Henry Edwin Sever Institute

With the Sever Institute’s flexible schedules, both new and experienced professionals can keep their careers moving forward while developing the knowledge and credentials that will set them apart. Our graduate students strive to make a positive impact on the challenges we face in technology, security and information management. The curriculum and course work will enhance students' knowledge and expertise. Students who complete our programs will understand the rapidly changing marketplace and be prepared to set the pace.

Degree Programs

- Master of Construction Management (http://bulletin.wustl.edu/grad/engineering/sever/construction-management/)
- Master of Cybersecurity Management (http://bulletin.wustl.edu/grad/engineering/sever/cyber-security-management/)
- Master of Engineering Management (http://bulletin.wustl.edu/grad/engineering/sever/engineering-management/)
- Master of Health Care Operational Excellence (http://bulletin.wustl.edu/grad/engineering/sever/health-care-operational-excellence/)
- Master of Information Systems Management (http://bulletin.wustl.edu/grad/engineering/sever/information-systems-management/)
- Master of Project Management (http://bulletin.wustl.edu/grad/engineering/sever/project-management/)

Graduate Certificates

- Graduate Certificate in Construction Management (http://bulletin.wustl.edu/grad/engineering/sever/construction-management/)
- Graduate Certificate in Cybersecurity Management (http://bulletin.wustl.edu/grad/engineering/sever/cyber-security-management/)
- Graduate Certificate in Engineering Management (http://bulletin.wustl.edu/grad/engineering/sever/engineering-management/)
- Graduate Certificate in Health Care Operational Excellence (http://bulletin.wustl.edu/grad/engineering/sever/health-care-operational-excellence/)
- Graduate Certificate in Information Systems Management (http://bulletin.wustl.edu/grad/engineering/sever/information-systems-management/)
- Graduate Certificate in Project Management (http://bulletin.wustl.edu/grad/engineering/sever/project-management/)

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Courses

Courses include the following:

- T54 PRJM (p. 1): Project Management
- T55 ETEM (p. 3): Engineering Management
- T64 CNST (p. 3): Construction Management
- T71 HLTHCARE (p. 4): Health Care Operations
- T81 INFO (p. 6): Information Management
- T83 CYBER (p. 7): Cybersecurity Management

Project Management

Visit online course listings to view semester offerings for T54 PRJM (https://courses.wustl.edu/CourseInfo.aspx?sch=T&dept=T54).

T54 PRJM 523 Project Planning Methodologies
This course will help students to build their expertise with today's critical project management methodologies for the modern world. Variations of Waterfall are widely used in industry, but new uses of Agile are being discovered every day, both inside and outside of software-based organizations. This course exposes the student to the fundamental and emerging techniques and tools used to manage successful projects of various sizes and complexity -- managing cost, schedule, quality, risk, solution, and requirements -- while adapting to today's fast-paced and uncertain business environment. The primary focus of this course is on Agile. Prerequisite: Graduate standing. Credit 3 units.

T54 PRJM 524 Hands-On With Traditional Project Management
This course offers a practical orientation for learning traditional project management techniques that produce predictable results (on time, within budget, and in accordance with stated specifications) and applying them to a project in trouble. Traditional project management is a universal and widely used practice that includes a set of developed techniques used for planning, estimating, and controlling activities. This course also introduces the standard project life cycle: initiating, planning, executing, controlling, and closing. Prerequisite: Graduate standing. Credit 3 units.
T54 PRJM 525 Introduction to Agile Project Management
SCRAM, XP, Kanban, ScrumBan, SAFs -- these are some of the key frameworks and processes covered in this course. Agile as a mindset, a skill set, and a tool set is critical in our fast-paced world. Today's businesses have either started or will soon begin their Agile journey. This course will use books from industry-recognized experts in the field of Agile development as well as case studies and varying practical assignments. Students will come away with a solid understanding of the core agile concepts, processes, best practices, roles and practices that are shown to deliver leading market and business value.
Credit 3 units.

