New Degree Program Proposal
Master of Science in Data Science and Strategic Analytics

(This new program will replace the current Master of Science in Computational Science)

Proposal Faculty

Preparation
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Preamble and context

Since 2007, Stockton has offered an undergraduate degree in computational science and an accelerated dual degree BS/MS in computational science. Since January 2010, Stockton has offered an MS in computational science (MSCP) as a standalone degree. The accelerated dual degree required 30 credits at the graduate level to confer the MS portion. The standalone MS degree required 36 credits.

In Fall 2012, the college decided that, due to low enrollments, the undergraduate degree was no longer viable and after a year-long process the program was closed leaving only the standalone MS degree.

A student entering the MSCP program acquires substantial experience in sophisticated computational software and programming tools that allows the student to explore mathematical, computational and data driven problems in science, business, social science, medicine and/or the humanities. Students also develop skills in data analysis, presentation, and visualization, skills that will permit them to visualize results and make predictions. The coursework is supplemented with real world projects and/or internships with industry providing experience and networking opportunities in industry or research. This degree also requires as a prerequisite, advanced skills in mathematics involving, for example, CALC III i.e., the intimate understanding of the solutions of partial differential equations. This prerequisite may have dampened enrollments given its highly advanced nature. In fact, MSCP enrollments have continued to be low throughout its existence.

During the lifetime of the computational science master's program, a new discipline involving data science and analytics grew quite rapidly and labor market demand shifted to that area. This proposal involves replacing the MSCP with a new program in data science and analytics. The working group for this initiative is proposing this new degree in response to the explosive growth of the "big data" industry sector. Stockton is extremely well-positioned to deliver this new degree since the data science curriculum will contain a mix of computational science as well as courses focused on the skills required of a data scientist and analyst. The faculty committee therefore believes that with a relatively painless shift in resources and curriculum restructuring we can deliver this new degree. This new degree program will heavily focus on statistics and data along with a more minor focus on analytical mathematics.

Figure 1: The inter-relationship between computational science and data science.

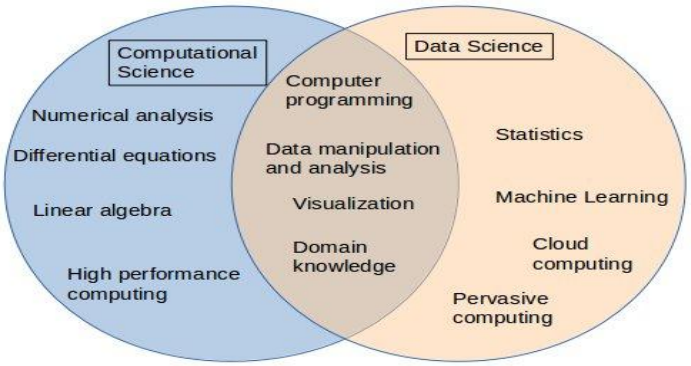
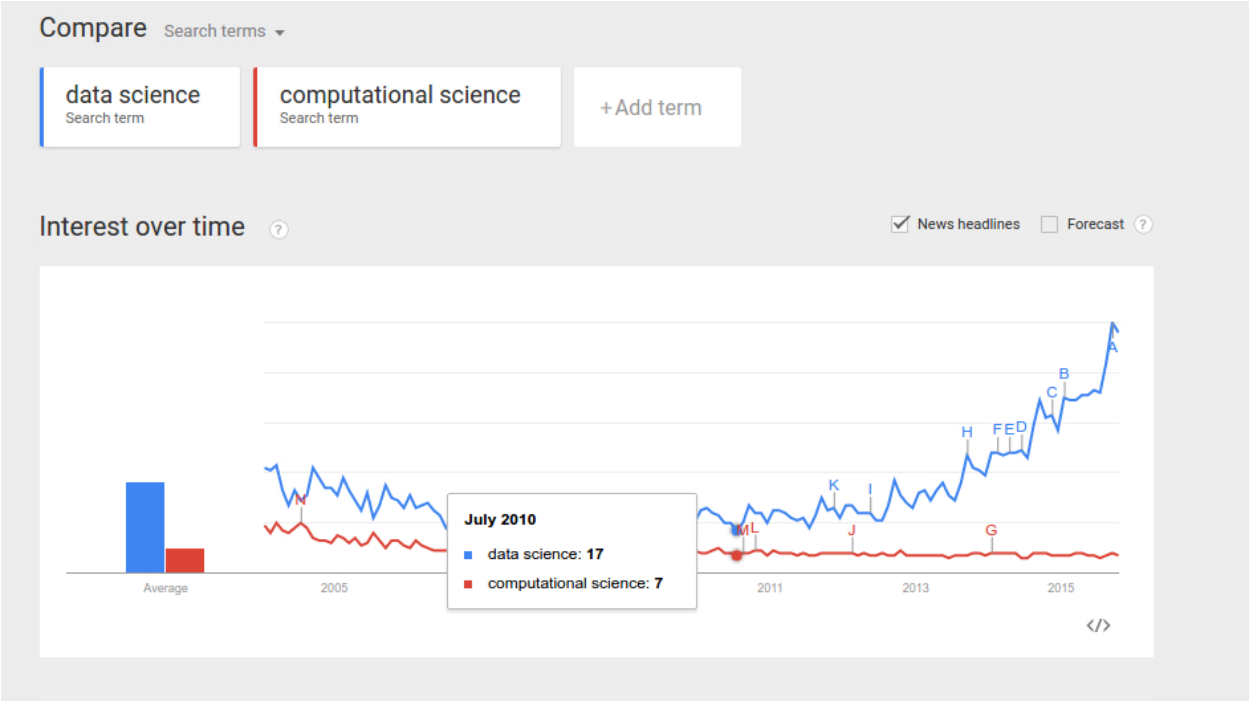


