Proposal for New Program:  
Minor in Data Science: Computational Analytics

1. “Rationale...” The proposed “Data Science: Computational Analytics” minor is designed for students interested in signaling capability 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, much less a minor program, could provide students with deep expertise in all aspects of the field. The “Computational Analytics” minor will give students with some mathematics and computer science experience a focus 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 and several of the B.S. programs that have been recently created are listed in our proposal for the B.S. While there are currently no minor programs that we discovered, we expect others will create them as well.

b. “disciplinary trends...” Data science is a rapidly growing field with an increasing demand in industry, research, and government. A recent McKinsey Global Institute study states that the US will face a shortage of about 190,000 data scientists and 1.5 million managers and analysts who can understand and make decisions using big data by 2018. Seventy four percent of the respondents of the recent ‘Peer-Research Big Data Analytics Survey’ have agreed that data science is adding value to their organization and allows vital information for making timely and effective business decisions of great importance. In a recent MIT Sloan Management Review survey, four in ten (43%) companies report their lack of appropriate analytical skills as a key challenge.

c. “comparison to top programs...” Our B.S. program is designed to be similar to the prominent undergraduate program in data science at the Ohio State University. The minor program is designed to allow students in a variety of majors to add on a minor of specialization in Data Science: Computational Analytics. These students will have taken
three key courses: CIS 3715, CIS 4526 and the new CIS 4xxx Data-Intensive and Cloud Computing course. While many of those adding on this minor will be Computer Science majors, other majors include the minimum prerequisites to get a student ready for this minor. These include: Mathematics based majors, Physics based majors, and Engineering based majors. Many other majors are only missing 1 or 2 prerequisites. College of Science and Technology is well positioned to offer this program because it already offers a full range of undergraduate courses necessary for educating data scientists specializing in computational analytics and because it hosts a strong core of professors with research expertise in various aspects of data science. Those two factors will result in a vibrant undergraduate program which will attract talented and ambitious students and teach them the tools to have successful careers in data science.

2. “Relationship...” This program will have relationships between computer science, mathematics, statistics, & science. The Data Science: Computational Analytics minor is two courses short of the Data Science: Computational Analytics minor, and the Data Science: Computational Analytics minor is about nine courses short of the Data Science: Computational Analytics B.S. Students will be able to flow up and down in their commitment to the field.

3. “Curriculum...” See Appendix A for the semester grid of the program. See Appendix B for a detailed analysis of the differences between this program and related programs.
   a. No courses are being created for this program. All of the new courses were already developed.
   b. This is a minor program and does not lead to a degree in and of itself.
   c. The program is only offered on Main campus.

4. “Impact on Faculty & Students...”
   a. The faculty who will be teaching these courses and working with these students in research are already in place.
   b. There is no special admission to the program. The minor will be advertised through our website as well as the university website and print materials. We expect this minor to add 5 students per year.

5. “Impact on Resources...”
   a. There is no special tuition for this program above the regular CST tuition.
   b. NA
   c. We project 5 additional students per year in the minor in addition to the other majors who will be taking the courses as electives.
   d. I see a small long term gain for the college because this is an area that students are looking for.
   e. The faculty are already on board so there will be no space resources needed for them. There are no new classes.
f. 1. There will be miniscule changes in tuition revenue and costs due to the increase in students of 5 per year, but these programs will continue to make Temple an attractive place for study.
   2. One faculty member will get a small amount of release time to develop the capstone course.
   3. NA
   4. NA

6. “Assessment...” The program goals are listed in Appendix C. Assessment will continue as it has before through the Assessment committee of the Computer and Information Science department.

7. See discussion in part 1.

8. “Implementation...”
   a. We would like this program change to begin in Fall 2016.
   b. Continuing students in related programs will be able to continue in their current programs or change to the new program.

