Annex B

List of research specialisms for Sub-panel 11: Computer Sciences and Informatics

This REF topic classification is taken from the Association of Computing Machinery (ACM) Computing Classification System March 2012 Revision, hence the use of American spelling.

Please have the REF topic classification number enclosed in '< >' as the first characters in the topic descriptor, followed by a text topic descriptor. If the output relates to more than one topic, please select the one to which the contribution is the greatest. Since the purpose is to assess whether we have sufficient expertise (and later, to assign outputs to sub-panel members), please use only a single topic. If there are many sub-topics which apply equally, then choose one at the highest level.

We think the ACM classification will apply to anything we have assessed in the past – from art to quantum physics – but we have allowed for 'Other topics'.

As noted, the information will enable the sub-panel to determine whether there are topics for which they do not have sufficient expertise, and a similar classification will be used to allocate outputs to sub-panel members for review. We realize this is a very coarse grained classification but a finer grained classification is impractical. This classification is only an aid to the sub-panel and will not affect assessment of outputs in any way.

Table of Contents

ACM 2012 Topics	REF Classification
Hardware	
Printed circuit boards	1
Electromagnetic interference and compatibility	1
PCB design and layout	1
Communication hardware, interfaces and storage	1
Signal processing systems	1
Digital signal processing	1
Beamforming	1
Noise reduction	1
Sensors and actuators	1
Buses and high-speed links	1
Displays and imagers	1
External storage	1
Networking hardware	1
Printers	1
Sensor applications and deployments	1
Sensor devices and platforms	1
Sound-based input / output	1
Tactile and hand-based interfaces	1
Touch screens	1
Haptic devices	1
Scanners	1
Wireless devices	1
Wireless integrated network sensors	1
Electro-mechanical devices	1
Integrated circuits	1
3D integrated circuits	1
Interconnect	1
Input / output circuits	1
Metallic interconnect	1
Photonic and optical interconnect	1
Radio frequency and wireless interconnect	1
Semiconductor memory	1
Dynamic memory	1
Static memory	1
Non-volatile memory	1
Read-only memory	1
Digital switches	1
Transistors	1
Logic families	1
Logic circuits	1
Arithmetic and datapath circuits	1
Asynchronous circuits	1
Combinational circuits	1
Design modules and hierarchy	1
Finite state machines	1
Sequential circuits	1
Reconfigurable logic and FPGAs	1
Hardware accelerators	1
High-speed input / output	1
Programmable logic elements	1

Programmable interconnect	1
Reconfigurable logic applications	1
Very large scale integration design	1
3D integrated circuits	1
Analog and mixed-signal circuits	1
Data conversion	1
Clock generation and timing	1
Analog and mixed-signal circuit optimization	1
Radio frequency and wireless circuits	1
Wireline communication	1
Analog and mixed-signal circuit synthesis	1
Application-specific VLSI designs	1
Application specific integrated circuits	1
Application specific instruction set processors	1
Application specific processors	1
Design reuse and communication-based design	1
Network on chip	1
System on a chip	1
Platform-based design	1
Hard and soft IP	1
Design rules	1
Economics of chip design and manufacturing	1
Full-custom circuits	1
VLSI design manufacturing considerations	1
On-chip resource management	1
On-chip sensors	1
Standard cell libraries	1
VLSI packaging	1
Die and wafer stacking	1
Input / output styles	1
Multi-chip modules	1
Package-level interconnect	1
VLSI system specification and constraints	1
Power and energy	1
Thermal issues	1
Temperature monitoring	1
Temperature simulation and estimation	1
Temperature control	1
Temperature optimization	1
Energy generation and storage	1
Batteries	1
Fuel-based energy	1
Renewable energy	1
Reusable energy storage	1
Energy distribution	1
Energy metering	1
Power conversion	1
Power networks	1
Smart grid	1
Impact on the environment	1
Power estimation and optimization	1
Switching devices power issues	1
Interconnect power issues	1
Circuits power issues	1
Chip-level power issues	1

