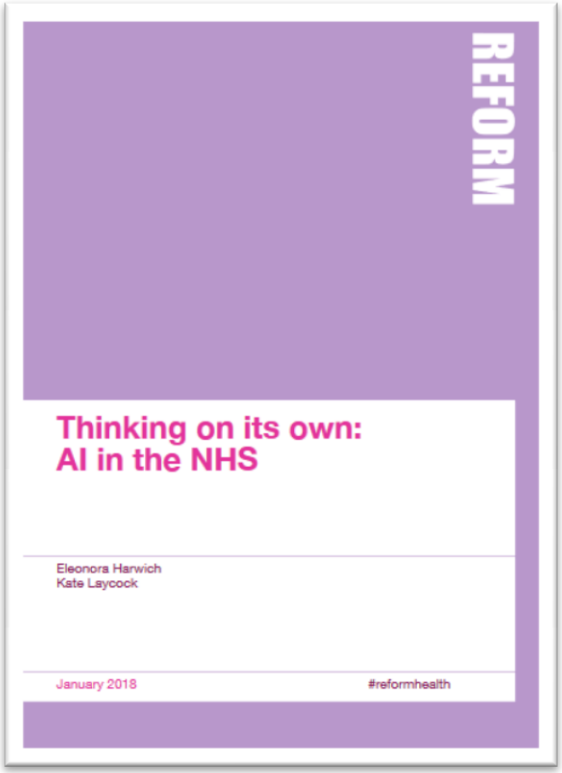

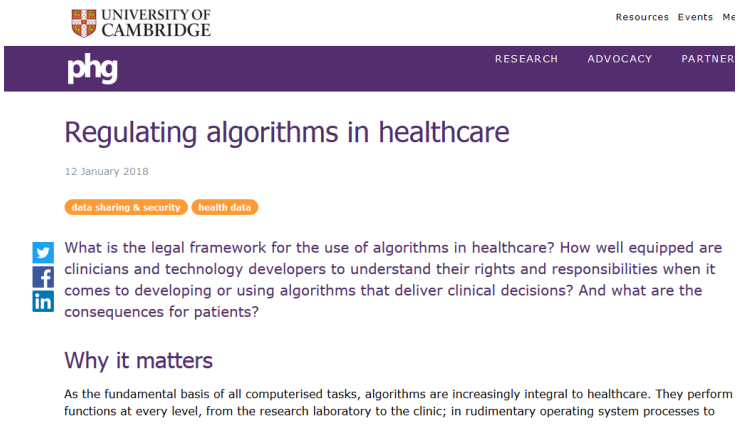

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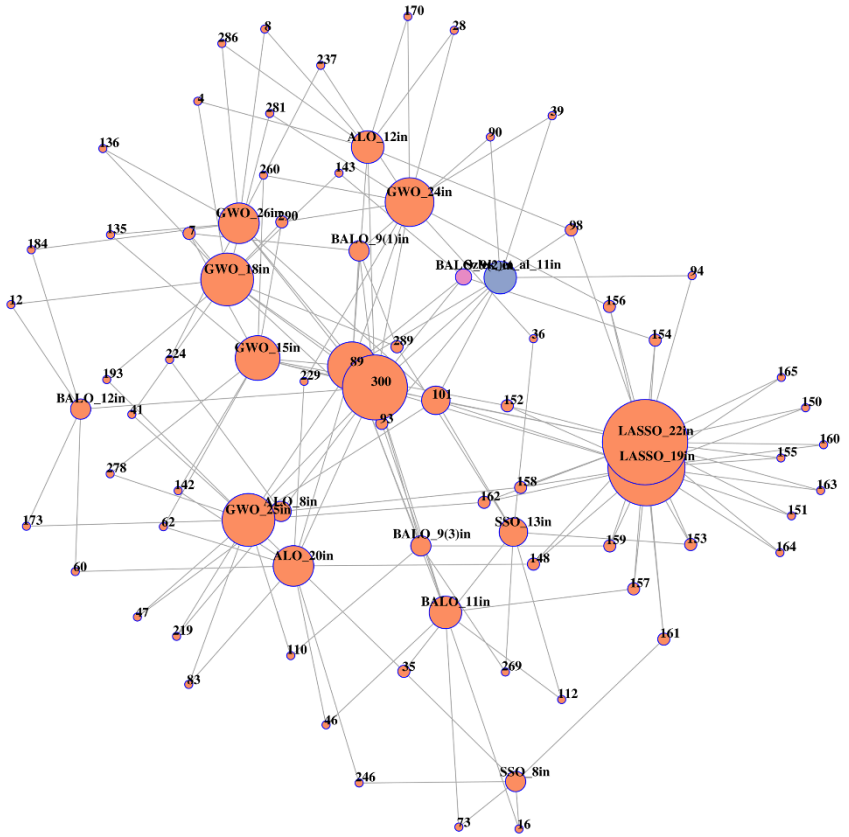
Optimisation & Drug Manufacturing