T54 PRJM 526 The Art & Science of Risk Management
This course focuses on why many project managers miss requirements for schedule, budget or even both. The course concentrates on key risk management techniques practiced by leading project and program managers and taught through fact-filled lectures, case work and project execution as applied to information systems, engineering, financial, product/process and design projects/programs in today's fast-moving environment. Students will take away key value propositions, including risk identification, risk quantification, risk monitoring, risk control and risk mitigation. This course will enable the student to address common scope, schedule, quality and cost risk events that occur on complex projects. Project risk management examines the types of risk, with a focus on understanding the process of risk identification, assessment, prevention, mitigation, and recovery; governance, auditing, and control of confidentiality; integrity; and availability of data. Using common operational, strategic, tactical, and technological scenarios, the course work provides a comprehensive approach to the challenges faced by managers when global data is readily available, risk is pervasive, regulations are ever-increasing, and the threat of disruption from potential crises is real. Prerequisite: Graduate standing.
Credit 3 units.

T54 PRJM 527 Strategies of Projects, Programs & Portfolios
This course addresses the strategic alignment and prioritization of projects, programs and portfolios -- both alignment with an organization's business objectives as well as across multiple projects of a portfolio. This includes the alignment and management of project resources, project schedules, and management attention. Included is a team-based project simulation offering practical exposure to negotiating and assigning project resources, which is a key success factor in project management. Prerequisite: Graduate standing.
Credit 3 units.

T54 PRJM 528 Advanced Topics in Agile Project Management
DevOps, Scaling Agile, Product Funding, and Enterprise Transformation are just a few of the advanced topics that will be covered in this course. Enterprise Agile Transformation is a highly sought-after capability for today's organizations. This course will use books and case studies from industry-recognized experts in DevOps, Dual Systems, Value Chain, Agile Center of Excellence, and Agile Maturity Models focused on advancing and transforming an organization to an Agile Mindset. Students will come away with a solid understanding of how to build, coach, and measure an organization's Agile Transformation with the use of a maturity model. Students will also be exposed to finance changes as organizations transition from project to product funding, where value is the focus.
Credit 3 units.

T54 PRJM 529 Leading in a Technology-Rich World
Leadership has fundamentally changed from top-down, autocratic, and task-focused to collaborative and people-focused in just a few generations. Great senior leaders now get their people to do the greatest things. These leaders must constantly learn, think innovatively, move and adapt very quickly, and collaborate over short and long distances. Students will learn new leadership skills, explore their individual leadership styles, and discuss the senior leadership challenges of an evolving, technology-rich world.
Credit 3 units.

T54 PRJM 530 Human Performance in the Organization
Through this course, students will gain insights into and practice the art and science of leadership. This course addresses the leadership and management capabilities required to move into positions of greater responsibility, with a focus on technology-based organizations. Topics include leadership, goals, motivation and performance, management of change, conflict and effectiveness, organizational development and work design. When a leader gets better, everyone gets better. Prerequisite: Graduate standing.
Credit 3 units.

T54 PRJM 531 Communication Excellence for Influential Leadership
Exceptional communicators become extraordinary leaders. This course will guide students to learn to exceptionally communicate their message by applying refined nuances that inspire and transform those with whom they converse. Through a proven communicative process, students will acquire the skills necessary to differentiate them as leaders. Students will learn how to communicate across a variety of settings using strategies that result in clear, vivid, and engaging exchanges. Students will practice storytelling; creating and using clear visuals; engaging listeners; demonstrating passion when speaking; responding to questions with clarity and brevity; and using their distinctive voice as a leadership asset. Each student will learn how to assess their own communication capabilities, adjust to different listeners, evaluate speaker effectiveness, and provide valuable feedback to others. Video recordings will be used to demonstrate incremental communicative changes throughout the course and to show how these strategies bring about outstanding leadership. Prerequisite: Graduate standing.
Credit 3 units.

T54 PRJM 532 Cross-Cultural Negotiation
This course introduces students to and gives them practice with principle-based tools and techniques to reach agreements across varied cultures. Best practices from the most famous negotiators of ancient history (i.e., the Phoenicians) are studied and used as a methodology that includes the role of a third party in resolving conflict. The cross-cultural elements are based on multicultural experiences, research studies and the real-life experiences of the instructor. The course is highly interactive (about 70% of the course work). Participants learn through role plays and simulation as well as through readings and case-study analysis.
Credit 3 units.
Engineering Management

T55 ETEM 504 Engineering Management & Financial Intelligence
Discover the full picture of how business works within the organization. This course walks the student through the complete business cycle and demonstrates the roles that various functions play in a business operation as well as how information is used to make business decisions (e.g., financial data, marketing data, production data, economic data). To bring these learnings to life, this course also uses management simulation games and classroom competitions. Includes strategy, product planning and management, sales and support, research and development, and manufacturing and supply chain, with particular emphasis on accounting, finance, and the use of financial statements. Prerequisite: graduate standing. Credit 3 units.

