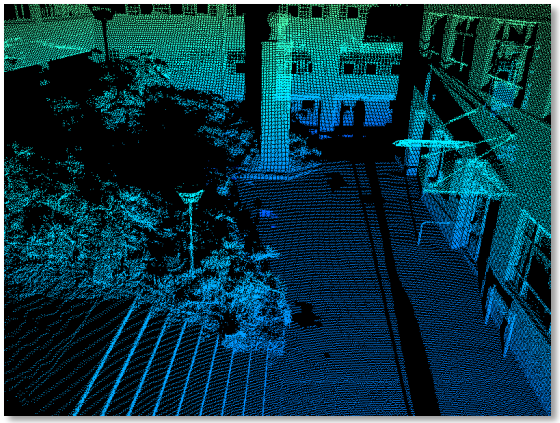
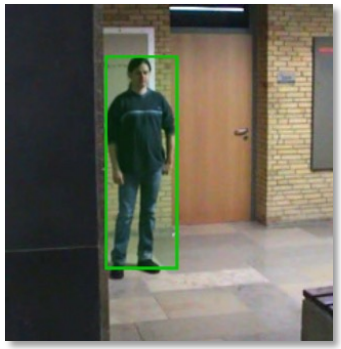
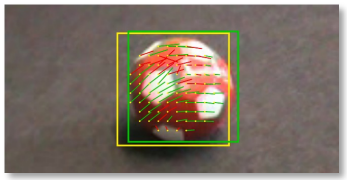
Intelligent Systems:
Machine Learning & Optimisation (IMLO)

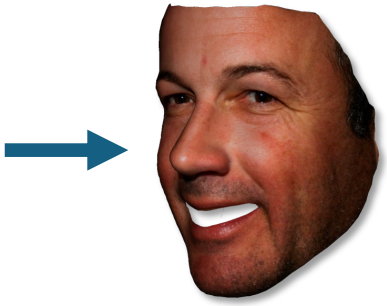
Department of Computer Science

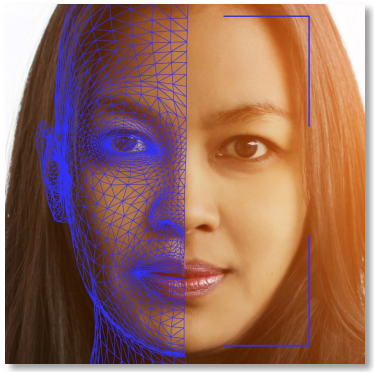
Semester 2











IMLO

- Module aims - Introducing the basics of machine learning from an optimisation perspective
  - Picking up from linear regression, to optimisation algorithms, to simple neural networks
  - Introducing linear algebra and continuous optimisation concepts needed to understand machine learning
  - (hopefully) Motivating real-world problems
  - Practical implementation of the techniques, using modern python-based machine learning libraries

Related modules

- Builds upon SOF2 - Familiarity with Python 3
- Compliments material in DATA - Data handling & processing, computing statistics on data, linear regression, a bit of K-Means & logistic regression
- Foundations for Y3 modules – DEEP (formally PADL)

Module content overview

- Introduction to Machine Learning
- Linear and logistic regression
- Loss functions
- Continuous optimisation
- Derivatives, partial derivatives, and gradients
- Overfitting and regularisation
- Neural networks

