MICHIGAN STATE UNIVERSITY
University Committee on Curriculum

SUBCOMMITTEE A – AGENDA

437 Administration Building
TUESDAY, April 16, 2019
1:30 p.m.

PART I – NEW ACADEMIC PROGRAMS AND PROGRAM CHANGES

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

1. Request to change the requirements for the **Bachelor of Science** degree in **Animal Science** in the Department of Animal Science.

The concentrations in the Bachelor of Science degree in Animal Science are noted on the student's academic record when the requirements for the degree have been completed.

*The concentration in **Production Animal Scholars** will no longer be available. Students who have not completed the requirements for this concentration by Fall 2021 will have to switch to a different concentration.*

a. Under the heading **Requirements for the Bachelor of Science Degree in Animal Science** replace the entire entry with the following:

The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 120 credits, including general elective credits, are required for the Bachelor of Science degree in Animal Science.

The University's Tier II writing requirement for the Animal Science major is met by completing one of the following courses: Animal Science 301, 314, or 409. Those courses are referenced in item 3. below.

Students who are enrolled in the Animal Science major leading to the Bachelor of Science degree in the Department of Animal Science may complete an alternative track to Integrative Studies in Biological and Physical Sciences that consists of the following courses: Biological Science 161 and 171, Chemistry 141, and Chemistry 143 or 251. The completion of Biological Science 171 satisfies the laboratory requirement. Biological Science 161 and 171, Chemistry 141, and Chemistry 143 or 251 may be counted toward both the alternative track and the requirements for the major referenced in item 3. below.

The completion of the College of Agriculture and Natural Resources mathematics requirement may also satisfy the University mathematics requirement.

The requirements of the College of Agriculture and Natural Resources for the Bachelor of Science degree.

Certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

The following requirements for the major:

				CREDITS
a.	All of the following courses (21 credits):			
	ANS	101	Professional Development in Animal Science I	1
	ANS	110	Introductory Animal Agriculture	3
	ANS	110L	Introductory Animal Agriculture Laboratory	1
	ANS	210	Introduction to Disciplines in Animal Agriculture	3
	ANS	301	Professional Development in Animal Science II (W)	3
	ANS	401	Issues in Animal Agriculture	1
	BS	161	Cell and Molecular Biology	3
	BS	171	Cell and Molecular Biology Laboratory	2
	CEM	141	General Chemistry	4
b.	One of the following courses (3 or 4 credits):			
	STT	200	Statistical Methods	3
	STT	201	Statistical Methods	4
	STT	231	Statistics for Scientists	3
	STT	421	Statistics I	3
	STT	464	Statistics for Biologists	3
c.	One of the following courses (3 or 4 credits):			

	CEM	143	Survey of Organic Chemistry	4
	CEM	251	Organic Chemistry I	3

d. Two of the following introductory species management courses (3 credits):

ANS	201	Animal Products	3
ANS	222	Introductory Beef Cattle Management	3
ANS	232	Introductory Dairy Cattle Management	3
ANS	242	Introductory Horse Management	3
ANS	252	Introduction to Management of Avian Species	3
ANS	262	Introductory Sheep Management	3
ANS	272	Introductory Swine Management	3
ANS	282	Companion Animal Biology and Management	3

e. A minimum of 14 credits from the following introductory discipline courses: (14 to 16 credits):

ANS	305	Applied Animal Behavior	3
ANS	305L	Applied Animal Behavior Laboratory	1
ANS	307	Animal Reproduction	3
ANS	309	Animal Health and Disease Management	3
ANS	313	Principles of Animal Feeding and Nutrition (W)	4
ANS	314	Genetic Improvement of Domestic Animals	4
ANS	315	Anatomy and Physiology of Farm Animals	4
ANS	407	Food and Animal Toxicology	3

f. One of the following advanced management courses (3 credits):

ANS	422	Advanced Beef Cattle Feedlot Management	3
ANS	432	Advanced Dairy Cattle Management	3
ANS	442	Advanced Horse Management	3
ANS	472	Advanced Swine Management	3
ANS	482	Advanced Companion Animal Management	3
FSC	432	Food Processing: Dairy Foods	3
FSC	433	Food Processing: Muscle Foods	3

g. A minimum of 2 credits in experiential learning (2 to 6 credits):

ANS	300A	Advanced Livestock Judging	2
ANS	300C	Advanced Dairy Cattle Judging	2
ANS	300D	Advanced Horse Judging	2
ANS	300E	Animal Welfare Judging	2
ANS	300F	Advanced Dairy Farm Evaluation	2
ANS	480	Animal Systems in International Development	3
ANS	492	Undergraduate Research in Animal Science	3
ANS	493	Professional Internship in Animal Science	3

A minimum of 2 credits in a department-approved Education Abroad program. 2 to 6

h. One of the following concentrations (23 to 33 credits):

Animal Industry (20 to 23 credits):

1. Both of the following course (5 credits):

ANS	201	Animal Products	3
CSS	110	Computer Applications in Agronomy	2

ANS 201 may not be used to fulfill requirement 3. d. above.

2. One of the following courses (3 credits):

ABM	100	Decision-making in the Agri-Food System	3
ABM	130	Farm Management I	3

3. One of the following advanced management courses (3 credits):

ANS	422	Advanced Beef Cattle Feedlot Management	3
ANS	432	Advanced Dairy Cattle Management	3
ANS	442	Advanced Horse Management	3
ANS	472	Advanced Swine Management	3
ANS	482	Advanced Companion Animal Management	3
FSC	432	Food Processing: Dairy Foods	3
FSC	433	Food Processing: Muscle Foods	3

Courses used to fulfill this requirement may not be used to fulfill requirement 3. f. above.

4. A minimum of 9 credits from the following courses (9 to 12 credits):

ANS	211	Animal and Product Evaluation	3
ANS	305	Applied Animal Behavior	3
ANS	305L	Applied Animal Behavior Laboratory	1
ANS	307	Animal Reproduction	3
ANS	309	Animal Health and Disease Management	3

	ANS	404	Introduction to Quantitative Genetics	3
	ANS	407	Food and Animal Toxicology	3
	ANS	409	Problems, Controversies and Advancements in Reproduction (W)	4
	ANS	413	Non-Ruminant Nutrition	4
	ANS	418	Animal Agriculture and the Environment	3
	ANS	425	Animal Biotechnology	3
	ANS	435	Mammary Physiology	4
	ANS	445	Equine Exercise Physiology	4
	ANS	455	Avian Physiology	4
	ANS	483	Ruminant Nutrition	3

Courses used to fulfill this requirement may not be used to fulfill requirement 3. e. above.

Animal Biology and Preveterinary (32 to 39 credits):

1. All of the following courses (11 credits):

BS	162	Organismal and Population Biology	3
BS	172	Organismal and Population Biology	2
CEM	161	Chemistry Laboratory I	1
CEM	252	Organic Chemistry II	3
CEM	255	Organic Chemistry Laboratory	2

2. One of the following courses (4 credits):

BMB	200	Introduction to Biochemistry	4
BMB	401	Comprehensive Biochemistry	4

3. A minimum of 9 credits from the following courses (9 to 12 credits):

ANS	404	Introduction to Quantitative Genetics	3
ANS	409	Problems, Controversies and Advancements in Reproduction (W)	4
ANS	413	Non-Ruminant Nutrition	4
ANS	418	Animal Agriculture and the Environment	3
ANS	425	Animal Biotechnology	3
ANS	427	Environmental Toxicology and Society	3
ANS	435	Mammary Physiology	4
ANS	445	Equine Exercise Physiology	4
ANS	455	Avian Physiology	4
ANS	483	Ruminant Nutrition	3

4. A minimum of 8 credits from the following courses (8 to 12 credits):

IBIO	313	Animal Behavior	3
IBIO	341	Fundamental Genetics	4
MMG	301	Introductory Microbiology	3
MMG	302	Introductory Laboratory for General and Allied Health Microbiology	1
MMG	409	Eukaryotic Cell Biology	3
PHM	450	Introduction to Chemical Toxicology	3
PHY	231	Introductory Physics I	3
PHY	232	Introductory Physics II	3
PHY	251	Introductory Physics Laboratory I	1
PHY	252	Introductory Physics Laboratory II	1

Companion and Exotic Animal Biology (30 to 33 credits)

1. All of the following courses (17 credits):

ANS	482	Advanced Companion Animal Management	3
BS	162	Organismal and Population Biology	3
BS	172	Organismal and Population Biology Laboratory	2
CEM	252	Organic Chemistry II	3
CEM	255	Organic Chemistry Laboratory	2
IBIO	328	Comparative Anatomy and Biology of Vertebrates	4

ANS 482 cannot be used to fulfill requirement 3. f. above.