T55 ETEM 505 Decision Analysis & Optimization
Expand your ability to analyze and optimize complex business situations by leveraging the key data. Decision-making in today's complex world requires advanced analytical methods and tools, including mathematical modeling and quantitative techniques. Powerful tools for forecasting, finance, operations, production and logistics. Emerging technologies such as the industrial "internet of things" and blockchain are enabling a whole new set of possibilities! Prerequisite: graduate standing, statistics. Credit 3 units.

T55 ETEM 506 Technology Strategy & Marketing
Learn the art and science of technology-rich strategy and marketing. Every business rises and falls on the value it brings to the customer and the value it simultaneously brings to the business itself. The engineer that understands and can communicate strategy and marketing is powerful! Business, technology and research budgets are allocated based on this value proposition, whether the commercialization or operationalization of the technology is one year out or 10 years out. Prerequisite: graduate standing. Credit 3 units.

T55 ETEM 510 Understanding Emerging & Disruptive Technologies
We live in an era of rapid technology innovation and disruption. Blockbuster was the darling of Wall Street in 2004 and filed for bankruptcy in 2010. According to the Blockbuster CEO in 2008, “Neither Redbox nor Netflix are even on the radar screen in terms of competition.” Blockbuster is not alone in their blindness. Microsoft laughed off the first iPhone and laughed off Google. IBM laughed off the first personal computer. These should be a horrible warning to all business leaders. Numerous technologies are threatening disruption today, including blockchain, the “internet of things,” artificial intelligence, autonomous vehicles, unmanned aerial vehicles (UAVs), 3D printing, 5G wireless networks, and gene editing. Understanding what they are and how they might disrupt will make or break countless companies in the coming years. Prerequisite: graduate standing. Credit 3 units.

T55 ETEM 520 Intro to Innovation & Entrepreneurship
Where do good ideas come from? Can anyone learn to be innovative? What does an innovative organization look and act like? How does innovation help create breakthrough technology and launch powerful businesses? Innovation is a skillset and a mindset, and they can be learned. This course introduces important frameworks and concepts, and it offers the student hands-on learning experiences that foster growth in innovation, both for the individual as well as for the organization. Credit 3 units.

T55 ETEM 525 Innovating For Defense
This interdisciplinary entrepreneurial course gives students the unique opportunity to solve real problems facing the U.S. Department of Defense (DoD) and the U.S. Intelligence Community (IC). This course is open to students from McKelvey School of Engineering and Olin Business School (in roughly equal proportions) who want to solve real problems for real customers in real time. Students will form their own interdisciplinary teams. Each team chooses their own DoD problems from those available to the class. Each problem has a dedicated DoD problem sponsor who will be regularly engaged with the team. Student teams learn and use the Lean Startup methodology and the Mission Model Canvas made famous by Stanford University to iteratively cut through the complexity of the problem. Teams develop a keen understanding of the problem, craft a business model and solution, and develop a prototype. Note: This course is sponsored by the U.S. DoD. It was originally developed at Stanford University and is now taught at 30+ U.S. universities. A student does NOT have to be a citizen of the United States to take this course; none of the DoD problems are classified. Credit 3 units.

T55 ETEM 585 MEM Capstone
The MEM capstone course is the culmination of the Master of Engineering Management degree program. Taken at the end of the program, the capstone course gives each student (as part of a team) an opportunity to apply a cross-section of knowledge and skills gained toward a current challenge/project from industry, government or nonprofit organization. Student teams are encouraged to interface with the sponsoring organization throughout the semester. Credit 3 units.

Construction Management
Visit online course listings to view semester offerings for T64 CNST (https://courses.wustl.edu/CourseInfo.aspx?sch=T&dept=T64).

T64 CNST 523A Construction Cost Estimating
Construction cost estimating explores the application of cost estimating principles and estimating within a project management framework in conjunction with scope definition, quality control, planning and scheduling, risk management and loss prevention techniques, local conditions, information and communication, and working relations with stakeholders. Using a single building project, the course introduces the application of basic quantity surveying and estimating principles using a methodical approach with suggested check lists and techniques.
T64 CNST 550D Heavy Civil Construction Management
This course provides a broad perspective of the means, methods, and procedures associated with managing civil engineering and heavy construction projects. Topics include strategic bidding and estimating, heavy equipment, marine construction heavy civil operations, and bridge building. Integration of scheduling, estimating, and construction contracts with a project-based approach. Prerequisites: graduate standing and CNST 573 or permission of instructor.
Credit 3 units.

