### Master of Science in Business Analytics (MSA)
Supply-Chain Analytics Track 2019-2020 Academic Year

39 credits as follows:  
- 18 common core credits  
- 18 supply chain required credits – as indicated by**  
- 3 elective credits  

#### Preprogram Foundation Requirements
Preparatory work begins in August, is in addition to required credits and does not affect GPA.

**Required:**
- MKT 500V Basics of R Programming (0.5)

**Track Required:**
- OMM 510 Operations Management Foundations (2)

#### Fall Semester (15 credits)

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<tr>
<td>Required:</td>
<td>DAT 560G: Database Design and SQL (1.5)</td>
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<td>Track Required:</td>
<td>OMM 576 Foundations of SC Management (1.5)**</td>
<td>DAT 560M Big Data and Cloud Computing (1.5)</td>
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<td>DAT 500N Prescriptive Analytics (1.5)</td>
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- **Required:**
  - MGT 560F Professional Business Communications (1.5)
  - DAT 500S Predictive Analytics for Business Decision-Making (3)
  - DAT 561 Intro to Python and Data Science (3)
  - OMM 521 Operations Platform (0)

Continued
### Spring Semester (15 or 16.5 Credits)

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<th>Track Required:</th>
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<tr>
<td>OMM 531 Supply Chain Finance (1.5)**</td>
<td>DAT 562 Text Mining (1.5)</td>
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<td>OMM 500M Stochastic Models (1.5)**</td>
<td>MGT 560N Introduction to Cybersecurity (1.5)</td>
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Required:
- DAT 500W A/B Testing (3)

**Track Required:**
- OMM 554 Operations Analytics (3)**
- OMM 501 Global Supply Chain and Logistics System Design Project – Practicum (1.5)** (or OMM 501 during 2\textsuperscript{nd} Fall)

**Electives:**
- OMM 573 Operations Management in the Service Industry (1.5)
- OMM 500E Supply Chain Risk Management (1.5)
- OMM 500D Project Management (3)
- MATH 420 Experimental Design (3)
- INFO 558 Applications of Deep Neural Networks (3)
- CSE 501N Introduction to Computer Science (3)
- CSE 503S Rapid Prototype Development and Creative Programming (3)
- CSE 514A Data Mining (3)
- CSE 517A Machine Learning (3)
  (or CSE 417A during Fall 2019)
- CSE 427 Cloud Computing with Big Data Applications (3)
- CSE 457A Introduction to Visualization (3)
- CSE 515T Bayesian Methods in Machine Learning (3)
- CSE 530S Database Management Systems (3)
### Final Fall Semester (9 or 10.5 Credits)

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<tr>
<td>OMM 520: Revenue Management (3)</td>
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<td>OMM 558: Advanced Operations Strategy (3)</td>
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<td>OMM 530: Supply Chain Analytics Capstone (3)</td>
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<tr>
<td>OMM 501: Global Supply Chain and Logistics System Design Project – Practicum (1.5) (or OMM 501 during 1st Spring)</td>
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<th>Electives:</th>
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<td>OMM 500D: Project Management (3)</td>
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<td>OMM 577: IT and Supply Chain Management (1.5)</td>
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<td>XXX: Enterprise Resource Planning Systems Implementation (3)</td>
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<td>MGT XXX: Introduction to Blockchain (1.5)</td>
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<td>M21-550: Introduction to Bioinformatics (3)</td>
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<td>MATH 475: Statistical Computation (3)</td>
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<td>DAT 537: Data Analysis, Forecasting and Risk Analysis (3)</td>
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<td>CSE 222S: Internet of Things (3)</td>
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<td>CSE 501N: Introduction to Computer Science (3)</td>
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<td>CSE 502N: Data Structures and Algorithms (3)</td>
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<td>CSE 316A: Social Network Analysis (3)</td>
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<td>CSE 417A: Introduction to Machine Learning (3) (or CSE 517A during Spring 2019)</td>
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<td>CSE 427: Cloud Computing with Big Data Applications (3)</td>
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Supply-Chain Analytics track required courses and elective courses can serve as electives for other MSA tracks.
**Summer Foundations Courses – Required:**