2. One of the following courses (4 credits):

BMB	200	Introduction to Biochemistry	4
BMB	401	Comprehensive Biochemistry	4

3. A minimum of 9 credits from the following courses (9 to 12 credits):

ANS	305	Applied Animal Behavior	3
ANS	305L	Applied Animal Behavior Laboratory	1
ANS	307	Animal Reproduction	3

ANS	309	Animal Health and Disease Management	3
ANS	313	Principles of Animal Feeding and Nutrition (W)	4
ANS	314	Genetic Improvement of Domestic Animals	4
ANS	315	Anatomy and Physiology of Farm Animals	4
ANS	404	Introduction to Quantitative Genetics	3
ANS	407	Food and Animal Toxicology	3
ANS	409	Problems, Controversies and Advancements in Reproduction (W)	4
ANS	413	Non-Ruminant Nutrition	4
ANS	418	Animal Agriculture and the Environment	3
ANS	425	Animal Biotechnology	3
ANS	427	Environmental Toxicology and Society	3
ANS	435	Mammary Physiology	4
ANS	445	Equine Exercise Physiology	4
ANS	455	Avian Physiology	4
ANS	483	Ruminant Nutrition	3
IBIO	313	Animal Behavior	3
IBIO	341	Fundamental Genetics	4
IBIO	355	Ecology	3
IBIO	369	Introduction to Zoo and Aquarium Science	3

Courses used to fulfill this requirement may not be used to fulfill requirement 3. e. above.

Effective Fall 2019.

2. Request to change the requirements for the **Bachelor of Science** degree in **Nutritional Sciences** in the Department of Food Science and Human Nutrition.

The concentrations in the Bachelor of Science degree in Nutritional Sciences are noted on the student's academic record when the requirements for the degree have been completed.

a. Under the heading **Requirements for the Bachelor of Science Degree in Nutritional Sciences** make the following changes:

(1) In item 3. b. under the **Biomedical and Molecular Nutrition** concentration, make the following changes:

(a) In item (7) delete the following course:

IBIO	408	Histology	4

Add the following courses:

IBIO	450	Cancer Biology (W)	3
MMG	451	Immunology	3
PHL	344	Ethical Issues in Healthcare	4
PSY	333	The Neurobiology of Food Intake and Overeating	3

(2) In item 3. b. under the **Global Nutrition and Health** concentration, make the following changes:

(a) Change the total credits from '42 to 47' to '42 to 49'.

(b) In item (1) change the credits from '23' to '17' and delete the following courses:

CSUS	215	International Development and Sustainability	3
SOC	362	Developing Societies	3

(c) In item (3) change the credits from '2 to 4' to '2 or 3' and delete the following courses:

ANP	370	Culture, Health, and Illness	3
COM	391	Topics in Verbal, Intercultural, or Gender Communication	4
GSAH	230	Values, Experience, and Difference in Global Contexts	3

(d) Renumber item (7) to item (8) and replace with the following:

Two of the following courses (6 to 8 credits):

ANP	270	Women and Health: Anthropological and International Perspectives	3
ANP	370	Culture, Health, and Illness	3
CSS	431	International Agricultural Systems	3
CSUS	215	International Development and Sustainability	3
CSUS	463	Food Fight: Politics of Food	3
EEM	260	World Food Population and Poverty	3
GEO	235	Geography of Environment and Health	3
GEO	435	Geography of Health and Disease	3
GLG	446	Ecosystems Modeling, Water and Food Security	3
GSAH	230	Values, Experience, and Difference in Global Contexts	3
MC	337	Global Public Health	4
MC	430	Applied International Development	4
PHL	452	Ethics and Development	3
PHL	453	Ethical Issues in Global Public Health	3
SOC	161	International Development and Change	3
SOC	362	Developing Societies	3

A course used to fulfill requirement (7) in this concentration may not be used to fulfill this requirement.

(e) Add the following item (7):

One of the following courses (3 or 4 credits):

CSUS	215	International Development and Sustainability	3
MC	430	Applied International Development	4
SOC	161	International Development and Change	3
SOC	362	Developing Societies	3

(3) In item 3. b. under the **Public Health Nutrition** concentration, make the following changes:

(a) Change the total credits from ’40 to 43’ to ’40 to 44’.

(b) In item (5) change the total credits from ‘6 or 7’ to ‘6 to 8’ and delete the following course:

EPI	240	Epidemiological Investigations in Nutrition and Health	3

Add the following courses:

CSUS	463	Food Fight: Politics of Food	3
MC	337	Global Public Health	4

Effective Fall 2019.

3. Request to change the requirements of the **Bachelor of Science** degree in **Packaging** in the School of Packaging.

The concentrations in the Bachelor of Science degree in Packaging are noted on the student's academic record when the requirements for the degree have been completed.

a. Under the heading **Requirements for the Bachelor of Science Degree in Packaging** make the following changes:

(1) Replace item 1., paragraph two, with the following:

The University's Tier II writing requirement for the Packaging major is met by completing Packaging 485. That course is referenced in item 3. below.

(2) In item 3. a. make the following changes:

(a) Change the total credits from '57' to '55'.

(b) Delete the following courses:

PKG	485	Packaging Development	3
PKG	486	Packaging Senior Capstone (W)	3

Add the following course:

PKG	485	Packaging Development (W)	4

Effective Summer 2020.

COLLEGE OF ENGINEERING

1. Request to establish a **Bachelor of Science** degree in **Computational Data Science** in the Department of Computer Science and Engineering. The University Committee on Undergraduate Education (UCUE) recommended approval of this request at its February 21, 2019 meeting.

a. **Background Information:**

Data science is an interdisciplinary field whose purpose is the extraction of actionable insights from data in its many forms. Data science employs theories and techniques drawn from various disciplines, including statistics, mathematics, computer science, and information science. Working data scientists use computational and analytical skills to do many things: to integrate, process, and interpret data from rich and diverse sources, or from large and potentially distributed data sets; to build mathematical models that can infer meaningful relationships in the data and can in turn be used for interpretation and prediction purposes; to create visualizations to aid in the understanding of their data and models; and to communicate their findings and insights to a variety of audiences so that decisions can be made and actions taken. Given the exponential increase in the size and complexity of datasets in virtually all industries, there is a rapidly growing demand for students with these skills (see, e.g., *https://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century and https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation*).

A practicing data scientist needs these skills to have a long and successful career and additionally must learn to think critically about the process of understanding and interpreting data. It is impractical for individual students to acquire all of the requisite skills using existing majors at Michigan State University, and a challenge to students and advisors alike is to determine the educational experiences that will be most important in maximizing their long-term job prospects. As a result, the Department of Computer Science and Engineering, working with the Departments of Statistics and Probability, and Computational Mathematics, Science and Engineering, proposes a new degree program, a Bachelor of Science in Computational Data Science. This major will provide students with an understanding of, and practical experience with, the key aspects of computer science, information science, statistics, and mathematics that are required to manipulate, analyze,

and visualize large and complex datasets. The program will emphasize the algorithmic concepts necessary to build software systems for these operations. Additionally, students in this major will learn to think critically about the data and processes they are working with and to communicate their analysis and results to a variety of audiences.

