GBIO0009 – Topics in Bioinformatics

Montefiore Institute - Systems and Modeling

GIGA - Bioinformatics

ULg

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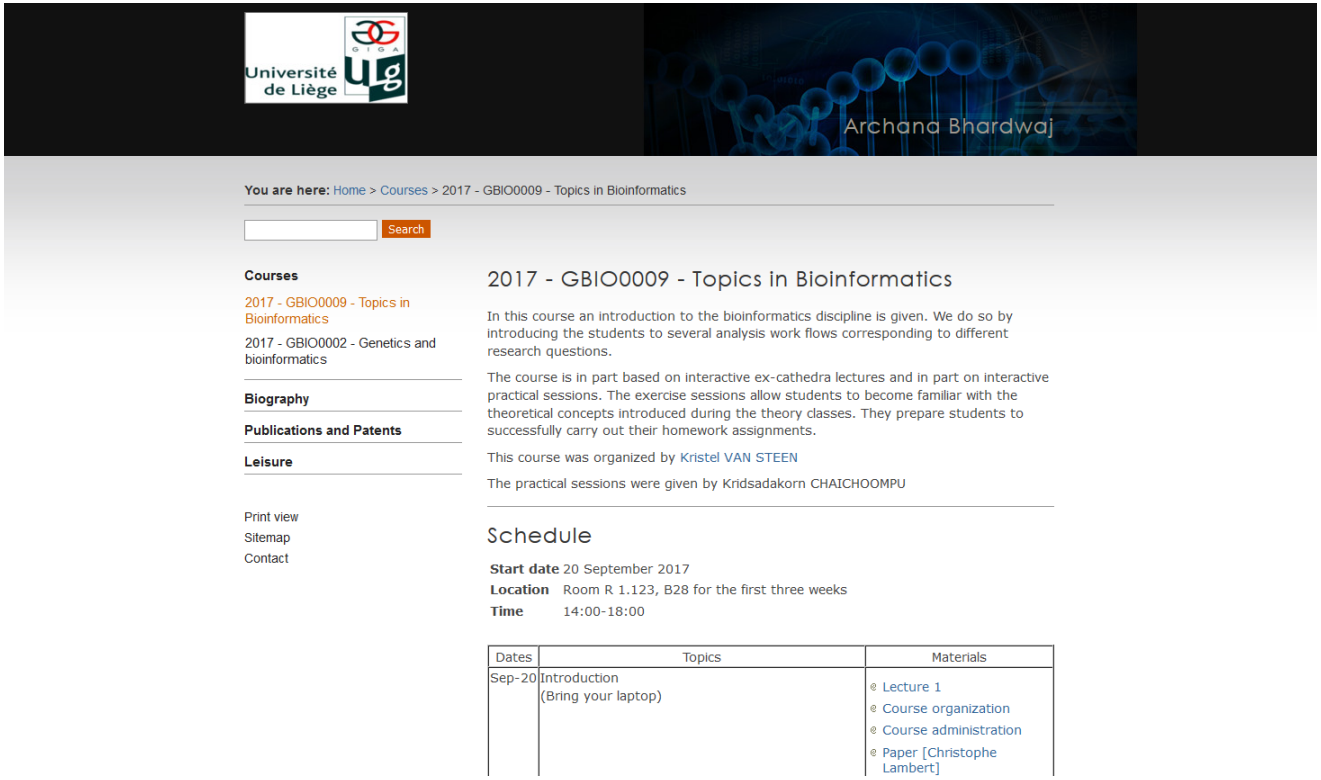
Administration

- Course website: http://bio3.giga.ulg.ac.be/archana_bhardwaj/?Courses



Kristel Van Steen, PhD²

Home

CV (Long - Updated)

Synopsis of activities

Consultancy Charter

FNRS CR Rita Brandão

References

Links to affiliations

- ULg homepage
- Institut Montefiore
- GIGA-R
- Center for Medical Genetics Ghent (at UG)
- Center for Human Genetics (at K.U.Leuven)
- ----X Marie Curie ITN: Machine Learning for Personalized Medicine
- ----X Pancreas COST Action: An integrated European platform for pancreas cancer research: from basic science to clinical and public health

