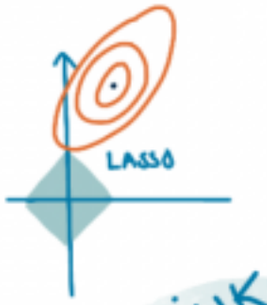
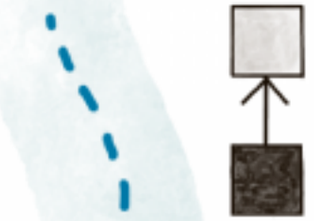
MA8701 Advanced methods in statistical inference and learning

V2021 - L1: Introduction

Mette Langaas, 2021-01-11

MA8701 ADVANCED STATISTICAL METHODS IN INFERENCE AND LEARNING





SHRINKAGE

1

2 ENSEMBLES

3 NEURAL NETS

4 XAi

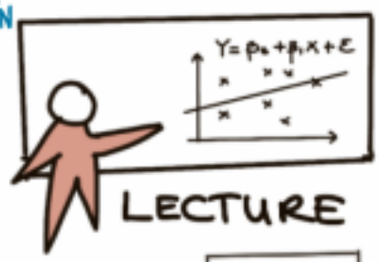
BIAS-VARIANCE TRADE-OFF

OPTIMIZATION

CLASSIFICATION

REGRESSION

STUDY TECHNIQUES



LECTURE

READING LIST

DISCUSSION

25 %

DATA ANALYSIS WRITTEN REPORT

25 %

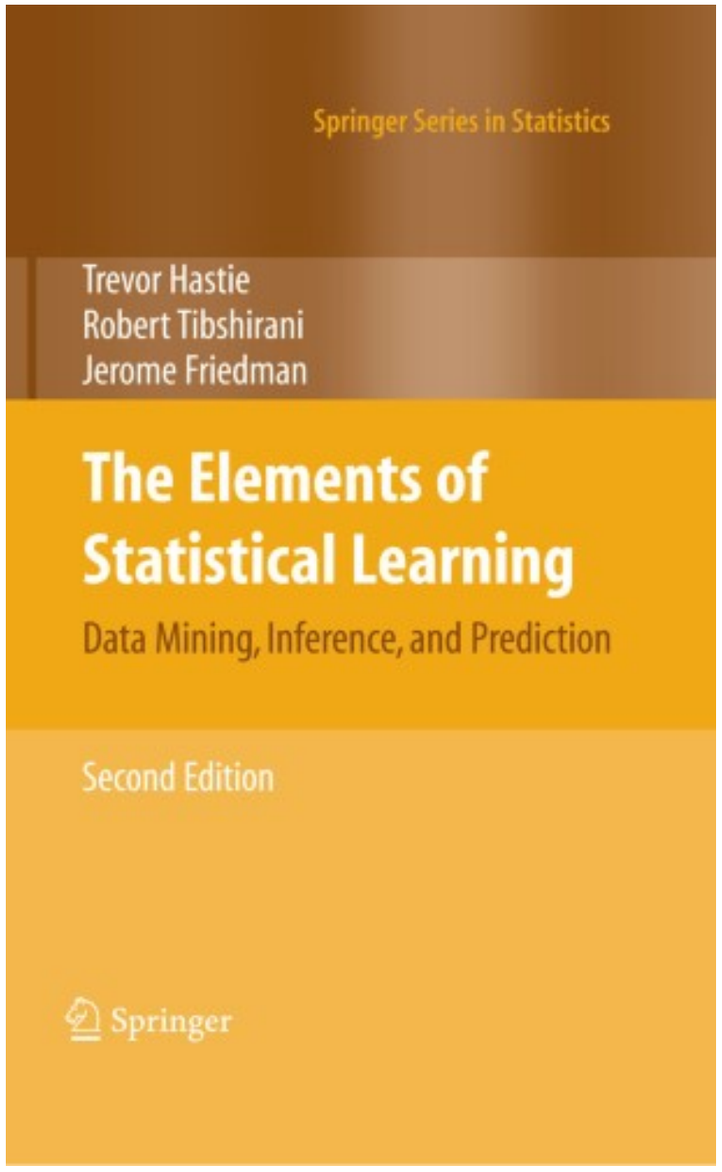
ORAL EXAM

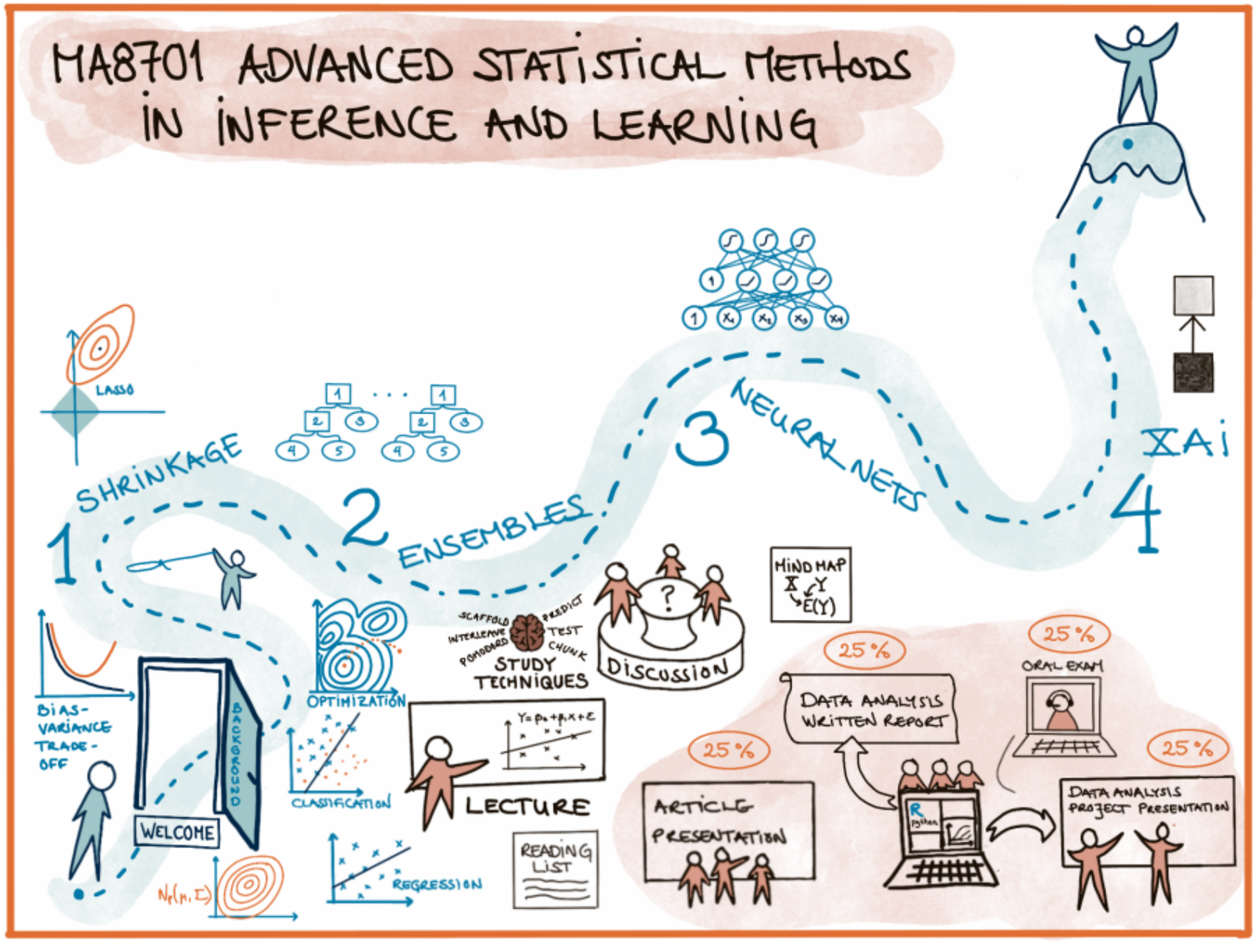
25 %

ARTICLE PRESENTATION

25 %

DATA ANALYSIS PROJECT PRESENTATION


Springer Series in Statistics
Trevor Hastie
Robert Tibshirani
Jerome Friedman
The Elements of Statistical Learning
Data Mining, Inference, and Prediction
Second Edition
Springer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SHRINKAGE
1
2