The degree program is based on courses administered by the Department of Computer Science and Engineering, the Department of Computational Mathematics, Science and Engineering, and the Department of Statistics and Probability. Due to the different needs of the student populations in the Colleges of Natural Science and Engineering, there is a plan to offer two related, but different, bachelor's degrees – a Bachelor of Science in Computational Data Science led by the Department of Computer Science and Engineering in the College of Engineering and a Bachelor of Science in Data Science led by the Department of Computational Mathematics, Science and Engineering in the College of Natural Science. The Departments of Computer Science and Engineering, Computational Mathematics, Science and Engineering, and Statistics and Probability each have faculty with unique expertise that is required to create these degree programs and sharing core courses will ensure that all three departments have a strong stake in the success of implementing, maintaining, and improving both degree programs.

Data science is rapidly becoming a popular program at many institutions. There are more than 100 active Data Science degree programs worldwide. Example programs include a B.S. degree in Data Analytics at Ohio State University and the B.S. and B.A. degrees in Data Science at the University of Rochester. The concept of multiple/parallel degree programs that share a common core has numerous precedents. The University of Michigan offers two B.S. degrees in Data Science, one administered by Statistics in the College of Literature, Science, and the Arts and the other administered by the Department of Electrical Engineering and Computer Science in the College of Engineering. Pennsylvania State University offers a B.S. in Data Science with specializations in Applied Data Sciences, Computational Data Sciences, and Statistical Modeling Data Sciences, each administered by a different department.

Michigan State University is an ideal setting to create a new degree in data science. There are faculty in several departments, such as Computer Science and Engineering (CSE) and Statistics and Probability (STT), whose research expertise lie in aspects of the computational and mathematical algorithms that are key to data science - in statistical analysis, machine learning, database systems, data mining, information retrieval, network analysis, signal processing, computer vision, and high performance computing - and MSU has been aggressively hiring faculty that apply these techniques to applications in a wide range of subject areas. This is further exemplified by the creation of the new Department of Computational Mathematics, Science and Engineering, which explicitly brings together faculty whose interests are in the algorithms and applications of computational modeling and data science techniques, as well as the Social Science Data Analytics initiative, which applies the tools of data science to topics outside of the traditional STEM fields. Additionally, several relevant courses in data science-related subjects have already been developed in these units, providing a base upon which to build a degree program.

There is significant student demand for these skills: MSU students have self-organized into an MSU Data Science student organization (see *http://msudatascience.com/*; this organization sees approximately 100 attendees at its events) and has been inviting speakers, hosting workshops, and distributing job postings to its members. Data Science-related elective offerings in the Department of Computer Science and Engineering are in high demand. These institutional trends support the creation of a degree in data science and ensure that the resources to maintain a thriving degree program will continue to exist far into the future.

b. **Academic Programs Catalog Text:**

The Bachelor of Science degree in Computational Data Science focuses on the computational foundations of data science, providing an in-depth understanding of the algorithms and data structures for storing, manipulating, visualizing, and learning from large data sets. Students in the program have unique access to a wide range of fundamental computer science courses in topics ranging from mobile application and web development to theory of computation and fundamental algorithms. Students can tailor their degree to their own unique interests and requirements, with an emphasis on computational foundations.

The Bachelor of Science degree program in Computational Data Science is accredited by the Computing Accreditation Commission of ABET, *www.abet.org*.

Requirements for the Bachelor of Science Degree in Computational Data Science

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 120 credits, including general elective credits, are required for the Bachelor of Science degree in Computational Data Science.

   The University's Tier II writing requirement for the Computational Data Science major is met by completing Computational Mathematics, Science and Engineering 495, referenced in item 3. b. below.

   Students who are enrolled in the College of Engineering may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading **Graduation Requirements for All Majors** in the College statement.

2. The requirements of the College of Engineering for the Bachelor of Science degree.

   The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

3. The following requirements for the major:

					CREDITS
a.	**Bioscience** (4 to 6 credits)				
	(1)	One of the following courses:			
		BS	161	Cell and Molecular Biology	3
		ENT	205	Pests, Society and Environment	3
		IBIO	150	Integrating Biology: From DNA to Populations	3
		MMG	141	Introductory Human Genetics	3
		MMG	201	Fundamentals of Microbiology	3
		PLB	105	Plant Biology	3
		PSL	250	Introductory Physiology	4
	(2)	One of the following courses:			
		BS	171	Cell and Molecular Biology Laboratory	2
		CEM	161	Chemistry Laboratory I	1
		CEM	162	Chemistry Laboratory II	1
		PHY	191	Physics Laboratory for Scientists, I	1
		PHY	192	Physics Laboratory for Scientists, II	1
		PLB	106	Plant Biology Laboratory	1
b.	All of the following courses (43 credits):				
	CMSE	201		Introduction to Computational Modeling	4
	CMSE	381		Fundamentals of Data Science Methods	4
	CMSE	382		Optimization Methods in Data Science	4
	CMSE	495		Experiential Learning in Data Science (W)	4
	CSE	232		Introduction to Programming II	4
	CSE	331		Algorithms and Data Structures	3
	CSE	404		Introduction to Machine Learning	3
	CSE	482		Big Data Analysis	3
	CSE	480		Database Systems	3
	MTH	314		Matrix Algebra with Computational Applications	3
	STT	180		Introduction to Data Science	4
	STT	380		Probability and Statistics for Data Science	4
c.	Two courses selected from the following (6 credits):				
	CSE	402		Biometrics and Pattern Recognition	3
	CSE	415		Introduction to Parallel Computing	3
	CSE	431		Algorithm Engineering	3
	CSE	440		Introduction to Artificial Intelligence	3
	Computer Science and Engineering 415 and Computational Science, Mathematics and Engineering 401 may not be used to fulfill both requirements c. and d.				
d.	Two courses selected from the following (6 credits):				
	CMSE	401		Methods for Parallel Computing	4
	CMSE	402		Visualization of Scientific Datasets	3
	CSE	402		Biometrics and Pattern Recognition	3

CSE	415	Introduction to Parallel Computing	3
CSE	431	Algorithm Engineering	3
CSE	440	Introduction to Artificial Intelligence	3
CSE	471	Media Processing and Multimedia Computing	3
CSE	472	Computer Graphics	3
MTH	451	Numerical Analysis I	3
MTH	468	Predictive Analysis	3
STT	464	Statistics for Biologists	3
STT	465	Bayesian Statistical Methods	3

Computer Science and Engineering 415 and Computational Science, Mathematics and Engineering 401 may not be used to fulfill both requirements c. and d.

Effective Fall 2019.

COLLEGE OF NATURAL SCIENCE

1. Request to change the **Graduation Requirements** for the **Bachelor of Arts and Bachelor of Science** degrees in the College of Natural Science. The University Committee on Undergraduate Education will consider this request.

   a. Under the heading **Graduation Requirements** make the following change in paragraph two, following item 3.:

      (1) Replace item 2. c. with the following:

      A minimum of 30 credits in courses numbered 300 and above.

   Effective Fall 2019.