Platform power issues	1
Enterprise level and data centers power issues	1
Electronic design automation	1
High-level and register-transfer level synthesis	1
Datapath optimization	1
Hardware-software codesign	1
Resource binding and sharing	1
Operations scheduling	1
Hardware description languages and compilation	1
Logic synthesis	1
Combinational synthesis	1
Circuit optimization	1
Sequential synthesis	1
Technology-mapping	1
Transistor-level synthesis	1
Modeling and parameter extraction	1
Physical design (EDA)	1
Clock-network synthesis	1
Packaging	1
Partitioning and floorplanning	1
Placement	1
Physical synthesis	1
Power grid design	1
Wire routing	1
Timing analysis	1
Electrical-level simulation	1
Model-order reduction	1
Compact delay models	1
Static timing analysis	1
Statistical timing analysis	1
Transition-based timing analysis	1
Methodologies for EDA	1
Best practices for EDA	1
Design databases for EDA	1
Software tools for EDA	1
Hardware validation	1
Functional verification	1
Model checking	1
Coverage metrics	1
Equivalence checking	1
Semi-formal verification	1
Simulation and emulation	1
Transaction-level verification	1
Theorem proving and SAT solving	1
Assertion checking	1
Physical verification	1
Design rule checking	1
Layout-versus-schematics	1
Power and thermal analysis	1
Timing analysis and sign-off	1
Post-manufacture validation and debug	1
Bug detection, localization and diagnosis	1
Bug fixing (hardware)	1
Design for debug	1
Hardware test	1

Analog, mixed-signal and radio frequency test	1
Board- and system-level test	1
Defect-based test	1
Design for testability	1
Built-in self-test	1
Online test and diagnostics	1
Test data compression	1
Fault models and test metrics	1
Memory test and repair	1
Hardware reliability screening	1
Test-pattern generation and fault simulation	1
Testing with distributed and parallel systems	1
Robustness	1
Fault tolerance	1
Error detection and error correction	1
Failure prediction	1
Failure recovery, maintenance and self-repair	1
Redundancy	1
Self-checking mechanisms	1
System-level fault tolerance	1
Design for manufacturability	1
Process variations	1
Yield and cost modeling	1
Yield and cost optimization	1
Hardware reliability	1
Aging of circuits and systems	1
Circuit hardening	1
Early-life failures and infant mortality	1
Process, voltage and temperature variations	1
Signal integrity and noise analysis	1
Transient errors and upsets	1
Safety critical systems	1
Emerging technologies	1
Analysis and design of emerging devices and systems	1
Emerging architectures	1
Emerging languages and compilers	1
Emerging simulation	1
Emerging tools and methodologies	1
Biology-related information processing	1
Bio-embedded electronics	1
Neural systems	1
Circuit substrates	1
III-V compounds	1
Carbon based electronics	1
Cellular neural networks	1
Flexible and printable circuits	1
Superconducting circuits	1
Electromechanical systems	1
Microelectromechanical systems	1
Nanoelectromechanical systems	1
Emerging interfaces	1
Memory and dense storage	1
Emerging optical and photonic technologies	1
Reversible logic	1
Plasmonics	1

Quantum technologies	1
Single electron devices	1
Tunneling devices	1
Quantum computation	1
Quantum communication and cryptography	1
Quantum error correction and fault tolerance	1
Quantum dots and cellular automata	1
Spintronics and magnetic technologies	1
Computer systems organization	
Architectures	2
Serial architectures	2
Reduced instruction set computing	2
Complex instruction set computing	2
Superscalar architectures	2
Pipeline computing	2
Stack machines	2
Parallel architectures	2
Very long instruction word	2
Interconnection architectures	2
Multiple instruction, multiple data	2
Cellular architectures	2
Multiple instruction, single data	2
Single instruction, multiple data	2
Systolic arrays	2
Multicore architectures	2
Distributed architectures	2
Cloud computing	2
Client-server architectures	2
n-tier architectures	2
Peer-to-peer architectures	2
Grid computing	2
Other architectures	2
Neural networks	2
Reconfigurable computing	2
Analog computers	2
Data flow architectures	2
Heterogeneous (hybrid) systems	2
Self-organizing autonomic computing	2
Optical computing	2
Quantum computing	2
Molecular computing	2
High-level language architectures	2
Special purpose systems	2
Embedded and cyber-physical systems	2
Sensor networks	2
Robotics	2
Robotic components	2
Robotic control	2
Robotic autonomy	2
External interfaces for robotics	2
Sensors and actuators	2
System on a chip	2
Embedded systems	2

