BINF400.3
Research Techniques in Bioinformatics
Terms 1&2, 2014/15

Course Outline

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Course Description

The objectives of the course include providing the students with an in-depth understanding of a selected area of bioinformatics

- beyond that available from other undergraduate courses,
- at or near the state-of-the-art, and
- under the guidance of an active researcher in the area.

BINF 400 is not intended to replace any existing course in the program. Rather, it is designed either for more concentrated study in some area or for study of an area not covered by an existing University course.

In terms of workload, BINF 400 should be considered slightly more demanding than a 4th-year science "half-class with laboratory", but spread out over two terms. It is expected that due to their enthusiasm, some students will spend more time than this. Students should be careful that enthusiasm for this course does not compromise their performance in other courses.

Course Coordinator

The course coordinator for 2014/15 is Dr. Tony Kusalik. His contact information is as follows:

office	S424 Spinks Addition, Thorvaldson Building
e-mail	`kusalik@cs.usask.ca` (do not cut-and-paste this address as it has hidden, "garbage" characters in it)
telephone	966-4904

Components of the Class

The components of the class are:

1. An introduction to scientific research, technical writing, and giving technical presentations. The former includes attendance at, and review of, research seminars.

2. An individual research project completed under the supervision of a faculty member.

3. Preparation and submission of documents (reports, papers) describing research progress and results.

4. Presentation of research progress and results to peers, their supervisors, and other interested parties.

Depending on the learning contract and the nature of the project undertaken, the "introduction to scientific research, technical writing, and giving technical presentations" in item 1 may be provided by the supervisor. Alternatively, the student may attend lectures where this material is given. For example, CMPT 400/405 may provide such lectures.

The Project

The main component of the course is completion of a research project under the supervision of a research scientist.

Faculty with interests in bioinformatics will provide project proposals. The course coordinator will then match students, projects, and supervisors bearing in mind

- the interests and skills of the student,
- the nature of the project, and
- the interests and preferences of the (potential) supervisor.

Students will have some say in the project they take on.

Students may wish to consider the following in selecting a project:

- their personal interest in a topic;
- the resources (including staff and equipment) available to help with the project;
- the value that completing the project may add to their potential job skills;
- the potential workload required to complete the project.

During the project, the student will:

- become familiar with the pertinent research literature;
- as appropriate, conduct experiments, perform laboratory procedure, write computer programs or scripts, conduct computer operations;
- collect and record experimental results;
- analyze experimental results;
- compose a final project report, as well as other project artifacts as set out in the learning contract;
- give oral presentations of the progress report midway through the class, and the final project results at the end.

Because of the inter-disciplinary nature of the subject area, it is also possible for a project to be co-supervised by two faculty from complementary areas. Further, it is also possible to have a project completed by a team of two students.

The Learning Contract

Because bioinformatics is a diverse field and the researchers in it come from a variety of backgrounds, it is necessary to allow for flexibility in choice of research topics, how the research will be conducted, and how the work and results will be evaluated. To this end, such details will be spelled out in a "learning contract" agreed to by the student and supervisor, and approved by the course coordinator. The learning contract will be prepared by the student in consultation with the supervisor, and signed by both parties and the course coordinator.

The learning contract should identify:

- The objectives of the project;
- The seminars which will be attended, or how those seminars will be selected;
- How the introduction to scientific research, technical writing, and giving technical presentations will be provided/obtained;
- Pertinent research literature;
- Any prior experience the student has in the research area;
- A project plan which decomposes the overall project into phases or subcomponents, each of which is represented by a milestone (identifiable accomplishment);
- A "time line" corresponding to the project plan, or estimates of the amount of time required to complete each portion of the plan;
- The resources needed for the project and how they will be obtained;
- Safety issues, as applicable;
- "Deliverables" or tangible artifacts of the project which can be evaluated, including at least one interim report and a final report;
- Mark allocation for deliverables and activities.

The contract may also address how artifacts are to be graded.

The exact form of each contract will be dependent on the characteristics of the project. For example, one project might reflect the structure of a BIOC 488 project, while another might be reminiscent of a CMPT 400 project. The section below on "Learning Objectives" will be of assistance in drafting the learning contract.

Students may compose their own learning contract document or fill out the learning contract template provided by the course coordinator.