Module Team - Academics

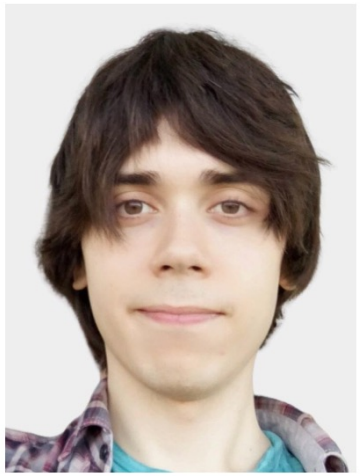
James Walker
Module Leader

Pourya Shamsolmoali
Academic

Claudio Guarnera
Academic

Module Team - GTAs

Babis Peteinarelis



Luca Resti

Owen Crucefix

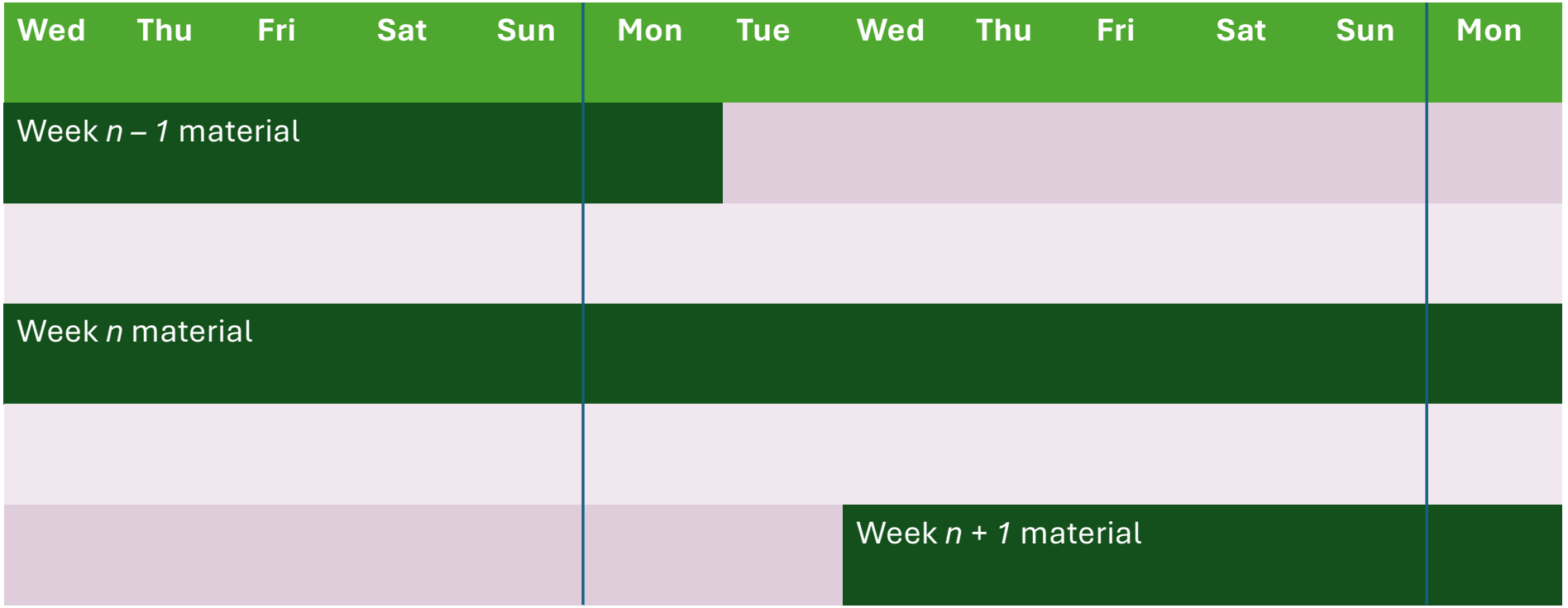
Wenhan Li

Module Structure

- Weekly in-person lecture (S2W1 - S2W10)
- Weekly practical labs (S2W2 – S2W11)
- Weekly practical solution sessions/tutorial (S2W2-S2W10)
- Weekly optional drop-in session (S2W1-S2W11)

