

Assign this CCS Concept

[Flat View](#)

CCS

General and reference

Document types

- Surveys and overviews
- Reference works
- General conference proceedings
- Biographies
- General literature
- Computing standards, RFCs and guidelines

Cross-computing tools and techniques

- Reliability
- Empirical studies
- Measurement
- Metrics
- Evaluation
- Experimentation
- Estimation
- Design
- Performance
- Validation
- Verification

Hardware

Printed circuit boards

- Electromagnetic interference and compatibility
- PCB design and layout

Communication hardware, interfaces and storage

- Signal processing systems
 - Digital signal processing
 - Beamforming
 - Noise reduction
- Sensors and actuators
- Buses and high-speed links
- Displays and imagers
- External storage
- Networking hardware
- Printers
- Sensor applications and deployments
- Sensor devices and platforms
- Sound-based input / output
- Tactile and hand-based interfaces
 - Touch screens
 - Haptic devices
- Scanners
- Wireless devices
- Wireless integrated network sensors

- Electro-mechanical devices

- **Integrated circuits**

- 3D integrated circuits

- Interconnect

- Input / output circuits

- Metallic interconnect

- Photonic and optical interconnect

- Radio frequency and wireless interconnect

- Semiconductor memory

- Dynamic memory

- Static memory

- Non-volatile memory

- Read-only memory

- Digital switches

- Transistors

- Logic families

- Logic circuits

- Arithmetic and datapath circuits

- Asynchronous circuits

- Combinational circuits

- Design modules and hierarchy

- Finite state machines

- Sequential circuits

- Reconfigurable logic and FPGAs

- Hardware accelerators

- High-speed input / output

- Programmable logic elements

- Programmable interconnect

- Reconfigurable logic applications

- Evolvable hardware

- **Very large scale integration design**

- 3D integrated circuits

- Analog and mixed-signal circuits

- Data conversion

- Clock generation and timing

- Analog and mixed-signal circuit optimization

- Radio frequency and wireless circuits

- Wireline communication

- Analog and mixed-signal circuit synthesis

- Application-specific VLSI designs

- Application specific integrated circuits

- Application specific instruction set processors

- Application specific processors

- Design reuse and communication-based design

- Network on chip

- System on a chip

- Platform-based design

- Hard and soft IP

- Design rules

- Economics of chip design and manufacturing

- Full-custom circuits

- VLSI design manufacturing considerations

- On-chip resource management

- On-chip sensors

- Standard cell libraries
- VLSI packaging
 - Die and wafer stacking
 - Input / output styles
 - Multi-chip modules
 - Package-level interconnect
- VLSI system specification and constraints

○ **Power and energy**

- Thermal issues
 - Temperature monitoring
 - Temperature simulation and estimation
 - Temperature control
 - Temperature optimization
- Energy generation and storage
 - Batteries
 - Fuel-based energy
 - Renewable energy
 - Reusable energy storage
- Energy distribution
 - Energy metering
 - Power conversion
 - Power networks
 - Smart grid
- Impact on the environment
- Power estimation and optimization
 - Switching devices power issues
 - Interconnect power issues
 - Circuits power issues
 - Chip-level power issues
 - Platform power issues
 - Enterprise level and data centers power issues

○ **Electronic design automation**

- High-level and register-transfer level synthesis
 - Datapath optimization
 - Hardware-software codesign
 - Resource binding and sharing
 - Operations scheduling
- Hardware description languages and compilation
- Logic synthesis
 - Combinational synthesis
 - Circuit optimization
 - Sequential synthesis
 - Technology-mapping
 - Transistor-level synthesis
- Modeling and parameter extraction
- Physical design (EDA)
 - Clock-network synthesis
 - Packaging
 - Partitioning and floorplanning
 - Placement
 - Physical synthesis
 - Power grid design
 - Wire routing

- Timing analysis
 - Electrical-level simulation
 - Model-order reduction
 - Compact delay models
 - Static timing analysis
 - Statistical timing analysis
 - Transition-based timing analysis
- Methodologies for EDA
 - Best practices for EDA
 - Design databases for EDA
 - Software tools for EDA

○ **Hardware validation**

- Functional verification
 - Model checking
 - Coverage metrics
 - Equivalence checking
 - Semi-formal verification
 - Simulation and emulation
 - Transaction-level verification
 - Theorem proving and SAT solving
 - Assertion checking
- Physical verification
 - Design rule checking
 - Layout-versus-schematics
 - Power and thermal analysis
 - Timing analysis and sign-off
- Post-manufacture validation and debug
 - Bug detection, localization and diagnosis
 - Bug fixing (hardware)
 - Design for debug

○ **Hardware test**

- Analog, mixed-signal and radio frequency test
- Board- and system-level test
- Defect-based test
- Design for testability
 - Built-in self-test
 - Online test and diagnostics
 - Test data compression
- Fault models and test metrics
- Memory test and repair
- Hardware reliability screening
- Test-pattern generation and fault simulation
- Testing with distributed and parallel systems

○ **Robustness**

- Fault tolerance
 - Error detection and error correction
 - Failure prediction
 - Failure recovery, maintenance and self-repair
 - Redundancy
 - Self-checking mechanisms
 - System-level fault tolerance
- Design for manufacturability
 - Process variations
 - Yield and cost modeling

- Yield and cost optimization
- Hardware reliability
 - Aging of circuits and systems
 - Circuit hardening
 - Early-life failures and infant mortality
 - Process, voltage and temperature variations
 - Signal integrity and noise analysis
 - Transient errors and upsets
- Safety critical systems

Emerging technologies

- Analysis and design of emerging devices and systems
 - Emerging architectures
 - Emerging languages and compilers
 - Emerging simulation
 - Emerging tools and methodologies
- Biology-related information processing
 - Bio-embedded electronics
 - Neural systems
- Circuit substrates
 - III-V compounds
 - Carbon based electronics
 - Cellular neural networks
 - Flexible and printable circuits
 - Superconducting circuits
- Electromechanical systems
 - Microelectromechanical systems
 - Nanoelectromechanical systems
- Emerging interfaces
- Memory and dense storage
- Emerging optical and photonic technologies
- Reversible logic
- Plasmonics
- Quantum technologies
 - Single electron devices
 - Tunneling devices
 - Quantum computation
 - Quantum communication and cryptography
 - Quantum error correction and fault tolerance
 - Quantum dots and cellular automata
- Spintronics and magnetic technologies