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BIAS-VARIANCE TRADE-OFF
WELCOME
BACKGROUND
OPTIMIZATION
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REGRESSION
SCAFFOLD
INTERLEAVE
POMODORO
PREDICT
TEST
CHUNK
STUDY TECHNIQUES
LECTURE
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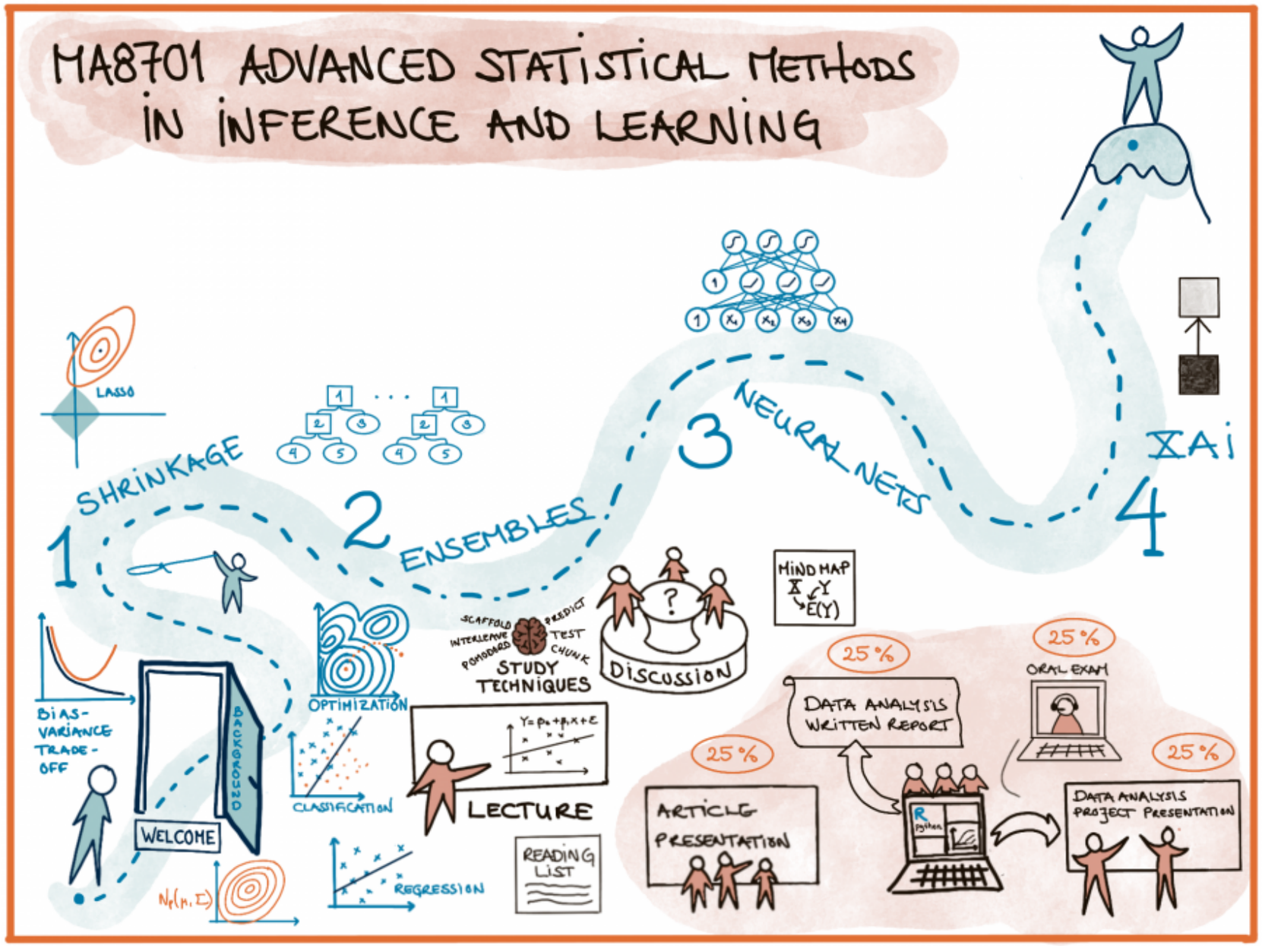
Course topics

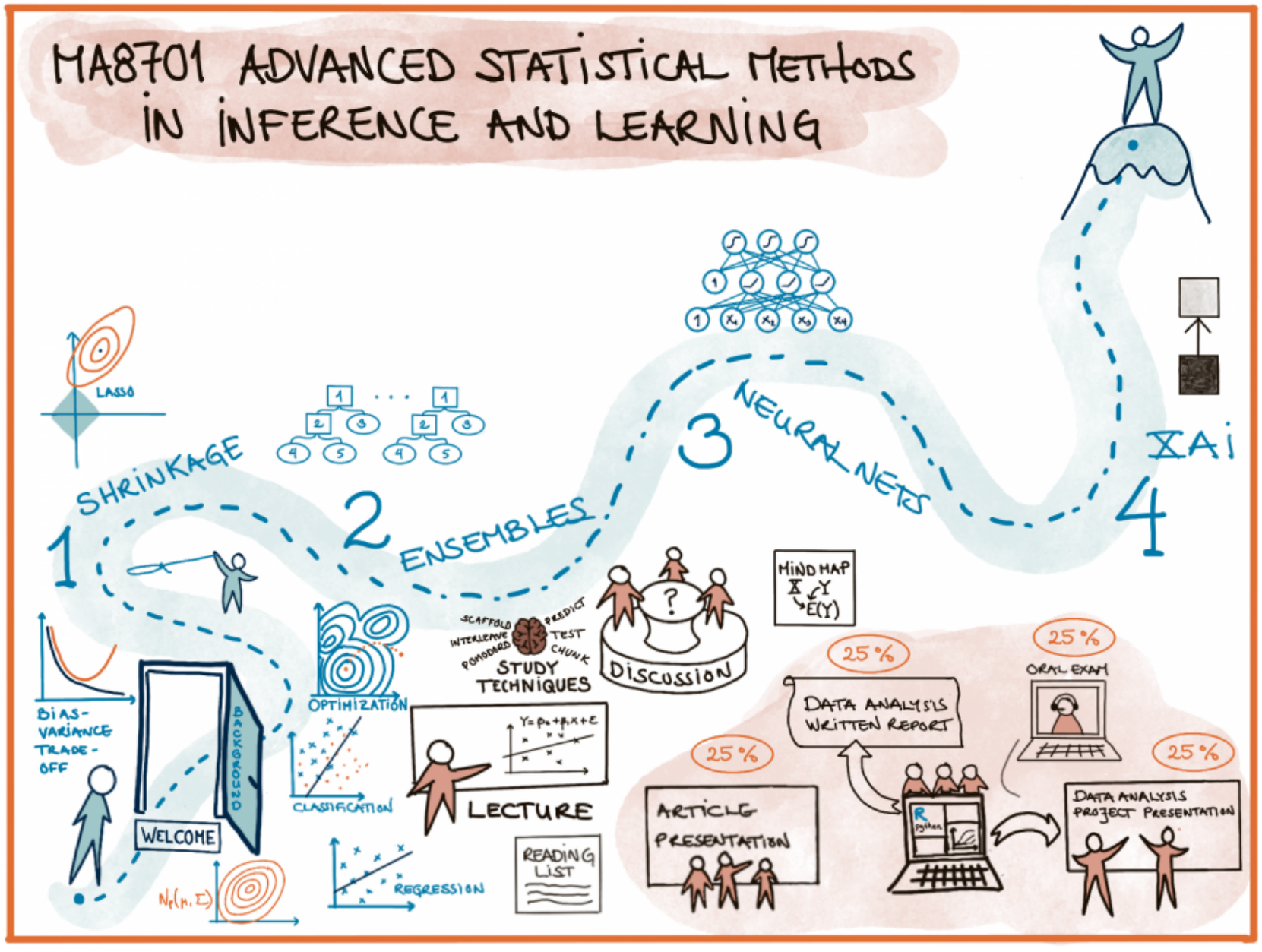


Course topics

Introduction [this part, one week]

Sort out assumed background knowledge, and learn something new

- Notation
- Statistical decision theoretic framework (partly new)
- Model selection and model assessment - including bias-variance trade-off (mostly new)



Course topics

Part 1: Shrinkage [3 weeks]

- ELS 3.2.3,3.4, 3.8, 4.4.4.
- Hastie, Tibshirani, Wainwright (HTW): Statistical Learning with Sparsity: The Lasso and Generalizations. Selected chapters.
- Post-selective inference (articles)
- An introduction to analysing text

Includes one data analysis project with short report.