A copy of the signed learning contract must be given to the course coordinator prior to the end of September.

Grade Allocation

seminar attendance, participation, and reviews	10%
oral presentations (progress report and final report)	5% + 10%
final project report	50%
other project artifacts (e.g. interim reports) and activities, supervisor's evaluation of performance, and other factors as specified in the learning contract	25%

Oral presentations will be graded by the project supervisor and course coordinator in conjunction. Criteria will include:

- clarity and organization of presentation;
- demonstrated understanding of the project, procedures, or results;
- technical content;
- quality of presentation materials;
- ability to answer questions.

Criteria for grading the final project report will include:

- mechanics of writing, including grammar, punctuation, and spelling;
- clarity and organization;
- use of illustrative materials;
- demonstrated understanding of the project and experiment technique;
- analysis and discussion of experimental results;
- insight and creative thought.

If the project involves "wet lab" work, that work may also be graded. Assessment will be based on criteria such as:

- understanding of the project and procedures;
- performance in the laboratory;
- participation in discussion of research plan and interpretation of results.

The supervisor may require the maintenance of a "work book" or "lab book" during the course of the project, and this may be evaluated when determining a grade for the laboratory work.

Timetable

For the most part, each student will arrange with their supervisor(s) the hours for work on BINF 400, as well as a regular meeting time. There should be regular meetings between the student and the supervisor. Once per week is suggested.

There is a regular class meeting time for BINF 400 listed in the University registration timetable. (It is Mondays, Wednesdays and Fridays from 2:30 to 4:20.) This is the same class time as used by Cmpt 400/405 and is listed mainly to allow BINF 400 students the opportunity to take advantage of lectures in Cmpt 400/405

on such topics as research methodologies, technical writing, literature research, use of library resources, giving technical presentations, etc. See the discussion under Components of the Class for further information.

Normally, BINF 400 will be completed over Terms 1 and 2, even though it is a 3 credit unit course. Preparatory work is usually completed during September. Actual research begins in October, and that research is completed by approximately the beginning of March. During March, a presentations of results is given, and a final report composed. The latter is due on the last day of regular classes.

Checkpoints

late August / early September	final agreement of faculty member to supervise a student
first week of October	completed and signed learning contract given to coordinator
end of November	oral presentation of project progress given
end of December	at least one interim report or other artificat completed, graded, and returned to the student
	mid-stream progress report from supervisor submitted to course coordinator
mid-March	oral presentation on research project given
last day of regular Term 2 classes (early April)	final written report submitted to supervisor for marking

By special arrangement between student, supervisor, and course coordinator, it is possible for BINF 400 to be completed in a single semester.

Attendance

Attendance is mandatory for all BINF 400 presentations (progress reports and final reports). This includes any lectures attended by the student to obtain an introduction to scientific research, technical writing, and giving technical presentations. Attendance will be taken during these sessions and will be factored into the final grade.

The student must also attend a selection of research seminars. Completion of this requirement will be based on recorded attendance.

Student Responsibilities

The student shall:

- keep the supervisor aware of his or her progress;
- keep the supervisor and course coordinator aware of any changes in the student's e-mail address;
- adhere to the College's and University's policies regarding plagiarism.

Safety

The individual supervisors, course coordinator, Heads of the participating departments, and other University

officials are responsible for the safety of the student and application of regulations covering research procedures. Thus, where applicable, each BINF 400 student must be properly instructed on general safety in the laboratory, use of experimental animals, radioisotopes and hazardous materials, etc. This will normally be done by the project supervisor. The University of Saskatchewan Work Alone Policy prohibits students from working alone in a chemical, biology, or biochemical laboratory. Therefore, if a BINF 400 project involves "wet lab" work, the student must not work in the laboratory when no other member of that laboratory is present.

Details regarding safety and adherence to safety regulations are to be spelled out in the learning contract.

Seminars

Binfo 400 students must attend four seminars per term (eight total) from the seminar or colloquium series of the various science departments and research units of the University, with at most one-half from any one department or unit. Presentations at the Bioinformatics Journal Club may also be used. The specific seminars attended will be determined by consultation between student and project supervisor. Seminars should be chosen based on general relevance to bioinformatics, and the student's project in particular. Details on which seminars will be attended, or how the seminars will be chosen, are to be in the learning contract.