Computer systems organization

Architectures

- Serial architectures
 - Reduced instruction set computing
 - Complex instruction set computing
 - Superscalar architectures
 - Pipeline computing
 - Stack machines
- Parallel architectures
 - Very long instruction word
 - Interconnection architectures
 - Multiple instruction, multiple data
 - Cellular architectures

- Multiple instruction, single data
- Single instruction, multiple data
- Systolic arrays
- Multicore architectures
- Distributed architectures
 - Cloud computing
 - Client-server architectures
 - n-tier architectures
 - Peer-to-peer architectures
 - Grid computing
- Other architectures
 - Neural networks
 - Reconfigurable computing
 - Analog computers
 - Data flow architectures
 - Heterogeneous (hybrid) systems
 - Self-organizing autonomic computing
 - Optical computing
 - Quantum computing
 - Molecular computing
 - High-level language architectures
 - Special purpose systems

○ **Embedded and cyber-physical systems**

- Sensor networks
- Robotics
 - Robotic components
 - Robotic control
 - Evolutionary robotics
 - Robotic autonomy
 - External interfaces for robotics
- Sensors and actuators
- System on a chip
- Embedded systems
 - Firmware
 - Embedded hardware
 - Embedded software

○ **Real-time systems**

- Real-time operating systems
- Real-time languages
- Real-time system specification
- Real-time system architecture

○ **Dependable and fault-tolerant systems and networks**

- Reliability
- Availability
- Maintainability and maintenance
- Processors and memory architectures
- Secondary storage organization
- Redundancy
- Fault-tolerant network topologies

● **Networks**

○ **Network architectures**

- Network design principles
 - Layering

- Naming and addressing
- Programming interfaces
- **Network protocols**
 - Network protocol design
 - Protocol correctness
 - Protocol testing and verification
 - Formal specifications
 - Link-layer protocols
 - Network layer protocols
 - Routing protocols
 - Signaling protocols
 - Transport protocols
 - Session protocols
 - Presentation protocols
 - Application layer protocols
 - Peer-to-peer protocols
 - OAM protocols
 - Time synchronization protocols
 - Network policy
 - Cross-layer protocols
 - Network File System (NFS) protocol
- **Network components**
 - Intermediate nodes
 - Routers
 - Bridges and switches
 - Physical links
 - Repeaters
 - Middle boxes / network appliances
 - End nodes
 - Network adapters
 - Network servers
 - Wireless access points, base stations and infrastructure
 - Cognitive radios
 - Logical nodes
 - Network domains
- **Network algorithms**
 - Data path algorithms
 - Packet classification
 - Deep packet inspection
 - Packet scheduling
 - Control path algorithms
 - Network resources allocation
 - Network control algorithms
 - Traffic engineering algorithms
 - Network design and planning algorithms
 - Network economics
- **Network performance evaluation**
 - Network performance modeling
 - Network simulations
 - Network experimentation
 - Network performance analysis
 - Network measurement
- **Network properties**
 - Network security
 - Security protocols

- Web protocol security
- Mobile and wireless security
- Denial-of-service attacks
- Firewalls
- Network range
 - Short-range networks
 - Local area networks
 - Metropolitan area networks
 - Wide area networks
 - Very long-range networks
- Network structure
 - Topology analysis and generation
 - Physical topologies
 - Logical / virtual topologies
 - Network topology types
 - Point-to-point networks
 - Bus networks
 - Star networks
 - Ring networks
 - Token ring networks
 - Fiber distributed data interface (FDDI)
 - Mesh networks
 - Wireless mesh networks
 - Hybrid networks
- Network dynamics
- Network reliability
 - Error detection and error correction
- Network mobility
- Network manageability
- Network privacy and anonymity

○ **Network services**

- Naming and addressing
- Cloud computing
- Location based services
- Programmable networks
- In-network processing
- Network management
- Network monitoring

○ **Network types**

- Network on chip
- Home networks
- Storage area networks
- Data center networks
- Wired access networks
- Cyber-physical networks
 - Sensor networks
- Mobile networks
- Overlay and other logical network structures
 - Peer-to-peer networks
 - World Wide Web (network structure)
 - Social media networks
 - Online social networks
- Wireless access networks
 - Wireless local area networks
 - Wireless personal area networks

- Ad hoc networks
- Mobile ad hoc networks
- Public Internet
- Packet-switching networks

• **Software and its engineering**

○ **Software organization and properties**

- Contextual software domains
- E-commerce infrastructure
- Software infrastructure
- Interpreters
- Middleware
 - Message oriented middleware
 - Reflective middleware
 - Embedded middleware
- Virtual machines
- Operating systems
 - File systems management
 - Memory management
 - Virtual memory
 - Main memory
 - Allocation / deallocation strategies
 - Garbage collection
 - Distributed memory
 - Secondary storage
 - Process management
 - Scheduling
 - Deadlocks
 - Multithreading
 - Multiprocessing / multiprogramming / multitasking
 - Monitors
 - Mutual exclusion
 - Concurrency control
 - Power management
 - Process synchronization
 - Communications management
 - Buffering
 - Input / output
 - Message passing
- Virtual worlds software
 - Interactive games
 - Virtual worlds training simulations
- Software system structures
 - Embedded software
 - Software architectures
 - n-tier architectures
 - Peer-to-peer architectures
 - Data flow architectures
 - Cooperating communicating processes
 - Layered systems
 - Publish-subscribe / event-based architectures
 - Electronic blackboards
 - Simulator / interpreter
 - Object oriented architectures
 - Tightly coupled architectures

- Space-based architectures
- 3-tier architectures
- Software system models
 - Petri nets
 - State systems
 - Entity relationship modeling
 - Model-driven software engineering
 - Feature interaction
 - Massively parallel systems
- Ultra-large-scale systems
- Distributed systems organizing principles
 - Cloud computing
 - Client-server architectures
 - Grid computing
 - Organizing principles for web applications
- Real-time systems software
- Abstraction, modeling and modularity
- Software functional properties
 - Correctness
 - Synchronization
 - Functionality
 - Real-time schedulability
 - Consistency
 - Completeness
 - Access protection
 - Formal methods
 - Model checking
 - Software verification
 - Automated static analysis
 - Dynamic analysis
- Extra-functional properties
 - Interoperability
 - Software performance
 - Software reliability
 - Software fault tolerance
 - Checkpoint / restart
 - Software safety
 - Software usability