**MKT 500V Basics of R Programming**

R has become the tool of choice for many data science and customer analytics professionals in every industry and field. It is not surprising to see a requirement for being familiar with R in job descriptions. R is very flexible in carry out data analysis. Part of the benefit of being open source is that many programmers/researchers are constantly introducing new statistical analysis tools into R through R packages. Given all the benefits, R does have a relatively steeper learning curve. To better prepare MSCA students, we introduce this 2 day introduction to R programming course. This class will help you master the basics of R. We will start from the very beginning - installation of the program. No prior knowledge in programming is required. Through in class demonstration and lots of hands-on practice, by the end of the second day, you will have the chance to undertake your own data analysis and solve relevant business problems using R. 0.5 Credits. Graded Pass/Fail.

**OMM 510 Operations Management Foundations**

This required course discusses the main principles and concepts in managing operations for competitive success. Among the topics covered are: Operations strategy, capacity analysis and organization, queuing theory, service management, quality management, inventory management, and a brief introduction to supply chain management. Students learn the basics of how to manage the operations of a firm, with the main goal of this course being to prepare students for advanced coursework in operations and supply chain management, beginning in the Fall A term. Most sessions consist of in-depth case discussion, integrated with theory. Letter-graded. 1.5 Credits.

**Summer Foundations Courses – Choose at least one of the following:**

**MKT 500R Basics of Statistics Using SPSS**

This foundational course, which is a required course for students in the MSCA program, will cover material that serves as useful preparation for courses offered in the Olin curriculum that rely extensively on applied statistical concepts (e.g., marketing research, advanced marketing research, database marketing, data analysis for brand management etc.). The course will provide students with both an overview of basic statistical concepts and a practical grasp of statistical analysis. Students will be trained to use SPSS, a popular statistical software package, in order to perform the statistical analysis. The course will also cover interpretation of results. 0.5 Credits. Graded Pass/Fail.

**MGT 573 Basics of SAS Programming**

Statistics using SAS serves as a technical basis for research and data analysis. This course will provide students with an overview of statistical knowledge and with a good practice of analysis techniques. Students will be trained to use SAS, one of the most commonly used tools in commercial analytics markets, to analyze data and interpret results. The course aims to prepare students for more advanced courses in data analytics. Graded pass/fail.
**MGT 574 Basics of Stata Programming**

As one of the most popular statistics software packages, Stata has served as an essential tool of data science in every industry and academia. The goals of the course are to better prepare students for success in future courses and careers. Students will be trained to obtain necessary technical skills of using Stata by the end of this two-day course. The introduction of Stata will be from the very beginning, and therefore there is no prerequisite required. Basic statistics foundations will be reviewed to facilitate the goals of the course. Graded pass/fail.

**Required Core Courses**

**DAT 560G Database Design and SQL**

Databases are at the foundation of every organization's information strategy. Understanding the structure of databases and mastering the tools to analyze data are essential skills in any role. The tools developed in this course assist students in implementing a company's data management strategy and developing well-grounded analytical recommendations. In this course we focus on understanding how data is structured in relational databases. With vast amounts of data available, from disparate sources, effective organization of the data is essential to its utilization. To complement this, we utilize SQL (Structured Query Language) as the primary tool to extract data for managerial reports and for advanced analytical models. Practical experience with current relational database software is developed throughout the course. This course is required for MS/CA students and priority will be given to SMP students. 1.5 Credits.

**DAT 500N Prescriptive Analytics**

This course covers optimization models and tools as they apply to the design and analysis of supply chains. Production planning, distribution, network design, and revenue management problems are covered using the methods of linear, non-linear, and integer programming. Upon successful completion of this course, students will demonstrate competency in formulating and solving supply chain optimization models of real-life complexity using state-of-the-art software. They will become proficient with industrial strength software tools like AMPL and Gurobi alongside Excel's Solver. The course emphasizes proficiency in model-building and using software tools rather than theory. 1.5 Credits.

