Projects in Bioinformatics

Vocational Training Projects in Bioinformatics

Apr 2023
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/](http://birc.au.dk/studies/pib/) for details on how to do this
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 your 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 organization, 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/](http://birc.au.dk/studies/vtpib/) for details on how to do this
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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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-documented describing the problem statement, activity plan, and supervision plan for your project, i.e. 18 out the information and paragraphs on the next page, and attach it to your contract.

The project contract, including attachment, must be submitted via https://konfirm.ruttech.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.

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 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 (christian@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 no later than the agreed submission date. If you are working in a group, the volume of the work and report must reflect this.

Problem statement / project description:

- The student should be able to explain how you plan to do the project outline in the problem statement.
- Example of general project goal: The student should be able to plan the overall aim of the project.
- Example of project specific goal: The student should be able to explain how a De Brujin Graph based assembler work.

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

Activity plan:

A few lines describing the overall 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.

Supervision:

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.
VTPiB contract

Vocational Training Project in Bioinformatics @ BIRC

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Signing up for a project: You sign up for a 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 different versions of VTPiB. This reflects whether the VTPiB you are signing up for is the 1-, 2-, or 3-ECTS 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 exam cf. below.

Project contract: After you have signed up for a VTPiB, 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 your project, i.e. fill out the information and paragraphs on the next page, and attach it to your contract.

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.

Problem statement:

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 a new theory. Remember that the project should be double 14-weeks (~375 hours of work, including the final exam), and that it should be possible to document it in a report of 20-25 pages. 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.

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-supervisor is present at the exam. The student should be able to explain how the project was done, e.g. why a set of methods and experiments was chosen, as well as the implemented methods and performed experiments.

Supervisor responsibility:

The supervisor must submit the problem statement and project description, e.g. state the overall problem to be solved. The supervisor is responsible for the content of the problem statement and project description, and for the content of the exam, including the content of the presentation. The supervisor must submit the problem statement and project description, and the problem statement and project description, as well as the problem statement and project description, before the first meeting with the student.

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.

Problem statement / project goals:

A brief and clear presentation of what the student should be able to do after the project formulated as 4-5 project goals:

- The student should be able to explain how the project was done, e.g. why a set of methods and experiments was chosen, as well as the implemented methods and performed 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.

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

Activity plan:

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

Supervision plan:

A few lines describing the overall structure of your supervision and collaboration with the company as agreed upon together with your supervisor. Think of the text as how you plan to do the project outline in the problem statement.
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!
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): $\alpha$, the proportion of substitutions that are adaptive, $\omega_A$, the rate of adaptive evolution relative to the mutation rate, and $K_{\alpha}$, the rate of adaptive amino acid substitution, which is equal to $\alpha K_{\omega}$. 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 – $K_{\alpha}$ and $\omega_A$ - 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 these 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 simulate 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
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) choose 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