Projects in Bioinformatics

Vocational Training Projects in Bioinformatics

Apr 2024

What is a PiB?

From Course Catalogue:

Description of qualifications
The participants will after the course have insight into the work in a group at the Bioinformatics Research Centre (BiRC). The working method of the course will also train the participants to independently seek information, to plan and complete projects, to communicate professional issues, and to read and understand research papers.

The participants must at the end of the course be able to:

- *Apply* a project-oriented work process.
- *Describe and apply* terminology, methods, and results from the respective area.
- *Plan and execute* a smaller practical project in a bioinformatics framework.

See http://birc.au.dk/studies/pib/ for details on how to do this

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Projects in Bioinformatics

A "Project in Bioinformatics" (PiB) is a 5 or 10 ECTS project related to the research at BiRC. The project work is carried out in consultation with a project supervisor at BiRC, and is documented in a written report and at an oral exam. If you are interested in doing a PiB, you should start by contacting a potential supervisor at BiRC.

Signing up for a project

You sign up for a PiB in the same manner as you sign up for a regular class, i.e. during the first week of November, if you are doing a project in the Spring, or during the first week of May, if you are doing a project in the Fall. When you sign up, you can choose between different versions of PiB. This reflects whether the PiB that you are signing up for is the 1st, 2nd, or 3rd PiB in your Study program.

Working in a group: You can do a PiB in a group of up to three students. Each group member must sign up for the PiB individually cf. above and each group member must make an individual contract cf. below (note in the contract that you are working in a group, and list your group members). The group hands in a single combined report and each group member has an individual oral exam cf. below.

Choosing a topic

Before you can make a project contract, and commence your project work, you must (of course) chose a topic and a supervisor. The supervisor must be a tenured researcher associated to BiRC, but you can also have one or more co-supervisors. When choosing a project topic, it is a good idea to think about the classes and projects that you have done during your Master's studies, and what kind of work do you like? Contact potential supervisors as early as possible to discuss your wishes and ideas. Remember that you are always welcome to come by our offices and discuss. You can also ask potential supervisors for examples of thesis's that they have supervised in order to get a better idea of how a thesis can look.

Project ideas (updated May 2021)

Project contract

After you have signed up for a PiB, you must make a project contract in coordination with your supervisor. As part of the project contract, you must attach a pdf-document describing the problem statement, activity plan, and supervision plan for you project. Please use this template:

What is a VTPiB (Erhvervsprojekt)?

From Course Catalogue:

Description of qualifications
The aim of the company project is to allow the student to apply and develop his/her professional skills in a company or an organiszation, in order to:

- Develop and strengthen the student's competencies based on a company collaboration
- Strengthen the insight into the academic and professional qualifications needed as a bioinformatician in a given job situation;
- Strengthen the insight into significant personal competences in the working life after the study.

See http://birc.au.dk/studies/vtpib/ for details on how to do this

Bioinformatics Research Centre

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Vocational Training Projects in Bioinformatics