**MGT 560F Professional Business Communication**

Communication is the process of sending and receiving messages, however, communication is effective only when the message is understood and when it stimulates action or encourages the receiver to think in a new way. This course will introduce students to fundamental best practices in business writing and business speaking that will ensure effective communication. Students will participate in activities that will develop professional business communication skills in both writing and speaking. These will include: preparing, writing and delivering presentations, composing clear concise business messages in a variety of formats, understanding emotional intelligence to reach the audience and utilizing critical thinking as a basis for communication strategies. 1.5 Credits.
DAT 500S Predictive Analytics for Business Decision-Making

Predictive Analytics deals with the employment of formal learning from business experience, using business data, to predict the future behavior of customers or other critical organizational elements in order to drive better business decisions. This course emphasizes data situations that students are likely to face in marketing, finance, manufacturing and consulting jobs. Students will analyze real-world business datasets using various advanced analytic techniques such as logistic regression, decision trees, neural networks, stochastic gradient boosting, MARSplines, Ensembles, Clustering, Associations etc. The focus of the course lies in the conversion of raw and messy business data into robust actionable predictions for decision-making. 3 credits.

DAT 561 Introduction to Python and Data Science

This is a 3-credit course offered to MSBA students. It provides students the necessary skill set to extract reliable insights from large datasets prevalent in various business applications, such as supply chain management, marketplace operations, healthcare analytics and financial engineering, using Python. In this course, students will develop basic tools to understand Python programs and implement data processing pipelines using Python. In particular, students will learn how to acquire, clean, analyze and visualize data in Python, which they will then use to improve decision-making processes. Throughout the course, students will use the Python programming language, which is very effective for data manipulation, reporting, and complex optimization. Topics covered include introduction to Python programming, data acquisition and cleaning, data manipulation, current multi-source data collection technology used in practice, basic data visualization using Matplotlib, ggplot2 and Bokeh.

DAT 560M Big Data & Cloud Computing

The growth in available data is a challenge to many companies. This presents an opportunity for companies to conquer the vast and various data available to them. The growth in data includes traditional structured data, as well as unstructured data created by both people and machines. It is essential for analysts to be comfortable in the new technologies and tools that are being developed to store, retrieve, analyze, and report, using the vast data resources available. This course introduces students to the technologies currently deployed to overcome the challenges of Big Data. Prerequisite: MGT 560G.

MGT 561 Text Mining

Consumers and companies constantly generate large amounts of unstructured or lightly structured texts on the web and offline: exchanges of consumer opinions on products and services on social media, transcripts of phone conversations with customer representatives, open-ended surveys, etc. By employing text analytics, businesses can derive at scale valuable insights into consumer attitudes to brands, competitive landscape, and customer relationships, among other applications. This course introduces students to the methods of mining, organizing, summarizing, and analyzing textual data with the objective of driving business decision-making. In particular, the course will cover the following substantive topics:
- Sources of business-relevant text data and web crawling;
- Topic analysis;
- Sentiment analysis;
- Use of text in predictive modeling (churn analysis, predicting CTR with search terms);
The focus of the course is on understanding and hands-on implementation of relevant algorithms and techniques, but the course will provide the opportunity to use a number of (open-source) software tools.

**MGT 560N Introduction to Cybersecurity**

This course covers a broad range of cyber security terms, definitions, perspectives, concepts, and current trends with a focus on managing risk and the use of information and cyber security as business enablers. Students will complete a cybersecurity analytics-related project as part of the coursework.

**MGT 500W Causal Inference**

This course introduces students to causal inference. The advance in information technology has given an enormous amount of valuable data to businesses. Data analysts and data scientists have become the cool kids due to high demand in data talents. In the meantime, however, artificial intelligence is getting better at finding correlational patterns in data. This means that AI may even replace some tasks performed by data scientists in the coming years.

The good news is that good data-driven decision making often goes beyond discovering correlations in the data. In particular, making the right prescriptive decisions often requires managers to tease out the causal relationship(s) between the prescriptions and outcomes of interest. Artificial intelligence has yet to show such abilities. Therefore, mastering causal inference is likely to become more rewarding over time as AI continues to complement human judgement with quick data analyses at a low cost.