2. Request to establish a **Bachelor of Science** degree in **Data Science** in the Department of Computational Mathematics, Science, and Engineering. The University Committee on Undergraduate Education (UCUE) recommended approval of this request at its February 21, 2019 meeting.

   a. **Background Information:**

      Data science is an interdisciplinary field whose purpose is the extraction of actionable insights from data in its many forms. Data science employs theories and techniques drawn from various disciplines, including statistics, mathematics, computer science, and information science. Working data scientists use their computational and analytical skills to do many things: to integrate, process, and interpret data from rich and diverse sources, or from large and potentially distributed data sets; to build mathematical models that can infer meaningful relationships in the data and can in turn be used for interpretation and prediction purposes; to create visualizations to aid in the understanding of their data and models; and to communicate their findings and insights to a variety of audiences so that decisions can be made and action can be taken. Given the exponential increase in the size and complexity of datasets in virtually all industries, there is a rapidly growing demand for students with these skills (see *https://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century* and *http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation*).

      A practicing data scientist needs all of the skills described above in order to have a long and successful career, and additionally must learn to think critically about the process of understanding and interpreting data. It is impractical for individual students to acquire all of these skills using existing majors at Michigan State University. A challenge to students and advisors alike is to determine the educational experiences that will be most important to maximize their long-term job prospects. As a result, the Departments of Computer Science and Engineering, Statistics and Probability, and Computational Mathematics, Science, and Engineering jointly will provide

resources to create a new Bachelor of Science in Data Science. The Department of Computational Mathematics, Science, and Engineering will be the administrative unit. This major will provide students with an understanding of, and practical experience with, the key aspects of statistics, mathematics, computer science, and information science that are required to manipulate, analyze, and visualize large and complex datasets. Additionally, students in this major will learn to think critically about the data and processes they are working with and to communicate their analysis and results to a variety of audiences.

Each of these departments have faculty with unique expertise that is required to create such a degree, and jointly managing the program will ensure that all three departments have a strong stake in the success of implementing, maintaining, and improving the degree program. Due to the different needs of the student populations in the Colleges of Natural Science and Engineering, MSU plans to offer two related, but different, bachelor's degrees - one led by the Department of Computational Mathematics, Science, and Engineering in the College of Natural Science, and the other led by the Department of Computer Science and Engineering in the College of Engineering.

Michigan State University is an ideal setting to create a new degree in data science. With key faculty in across departments whose research expertise is in aspects of the computational and mathematical algorithms that are key to data science - in statistical analysis, machine learning, database systems, data mining, information retrieval, network analysis, signal processing, computer vision, and high performance computing - MSU has been aggressively hiring faculty that apply these techniques to applications in a wide range of subject areas. This is further exemplified by the creation of the new Department of Computational Mathematics, Science, and Engineering (CMSE), which explicitly brings together faculty whose interests are in the algorithms and applications of computational modeling and data science techniques, as well as the Social Science Data Analytics initiative, which applies the tools of data science to topics outside of the traditional STEM fields. Additionally, several relevant courses in data science-related subjects have already been developed in these units, providing a base upon which to build a degree program. Furthermore, there is significant student demand for these skills: MSU students have self-organized into an MSU Data Science student organization. See http://msudatascience.com/. This organization sees approximately 100 attendees at its events, and has been inviting speakers, hosting workshops, and distributing job postings to its members. These institutional trends support the creation of a degree in data science and ensure that the resources to maintain a thriving degree program will continue to exist far into the future.

A substantial number of universities have created data science degrees in the last few years. In the Big 10, Penn State, Ohio State, and the University of Michigan have all developed a Bachelor of Science degree in Data Science with learning goals and course progressions that are similar to those outlined below. Interestingly, all of these programs are collaborative efforts between multiple departments: typically some combination of computer science, electrical engineering, and/or statistics. Nationwide, there are approximately twenty bachelor programs in data science available, and a comparable number of master's programs in data science, data analytics, or business analytics.

Broadly speaking the goals of this degree are to provide a solid foundation in the core principles, methods, and tools of data science, as well as to be able to apply these to solve important data-centric problems in a wide variety of disciplines by application of the scientific method. More specifically, a student graduating with a Bachelor's of Science in Data Science from MSU will be able to: (1) Understand and be able to apply mathematical and statistical models and concepts to detect patterns that exist in datasets, and to draw inferences and conclusions supported by that data; (2) Understand and be able to apply computer science principles relating to algorithm analysis, software design, data representation and retrieval, and programming; (3) Demonstrate critical thinking skills associated with the concepts and practices described above by using the scientific methods to reason effectively with data to identify and solve problems, to inform decision making, and to generate a logical synthesis of information from disparate sources of data; and (4) Clearly communicate their findings and the implications of those findings both orally and in writing, and to do so effectively in a variety of organizational contexts.

b. **Academic Programs Catalog Text:**

The Bachelor of Science degree in Data Science is designed to provide students with a strong background in data science using a broad range of computational techniques, practice in statistical thinking, as well as in-depth exposure to topics in data science.

Requirements for the Bachelor of Science Degree in Data Science

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 120 credits, including general elective credits, are required for the Bachelor of Science degree in Data Science.

   The University's Tier II writing requirement for the Data Science major is met by completing Computational Mathematics, Science and Engineering 495, referenced in item 3. below.
2. The requirements of the College of Natural Science for the Bachelor of Science degree.
3. The following requirements for the major:

					CREDITS
a.	One course from each of the following groups (8 or 10 credits):				
	(1)	CEM	141	General Chemistry	4
		CEM	151	General and Descriptive Chemistry	4
		CEM	181H	Honors Chemistry I	4
		LB	171	Principles of Chemistry I	4
	(2)	CEM	142	General and Inorganic Chemistry	3
		CEM	152	Principles of Chemistry	3
		CEM	182H	Honors Chemistry II	4
		LB	172	Principles of Chemistry II	3
	(3)	CEM	161	Chemistry Laboratory I	1
		CEM	185H	Honors Chemistry Laboratory I	2
		LB	171L	Introductory Chemistry Laboratory I	1
b.	One course from each of the following groups (8 credits):				
	(1)	LB	273	Physics I	4
		PHY	183	Physics for Scientists and Engineers I	4
	(2)	LB	274	Physics II	4
		PHY	184	Physics for Scientists and Engineers II	4
c.	One course from each of the following groups (14 or 15 credits):				
	(1)	LB	118	Calculus I	4
		MTH	132	Calculus I	3
		MTH	152H	Honors Calculus I	3
	(2)	LB	119	Calculus II	4
		MTH	133	Calculus II	4
		MTH	153H	Honors Calculus II	4
	(3)	LB	220	Calculus III	4
		MTH	234	Multivariable Calculus	4
		MTH	254H	Honors Multivariable Calculus	4
	(4)	MTH	314	Matrix Algebra with Computational Applications	3
d.	One of the following groups (4 or 6 credits):				
	(1)	STT	380	Probability and Statistics for Data Science	4
	(2)	STT	441	Probability and Statistics I: Probability	3
		STT	442	Probability and Statistics I: Statistics	3
e.	All of the following courses (31 credits):				
		CMSE	201	Introduction to Computational Modeling and Data Analysis	4
		CMSE	202	Computational Modeling Tools and Techniques	4
		CMSE	381	Fundamentals of Data Science Methods	4
		CMSE	382	Optimization Methods in Data Science	4
		CMSE	495	Experiential Learning in Data Science (W)	4
		CSE	232	Introduction to Programming II	4
		CSE	331	Algorithms and Data Structures	3
		STT	180	Introduction to Data Science	4
f.	A minimum of 12 credits of approved 400-level courses or above. The following courses are eligible to fulfill this requirement. Other may be substituted with advisor approval.				
		CMSE	401	Methods for Parallel Computing	4
		CMSE	402	Data Visualization Principles and Techniques	3
		CMSE	410	Computational Biology and Bioinformatics	3
		CMSE	411	Computational Medicine	3
		CMSE	492	Special Topics in Data Science	1 to 4
		CSE	402	Biometrics and Pattern Recognition	3
		CSE	440	Introduction to Artificial Intelligence	3
		CSE	480	Database Systems	3

CSE	482	Big Data Analysis	3
MTH	468	Predictive Analytics	3
STT	464	Statistics for Biologists	3
STT	465	Bayesian Statistical Methods	3

A maximum of 12 credits may count towards the degree for enrollments in CMSE 492 with advisor approval.

