Proposal for New Program:  
**BS in Data Science: Computational Analytics**

1. “Rationale…” The proposed “Data Science: Computational Analytics” major is designed for students interested in developing expertise in data science, with specialization in computational analytics. Data Science is an interdisciplinary discipline about methods and systems to extract knowledge or insights from large quantities of data coming in various forms. Data science employs techniques and theories drawn from many fields within the broad areas of mathematics, statistics, and computer and information sciences and applies them on a wide range of data-rich domains such as biomedical sciences, physical science, geoscience, social science, engineering, business, and education.

Data science is a very broad and multifaceted field and it is not realistic to expect that a B.S. program could provide students with deep expertise in all aspects of the field. The “Computational Analytics” specialization will give students a strong background in mathematics, algorithmic and computational thinking, computer systems, and data analysis, and will enable students to analyze large quantities of data to discover new knowledge and facilitate decision making.

Graduates of this program will have multiple career opportunities. Some of them will choose to find data science jobs in a private or a public sector and some will choose to continue with graduate studies either to deepen their overall data science expertise or learn how to better use their analytics skills in a particular data-rich domain.

a. “regional and national competitors…” Following the rapid growth of the field, there is an increasing number of undergraduate and graduate programs in data science. Currently, there are more M.S. than B.S. level programs in data science in the US. The proposed program is the most similar to the Ohio State University “Data Analytics: Computational Analytics” major (https://data-analytics.osu.edu/major/specialization/computational-analytics), which is probably the most prominent existing undergraduate degree in data science. New data science related programs are cropping up regionally. College of Computing and Informatics at Drexel University is introducing B.S. in Data Science in Fall 2016 (http://drexel.edu/cci/programs/undergraduate-program/bs-datascience/). At the graduate level, in Fall 2015 Wharton School at Penn started offering online “Business Analytics” specialization at Coursera (https://news.wharton.upenn.edu/press-releases/2015/09/wharton-school-offer-new-business-analytics-specialization-coursera-online-learning-platform/), whose focus is on using data science in business domain. Villanova started offering an M.S. program that focuses on business analytics (https://www1.villanova.edu/villanova/business/graduate/specializedprograms/msa.html). The Rutgers School of Business in Camden is offering a two-day certificate program to provide working professionals with analytical skills that can help them solve business problems entitled “Unlocking the Mystery, Challenge and Opportunity of Big Data” (http://rdi2.rutgers.edu/news/rutgers-offering-certificate-program-big-data). Department of Political Science at Penn State is introducing B.S. degree in “Social Data Analytics” (http://soda.la.psu.edu/), which focuses on social sciences domain.
## Appendix A
### Data Science: Computational Analytics BS Semester Sequence Proposal

<table>
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<tr>
<th>Semester</th>
<th>Courses</th>
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| **Freshman – Fall** (16 cr.) | CIS 1068 Program Design and Abstraction (4 cr.)  
CIS 1166 Mathematical Concepts in Computing I (4 cr.)  
Math 1041 Calculus I (4 cr.)  
Gen Ed English 0802 (4 cr.) |
| **Freshman – Spring** (17 cr.) | CIS 2168 Data Structures (4 cr.)  
Math 1042 Calculus II (4 cr.)  
Gen Ed IH 0851 (3 cr.)  
Gen Ed World Society (3 cr.)  
Gen Ed Race (3 cr.) |
| **Sophomore – Fall** (16 cr.) | CIS 2107 Computer Systems and Low-Level Programming (4 cr.)  
CIS 2166 Mathematical Concepts in Computing I (4 cr.)  
Math 2043 Calculus III (4 cr.)  
Gen Ed Arts (3-4 cr)  
Elective (1-0 cr.) |
| **Sophomore – Spring** (14 cr.) | CIS 3223 Data Structures and Algorithms (4 cr.)  
CIS 3715 Principles of Data Science (4 cr.)  
Math 3031 Probability Theory I (3 cr.)  
Gen Ed IH 0852 (3 cr.) |
| **Junior – Fall** (14 cr.) | CIS 4331 Principles of Database Systems (4 cr.)  
Math 3032 Probability Theory II (3 cr.)  
Math 3045 Differential Equations with Linear Algebra (4 cr.)  
Math 2101 Linear Algebra (3 cr.)  
Math 2103 Linear Algebra with Lab (4 cr.)  
Gen Ed US Society (3 cr.)  
Elective (0-1 cr.) |
| **Junior – Spring** (14 cr.) | CIS 4517 Data-Intensive and Cloud Computing (4 cr.)  
Science A (4 cr.)  
DS: Computational Elective (3 cr.)  
Gen Ed Behavior (3 cr.) |
| **Senior – Fall** (16 cr.) | CIS 4526 Foundations of Machine Learning (3 cr.)  
DS: Computational Elective (3 cr.)  
Science B (4 cr.)  
Eng 2696 Technical Writing (3 cr.)  
Elective (3 cr.) |
| **Senior – Spring** (16 cr.) | SCTC Advanced Data Visualization (3 cr.)  
DS: Computational Elective (3 cr.)  
Elective (4 cr.)  
Elective (3 cr.)  
Elective (3 cr.) |