○ **Software notations and tools**

- General programming languages
 - Language types
 - Parallel programming languages
 - Distributed programming languages
 - Imperative languages
 - Object oriented languages
 - Functional languages
 - Concurrent programming languages
 - Constraint and logic languages
 - Data flow languages
 - Extensible languages
 - Assembly languages
 - Multiparadigm languages
 - Very high level languages
 - Language features

- Abstract data types
- Polymorphism
- Inheritance
- Control structures
- Data types and structures
- Classes and objects
- Modules / packages
- Constraints
- Recursion
- Concurrent programming structures
- Procedures, functions and subroutines
- Patterns
- Coroutines
- Frameworks
- Formal language definitions
 - Syntax
 - Semantics
- Compilers
 - Interpreters
 - Incremental compilers
 - Retargetable compilers
 - Just-in-time compilers
 - Dynamic compilers
 - Translator writing systems and compiler generators
 - Source code generation
 - Runtime environments
 - Preprocessors
 - Parsers
- Context specific languages
 - Markup languages
 - Extensible Markup Language (XML)
 - Hypertext languages
 - Scripting languages
 - Domain specific languages
 - Specialized application languages
 - API languages
 - Graphical user interface languages
 - Window managers
 - Command and control languages
 - Macro languages
 - Programming by example
 - State based definitions
 - Visual languages
 - Interface definition languages
- System description languages
 - Design languages
 - Unified Modeling Language (UML)
 - Architecture description languages
 - System modeling languages
 - Orchestration languages
 - Integration frameworks
 - Specification languages
- Development frameworks and environments
 - Object oriented frameworks
 - Software as a service orchestration system

- Integrated and visual development environments
- Application specific development environments
- Software configuration management and version control systems
- Software libraries and repositories
- Software maintenance tools

○ **Software creation and management**

- Designing software
 - Requirements analysis
 - Software design engineering
 - Software design tradeoffs
 - Software implementation planning
 - Software design techniques
- Software development process management
 - Software development methods
 - Rapid application development
 - Agile software development
 - Capability Maturity Model
 - Waterfall model
 - Spiral model
 - V-model
 - Design patterns
 - Risk management
- Software development techniques
 - Software prototyping
 - Object oriented development
 - Flowcharts
 - Reusability
 - Software product lines
 - Error handling and recovery
 - Automatic programming
 - Genetic programming
- Software verification and validation
 - Software prototyping
 - Operational analysis
 - Software defect analysis
 - Software testing and debugging
 - Fault tree analysis
 - Process validation
 - Walkthroughs
 - Pair programming
 - Use cases
 - Acceptance testing
 - Traceability
 - Formal software verification
 - Empirical software validation
- Software post-development issues
 - Software reverse engineering
 - Documentation
 - Backup procedures
 - Software evolution
 - Software version control
 - Maintaining software
 - System administration
- Collaboration in software development

- Open source model
- Programming teams
- Search-based software engineering

• **Theory of computation**

○ **Models of computation**

- Computability
 - Lambda calculus
 - Turing machines
 - Recursive functions
- Probabilistic computation
- Quantum computation theory
 - Quantum complexity theory
 - Quantum communication complexity
 - Quantum query complexity
 - Quantum information theory
- Interactive computation
- Streaming models
- Concurrency
 - Parallel computing models
 - Distributed computing models
 - Process calculi
- Timed and hybrid models
- Abstract machines

○ **Formal languages and automata theory**

- Formalisms
 - Algebraic language theory
 - Rewrite systems
- Automata over infinite objects
- Grammars and context-free languages
- Tree languages
- Automata extensions
 - Transducers
 - Quantitative automata
- Regular languages

○ **Computational complexity and cryptography**

- Complexity classes
- Problems, reductions and completeness
- Communication complexity
- Circuit complexity
- Oracles and decision trees
- Algebraic complexity theory
- Quantum complexity theory
- Proof complexity
- Interactive proof systems
- Complexity theory and logic
- Cryptographic primitives
- Cryptographic protocols

○ **Logic**

- Logic and verification
- Proof theory
- Modal and temporal logics
- Automated reasoning

- Constraint and logic programming
- Constructive mathematics
- Description logics
- Equational logic and rewriting
- Finite Model Theory
- Higher order logic
- Linear logic
- Programming logic
- Abstraction
- Verification by model checking
- Type theory
- Hoare logic
- Separation logic

○ **Design and analysis of algorithms**

- Graph algorithms analysis
 - Network flows
 - Sparsification and spanners
 - Shortest paths
 - Dynamic graph algorithms
- Approximation algorithms analysis
 - Scheduling algorithms
 - Packing and covering problems
 - Routing and network design problems
 - Facility location and clustering
 - Rounding techniques
 - Stochastic approximation
 - Numeric approximation algorithms
- Mathematical optimization
 - Discrete optimization
 - Network optimization
 - Optimization with randomized search heuristics
 - Simulated annealing
 - Evolutionary algorithms
 - Tabu search
 - Randomized local search
 - Continuous optimization
 - Linear programming
 - Semidefinite programming
 - Convex optimization
 - Quasiconvex programming and unimodality
 - Stochastic control and optimization
 - Quadratic programming
 - Nonconvex optimization
 - Bio-inspired optimization
 - Mixed discrete-continuous optimization
 - Submodular optimization and polymatroids
 - Integer programming
 - Bio-inspired optimization
 - Non-parametric optimization
 - Genetic programming
 - Developmental representations
- Data structures design and analysis
 - Data compression
 - Pattern matching

- Sorting and searching
- Predecessor queries
- Cell probe models and lower bounds
- Online algorithms
- Online learning algorithms
- Scheduling algorithms
- Caching and paging algorithms
- K-server algorithms
- Adversary models
- Parameterized complexity and exact algorithms
- Fixed parameter tractability
- W hierarchy
- Streaming, sublinear and near linear time algorithms
- Bloom filters and hashing
- Sketching and sampling
- Lower bounds and information complexity
- Random order and robust communication complexity
- Nearest neighbor algorithms
- Parallel algorithms
- MapReduce algorithms
- Self-organization
- Shared memory algorithms
- Vector / streaming algorithms
- Massively parallel algorithms
- Distributed algorithms
- MapReduce algorithms
- Self-organization
- Algorithm design techniques
- Backtracking
- Branch-and-bound
- Divide and conquer
- Dynamic programming
- Preconditioning
- Concurrent algorithms

○ **Randomness, geometry and discrete structures**

- Pseudorandomness and derandomization
- Computational geometry
- Generating random combinatorial structures
- Random walks and Markov chains
- Expander graphs and randomness extractors
- Error-correcting codes
- Random projections and metric embeddings
- Random network models
- Random search heuristics

