INTERDISCIPLINARY STUDIES: SPECIALIZATION IN BIOINFORMATICS (PHD)

Doctor of Philosophy in Interdisciplinary Studies, specialization in Bioinformatics
Unit: Graduate School (http://louisville.edu/graduate/) (GI)
Program Website (http://bioinformatics.louisville.edu/)
Academic Plan Code(s): IS__PHDINF

Program Information
The Interdisciplinary PhD Program in Bioinformatics (the Bioinformatics Program) trains students in bioinformatics for careers in research, education, and industry. Bioinformatics is a broad and diverse domain, ranging from management of biological research databases to computational approaches to biomedical modeling and data analysis.

The Bioinformatics Program focuses on those aspects of bioinformatics that reflect the research interests and experience of the Program’s faculty. These include basic research in biostatistical methodology, computer science and mathematical modeling with applications to biochemistry, cell biology, and molecular biology. The following areas have been identified and named by the Bioinformatics Program faculty to represent the focus application areas of the Program:

- Biomedical and Natural Sciences
- Computational Sciences
- Mathematics and Statistics

Students in the Bioinformatics Program specialize in one of the three focus application areas and graduate with cutting-edge expertise in this area and working knowledge in the other two focus application areas.

To earn the Doctor of Philosophy in Interdisciplinary Studies, specialization in Bioinformatics, a student is required to successfully complete the following:

- Core coursework in the focus application areas
- Required coursework in the student’s area of specialization
- Elective courses in the student’s area of specialization
- Qualifying examination
- Dissertation
- Presentation and defense of a dissertation

Upon successful completion of the written and oral portions of the qualifying examination, the examination committee will recommend acceptance into PhD candidacy. Successful completion of the dissertation and its presentation and defense is established by the approval of the student’s dissertation committee and the approval of the chair of the sponsoring department and the program chair.

Admission Requirements
Applicants for interdisciplinary doctoral programs must present complete admission credentials and have an approved program of study in order to be formally admitted by the Graduate School (http://louisville.edu/graduate/).

- Complete graduate application (http://louisville.edu/graduate/futurestudents/apply-materials/application/).
- A 3.25 grade point average.
- Competitive scores on the Quantitative, Verbal, Critical Thinking and Analytical portions of the Graduate Record Exam (GRE).
- Proof of a Baccalaureate Degree and official transcripts of all undergraduate and graduate course work.
- International students for whom English is not their primary language must show English language proficiency by one of the following:
  - TOEFL examination score 213 (computer-based test) or 79 (internet-based test)
  - IELTS test score of 6.5 or higher
  - Duolingo score of 105.
- Demonstration of a degree awarded from an acceptable English language institution.
- Three letters of recommendation from individuals who are able to comment on the student’s academic abilities and a potential for success in graduate studies.

Programs of Study
Course requirements for the Interdisciplinary PhD Degree Program in Bioinformatics consist of 16 core credit hours (that will be conditional based upon focus area) and 21 credit hours derived from a combination of required courses from a chosen focus area and electives from each of the three focus areas. Students with an appropriate background in the biomedical and natural sciences may petition to substitute a course in either the Computational Sciences or Mathematics and Statistics focus for the core course BIOC 545 and a corresponding course in either the Computational Sciences or Mathematics and Statistics, thus maintaining 16 core credit hours. Following acceptance into a focus area, students will be required to complete three courses totaling at least nine hours from the declared focus area. At least four additional elective courses (12 credit hours) will be selected from available elective courses, with the provision that two elective courses must be selected in each of the other two focus areas. The Program of Study will be determined by the student and approved by both an advisor residing in a declared focus area department and the Executive Committee. The following tables list the required courses for the core as well as the required and elective courses in each of the focus areas. Students must accumulate at least nine (9) credit hours of dissertation.

