Proposal for New Program:

BS in Data Science: Modeling Physical Systems

1. “Rationale...” The proposed “Data Science: Modeling Physical Systems” major is intended for students interested in understanding the fundamentals of computer science necessary to create computational models of complex systems and simulations of natural systems. Examples of relevant and important modern complex systems include safety testing simulations, climate models, stock market analysis, electronic chip design, predicting pharmaceutical side-effects, air traffic control systems, defense applications, and smart grid studies.

Data Science is an extremely broad and deep interdisciplinary field, and this specialization aims to equip a B.S. student with the tools necessary to create accurate, robust, and detailed models of real systems in a scientific or professional field. A strong core of mathematics, physics, computational methods and techniques, and data analysis will equip students with the basics necessary to model any complex physical system. Meanwhile, elective courses will allow students to specialize in a specific area and give them a head start in that area. The capstone project will give students tangible credentials, while studies in visualization techniques will provide skills needed to succinctly summarize and present data, and to promote their work.

A graduate of this program will be equipped to build computational models of important real-world systems in any field. The elective courses will allow each to student to focus their interests, increasing their employ-ability within a specific field, but without locking them into that field. A graduate of this program could continue on into graduate school, work in a research group, or join a private or public sector organization that has a need for modeling complex systems.
# Appendix A

## Data Science: Modeling Physical Systems BS Semester Sequence Proposal

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<thead>
<tr>
<th>Freshman – Fall (16 cr.)</th>
<th>Freshman – Spring (15 cr.)</th>
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<tbody>
<tr>
<td>CIS 1068 Program Design and Abstraction (4 cr.)</td>
<td>CIS 1166 Mathematical Concepts in Computing I (4 cr.)</td>
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<tr>
<td>Math 1041 Calculus I (4 cr.)</td>
<td>or Math 2111 Basic Concepts in Math (3 cr.)</td>
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<tr>
<td>Phys 1061 Elementary Classical Physics I (4 cr.)</td>
<td>Math 1042 Calculus II (4 cr.)</td>
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<td>Gen Ed English 0802 (4 cr.)</td>
<td>Phys 1062 Elementary Classical Physics II (4 cr.)</td>
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<td>Gen Ed IH 0851 (3 cr.)</td>
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<td>Elective (0-1 cr.)</td>
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<th>Sophomore – Fall (14 cr.)</th>
<th>Sophomore – Spring (17 cr.)</th>
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<tbody>
<tr>
<td>CIS 2168 Data Structures (4 cr.)</td>
<td>CIS 2166 Mathematical Concepts in Computing I (4 cr.)</td>
</tr>
<tr>
<td>Math 2043 Calculus III (4 cr.)</td>
<td>Math 3032 Probability Theory II (3 cr.)</td>
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<td>Math 3031 Probability Theory I (3 cr.)</td>
<td>Phys 2796S Introduction to Modern Physics (4 cr.)</td>
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<tr>
<td>Gen Ed IH 0852 (3 cr.)</td>
<td>Gen Ed US Society (3 cr.)</td>
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<td>Gen Ed Behavior (3 cr.)</td>
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<tr>
<th>Junior – Fall (15 cr.)</th>
<th>Junior – Spring (17 cr.)</th>
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<tbody>
<tr>
<td>CIS 3223 Data Structures and Algorithms (4 cr.)</td>
<td>CIS 3715S Principles of Data Science (4 cr.)</td>
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<tr>
<td>Math 3045S Differential Equations with Linear Algebra (4 cr.) or Math 2101 Linear Algebra (3 cr.) or Math 2103 Linear Algebra with Lab (4 cr.)</td>
<td>Phys 2502S Mathematical Physics (4 cr.)</td>
</tr>
<tr>
<td>Gen Ed Arts (3-4 cr)</td>
<td>DS: Modeling Elective (3 cr.)</td>
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<tr>
<td>Elective (3 cr.)</td>
<td>Gen Ed Race (3 cr.)</td>
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<tr>
<td>Elective (2-0 cr.)</td>
<td>Gen Ed World Society (3 cr.)</td>
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<th>Senior – Fall (15 cr.)</th>
<th>Senior – Spring (14 cr.)</th>
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</thead>
<tbody>
<tr>
<td>Math 3043F Numerical Analysis I (3-4 cr.)</td>
<td>SCTC5 xxxx Advanced Data Visualization (3 cr.)</td>
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<tr>
<td>Phys 2501F Computing for Scientists (3 cr.)</td>
<td>DS: Modeling Elective (3 cr.)</td>
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<tr>
<td>DS: Modeling Elective (3 cr.)</td>
<td>Elective (4 cr.)</td>
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<tr>
<td>Elective (3-2 cr.)</td>
<td>Elective (4 cr.)</td>
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<tr>
<td>Elective (3 cr.)</td>
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Credits in the major: 77-81
Credits in General Education: 25-26
Elective credits: 21-16
Total credits: 123
Appendix B