○ **Theory and algorithms for application domains**

- Machine learning theory
- Sample complexity and generalization bounds
- Boolean function learning
- Unsupervised learning and clustering
- Kernel methods
- Support vector machines
- Gaussian processes
- Boosting
- Bayesian analysis

- Inductive inference
- Online learning theory
- Multi-agent learning
- Models of learning
- Query learning
- Structured prediction
- Reinforcement learning
 - Sequential decision making
 - Inverse reinforcement learning
 - Apprenticeship learning
 - Multi-agent reinforcement learning
 - Adversarial learning
- Active learning
- Semi-supervised learning
- Markov decision processes
- Regret bounds
- Algorithmic game theory and mechanism design
 - Social networks
 - Algorithmic game theory
 - Algorithmic mechanism design
 - Solution concepts in game theory
 - Exact and approximate computation of equilibria
 - Quality of equilibria
 - Convergence and learning in games
 - Market equilibria
 - Computational pricing and auctions
 - Representations of games and their complexity
 - Network games
 - Network formation
 - Computational advertising theory
- Database theory
 - Data exchange
 - Data provenance
 - Data modeling
 - Database query languages (principles)
 - Database constraints theory
 - Database interoperability
 - Data structures and algorithms for data management
 - Database query processing and optimization (theory)
 - Data integration
 - Logic and databases
 - Theory of database privacy and security
 - Incomplete, inconsistent, and uncertain databases
- Theory of randomized search heuristics

○ **Semantics and reasoning**

- Program constructs
 - Control primitives
 - Functional constructs
 - Object oriented constructs
 - Program schemes
 - Type structures
- Program semantics
 - Algebraic semantics
 - Denotational semantics

- Operational semantics
- Axiomatic semantics
- Action semantics
- Categorical semantics
- Program reasoning
- Invariants
- Program specifications
- Pre- and post-conditions
- Program verification
- Program analysis
- Assertions
- Parsing
- Abstraction

• **Mathematics of computing**

○ **Discrete mathematics**

- Combinatorics
 - Combinatoric problems
 - Permutations and combinations
 - Combinatorial algorithms
 - Generating functions
 - Combinatorial optimization
 - Combinatorics on words
 - Enumeration
- Graph theory
 - Trees
 - Hypergraphs
 - Random graphs
 - Graph coloring
 - Paths and connectivity problems
 - Graph enumeration
 - Matchings and factors
 - Graphs and surfaces
 - Network flows
 - Spectra of graphs
 - Extremal graph theory
 - Matroids and greedoids
 - Graph algorithms
 - Approximation algorithms

○ **Probability and statistics**

- Probabilistic representations
 - Bayesian networks
 - Markov networks
 - Factor graphs
 - Decision diagrams
 - Equational models
 - Causal networks
 - Stochastic differential equations
 - Nonparametric representations
 - Kernel density estimators
 - Spline models
 - Bayesian nonparametric models
- Probabilistic inference problems
 - Maximum likelihood estimation

- Bayesian computation
- Computing most probable explanation
- Hypothesis testing and confidence interval computation
- Density estimation
 - Quantile regression
- Max marginal computation
- Probabilistic reasoning algorithms
 - Variable elimination
 - Loopy belief propagation
 - Variational methods
 - Expectation maximization
 - Markov-chain Monte Carlo methods
 - Gibbs sampling
 - Metropolis-Hastings algorithm
 - Simulated annealing
 - Markov-chain Monte Carlo convergence measures
 - Sequential Monte Carlo methods
 - Kalman filters and hidden Markov models
 - Resampling methods
 - Bootstrapping
 - Jackknifing
 - Random number generation
- Probabilistic algorithms
- Statistical paradigms
 - Queueing theory
 - Contingency table analysis
 - Regression analysis
 - Robust regression
 - Time series analysis
 - Survival analysis
 - Renewal theory
 - Dimensionality reduction
 - Cluster analysis
 - Statistical graphics
 - Exploratory data analysis
- Stochastic processes
 - Markov processes
- Nonparametric statistics
- Distribution functions
- Multivariate statistics

○ Mathematical software

- Solvers
- Statistical software
- Mathematical software performance

○ Information theory

- Coding theory

○ Mathematical analysis

- Numerical analysis
 - Computation of transforms
 - Computations in finite fields
 - Computations on matrices
 - Computations on polynomials
 - Gröbner bases and other special bases

- Number-theoretic computations
- Interpolation
- Numerical differentiation
- Interval arithmetic
- Arbitrary-precision arithmetic
- Automatic differentiation
- Mesh generation
- Discretization
- Mathematical optimization
 - Discrete optimization
 - Network optimization
 - Optimization with randomized search heuristics
 - Simulated annealing
 - Evolutionary algorithms
 - Tabu search
 - Randomized local search
 - Continuous optimization
 - Linear programming
 - Semidefinite programming
 - Convex optimization
 - Quasiconvex programming and unimodality
 - Stochastic control and optimization
 - Quadratic programming
 - Nonconvex optimization
 - Bio-inspired optimization
 - Mixed discrete-continuous optimization
 - Submodular optimization and polymatroids
 - Integer programming
 - Bio-inspired optimization
 - Non-parametric optimization
 - Genetic programming
 - Developmental representations
- Differential equations
 - Ordinary differential equations
 - Partial differential equations
 - Differential algebraic equations
 - Differential variational inequalities
- Calculus
 - Lambda calculus
 - Differential calculus
 - Integral calculus
- Functional analysis
 - Approximation
- Integral equations
- Nonlinear equations
- Quadrature

○ Continuous mathematics

- Calculus
 - Lambda calculus
 - Differential calculus
 - Integral calculus
- Topology
 - Point-set topology
 - Algebraic topology
 - Geometric topology