Good standing requires that the student maintain a minimum 3.0 grade point average. Upon successful completion of the written and oral portions of the qualifying examination, the examination committee will recommend acceptance into PhD candidacy. Successful completion of the dissertation and its presentation and defense is established by the approval of the student’s dissertation committee and the approval of the chair of the sponsoring department and the program chair.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 545</td>
<td>Biochemistry I(^{1,2,3})</td>
<td>16</td>
</tr>
<tr>
<td>or BIOC 667</td>
<td>Cell Biology</td>
<td></td>
</tr>
<tr>
<td>BIOC 667</td>
<td>Cell Biology(^{1,2,3})</td>
<td></td>
</tr>
<tr>
<td>BIOC 630</td>
<td>Responsible Conduct of Research: Survival Skills and Research Ethics (^{1})</td>
<td></td>
</tr>
<tr>
<td>CSE 619</td>
<td>Design and Analysis of Computer Algorithms(^{1})</td>
<td></td>
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<tr>
<td>or CSE 632</td>
<td>Data Mining</td>
<td></td>
</tr>
<tr>
<td>CSE 660</td>
<td>Introduction to Bioinformatics (^{1})</td>
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</tbody>
</table>
PHST 750  Statistics for Bioinformatics

Focus Area & Electives (see lists below)  21

Focus Area (minimum three courses)  4

Electives (minimum four courses)  4

Dissertation  9

Minimum Total Hours  46

1 All courses are required.
2 CHEM 645 may be substituted. Students may take either the
  BIOC 545/BIOC 547 or CHEM 645/CHEM 647 sequence but are not allowed to take the sequence
  BIOC 545/CHEM 547 or
  CHEM 645/BIOC 547.
3 Students with an appropriate background in the biomedical and
  natural sciences may petition to substitute a course in either
  the Computational Sciences or Mathematics and Statistics focus.
4 Courses selected with approval of advisor and the Executive
  Committee
5 At least one elective course must be selected from each of the other
  two focus areas other than the student’s primary focus area.

Focus Area Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 505</td>
<td>Introduction to Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 561</td>
<td>Probability 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 565</td>
<td>Computational Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 625</td>
<td>Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 636</td>
<td>Mathematical Modeling II</td>
<td>3</td>
</tr>
<tr>
<td>PHST 661</td>
<td>Probability 1</td>
<td>3</td>
</tr>
<tr>
<td>PHST 662</td>
<td>Mathematical Statistics 1</td>
<td>3</td>
</tr>
<tr>
<td>MATH 652</td>
<td>Mathematical Statistics 1</td>
<td>3</td>
</tr>
<tr>
<td>MATH 681</td>
<td>Combinatorics and Graph Theory I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 682</td>
<td>Combinatorics and Graph Theory II</td>
<td>3</td>
</tr>
<tr>
<td>PHST 682</td>
<td>Multivariate Statistical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHST 691</td>
<td>Bayesian Inference and Decision</td>
<td>3</td>
</tr>
<tr>
<td>PHST 710</td>
<td>Advanced Statistical Computing I</td>
<td>3</td>
</tr>
<tr>
<td>PHST 724</td>
<td>Advanced Clinical Trials</td>
<td>3</td>
</tr>
<tr>
<td>PHST 762</td>
<td>Advanced Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>PHST 751</td>
<td>High-throughput Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHST 752</td>
<td>Statistical Genetics</td>
<td>3</td>
</tr>
<tr>
<td>PHST 780</td>
<td>Advanced Nonparametrics</td>
<td>3</td>
</tr>
<tr>
<td>PHST 781</td>
<td>Advanced Linear Models</td>
<td>3</td>
</tr>
<tr>
<td>PHST 782</td>
<td>Generalized Linear Models</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Credit only for one: MATH 505/PHST 661; MATH 562/PHST 662

Code  Title                                      | Hours |
Elective Courses in Computational Sciences
CSE 625  Parallel Programming                    | 3     |
CSE 619  Design and Analysis of Computer Algorithms | 3     |
CSE 622  Simulation and Modeling of Discrete Systems | 3     |
CSE 627  Digital Image Processing                 | 3     |
CSE 628  Computer Graphics                        | 3     |
CSE 629  Distributed System Design                | 3     |
CSE 630  Advanced Databases                       | 3     |
CSE 632  Data Mining                              | 3     |
CSE 641  Medical Imaging Systems                  | 3     |

CHEM 647  Advanced Biochemistry II                | 4     |
BIOC 661  Molecular Mechanisms of Toxicology      | 3     |
BIOC 668  Molecular Biology                       | 4     |

1 Credit only for one: CHEM 645/BIOC 645, CHEM 647/BIOC 647.
Students may take either the BIOC 545/BIOC 547 or
CHEM 645/CHEM 647 sequence but are not allowed to take the sequence BIOC 545/CHEM 647 or
CHEM 645/BIOC 547.