T64 CNST 572 Legal Aspects of Construction
This course is a survey of the legal problems of the construction manager, including but not limited to liability in the areas of contracts, agency, torts, insurance, bad judgment, and oversight. Prerequisite: Graduate standing.
Credit 3 units.

T64 CNST 573 Fundamentals in Construction Management
In this course, students will be exposed to the overall construction process, from initial concept through startup of the completed facility. The focus is to provide familiarization with the construction and contracting process and with potential involvements by construction managers in the planning, design, construction, and post-construction phases. Additional topics are introduced to provide a foundation that will prepare students for future construction management coursework. Case studies and industry examples are used throughout the course to authenticate the lectures and assignments. Prerequisite: graduate standing.
Credit 3 units.

T64 CNST 574C Construction Project Planning and Scheduling
Project planning and scheduling process utilizing current techniques including critical path analysis for effective and logical scheduling of construction projects. Identification of project activities and their relationships; schedule development, analysis, and updating; relationship of project costs and resources to the schedule; legal implications; effective communication of schedule information; development of procedures to monitor actual field progress; computer application in project scheduling. Prerequisite: T64-573 or permission of instructor.
Credit 3 units.

T64 CNST 579 Advanced Construction Management
This course involves a comprehensive study of the operations encountered in the management of a construction firm. Topics include estimating, scheduling, forms of contracts, risk analysis and management, extra work orders, claims and disputes, construction safety, and contract close out. Prerequisites: T64 573, T64 574, T64 523A, and permission of program director.
Credit 3 units.

T64 CNST 580B Digital Construction Technology
This course focuses on BIM's philosophy of integration between designers, construction professionals and owners, in order to overcome both technological and implementation changes using Virtual Design and Construction (VDC) and Integrated Project Delivery (IPD). VDC is a methodology that relies on a multidisciplinary collaboration of the digital simulation of design & construction. IPD, on the other hand, integrates people, systems, business structures and practices into a process to optimize efficiency and productivity. In this course, students will learn about BIM's application by exploring 3D, 4D aspects of BIM including geometry, spatial relationships, quantity take off, estimation and scheduling. Along with that, students also will learn about Virtual Design and Construction (VDC) and Integrated Project Delivery (IPD) systems that are integral components of successful BIM projects.
Credit 3 units.

T64 CNST 581A MCM/MArch Capstone Project Phase 1
This capstone course allows MCM/MArch joint-degree program students to apply constructability principles to their MArch degree projects (A46 ARCH 616) and to successfully demonstrate how they have applied those principles. Constructability principles include analysis of the construction methods and procedures, project cost, time, value, quality, and safety. Phase 1 is to be taken simultaneously with A46 ARCH 616 Degree Project. Phase 1 students will develop a constructability review, analysis, and plan for their individual project. Prerequisites: Admission to the MCM/MArch joint-degree program, CNST 573, CNST 523A, and CNST 574C.
Credit 1 unit.

T64 CNST 581B MCM/MArch Capstone Project Phase 2
This capstone course allows MCM/MArch joint-degree program students to apply constructability principles to their MArch degree projects (A46 ARCH 616) and to successfully demonstrate how they have applied those principles. Constructability principles include analysis of the construction methods and procedures, project cost, time, value, quality, and safety. Phase 2 is to be taken after completing A46 ARCH 616 Degree Project. Phase 2 students will execute the constructability plan developed in Phase 1 and prepare and present the deliverables. Prerequisite: CNST 581A.
Credit 2 units.

Health Care Operations
Visit online course listings to view semester offerings for T71 HLTHCARE (https://courses.wustl.edu/CourseInfo.aspx?sch=T&dept=T71&crslvl=5:8).

T71 HLTHCARE 501 Introductory Overview of Operational Excellence in Health Care
This introductory course is designed to prepare students for the Master's of Healthcare Operational Excellence program. Students will learn the fundamentals of operational excellence principles and how the organizational complexities, regulatory and economic framework, and nuances of healthcare impact the ability to apply them. Students will research and explore both healthcare and non-healthcare examples of performance improvement and operational excellence efforts within different organizations and from different stakeholder perspectives.
Throughout the course, students will gain an understanding of how the various methods, both social and technical, can play an integral role in achieving operational excellence, and how to identify and mitigate challenges and barriers. Specific methods will include facilitating teams, change management, lean, six sigma, project management and the importance of principle-based deployments rooted in changing behaviors and transforming culture. By completing this introductory overview course, students will understand the level of personal transformation in mindset and skills that will be necessary in order to successfully impact the changes needed for health care operational excellence.

