mary research sources. Specific topics covered each semester may vary slightly. Examples of topics include: subliminal perception; automatic processing; implicit memory; eyewitness testimony; memory reconstruction; expertise and problem solving; the use of heuristics in decision making; person memory.
Prerequisite: 212 and 275

400 Seminar in Cognitive and Language Development
Current theory and research regarding children's understanding, thinking processes, and language acquisition are discussed. Topics include knowledge acquisition, concept formation, grammatical development, and the nature of developmental change.
Prerequisites: 200 and one additional PSY course or permission of the instructor

401 Physiological Psychology
A study of the brain, its function and its control of behavior. Neuroanatomical, neurophysiological, and biochemical substrates of behaviors associated with feeding, drinking, sex, sleep, arousal, emotion, learning and memory are examined. Four lectures and three laboratory hours per week.
Prerequisites: 212 and BIOL 101 (or equivalent)

407 Seminar in Behavioral Neuroscience
Analysis and discussion of selected theories and new research concerning brain mechanisms that subserve behavior. Advances in methodology and instrumentation also will be examined.
Prerequisite: 401

422 History and Systems
How contemporary psychology developed from its remote and more recent roots. Emphasis upon the contributions, contributors and perennial issues that led to psychology today and that could help to fashion its future.
Prerequisites: four courses in psychology

424 Clinical Psychology
Study of the clinical application of the psychological processes in the evaluation, diagnosis and treatment of behavioral disorders
Prerequisites: 301 and three psychology courses or permission of instructor

428 Theories of Counseling and Psychotherapy
Theories and procedures of counseling and psychotherapy are discussed, including psychoanalysis, client-centered therapy, cognitive therapy, behavior therapy, and others.
Prerequisites: 301 and three psychology courses or permission of the instructor

475, 476, 477, 478 Experiential Learning
See the description of these courses at the beginning of the "Departments and Curricula" section of this catalog.

483, 484, 485, 486 Seminar
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487, 488, 489, 490 Topics
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491, 492, 493, 494 Research
See the description of these courses at the beginning of the "Departments and Curricula" section of this catalog.

495, 496, 497, 498 Individual Study
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Public Relations

See Department of Journalism and Mass Communication.

Quantitative Methods and Computer Science (QMCS)

Schwebel (chair), Bennett, Hanna, Hansen, Jaede, Jarvis, Misra, Raymond, Sharrock, Sturm, Werness, West, Callaghan*, Darling*, Kaminski*

Quantitative Methods and Computer Science is part of the liberal arts curriculum at the University of St. Thomas. The QMCS program is concerned with the areas of today's society that involve the collection, organization, processing, storage, retrieval, communication and use of information. The

department's emphasis is on the broad basic core of knowledge required to become an effective user of information; to design and implement system and application software; and to understand the concepts involved in areas such as computer graphics, telecommunication, artificial intelligence, database design, statistics and operations research.

The department has arranged its program to prepare students to work in business, industry, education, and government, as designers or users, or to pursue entrepreneurial interests in technologically supported areas or to continue study in graduate school. Courses are arranged so that students from other disciplines may participate to whatever extent they wish.

The undergraduate major or minors in QMCS are offered in the day school and through the School of Continuing Studies.

Students interested in elementary education and math, science or computer science should see Science and Mathematics in Elementary Education.

Major in Quantitative Methods and Computer Science

One of:
130 Problem Solving in the Natural Sciences*
237 Software Design using Scientific Languages*
238 Software Design Using Business Languages*

Plus:
220 Statistics I
280 Object-Oriented Design and Programming*
350 Data and File Structures
*A grade of C- or higher must be earned by majors in each of these courses chosen to fulfill the core requirement.

Plus (for all majors):
Two elective courses numbered 240 through 450. Students should consult with their department adviser in choosing the most appropriate courses.

Plus:
A set of courses in one of three paths (CS, CIS, or QM) below:

Computer Science (CS)
A traditional computer-science path that emphasizes low-level computing fundamentals as well as high-level design issues.
420 Systems Analysis and Design I
450 Database Design

Plus one of:
300 Computer Organization
340 Digital Electronics and Microprocessors

Computer Information Systems (CIS)
A management information systems path emphasizing high-level design issues and designer/user interaction.
420 Systems Analysis and Design I
450 Database Design

Plus one of:
421 Systems Analysis and Design II
425 Information Resource Management

Quantitative Methods (QM)
A path emphasizing the role of statistics, mathematics and operations research as well as the use of computers in solving problems in organizations.
410 Operations Research I

Plus two of:
320 Statistics II
411 Operations Research II
420 Systems Analysis and Design I
450 Database Design

Allied requirements:
MATH 128 Introduction to Discrete Mathematics

Plus one of:
MATH 109 Calculus with Review II
MATH 111 Calculus for Business and Social Science
MATH 113 Calculus I

Plus one of:
COMM 100 Public Speaking
COMM 105 Communication in the Workplace

The department also strongly encourages its majors to obtain a minor in another field.