Effective Fall 2019.

3. Request to establish a **Minor** in **Data Science** in the Department of Computational Mathematics, Science, and Engineering. The University Committee on Undergraduate Education (UCUE) recommended approval of this request at its February 21, 2019 meeting.

a. **Background Information:**

Data science is an interdisciplinary field whose purpose is the extraction of actionable insights from data in its many forms. Data science employs theories and techniques drawn from various disciplines, including statistics, mathematics, computer science, and information science. Working data scientists use their computational and analytical skills to do many things: to integrate, process, and interpret data from rich and diverse sources, or from large and potentially distributed data sets; to build mathematical models that can infer meaningful relationships in the data and can in turn be used for interpretation and prediction purposes; to create visualizations to aid in the understanding of their data and models; and to communicate their findings and insights to a variety of audiences so that decisions can be made and action can be taken. Given the exponential increase in the size and complexity of datasets in virtually all industries, there is a rapidly growing demand for students with these skills (see *https://hbr.org/2012/10/data-scientist-the-sexiest-job-of-the-21st-century* and *http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation*).

A practicing data scientist needs all of the skills described above in order to have a long and successful career, and additionally must learn to think critically about the process of understanding and interpreting data. It is impractical for individual students to acquire all of these skills using existing minors at Michigan State University. A challenge to students and advisors alike is to determine the educational experiences that will be most important to maximize their long-term job prospects. As a result, the Department of Statistics and Probability, and Computational Mathematics, Science, and Engineering jointly will provide resources to create a new Minor in Data Science. The Department of Computational Mathematics, Science, and Engineering will be the administrative unit. This minor will provide students with an understanding of, and practical experience with, the key aspects of statistics, mathematics, computer science, and information science that are required to manipulate, analyze, and visualize large and complex datasets. Additionally, students in this minor will learn to think critically about the data and processes they are working with and to communicate their analysis and results to a variety of audiences.

Each of these departments have faculty with unique expertise that is required to create such the minor, and jointly managing the program will ensure that both departments have a strong stake in the success of implementing, maintaining, and improving the program.

Michigan State University is an ideal setting to create a minor in data science. With key faculty in across departments whose research expertise is in aspects of the computational and mathematical algorithms that are key to data science - in statistical analysis, machine learning, database systems, data mining, information retrieval, network analysis, signal processing, computer vision, and high performance computing - MSU has been aggressively hiring faculty that apply these techniques to applications in a wide range of subject areas. This is further exemplified by the creation of the new Department of Computational Mathematics, Science, and Engineering (CMSE), which explicitly brings together faculty whose interests are in the algorithms and applications of computational modeling and data science techniques, as well as the Social Science Data Analytics initiative, which applies the tools of data science to topics outside of the traditional STEM fields. Additionally, several relevant courses in data science-related subjects have already been developed in these units, providing a base upon which to build a degree program. Furthermore, there is significant student demand for these skills: MSU students have self-organized into an MSU Data Science student organization. See http://msudatascience.com/. This organization sees approximately 100 attendees at its events, and has been inviting speakers, hosting workshops, and distributing job postings to its members. These institutional trends support the creation of a degree

in data science and ensure that the resources to maintain a thriving degree program will continue to exist far into the future.

A substantial number of universities have created data science degrees in the last few years. In the Big 10, Penn State, Ohio State, and the University of Michigan have all developed a Bachelor of Science degree in Data Science with learning goals and course progressions that are similar to those outlined below. Interestingly, all of these programs are collaborative efforts between multiple departments: typically some combination of computer science, electrical engineering, and/or statistics. Nationwide, there are approximately twenty bachelor programs in data science available, and a comparable number of master's programs in data science, data analytics, or business analytics. Many of these programs also offer minors.

Broadly speaking the goals are to provide a solid foundation in the core principles, methods, and tools of data science, as well as to be able to apply these to solve important data-centric problems in a wide variety of disciplines by application of the scientific method. More specifically, a student graduating with a Minor in Data Science from MSU will be able to: (1) Understand and be able to apply mathematical and statistical models and concepts to detect patterns that exist in datasets, and to draw inferences and conclusions supported by that data; (2) Understand and be able to apply computer science principles relating to algorithm analysis, software design, data representation and retrieval, and programming; (3) Demonstrate critical thinking skills associated with the concepts and practices described above by using the scientific methods to reason effectively with data to identify and solve problems, to inform decision making, and to generate a logical synthesis of information from disparate sources of data; and (4) Clearly communicate their findings and the implications of those findings both orally and in writing, and to do so effectively in a variety of organizational contexts.

b. **Academic Programs Catalog Text:**

The Minor in Data Science, which is administered by the Department of Computational Mathematics, Science, and Engineering, is designed to provide students with a strong background in data science using a broad range of computational techniques, practice in statistical thinking, as well as in-depth exposure to topics in data science.

The minor is available as an elective to students enrolled in bachelor's degree programs at Michigan State University with the exception of the Bachelor of Science degree in Data Science and the Bachelor of Science Degree in Computational Data Science. With the approval of the department and college that administer the student's degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor's degree.

Students who plan to apply to the program should consult the undergraduate advisor in the Department of Computational Mathematics, Science, and Engineering.

Requirements for the Minor in Data Science

Complete a minimum of 23 credits from the following:

					CREDITS
1.	All of the following courses (19 credits):				
	CMSE	180		Introduction to Data Science	4
	CMSE	201		Introduction to Computational Modeling and Data Analysis	4
	CMSE	202		Computational Modeling Tools and Techniques	4
	CMSE	381		Fundamentals of Data Science Methods	4
	MTH	314		Matrix Algebra with Computational Applications	3
2.	One of the following groups (4 or 6 credits):				
	(a)	STT	380	Probability and Statistics for Data Science	4
	(b)	STT	441	Probability and Statistics I: Probability	3
		STT	442	Probability and Statistics I: Statistics	3

Effective Fall 2019.

COLLEGE OF NURSING

1. Request to change the requirements for the **Master of Science in Nursing** degree in **Nursing**. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2019 meeting.

The concentrations in the Master of Science in Nursing degree in Nursing are noted on the student's academic record when the requirements for the degree have been completed.

a. Under the heading **Admission** make the following changes:

(1) In item 8., add the following second sentence:

Recommendations for admission are made by the faculty committee to the Dean of the college based on the requirements for admission and the personal interview.

b. Under the heading **Requirements for the Master of Science in Nursing Degree in Nursing** make the following changes:

(1) Change the total credits required from '45 to 48' to '54'

(2) In item 1., add the following courses:

NUR	903	Healthcare Informatics	3
NUR	904	Health Policy and Advocacy	3
NUR	906	Leadership in Complex Health Systems	3

(3) Add the following concentration:

NURSE PRACTITIONER – PSYCHIATRIC MENTAL HEALTH (30 credits)

EPI	840	Clinical Epidemiology for Healthcare Practice	3
NUR	952	Psychopharmacology and Neuropathological Basis of Mental Illness	3
NUR	953	Clinical Diagnosis and Management I – Psychiatric Assessment and Diagnosis	6
NUR	954	Clinical Diagnosis and Management II – Evidence Based Therapeutic Interventions	6
NUR	955	Clinical Diagnosis and Management III – Special Populations and Group	6
NUR	956	Clinical Diagnosis and Management IV – Complex and Collaborative Mental Health Care	6

(4) In the **ADULT-GERONTOLOGY CLINICAL NURSE SPECIALIST** concentration make the following changes:

(a) Change the total credits from '33' to '30'.