- Any other issues, please email module leaders

What an IMLO week looks like…



… In Terms Of Timetabled Sessions

Semester Week	Date Commencing	Monday Lecture Slot	Tues/Wed Labs Slot	Wednesday Lecture Slot
1	9th Feb	Wk 1 - Lecture	-	Wk 2 - Lecture
2	16th Feb	Wk 1 - Tutorial	Wk 2 - Labs	Wk 3 - Lecture
3	23rd Feb	Wk 2 - Solutions	Wk 3 - Labs	Wk 4 - Lecture
4	2nd Mar	Wk 3 - Solutions	Wk 4 - Labs	Wk 5 - Lecture
5	9th Mar	Wk 4 - Solutions	Wk 5 - Labs	Wk 6 - Lecture
6	16th Mar	Wk 5 - Solutions	Wk 6 - Labs	Wk 7 - Lecture
7	23rd Mar	Wk 6 - Solutions	Wk 7 - Labs	Wk 8 - Lecture
8	13th Apr	Wk 7 - Solutions	Wk 8 & 9 - Labs	Wk 9 - Lecture
9	20th Apr	Wk 8 - Tutorial	Wk 8 & 9 - Labs	Wk 10 - Lecture
10	27th Apr	Wk 8 & 9 - Solutions	Wk 10 - Labs	Guest Lecture
11	4th May	-	Coursework	-

Module Assessment - Exam

- VLE based exam
  - Online
  - 3 hours to complete
- 70% of module mark
- During the common assessment period (S2W13 - S2W15)

Module Assessment – Exam (Cont’d)

- Sample Exam Paper
  - 10 Questions
  - ~1 hour to complete
- Separate paper with answers
- Available now on the VLE

Module Assessment - Coursework

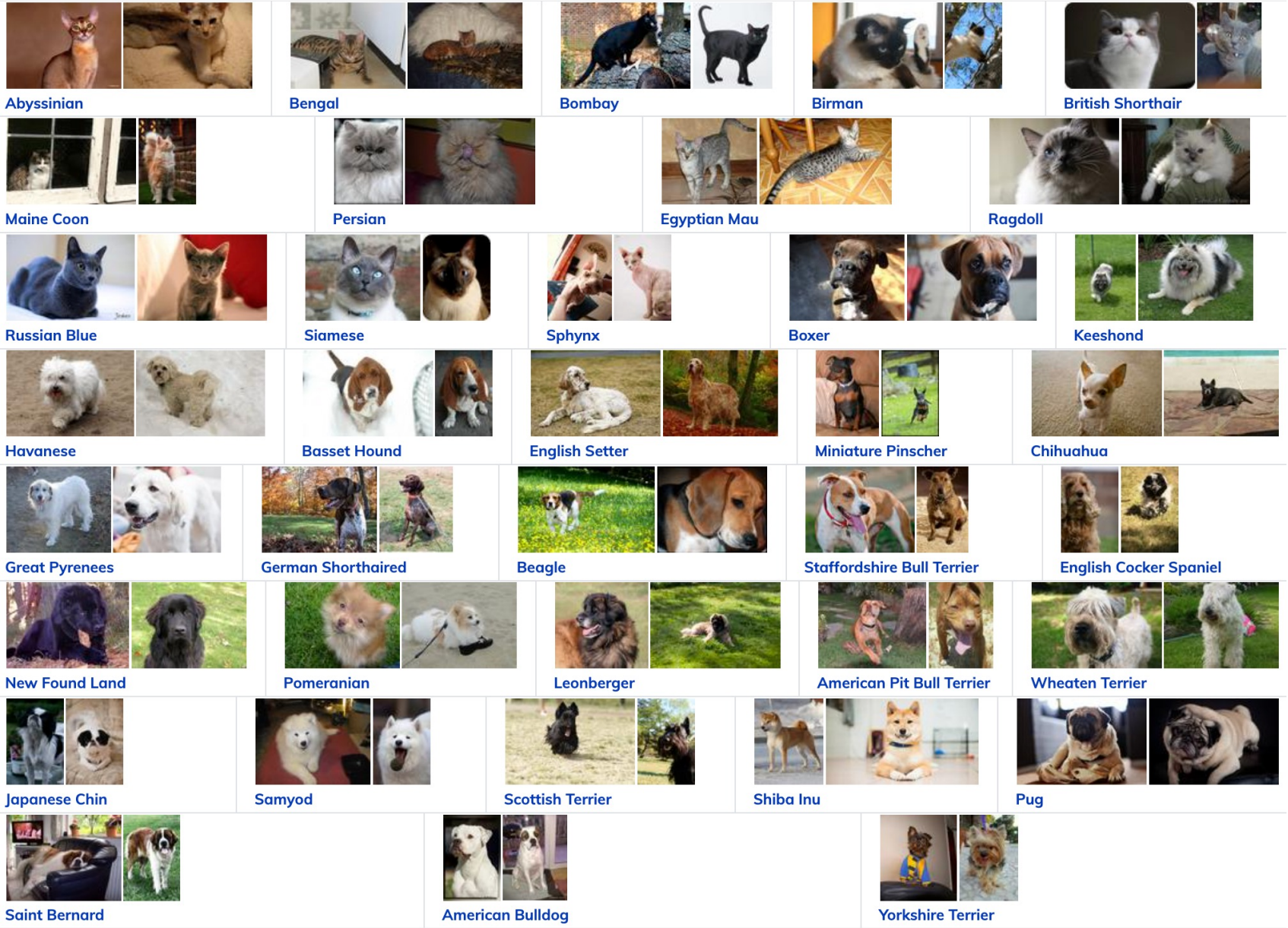
- Individual project
  - Released S2W2 – **not expected to do the coursework yet!**
  - Submission portal opens S2W11
  - Submission portal deadline S2W13