Throughout the course, we will go over many examples of why understanding causal relationships is important. Spoiler alert: in one example, Lewis, Rao, and Reiley (2012) find that a naïve estimation could show that advertisement leads to an 870%--1,200% increase in consumers' likelihood of search for the advertised brand, while the true causal effect is 0. Imagine how disastrous it would be if companies make advertising decisions based on false causal inferences!

Our goals in the course are

- Use proper statistical tools to tease out the deterministic process that have generated the data in the presence of randomness.
- Become skeptical about claims of causality. You should be able to give alternative data generating processes that could have generated the same data.
- Understand that observational data come from agents’ decisions, and that these decisions could lead to biased samples.
- Understand omitted variable bias and reverse causality
- Design and implement various statistical and experimental methods of addressing the basic causal-inference problem using statistical software.
- Dig deeper into the mechanisms (decision trees) that yield the causal relations.
- Articulate analyses in presentations.

3 Credits
**Required Track Courses**

**OMM 576 Foundations of Supply Chain Management**

Examines how companies manage effectively the entire set of activities involved in the production and delivery of goods and services to their customers. Supply chain management (SCM) deals with the management of materials, information, and financial flows in networks consisting of suppliers, manufacturers, distributors, and customers. Recent trends in communication technology, sophisticated information systems, globalization of operations and markets, increased demand for mass customization, and increasing customer expectations have made the coordination and integration of these flows within and across companies critical to the success of businesses. This course focuses primarily on the foundations of SCM, touching topics such as: 1) matching supply with uncertain demand, 2) inventory management, 3) logistics, 4) design for variety, 5) global issues in SCM, 6) Quick/Accurate Response, 7) collaborative processes. 1.5 Credits.

**OMM 531 Supply Chain Finance**

This course focuses on understanding ways to better integrate operational and financial decisions within a supply chain. Our studied firms and world-class practices better integrate physical and financial flows by endogenizing not only the operational choices of the firm and its agents but also their financial decisions. Students will better understand how to make informed decisions using all relevant analytics tools at the interface of operations, finance and risk management. There are three main topics the course will explore: Supply Chain Financing: Understand how capital constraints of firms in a supply chain affect their operational choices, and what are better ways to finance working capital needs of a firm in a supply chain, when fully accounting for the operational and risk management implications of such solutions. The financing solutions that will be explored are divided into "supplier led" (e.g., trade credit) and "buyer led" (e.g., reverse factoring). Supply Chain Contracting in the presence of Financial Frictions: Study the effect of financial frictions (e.g. limited working capital, transaction costs, taxes, bankruptcy costs) on contracts and the implementation of operational strategies. The contracting issues to be explored within a supply chain finance setting are incentive coordination among firms in the chain, information asymmetries, and moral hazard issues. Integrated Operational and Financial Risk Hedging: Understand how operational and financial risks in global supply chains interact (e.g, exchange rates, commodity procurement risks, etc.), and what combination of operational and financial tools can be used to effectively manage those risks. PREREQ: OMM 510; OMM 5704

**OMM 500M Supply Chain Analytics: Stochastic Models**

This course covers the two key types of simulation models of uncertain events: Monte Carlo simulation and Discrete Event Simulation. The conceptual difference between these simulation methodologies is in their treatment of time. Discrete Event Simulation is used to model dynamic systems where events occur at specified, random, time. In Monte Carlo simulation the timing of events is typically inconsequential. Upon successful completion of this course, students will demonstrate competency in formulating and analyzing stochastic models using state-of-the-art simulation software. They will become proficient with software tools like **Arena** for Discrete Event Simulation and **Crystal Ball** for Monte Carlo simulation. The course emphasizes proficiency in using software tools to analyze models rather than theory. 1.5 Credits.
OMM 554  Operations Analytics

Examines approaches to problems of operations planning and control in various organizational settings. Topics include demand forecasting (data analysis, forecasting techniques, and control of forecasting systems), end-item inventory control (lot sizing, safety stock, and evaluation of systems), and materials requirements planning (master scheduling, shop scheduling, aggregate capacity planning, and systems implementation). 3 Credits.