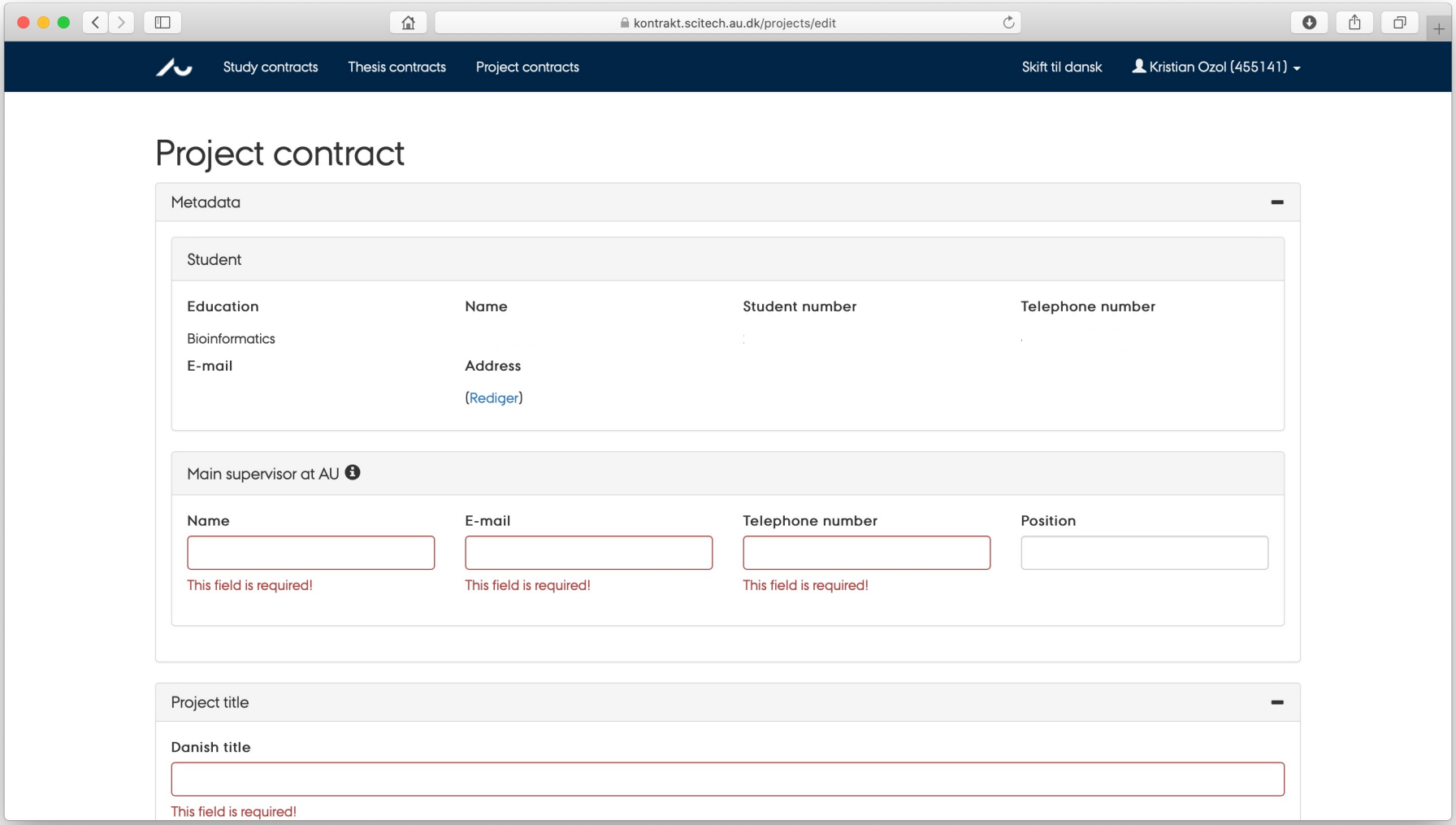
A "Vocational Training Project in Bioinformatics" (VTPiB) is 10 ECTS project done in collaboration with a company (see course description in the Course Catalogue), which is carried out in consultation with a project supervisor at BiRC and a project supervisor at the involved company. A VTPiB require that the student has established contact to a potential company and company supervisor. If you are interested in doing a VTPiB, you should start by contacting Kasper Munch Terkelsen who is the VTPiB coordinator.

Signing up for a project

You sign up for a project VTPiB in the same manner as you sign up for a regular class, i.e. during the first week of November, if you are doing a project in the Spring, or during the first week of May, if you are doing a project in the Fall. When you sign up, you can choose between "A", "B" and "C" versions of VTPiB. This reflects whether the VTPiB that you are signing up for is the (A) 1st, (B) 2nd, or (C) 3rd VTPiB in your Study program.

Working in a group: You can do a VTPiB in a group of up to three students. Each group member must sign up for the VTPiB individually cf. above and each group member must make an individual contract cf. below (note in the contract that you are working in a group, and list your group members). The group hands in a single combined report and each group member has an individual oral exam cf. below

PiB and VTPiB contract



http://kontrakt.nattech.au.dk

PiB contract

Project in Bioinformatics @ BiRC

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The project contract, including attachment, must be submitted via https://kontrakt.nattech.au.dk/ before **September 1**, if the project is done in the Fall semester, and **February 1**, if the project is done in the Spring semester. Note that you in the project contract must agree on a **submission date** in the exam period immediately following the project work. The submission must be chosen such that it is possible to do the exam in the same exam period. Typical submission dates are January 15, if the project is done in the Fall semester, and June 15, if the project is done in the Spring semester.

Project work: When a project contract has been submitted, and approved, it is your responsibility, under supervision, to do the described project, and hand in the report (10-15 pages, if a 5 ECTS project, and 20-25 pages, if a 10 ECTS project) via Digital Exam no later than the agreed submission date. If you are working in a group, the volume of the work and report must reflect this.