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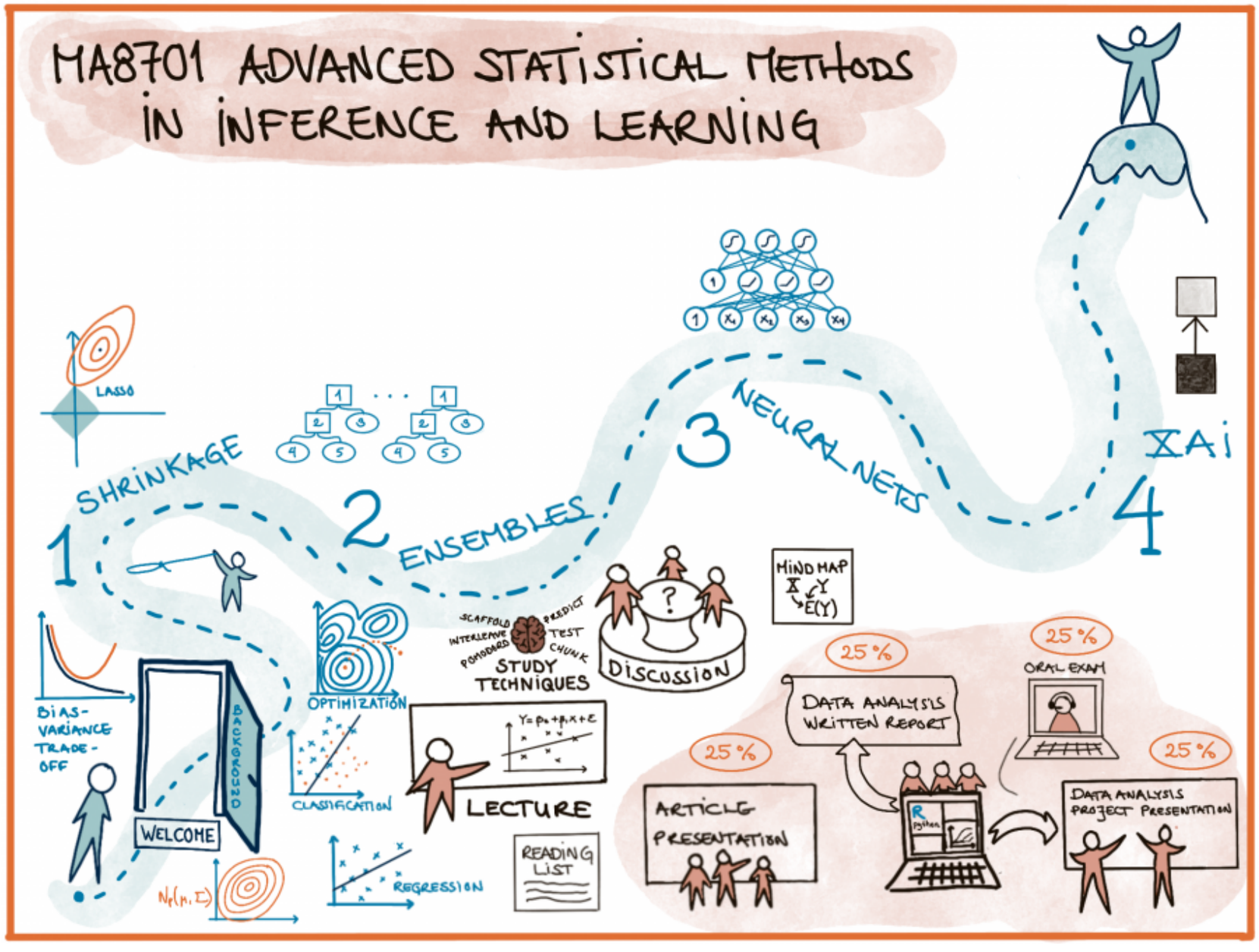

Course topics

Part 2: Ensembles [4 (5) weeks]

- trees, bagging and forests
- general ensembles (similar to super learner)
- boosting
- hyper-parameter tuning

Selected chapters in ELS (8.7, 8.8, 9.2, parts of 10, 15, 16) and several articles.

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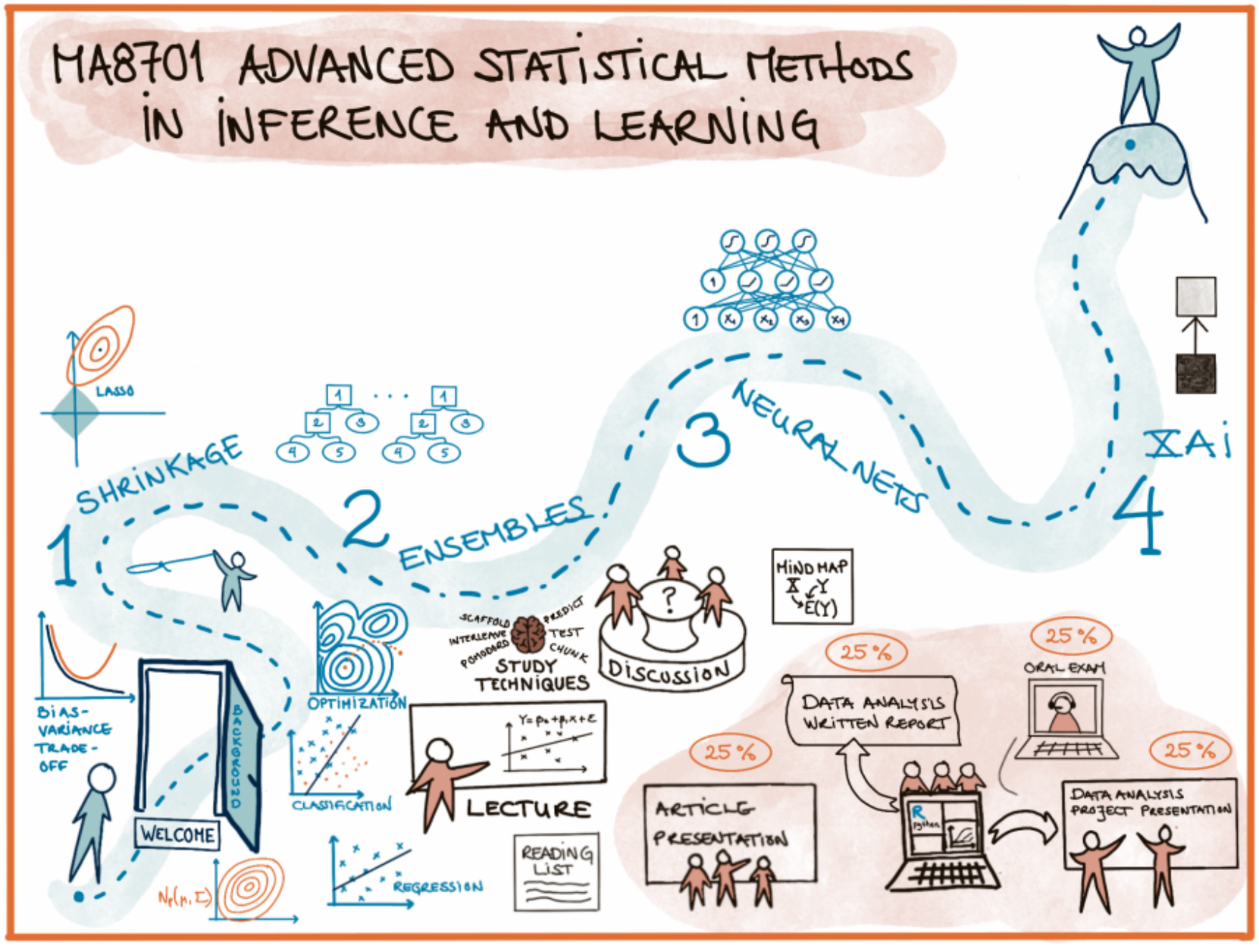