OMM 501  Global Supply Chain Logistics System Design Project – Practicum

Students work in small teams on an operations and/or supply chain related consulting project for a client organization, applying insights from their course work to real-world business problems under supervision of both a faculty advisor and a client project lead. Each student is expected to spend about 150 hours on the project. Grades are based on the quality of the project work and the final deliverables (e.g., written and oral reports), as determined by the faculty advisor and client project lead. 1.5 Credits.

OMM 520  Revenue Management

This course examines the core concepts of revenue management: how to accurately align product pricing, placement, and availability with a retailer’s perception of consumer demand. Students will be introduced to linear and dynamic programming as a means to model a variety of capacity allocation and pricing problems that are relevant to airline, hotel, or restaurant industries. Specifically, most problems will be framed within the context of the single resource and network level revenue management problems. For the single resource problem, we will derive efficient exact solution methods and also consider a variety of extensions to the original model which incorporate overbooking and no-show behavior. For the network problem, we will learn how to extract near-optimal, and easily implementable policies from deterministic approximations. While the main goal of this course is to provide insight into industry specific problems, another central objective is to introduce students to concepts such as robust optimization and approximate dynamic programming to expand their breadth of modeling tools. Moreover, students will learn how to use Python to solve complex and industry-level optimization problems with data. At the successful completion of this course, students should feel confident modeling and analyzing a broad series of stochastic optimization problems. Students should also feel comfortable with using Python to make revenue management decisions with data. Beyond studying and analyzing classical RMP problems the students will gain valuable computational skills. Students will be asked to code up dynamic programming formulations, solve large scale linear programs with Python (coupled with Gurobi) and use machine learning techniques for demand estimation and forecasting.

OMM 558  Advanced Operation Strategy

This course deals with operations issues having a long-term impact on the corporate strategy, and on the competitive viability of a firm. We develop a general framework for creating and analyzing strategies for managing domestic and international manufacturing and service operations. The strategic decision categories to be examined include product-process technology strategies, facilities, and capacity management, performance measurement, managing quality and productivity, and system design. The course covers productivity measurement, process choice, product profiling, interfaces with marketing, experience costs, process positioning, accounting and financial perspectives, and international operations. It gives equal attention to service operations and manufacturing operations. Emphasis is on the application of systems thinking to case studies and the design of world class operations. It is valuable for students with an operations or general management focus, as well as for finance and marketing students. 3 Credits.
OMM 530 Supply Chain Analytics Capstone
This capstone course offers opportunities for students to apply various analytics techniques learned from different courses to large-scale real-world datasets and problems. Students will work on several projects, each involving (1) exploring dataset to identify problems, (2) defining project scopes, (3) conducting data analysis (prediction models, forecasting), (4) setting up decision making models (real-time, large-scale optimization models, simulation models), (5) prescribing decision recommendations. By applying relevant analytic tools and going through a complete problem solving process, students will gain confidence in applying theories and techniques to solve real-world problems.

Electives

OMM 500D  Project Management
Change management has become synonymous with project management, since organizations that want to change their focus or direction increasingly recognize that introducing new products, processes, or programs in a timely and cost effective manner requires professional project management. This course analyzes complex projects and discusses available tools for managing them. Some of the topics covered include life cycle models, project selection, project monitoring and control, planning with uncertainty, project risk management, the critical chain method, and managing multiple projects. It also discusses commercial project management software and how to overcome its limited functionality to address the requirements of managing risky complex projects in practice. Students learn project management skills that will be useful throughout their careers. As such, this course is essential for current or future managers regardless of their career concentration. 3 Credits.