- Feature selection: as multiobjective optimisation
- Application to PLGA synthesis (used for drug manufactoring, it is a component that maintains the function, shape, etc of a pill)
- Transfer learning and meta-learning.



4 = No of oxygen atoms – protein
7 = No of aliphatic bonds – prot.
8 = No of aliphatic rings – prot.
12 = No of asymmetric atoms – prot.
16 = No of chain atoms – prot.
28 = Largest ring size – prot.
35 = Minimal projection radius – prot.
36 = Length perpend. to the min area– prot.
39 = Szeged index– prot.
41 = No of ring atoms – prot.
46 = No of rotatable bonds – prot.
47 = No of atoms – prot.
60 = No of ring atoms– prot.
62 = No of chain atoms – prot.
73 = No of aliphatic rings – prot.
83 = van der Waals vol. – prot.
89 = PVA inner ph. conc.(%)– form. charact.
90 = PVA outer ph. conc.(%)– form. charact.
93 = Encapsulation ratio– form. charact.
94 = Mean particle size– form. charact.
97 = PLGA to plast. ratio– form. charact.
98 = Dissol. pH– form. charact.
101 = Prod. method – form. charact.
110 = No of heteroaliphatic rings– plast.
112 = No of ring bonds – plast.
135 = Harary index– plast.
136 = Hyper wiener index– plast.
142 = Platt index– plast.
143 = Randic index– plast.
148 = Molec. fragment count– plast.
150 = logD at pH 0– plast.
151 = logD at pH 1– plast.
152 = logD at pH 2– plast.
153 = logD at pH 3– plast.
154 = logD at pH 4– plast.
155 = logD at pH 5– plast.
156 = logD at pH 6– plast.
157 = logD at pH 7– plast.
158 = logD at pH 8– plast.
159 = logD at pH 9– plast.
160 = logD at pH 10– plast.
161 = logD at pH 11– plast.
162 = logD at pH 12– plast.
163 = logD at pH 13– plast.
164 = logD at pH 14– plast.
165 = logP– plast.
170 = No of acceptor atoms at pH 0– plast.
173 = No of acceptor atoms at pH 3– plast.
184 = No of acceptor atoms at pH 14– plast.
193 = No of donor atoms at pH 8– plast.
219 = Princ. comp. of polar. tensor axx– emulsif.
224 = ASA+– emulsif.
229 = No of asymmetric atoms– emulsif.
237 = Maximal projection area– emulsif.
246 = Wiener polarity– emulsif.
260 = LogD at pH 10– emulsif.
269 = No of donor atoms– emulsif.
278 = No of acceptor atoms at pH 8– emulsif.
281 = No of acceptor atoms at pH 11– emulsif.
286 = No of donor atoms at pH 1– emulsif.
289 = No of donor atoms at pH 4– emulsif.
290 = No of donor atoms at pH 5– emulsif.
300 = Time (days)

Graph showing the frequencies of occurrence together with connections between selected vectors of features