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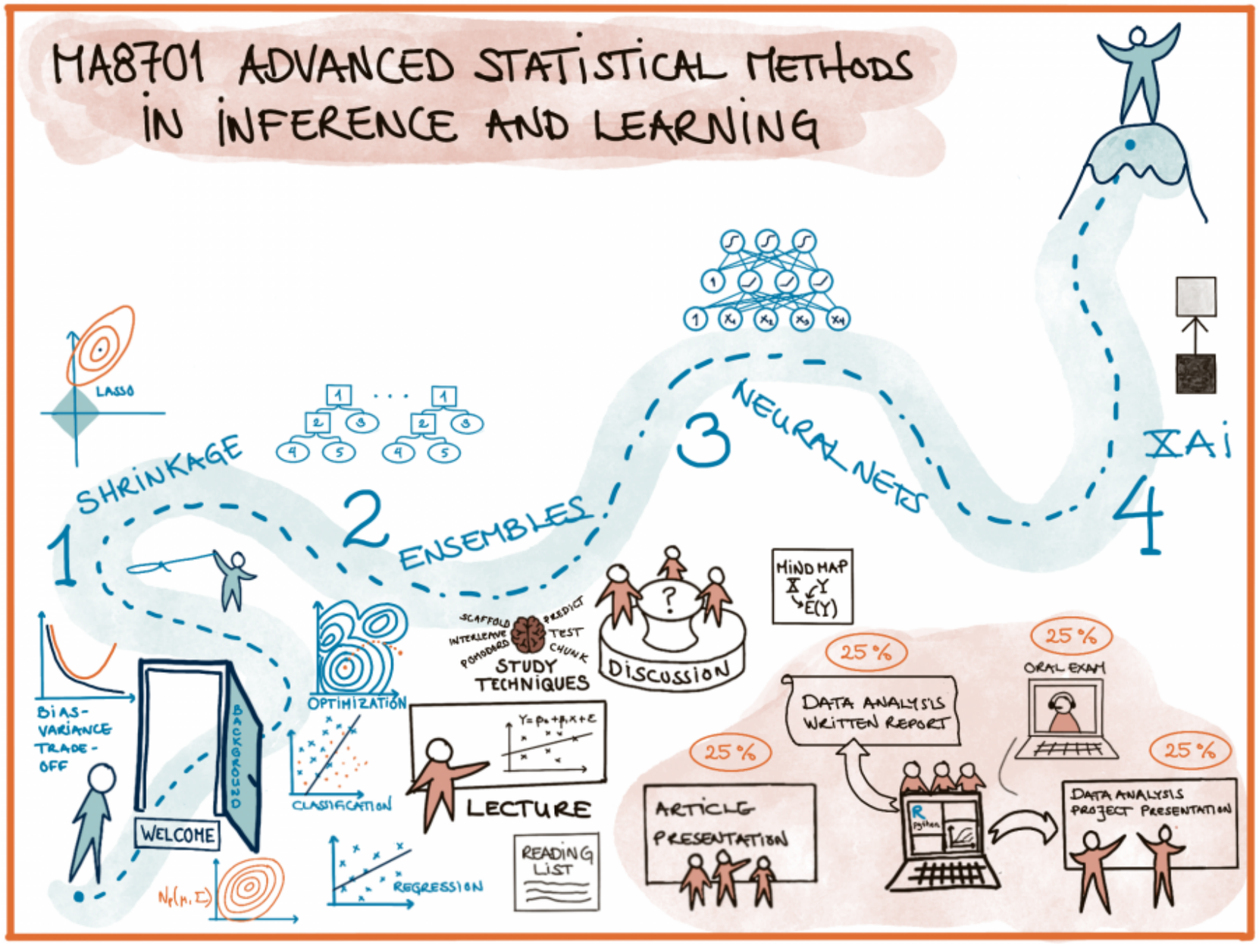

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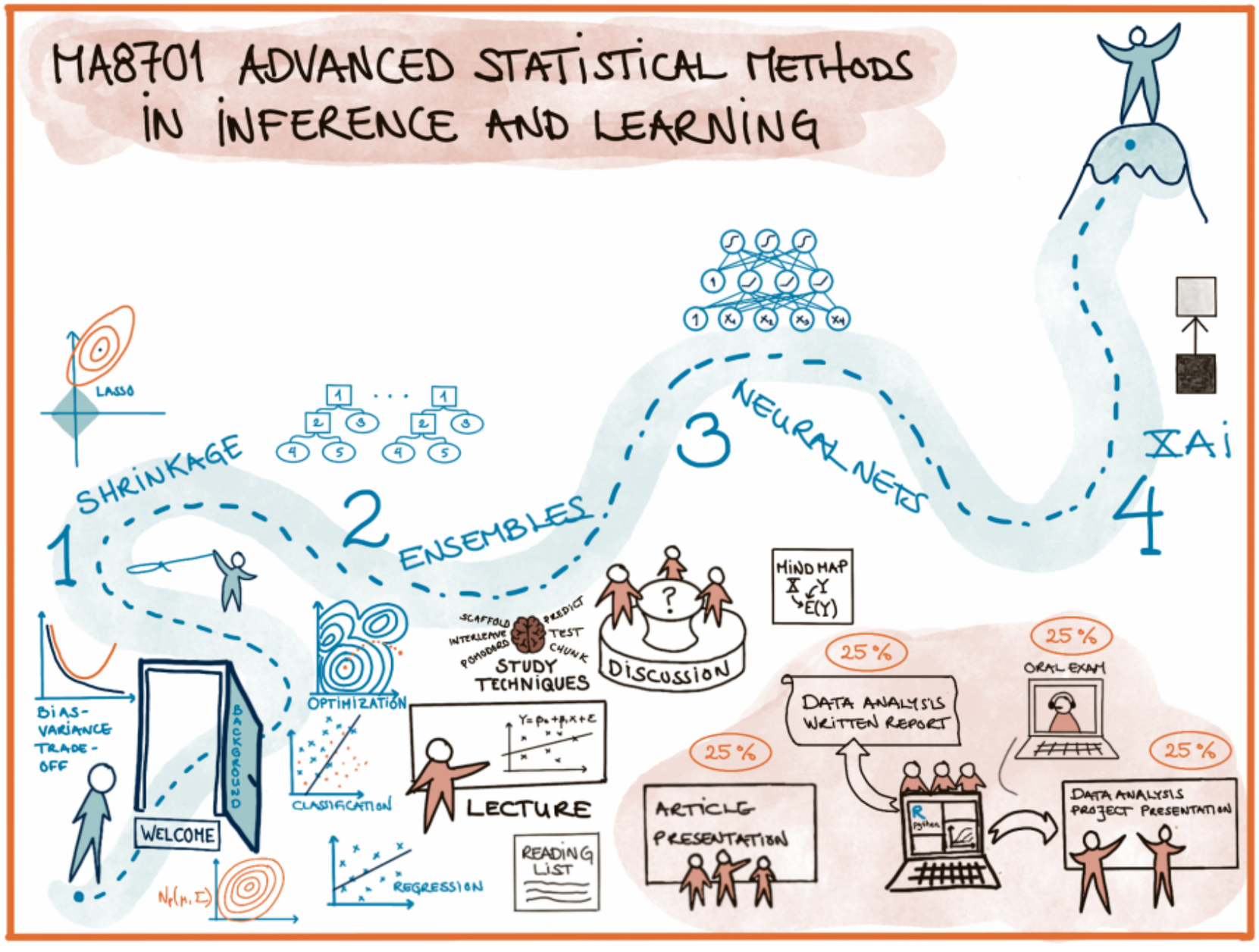
Lectured by Kjersti Aas.

Articles on LIME, partial dependence plots, Shapley values, relative weights and counterfactuals.



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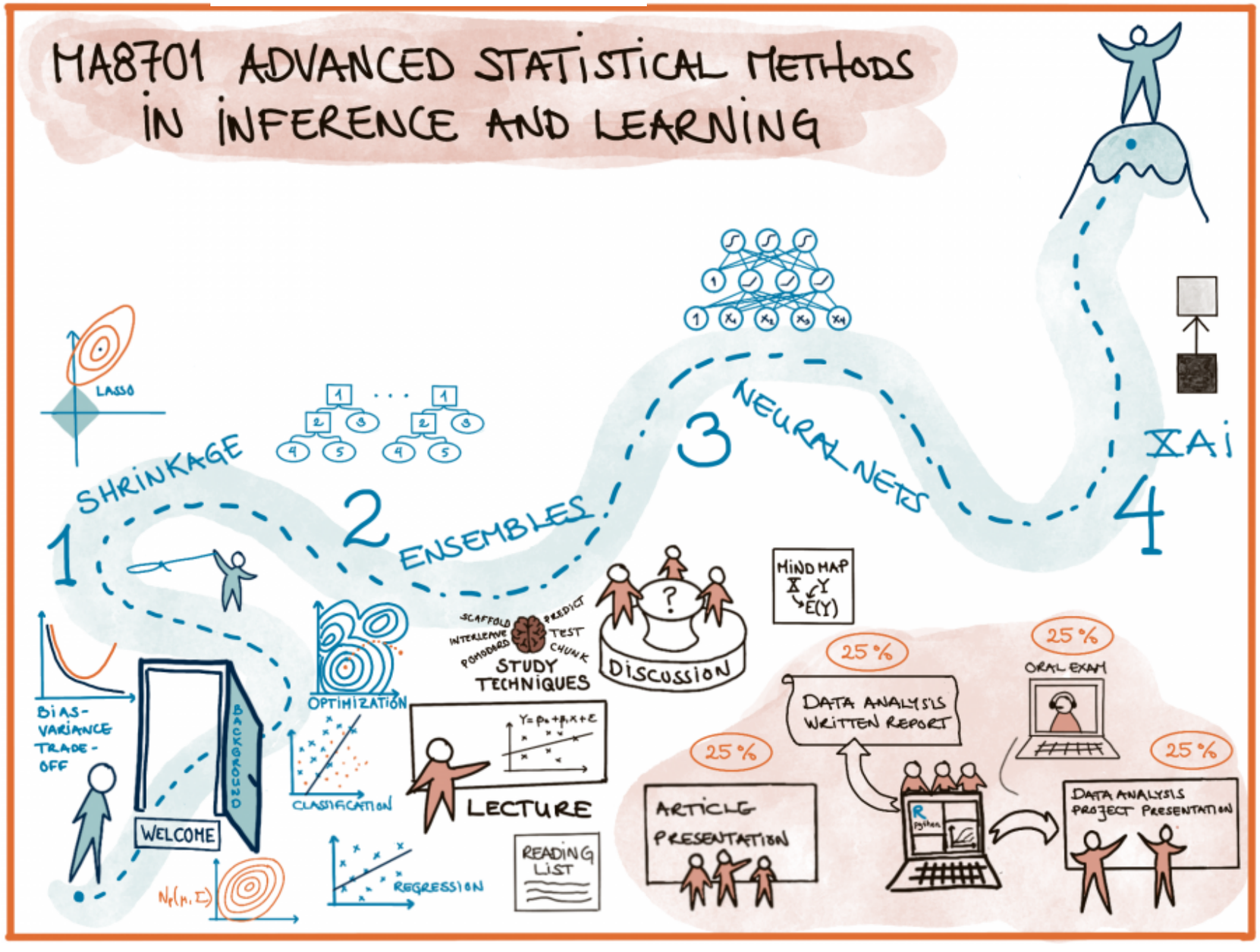
Closing [1 week]