OMM 500E  Supply Chain Risk Management
Many events in the last few years made supply chain managers keenly aware of the multiplicity and diversity of risks affecting them, from fluctuating commodity prices, unstable currencies, hurricanes and earthquakes, fires, terrorist attacks, contaminated material sourced from developing countries, and suppliers going bankrupt in tight financial credit environments. Building a functional supply chain requires careful planning and consideration of a variety of disruption risks, and it is of paramount importance to integrate management of physical flows and financial hedges when dealing with such risks. Companies that effectively manage their supply chain risks enjoy a level of robustness (flexibility) and resilience disruption-“proof-ness”) that affords them significant competitive advantage. This course will develop a comprehensive risk management framework for complex supply chains and introduce students to all needed decision tools for supply management and risk hedging. In addition, it will outline a portfolio of proven strategies to assess, reduce, hedge, and mitigate supply chain risks. 1.5 Credits

OMM 573  Operations Management in the Service Industry
The service industry is of vital importance to today’s economy. Through a greater understanding of the design and operation of services, productivity improvements can be achieved which result in real growth. In this course we will analyze both the strategic issues in service management as well as the particular aspects of running firms. We will discuss important issues in the operations of major service providers such as hotels and restaurants, airlines, retailers, financial services, and health care providers. We cover such topics as: service design, capacity and demand management, quality in services, variability and bottlenecks, and revenue management. The course will approach services from an operations management viewpoint, though related aspects of strategy, marketing, technology management and organizations will be discussed. Much of the discussion will focus on case studies
and articles. Students will be required to write-up several cases, complete other written assignments, and may be required to take part in a term project. 1.5 Credits.

**OMM 577 IT & Supply Chain Management**

Recent developments and breakthroughs in information technology have radically changed the business world, offering opportunities not only for new products and services also for reengineering supply chains and improving supply chain performance. The course will study how the innovations in information technology affect the ways information flows through the supply chain, which in turns provide opportunities to better coordinate the material and financial flows. The course will review business cases in which companies use supply chain management concepts and emerging technologies to improve business processes as well as creating values. 1.5 Credits.

**CSE 501N Programming Concepts and Practice**

An introduction to software concepts and implementation, emphasizing problem solving through abstraction and decomposition. Introduces processes and algorithms, procedural abstraction, data abstraction, encapsulation, and object-oriented programming. Recursion, iteration, and simple data structures are covered. Concepts and skills are mastered through programming projects, many of which employ graphics to enhance conceptual understanding. Java, an object-oriented programming language, is the vehicle of exploration. Active-learning sessions are conducted in a studio setting in which students interact with each other and the professor to solve problems collaboratively. Prerequisites: Comfort with algebra and geometry at the high school level is assumed. Patience, good planning, and organization will promote success. This course assumes no prior experience with programming. 3 Credits.

**CSE 503S Rapid Prototype Development and Creative Programming**

This course uses web development as a vehicle for developing skills in rapid prototyping. Students acquire the skills to build a Linux web server in Apache, to write a web site from scratch in PHP, to run an SQL database, to perform scripting in Python, to employ the AngularJS web framework, and to develop modern web applications in client-side and server-side JavaScript. The course culminates with a creative project in which students are able to synthesize the course material into a project of their own interest. The course implements an interactive studio format: after a formal presentation of a topic, students develop a related project under the supervision of the instructor. 330S and 503S share the same lecture.

**CSE 514A Data Mining**

With the vast advancement in science and technology, data acquisition in large quantities are routinely done in many fields. Examples of large data include various types of data on the internet, high-throughput sequencing data in biology and medicine, extraterrestrial data from telescopes in astronomy, and images from surveillance camera in security. Mining a large amount of data through data mining has become an effective means to extracting knowledge from data. This course introduces the basic concepts and methods for data mining and provides hands-on experience for processing, analyzing and modeling structured and unstructured data. Homework problems, examines and programming assignments will be administrated throughout the course to enhance the learning. 3 Credits

**CSE 517A Machine Learning**

This course assumes a basic understanding of machine learning and covers advanced topics at the frontier of the field in-depth. Topics to be covered include kernel methods (support vector machines, Gaussian processes), neural networks (deep learning), and unsupervised learning. Depending on
developments in the field, the course will also cover some advanced topics, which may include learning from structured data, active learning, and practical machine learning (feature selection, dimensionality reduction). 3 Credits.

**CSE 427S Cloud Computing with Big Data Applications**

This course provides a comprehensive introduction to applied parallel computing using the MapReduce programming model facilitating large scale data management and processing. There will be an emphasis on hands-on experience working with the Hadoop architecture, an open-source software framework written in Java for distributed storage and processing of very large data sets on computer clusters. Further, we will make use of related big data technologies from the Hadoop ecosystem of tools, such as Hive, Impala, and Pig in developing analytics and solving problems faced by enterprises today. 3 Credits.