Minor in Quantitative Methods and Computer Science – for sciences
This minor is intended to support majors in biology, chemistry, environmental studies, geology, mathematics and physics.
280 Object-Oriented Design and Programming

Plus one of:
130 Problem Solving in the Natural Sciences
237 Software Design Using Scientific Languages

Plus three of:
220 Statistics I
300 Computer Organization
320 Statistics II
330 Graphics and Numerical Methods
340 Digital Electronics and Microprocessors
342 Computer Applications in Experimental Sciences
350 Data and File Structures
380 Artificial Intelligence and Robotics
381 Expert Systems
410 Operations Research I
411 Operations Research II
450 Database Design

Minor in Quantitative Methods and Computer Science – for business
This minor is intended to support majors in any concentration of business administration, economics and other related disciplines.
110 Introduction to Information Processing

Plus one of:
237 Software Design using Scientific Languages
238 Software Design using Business Languages

Plus three of:
280 Object-Oriented Design and Programming
420 Systems Analysis and Design I
425 Information Resource Management
450 Database Design

Minor in Quantitative Methods and Computer Science – for mathematics
This minor is intended to support majors in mathematics and those interested in statistics and operations research.
One of:
130 Problem Solving in the Natural Sciences
237 Software Design Using Scientific Languages

Plus four of:
220 Statistics I
280 Object-Oriented Design and Programming
320 Statistics II
330 Graphics and Numerical Methods
410 Operations Research I
411 Operations Research II

110 Introduction to Information Processing
Introduction to basic concepts of hardware, software and information processing systems. Introduction to computer programming concepts.Use of microcomputer application packages, including spreadsheets and database packages. Introduction to the Internet and World Wide Web. Investigation of the impact of the computer and future trends. This course fulfills the second-level Computer Competency requirement in the core curriculum.

120 Computers in Elementary Education and LOGO
This course is intended for elementary education majors. Topics will include the role of the computer in elementary education, computer applications in science and mathematics, software packages

for use in elementary school classrooms, Computer-Assisted Instruction (CAI), multimedia, telecommunication and LOGO programming, experiments and examples. LOGO will be used to teach programming concepts and to solve problems in math and science using LOGO's arithmetic, graphic and animation capabilities. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: elementary education or SMEE major

130 Problem Solving in the Natural Sciences (237)
Introduction to solving problems in the natural sciences with the aid of a computer. Introduction to the use of scientific languages for writing programs to solve scientific problems. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: MATH 109 or 111 or 113

201 Introductory Statistics II (220) 2 credits
This course is for students desiring to satisfy the coverage of QMCS 220 (a full semester of statistics), but who have taken less than one full semester of statistics. Review of basic statistical techniques (confidence intervals, hypothesis testing, regression), multiple regression, contingency tables, analysis of variance, sampling, plus emphasis on use of statistical packages and design of a statistical study.
Prerequisite: 206 or at least .35 semester, but less than one semester, of statistics

215 Spreadsheet and Database Software
Introduction to current, user-friendly program development tools. These tools allow non-programmers to create usable software without significant programmer assistance. Students will be exposed to software packages emphasizing structured programming techniques, integrated spreadsheet processors, database management software and application generators. QMCS majors may take this course but it cannot substitute for a QMCS course specified for an individual concentration nor serve as a prerequisite for QMCS 280. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: 110 or equivalent

216 Quantitative Techniques in Business (110) 2 credits
The use of microcomputer spreadsheet software to aid in solving quantitative business problems.
Prerequisite: ACCT 211

220 Statistics I (201)
Introductory applied statistics: sampling, descriptive (exploratory) statistics, probability, sampling distributions, estimation and hypothesis testing, non-parametrics, simple and multiple linear regression, introduction to analysis of variance; use of statistical packages. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: math placement at level of MATH 111 or above; or MATH 100, 101, or 105, or 109, 111 or 113

237 Software Design Using Scientific Languages (130)
Introduction to applications software using algorithmic programming languages. Topics include: algorithm development, sequential and direct-access file processing, arrays, iteration and recursion, structured programming and program correctness. This course fulfills the second-level Computer Competency requirement in the core curriculum.

238 Software Design Using Business Languages
Introduction to applications software using COBOL and other business languages. Topics include algorithm development, sequential and direct-access file processing, tables, sorting, structured programming and software validation. This course fulfills the second-level Computer Competency requirement in the core curriculum.