Figure 2: Google trends for the nomenclature "data science" versus "computational science". Google trends graphs plot the y ordinate relative to the maximum within the time window plotted.



Computational Science Transition Plan:

> *Step 1. Sunsetting the Master of Science in Computational Science (MSCP) (closed for applications for fall of 2016) and introducing a new online degree called a Master of Science in Data Science and Strategic Analytics (MS-DSSA)*

(hopefully in the fall term of 2016). Additionally, offering *a* graduate certificate in data science that includes the first five courses in the curriculum (outlined further in section on Degree Requirements).
Step 2. Continued restructuring of the present MSCP curriculum to better reflect the emerging data science industry. This has required eliminating certain courses and introducing new ones. We have already introduced data science courses into the current curriculum because we believe this serves our students better. Therefore some of those courses would remain owing to the overlap of the two disciplines.

Unlike the computational science master's degree, the new data science program will include critical skills such as:

- *acquiring, analyzing and visualizing data;*
- *finding and communicating data stories;*
- *tackling real-world problems through industry partnerships.*

Introduction

> ***"Information is the oil of the 21st century, and analytics is the combustion engine." - Peter Sondergaard, Senior Vice President, Gartner Research.***

In 2013, IBM estimated that two and a half million terabytes of data are created every day. For the layman, this is the equivalent of over 300 million high definition movies. The National Security Agency (NSA) gathers as much information as is stored in the Library of Congress every 6 hours[1]. Ninety percent of the world's data was generated in just the past two years. Data is created by, among others:

1. Individuals (through social networks and smartphones)
2. Machines (through real-time, network connected sensors – "the internet of things")
3. Business and commerce (e.g. transaction records and financial data)
4. Higher Education (e.g. registrations, completion and retention data, faculty workload)
5. Science (e.g. bioinformatics, large scale simulation, personal health records)

Making sense of this vast sea of data for the use and benefit of society is considered an imperative for the coming years, indeed many companies and higher education institutions are already strategizing and restructuring for this "big data" tsunami. Data science has emerged as an interdisciplinary paradigm for developing solutions for gathering, cleaning, archiving, analyzing and visualizing data for the purposes of making informed decisions.

The McKinsey Report on big data starts, "Data have become a torrent flowing into every area of the global economy"[2]. Two of their main summary findings are the following:

- Data have swept into every industry and business function and are now an important factor of production.
- There will be a shortage of talent necessary for organizations to take advantage of big data.

Some examples of data science projects include:

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[1]http://www.popsci.com/technology/article/2011-05/every-six-hours-nsa-gathers-much-data-stored-entire-library-congress

[2]Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., and Byers, A. H. (2011). Big data: The next frontier for innovation, competition, and productivity. Technical report, McKinsey.

Business: Using historical discounting data from a department chain store at two hundred locations to predict how sales vary with department.

Entertainment: Conducting a sentiment analysis on the tweets about summer blockbuster movies and using the data to predict future box office receipts.