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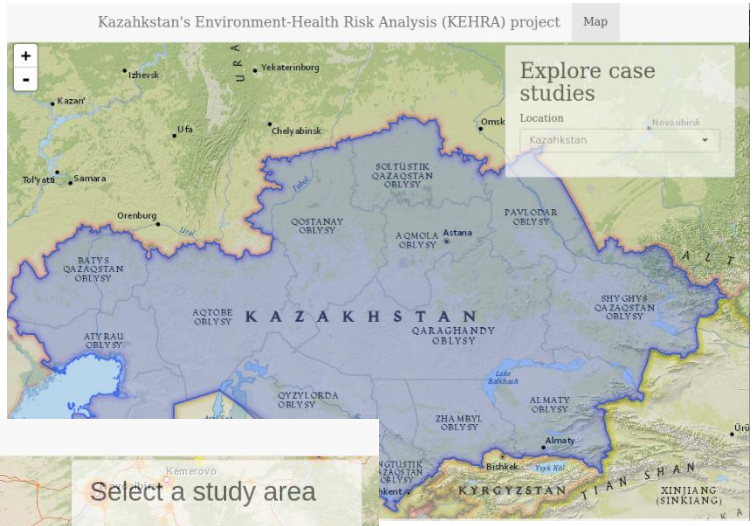
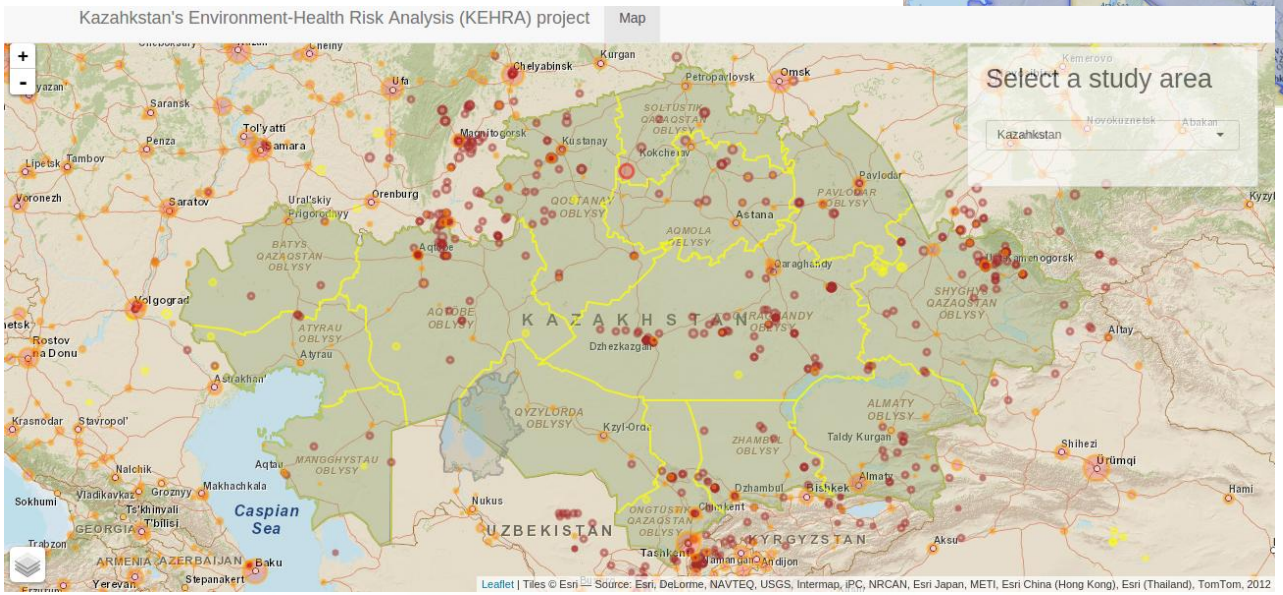
IDA Research

Epidemiology in Kazahkstan

BRITISH COUNCIL





Air pollution + climate change + health outcomes (monthly):

- Sulfur dioxide (SO2)
- Carbon monoxide (CO)
- Nitrogen dioxide (NO2)
- Nitrogen oxide (NO)
- Suspended particles
- Ozone (O3)
- Hydrogen sulfide (H2S)
- Ammonia (NH3)