(b) Add the following course:

EPI	840	Clinical Epidemiology for Healthcare Practice	3

Delete the following courses:

NUR	904	Health Policy and Advocacy	3
NUR	906	Leadership in Complex Health Systems	3

Effective Summer 2019.

2. Request to change the requirements for the **Doctor of Nursing Practice** degree in **Nursing Practice**. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2019 meeting.

The concentrations in the Doctor of Nursing Practice degree in Nursing Practice are noted on the student's academic record when the requirements for the degree have been completed.

a. Under the heading **Requirements for the Doctor of Nursing Practice Degree in Nursing Practice** make the following changes:

(1) In item 2., add the following concentration:

NURSE PRACTITIONER – PSYCHIATRIC MENTAL HEALTH (42 credits)

NUR	907	Advanced Pathophysiology for the Advanced Practice Registered Nurse	3
NUR	908	Advanced Physical Assessment for the Advanced Practice Registered Nurse	3
NUR	909	Advanced Pharmacology for the Advanced Practice Registered Nurse	3
NUR	952	Psychopharmacology and Neuropathological Basis of Mental Illness	3
NUR	953	Clinical Diagnosis and Management I – Psychiatric Assessment and Diagnosis	6
NUR	954	Clinical Diagnosis and Management II – Evidence Based Therapeutic Interventions	6
NUR	955	Clinical Diagnosis and Management III – Special Populations and Group	6
NUR	956	Clinical Diagnosis and Management IV – Complex and Collaborative Mental Health Care	6
NUR	957	Clinical Diagnosis and Management V – Clinical Immersion – Psychiatric Mental Health	6

b. Delete the section **Guidance Committee**.

c. Under the heading **Comprehensive Examinations** change the credits for the synthesis project from '6' to '10'.

Effective Fall 2019.

COLLEGE OF OSTEOPATHIC MEDICINE

1. Request to change the requirements for the **Professional Program in Osteopathic Medicine** leading to the Doctor of Osteopathic Medicine degree the College of Osteopathic Medicine. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2019 meeting.

   a. Under the heading **Clerkship Curriculum** replace the entire entry with the following:

      The clinical clerkship curriculum includes 83 weeks of clinical training in community hospitals, clinics, and private practice offices affiliated with the college from across the State of Michigan.

      The third year curriculum consists of 51 weeks, transition from classroom to bedside, ambulatory family medicine, ambulatory internal medicine, ambulatory or in-patient pediatrics, in-patient internal medicine, neurology, psychiatry, obstetrics/gynecology, general surgery, and emergency medicine each in 4-week blocks. In addition, anesthesia and radiology each in 2-week blocks.

      The fourth year curriculum consists of 32 weeks. Of those 32 weeks, 12 are required to be completed within our Statewide Campus System hospitals. The remaining 20 weeks are required to be completed within either the Statewide Campus System or any institution approved by the College of Osteopathic Medicine with advanced planning and scheduling on the part of the student. Within the 32 weeks, students will be required to complete 8 weeks in a surgical field and 12 weeks in a medicine related field. A list of possible rotations for each field is available from the College of Osteopathic Medicine.

   Effective Fall 2019.

PART II - NEW COURSES AND CHANGES

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

ANS 110 Introductory Animal Agriculture
Fall of every year. Spring of every year. ~~4(3-2)~~ 3(3-0) R: Open to undergraduate students or agricultural technology students.
~~History of animal agriculture and its relationship to human needs, production systems, marketing, and environmental considerations. Current goals of and limitations affecting U.S. farm animal production. Field trips required.~~ History of animal agriculture and its relationship to human needs, production systems, marketing, and environmental considerations. Current goals and limitations affecting U.S. farm animal production.
SA: ANS 112
~~Effective Spring 2014~~ Effective Fall 2019

ANS 110L Introductory Animal Agriculture Laboratory
Fall of every year. Spring of every year. 1(0-2)
NEW Hands on experience in working with farm and other animals. Field trip required.
Effective Fall 2019

ANS 201 Animal Products
Fall of every year. Spring of every year. 3(3-0) RB: ANS 110 R: Not open to freshmen.
Edible animal products. Food safety. Preservation, storage and distribution of dairy, meat and egg products.
~~Effective Spring 2014~~ Effective Spring 2020

ANS 210 Introduction to Disciplines in Animal Agriculture
Fall of every year. Spring of every year. 3(3-0) P: ANS 110 or concurrently
NEW Scientific disciplines of Animal Science. Problem solving, literature searches and comprehension with realistic examples to demonstrate multi-disciplinary scientific solutions in Animal Science.
Effective Fall 2019

ANS 262 Introductory Sheep Management
Fall of every year. ~~Spring of every year.~~ 3(2-2)
Principles of sheep management: genetics, reproduction, nutrition, marketing, and economics.
~~Effective Fall 2013~~ Effective Fall 2019

ANS 301 ~~Professional Development in Animal Science II~~
Professional Development in Animal Science II (W)
Fall of every year. Spring of every year. ~~2(1-2)~~ 3(3-0) ~~P: (ANS 101 and ANS 110) and completion of Tier I writing requirement~~ P: (ANS 110) and completion of Tier I writing requirement RB: ANS 101 and ANS 110 R: Open to juniors or seniors in the Department of Animal Science.
~~Career preparation in animal science. Job interviewing skills. Oral presentation, written communication, and critical evaluation of science literature.~~ Career preparation in animal science. Job interviewing, oral presentation, and written communication skills.
~~Effective Fall 2013~~ Effective Fall 2019

ANS 305 Applied Animal Behavior
Spring of every year. Summer of every year. ~~3(2-2)~~ 3(3-0) ~~P: BS 161 or LB 145 or BS 181H~~ P: (ANS 210) and (BS 162 or LB 144 or BS 182H)
Techniques for assessing health and welfare of domestic animals based on their behavior.
~~Effective Fall 2013~~ Effective Fall 2019

ANS 305L Applied Animal Behavior Laboratory
Fall of every year. 1(0-2) P: ANS 305
NEW Understanding of biological basis of behavior to improve animal health, productivity and welfare.
Effective Fall 2019

ANS 307 Animal Reproduction
Fall of every year. 3(3-0) P: ANS 210
NEW Reproductive physiology of farm and companion animals. Comparative reproduction in human and laboratory animals.
Effective Fall 2019

ANS 313 ~~Principles of Animal Feeding and Nutrition~~
Principles of Animal Feeding and Nutrition (W)
Fall of every year. 4(3-2) P: ((BS 161 or LB 145 or BS 181H) and completion of Tier I writing requirement) and ((CEM 143 or concurrently) or (CEM 251 or concurrently))
Comparative nutrition and metabolism for production, health, and stewardship of cattle, horses, swine, poultry, dogs and cats. Diet evaluation and formulation. Feeding management.
~~Effective Spring 2014~~ Effective Fall 2019

ANS 314 ~~Genetic Improvement of Domestic Animals~~
Genetic Improvement of Domestic Animals (W)
~~Fall of every year.~~ Spring of every year. 4(4-0) P: ((BS 161 or BS 181H or LB 145) and completion of Tier I writing requirement) and (STT 200 or STT 201 or STT 421 or STT 464 or STT 231)
Molecular, Mendelian, population, and quantitative genetics of domestic animals.
~~Effective Spring 2014~~ Effective Spring 2020

ANS 315 Anatomy and Physiology of Farm Animals
Spring of every year. 4(3-2) ~~P: (BS 161 or LB 145 or BS 181H) and completion of Tier I writing requirement~~ P: BS 161 or LB 145 or BS 181H
Gross and microanatomy of farm animals. Structure directed function of tissues. Endocrine integration for homeostasis. Regulation of growth, lactation, and reproduction. Homeorhesis.
~~Effective Spring 2014~~ Effective Spring 2020