In addition to attendance at the seminars, students must critically review 2 seminars, and submit those reviews to their project supervisor for grading. These grades will contribute towards the student's final grade.

It is the student's responsibility to keep abreast of the seminars being offered, their times, and locations.

Reviews must follow the guidelines below --

- Length: one to two pages.
- Identification at the beginning (student name and Student Number, speaker name, seminar series, title of presentation, date and time).
- Part 1: a description, **in the student's own words** of the content of the seminar, as the student understood it. What was the speaker trying to accomplish, or to say? **This must not be a repetition of the description in the seminar notice**.
- Part 2: an evaluation of the seminar from the student's viewpoint. How well was it delivered? How good were the presentation materials (e.g. slides)? What was done well, and what could have been improved? What did the author of the review learn from the seminar (honesty please!), and why?

Final Project Report

The final project report should be organized and formatted as a scientific paper in the bioinformatics field. Unfortunately, that means that there is no single correct organization; the sections present will be dependent on the nature of the project. Possible organizations include:

- Abstract, Introduction (including background), Objectives, Materials and Methods, Results, Discussion, Conclusions, Future Work, and References;
- Abstract, Introduction (including background), Objectives, Algorithms, Testing, Results, Discussion,

Conclusions, Future Work, and References;
- Abstract, Introduction (including background), Objectives, Data and Methods, Results, Discussion, Conclusions, Future Work, and References;
- Abstract, Introduction (including background), Objectives, Definitions, Main Result, Corollaries, Conclusions, Future Work, and References;

In general, supplementary material may be included in the Appendix.

The project report is to be submitted to the supervisor and project coordinate in either

- electronic form, as a PDF file, or
- hardcopy form.

In cases where the experiments did not provide the expected results, the student should present and discuss carefully all experiments performed. The discussion should also address the plausible reasons why the findings were not those anticipated. Where possible, the student should propose further testable hypotheses, together with suggested experiments, which would prove or disprove these hypotheses. The latter will be a significant factor in the evaluation; i.e. some experiments just do not work, and lack of success does not preclude positive assessment.

One of the goals of this course is to teach the students how to write research papers. Thus, the supervisor will guide the student on the preparation of the final project report with respect to material to be included, organization of content, and discussion of interpretation and significance of results, as well as review and critique at least one draft. However, because the report constitutes the final exam for this course, the supervisor should not be involved in the actual writing of the report.

Oral Presentations

Each BINF 400 student will give two oral presentations: a "progress report presentation" approximately midway through the project, and a final project presentation. The former will be short (10 to 15 minutes), include an introduction to the project being pursued, and present interim results. It is also meant to provide practice toward the second presentation. The final project presentation will be longer (about 20 minutes), and will highlight the results of the research.

The supervisor will provide guidance to the student on preparation of presentation materials. He or she will also participate in grading of the presentation.

Learning Objectives

The starting point in developing the learning contract is to identify a number of learning objectives, typically at least four. These learning objectives will specify what the student plans to accomplish as part of the course. Academically, they provide evidence of suitable fourth-year level academic work. Learning objectives should be as concrete or objective as possible in the accomplishments they specify. The should also reflect the research orientation of BINF 400.

A Binfo 400 project normally involves:

- identifying project objectives, their importance, and how they relate to current research or practice in the field in question;
- elaborating on the objectives by exploring relevant research literature;
- presenting a unique view of the topic via synthesis, experimentation or further exploration, or presenting a hypothesis which can be tested via experimentation or the gathering of observations;
- presenting conclusions, including an analysis of accomplishments and future directions.

Thus, typical learning objectives for BINF 400 might make use of wordings such as the following:

- "identify and compare ...."
- "determine which ... is superior in terms of ...."
- "develop modifications or extensions to improve ...."
- "compare alternate methods to ..."
- "design and conduct an experiment to ..."
- "evaluate the results of an experiment on ..."
- "synthesize and evaluate recommendations for the design of ..."
- "develop and test a new technique for ..."
- "apply ... technique(s) to ..."

Students in BINF 400 are expected to go beyond summarizing instances of existing information in their project paper. Students are expected to demonstrate their understanding of the material by techniques such as: comparing, contrasting, synthesizing, hypothesizing, performing experiments, and evaluating. Students will typically have utilized experiments to test their ideas or to gain knowledge.

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