Water (status of surface water quality on hydro-chemical indicators, 2010-2014)
Radioactive contamination (2005-2014)
Spatial information

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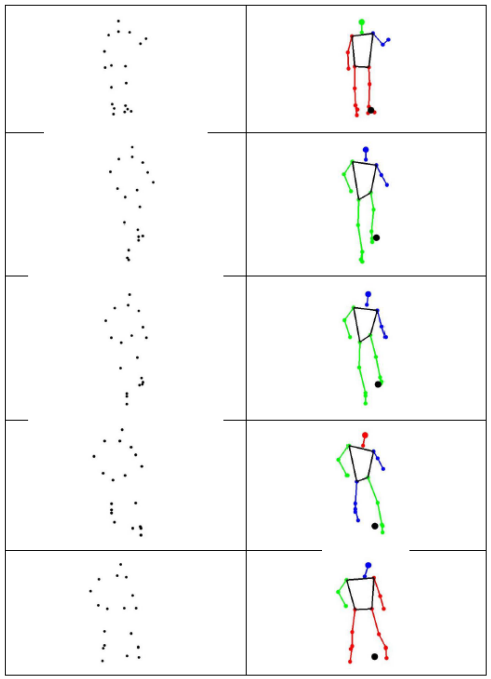
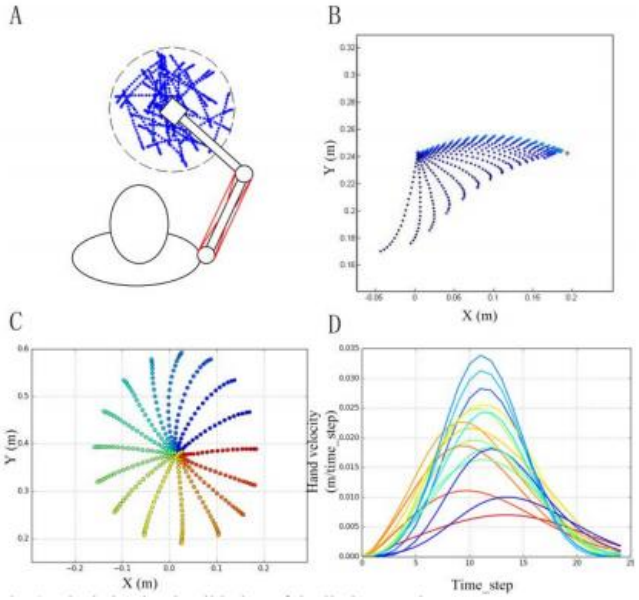
Biomechanical Modelling

- Modelling human behaviour
- Sports modelling
- Gesture modelling





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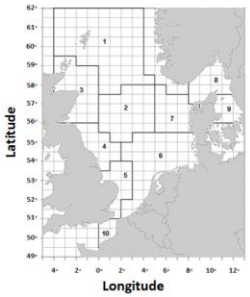
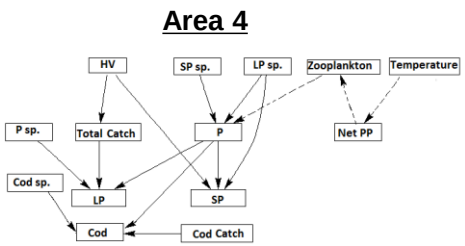
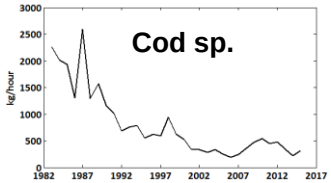
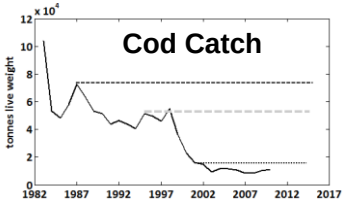
IDA Research