History: Developing a geospatial database of conflicts occurring during the Scottish Wars of Independence (1296-1328).

Health: Predicting disease likelihood by exploring and correlating patient case history and genetic databases.

Criminal Justice: Gathering and visualizing real time crime statistics for a city for the sake of efficient resource deployment.

Education: Creating a web-based dashboard for describing student performance metrics across a school district.

Science: Analyzing the jpg images of one million galaxies to categorize them according to their morphology.

Sustainability: Creating a "smart building": a building fitted with sensors collecting data on all aspects of the building's efficiency thus allowing real time adjustments to save energy.

We propose this new degree in response to this exploding "big data" industry sector. Stockton University is extremely well-positioned to deliver such a degree because of existing resources - including faculty (full-time and adjunct), computer equipment, curriculum and courses – within existing schools and programs.

Specifically, we wish to create a Master of Science in Data Science and Strategic Analytics (MS-DSSA) by pooling and re-structuring present Stockton resources (faculty, equipment, courses) to better reflect the emerging data science industry. Students in the existing computational science master's degree program are already being introduced to data science courses. Program faculty felt we had to offer such courses to properly serve our students. Students in the existing degree would be given the choice as to whether they want to complete the MSCP degree or switch to pursuing a MS-DSSA degree.

1. Program Objectives

The primary academic objectives for this proposed new degree program will be the development of high level skills in:

- identifying and defining problems and decisions that can be answered by data
- acquiring, analyzing and exploring data
  - Acquiring: getting, cleaning, archiving, integrating data
  - Analyzing: visually, mathematically, statistically
  - Exploring: seeking trends and patterns
- managing and communicating data narratives (stories) that transform data into actionable information
- exposure to real-world problems through industry partnerships/practicums involving big data.

Upon successful completion of this program, graduates will be well positioned to find employment in the burgeoning data science and analytics industry: indeed, because of industry sponsored practicums, it is possible that many will already be in that industry. This will be an interdisciplinary degree drawing on faculty from various schools (NAMS, ARHU, BUSN, SOBL) and programs (e.g., science, business, computer science, mathematics, digital humanities, psychology) in a similar way to our Professional Science Masters in Environmental Science or the Master of Arts in American Studies.

Though supported by professional standards, the program is not tied to any particular professional certification or accreditation. Data science is an emerging field and as such no specific national accrediting body is currently in place. The Middle States Association of Colleges and Schools is the regional accreditation body for Stockton University and thus all of Stockton's programs. That said, the degree is designed to be cognizant of voluntary external certifications such as the "Certified Analytical Professional" offered through Informs or the "Certified Web Analyst" offered through the Digital Analytics Association. The data science curriculum will provide much (if not all) of the background for these exams. The Data Analytics Association provides the following information to prospective candidates for certification, "Due to the required years of experience in order to be eligible to test for certification, we expect that many web analytics professionals eligible for certification should be able to pass the certification test without taking any courses."

It is also important to note that Stockton is a founding member of the New Jersey Big Data Alliance[3] and will seek opportunities and synergies from that relationship. This alliance brings together universities and colleges from across the state, and has the overarching goals of identifying common challenges and areas of synergy, developing joint programs, and ultimately nucleating an effective alliance that will increase our research competitiveness and drive economic development in New Jersey.

[3] http://rdi2.rutgers.edu/new-jersey-big-data-alliance

2. Evaluation and Learning Outcomes Assessment Planning

The program will conduct learning outcomes assessment on a scheduled basis and report its findings on an annual basis (Graduate Program Director Annual Report and another mechanism to reach the larger Stockton community). We will collect reliable direct and indirect evidence of student learning that will bear upon making improvements in the curriculum, teaching methods and learning outcomes. Overtime, programmatic changes will be based on learning assessment results.

The proposed Master of Science in Data Science and Strategic Analytics will align its curriculum so that it will be consistent with the broad objectives/outcomes in the following Stockton University Essential Learning Outcomes (taken to the graduate level):

- Program Competency…..(integrating concepts, theories and key principles)
- Quantitative reasoning….(working comfortably with numbers and math concepts)
- Critical Thinking……..(formulating effective, balanced perspectives issues and topics)
- Communication Skills…..(sharing ideas and knowledge in various formats)
- Creativity and Innovation.(generating new ideas, processes or products)
- Teamwork/Collaboration..(joining others to achieve common goals)
- Information Literacy…….(finding and using information to solve problems)

These Essential Learning Outcomes will be assessed with a focus on coursework learning outcomes, research project outcomes, data scripting outcomes, testing, conformance to best practices, student portfolios, surveys, class presentations and a variety of evaluations.