Exam: The exam is a 15 min presentation of the project, followed by a 15 min discussion of the presentation and the report. Besides the supervisor, an internal co-examiner (another BiRC researcher) must be present at the exam. The final grade is based on an overall assessment of the written report, the presentation, and the following discussion, where the assessment of written report contributes the most. If you are working in a group, all group members have individual exams.

Supervisor responsibility: It is the responsibility of the supervisor to conduct the exam during the exam period immediately following the project period, and plan accordingly with the student(s) and internal examiner. The supervisor must submit name of the internal examiner to Christian Storm Pedersen (cstorm@birc.au.dk) before **December 1**, if the project is done in the Fall semester, and **May 1**, if the project is done in the Spring semester. The supervisor and internal examiner get the project report via Digital Exam, and must submit the final grade via Digital Exam.

See http://birc.au.dk/studies/pib/ for more information.

Project in Bioinformatics @ BiRC

Student ID	20xxxxxx
Student name	
Group members	
Supervisor	
Project title	
Start date	September 1 (for Fall projects) / February 1 (for Spring projects)
Submission date	January 15 (for Fall projects) / June 15 (for Spring projects)
ECTS	5 ECTS / 10 ECTS

Problem statement / project description:
5-7 lines describing the overall aim of the project. Make it clear what the objectives are, e.g. analyse data sets, implement an algorithm, develop or use theory. Remember that the project should be doable in 7 weeks (~137,5 hours of work, including the final exam) for a 5 ECTS project, and 14 weeks (~275 hours of work, including the final exam) for a 10 ECTS project, and that it should be possible to document it in a report of 10-15 pages for a 5 ECTS project, and 20-25 pages for a 10 ECTS project. If you are working in a group, the volume of the work and report must reflect this. **Think of the text as how you would explain your project and its objectives to others.**

YOUR TEXT HERE

Problem statement / project goals:
A brief and clear presentation of what the student should be able do to after the project formulated as 4-5 project goals:
- The student should be able to describe ...
- The student should be able to implement …
- The student should be able to analyse ...
- The student should be able to discuss ...

Example of general project goals that could be made project specific by naming concrete methods and experiments:
- The student should be able to describe the project background and the theoretical basis of the used methods.
- The student should be able to implement relevant methods and/or experiments.
- The student should be able to analyse the implemented methods and performed experiments.
- The student should be able to discuss and visualize the findings in the project.
- The student should be able to discuss future perspectives of the project.

Example of project specific goals:
- The student should be able to explain how a De Bruijn Graph based assembler work.
- The student should be able to implement the BW transformation in Python.
- The student should be able to analyse the running time of the algorithm implemented for suffix array construction.
- The student should be able to identify cancer driver genes.
- The student should be able to discuss fairness in neural network algorithms.

Think of these items as what you and your project will be evaluated by at the exam.

YOUR TEXT HERE

Activity plan:
A few lines describing the overall the timeline of your project activities, for example formulated bi-weekly milestones. **Think of the text as how you plan to do the project outline in the problem statement.**

Week 1-2: Reading papers and getting data.
...
Week 13-14: Finalize project report and submit on time.

YOUR TEXT HERE

Supervision plan:
A few lines describing the overall structure of your supervision as agreed upon together with your supervisor, e.g. "We plan bi-weekly meetings of ~45 minutes. Specific questions to be addressed at the meeting must be e-mailed to the supervisor at least a day before the meeting in order to give proper time for preparation.". **Think of the text as an alignment of expectations between you and your supervisor.**

YOUR TEXT HERE

Problem statement, activity plan, supervision plan

VTPiB contract

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YOUR TEXT HERE

Problem statement, activity plan, supervision plan

PiB – Things to remember

Before summer break:

- Find a supervisor at BiRC and think about project ideas.

Before September 1:

- Finalize project idea and make contract via http://kontrakt.nattech.au.dk/ **before September 1.**

During the semester:

- Make your project!
  - Remember that **10 ECTS is 250 hours** of work, i.e., **15 hours per week** during the 14 weeks in the semester, and **40 hours for the exam**.
  - The project should be planned - and will be evaluated – with this in mind.
  - You must schedule the work your self, but your supervisor will help.

- **Good idea**: Schedule **regular meetings with your supervisor**, but keep in mind that the supervisor is expected to spend ~10 hours (~1 hour per ECTS) on supervision in total, including exams. Use the time carefully!

- **Remember:** It is your project. Your supervisor is there to guide it, not make it!

PiB Contract – Example

Project description

Title: Investigating the statistical performance of the PolyDFE framework to estimate three complementary measures of adaptive evolution.

