# 36685 Immunological Bioinformatics

January 2019

Introduction to Project Work and Exam

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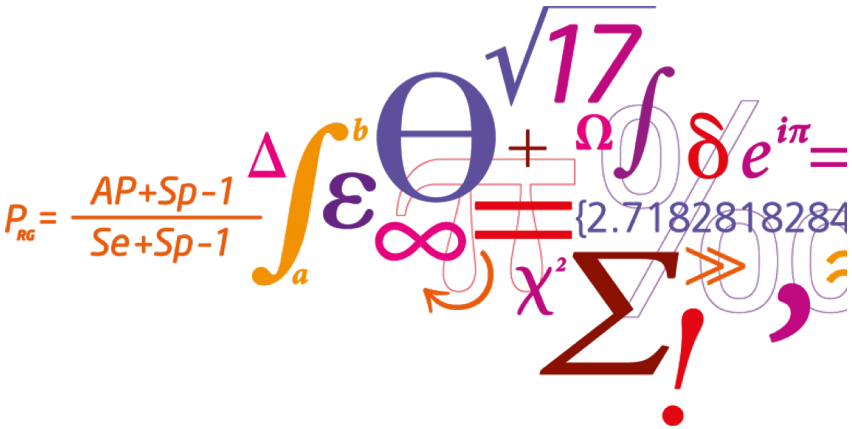



**Immunoinformatics and Machine Learning**
Department of Bio and Health Informatics

# Introduction to Project Work

- Project time frame
  - Wednesday January 16th – Wednesday January 23rd

- Groups
  - The project will be done in the groups you are already in (QC next slide)

- Outcome
  - A project presentation (PowerPoint) presented at the exam
    - **Deadline: Wednesday January 23rd 23:59 by upload to DTU Inside**
  - Note, you should *not* hand in a project report

- There is a *very* limited time frame for the project, so you need to start the project today! (Wednesday)

# Groups

1. Andreas (s134890), Asbjørn (s143849), Galal (s154802), Chaza (s144491)
2. Madeeha (s154213), Amera (s130076), Alla (s061664), Asma (s161091)
3. Cirkeline (s133643), Dorthe (s175824), Milena (milvu), Kristine (s111518)
4. Marie (s143921), Catrine (s136574), Mikkel (s183049), Mikkel (s190095)
5. Anna M (s136582), Pernille (s144499), Helena (s144530), Sebastian (s163691)
6. Steinunn (s182233), Hrafnhildur (s182471), Vladislav (s182333)
7. Ricki (s134898), Maria (s134878), Anna-Lisa (s190228)
8. Lasse (s134887), Lasse (s173158), Anna (s124062), Jakob (s163726), Jakob (s163698)
9. Daniel (s181782), Juan (s182441), Shreya (s181330), Kent (s133497), Adrianna (s181311)

# Project Examples

- **Project type I – Pathogen vaccine**

  a) Choose a single protein from a human pathogen, which would be the best suited for a vaccine considering B-cell epitopes

  b) Make a peptide based t-cell vaccine with both broad HLA* and pathogen coverage. E.g. a polytope consisting of class-I and class-II epitopes. Select from all proteins in the organism. Consider the processing of the final polytope to avoid the presence of neo-epitopes and if relevant, check similarity to self

- **You are free to limit your focus to a special population and genotypes, but should justify your choices*

# Project Examples

- **Project type II – Cancer vaccine**
  - As project I, but aimed at cancer specific proteins, e.g. in testis cancer

- **Project type III – Cancer Immunotherapy**
  - E.g. humanization project: CAR T-cell humanisation and de-immunisation

- **Project type IV – Drug de-immunization**
  - De-immunisation of biologics

- **Project X**
  - Any other great ideas *that will cover several of the methods* introduced are also welcome!

  - You should however include a part about HLA immune activation

# Project Examples

- Examples of pathogens with fully sequenced genomes:
  - *HIV*
  - *HCV*
  - *HPV*
  - *Ebola/Marburg*
  - *Smallpox*
  - *Mycobacterium tuberculosis*
  - *Influenza*
  - *Chlamydomonas reinhardtii*
  - *Measles virus*
  - *Salmonella typhii*
  - *HantaVirus*

# Examples of Previous Project Titles

- *"Peptide Vaccine Design against Epstein-Barr Virus for Prevention of Nasopharyngeal Cancer"*
- *"Winter is coming - a bioinformatic approach to prepare for the next influenza virus"*
- *"Zika virus vaccine for Brazilian Population"*
- *"Identifying target epitopes for designing a vaccine against Acinetobacter baumannii"*
- *"HIV vaccine development for sub-saharian Africans"*
- *"EViVa – Vaccine for EBV"*
- *"Zika-virus Vaccine Development"*

# Guide to Presentation

- The IMRAD approach
  - Introduction
  - Materials and methods
  - Results And Discussion

- Brief and clear (limit amount of text on each slide)

- Be sure to think about the information you wish to convey with each slide

- IMPORTANT: ALL MEMBERS OF THE GROUP ARE RESPONSIBLE FOR ALL PROJECT ASPECTS

- Remember to include references, e.g.
  - **NetMHCpan-4.0: Improved Peptide–MHC Class I Interaction Predictions Integrating Eluted Ligand and Peptide Binding Affinity Data.** Jurtz, V., Paul, S., Andreatta, M., Marcatili, P., Peters, B. and Nielsen, M. J. Immunol. (2017)

# Project Trouble shooting

- If you get stuck in the project, you should as a *point of reference* try to solve the challenge in the group

- If this is *not at all possible*, then contact whomever of the primary lecturers who gave the lectures within the particular challenge you are stuck in, i.e.
  - Birkir, Leon, Paolo and Morten

# Introduction to Exam

- Exam dates are (Both days starting at 9am):
  - Day 1: Thursday January 24th
  - Day 2: Friday January 25th

- Groups will randomly be assigned an exam slot both time and day wise

- Examinations will be by Morten and Leon

- The group will give the presentation ~10 minutes followed by 5 min of project questioning

- IMPORTANT: ALL MEMBERS OF THE GROUP ARE RESPONSIBLE FOR ALL PROJECT ASPECTS

- Following the presentation, there will be an individual oral exam in the project *and* course curriculum, also ~10 minutes (Total time per group will be ~1 hour)

# Introduction to the exam

- What is expected of you?