Evaluation and Assessment

The Data Science and Strategic Analytics faculty will follow the assessment standards for graduate education.

The program faculty will assess the intellectual development and affective dispositions of students through various formative and summative means at the course level and at the program level. A mixed-method program assessment approach will employ direct and indirect assessment measures and will be used to inform pedagogical, structural, and learning outcome modifications as the program matures.

<u>Indirect Measures</u>

From the outset the program will use IDEA group summary reports to assess the alignment of essential and important objective with the stated objectives of the program. Additionally the IDEA group summary reports will allow for a review of students' perception of their progress, the rigor of the courses, and the pedagogy that faculty used in comparison to the interdisciplinary and college norms. All data science graduates will complete an exit survey to assess both the processes

and the outcomes of their courses and their interactions with faculty and fellow students. Other indirect measures such as surveys, interviews, and aggregate reports on retention, graduation, and placement will be utilized.

Direct Measures

With rigorous intellectual engagement of students as a primary consideration, the data science program will review all students' final projects as well as assessing actual samples of student work during the progress of the course. As noted above, exams/tests, papers, projects, presentations, portfolios, etc. will capture what students actually learn and their mastery of these skills. All projects will be assessed according to a standard rubric and each course will conclude with a multiple choice skills assessment test to ascertain level of competency achieved.

Process Assessments

The Graduate Program Director of the data science program will conduct appropriate process assessments (especially that of student feedback) to fine-tune the operation of the DSSA program and will use this feedback to make appropriate adjustments to classroom and assignment practices. Evaluation and assessment of the program will follow similar processes used in other Stockton graduate programs including assessment in all courses per the instructor's particular means of assessment. Mid-term course assessment will be conducted as advocated by Stockton's Institute for Faculty Development.

Summative evaluations will include surveys of continuing and graduating students that will be conducted each year, along with faculty evaluations and input from a program faculty academic committee that will be established. This committee will overview curriculum and the admissions process. A focus group approach will be conducted each year with graduating students and one year alumni. The focus groups will determine student opinions on the curriculum and courses and on course delivery. The alumni will be able to tell us how well they were prepared for industry.

Formative assessment will include student coursework utilizing assignment completion submissions and portfolio reviews. Faculty will meet once a year to review student progress and quality. In addition, the program will undergo the yearly reporting process via Graduate Program Director Annual Reports and a five year review of the program will include an external consultant from a university similar to ours. We will work closely with the Stockton University Director of Academic Assessment on how to adopt the most valuable protocols for the new program.

Consistent with the program objectives described in section one, the program goals (which include core competencies and technical skills) include:

At the end of this program, students will be able to ……

- define problems to be addressed through data analysis
- gather data from a variety of public and private sources including web-mining and database interrogation.
- harmonize, rescale, clean, parse and convert data files to and from any data format.
- analyze data for patterns and trends.
- find and test predictive models that describe data.
- create meaningful descriptive data visualizations.
- creatively, innovatively, and entrepreneurially design data driven solutions.
- communicate data stories verbally and in writing.
- build teams and collaborative networks.

Although students will undoubtedly learn other technologies (e.g. Excel, HTML, CSS, JavaScript, D3) within this master's degree they will become expert in the following technologies since these are pervasive in the data science industry:

- an operating system of choice for data science (initially this would be Linux)
- a high level scripting language for quantitative data manipulation and visualization (initially Python)
- a high level programming tool for statistics and machine learning (initially R or SAS)

3. Relationship to Institutional Strategic Plan and Impact on its own Offerings

The creation of the master's degree in data science and strategic analytics is consistent with the Graduate Education Mission Statement: “Stockton University provides quality graduate programs which promote advanced inquiry and application of new knowledge, foster advanced level career opportunities, and transmit our intellectual and cultural heritage in all its diversity…Through accessible graduate education, the College responds to the State and regional needs.”

In keeping with Stockton’s mission-specific commitment to “insisting on breadth, as well as depth, in our curriculum,” this interdisciplinary program will advance knowledge and skills both within the field of data science and analytics and across different domain knowledge fields of application through industry partnered internships and project work. The interdisciplinary curriculum resonates with Stockton’s historical interdisciplinary design. Specifically, one of the objectives of Stockton’s 2020 Strategic Plan calls upon the University to “deliver high-value learning experiences”.