Credit 3 units.

T71 HLTHCARE 502 Facilitation Skills/Change Management
This course integrates strategy and organizational due diligence with facilitation and change management strategies. By examining the relationship between employees, teams, and organizations, students will explore each level and practice assessing and facilitating team processes to maximize productivity and results for members and stakeholders. The course addresses how to get things done when teams lack leadership or authority. Supporting topics include how to build teams, how to manage meetings, how to build relationships beyond the team, and how to keep teams effective over their life span. Students will learn processes of change and the techniques of change to apply to various types of organizations while using useful design frameworks for facilitation.

Credit 3 units.

T71 HLTHCARE 503 Lean Healthcare Concepts, Tools and Lean Management Systems
Students will learn and apply core Lean tools including Value Stream Mapping, 5S, Visual Management, Standard Work, JIT, Push/Pull, Error Proofing, and Daily Management. Critical to applying Lean effectively, participants will also learn how to plan and lead Rapid Improvement Events and other group activities and tactics. This program has been adopted by BJC executive leadership and is identified as a core competency for transformational efforts. Students will also learn the essential elements of a Lean Management System and how to accomplish sustainable results and the development of a continuous improvement culture.

Credit 3 units.

T71 HLTHCARE 504 Six Sigma Concepts and Tools
This course is designed to teach the tools associated with the five DMAIC phases: Define, Measure, Analyze, Improve and Control. Some of the tools considered for inclusion are Critical to Quality Matrix (CTQ), Failure Modes Effectiveness Analysis (FMEA), Statistical Analysis, Contingency Tables, Hypothesis Testing, Confidence Intervals, Correlation & Regression, Analysis of Variation (ANOVA), Pareto Analysis, Statistical Process Control (SPC), Measurement Systems Analysis (MSA), Data Collection, Time Studies, Root Cause Analysis (RCA), Fishbone Diagramming, Cost of Poor Quality (COPQ), SIPOC, Detailed Process Mapping, Cause and Effect tools, and Design of Experiment (DOE).

Credit 3 units.

T71 HLTHCARE 505 Healthcare Financial Models
This course provides an overview of how healthcare financing and reimbursement systems work in the United States. The course focuses on the evolution of insurance, HMOs, and managed care. Students learn how hospitals, outpatient centers, clinicians, and other providers are reimbursed for the services. Private and public reimbursement; state rate setting; risk management; new models of reimbursement; the role of billing, coding, and accounts receivable; and managed competition are explained.

Credit 3 units.

T71 HLTHCARE 506 Innovation Science and Human-Centered Design/Human Factors
This course is intended to introduce the student to the concept of "design thinking" as well as the process for innovating. It is dependent on an individual’s ability to observe what people are actually doing and how they are doing it. It also requires an iterative process for understanding, synthesizing, ideating, prototyping, testing, and implementing. Emphasis will be placed on how to build stakeholder/user personas and requirements as well as how to map their emotional experience with a process to gain more insights than a quantitative analysis alone would provide. Healthcare needs a "human-centered" design approach to navigate the blurring of lines between product and service, provider and patient. Designers of processes, methods, and systems now must take the needs of the entire world -- including the environment -- into account. Human factors will need to be applied during the iterative process to account for human factors and the parameters of users and uses.

Credit 3 units.

T71 HLTHCARE 507 Project Management in Healthcare
This course is a practical experiential orientation to project management processes, including relevance and application. Students will be exposed to the art of project leader competencies and emotional intelligence in addition to the science of traditional project management methodologies in a healthcare setting. Participants will engage in project initiation, including strategic organizational alignment, concept of why, and charter development. Project planning will include scoping, elicitation of stakeholder requirements, work breakdown structure, scheduling, cost, quality, resources, communications and risk management. Healthcare-related project management and execution will be the focus of practical application, along with other relevant examples from outside of the healthcare industry. Learners will apply the management of triple constraint (time, cost, schedule) as well as skills to align executive sponsor(s) and key stakeholders. Exposure will include disciplines of execution, monitoring, and controlling and closing processes. The course will integrate core concepts of initiating change, portfolio and program management, business analysis, performance improvement, and effective facilitation in a healthcare setting.