- Visit the DTU course base

# General Course Objectives

- Theory and application of computational methods in context with the prediction of immune responses, moreover:
  - The involvement of TCR and BCR and MHC class I/II in inducing immune response
  - The structural and genetic characteristics of the TCR and BCR and MHC class I/II and corresponding epitopes
  - Computational methods for modelling TCR and BCR and MHC class I/II and respective epitope interactions
  - Application and challenges of the above in disease context, i.e. vaccinology of infectious diseases and cancer
- General engineering competencies are included in the form of theory in context with concrete application and group based project work, where the students are responsible for planning, designing, implementing and communicating a project.

# Learning Objectives 1-6

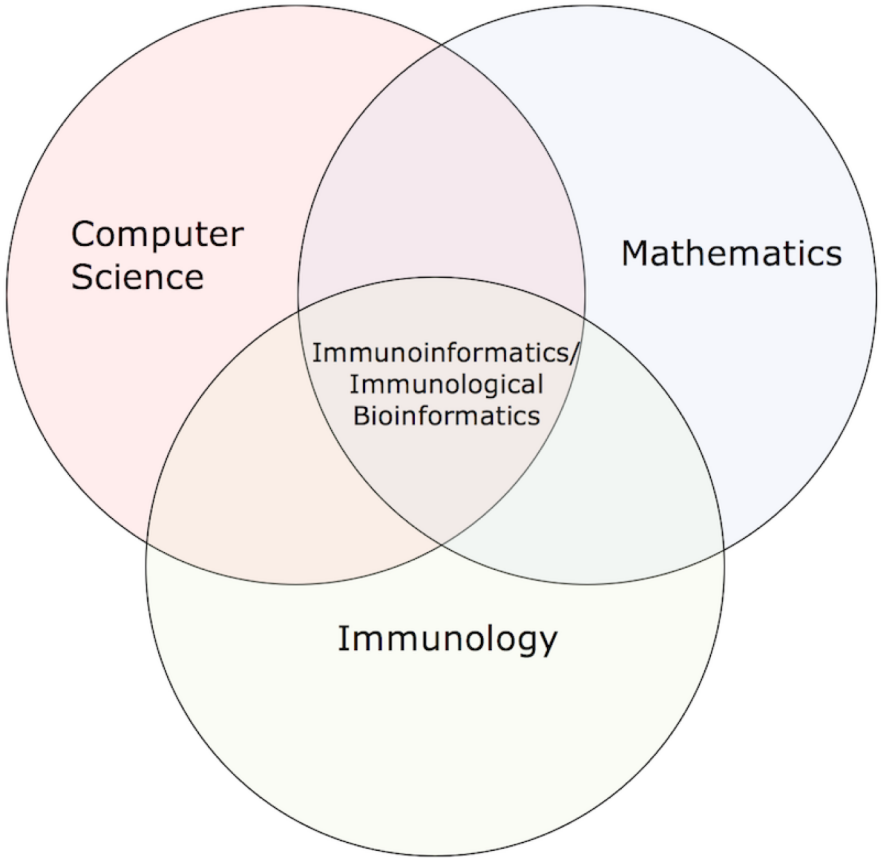
- List the structural characteristics of the MHC class I and II molecules, respective antigen processing pathways and ligands
- Identify relevant immunological databases on the internet and extract desired data
- Identify the used germ-line genes in a final rearrangement of antibody encoding genes
- Explain the structural and functional differences between the MHC class I and class II molecules and an antibody/BCR and a TCR
- Explain the background for predicting peptide-MHCI/II binding and linear and conformational B cell epitopes
- Explain what a Position Specific Scoring Matrix is and how a PSSM is used to create a sequence logo from a set of peptides

# Learning Objectives 7-12

- Conceptually explain how an artificial neural network is constructed, trained and predictions are made
- Use appropriate tool for predicting: i. Peptide-MHCI/II binding (T-cell epitopes), ii. Linear/conformational B cell epitopes, iii. Interaction between a TCR and the pMHC complex and IV. T-Cell receptor and antibody structure
- Use the allele frequencies database to identify vaccine population coverage
- Use web-based tools for the analysis of repertoires of TCRs and BCRs
- When presented with a proposed peptide vaccine, determine if it meets target disease criteria and population coverage and evaluate its potential effectiveness
- Using the knowledge obtained in the course by applying in silico methods, plan and conduct i. A peptide vaccine design project and ii. A protein drug de-immunization project

# Now, can be a bit overwhelming

- The content of the seminar today, which lies beyond course content so far is not curriculum
- You have been exposed to a lot the past 8 days of teaching, this is a consequence of the inherent interdisciplinarity of immunoinformatics (Once more unto the Venn, dear friends)
- In our experience the pieces fall into place during the project period
- Good luck with your projects! ☺



# Questions?

- Meet back here at 3pm today, where you as a group should be ready with a crude powerpoint presentation with:
  - Group members
  - Project title
  - As much of a project plan as possible, i.e.
    - Chosen project type
    - Step 1: Headline
    - Step 2: Headline
    - Etc.