10. “Process...” Faculty in a wide variety of CST departments created the program and approved the proposal. Dean Michael Klein, and Mia Luehrmann were consulted. The CST Undergraduate Committee was consulted and unanimously approved the proposal. The CST Dean’s Advisory Committee was consulted and unanimously approved the proposal. The CST Collegial Assembly was consulted and unanimously approved the proposal.
## Appendix A
### Data Science: Computational Analytics BS Semester Sequence Proposal

#### Minimum Prerequisite Path*

<table>
<thead>
<tr>
<th>Term 1 (8 cr.)</th>
<th>Term 2 (8 cr.)</th>
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<tbody>
<tr>
<td>Math 1041 Calculus I (4 cr.)</td>
<td>Math 1042 Calculus II (4 cr.)</td>
</tr>
<tr>
<td>CIS 1068 Program Design &amp; Abstraction (4 cr.)</td>
<td>CIS 1166 Math Concepts in Computing I (4 cr.)*</td>
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<tr>
<th>Term 3 (8 cr.)</th>
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<tr>
<td>Math 2043 Calculus III (4 cr.)</td>
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*This course is required if the student is taking CIS 2166, but not if the student is taking Math 2101 or its equivalents in mathematics.

#### Minor Requirements

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<tr>
<th>Term 1 (6-8 cr.)</th>
<th>Term 2 (8 cr.)</th>
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<tbody>
<tr>
<td>CIS 2033 Computational Prob &amp; Stat (4 cr.) or Math 3031 Probability Theory I (3 cr.) or Stat 2103 Statistical Business Analytics (4 cr.) or BIOL 3312 Biostatistics (3 cr.) CIS 2166 Mathematical Concepts in Computing II (3 cr.) or Math 2101 Linear Algebra (3 cr.) or Math 2103 Linear Algebra with Lab (4 cr.) or Math 3045 Differential Equations with Linear Algebra (4 cr.)</td>
<td>CIS 3715 Principles of Data Science (4 cr.) CIS 2168 Data Structures (4 cr.)</td>
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<th>Term 3 (7 cr.)</th>
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<tr>
<td>CIS 4526 Foundations of Machine Learning (3 cr.)</td>
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<tr>
<td>CIS 4xxx Data-Intensive and Cloud Computing (4 cr.)</td>
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Credits in the minor: 21-23
Appendix B

New Data Science: Computational Analytics Minor

Minimum Prerequisites:
- CIS 1068 (4 cr.) Program Design and Abstraction
- CIS 1166 (4 cr.) Mathematical Concepts in Computing I
- Math 1041 (4 cr.) Calculus I
- Math 1042 (4 cr.) Calculus II
- Math 2043 (4 cr.) Calculus III

Subtotal 12 credits

Minor Requirements:
- CIS 2033 (4 cr.) Computational Prob & Stat or Math 3031 (3 cr.) Probability Theory I or Stat
- 2103 (4 cr.) Statistical Business Analytics or BIOL 3312 (3 cr.) Biostatistics
- CIS 2166 (4 cr.) Mathematical Concepts in Computing II or Math 2101 (3 cr.) Linear
  Algebra or Math 2103 (4 cr.) Linear Algebra with Lab or Math 3045F (4 cr.) Differential
  Equations with Linear Algebra
- CIS 2168 (4 cr.) Data Structures
- CIS 3715 (4 cr.) Principles of Data Science
- CIS 4526 (3 cr.) Foundations of Machine Learning
- CIS 4517 (4 cr.) Data-Intensive and Cloud Computing 4cr

Total 21-23 credits
Comparison to Data Science: Computational Analytics Certificate:

Requirements beyond Data Science: Computational Analytics Certificate (8 additional credits):

- CIS 2168 (4 cr.) Data Structures
- CIS 4517 (4 cr.) Data-Intensive and Cloud Computing 4cr

Requirements needed to complete Data Science: Computational Analytics BS (43-44 additional credits):

- 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)
- Other one of CIS 2166 (4 cr.) Mathematical Concepts in Computing II OR Math 2101 (3 cr.)
  - Linear Algebra or Math 2103 (4 cr.) Linear Algebra with Lab or Math 3045F (4 cr.)
  - Differential Equations with Linear Algebra
- Math 3031 (3 cr.) Probability Theory I
- Math 3031 (3 cr.) Probability Theory II
- CIS 2107 (4 cr.) Computer Systems and Low-Level Programming
- CIS 3223 (3 cr.) Data Structures and Algorithms
- CIS 4331 (4 cr.) Principles of Database Systems 4cr
- ENG 2696 (3 cr.) Program Design and Abstraction
- SCTC xxxx (3 cr.) Advanced Data Visualization
- Elective Course Requirements (9 credits required):