ANS 404 Introduction to Quantitative Genetics
Fall of every year. 3(3-0) P: (ANS 314) and (STT 200 or STT 201 or STT 231 or STT 421 or STT 464)
NEW Theories and applications of quantitative genetics; mutations, recombination, selection, and their roles in shaping genetic variation and covariance in idealized and finite populations; analysis of quantitative trait variation and genetic parameters; gene mapping and genetic prediction; applications in breeding.
Effective Fall 2019

ANS 409 ~~Problems, Controversies and Advancements in Reproduction~~
Problems, Controversies and Advancements in Reproduction (W)
Fall of every year. ~~3(3-0)~~ 4(4-0) ~~P: BS 161 or PSL 250~~ P: (BS 161 or PSL 250) and completion of Tier I writing requirement RB: ANS 307
Selected topics in endocrine, cellular, molecular and genetic aspects of sex differentiation, gametogenesis, folliculogenesis, sexual cycles, behavior, fertilization, early embryo development, pregnancy, parturition, infertility, reproductive disorders, assisted reproductive technologies in humans, livestock and animal models.
~~Effective Fall 2014~~ Effective Fall 2019

ANS 435 ~~Mammary Physiology~~
Mammary Physiology (W)
Spring of every year. ~~4(3-2)~~ 3(3-0) ~~P: (BS 161 or LB 145 or BS 181H) and (ANS 313 and ANS 315)~~ P: ((BS 161 or LB 145 or BS 181H) and completion of Tier I writing requirement) and (ANS 313 and ANS 315) R: Not open to freshmen and not open to sophomores.
Anatomy of the mammary gland and physiology of lactation in domestic and laboratory mammals. Mammary gland health and factors affecting lactation. Dairy herd milking management. Field trips required.
~~Effective Spring 2014~~ Effective Spring 2020

ANS 482 Advanced Companion Animal Management
Spring of every year. 3(2-2) P: ANS 282 and ANS 210 RB: ANS 305 or IBIO 313
NEW Companion animal behavior, welfare, anatomy, physiology, nutrition and health. Careers in the companion animal industry. Experiential learning projects. Field trip required.
Effective Spring 2020

TSM 331 Water Management in Agriculture and Food Systems
Spring of every year. 3(3-0) Interdepartmental with Crop and Soil Sciences. P: MTH 103 or MTH 124 or MTH 132 or LB 118
Principles of water management, use efficiency and conservation in agricultural production, natural resources and food processing facilities. Best agricultural water management practices, water rights, irrigation scheduling, irrigation systems selection, evaluation and management and drainage principles. Large scale water use, management and conservation in food processing.
SA: TSM 431
~~Effective Fall 2015~~ Effective Fall 2018

FOR 804 Forest Ecology
Fall of odd years. 3(3-0) RB: FOR 404
REINSTATEMENT Processes controlling population, community, ecosystem, landscape, and global ecology of forested systems. Extrapolation across scales, succession, spatial models of forest dynamics, causes and consequences of biodiversity, nutrient cycling, sustainability of managed ecosystems and human-accelerated environmental change.
Effective Fall 2019

PKG 485 ~~Packaging Development~~
Packaging Development (W)
Fall of every year. Spring of every year. ~~3(3-0)~~ 4(4-0) ~~P: (PKG 410 and PKG 432) and (PKG 315 or EGR 102) and (PKG 411 or concurrently)~~ P: ((PKG 410 and PKG 432) and completion of Tier I writing requirement) and (PKG 315 or EGR 102) and (PKG 411 or concurrently) R: Open to seniors or graduate students in the School of Packaging.
Package development including selection, design and implementation of package systems for protection, distribution, merchandising, use and disposal.
~~Effective Fall 2016~~ Effective Fall 2019

COLLEGE OF ENGINEERING

CSE 331 Algorithms and Data Structures
Fall of every year. Spring of every year. 3(3-0) ~~P: CSE 232 and CSE 260~~ P: (CSE 232) and (CSE 260 or CMSE 202) ~~R: Open to students in the Department of Computer Science and Engineering or in the Computer Engineering Major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major or in the Computer Science Disciplinary Teaching Minor.~~ R: Open to students in the Department of Computer Science and Engineering or in the Computer Engineering Major or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major and open to juniors or seniors in the College of Engineering.
Linear data structures, trees, graphs and algorithms which operate on them. Fundamental algorithms for searching, sorting, string matching, graph problems. Design and analysis of algorithms.
~~Effective Spring 2014~~ Effective Fall 2019

CSE 402 Biometrics and Pattern Recognition
Fall of every year. 3(3-0) ~~P: CSE 331 and STT 351~~ P: (CSE 331) and (STT 351 or STT 380 or STT 430 or STT 441) R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.
Automated techniques used for feature extraction and pattern matching focusing on face, fingerprint and iris recognition.
~~Effective Fall 2017~~ Effective Fall 2019

CSE 404 Introduction to Machine Learning

Fall of every year. 3(3-0) Interdepartmental with Computational Mathematics, Science, and Engineering and Statistics and Probability. P: (CSE 331) and (STT 351 or STT 380 or STT 430 or STT 441) RB: Basic linear algebra R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

NEW

Core principles and techniques of machine learning. Supervised, semi-supervised, and unsupervised learning. Machine learning model design. Programming machine learning algorithms.

Effective Fall 2019

CSE 415 Introduction to Parallel Computing

Spring of every year. 3(3-0) P: CSE 320 and CSE 331 R: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major. Not open to students with credit in CMSE 401.

Core principles and techniques of parallel computing. Parallel architectures. Parallel programming models. Principles of parallel algorithm design. Performance analysis and optimization. Use of parallel computers.

~~Effective Fall 2017~~ Effective Fall 2019

CSE 482 Big Data Analysis

Spring of every year. 3(3-0) ~~P: CSE 331 and CSE 335 and STT 351~~ P: (CSE 331) and (STT 351 or STT 380 or STT 430 or STT 441) R: Open to juniors or seniors in the College of Engineering or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.

Data collection, storage, and preprocessing, and analysis techniques. Programming for large-scale data analysis. Case studies and applications.

~~Effective Spring 2017~~ Effective Fall 2019

COLLEGE OF HUMAN MEDICINE

EM 632 Senior Clinical Elective in Emergency Medicine

Fall of every year. Spring of every year. Summer of every year. 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. ~~P: (FM 641 and MED 641 and PHD 641 and PSC 641 and OGR 641 and SUR 641) or (FM 608 and MED 608 and PHD 600 and PSC 608 and OGR 608 and SUR 608)~~ P: {(FM 641 or MED 641 or PHD 641 or PSC 641 or OGR 641 or SUR 641) and (FM 641 or MED 641 or PHD 641 or PSC 641 or OGR 641 or SUR 641) and (FM 641 or MED 641 or PHD 641 or PSC 641 or OGR 641 or SUR 641) and (FM 641 or MED 641 or PHD 641 or PSC 641 or OGR 641 or SUR 641)} or (FM 608 and MED 608 and PHD 600 and PSC 608 and OGR 608 and SUR 608) R: Open to graduate-professional students in the College of Human Medicine.

Four-week elective in clinical diagnosis and treatment of the undifferentiated patient in the emergency department setting. Intended for students planning to apply to an Emergency Medicine Residency.

Request the use of the Pass-No Grade (P-N) system.

Request the use of ET-Extension to postpone grading.

The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.