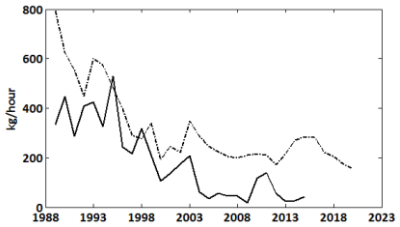
Eco – Informatics

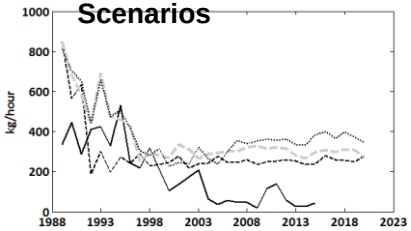










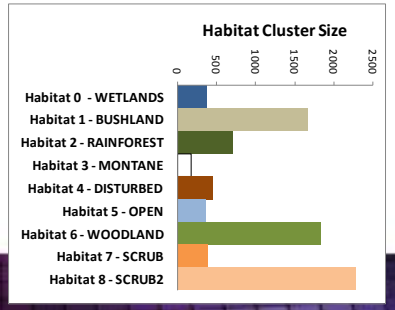


NERC SCIENCE OF THE ENVIRONMENT

Cefas

- Latent Variables
- Food Web Discovery
- Forecasting

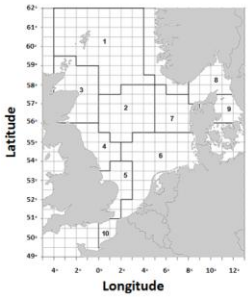
- Text Mining
- Species Pattern Discovery
- Impact of change

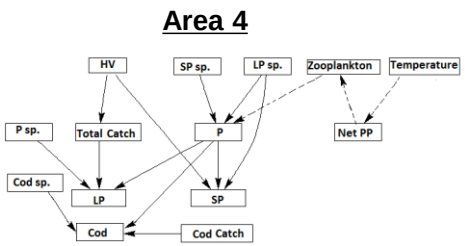


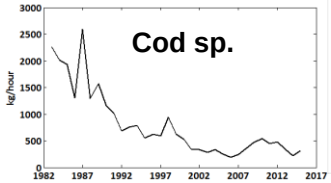
Kew ROYAL BOTANIC GARDENS

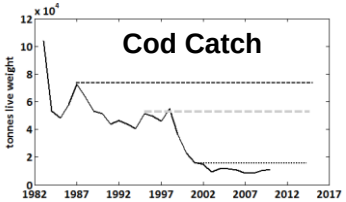
IDA Research

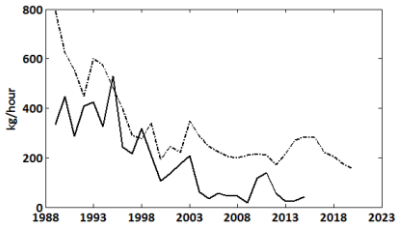
Eco – Informatics

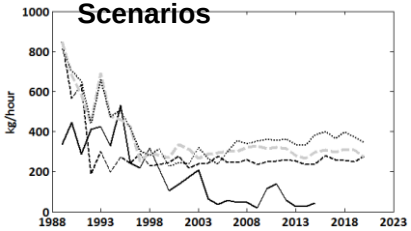












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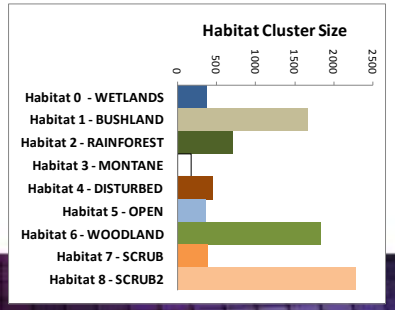