The proposed Master of Science in Data Science and Strategic Analytics is consistent with the four themes of Stockton’s strategic plan. The four themes include Learning (high quality impactful courses), Engagement (industry practicums, corporate partnering), Global Perspectives (global data science such as climate change, water issues, etc.) and Sustainability (data induced efficacies in a variety of environmental settings).

Finally, as indicated in the Program Objectives section, the proposed MS-DSSA utilizes the broad objectives/outcomes of Stockton University's Essential Learning Outcomes and is aligned with the Graduate Education Mission Statement which includes a focus on graduate programs which promote advanced inquiry, application of new knowledge, and which fosters advanced-level career opportunities.

This degree will be attractive and valuable for graduating seniors in Computer Science, the Sciences, Business and the digital Humanities. It is envisaged that undergraduate students in these degree programs will be advised as per Stockton policy to take two of the courses in this masters in their senior year and thus garner a head start on their graduate degree.

This graduate degree offers potential synergies with Stockton's current undergraduate Computer Science and Information Systems and Business Studies programs. For example, the Association for Computing Machinery's "IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems" lists business intelligence and more specifically business analytics as a foundational information systems (IS) topic. Likewise, several foundational elements of data science are core components of computer science (CS), including data structures, as well as the basics of machine learning within an artificial intelligence course.

4. Need

The McKinsey Report[2] suggests that by 2018 in the USA the data science industry "...faces a shortage of 140,000 to 190,000 people with deep analytical skills as well as 1.5 million managers and analysts to analyze big data and make decisions based on their findings." A search of any of the large job websites (such as simplyhired.com) reveals hundreds of current openings in data science.

In terms of compensation the best study has been done by Burtch Works Executive Recruiting and has been documented in their report, "Data Science Salary Study" in 2014. It suggested that,

> Data scientists who are managers make considerably more than those who are individual contributors, but for both, compensation increases significantly with scope of responsibility and years of experience. The median base salary increases from $80,000 for level 1 individual contributors to $150,000 for those at level 3, while it increases from $140,000 for a level 1 manager to $232,500 for a level 3 manager. While 63% of level 1 individual contributors are eligible for a bonus and earned a median bonus of $11,100, 69% of those at level 3 are eligible and earned a median bonus of $40,000. Among managers at level 1, 63% are eligible for a bonus and earned a median bonus of $23,600, while 100% of those at level 3 are eligible and earned a median bonus of $82,500. [4]

[4] http://www.burtchworks.com/big-data-analyst-salary/big-data-career-tips/

In terms of the current economy in Atlantic County, and particularly Atlantic City, there is need for data scientists at the Federal Aviation Administration and some opportunity for employment in the healthcare, education, finance and casino related industries, however the faculty preparing this paper wish to emphasize that local employment in this field is limited and this degree should not be marketed nor should student recruitment be driven by local industries. This will be a fully online degree to attract students throughout the state and region.

5. Students

Enrollment projections

The DSSA program would like to attract a sustainable enrollment with an upper limit of 25 per cohort each fall.

Students with prerequisite knowledge and experience with descriptive statistics, college algebra, data processing/analysis, computer and mathematical skills will make up the vast majority of applications and enrollments. However, students with prerequisite knowledge in biology may seek enrollment in order to pursue careers in bioinformatics.

A market demand survey was launched in early September 2015 to 12,000 potential respondents. The individuals surveyed were selected Stockton alumni and undergraduate students of Stockton University. 434 valid responses were collected. The information from the survey is in the table below:

Master of Science in Data Science and Strategic Analysis
Market Demand Survey Results

Questions	***# of Total and Category Responses***	***Results***
1. Would you be interested in attending a Master of Science Graduate Degree in Data Science and Strategic Analytics?	434	Yes--68% No—32%
2. What is your present student and employment status? Check all that apply.	Total=284 Category = 270	Stockton Alumnus--51% Undergraduate/Stockton--34% Other--10%
	Total =284 Category = 178	Employed Full time—45% Employed Part Time—15% Not employed--6%
3. Location of permanent residence?	282	South Jersey—68% Central Jersey—18% Other—15%
4. Preferred Class Format? Check as many as you wish.	Total = 280 Category = 226	Two classes per semester—hybrid--31%
		Two classes per semester—online--26%
		Two classes per semester—F to F--24%