~~Effective Fall 2018~~ Effective Summer 2019

MED 628 Advanced Internal Medicine: Senior Medicine Sub-Internship
Fall of every year. Spring of every year. Summer of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. P: MED 608 or MED 641 ~~RB: MED 608 or HM 556~~ R: Open to graduate-professional students in the College of Human Medicine.
Advanced clinical experiences to refine diagnostic and management skills in complicated general internal medicine patients.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
Effective Summer 2019

SUR 615 Ophthalmology Clerkship
Fall of every year. Spring of every year. Summer of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. ~~P: SUR 608 or SUR 641~~ RB: SUR 608 or SUR 641 R: Open to graduate-professional students in the College of Human Medicine.
Medical and surgical treatment of eye diseases. Clinical experiences include private office practice, surgical observations, pre-and post-operative care.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
~~Effective Fall 2018~~ Effective Summer 2019

SUR 618 Anesthesia Clerkship
Fall of every year. Spring of every year. Summer of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. ~~P: SUR 608 or SUR 641~~ RB: SUR 608 or SUR 641 R: Open to graduate-professional students in the College of Human Medicine.
Common anesthetic agents and procedures. Operative and post-operative effects, complications, patient risk, cost. Performing anesthetic procedures under faculty supervision.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
~~Effective Fall 2018~~ Effective Summer 2019

SUR 630 Surgical Wound Care Clerkship
Fall of every year. Spring of every year. Summer of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. ~~P: SUR 608 or SUR 641~~ RB: SUR 608 or SUR 641 R: Open to graduate-professional students in the College of Human Medicine.
Evaluation, management and knowledge of wound care in surgical patients.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
~~Effective Fall 2018~~ Effective Summer 2019

SUR 632 Surgical Nutrition Clerkship
Fall of every year. Spring of every year. Summer of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. ~~P: SUR 608 or SUR 641~~ RB: SUR 608 or SUR 641 R: Open to graduate-professional students in the College of Human Medicine.
Evaluation, management and knowledge of nutrition in critically-ill surgical patients.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
~~Effective Fall 2018~~ Effective Summer 2019

COLLEGE OF NATURAL SCIENCE

CMSE 381 Fundamentals of Data Science Methods
Fall of every year. Spring of every year. 4(4-0) Interdepartmental with Statistics and Probability. P: (STT 180 and MTH 314 and CMSE 201 and STT 380) or (STT 180 and MTH 314 and CMSE 201 and STT 441 and STT 442)

NEW Fundamental concepts of data science methods, including unsupervised learning and supervised learning, feature extraction, dimension reduction, clustering, regression and classification.
Effective Fall 2019

CMSE 382 Optimization Methods in Data Science
Fall of every year. Spring of every year. 4(4-0) P: CMSE 202 and CMSE 381

NEW Concepts, mathematical foundations, methods, and algorithms of optimization in data modeling, all applied to modeling real-world data.
Effective Fall 2019

CMSE 492 Selected Topics in Data Science
Fall of every year. Spring of every year. 1 to 4 credits. Interdepartmental with Computer Science and Engineering and Statistics and Probability. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.

NEW Topics selected to supplement and enrich existing courses in Data Science.
Effective Fall 2019

CMSE 495 Experiential Learning in Data Science (W)
Fall of every year. Spring of every year. 4(2-4) Interdepartmental with Computer Science and Engineering and Statistics and Probability. P: (CSE 232 and CMSE 382) and completion of Tier I writing requirement R: Open to seniors.

NEW Team-based data science projects on realistic, large-scale data.
Effective Fall 2019

STT 180 Introduction to Data Science
Fall of every year. Spring of every year. 4(4-0) Interdepartmental with Computational Mathematics, Science, and Engineering. P: (MTH 124 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) Not open to students with credit in STT 301.

NEW Pervasiveness and utility of data in modern society; obtaining and managing data; summarizing and visualizing data; ethical issues in data science; communication with data; fundamentals of probability and statistics; all in the context of the statistical software R.
Effective Fall 2019

STT 380 Probability and Statistics for Data Science
Fall of every year. Spring of every year. 4(4-0) P: ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently)) and (MTH 314 or concurrently)

NEW Fundamental concepts and methods in probability and statistics from a data science perspective
Effective Fall 2019

STT 804 Statistical Consulting and Practice
Fall of every year. 3(3-0) RB: Excellent command of English language due to reading research articles in applied fields R: Open to master's students in the College of Natural Science or in the Department of Statistics and Probability or in the Statistics Major. Approval of department.

NEW This course will provide a discussion-based introduction to statistical consulting and the practical aspects of the consulting environment. This course is geared towards quantitative graduate students of various disciplines in their second-year master's program. Students will be asked to work on consulting projects, write statistical reports, and give presentations, gaining soft skills that are not necessarily covered in other courses. Covered topics will include aspects of the consulting process including (a) ethics; (b) communication skills; (c) data management (d) statistical methods.
Effective Fall 2019

COLLEGE OF NURSING

NUR 434 ~~Nursing Care of Acute and Chronically Ill Patients III~~
Nursing Care of Acute and Critically Ill Patients
Fall of every year. Spring of every year. 4(2-6) P: NUR 337 and NUR 371 and NUR 342
Nursing process and clinical judgment to manage and evaluate care for acute and critically ill patients at an advanced level.
Effective Fall 2019

NUR 952 Psychopharmacology and Neuropathological Basis of Mental Illness
Summer of every year. 3(3-0) R: Open to graduate students or lifelong graduate students in the College of Nursing.
NEW Application of advanced pharmacology and psycho-pharmacotherapeutics and the putative neuropathophysiology of common psychiatric illnesses that occur across the lifespan.
Effective Spring 2020

NUR 953 Clinical Diagnosis & Management I - Psychiatric Assessment and Diagnosis
Fall of every year. 6(3-9) P: NUR 907 and NUR 908 and NUR 909 and NUR 952 R: Open to graduate students in the College of Nursing.
NEW Integration of mental health assessment and diagnostic screening to formulate differential diagnoses for common mental health conditions/problems across the lifespan.
Effective Spring 2020

NUR 954 Clinical Diagnosis & Management II – Evidence-Based Therapeutic Interventions
Spring of every year. 6(3-9) P: NUR 953 R: Open to graduate students in the College of Nursing.
NEW Integration of assessment and intervention strategies for health promotion and common mental health problems in the clinical setting across the lifespan.
Effective Spring 2020

NUR 955 Clinical Diagnosis & Management III – Special Populations and Group
Summer of every year. 6(3-9) P: NUR 954 R: Open to graduate students in the College of Nursing.
NEW Integration of assessment, intervention, including group psychotherapy, and management strategies for special and vulnerable populations with mental health problems across the lifespan.
Effective Spring 2020

NUR 956 Clinical Diagnosis & Management IV – Complex and Collaborative Mental Health Care
Fall of every year. 6(2-12) P: NUR 955 R: Open to graduate students in the College of Nursing.
NEW Integrates evidence-based strategies to deliver collaborative mental health care across the wellness/illness continuum with patients across the lifespan.
Effective Spring 2020

NUR 957 Clinical Diagnosis & Management V – Clinical Immersion – Psychiatric Mental Health
Spring of every year. 6(2-12) P: NUR 956 R: Open to graduate students in the College of Nursing.
NEW Evidence- based management of chronic stable and complex mental health problems within collaborative practice in complex health systems across the lifespan.
Effective Spring 2020

COLLEGE OF VETERINARY MEDICINE

VM 826 Creating a Food Safety Culture

Summer of odd years. 3(3-0) RB: Professional or graduate status with knowledge of food safety. ~~R: Open to graduate students in the College of Veterinary Medicine or in the Department of Large Animal Clinical Sciences or in the Food Safety Major or approval of college.~~ R: Open to graduate students. Approval of college.

Explores proven, evidence-based ways to change or strengthen the food safety culture of an organization and influence employee behavior.

Request the use of ET-Extension to postpone grading.

The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.

~~Effective Summer 2017~~ Effective Summer 2019