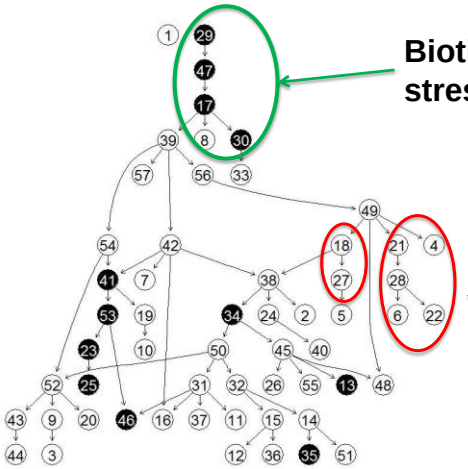
Kew
ROYAL BOTANIC GARDENS

IDA Research

Gene Regulatory Networks

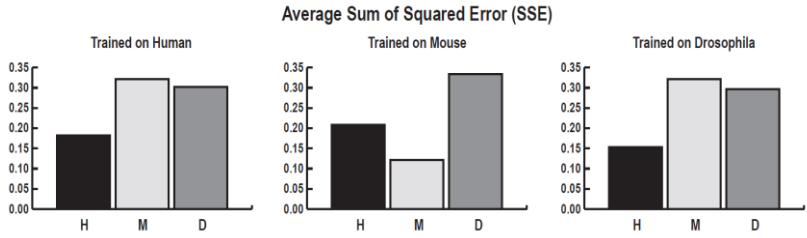
ROTHAMSTED RESEARCH

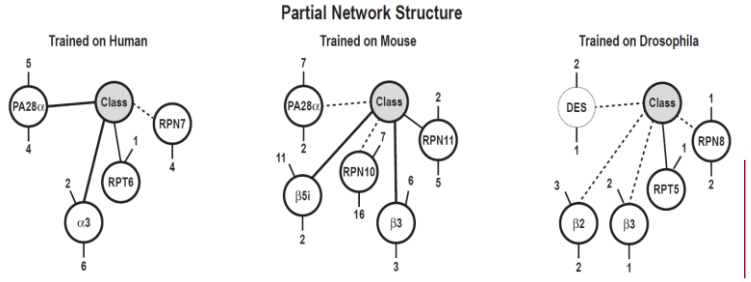
EPSRC
Engineering and Physical Sciences Research Council