New Data Science: Modeling Physical Systems B.S. Degree

**Intro Science Requirements:**
- Phys 1061 (4 cr.) Elementary Classical Physics I (plus variants)
- Phys 1062 (4 cr.) Elementary Classical Physics II (plus variants)

Subtotal 8 credits

**Calculus Requirements:**
- Math 1041 (4 cr.) Calculus I
- Math 1042 (4 cr.) Calculus II
- Math 2043 (4 cr.) Calculus III

Subtotal 12 credits

**Math Methods in Computing Requirements:**
- CIS 1166 (4 cr.) Mathematical Concepts in Computing I or Math 2111 (3 cr.) Basic Concepts of Math
- CIS 2166 (4 cr.) Mathematical Concepts in Computing II
- Math 3045 (4 cr.) Probability Theory I or Math 2101 (3 cr.) Linear Algebra or Math 2103 (4 cr.) Linear Algebra with Lab

Subtotal 10-12 credits

**Probability and Statistics Requirements:**
- Math 3031 (3 cr.) Probability Theory I
- Math 3032 (3 cr.) Probability Theory II

Subtotal 6 credits

**Programming Requirements:**
- CIS 1068 (4 cr.) Program Design and Abstraction
- CIS 2168 (4 cr.) Data Structures

Subtotal 8 credits

**Specialty Course Requirements:**
- CIS 3223 (3 cr.) Data Structures and Algorithms
- CIS 3715 (4 cr.) Principles of Data Science
- Math 3043 (3-4 cr.) Numerical Analysis I
- Phys 2501 (3 cr.) Computing for Scientists
- Phys 2502 (4 cr.) Mathematical Physics

Subtotal 17-18 credits

**WI/Capstone Requirements:**
- Phys 2796 (4 cr.) Introduction to Modern Physics
- SCTC xxxx (3 cr.) Advanced Data Visualization

Subtotal 7 credits
Elective Course Requirements (9 credits required):
CEE 3048. (3 cr.) Probability, Statistics & Stochastic Methods
CIS 3219. (4 cr.) Computer Graphics and Image Processing
CIS 4523/9664 (3 cr.) Data Mining
CIS 4xxx/5245 Analysis and Modeling of Information Networks
CIS 4526 (3 cr.) Foundations of Machine Learning
EES 3011 (4 cr.) Remote Sensing and GIS
EES 4xxx/5xxx (3 cr.) Ice Sheet Dynamics (with permission)
Math 3044 (3 cr.) Numerical Analysis II
Math 4033 (3 cr.) Probability Theory
Math 4041 (3 cr.) Partial Differential Equations
Math 4043 (3 cr.) Applied Mathematics
Math 5043 (3 cr.) Grad Numerical Analysis
Phys 2101 (3 cr.) Classical Mechanics
Phys 3101 (3 cr.) Analytical Mechanics
Phys 3301 (4 cr.) Electricity and Magnetism
Phys 3302 (3 cr.) Classical Electricity and Magnetism
Phys 3701 (3 cr.) Introduction to Quantum Mechanics
Phys 4101 (3 cr.) Thermodynamics and Kinetic Theory or Elective
Phys 4302 (3 cr.) Optics
Phys 4701 (3 cr.) Intro to Solid State Physics
Phys 4702 (3 cr.) Atomic, Nuclear, & Particle Physics
Math 4082 (max of 3 cr. Across all indep. study) Independent Study
Phys 4091 (max of 3 cr. Across all indep. study) Independent Study
SCTC 21xx (3 cr.) Modeling and Simulation in Science & Technology