Firmware	2
Embedded hardware	2
Embedded software	2
Real-time systems	3
Real-time operating systems	3
Real-time languages	3
Real-time system specification	3
Real-time system architecture	3
Dependable and fault-tolerant systems and networks	3
Reliability	3
Availability	3
Maintainability and maintenance	3
Processors and memory architectures	3
Secondary storage organization	3
Redundancy	3
Fault-tolerant network topologies	3
Networks	
Network architectures	4
Network design principles	4
Layering	4
Naming and addressing	4
Programming interfaces	4
Network protocols	4
Network protocol design	4
Protocol correctness	4
Protocol testing and verification	4
Formal specifications	4
Link-layer protocols	4
Network layer protocols	4
Routing protocols	4
Signaling protocols	4
Transport protocols	4
Session protocols	4
Presentation protocols	4
Application layer protocols	4
Peer-to-peer protocols	4
OAM protocols	4
Time synchronization protocols	4
Network policy	4
Cross-layer protocols	4
Network File System (NFS) protocol	4
Network components	4
Intermediate nodes	4
Routers	4
Bridges and switches	4
Physical links	4
Repeaters	4
Middle boxes / network appliances	4
End nodes	4
Network adapters	4
Network servers	4
Wireless access points, base stations and infrastructure	4
Cognitive radios	4

Logical nodes	4
Network domains	4
Network algorithms	5
Data path algorithms	5
Packet classification	5
Deep packet inspection	5
Packet scheduling	5
Control path algorithms	5
Network resources allocation	5
Network control algorithms	5
Traffic engineering algorithms	5
Network design and planning algorithms	5
Network economics	5
Network performance evaluation	5
Network performance modeling	5
Network simulations	5
Network experimentation	5
Network performance analysis	5
Network measurement	5
Network properties	6
Network security	6
Security protocols	6
Web protocol security	6
Mobile and wireless security	6
Denial-of-service attacks	6
Firewalls	6
Network range	6
Short-range networks	6
Local area networks	6
Metropolitan area networks	6
Wide area networks	6
Very long-range networks	6
Network structure	6
Topology analysis and generation	6
Physical topologies	6
Logical / virtual topologies	6
Network topology types	6
Point-to-point networks	6
Bus networks	6
Star networks	6
Ring networks	6
Token ring networks	6
Fiber distributed data interface (FDDI)	6
Mesh networks	6
Wireless mesh networks	6
Hybrid networks	6
Network dynamics	6
Network reliability	6
Error detection and error correction	6
Network mobility	6
Network manageability	6
Network privacy and anonymity	6
Network services	6
Naming and addressing	6
Cloud computing	6

Location based services	6
Programmable networks	6
In-network processing	6
Network management	6
Network monitoring	6
Network types	6
Network on chip	6
Home networks	6
Storage area networks	6
Data center networks	6
Wired access networks	6
Cyber-physical networks	6
Sensor networks	6
Mobile networks	6
Overlay and other logical network structures	6
Peer-to-peer networks	6
World Wide Web (network structure)	6
Social media networks	6
Online social networks	6
Wireless access networks	6
Wireless local area networks	6
Wireless personal area networks	6
Ad hoc networks	6
Mobile ad hoc networks	6
Public Internet	6
Packet-switching networks	6
Software and its engineering	
Software organization and properties	7
Contextual software domains	7
E-commerce infrastructure	7
Software infrastructure	7
Interpreters	7
Middleware	7
Message oriented middleware	7
Reflective middleware	7
Embedded middleware	7
Virtual machines	7
Operating systems	7
File systems management	7
Memory management	7
Virtual memory	7
Main memory	7
Allocation / deallocation strategies	7
Garbage collection	7
Distributed memory	7
Secondary storage	7
Process management	7
Scheduling	7
Deadlocks	7
Multithreading	7
Multiprocessing / multiprogramming / multitasking	7
Monitors	7