Biotic stress

Heat stress and **photosynthesis**



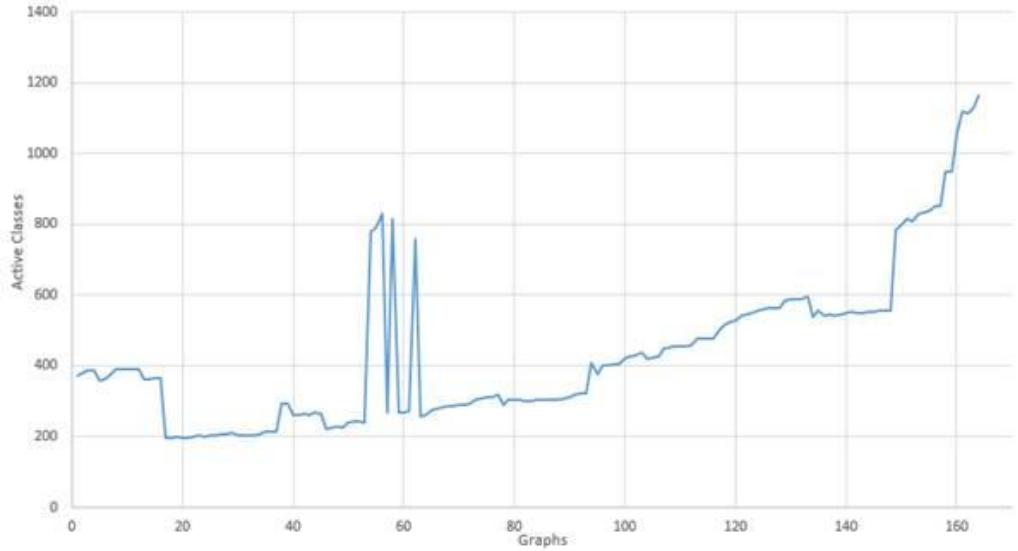


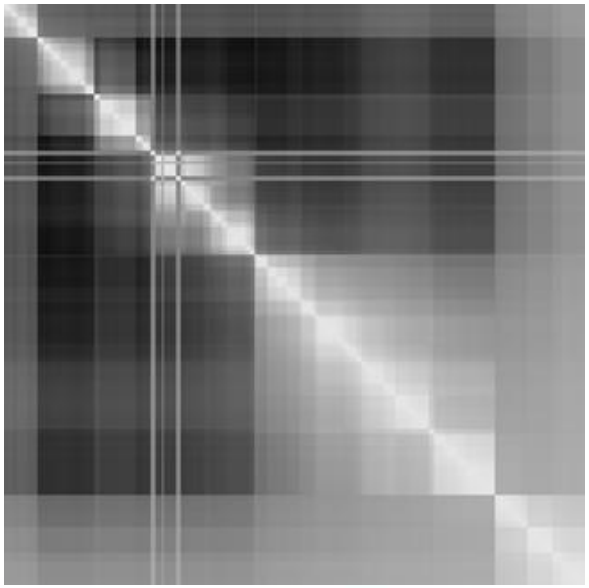
Universiteit Leiden

EXCELLENCE IN SCIENCE
THE ROYAL SOCIETY

IDA in Software Engineering

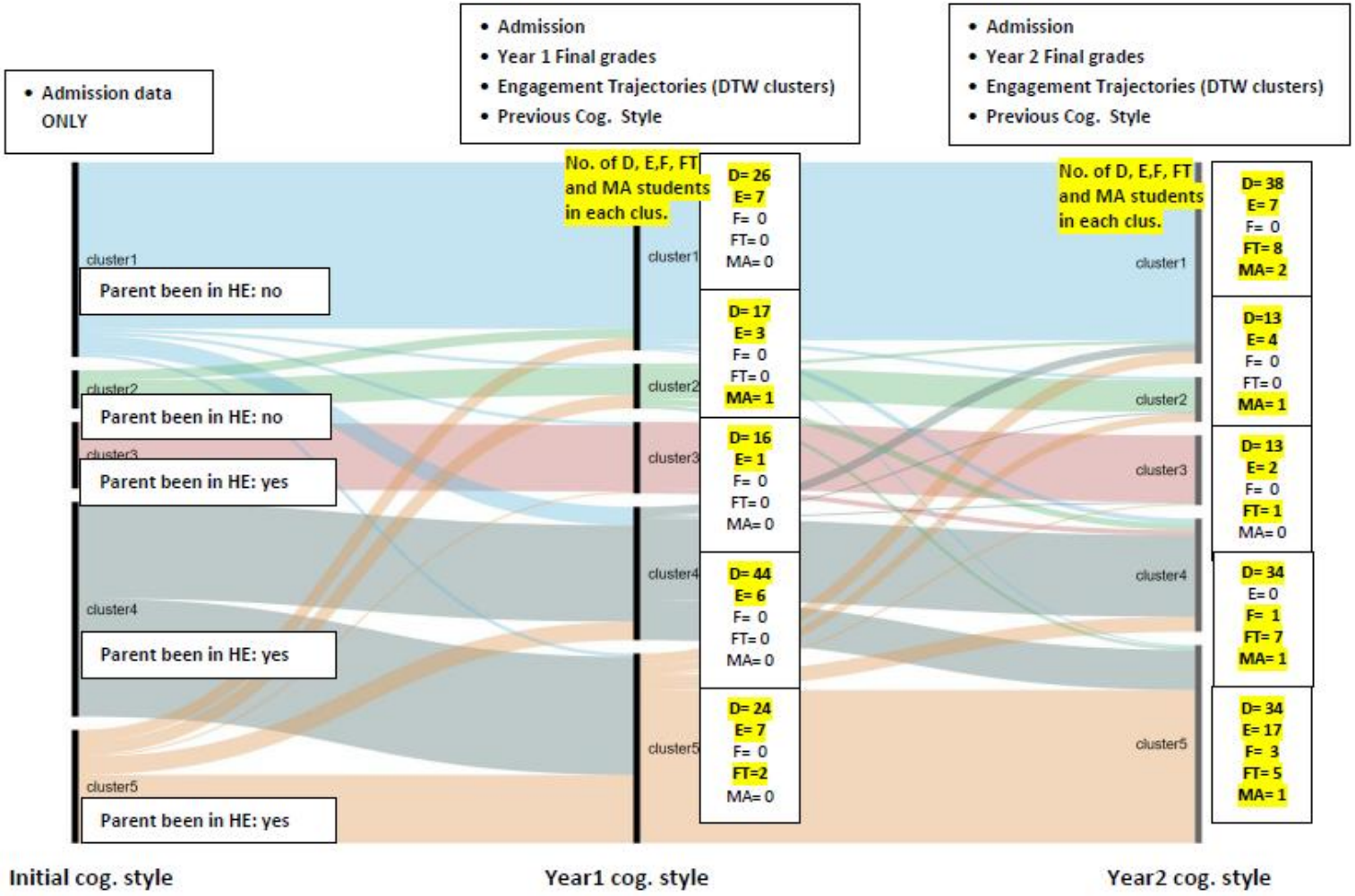
- Collaborations with BSEL
- Refactoring
- Clustering
- Time-Series