Credit 3 units.

T71 HLTHCARE 508 Capstone Seminar
This course integrates the learning from all disciplines and subject matter presented in the Master’s in Healthcare Operational Excellence program to complete a comprehensive, practical project in a healthcare-related organization. It will include a summary of the key topics covered within the program.
and how these apply to student’s projects. The course will also focus on leading organizational change and fostering a culture of continuous improvement in healthcare and related service organizations into the future.

Credit 3 units.

**T81 HLTHCARE 509 Capstone Project**

The capstone project incorporates operational excellence principles, the lean management system, rapid cycle improvement methods, data analysis, change management, facilitation, project management and healthcare cultural issues, thereby integrating the lessons learned through the course work to demonstrate students’ mastery of operational excellence in healthcare. Students will work in multidisciplinary teams, delivering a final project that applies their cumulative course work within a context of real industry work.

Credit 3 units.

**Information Management**

Visit online course listings to view semester offerings for T81 INFO (https://courses.wustl.edu/CourseInfo.aspx?sch=T&dept=T81&crslvl=5:8).

**T81 INFO 506 Fundamentals of Information Technology**

This course is designed to provide a comprehensive survey of the information technology field. The enterprise relies heavily on information technology to generate value, efficiency, and effectiveness. As such, organizational leaders must ensure that the enterprise transforms to keep pace in the competitive environment. Globalization, mergers and acquisitions, and the proliferation of new business and operating models require management to continuously reconsider technology infrastructures, organizational structures, process re-engineering, outsourcing, innovation, technology effectiveness, and the creation and management of data and knowledge. Given these challenges and opportunities, the IT professional has never been more crucial to organizational success. In this context, students will become familiar with core IT concepts, processes, and technology and gain an increased understanding of the crucial role of IT in the modern enterprise.

Credit 3 units.

**T81 INFO 517 Operational Excellence & Service Delivery**

This course examines needed management skills and processes for the efficient and effective functioning of IT infrastructure and operational environments to deliver the right set of services at the right quality and at the right costs for internal and external users and customers. Specific emphasis is placed on understanding the roles of IT operations, including system administration, network administration, help desk services, asset management, DevOps, and reporting. Students will study the application of industry best practice frameworks for the management of IT infrastructure, operations, and development. Frameworks covered include the Information Technology Infrastructure Library (ITIL) and Control Objectives for Information and Related Technology (COBIT). Through the application of continuous service improvement, students will understand the IT service life cycle and be able to assess the effectiveness of processes and services.

Credit 3 units.

**T81 INFO 540 IT Architecture & Infrastructure**

This course will demonstrate the importance of understanding organizational strategies and goals and then designing and deploying an information technology (IT) infrastructure that supports those strategies and goals. The course will showcase how fundamental IT building blocks are integrated in meaningful ways in order to support IT services that drive core business outcomes. Through a hands-on enterprise architecture design project, students will learn to design IT infrastructure in a rational, innovative, and cost-effective manner. We will cover a range of enterprise architecture design considerations that are commonly faced by organizations as they enhance their services, launch new products, or expand to new markets.

Credit 3 units.

**T81 INFO 555 Applications of Deep Neural Networks**

Deep learning is a group of exciting new technologies for neural networks. Through a combination of advanced training techniques and neural network architectural components, it is now possible to create neural networks of much greater complexity. Deep learning allows a neural network to learn hierarchies of information in a way that is like the functioning of the human brain. This course will introduce the student to computer vision with Convolution Neural Networks (CNN), time series analysis with Long Short-Term Memory (LSTM), classic neural network structures, and application to computer security. High Performance Computing (HPC) aspects will demonstrate how deep learning can be leveraged on both graphical processing units (GPUs) and grids. The focus is primarily on the application of deep learning to problems, with some introductory mathematical foundations. Students will use the Python programming language to implement deep learning using Google TensorFlow and Keras. It is not necessary to know Python prior to this course; however, familiarity with at least one programming language is assumed. This course will be delivered in a hybrid format that includes both classroom and online instruction.