- Continuous functions

- **Information systems**

- **Data management systems**

- Database design and models

- Relational database model

- Entity relationship models

- Graph-based database models

- Hierarchical data models

- Network data models

- Physical data models

- Data model extensions

- Semi-structured data

- Data streams

- Data provenance

- Incomplete data

- Temporal data

- Uncertainty

- Inconsistent data

- Data structures

- Data access methods

- Multidimensional range search

- Data scans

- Point lookups

- Unidimensional range search

- Proximity search

- Data layout

- Data compression

- Data encryption

- Record and block layout

- Database management system engines

- DBMS engine architectures

- Database query processing

- Query optimization

- Query operators

- Query planning

- Join algorithms

- Database transaction processing

- Data locking

- Transaction logging

- Database recovery

- Record and buffer management

- Parallel and distributed DBMSs

- Key-value stores

- MapReduce-based systems

- Relational parallel and distributed DBMSs

- Triggers and rules

- Database views

- Integrity checking

- Distributed database transactions

- Distributed data locking

- Deadlocks

- Distributed database recovery

- Main memory engines

- Online analytical processing engines

- Stream management
- Query languages
 - Relational database query languages
 - Structured Query Language
 - XML query languages
 - XPath
 - XQuery
 - Query languages for non-relational engines
 - MapReduce languages
 - Call level interfaces
- Database administration
 - Database utilities and tools
 - Database performance evaluation
 - Autonomous database administration
 - Data dictionaries
- Information integration
 - Deduplication
 - Extraction, transformation and loading
 - Data exchange
 - Data cleaning
 - Wrappers (data mining)
 - Mediators and data integration
 - Entity resolution
 - Data warehouses
 - Federated databases
- Middleware for databases
 - Database web servers
 - Application servers
 - Object-relational mapping facilities
 - Data federation tools
 - Data replication tools
 - Distributed transaction monitors
 - Message queues
 - Service buses
 - Enterprise application integration tools
 - Middleware business process managers

○ **Information storage systems**

- Information storage technologies
 - Magnetic disks
 - Magnetic tapes
 - Optical / magneto-optical disks
 - Storage class memory
 - Flash memory
 - Phase change memory
 - Disk arrays
 - Tape libraries
- Record storage systems
 - Record storage alternatives
 - Heap (data structure)
 - Hashed file organization
 - Indexed file organization
 - Linked lists
 - Directory structures
 - B-trees

- Vnodes
- Inodes
- Extent-based file structures
- Block / page strategies
- Slotted pages
- Intrapage space management
- Interpage free-space management
- Record layout alternatives
- Fixed length attributes
- Variable length attributes
- Null values in records
- Relational storage
- Horizontal partitioning
- Vertical partitioning
- Column based storage
- Hybrid storage layouts
- Compression strategies
- Storage replication
- Mirroring
- RAID
- Point-in-time copies
- Remote replication
- Storage recovery strategies
- Storage architectures
- Cloud based storage
- Storage network architectures
- Storage area networks
- Direct attached storage
- Network attached storage
- Distributed storage
- Storage management
- Hierarchical storage management
- Storage virtualization
- Information lifecycle management
- Version management
- Storage power management
- Thin provisioning
- **Information systems applications**
- Enterprise information systems
- Intranets
- Extranets
- Enterprise resource planning
- Enterprise applications
- Data centers
- Collaborative and social computing systems and tools
- Blogs
- Wikis
- Reputation systems
- Open source software
- Social networking sites
- Social tagging systems
- Synchronous editors
- Asynchronous editors
- Spatial-temporal systems

- Location based services
- Geographic information systems
- Sensor networks
- Data streaming
- Global positioning systems
- Decision support systems
 - Data warehouses
 - Expert systems
 - Data analytics
 - Online analytical processing
- Mobile information processing systems
- Process control systems
- Multimedia information systems
 - Multimedia databases
 - Multimedia streaming
 - Multimedia content creation
 - Massively multiplayer online games
- Data mining
 - Data cleaning
 - Collaborative filtering
 - Association rules
 - Clustering
 - Nearest-neighbor search
 - Data stream mining
- Digital libraries and archives
- Computational advertising
- Computing platforms

○ **World Wide Web**

- Web searching and information discovery
 - Web search engines
 - Web crawling
 - Web indexing
 - Page and site ranking
 - Spam detection
 - Content ranking
 - Collaborative filtering
 - Social recommendation
 - Personalization
 - Social tagging
- Online advertising
 - Sponsored search advertising
 - Content match advertising
 - Display advertising
 - Social advertising
- Web mining
 - Site wrapping
 - Data extraction and integration
 - Deep web
 - Surfacing
 - Search results deduplication
 - Web log analysis
 - Traffic analysis
- Web applications
 - Internet communications tools

- Email
- Blogs
- Texting
- Chat
- Web conferencing
- Social networks
- Crowdsourcing
 - Answer ranking
 - Trust
 - Incentive schemes
 - Reputation systems
- Electronic commerce
 - Digital cash
 - E-commerce infrastructure
 - Electronic data interchange
 - Electronic funds transfer
 - Online shopping
 - Online banking
 - Secure online transactions
 - Online auctions
- Web interfaces
 - Wikis
 - Browsers
 - Mashups
- Web services
 - Simple Object Access Protocol (SOAP)
 - RESTful web services
 - Web Services Description Language (WSDL)
 - Universal Description Discovery and Integration (UDDI)
 - Service discovery and interfaces
- Web data description languages
 - Semantic web description languages
 - Resource Description Framework (RDF)
 - Web Ontology Language (OWL)
 - Markup languages
 - Extensible Markup Language (XML)
 - Hypertext languages

○ **Information retrieval**

- Document representation
 - Document structure
 - Document topic models
 - Content analysis and feature selection
 - Data encoding and canonicalization
 - Document collection models
 - Ontologies
 - Dictionaries
 - Thesauri
- Information retrieval query processing
 - Query representation
 - Query intent
 - Query log analysis
 - Query suggestion
 - Query reformulation
- Users and interactive retrieval

- Personalization
- Task models
- Search interfaces
- Collaborative search
- Retrieval models and ranking
 - Rank aggregation
 - Probabilistic retrieval models
 - Language models
 - Similarity measures
 - Learning to rank
 - Combination, fusion and federated search
 - Information retrieval diversity
 - Top-k retrieval in databases
 - Novelty in information retrieval
- Retrieval tasks and goals
 - Question answering
 - Document filtering
 - Recommender systems
 - Information extraction
 - Sentiment analysis
 - Expert search
 - Near-duplicate and plagiarism detection
 - Clustering and classification
 - Summarization
 - Business intelligence
- Evaluation of retrieval results
 - Test collections
 - Relevance assessment
 - Retrieval effectiveness
 - Retrieval efficiency
 - Presentation of retrieval results
- Search engine architectures and scalability
 - Search engine indexing
 - Search index compression
 - Distributed retrieval
 - Peer-to-peer retrieval
 - Retrieval on mobile devices
 - Adversarial retrieval
 - Link and co-citation analysis
 - Searching with auxiliary databases
- Specialized information retrieval
 - Structure and multilingual text search
 - Structured text search
 - Mathematics retrieval
 - Chemical and biochemical retrieval
 - Multilingual and cross-lingual retrieval
 - Multimedia and multimodal retrieval
 - Image search
 - Video search
 - Speech / audio search
 - Music retrieval
 - Environment-specific retrieval
 - Enterprise search
 - Desktop search
 - Web and social media search