Contact Information

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http://www.montefiore.ulg.ac.be/~kvansteen/

Administration

- Course instructors

Prof. Kristel Van Steen
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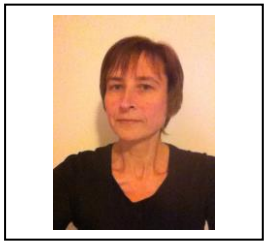

Teaching Assistant
- Archana Bhardwaj
- Office: level +1, B34 (GIGA tower)
- A.Bhardwaj@uliege.be

Administration

- Tutor-student commitments (progcours.ulg.ac.be)

Planned learning activities and teaching methods

The course mainly involves interactive sessions, where discussions in the more theoretical oriented classes emerge from the input given by the students. The exercise sessions allow students to see how software tools, related to the discussed research questions, are used and how their output needs to be interpreted. A few classes will be dedicated to invited speakers, who will talk about their areas of bioinformatics.

Regarding the homework assignments, three homework styles may be presented: 1) literature-based (i.e., discussing a paper related to the class topic); 2) programming-based (i.e., targeting students with a strong informatics background); 3) classic style (i.e., questions-answers type of homework). Students can work in groups but should select at least 2 styles throughout the course and at least once a literature-based homework. The latter are presented and discussed in class, to further clarify concepts covered during the theoretical or practical course sessions.

The aforementioned homework scheme will be adapted, when the number of students is too small (<6).

What will we be doing?

- General course content

In this course an introduction to the bioinformatics discipline is given. We do so by introducing the students to several analysis work flows corresponding to different research questions.

Topics that are covered in this course include:

- Genome-wide association screening using SNP chip arrays
- Post-GWAS bioinformatics
- Bioinformatics in Personalized Medicine
- Systems Medicine
- Biological Interactions
- Case studies

What will we be doing?

- General course content
  - Analytics
  - Focus on
    - Theoretical underpinnings of analysis types
    - Informatics / Software (what? Context? How?)

How will we do it?

"Theory" classes

- Course notes are in English
- Main instructor: K Van Steen
- Guest speakers on particular subtopics (e.g., systems biology and protein-protein interaction networks)

- The "theory" course will be interactive in English/French:
  - In-class discussion papers
  - Analysis frameworks: discussing different viewpoints
  - Slides and course website information as supporting docs ("syllabus")

How will we do it?

"Practical" classes

- "Homework assignments" constitute an important part of this class and make links to the theory and practical classes.
- Main tutor: Archana Bhardwaj (who will provide details)
- Homeworks:
  - Reading assignment with presentation and in-class discussions (graded)
  - Computing project with guiding Questions (graded)
- Homework assignments result in a "group" report / slides and should be handed in electronically in English (cfr. A Bhardwaj: step by step guide)
- See documentation on course website + next slide

Organization of GBIO0009 Homework Assignments
Topics in Bioinformatics

Type 1: Literature-based project

This involves choosing a paper from the literature that extends or provides additional background on the material of the course (chapter) and then summarizing the paper, its objectives, results while further browsing the internet for additional information or supporting material.

Do not copy the paper, but show you have understood the main ideas of the paper and "discuss" the paper. Such a discussion could include thoughts on what was the key idea, strengths or weaknesses of the methods/experiments, comments on the writing, ways to extend the work, flaws in the argument/data/experiments, etc. Anything is fine, as long as it demonstrates some real thought. Especially for review papers, make sure one subtopic is worked out in more detail, by following up on referenced work or by searching the internet.

A selection of papers will be provided, but if you have another interesting paper to discuss, please send your suggestion to the TA. The course instructors will then decide whether the paper is eligible or not.

All literature projects will be **presented** and discussed in class. No report is needed. Only slides will do.