Credit 3 units.
for the technology underpinnings of data life cycle management and sources. The ultimate goal is to create a strategic context making by establishing policies and ownership of key data types organization. EDM enables data-driven applications and decision quality of all data involved in the business processes of an approach to defining, governing, securing, and maintaining data as a strategic imperative. EDM is a comprehensive enterprise data strategy and management (EDM) practices thatUnfortunately, organizations have not developed comprehensive in — even drowning in — data but starved for knowledge. and challenge for contemporary organizations who are awash rapidly in importance across industry, government, and nonprofit organizations. This course seeks to equip students with a wide range of data analytics techniques that serve as the foundation for a broad range of applications, including descriptive, inferential, predictive, and prescriptive analytics. Students will learn the process of building a data model as well as a variety of analytics techniques and under what situations they are best employed. Through lectures and practical exercises, students will become familiar with the computational mathematics that underpin analytics: the elements of statistical modeling and machine learning; model interpretation and assessment; and structured and unstructured data analysis. Students will also undertake a project to build an analytical model using a "real-world" data set. Credit 3 units.

T81 INFO 575 Enterprise Data Management
Organizations have begun generating, collecting, and accumulating more data at a faster pace than ever before. The advent of "Big Data" has proven to be both opportunity and challenge for contemporary organizations who are awash in — even drowning in — data but starved for knowledge. Unfortunately, organizations have not developed comprehensive enterprise data strategy and management (EDM) practices that treat data as a strategic imperative. EDM is a comprehensive approach to defining, governing, securing, and maintaining the quality of all data involved in the business processes of an organization. EDM enables data-driven applications and decision making by establishing policies and ownership of key data types and sources. The ultimate goal is to create a strategic context for the technology underpinnings of data life cycle management and to ensure good stewardship of an organization's data. This course will cover the critical components of building an enterprise data strategy, including but not limited to data strategy, data governance, data security, data architecture, data quality, data ownership, and metadata management. Credit 3 units.

T81 INFO 576 Analytics Applications
This course builds on the content taught in Enterprise Data Management and Foundations of Data Analytics. It focuses on the strategic, operational, tactical, and practical use of data analytics to inform decisions within an organization across a range of industry and government sectors as well as within organizational functions. Students will be introduced to specific analytics techniques that are used currently by practitioners in areas of diagnostic, descriptive, predictive, and prescriptive analytics. Students will learn the critical phases of analytics including data preparation, model development, evaluation, validation, selection, and deployment. In so doing, students will learn to apply data analytics in order to optimize organizational processes, improve performance, and inform decision making. Credit 3 units.

T81 INFO 577 Applied Data Science for Practitioners
Organizations are rapidly transforming the way they ingest, integrate, store, and serve data and perform analytics. In this course, students will learn the steps involved with designing and implementing data science projects. Topics addressed include ingesting and parsing data from various sources, dealing with messy and missing data, transforming and engineering features, building and evaluating models, and visualizing results. Using Python as well as tools such as Numpy, Pandas, and Scikit-learn, students will complete a practical data science project that addresses the entire design and implementation process. Students will also become familiar with the best practices and current trends in data science, including writing elegant code, documenting and version controlling, creating reproducible research in container platforms, and working in a cloud environment. Upon completion of the course, students will emerge equipped with data science knowledge and skills that can be applied from day one on the job. Credit 3 units.

T81 INFO 585 Capstone
This capstone course is the culmination of the Masters of Information Systems Management program. The capstone project provides the opportunity for students to employ the knowledge and skills they have gained from their course work in a rigorous and systematic manner. Projects are sponsored by external corporate, government, and non-profit organizations, and they provide the opportunity for students to deliver meaningful research and recommendations for "real-world" IT challenges and problems. Credit 3 units.

Cybersecurity Management
Visit online course listings to view semester offerings for T83 CYBER (https://courses.wustl.edu/CourseInfo.aspx?sch=T&dept=T83).
T83 CYBER 559 Introduction to Cybersecurity
This course is intended as a comprehensive introduction to the cybersecurity field. It covers a broad range of cybersecurity terms, definitions, historical perspectives, concepts, processes, technologies, and trends, with a focus on managing risk and the employment of cybersecurity as an organizational enabler. Credit 3 units.

T83 CYBER 560 Cybersecurity Technical Fundamentals
This course presents a detailed and comprehensive study of network environments against cyber threats. Students will gain practical experience in secure network architectures and design approaches. Using a building-block approach to case studies and design exercises, the course will establish the value of applied foundational security frameworks and system models. Specific topics include defensive network design, advanced treatment of appropriate security implementation tools and techniques, boundary defense, secure wireless and mobility solutions, remote and business partner access, and third-party vendor interactions to ensure appropriate enterprise network solutions are implemented. Credit 3 units.