	Total = 280 Category = 139	One classes per semester—online--19%
		One classes per semester—hybrid--18%
		One classes per semester—F to F--13%
	Total = 280 Category =151	7 week accelerated sessions, one class per session—online—15%
		7 week accelerated sessions, one class per session—hybrid—13%
		7 week accelerated sessions, one class per session—F to F—13%
		7 week sessions, two classes per session--online only--13%
5. If you chose face to face or hybrid class formats, when would you like to attend class? Check as many as you wish.	239	Evenings—65% Saturdays—36% Mornings—29% Afternoons—17%
6. What are the three most important factors in your choice of a master's degree program? Check as many as you wish.	268	Cost of Tuition/fees—81% Flexible Scheduling—60% Course Content—54% All other responses were below 20%
7. What was your undergraduate major?	244	Sciences—52% (Natural, Social, Computer and Health) Business—41% All Others—7%

The data from this survey clearly shows prospective student interest in the program. Hybrid and online courses are favored. Accelerated coursework formats are a possibility and could be introduced after additional surveying is completed with matriculated students. Furthermore, we expect to see applications from individuals currently working within a wide variety of economic sectors and industries in the region (and possibly beyond) due to the interest in data science and data-driven decision making across many economic sectors. The responses received from particular "majors" is aligned with the type of students we are seeking to matriculate into the data science program. Of particular note is that the largest influencing factor in choosing a graduate program is cost (at 81%). We believe that we are beginning to address this by offering the degree as 30 credits over one calendar year.

6. Program Resources

A. Faculty

Since the proposed program is interdisciplinary in scope, it is important to include faculty who represent the different employer types included in the program which include, but are not limited to business, healthcare, education, government, science, engineering and humanities. "Lead" faculty in the Master of Science in Data Science and Strategic Analytics program would be expected to hold a terminal degree in data science or a related field (e.g. Ph.D.). Due to the crucial industrial and applied aspects of the proposed program, it is necessary to involve professional and/or adjunct (affiliated) faculty who are current leaders in the various organizational types included in the program. Per college policy, these current leaders will possess a master's degree at a minimum along with relevant, applied experience. Current data scientists and practitioners will also be included as guest lecturers or speakers. Stockton has specific teaching, research, and service requirements for faculty based on rank. Faculty members are expected to meet or exceed these requirements. This new program will not require any new full-time faculty lines, at least in its initial stages. Faculty at Stockton have already expressed an interest in teaching in this degree. These faculty will need a release from current program and general studies teaching or would need to teach as overload (as is currently the practice in support of many of our graduate programs). Fortunately, we also have two excellent adjuncts with appropriate credentials and experience who have committed to teach in the new program (see front page). The faculty supporting the DSSA degree will be able to help the computational science student complete their master's degree. Data Science courses can be used as substitutes for Computational Science courses.

Although "big data" has exploded most rapidly in the business, marketing and healthcare sectors, data science is a pervasive discipline, and therefore it is crucial that the proposed program is interdisciplinary in scope. It is important that its delivery and administration is shared among schools and includes faculty with relevant, applied experience who represent the different "data using" organization types that the degree serves. Current leaders will also be included as guest lecturers or speakers.

B. Equipment, Materials, Library

Based on the nature of the program, we anticipate no additional physical resources beyond the current Stockton Campus and Off-Campus facilities. We plan to utilize the resources and expertise offered by the Office of E-Learning and the Office of Computer Services. These offices will continue to support the online components of this program as they have already being doing for the MSCP. Blackboard will be utilized extensively. The data science industry makes extensive use of open license and open source materials; the largest user base is in Linux, Python and R which are all free to use. Our courses will all be based on open license software.

In terms of library support, the college library has significant holdings in computer and computational studies. Data science is an emerging discipline and so it draws from a variety of existing resources. These include both print and internet sources. In addition, faculty will subscribe to online journals and reviews, as well as blogs. We do not anticipate significant additional resources to be needed either in equipment or software to support this program.

C. Accreditation

Regional accreditation will continue as per the Middle States Association Commission on Higher Education. No specialized accreditation is currently required or will be sought for this program, however this may change as the industry/discipline matures.