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- **Security and privacy**

- **Cryptography**

- Key management
- Public key (asymmetric) techniques
 - Digital signatures
 - Public key encryption
- Symmetric cryptography and hash functions
 - Block and stream ciphers
 - Hash functions and message authentication codes
- Cryptanalysis and other attacks
- Information-theoretic techniques
- Mathematical foundations of cryptography

- **Formal methods and theory of security**

- Trust frameworks
- Security requirements
- Formal security models
- Logic and verification

- **Security services**

- Authentication
 - Biometrics
 - Graphical / visual passwords
 - Multi-factor authentication
- Access control
- Pseudonymity, anonymity and untraceability
- Privacy-preserving protocols
- Digital rights management
- Authorization

- **Intrusion/anomaly detection and malware mitigation**

- Malware and its mitigation
- Intrusion detection systems
 - Artificial immune systems
- Social engineering attacks
 - Spoofing attacks
 - Phishing

- **Security in hardware**

- Tamper-proof and tamper-resistant designs
- Embedded systems security
- Hardware security implementation
 - Hardware-based security protocols
- Hardware attacks and countermeasures
 - Malicious design modifications
 - Side-channel analysis and countermeasures
- Hardware reverse engineering

- **Systems security**

- Operating systems security
 - Mobile platform security
 - Trusted computing
 - Virtualization and security
- Browser security
- Distributed systems security
- Information flow control
- Denial-of-service attacks
- Firewalls
- Vulnerability management

- Penetration testing
- Vulnerability scanners
- File system security
- **Network security**
 - Security protocols
 - Web protocol security
 - Mobile and wireless security
 - Denial-of-service attacks
 - Firewalls
- **Database and storage security**
 - Data anonymization and sanitization
 - Management and querying of encrypted data
 - Information accountability and usage control
 - Database activity monitoring
- **Software and application security**
 - Software security engineering
 - Web application security
 - Social network security and privacy
 - Domain-specific security and privacy architectures
 - Software reverse engineering
- **Human and societal aspects of security and privacy**
 - Economics of security and privacy
 - Social aspects of security and privacy
 - Privacy protections
 - Usability in security and privacy
- **Human-centered computing**
 - **Human computer interaction (HCI)**
 - HCI design and evaluation methods
 - User models
 - User studies
 - Usability testing
 - Heuristic evaluations
 - Walkthrough evaluations
 - Laboratory experiments
 - Field studies
 - Interaction paradigms
 - Hypertext / hypermedia
 - Mixed / augmented reality
 - Command line interfaces
 - Graphical user interfaces
 - Virtual reality
 - Web-based interaction
 - Natural language interfaces
 - Collaborative interaction
 - Interaction devices
 - Graphics input devices
 - Displays and imagers
 - Sound-based input / output
 - Keyboards
 - Pointing devices
 - Touch screens
 - Haptic devices
 - HCI theory, concepts and models
 - Interaction techniques

- Auditory feedback
- Text input
- Pointing
- Gestural input
- Interactive systems and tools
 - User interface management systems
 - User interface programming
 - User interface toolkits
- Empirical studies in HCI

○ **Interaction design**

- Interaction design process and methods
 - User interface design
 - User centered design
 - Activity centered design
 - Scenario-based design
 - Participatory design
 - Contextual design
 - Interface design prototyping
- Interaction design theory, concepts and paradigms
- Empirical studies in interaction design
- Systems and tools for interaction design
 - Wireframes

○ **Collaborative and social computing**

- Collaborative and social computing theory, concepts and paradigms
 - Social content sharing
 - Collaborative content creation
 - Collaborative filtering
 - Social recommendation
 - Social networks
 - Social tagging
 - Computer supported cooperative work
 - Social engineering (social sciences)
 - Social navigation
 - Social media
- Collaborative and social computing design and evaluation methods
 - Social network analysis
 - Ethnographic studies
- Collaborative and social computing systems and tools
 - Blogs
 - Wikis
 - Reputation systems
 - Open source software
 - Social networking sites
 - Social tagging systems
 - Synchronous editors
 - Asynchronous editors
- Empirical studies in collaborative and social computing
- Collaborative and social computing devices

○ **Ubiquitous and mobile computing**

- Ubiquitous and mobile computing theory, concepts and paradigms
 - Ubiquitous computing
 - Mobile computing

- Ambient intelligence
- Ubiquitous and mobile computing systems and tools
- Ubiquitous and mobile devices
 - Smartphones
 - Interactive whiteboards
 - Mobile phones
 - Mobile devices
 - Portable media players
 - Personal digital assistants
 - Handheld game consoles
 - E-book readers
 - Tablet computers
- Ubiquitous and mobile computing design and evaluation methods
- Empirical studies in ubiquitous and mobile computing

○ **Visualization**

- Visualization techniques
 - Treemaps
 - Hyperbolic trees
 - Heat maps
 - Graph drawings
 - Dendrograms
 - Cladograms
- Visualization application domains
 - Scientific visualization
 - Visual analytics
 - Geographic visualization
 - Information visualization
- Visualization systems and tools
 - Visualization toolkits
- Visualization theory, concepts and paradigms
- Empirical studies in visualization
- Visualization design and evaluation methods

○ **Accessibility**

- Accessibility theory, concepts and paradigms
- Empirical studies in accessibility
- Accessibility design and evaluation methods
- Accessibility technologies
- Accessibility systems and tools

● **Computing methodologies**

○ **Symbolic and algebraic manipulation**

- Symbolic and algebraic algorithms
 - Combinatorial algorithms
 - Algebraic algorithms
 - Nonalgebraic algorithms
 - Symbolic calculus algorithms
 - Exact arithmetic algorithms
 - Hybrid symbolic-numeric methods
 - Discrete calculus algorithms
 - Number theory algorithms
 - Equation and inequality solving algorithms
 - Linear algebra algorithms
 - Theorem proving algorithms

- Boolean algebra algorithms
- Optimization algorithms
- Computer algebra systems
- Special-purpose algebraic systems
- Representation of mathematical objects
- Representation of exact numbers
- Representation of mathematical functions
- Representation of Boolean functions
- Representation of polynomials