Aims:

Whole genome sequencing of several individuals within offers the opportunity to infer the proportion of amino acid substitution that are adaptive. Three measures of adaptive evolution can be defined (Castellano et al 2016): α, the proportion of substitutions that are adaptive, ω_A, the rate of adaptive evolution relative to the mutation rate, and K_{a+}, the rate of adaptive amino acid substitution, which is equal to αK_a. PolyDFE is a probabilistic framework that allows to infer the distribution of fitness effects (DFE) as well as the proportion of adaptive substitution, alpha, from polymorphism alone (Tataru et al 2017). In that context, the goal of the PIB is to evaluate via simulations the performance of the polyDFE framework to estimate other related quantities – K_{a+} and ω_A - as well as applying the framework to real datasets. If time allows, comparison with other state of the art methods that make different assumption for estimation of there parameters (DFE-alpga) will be made.

Methods for simulation and analysis of statistical performance will be implemented in R / python (depending on the execution time performance and / or the building blocks already available in the literature).

Learning outcome:

- The student should understand the statistical & computational challenges posed by genome data.
- The student should be able to implement a statistical analysis framework in R/python and troubleshoot issues of data handling and numeric fitting/ convergence.
- The student should be able to simukate and analyse a real data using the polyDFE framework
- The student should be able to discuss critically both the statistical and computational aspects of the framework she implemented and used (trade-off between computing time and stat accuracy, robustness of the framework for actual data analysis)

Requirements: The student should be able to implement small programs in Python and /or R. - The student should have an understanding of basic statistical theory corresponding "Learning from genome data1 & 2" courses.

Required reading for the project

Castellano D, Coronado-Zamora M, Campos JL, Barbadilla A, Eyre-Walker A. 2016. Adaptive Evolution Is Substantially Impeded by Hill–Robertson Interference in Drosophila. *Molecular Biology and Evolution* **33**: 442–455.

Tataru et al 2017 Inference of distribution of fitness effects and proportion of adaptive substitutions from polymorphism data doi: https://doi.org/10.1101/062216

Possible projects

… “Before you can make a project contract, and commence your project work, you must (of course) chose a topic and a supervisor. The supervisor must be a tenured researcher associated to BiRC, but you can also have one or more co-supervisors. When choosing a project topic, it is a good idea to think about the classes and projects that you have done during your Master’s studies, and what kind of work do you like? ***Contact potential supervisors as early as possible to discuss your wishes and ideas. Remember that you are always welcome to come by our offices and discuss. You can also ask potential supervisors for examples of thesis’s that they have supervised in order to get a better idea of how a project can look.***” …

http://birc.au.dk/studies/pib/

Also contains a reference to possible projects

Possible projects

RESEARCH OPPORTUNITIES USING BIG DATA

Are you interested in research and seeking mentors for a research year, master thesis or similar? Look no further.

Genetic Epidemiology space at Steno Diabetes Center Aarhus is dedicated to utilizing genetic studies to explore causal relationships, predict diseases, and stratify risks. Our ultimate goal is to translate this knowledge into clinical applications, leading to improved health outcomes.

WHAT WE DO

🔍 **Genome-wide Association Studies (GWAS)**: Our research relies on GWAS data to investigate millions of genetic variants associated with various traits.

🧬 **Mendelian Randomization and Polygenic Risk Scores**: We utilize advanced methods to explore causal associations between exposures and outcomes, as well as predict disease risks.

🔬 **Big data**: Access to detailed multi-omics, genetic and health information on 500,000 UK Biobank participants allows us to identify preventable risk factors and potential drug targets in diabetes and associated diseases.

📚 **Skill Development:** Continuous learning, sharing expertise, and enjoying a friendly and fun workplace are our top priorities, aimed at helping everyone grow and develop.

🛠️ **Pipeline Construction**: Our efforts involve constructing pipelines for genetic epidemiology, maximizing research efficiency.

🌍 **Collaboration and Global Partnerships**: We collaborate with national and international groups to leverage rich genetic and health data for impactful research.

Ready to work with big data and make a difference for individuals with cardiometabolic diseases/conditions? We have numerous project concepts and provide opportunities for you to tailor the project to suit your particular interests.

CONTACT:

Anne Lundager Madsen, MSc in molecular biomedicine, PhD anne.lundager@auh.rm.dk

Alisa Kjærgaard, MD, PhD alisa@clin.au.dk

Work in groups

PiB projects can be/should be done in groups of up to 3 persons

Groups are good! They are robust and tend to perform better

Your potential supervisor might suggest groups