Credits in the major: 82-83  
Credits in General Education: 25-26  
Elective credits: 16-14  
Total credits: 123
Appendix B

New Data Science: Computational Analytics B.S. Degree.

Intro Science Requirements:
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)
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
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 11-12 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 2107 (4 cr.) Computer Systems and Low-Level Programming
CIS 3223 (3 cr.) Data Structures and Algorithms
CIS 3715 (4 cr.) Principles of Data Science
CIS 4331 (4 cr.) Principles of Database Systems 4cr
CIS 4526 (3 cr.) Foundations of Machine Learning
CIS 4517 (4 cr.) Data-Intensive and Cloud Computing 4cr
Subtotal 28 credits

WI/Capstone Requirements:
ENG 2696 (3 cr.) Technical Writing
SCTC xxxx (3 cr.) Advanced Data Visualization
Subtotal 6 credits
Elective Course Requirements (9 credits required):
  BIOE 3301. (3 cr.) Biomedical Signals and Systems
  CEE 3048. (3 cr.) Probability, Statistics & Stochastic Methods
  CEE 3711. (3 cr.) Environmental Engineering
  CEE 4221. (3 cr.) Intelligent Transportation Systems
  CEE 4531. (3 cr.) Life Cycle Assessment and Carbon Footprinting
  CIS 3203. (3 cr.) Introduction to Artificial Intelligence
  CIS 3207. (4 cr.) Introduction to Systems Programming and Operating Systems
  CIS 3219. (4 cr.) Computer Graphics and Image Processing
  CIS 3515. (4 cr.) Introduction to Mobile Application Development
  CIS 3605. (3 cr.) Introduction to Digital Forensics
  CIS 4082 (max of 3 cr.) Independent Study
  CIS 4523/9664 (3 cr.) Knowledge Discovery and Data Mining
  CIS 4524 (3 cr.) Analysis and Modeling of Social and Information Systems (from Math)
  EES 3011 (4 cr.) Remote Sensing and GIS
  HCM 3501 (3 cr.) Introduction to Health Service Systems
  MATH 3043 (3-4 cr.) Numerical Analysis I
  MATH 3044 (3 cr.) Numerical Analysis II
  MATH 4033 (3 cr.) Probability Theory
  MATH 4043 (3 cr.) Applied Mathematics
  MKTG 3508 (3 cr.) Digital Marketing (has college restriction, MKTG 2101 as a prereq, ask for a permission)
  MKTG 3509 (3 cr.) Customer Data Analytics (has college restriction, has MKTG 2101 as a prereq, ask for a permission)
  Stat 2522 (3 cr.) Survey Design and Sampling
  Stat 2523 (3 cr.) Design of Experiments & Quality Control
  Stat 3504 (3 cr.) Time Series and Forecasting Models
  Stat 3506 (3 cr.) Nonparametric and Categorical Data Analysis

Subtotal 9 credits

Total 82-83 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: Computational Analytics BS Comparison to CST Data Science Common Core

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 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 4517 (4 cr.) Data-Intensive and Cloud Computing 4cr
- Math 2043 (4 cr.) Calculus III
- ENG 2696 (3 cr.) Technical Writing

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: 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

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: Computational Analytics BS to Computer Science BS**

**Removed**

- CIS 1001 (New) (1 cr.) Freshman Seminar in Computer Science
- CIS 2033 (4 cr.) Computational Probability and Statistics
- CIS 3238 (4 cr.) Software Design
- CIS 4397 (4 cr.) Independent Research in Computer Science or CIS 4398 Projects in Computer Science (4 cr.)

**Specified**

- 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) as Science A and Science B

**Added**

- Math 2043 (4 cr.) Calculus III
- 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
- CIS 3715 (4 cr.) Principles of Data Science
- CIS 4331 (4 cr.) Principles of Database Systems 4cr
- CIS 4526 (3 cr.) Foundations of Machine Learning
- CIS 4517 (4 cr.) Data-Intensive and Cloud Computing 4cr
- SCTC xxxx (3 cr.) Advanced Data Visualization