Total 77-81 credits
**CST Data Science BS programs Common Core**
- Chem 1031&1033&1032&1034 General Chemistry I&II (3+1+3+1 cr.) OR Biol 1111&2112 Introduction to Biology I&II (4+4 cr.) OR Phys 1061&1062 (4+4 cr.) Elementary Classical Physics I&II (plus variants)
- CIS 1068 (4 cr.) Program Design and Abstraction
- CIS 2168 (4 cr.) Data Structures
- CIS 1166 (4 cr.) Mathematical Concepts in Computing I
- CIS 2166 (4 cr.) Mathematical Concepts in Computing II
- Math 1041 (4 cr.) Calculus I
- Math 1042 (4 cr.) Calculus II
- Math 3031 (3 cr.) Probability Theory I
- Math 3032 (3 cr.) Probability Theory II
- CIS 3715 (4 cr.) Principles of Data Science
- SCTC xxxx (3 cr.) Advanced Data Visualization

**Data Science: Modeling Physical Systems BS Comparison to CST Data Science Common Core**

**Changed**
- Phys 1061&1062 (4+4 cr.) Elementary Classical Physics I&II (plus variants) specified

**Added**
- Math 3045 (4 cr.) Probability Theory I or Math 2101 (3 cr.) Linear Algebra or Math 2103 (4 cr.) Linear Algebra with Lab
- CIS 3223 (4 cr.) Data Structures and Algorithms
- Math 2043 (4 cr.) Calculus III
- Math 3043 (3-4 cr.) Numerical Analysis I
- Phys 2501 (3 cr.) Computing for Scientists
- Phys 2502 (4 cr.) Mathematical Physics
- Phys 2796 (4 cr.) Introduction to Modern Physics

**Data Science: Genomics BS Comparison to CST Data Science Common Core**

**Changed**
- Chem 1031&1033&1032&1034 General Chemistry I&II (3+1+3+1 cr.) (plus variants) specified

**Added**
- Biol 1111 Introduction to Biology I (4 cr.)
- Biol 2112 Introduction to Biology II (4 cr.)
- Biol 2296 Genetics (4 cr.)
- Biol 3101 Evolution (3 cr.)
- Biol 3111 Genomics in Medicine (3 cr.)
- Chem 2201&2203 Organic Chemistry I (3+1 cr.)
- Chem 2202&2204 Organic Chemistry I (3+1 cr.)
Data Science: Computational Analytics BS Comparison to CST Data Science

Common Core

- Math 3045 (4 cr.) Probability Theory I or Math 2101 (3 cr.) Linear Algebra or Math 2103 (4 cr.) Linear Algebra with Lab
- CIS 2107 (4 cr.) Computer Systems and Low-Level Programming
- CIS 3223 (4 cr.) Data Structures and Algorithms
- CIS 4331 (4 cr.) Principles of Database Systems 4cr
- CIS 4526 (3 cr.) Foundations of Machine Learning
- CIS 4xxx (4 cr.) Data-Intensive and Cloud Computing 4cr
- Math 2043 (4 cr.) Calculus III
- ENG 2696 (3 cr.) Technical Writing

Comparison of CST Data Science BS programs Common Core to Statistics and Data Science BS

Common

- CIS 1068 (4 cr.) Program Design and Abstraction
- Math 1041 (4 cr.) Calculus I
- Math 1042 (4 cr.) Calculus II