pair-wise comparison of the graphs (versions) of a software system

Education Analytics



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Sample Publications

- I Olier, N Sadawi, GR Bickerton, J Vanschoren, C Grosan, L Soldatova, R.King, Meta-QSAR: a large-scale application of meta-learning to drug design and discovery
  Machine Learning 107 (1), 285–311, 2018
- M Li, S Yang, and X Liu (2016) “Pareto or Non-Pareto: Bi-Criterion Evolution in Multi-Objective Optimization”, *IEEE Transactions on Evolutionary Computation*, 20(5):645-665.
- D Chen, Y Tian and X Liu (2016) “Structural Non-Parallel Support Vector Machine for Pattern Recognition”, *Pattern Recognition*, 60:296-305.
- Uusitalo, L., Tomczak, MT., Müller-Karulis, B., Putnis, I., Trifonova, N. and Tucker, A. (2018) 'Hidden variables in a Dynamic Bayesian Network identify ecosystem level change'. *Ecological Informatics*, 45. pp. 9 - 15. ISSN: 1574-9541
- Tucker, A., Li, Y. and Garway-Heath, D. (2017) 'Updating Markov models to integrate cross-sectional and longitudinal studies'. *Artificial Intelligence in Medicine*, 77. pp. 23 - 30. ISSN: 0933-3657
- Bo, V., Curtis, T., Lysenko, A., Saqi, M., Swift, S. and Tucker, A. (2014) 'Discovering Study-Specific Gene Regulatory Networks'. *PLoS One*. ISSN: 1932-6203
- Wang, D., Wang, Z., Shen, B., Li, Y., and Alsaadi, F. E. An event-triggered approach to robust recursive filtering for stochastic discrete time-varying spatial-temporal systems. Signal Processing, volume 145, pages 91-98, 2018.
- Roth, T., Weier, M., Hinkenjann, A., Slusallek, P., & Li, Y. A Quality-Centered Analysis of Eye Tracking Data in Foveated Rendering. Journal of Eye Movement Research, volume 10, number 5, pages 1-12, 2018. Javadi, S. M., Li, Y., & Liu, X. Removing Shadows from Video. International Journal of Machine Learning and Computing, volume 7, number 6, pages 232-237, 2017.

Brunel University London

Sample Grants

- IntelliRehab: Intelligent medical system with customised exercises for personalized home telerehabilitation, TSB, £414146.75 (FEC)
- British Council Institutional Links Grant "A multi-dimensional environment-health risk analysis system for Kazakhstan" (2015)
- INTEGRADDE: “Intelligent data-driven pipeline for the manufacturing of certified metal parts through Direct Energy Deposition processes” EC Horizon 2020 [2018-2022], €12,700,000.
- What Works Wellbeing: Culture Sport and Wellbeing Evidence Review: Social Diversity & Context Matters ESRC, ES/N003721/1 : GBP 23,638.14
- Royal Academy of Engineering Newton Fund Programmes [2017-2019], £100K, “Modelling, Quantification Analysis and Applications of Lateral Flow Immunoassay”, Co-Investigator (with Zidong Wang and Fuzhou University).
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