Mutual exclusion	7
Concurrency control	7
Power management	7
Process synchronization	7
Communications management	7
Buffering	7
Input / output	7
Message passing	7
Virtual worlds software	7
Interactive games	7
Virtual worlds training simulations	7
Software system structures	7
Embedded software	7
Software architectures	7
n-tier architectures	7
Peer-to-peer architectures	7
Data flow architectures	7
Cooperating communicating processes	7
Layered systems	7
Publish-subscribe / event-based architectures	7
Electronic blackboards	7
Simulator / interpreter	7
Object oriented architectures	7
Tightly coupled architectures	7
Space-based architectures	7
3-tier architectures	7
Software system models	7
Petri nets	7
State systems	7
Entity relationship modeling	7
Model-driven software engineering	7
Feature interaction	7
Massively parallel systems	7
Ultra-large-scale systems	7
Distributed systems organizing principles	7
Cloud computing	7
Client-server architectures	7
Grid computing	7
Organizing principles for web applications	7
Real-time systems software	7
Abstraction, modeling and modularity	7
Software functional properties	7
Correctness	7
Synchronization	7
Functionality	7
Real-time schedulability	7
Consistency	7
Completeness	7
Access protection	7
Formal methods	7
Model checking	7
Software verification	7
Automated static analysis	7
Dynamic analysis	7
Extra-functional properties	7

Interoperability	7
Software performance	7
Software reliability	7
Software fault tolerance	7
Checkpoint / restart	7
Software safety	7
Software usability	7
Software notations and tools	8
General programming languages	8
Language types	8
Parallel programming languages	8
Distributed programming languages	8
Imperative languages	8
Object oriented languages	8
Functional languages	8
Concurrent programming languages	8
Constraint and logic languages	8
Data flow languages	8
Extensible languages	8
Assembly languages	8
Multiparadigm languages	8
Very high level languages	8
Language features	8
Abstract data types	8
Polymorphism	8
Inheritance	8
Control structures	8
Data types and structures	8
Classes and objects	8
Modules / packages	8
Constraints	8
Recursion	8
Concurrent programming structures	8
Procedures, functions and subroutines	8
Patterns	8
Coroutines	8
Frameworks	8
Formal language definitions	8
Syntax	8
Semantics	8
Compilers	8
Interpreters	8
Incremental compilers	8
Retargetable compilers	8
Just-in-time compilers	8
Dynamic compilers	8
Translator writing systems and compiler generators	8
Source code generation	8
Runtime environments	8
Preprocessors	8
Parsers	8
Context specific languages	8
Markup languages	8
Extensible Markup Language (XML)	8
Hypertext languages	8

Scripting languages	8
Domain specific languages	8
Specialized application languages	8
API languages	8
Graphical user interface languages	8
Window managers	8
Command and control languages	8
Macro languages	8
Programming by example	8
State based definitions	8
Visual languages	8
Interface definition languages	8
System description languages	8
Design languages	8
Unified Modeling Language (UML)	8
Architecture description languages	8
System modeling languages	8
Orchestration languages	8
Integration frameworks	8
Specification languages	8
Development frameworks and environments	8
Object oriented frameworks	8
Software as a service orchestration systems	8
Integrated and visual development environments	8
Application specific development environments	8
Software configuration management and version control systems	8
Software libraries and repositories	8
Software maintenance tools	8
Software creation and management	9
Designing software	9
Requirements analysis	9
Software design engineering	9
Software design tradeoffs	9
Software implementation planning	9
Software design techniques	9
Software development process management	9
Software development methods	9
Rapid application development	9
Agile software development	9
Capability Maturity Model	9
Waterfall model	9
Spiral model	9
V-model	9
Design patterns	9
Risk management	9
Software development techniques	9
Software prototyping	9
Object oriented development	9
Flowcharts	9
Reusability	9
Software product lines	9
Error handling and recovery	9
Software verification and validation	9
Software prototyping	9
Operational analysis	9

Software defect analysis	9
Software testing and debugging	9
Fault tree analysis	9
Process validation	9
Walkthroughs	9
Pair programming	9
Use cases	9
Acceptance testing	9
Traceability	9
Formal software verification	9
Empirical software validation	9
Software post-development issues	9
Software reverse engineering	9
Documentation	9
Backup procedures	9
Software evolution	9
Software version control	9
Maintaining software	9
System administration	9
Collaboration in software development	9
Open source model	9
Programming teams	9
Theory of computation	
Models of computation	10
Computability	10
Lambda calculus	10
Turing machines	10
Recursive functions	10
Probabilistic computation	10
Quantum computation theory	10
Quantum complexity theory	10
Quantum communication complexity	10
Quantum query complexity	10
Quantum information theory	10
Interactive computation	10
Streaming models	10
Concurrency	10
Parallel computing models	10
Distributed computing models	10
Process calculi	10
Timed and hybrid models	10
Abstract machines	10
Formal languages and automata theory	10
Formalisms	10
Algebraic language theory	10
Rewrite systems	10
Automata over infinite objects	10
Grammars and context-free languages	10
Tree languages	10
Automata extensions	10
Transducers	10
Quantitative automata	10
Regular languages	10