**CSE 457A Introduction to Visualization**

We are in an era where it is possible to have all of the world's information at our fingertips. However, the more information we can access, the more difficult it is to obtain a holistic view of the data or to determine what's important to make decisions. Computer based visualization systems provide the opportunity to represent large and/or complex data visually to aid comprehension and cognition. In this course, we study the principles for transforming abstract data into effective information visualizations. We learn about the state-of-the-art in visualization research and development, and we gain hands-on experience with designing and developing information visualizations. We also learn how to critique existing visualizations and how to evaluate the systems we build. Readings will include current research papers from the Information Visualization community. 3 Credits.

**CSE 222S Internet of Things**

For a very long time, the Things in our world have lived relatively lonely and single-purposed lives. With the advent of the Internet of Things, we can address, control, and interconnect these formerly isolated devices to create new and interesting applications. In this course we study Bluetooth Low Energy, one of the fundamental networking technologies behind Internet-of-Things devices, and Accessories, which include smart watches, health monitors, toys, and appliances. In addition to learning about the Bluetooth Low Energy protocol and network stack, students gain hands-on experience developing multi-platform solutions that control and communicate with Things using an accompanying app on a mobile device. Students apply their knowledge and skill to develop a project of their choosing using topics from the course. Prereq: CSE 132 3 Credits.

**CSE 515T Bayesian Methods in Machine Learning**

This course will cover machine learning from a Bayesian probabilistic perspective. Bayesian probability allows us to model and reason about all types of uncertainty. The result is a powerful, consistent framework for approaching many problems that arise in machine learning, including parameter estimation, model comparison, and decision making. We will begin with a high-level introduction to Bayesian inference, then proceed to cover more-advanced topics. These will include inference techniques (exact, MAP, sampling methods, the Laplace approximation, etc.), Bayesian decision theory, Bayesian model comparison, Bayesian nonparametrics, and Bayesian optimization. Prerequisites: CSE 417T, ESE 326 3 Credits.

**CSE 530S Database Management Systems**

A study of data models and the database management systems that support these data models. The design theory for databases is developed and various tools are utilized to apply the theory. General
query languages are studied and techniques for query optimization are investigated. Integrity and security requirements are studied in the context of concurrent operations on a database, where the database may be distributed over one or more locations. The unique requirements for engineering design databases, image databases, and long transaction systems are analyzed. Prerequisite: CSE 247. 3 Credits.

**DAT 537 Data Analysis, Forecasting and Risk Analysis**

This course presents a modern and contemporary coverage of several econometric models that are used for the analysis and forecasting of business data. The basic building blocks for the analysis are regression time series models. Broad coverage of non-seasonal and seasonal ARIMA models is included. The important family of ARCH-GARCH models, used to represent changing volatility, are also covered in detail. These models are widely used in option pricing and in other financial applications. The course includes some extensions of these models to multivariable problems. Students are exposed to numerous real data sets in class and in assignments. All the models are analyzed with a popular econometrics software package that is employed in business. A group project is required. 3 Credits

**CSE 502N Algorithms and Data Structures**

Study of fundamental algorithms, data structures, and their effective use in a variety of applications. Emphasizes importance of data structure choice and implementation for obtaining the most efficient algorithm for solving a given problem. A key component of this course is worst-case asymptotic analysis, which provides a quick and simple method for determining the scalability and effectiveness of an algorithm. 3 Credits.

**CSE 316A Social Network Analysis**

This course looks at social networks and markets through the eyes of a computer scientist. We will look at questions including, "Why are acquaintances rather than friends more likely to get us job opportunities?" and, "Why do the rich get richer?" We begin by studying graph theory (allowing us to study the structure) and game theory (allowing us to study the interactions) of social networks and market behavior at the introductory level. Among other topics, we will study auctions, epidemics, and the structure of the Internet (including web searches). This course examines the intersection of computer science, economics, sociology, and applied mathematics.