Useful/required previous knowledge

- TMA4267 Linear Statistical Methods
- TMA4268 Statistical learning
- TMA4295 Statistical inference
- TMA4300 Computer intensive statistical methods
- TMA4315 Generalized linear models

- Good understanding and experience with R, or with Python, for statistical data analysis
- Knowledge of RMarkdown for writing reports and presentations
- Skills in group work - possibly using git

Learning outcome

1. Knowledge.
Understand and explain the central theoretical aspects in statistical inference and learning. Understand and explain how to use methods from statistical inference and learning to perform a sound data analysis. Be able to evaluate strengths and weaknesses for the methods and choose between different methods in a given data analysis situation.

2. Skills
Be able to analyse a dataset using methods from statistical inference and learning in practice (using R or Python), and give a good presentation and discussion of the choices done and the results found.

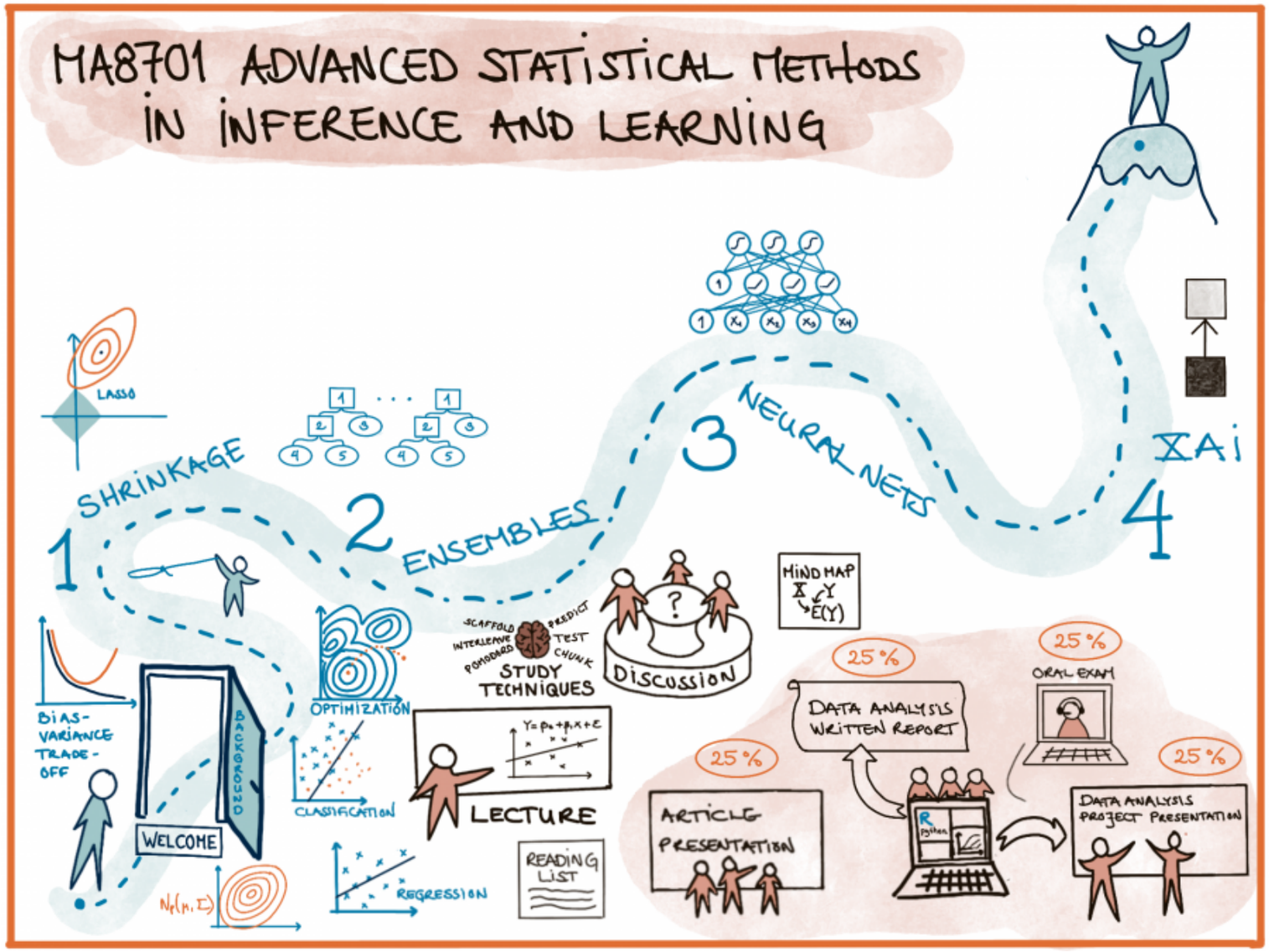
3. Competence
The students will be able to participate in scientific discussions, read research presented in statistical journals, and carry out research in statistics at high international level. They will be able to participate in applied projects, and analyses data with methods from statistical inference and learning.

Learning methods and activities

Herbert A. Simon (Cognitive science, Nobel Laureate)

Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.

Learning methods and activities



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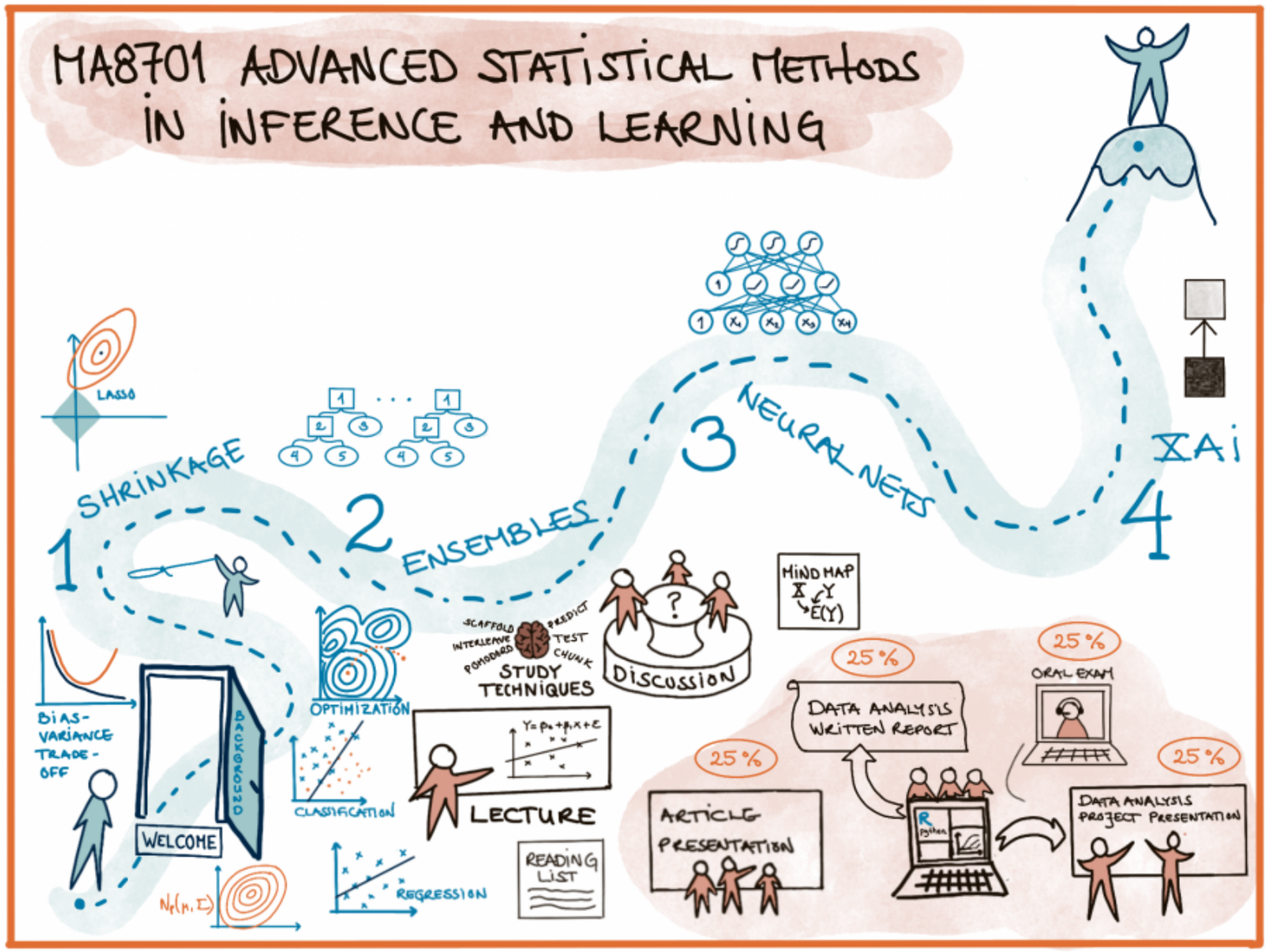