280 Object-Oriented Design and Programming
Object-oriented design and programming using an object-oriented language with procedural capabilities (such as C++ or JAVA). Object-oriented design and programming topics include: classes, inheritance, encapsulation, polymorphism, information hiding, patterns, and CRC cards. Typical programming language topics might include: templates, exception handling, virtual functions, and the parameterized data types. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: 130 or 234 or 237 or 238

295, 296, 297, 298 Topics
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300 Computer Organization (formerly 240)
Concepts of computer system organization and programming. Instruction and data representations. Instruction set decoding, addressing modes, and fundamentals of assembly language. The organization and the operation of the central processing unit, instruction fetching and execution, hardwired and microprogrammed control, I/O structures, direct memory access, interrupts, bus protocols and I/O interfaces, multiple-module memory, caches, memory, memory organization, registers, microprocessor families, pipelining, and RISC features.
Prerequisite: 130, or 237, or 238 and MATH 128

320 Statistics II
Analysis of variance; regression with indicator variables; topics from: general linear model; design of experiments; further use of statistical packages, discriminant, cluster analysis, time series.
Prerequisite: 201 or 220

330 Graphics and Numerical Methods
An integrated approach to using the computer to solve numerical problems and to present information in graphical form. Includes: non-linear equations, systems of linear equations, interpolation, approximation, differential equations, two and three-dimensional picture transformations plus viewing and rendering of graphical images.
Prerequisite: 130, or 237 and MATH 109, or 111 or 113

340 Digital Electronics and Microcomputers
Digital electronics techniques: semiconductor devices, digital logic, counters, clocks, shift registers, combinatorial and sequential logic circuits and minimization. Microprocessor organization, programming, device addressing, buffering and enabling. Microprocessor interfacing with switches, A to D, D to A, and communications.
Prerequisite: 130, or 237, or 238 and MATH 128

342 Computer Applications in Experimental Sciences
Introduction to the use of computers in the collection and analysis of scientific information. The course is designed to meet the needs of both natural science majors with an interest in scientific computing and computer science majors with an interest in laboratory science. Emphasis is placed on application of concepts and techniques using software packages and not on programming. Topics include laboratory device interfacing, analog-signal acquisition and processing, data-analysis packages and simulation. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisites: 130, or 237 or 238; MATH 109, or 111 or 113; and one course in a laboratory science

350 Data and File Structures
A study of data handling as related to both computer hardware and software. Data structures, direct access storage devices, file accessing mechanisms, sorting and searching, file recovery, database security and maintenance of integrity.
Prerequisites: 280 and MATH 128

360 Operating Systems Design
Topics include batch and interactive processing, concurrent processes, memory management, resource allocation, deadlock, processor scheduling and system security.
Prerequisite: 130 or 237 or 238

370 Telecommunications and Teleprocessing
The fundamental concepts of telecommunications and networking for voice, data and video, including hardware, media, signaling and digital switching, open-system interconnection model, standards and protocols, local and wide-area networks and inter-networking.
Prerequisites: 130, or 237, or 238 and MATH 128

371 Advanced Voice and Data Communications
Analysis of voice, data and video telecommunication requirements, network configuration, network operations, network monitoring and optimization, documentation and legal issues.
Prerequisite: 370

380 Artificial Intelligence and Robotics
Theory and implementation techniques using computers to solve problems, play games, prove theorems, recognize patterns, create artwork and musical scores, translate languages, read handwriting, speak and perform mechanical assembly. Emphasis placed on implementation of these techniques in robots.
Prerequisites: 220 and 280

381 Expert Systems
Emphasis on a practical understanding of artificial intelligence, LISP, and the expert system-building process. Course goals include understanding what expert systems are, how they operate, techniques

used to build expert systems, and evaluating commercially available expert systems packages.
Prerequisites: 280 and junior standing

410 Operations Research I
Utilization of computer and analytic techniques to support the decision-making process in both the public and private sectors. Topics include linear programming, simulation, PERT, inventory control, goal programming and queuing theory. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: 220; MATH 109, or 111 or 113

411 Operations Research II
Advanced modeling techniques. Techniques include: decision theory, Markov chains, integer programming, dynamic programming, forecasting, game theory, transportation problems and decision theory.
Prerequisite: 410; MATH 112 or 114

420 Systems Analysis and Design I
A study of process, data, and object models for the analysis and design of information systems. Includes enterprise models, data-flow diagrams, structure charts, entity-relationship models, normalization and state transition diagrams. Alternative system development life cycles are discussed, as well as testing, quality and installation strategies.
Prerequisites: 130 or 237 or 238 and junior standing

421 Systems Analysis and Design II
Continuation of 420. Concentration on implementation problems, software and hardware limitations. Emphasis on managerial problems in an information-processing system. Continued use of computer-based analysis and design and project-management tools. A "real world" project is an integral part of this course.
Prerequisite: 420

425 Information Resource Management
A study of relevant technologies and how they are used in today's modern organizations to help manage the information resource of those organizations. Emphasis is placed on the organizational issues and concerns wrought by these technologies. This is an "active learning" course in which students will be researching current information systems technologies and participating in the establishment of an organization that provides information services.
Prerequisites: 130 or 237 or 238 and junior standing

450 Database Design
Introduction to database management systems design philosophy. Design considerations for satisfying both availability and integrity requirements. Data models used to structure the logical view of the database. Schema, subschemas, binding. Custom, special purpose and generalized database systems.
Prerequisite: 280 or 420 or 425

460 Senior Project
Work on a software analysis, design, and implementation project under the direction of a faculty member.
Prerequisite: Senior status with approved B.S. degree program on file and permission of the instructor

475, 476, 477, 478 Experiential Learning
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483, 484, 485, 486 Seminar
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