T83 CYBER 561 Oversight for Excellence: Cybersecurity Management and Governance
This course takes a comprehensive approach to the management of the organizational cybersecurity function. It also explores the principles of information technology governance. Course work provides a deeper understanding of best practices for managing cybersecurity processes and meeting multiple needs of enterprise management through lab exercises, in-class studios, and scenarios. Topics covered include security considerations surrounding operating systems, the web, email, databases, wireless technology, the cloud, and the Internet of Things. Also addressed are cryptography, secure software design, physical security, and human factors in cybersecurity. Credit 3 units.

T83 CYBER 562 Efficient and Effective Cybersecurity Operations
In this course, students will gain understanding of what it takes to manage the people, processes, and technology needed for effective and efficient day-to-day cybersecurity operations. Using the Cybersecurity Operations Center (CSOC) as the fundamental exemplar, students will learn the functions and processes that comprise a typical CSOC, with an underlying focus on continually optimizing operations for agility and performance. Options for structuring the CSOC will be examined along with core CSOC functions and processes, such as threat intelligence; monitoring, detection, and threat assessment; vulnerability management; incident response; prevention, including awareness training; partner and third-party coordination; analytics, metrics, and reporting; training; and CSOC technologies and instrumentation. Credit 3 units.

T83 CYBER 563 Enterprise Network Security
This course presents a detailed and comprehensive study of the architecture and defensive approaches to protect enterprise network environments against cyber threats. Students will gain practical experience in secure network architectures and design approaches. Using a building-block approach to case studies
T83 CYBER 567 The Hacker Mindset: Cyber Attack Fundamentals
This course is designed to provide an introductory understanding of how offensive security techniques practically operate. During this course, students will use hacking techniques to compromise systems, collect data, and perform other tasks that fall under the generally understood use of the term "hacker." These techniques will be related to risk-based defensive security practices, with a view toward enhancing the student’s understanding of what it takes to be a successful “defender.” By the conclusion of the course, students will have a baseline technical understanding of hacking techniques; they will have executed offensive security operations and increased their technical understanding of what it takes to deal with cyber threats.
Credit 3 units.

T83 CYBER 568 Emerging Issues and Technology in Cybersecurity
Each new technology advancement brings with it promises and challenges. Will it be used for good, or will it lead to disaster? This course examines contemporary and near-future cybersecurity threats and the potential security impact of new technologies. Topics include new forms of computing and communications and their implications for cybersecurity practitioners as well as incipient threat vectors. Historical security incidents will also be used to provide context and insight into the relationship of technology and security. Throughout the course, students will be challenged to develop strategies and responses to deal with emerging technologies and threats in the ever-evolving cybersecurity domain.
Credit 3 units.

T83 CYBER 569 Incident Response and Business Continuity
This course focuses on the end-to-end process and methods to deal with cybersecurity incidents. Using recent examples of cyber breaches and incidents, students explore how CISOs react and respond to these incidents and learn best practices for doing so. Topics include developing an incident response plan, organizing an incident response team, leveraging cyber intelligence and external partners to aid in response, handling public and private communications about the incident, and post-breach restoration. Particular attention will be paid to establishing a strong understanding of cybersecurity indicators and motives for espionage activities from both an external and rogue insider's perspective. Students will learn about host-based and network incident response tools and digital forensic tools, including techniques and tactics for their effective use. This section of the course includes key “hands-on” activities that are typically used in post-breach analysis and investigations, such as the forensic analysis of network storage, hard drives, and memory. Students will also become familiar with post-breach report construction and examine the proper drafting and use of such reports for submission to legal counsel, the courts, and organizational leaders.
Credit 3 units.

T83 CYBER 570 Managerial and Technical Approaches to Cybersecurity Assurance
How do you know if your organization is secure? How do you communicate your security posture with confidence to non-practitioners, especially your senior leadership and the board. This course provides you the concepts, methods, tools, and intellectual thought process to achieve cybersecurity assurance and how you as cybersecurity leaders communicate that assurance to the C-suite and the board. Topics covered include adopting a cybersecurity maturity model, metrics selection and development, the critical role of internal and external security assessments and compliance audits, vulnerability management as a foundation of cybersecurity assurance, and how to effectively employ red/blue team activities.
Credit 3 units.