BIOINFORMATICS AND COMPUTATIONAL BIOLOGY, M.S.

The use of computational techniques and information systems has revolutionized research in the biological sciences — from the analysis of DNA sequences and the understanding of gene expression and regulation, to the structural modeling of proteins and RNAs and the evolutionary relationship between species. The fields of bioinformatics and computational biology have become an important academic discipline for such breakthroughs and a critical part of success for firms in the biotechnology sector.

The bioinformatics and computational biology program brings together expertise from across Saint Louis University in biology, chemistry, computer science, mathematics and statistics, biochemistry and molecular biology.

Leadership
Maureen J. Donlin, Ph.D.
Program Director

Curriculum Overview
The 30-credit bioinformatics and computational biology program is designed for students with academic backgrounds in the life sciences, mathematics, computer science, health sciences, and statistics. The curriculum consists of a mix of required courses that build a strong foundation in bioinformatics and computational biology and elective classes that allow students to specialize their expertise. Students will be expected to complete the program in one-and-a-half to two years.

Fieldwork and Research Opportunities
As a student in the bioinformatics and computational biology program, students will be required to complete either a research experience with faculty or an internship with a biotech firm in the St. Louis area, which is home to one of the largest concentrations of biotech companies in the country.

This requirement gives students the opportunity for hands-on experience working with academic researchers or private industry. Industry partners are:
- Appistry
- Bayer-Monsanto
- BioSTL
- Cofactor Genomics
- Confluence Discovery Technologies
- Donald Danforth Plant Sciences Center
- Mallinckrodt Pharmaceuticals
- MoGene
- Nestlé-Purina
- Sigma-Aldrich

Careers
There are many employment opportunities for this program’s graduates in the biotechnology, pharmaceutical, health care and software industries, as well as in academic, private and governmental research labs. St. Louis is home to many large and small biotech firms and is a national leader in biotech startups. St. Louis has medical schools at Saint Louis University and Washington University and is home to the Donald Danforth Plant Sciences center, a world leader in plant and life sciences.

Admission Requirements
A bachelor’s degree in biology, biochemistry, computer science, mathematics, statistics or a closely related field is required. Ideally prepared students will have completed the following coursework in biology, chemistry, molecular biology, computer science and statistics (SLU equivalent):
- Principles of Biology I (BIOL 1240)/Principles of Biology I Laboratory (BIOL 1245)
- Principles of Biology II (BIOL 1260)/Principles of Biology II Laboratory (BIOL 1265)
- General Chemistry 1 (CHEM 1110)/General Chemistry 1 Laboratory (CHEM 1115)
- General Chemistry 2 (CHEM 1120)/General Chemistry 2 Laboratory (CHEM 1125)
- Biochemistry and Molecular Biology (BIOL 3020) or Cell Structure & Function (BIOL 3040)
- Principles of Genetics (BIOL 3030)
- Introduction to Object-Oriented Programming (CSCI 1300)
- Data Structures (CSCI 2100)
- Calculus I (MATH 1510)
- Calculus II (MATH 1520)
- Discrete Mathematics (MATH 1660)
- Elementary Statistics with Computers (MATH 1300), Foundation of Statistics (MATH 3850) or Statistical Models (MATH 4860)

Students may complete these prerequisites as part of the program but the courses will not count toward the 30 credits required for the degree.

Application Requirements
- Application form and fee
- Three letters of recommendation
- Résumé
- Goal statement
- GRE scores
- TOEFL/IELTS scores (international students only)

Requirements for International Students
All admission policies and requirements for domestic students apply to international students along with the following:
- Demonstrate English Language Proficiency (http://catalog.slu.edu/academic-policies/office-admission/undergraduate/english-language-proficiency)
- Proof of financial support must include:
  - A letter of financial support from the person(s) or sponsoring agency funding the time at Saint Louis University
  - A letter from the sponsor’s bank verifying that the funds are available and will be so for the duration of study at the University
- Academic records, in English translation, of students who have undertaken postsecondary studies outside the United States must include the courses taken and/or lectures attended, practical
laboratory work, the maximum and minimum grades attainable, the grades earned or the results of all end-of-term examinations, and any honors or degrees received. WES and ECE transcripts are accepted.

**Assistantship Application Deadline**

Students who want to be considered for an assistantship must submit their application by Feb. 1.

The final application deadline is March 1.

**Review Process**

Applications will be reviewed once they are complete. A panel of senior faculty members will review each application and decide on acceptance and potential assistantships. Applicants who are U.S. citizens will need to fill out a FAFSA to be eligible for support from the National Science Foundation.

**Scholarships, Assistantships and Financial Aid**

For priority consideration for graduate assistantship, applicants should complete their applications by the program admission deadlines listed. Fellowships and assistantships provide a stipend and may include health insurance and a tuition scholarship for the duration of the award.

For more information, visit the student financial services office online at http://www.slu.edu/financial-aid.

**Learning Outcomes**

1. Graduates will be able to design and implement in silico experiments for biological problems
2. Graduates will be able to apply and combine existing tools for processing and analysis of biological data sets
3. Graduates will be able to use small- and large-scale quantitative data sets to model complex biological systems
4. Graduates will be able to work as part of multidisciplinary teams in corporate or academic environments
5. Graduates will be able to effectively communicate research approaches and findings

**Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>Required Courses</strong></td>
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</tr>
<tr>
<td>BCB 5200</td>
<td>Introduction Bioinformatics I</td>
<td>3</td>
</tr>
<tr>
<td>BCB 5250</td>
<td>Introduction Bioinformatics II</td>
<td>3</td>
</tr>
<tr>
<td>BCB 5300</td>
<td>Algorithms in Computational Biology</td>
<td>3</td>
</tr>
<tr>
<td>BCB 5810</td>
<td>Bioinformatics Colloquium</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 5030</td>
<td>Genomics</td>
<td>3</td>
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<tr>
<td><strong>Biology Elective</strong></td>
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<td>Select one of the following:</td>
<td>3</td>
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<tr>
<td>BIOL 5090</td>
<td>Biometry</td>
<td></td>
</tr>
<tr>
<td>BIOL 5100</td>
<td>Cellular and Molecular Genetic</td>
<td></td>
</tr>
<tr>
<td>BIOL 5700</td>
<td>Advanced Molecular Biology</td>
<td></td>
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<tr>
<td>BIOL 5780</td>
<td>Molecular Phylogenetic Analysis</td>
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<tr>
<td><strong>Computer Science</strong></td>
<td></td>
<td></td>
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<tr>
<td>Select one of the following:</td>
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</tr>
<tr>
<td>CSCI 5710</td>
<td>Databases</td>
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</table>

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CSCI 5750</td>
<td>Machine Learning</td>
<td></td>
</tr>
<tr>
<td>CSCI 5850</td>
<td>High-Performance Computing</td>
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</table>

**Internship/Research Experience**

Select three credits of the following: 3

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BCB 5910</td>
<td>Bioinformatics Internship</td>
<td></td>
</tr>
<tr>
<td>BIOL 4911</td>
<td>Integrated Bioinformatics Internship</td>
<td></td>
</tr>
<tr>
<td>BCB 5970</td>
<td>Research Topics</td>
<td></td>
</tr>
<tr>
<td>BIOL 5970</td>
<td>Research Topics</td>
<td></td>
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<tr>
<td>CHEM 5970</td>
<td>Research Topics</td>
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<tr>
<td>CSCI 5970</td>
<td>Research Topics</td>
<td></td>
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<tr>
<td>IAS 6970</td>
<td>Research Topics</td>
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</tbody>
</table>

**Bioinformatics & Computational Biology**

Select remaining courses to reach 30 credits: 8

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCB 5100</td>
<td>Advanced Scripting for Life Sciences</td>
<td></td>
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<tr>
<td>BCB 5930</td>
<td>Special Topics</td>
<td></td>
</tr>
<tr>
<td>BIOL 5050</td>
<td>Molecular Techniques Lab</td>
<td></td>
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<tr>
<td>BIOL 5070</td>
<td>Advanced Biological Chemistry</td>
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<tr>
<td>BIOL 5170</td>
<td>Intro to GIS</td>
<td></td>
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<tr>
<td>BIOL 5180</td>
<td>Intermediate GIS</td>
<td></td>
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<tr>
<td>BIOL 5190</td>
<td>Geographic Information Systems in Biology</td>
<td></td>
</tr>
<tr>
<td>CSCI 5150</td>
<td>Computational Geometry</td>
<td></td>
</tr>
<tr>
<td>CSCI 5830</td>
<td>Image Processing</td>
<td></td>
</tr>
<tr>
<td>CSCI 5930</td>
<td>Special Topics</td>
<td></td>
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<tr>
<td>MATH 4850</td>
<td>Mathematical Statistics</td>
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<tr>
<td>CHEM 4610 &amp; CHEM 4615</td>
<td>Biochemistry 1 and Biochemistry 1 Laboratory</td>
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</tr>
<tr>
<td>CHEM 4620 &amp; CHEM 4625</td>
<td>Biochemistry 2 and Biochemistry 2 Laboratory</td>
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</table>

**Total Credits** 30

**Continuation Standards**

Students must maintain a cumulative grade point average (GPA) of 3.00 in all graduate/professional courses.

**Roadmap**

Roadmaps are recommended semester-by-semester plans of study for programs and assume full-time enrollment unless otherwise noted.

Courses and milestones designated as critical (marked with !) must be completed in the semester listed to ensure a timely graduation. Transfer credit may change the roadmap.

This roadmap should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor/mentor each semester. Requirements, course availability and sequencing are subject to change.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>Year One</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td></td>
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<tr>
<td>! Participation in BCB Colloquium</td>
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<td></td>
</tr>
<tr>
<td>BCB 5200</td>
<td>Introduction Bioinformatics I</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 5030</td>
<td>Genomics</td>
<td>3</td>
</tr>
</tbody>
</table>

Students missing admission pre-requisite courses may be required to take an additional 3 credit course, for example: † 0-3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CSCI 5001</td>
<td>Object-Oriented Programming</td>
<td>6-9</td>
</tr>
<tr>
<td></td>
<td><strong>Spring</strong></td>
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</tr>
<tr>
<td>BCB 5250</td>
<td>Introduction Bioinformatics II</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 5090</td>
<td>Biometry</td>
<td>4</td>
</tr>
<tr>
<td>BCB 5930</td>
<td>Unix tools</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Students missing admission pre-requisite courses may be required to take an additional 3 credit course, for example: †</td>
<td>0-3</td>
</tr>
<tr>
<td>CSCI 5002</td>
<td>Data Structures</td>
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<td></td>
<td><strong>Summer</strong></td>
<td>1-3</td>
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<tr>
<td>BCB 5910</td>
<td>Bioinformatics Internship</td>
<td></td>
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<tr>
<td></td>
<td><strong>Year Two</strong></td>
<td>1-3</td>
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<tr>
<td></td>
<td><strong>Fall</strong></td>
<td></td>
</tr>
<tr>
<td>Completion of BCB 5910 if not during summer</td>
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</tr>
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<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Spring</strong></td>
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<tr>
<td>BIOL 5780</td>
<td>Molecular Phylogenetic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 5750</td>
<td>Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td>31-39</td>
</tr>
</tbody>
</table>

† This course allows students to fill in missing pre-requisite course work, such as Data Structures. It does not count towards the 30 credits needed for graduation.

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