- 30% of module mark

- Question form to complete on submission portal
  - Questions released on VLE in S2W2

Coursework Task

- Categorical classification
- Design and train a neural network for the classification task



Coursework Task

- 37 breed groups
  - 25 dogs
  - 12 cats

- Dataset split into:
  - Trainval
  - Test

- Trainval can be further split into:
  - Train
  - Validation

Dataset Statistics

Breed	Count
American Bulldog	200
American Pit Bull Terrier	200
Basset Hound	200
Beagle	200
Boxer	199
Chihuahua	200
English Cocker Spaniel	196
English Setter	200
German Shorthaired	200
Great Pyrenees	200
Havanese	200
Japanese Chin	200
Keeshond	199
Leonberger	200
Miniature Pinscher	200
Newfoundland	196
Pomeranian	200
Pug	200
Saint Bernard	200
Samyoed	200
Scottish Terrier	199
Shiba Inu	200
Staffordshire Bull Terrier	189
Wheaten Terrier	200
Yorkshire Terrier	200
Total	4978

1.Dog Breeds

Breed	Count
Abyssinian	198
Bengal	200
Birman	200
Bombay	200
British Shorthair	184
Egyptian Mau	200
Main Coon	190
Persian	200
Ragdoll	200
Russian Blue	200
Siamese	199
Sphynx	200
Total	2371

2.Cat Breeds

Family	Count
Cat	2371
Dog	4978
Total	7349

3.Total Pets

Resources

- Coursera *Machine Learning* by Andrew Ng / Stanford CS229
  - https://www.coursera.org/learn/machine-learning, http://cs229.stanford.edu/
- MIT 6.036 *Introduction to Machine Learning*
  - https://openlearninglibrary.mit.edu/courses/course-v1:MITx+6.036+1T2019/course/
- *Numerical Algorithms*, Justin Solomon (2015)
  - https://people.csail.mit.edu/jsolomon/ (library / free PDF)
- *Deep Learning*, Ian Goodfellow et al. (2016)
  - https://www.deeplearningbook.org/
- *Linear Algebra* course by Gilbert Strang (MIT)
  - https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/
  - YouTube playlist: https://www.youtube.com/watch?v=YeyrH-Oc2p4&list=PL221E2BBF13BECF6C&index=2
  - Matrix Methods in Data Analysis, Signal Processing, and Machine Learning https://ocw.mit.edu/courses/mathematics/18-065-matrix-methods-in-data-analysis-signal-processing-and-machine-learning-spring-2018/
- *Pattern Recognition and Machine Learning* ("PRML"), Christopher Bishop (2006)
  - https://www.microsoft.com/en-us/research/people/cmbishop/prml-book/ (library / free PDF)
- *Neural Networks and Deep Learning: A Textbook*, Charu C. Aggarwal (2018)
- *Neural Networks and Learning Machines*, Simon S. Haykin (2008) (library)
- *An Introduction to Statistical Learning*, Gareth James et al. (2017)
  - https://statlearning.com/ (free PDF)