7. Degree Requirements

The Master of Science in Data Science and Strategic Analytics (MS-DSSA) will be a 30-credit online master's degree. A graduate certificate in data science that includes the first five courses in the curriculum will also be offered to those who wish to have some data science at their command. The graduate certificate would require a student to be matriculated. As with academic minors, certificates allow students to acquire some of the knowledge and skills of the discipline without committing to a complete degree. It is anticipated that on completion of a certificate some of the students may go on to complete the degree.

Curriculum/Delivery

It is proposed that this self-standing master's degree program will consists of 30 credit hours (10 required graduate courses) that may be completed in full-time or part-time study. Our current plan is to offer this degree online, in a series of "intensive" 7-week courses (using the subterm A and subterm B structure at Stockton). It is recommended that the courses be offered in three consecutive semesters (Fall, Spring, Summer) resulting in a degree awarded within one calendar year. The complete curriculum and the ideal sequence shown in table 1. Note that even part-time students can benefit from the three semester sequence as courses are always running. Graduate students tend not to want the same summer breaks as undergraduates. Master's degree students are

bound by the academic progress requirements of the College's graduate school, covered in the Graduate *Bulletin*.

The program will work closely with the office of e-Learning and the faculty for this program will work with a common online structure. All 10 courses will have a similar online structure and/or "look and feel" to make the student experience an "integrated" experience, instead of ten courses that are merely "co-located".

Table 1: Curriculum and ideal sequence of courses (accelerated 7-week course structure model)

Course	Description	Sequence
REQUIRED CORE COURSES [These five courses also constitute the certificate]		
DSSA 5001 Introduction to data science and analytics	A survey course introducing the student to the field of big data. Various application areas will be studied along. Basic introduction to data gathering, analysis and visualization. Introduction to tools and technologies. Overview of cybersecurity.	Fall: subterm A
DSSA 5101 Data structures and exploration	Manipulating and cleaning datasets; storing data in appropriate data structures. Techniques for exploring large datasets introduced. Extensive use of industry standard software tools and operating systems/scripting languages.	Fall: subterm A
DSSA 5102 Data gathering and warehousing	Gathering data from public and private databases. Database and web mining. Structured and unstructured database usage. Extensive use of industry standard software tools and operating systems/scripting languages. Data security.	Fall: subterm B
DSSA 5103 Data Visualization	Interactive visualization of large datasets. Visualization delivery by web interface. Emphasis on integrity, parsimony and aesthetics of data representation. Extensive use of industry standard software tools and operating systems/scripting languages.	Fall: subterm B

DSSA 5104 Data Analysis and Operations Research	Data analysis using various techniques including mathematical modeling, statistical and stochastic analysis, and mathematical optimization to find at optimal or near-optimal solutions to complex data driven problems. Extensive use of industry standard software tools and operating systems/scripting languages	Spring: subterm A
ADVANCED COURSES (MUST TAKE DSSA 5201 + TWO OTHERS)		
DSSA 5201 Machine Learning	Machine learning is a branch of computational science that develops codes, algorithms and systems that are able to train themselves to automate tasks usually based on large acquired data sets. Pattern recognition and statistical algorithms will be covered.	Spring: subterm A or B
DSSA 5202 Case Studies in Analytics	Using case studies from multiple domains, students will explore the process of analytics from problem framing, application of analytics techniques, obtaining data, methodology selection, model building and deployment, and model life cycle management.	Spring: subterm A or B
DSSA 5203 Financial Modeling with Analytics	Students will learn about quantitative methods and their computer implementation in finance and financial econometrics. Topics covered will include methods such as portfolio management, risk management, asset valuation, and financial instruments.	Spring: subterm A or B
DSSA 5204 Pervasive Computing	Students will learn to write applications and codes for uniquely identifiable computer-like devices (e.g. phones, smartpads, raspberry pis, Intel edisons etc). Application design, build and deployment will be considered.	Spring: subterm A or B
DSSA 5205 Applied Cloud Computing	Students will learn how to deploy applications and leverage resources in the cloud. Current cloud architectures will be used as platforms (e.g. Google App Engine and Amazon Web Services).	Spring: subterm A or B

REQUIRED CAPSTONE EXPERIENCE		
DSSA 5301 Communicating Data Stories	Creating a narrative with data. Covers selection, refinement, analysis and visualization with data. Data journalism. Data rhetoric and modes of communication.	Summer
DSSA 5302 **Data Practicum**	Student will work with an industry sponsor and faculty member to solve a real data science problem using techniques learned in previous courses. Communicating results and practical aspects of working in industry will be emphasized.	Summer II