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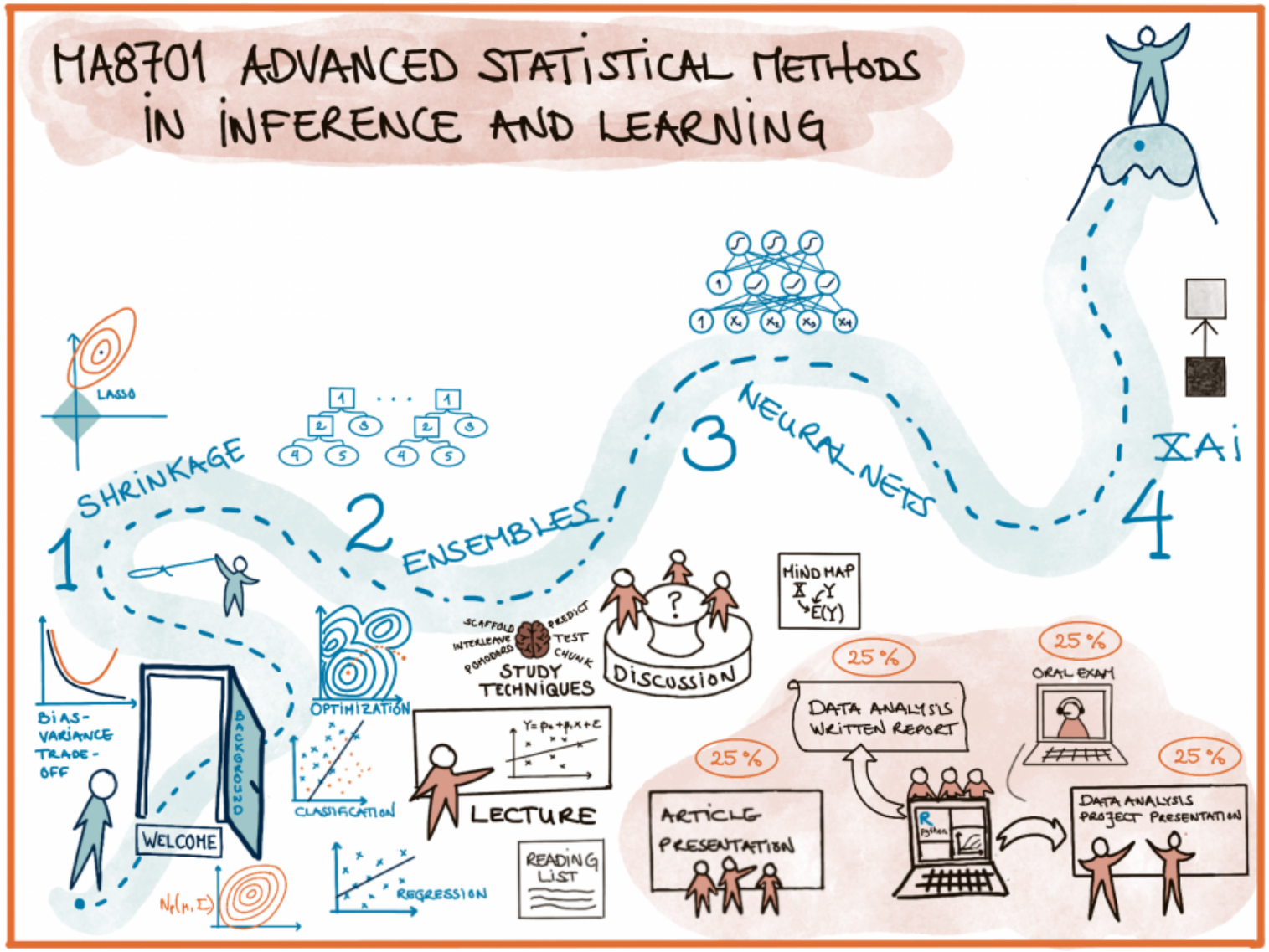

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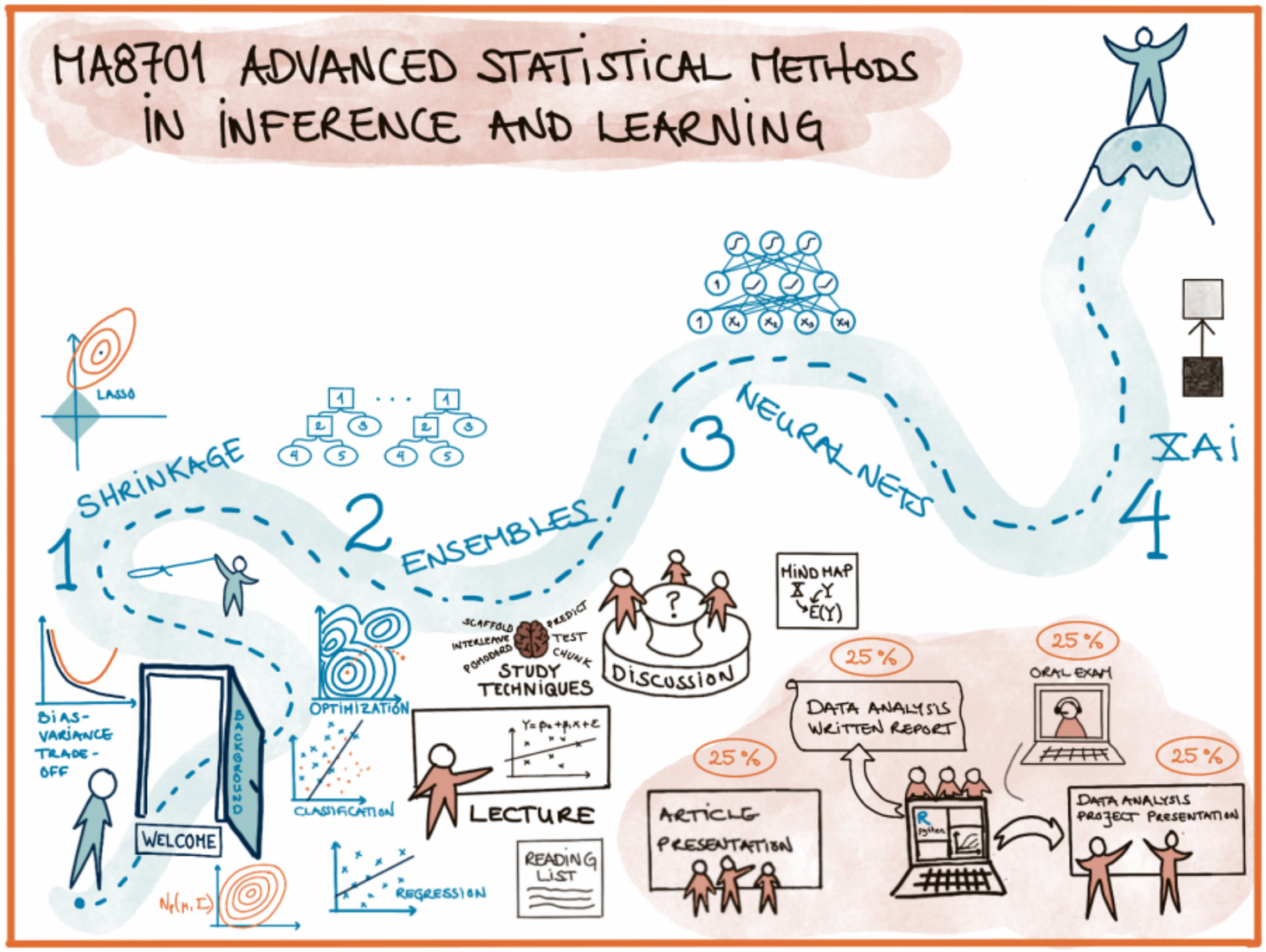