○ **Parallel computing methodologies**

- Parallel algorithms
- MapReduce algorithms
- Self-organization
- Shared memory algorithms
- Vector / streaming algorithms
- Massively parallel algorithms
- Parallel programming languages

○ **Artificial intelligence**

- Natural language processing
 - Information extraction
 - Machine translation
 - Discourse, dialogue and pragmatics
 - Natural language generation
 - Speech recognition
 - Lexical semantics
 - Phonology / morphology
 - Language resources
- Knowledge representation and reasoning
 - Description logics
 - Semantic networks
 - Nonmonotonic, default reasoning and belief revision
 - Probabilistic reasoning
 - Vagueness and fuzzy logic
 - Causal reasoning and diagnostics
 - Temporal reasoning
 - Cognitive robotics
 - Ontology engineering
 - Logic programming and answer set programming
 - Spatial and physical reasoning
 - Reasoning about belief and knowledge
- Planning and scheduling
 - Planning for deterministic actions
 - Planning under uncertainty
 - Multi-agent planning
 - Planning with abstraction and generalization
 - Robotic planning
 - Evolutionary robotics
- Search methodologies
 - Heuristic function construction
 - Discrete space search
 - Continuous space search
 - Randomized search
 - Game tree search

- Abstraction and micro-operators
- Search with partial observations
- Control methods
 - Robotic planning
 - Evolutionary robotics
 - Computational control theory
 - Motion path planning
- Philosophical/theoretical foundations of artificial intelligence
 - Cognitive science
 - Theory of mind
- Distributed artificial intelligence
 - Multi-agent systems
 - Intelligent agents
 - Mobile agents
 - Cooperation and coordination
- Computer vision
 - Computer vision tasks
 - Biometrics
 - Scene understanding
 - Activity recognition and understanding
 - Video summarization
 - Visual content-based indexing and retrieval
 - Visual inspection
 - Vision for robotics
 - Scene anomaly detection
 - Image and video acquisition
 - Camera calibration
 - Epipolar geometry
 - Computational photography
 - Hyperspectral imaging
 - Motion capture
 - 3D imaging
 - Active vision
 - Computer vision representations
 - Image representations
 - Shape representations
 - Appearance and texture representations
 - Hierarchical representations
 - Computer vision problems
 - Interest point and salient region detections
 - Image segmentation
 - Video segmentation
 - Shape inference
 - Object detection
 - Object recognition
 - Object identification
 - Tracking
 - Reconstruction
 - Matching

○ Machine learning

- Learning paradigms
 - Supervised learning
 - Ranking
 - Learning to rank

- Supervised learning by classification
- Supervised learning by regression
- Structured outputs
- Cost-sensitive learning
- Unsupervised learning
 - Cluster analysis
 - Anomaly detection
 - Mixture modeling
 - Topic modeling
 - Source separation
 - Motif discovery
 - Dimensionality reduction and manifold learning
- Reinforcement learning
 - Sequential decision making
 - Inverse reinforcement learning
 - Apprenticeship learning
 - Multi-agent reinforcement learning
 - Adversarial learning
- Multi-task learning
 - Transfer learning
 - Lifelong machine learning
 - Learning under covariate shift
- Learning settings
 - Batch learning
 - Online learning settings
 - Learning from demonstrations
 - Learning from critiques
 - Learning from implicit feedback
 - Active learning settings
 - Semi-supervised learning settings
- Machine learning approaches
 - Classification and regression trees
 - Kernel methods
 - Support vector machines
 - Gaussian processes
 - Neural networks
 - Logical and relational learning
 - Inductive logic learning
 - Statistical relational learning
 - Learning in probabilistic graphical models
 - Maximum likelihood modeling
 - Maximum entropy modeling
 - Maximum a posteriori modeling
 - Mixture models
 - Latent variable models
 - Bayesian network models
 - Learning linear models
 - Perceptron algorithm
 - Factorization methods
 - Non-negative matrix factorization
 - Factor analysis
 - Principal component analysis
 - Canonical correlation analysis
 - Latent Dirichlet allocation
- Rule learning

- Instance-based learning
- Markov decision processes
- Partially-observable Markov decision processes
- Stochastic games
- Learning latent representations
 - Deep belief networks
- Bio-inspired approaches
 - Artificial life
 - Evolvable hardware
 - Genetic algorithms
 - Genetic programming
 - Evolutionary robotics
 - Generative and developmental approaches
- Machine learning algorithms
 - Dynamic programming for Markov decision processes
 - Value iteration
 - Q-learning
 - Policy iteration
 - Temporal difference learning
 - Approximate dynamic programming methods
 - Ensemble methods
 - Boosting
 - Bagging
 - Spectral methods
 - Feature selection
 - Regularization
- Cross-validation

○ **Modeling and simulation**

- Model development and analysis
 - Modeling methodologies
 - Model verification and validation
 - Uncertainty quantification
- Simulation theory
 - Systems theory
 - Network science
- Simulation types and techniques
 - Uncertainty quantification
 - Quantum mechanic simulation
 - Molecular simulation
 - Rare-event simulation
 - Discrete-event simulation
 - Agent / discrete models
 - Distributed simulation
 - Continuous simulation
 - Continuous models
 - Real-time simulation
 - Interactive simulation
 - Multiscale systems
 - Massively parallel and high-performance simulations
 - Data assimilation
 - Scientific visualization
 - Visual analytics
 - Simulation by animation
 - Artificial life

- Simulation support systems
- Simulation environments
- Simulation languages
- Simulation tools
- Simulation evaluation

○ **Computer graphics**

- Animation
 - Motion capture
 - Procedural animation
 - Physical simulation
 - Motion processing
 - Collision detection
- Rendering
 - Rasterization
 - Ray tracing
 - Non-photorealistic rendering
 - Reflectance modeling
 - Visibility
- Image manipulation
 - Computational photography
 - Image processing
 - Texturing
 - Image-based rendering
 - Antialiasing
- Graphics systems and interfaces
 - Graphics processors
 - Graphics input devices
 - Mixed / augmented reality
 - Perception
 - Graphics file formats
 - Virtual reality
- Image compression
- Shape modeling
 - Mesh models
 - Mesh geometry models
 - Parametric curve and surface models
 - Point-based models
 - Volumetric models
 - Shape analysis

○ **Distributed computing methodologies**

- Distributed algorithms
 - MapReduce algorithms
 - Self-organization
- Distributed programming languages

○ **Concurrent computing methodologies**

- Concurrent programming languages
- Concurrent algorithms

• **Applied computing**

○ **Electronic commerce**

- Digital cash
- E-commerce infrastructure
- Electronic data interchange

- Electronic funds transfer
- Online shopping
- Online banking
- Secure online transactions
- Online auctions