Type 2: Computing project (with guiding questions)

You will be given a data and a real-life bioinformatics data problem. Using software that will be explained in class (TA), you will be asked to solve the problem. Guiding questions and supporting documents will be presented to you, to help you in achieving this goal. **Homeworks are handed in in the form of a report and an accessible link to your software code.**

Type 3: Classic style Q&A homework

Via representative questions, the idea is to further understand concepts provided in class. Occasionally, simulated or real-life data problems may be provided, that have been analyzed and for which the results require an interpretation. Use the material provided in class but be not afraid to consult the literature. As long as you can answer the given questions, everything is allowed. When you do use the literature, please provide references.

Please follow instructions in class, regarding how to draft your **report**.

What will be evaluated?

- At the end of the course, you have an idea about what bioinformatics entails as a profession.
- Since this course covers several subtopics within bioinformatics, you will be evaluated about key concepts related to each subtopic, rather than in-depth understanding of each subfield (analytics)
- Pros and cons of certain theoretical analytic routes or practical implementations and their motivations may be evaluated as well

How will be evaluated?

HW1	HW2	Examination
30	30	40

- No final grade without homeworks; no final grade without exam
- Homeworks not handed in in time: 0
- Oral exam in January (“open book”)
- Second term exam: oral exam + redo worst homework (50/50 score)

How will be evaluated?

Literature style homeworks

[1 homework = discuss 1 paper – or a section, indicated by the instructors, when the paper is too large]

- Discuss the paper and make a group report
- Make links
  - between the paper and the course,
  - between the paper and additional info outside the course

Evaluation criteria – presentation

Criterium	Key words
Clarity	Concepts, slides content, slides composition, fellow students do not have questions regarding “new” statements (i.e., not covered in class) made on the slides or during the presentation
Illustrations on slide	Not too much; not only copy and paste from course but novel illustrations; supportive
Presentation Skills	Eager beaver (a person who is very enthusiastic about doing something)
Understanding	Presentation content as presented is understood: adequate reply to questions and comments (incl. those from fellow students)
Group dynamics	Scoring will be done on an individual basis; balanced partitioning of tasks

Evaluation criteria – report (e.g., programming-style)

- Ability to formulate the research problem and to sketch the context (introductions, data description, tool description, etc)
- Presentation summary of the analysis workflow (methods, analysis section)
- Discussion (of the analysis tools, of the quality of the analysis, validity of results – when put in a broader context, …)
- Correct and creative input (stuffing, conclusion section)
- General structure of the report (sectioning)

Tentative course layout

[changes will be communicated via the course website]

Topics in bioinformatics (room 1.123, B28) **2018-2019**

19-Sep	KVS +TA	Meet & Greet, Course organization; What to expect? -- Video (intro genetics)	
26-Sep	TA	Introduction to R and PLINK	
03-Oct	KVS	Genetic mapping using GWAS: Why, What, How?	
10-Oct	TA	GWAS in PLINK and post-GWAS with DEPICT	HW1 assignment
17-Oct	KVS	Bioinformatics in Personalized Medicine: focus on molecular subtyping	HW2a assignment
24-Oct	TA	Molecular subtyping in practice (advanced clustering)	HW2b assignment
31-Oct			
07-Nov	KVS	Systems medicine: looking at interactions	HW1 reports due
14-Nov	TA	Practical use of Biofilter in GWAIs	
21-Nov	GUEST	Systems biology	
28-Nov	GUEST	Systems biology	HW2 reports due
05-Dec	GUEST	Systems biology	
12-Dec	ALL	Presentations of HWs	
19-Dec	ALL	Feedback on homeworks; Opportunity for Q&A to exam	

Course references

Recommended or required readings

Since a variety of « hot » topics are covered, there is no single textbook. Useful references will be given as the course progresses.
All course material is posted on the course website, which can be accessed via

http://bio3.giga.ulg.ac.be/archana_bhardwaj/?Courses

Supporting references:

- Applied Statistics for Bioinformatics using R

https://cran.r-project.org/doc/contrib/Krijnen-IntroBioInfStatistics.pdf

- Open-ended problems in bioinformatics

http://www.pnas.org/bioinformatics

Questions?