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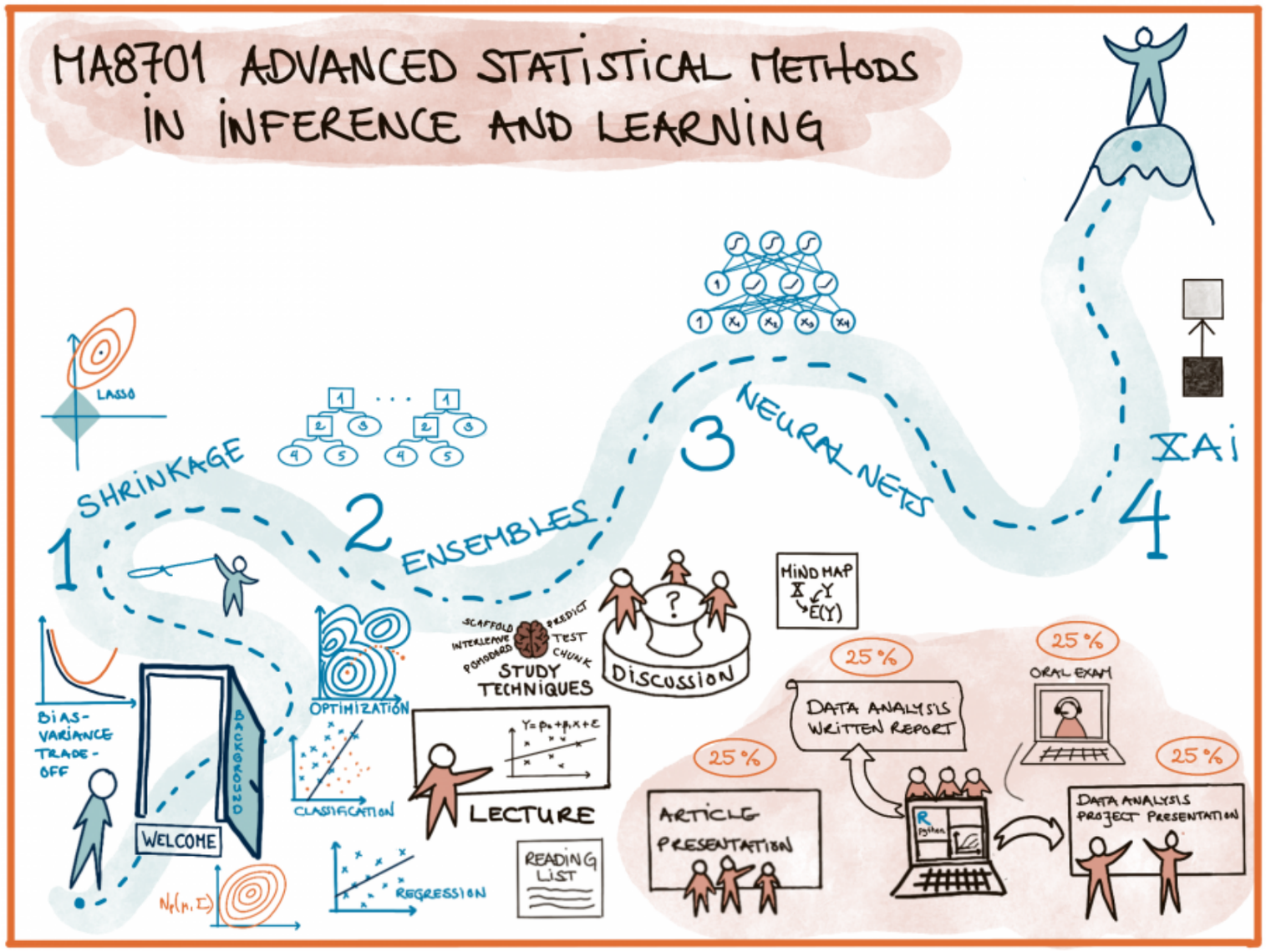

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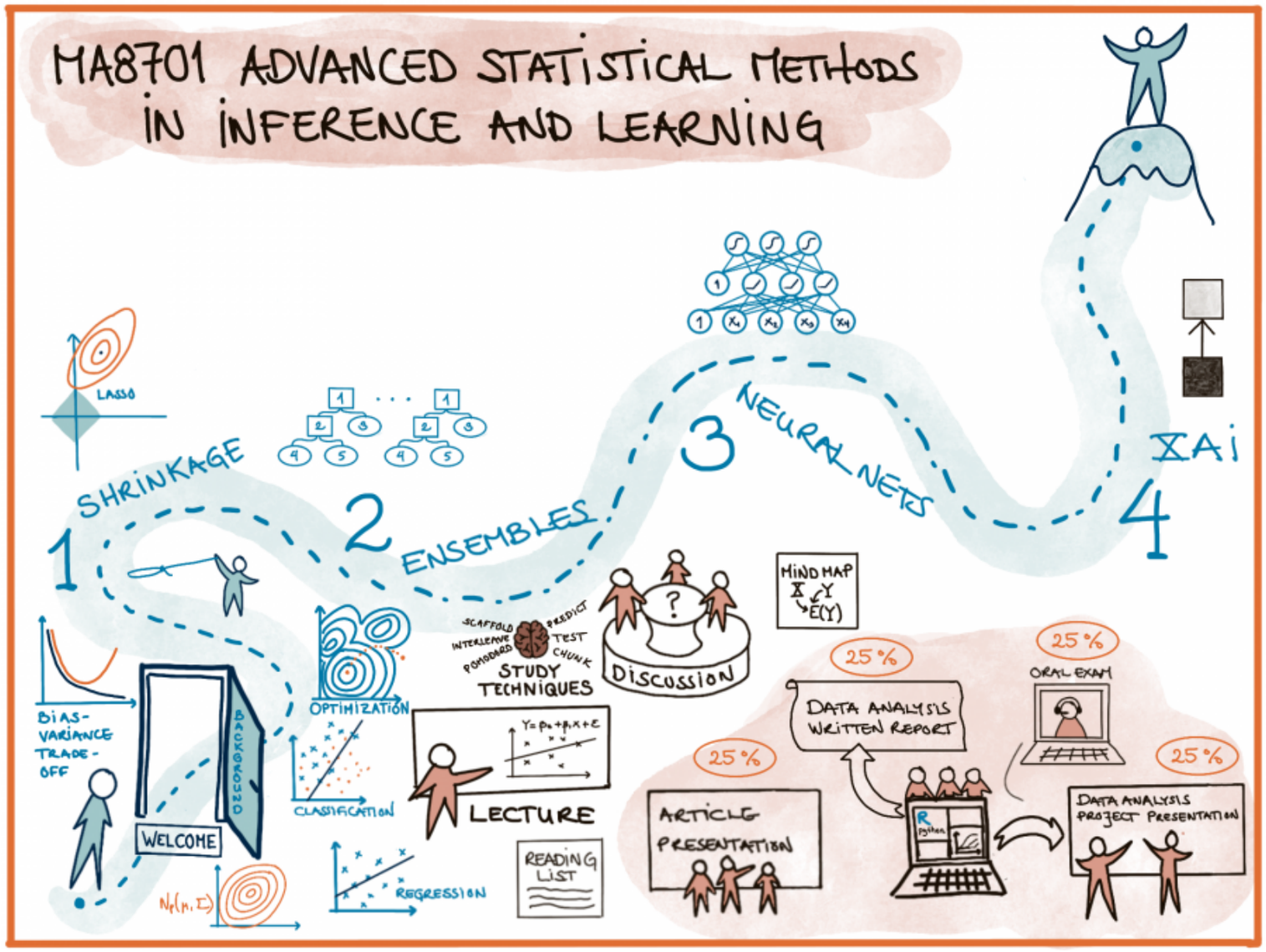