Alternates

- CIS 2168 (4 cr.) Data Structures versus CIS 1051. Introduction to Problem Solving and Programming in Python (4 cr.)
- Math 3031 (3 cr.) Probability Theory I versus Stat 2103/2903 Statistics for Business Analytics (4)
- Math 3032 (3 cr.) Probability Theory II versus Stat 2512 Intermediate Statistics (3)

Statistics and Data Science BS only

- BA 2196/2996 Business Communications – (3)
- BA 2104 Excel for Business Applications (1)
- HRM 1101/1901 Leadership and Organizational Management- (3)
- ECON 1102/1902 Microeconomic Principles (3)
- ECON 1101/1901 Macroeconomics Principles (3)
- RMI 2101/2901. Introduction to Risk Management – (3)
- MKTG 2101/2901. Marketing Management- (3)
- Acct 2101/2901 Financial Accounting- (3)
- Stat 2501 Quantitative Foundations for Data Science –(3) new course
- Stat 2521 Data Analysis and Statistical Computing- (3)
- Stat 2523 Design of Experiments & Quality Control- (3)
- Stat 2522 Survey Design and Sampling- (3)
- Stat 3503 Intermediate Business Statistics- (3)
- Stat 3505 Introduction to SAS for Data Analytics (3) – new course
- Stat 3502 Regression and Predictive Analytics(3) – new course
- Stat 3504 Time Series and Forecasting Models(3) – new course
- Stat 3506 Nonparametric and Categorical Data Analysis(3) – new course
• Stat 4501 Capstone: Statistical methods and Data Analytics (use of SAS (with Online certification) and R (3) – new course
• 2 elective courses

**CST Data Science BS programs Common Core only**

• Chem 1031&1033&1032&1034 General Chemistry I&II (3+1+3+1 cr.) OR Biol 1111&2112 Introduction to Biology I&II (4+4 cr.) OR Phys 1061&1062 (4+4 cr.) Elementary Classical Physics I&II (plus variants)
• CIS 1068 (4 cr.) Program Design and Abstraction
• CIS 1166 (4 cr.) Mathematical Concepts in Computing I
• CIS 2166 (4 cr.) Mathematical Concepts in Computing II
• CIS 3715 (4 cr.) Principles of Data Science
• SCTC xxxx (3 cr.) Advanced Data Visualization
• 7-8 required courses based on particular CST Data Science BS program
• 3 elective courses based on particular CST Data Science BS program

**Comparison of Data Science: Modeling Physical Systems Science BS to Computer Science and Physics BS**

**Removed**

• CIS 2107 (4 cr.) Computer Systems and Low-Level Programming
• CIS 3207 (4 cr.) Introduction to Systems Programming and Operating Systems
• CIS 3238 (4 cr.) Software Design or Elective (3-4 cr.)
• One of the following
  o Phys 2101 (3 cr.) Classical Mechanics
  o Phys 3301 (3 cr.) Electricity and Magnetism
  o Phys 3701 (3 cr.) Introduction to Quantum Mechanics
  o Phys 4101 (3 cr.) Thermodynamics and Kinetic Theory or Elective

**Specified**

• 3 of the following as the elective courses:
  o Phys 2101 (3 cr.) Classical Mechanics
  o Phys 3301 (3 cr.) Electricity and Magnetism
  o Phys 3701 (3 cr.) Introduction to Quantum Mechanics
  o Phys 4101 (3 cr.) Thermodynamics and Kinetic Theory or Elective

**Added**

• Math 3031 (3 cr.) Probability Theory I
• Math 3032 (3 cr.) Probability Theory II
• Math 3045 (4 cr.) Probability Theory I or Math 2101 (3 cr.) Linear Algebra or Math 2103 (4 cr.) Linear Algebra with Lab
• Math 3043 (3-4 cr.) Numerical Analysis I
• CIS 3715 (4 cr.) Principles of Data Science
• SCTC xxxx (3 cr.) Advanced Data Visualization