○ **Enterprise computing**

- Enterprise information systems
 - Intranets
 - Extranets
 - Enterprise resource planning
 - Enterprise applications
 - Data centers
- Business process management
 - Business process modeling
 - Business process management systems
 - Business process monitoring
 - Cross-organizational business processes
 - Business intelligence
- Enterprise architectures
 - Enterprise architecture management
 - Enterprise architecture frameworks
 - Enterprise architecture modeling
- Service-oriented architectures
- Event-driven architectures
- Business rules
- Enterprise modeling
- Enterprise ontologies, taxonomies and vocabularies
- Enterprise data management
- Reference models
- Business-IT alignment
- IT architectures
- IT governance
- Enterprise computing infrastructures
- Enterprise interoperability
 - Enterprise application integration
 - Information integration and interoperability

○ **Physical sciences and engineering**

- Aerospace
 - Avionics
- Archaeology
- Astronomy
- Chemistry
- Earth and atmospheric sciences
 - Environmental sciences
- Engineering
 - Computer-aided design
- Physics
- Mathematics and statistics
- Electronics
 - Avionics
- Telecommunications
 - Internet telephony

- **Life and medical sciences**

- Computational biology
 - Molecular sequence analysis
 - Recognition of genes and regulatory elements
 - Molecular evolution
 - Computational transcriptomics
 - Biological networks
 - Sequencing and genotyping technologies
 - Imaging
 - Computational proteomics
 - Molecular structural biology
 - Computational genomics
- Genomics
 - Computational genomics
- Systems biology
- Consumer health
- Health care information systems
- Health informatics
- Bioinformatics
- Metabolomics / metabonomics
- Genetics
 - Population genetics
 - Proteomics
 - Computational proteomics
 - Transcriptomics

- **Law, social and behavioral sciences**

- Anthropology
 - Ethnography
- Law
- Psychology
- Economics
- Sociology

- **Computer forensics**

- Surveillance mechanisms
- Investigation techniques
- Evidence collection, storage and analysis
- Network forensics
- System forensics
- Data recovery

- **Arts and humanities**

- Fine arts
- Performing arts
- Architecture (buildings)
 - Computer-aided design
- Language translation
- Media arts
- Sound and music computing

- **Computers in other domains**

- Digital libraries and archives
- Publishing
- Military

- Cyberwarfare
- Cartography
- Agriculture
- Computing in government
 - Voting / election technologies
 - E-government
- Personal computers and PC applications
 - Word processors
 - Spreadsheets
 - Computer games
 - Microcomputers

○ **Operations research**

- Consumer products
- Industry and manufacturing
 - Supply chain management
 - Command and control
- Computer-aided manufacturing
- Decision analysis
 - Multi-criterion optimization and decision-making
- Transportation
- Forecasting
- Marketing

○ **Education**

- Digital libraries and archives
- Computer-assisted instruction
- Interactive learning environments
- Collaborative learning
- Learning management systems
- Distance learning
- E-learning
- Computer-managed instruction

○ **Document management and text processing**

- Document searching
- Document management
 - Text editing
 - Version control
 - Document metadata
- Document capture
 - Document analysis
 - Document scanning
 - Graphics recognition and interpretation
 - Optical character recognition
 - Online handwriting recognition
- Document preparation
 - Markup languages
 - Extensible Markup Language (XML)
 - Hypertext languages
 - Annotation
 - Format and notation
 - Multi / mixed media creation
 - Image composition
 - Hypertext / hypermedia creation

- Document scripting languages

- **Social and professional topics**

- **Professional topics**

- Computing industry

- Industry statistics

- Computer manufacturing

- Sustainability

- Management of computing and information systems

- Project and people management

- Project management techniques

- Project staffing

- Systems planning

- Systems analysis and design

- Systems development

- Computer and information systems training

- Implementation management

- Hardware selection

- Computing equipment management

- Pricing and resource allocation

- Software management

- Software maintenance

- Software selection and adaptation

- System management

- Centralization / decentralization

- Technology audits

- Quality assurance

- Network operations

- File systems management

- Information system economics

- History of computing

- Historical people

- History of hardware

- History of software

- History of programming languages

- History of computing theory

- Computing education

- Computational thinking

- Accreditation

- Model curricula

- Computing education programs

- Information systems education

- Computer science education

- CS1

- Computer engineering education

- Information technology education

- Information science education

- Computational science and engineering education

- Software engineering education

- Informal education

- Computing literacy

- Student assessment

- K-12 education

- Adult education

- Computing and business

- Employment issues
- Automation
- Computer supported cooperative work
- Economic impact
- Offshoring
- Reengineering
- Socio-technical systems
- Computing profession
 - Codes of ethics
 - Employment issues
 - Funding
 - Computing occupations
 - Computing organizations
 - Testing, certification and licensing
 - Assistive technologies

○ **Computing / technology policy**

- Intellectual property
 - Digital rights management
 - Copyrights
 - Software reverse engineering
 - Patents
 - Trademarks
 - Internet governance / domain names
 - Licensing
 - Treaties
 - Database protection laws
 - Secondary liability
 - Soft intellectual property
 - Hardware reverse engineering
- Privacy policies
- Censorship
 - Pornography
 - Hate speech
 - Political speech
 - Technology and censorship
 - Censoring filters
- Surveillance
 - Governmental surveillance
 - Corporate surveillance
- Commerce policy
 - Taxation
 - Transborder data flow
 - Antitrust and competition
 - Governmental regulations
 - Online auctions policy
 - Consumer products policy
- Network access control
 - Censoring filters
 - Broadband access
 - Net neutrality
 - Network access restrictions
 - Age-based restrictions
 - Acceptable use policy restrictions
 - Universal access

- Computer crime
 - Social engineering attacks
 - Spoofing attacks
 - Phishing
 - Identity theft
 - Financial crime
 - Malware / spyware crime
- Government technology policy
 - Governmental regulations
 - Import / export controls
- Medical information policy
 - Medical records
 - Personal health records
 - Genetic information
 - Patient privacy
 - Health information exchanges
 - Medical technologies
 - Remote medicine

○ **User characteristics**

- Race and ethnicity
- Religious orientation
- Gender
 - Men
 - Women
- Sexual orientation
- People with disabilities
- Geographic characteristics
- Cultural characteristics
- Age
 - Children
 - Seniors
 - Adolescents