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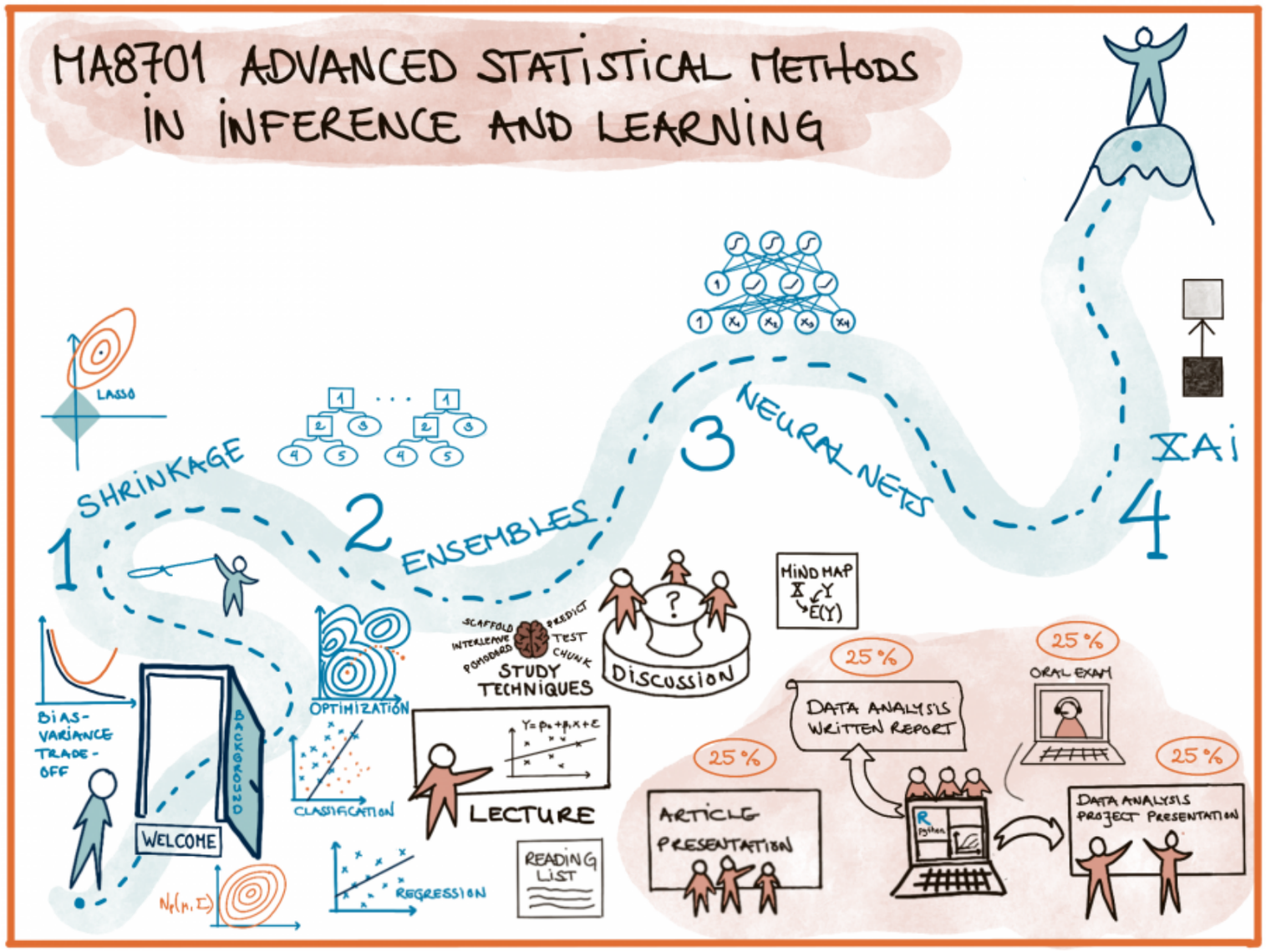

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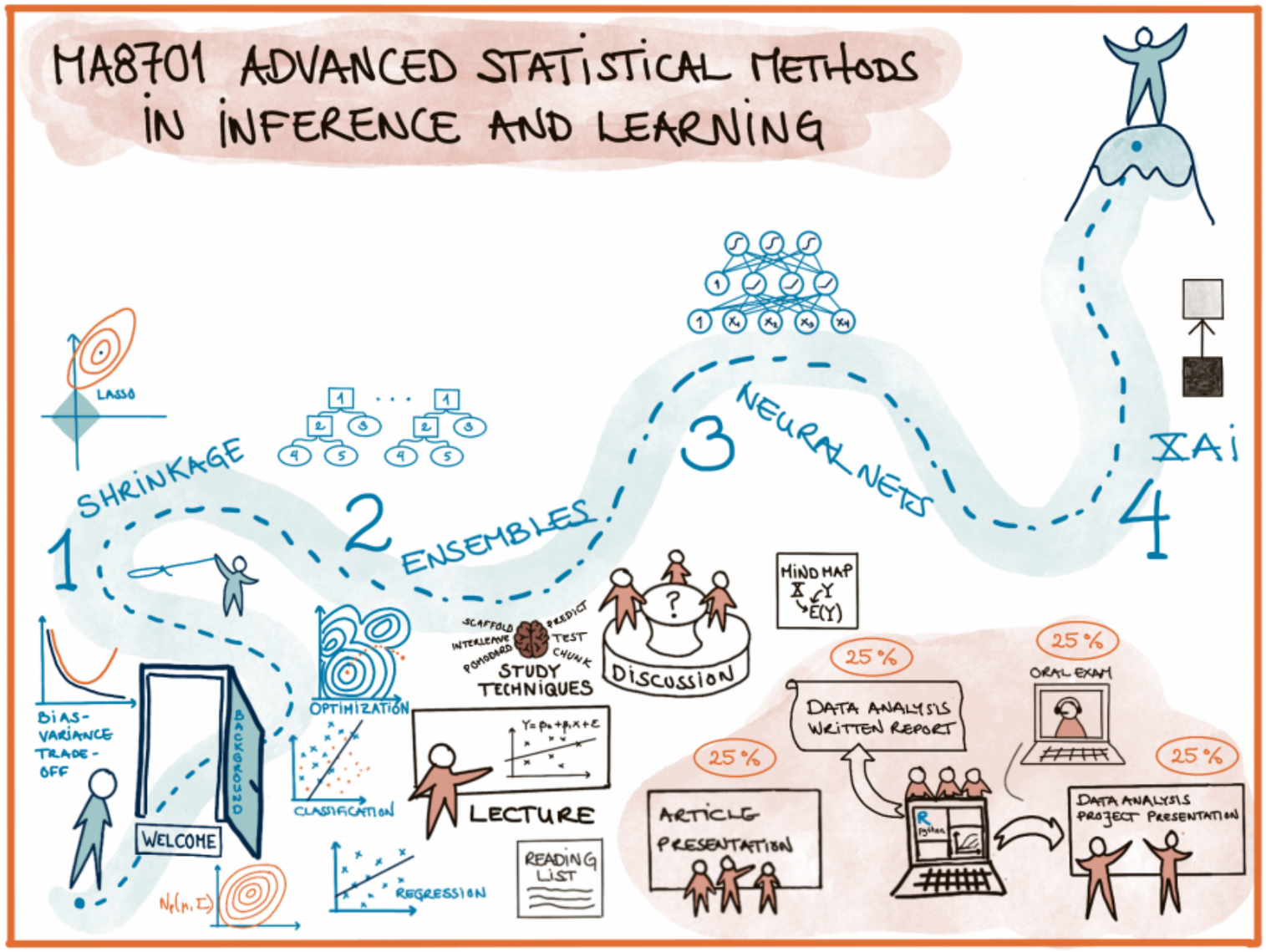

- Exploring different study techniques (one or more each lecture).
- Problem sets to work on between lectures.
- Final individual oral exam (25% of pass/fail grade) in May.

Learning methods and activities

Learning methods and activities

- One practical compulsory group project in data analysis (application of course theory using R or Python) with short report. Topic: Part 1 on Shrinkage, chosen data set discussed with lecturer before start. Due mid February. First given comments by one other group, then evaluated by course responsible. (25% of pass/fail grade)

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- One article group presentation, orally (15 minutes+questions). Material from Parts 2 and 3 preferred, and must be decided on with lecturer (might also be parts of your own master thesis if applicable). Due before Easter. (25% of pass/fail)

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- Practical compulsory project in data analysis (application of course theory using R or Python) with oral presentation (15 minutes+questions). Topic: Part 2-4, data set and methods discussed with lecturer before start. Due after Part 4 is finished. (25% of pass/fail grade)

Course wiki

https://wiki.math.ntnu.no/ma8701/2021v/start

Rediger

MA8701 Advances statistical methods in inference and learning - Spring 2021

This is a phd course in statistics - and requires active participation.

If you want to attend and have not received a zoom-link, then email Mette.Langaas@ntnu.no.

Please help develop the course by answering this start-up quiz: https://forms.office.com/Pages/ResponsePage.aspx?id=cgahCS-CZ0SluluzdZZ8BT4clV79y-hBsxAT20m0HLdUMlhRNURSVUxMWU9QR0tBODNHOEJRQTBDRC4u

Course coordinator/lecturer: Mette Langaas
Guest lecturer: Kjersti Aas (Part 4)

Class activity

Aim: get to know each other - to improve on subsequent group work!

while (at least one student not presented)

- lecturer give two alternatives, you choose one
- lecturer choose a few students to
    - present their view

    together with giving their
    - name and study programme
    - say if they are looking for group members - specifying programming language

- present their view

together with giving their

- name and study programme
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- present their view

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cat person or dog person?

- present their view

together with giving their

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- say if they are looking for group members)

In class: take notes or not?

- present their view

Analysing data: R or python?

together with giving their

- name and study programme
- say if they are looking for group members)

- present their view

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Learning something new: read a book or watch a video?

- present their view

together with giving their

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- say if they are looking for group members)

If I show you results of a descriptive analysis: prefer table summary or graphical display?

- present their view

together with giving their

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Is logistic regression statistical learning or machine learning?

- present their view

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Analysing data: report p-values and/or confidence intervals?

- present their view

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For programming: use CamelCase or snake_case?

- present their view

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