Nonconvex optimization	12
Mixed discrete-continuous optimization	12
Submodular optimization and polymatroids	12
Integer programming	12
Data structures design and analysis	12
Data compression	12
Pattern matching	12
Sorting and searching	12
Predecessor queries	12
Cell probe models and lower bounds	12
Online algorithms	12
Online learning algorithms	12
Scheduling algorithms	12
Caching and paging algorithms	12
K-server algorithms	12
Adversary models	12
Parameterized complexity and exact algorithms	12
Fixed parameter tractability	12
W hierarchy	12
Streaming, sublinear and near linear time algorithms	12
Bloom filters and hashing	12
Sketching and sampling	12
Lower bounds and information complexity	12
Random order and robust communication complexity	12
Nearest neighbor algorithms	12
Parallel algorithms	12
MapReduce algorithms	12
Self-organization	12
Shared memory algorithms	12
Vector / streaming algorithms	12
Massively parallel algorithms	12
Distributed algorithms	12
MapReduce algorithms	12
Self-organization	12
Algorithm design techniques	12
Backtracking	12
Branch-and-bound	12
Divide and conquer	12
Dynamic programming	12
Preconditioning	12
Concurrent algorithms	12
Randomness, geometry and discrete structures	12
Pseudorandomness and derandomization	12
Computational geometry	12
Generating random combinatorial structures	12
Random walks and Markov chains	12
Expander graphs and randomness extractors	12
Error-correcting codes	12
Random projections and metric embeddings	12
Random network models	12
Theory and algorithms for application domains	12
Machine learning theory	12
Sample complexity and generalization bounds	12
Boolean function learning	12
Unsupervised learning and clustering	12

Kernel methods	12
Support vector machines	12
Gaussian processes	12
Boosting	12
Bayesian analysis	12
Inductive inference	12
Online learning theory	12
Multi-agent learning	12
Models of learning	12
Query learning	12
Structured prediction	12
Reinforcement learning	12
Sequential decision making	12
Inverse reinforcement learning	12
Apprenticeship learning	12
Multi-agent reinforcement learning	12
Adversarial learning	12
Active learning	12
Semi-supervised learning	12
Markov decision processes	12
Regret bounds	12
Algorithmic game theory and mechanism design	12
Social networks	12
Algorithmic game theory	12
Algorithmic mechanism design	12
Solution concepts in game theory	12
Exact and approximate computation of equilibria	12
Quality of equilibria	12
Convergence and learning in games	12
Market equilibria	12
Computational pricing and auctions	12
Representations of games and their complexity	12
Network games	12
Network formation	12
Computational advertising theory	12
Database theory	12
Data exchange	12
Data provenance	12
Data modeling	12
Database query languages (principles)	12
Database constraints theory	12
Database interoperability	12
Data structures and algorithms for data management	12
Database query processing and optimization (theory)	12
Data integration	12
Logic and databases	12
Theory of database privacy and security	12
Incomplete, inconsistent, and uncertain databases	12
Semantics and reasoning	10
Program constructs	10
Control primitives	10
Functional constructs	10
Object oriented constructs	10
Program schemes	10
Type structures	10

Program semantics	10
Algebraic semantics	10
Denotational semantics	10
Operational semantics	10
Axiomatic semantics	10
Action semantics	10
Categorical semantics	10
Program reasoning	10
Invariants	10
Program specifications	10
Pre- and post-conditions	10
Program verification	10
Program analysis	10
Assertions	10
Parsing	10
Abstraction	10
Mathematics of computing	
Discrete mathematics	13
Combinatorics	13
Combinatoric problems	13
Permutations and combinations	13
Combinatorial algorithms	13
Generating functions	13
Combinatorial optimization	13
Combinatorics on words	13
Enumeration	13
Graph theory	13
Trees	13
Hypergraphs	13
Random graphs	13
Graph coloring	13
Paths and connectivity problems	13
Graph enumeration	13
Matchings and factors	13
Graphs and surfaces	13
Network flows	13
Spectra of graphs	13
Extremal graph theory	13
Matroids and greedoids	13
Graph algorithms	13
Approximation algorithms	13
Probability and statistics	13
Probabilistic representations	13
Bayesian networks	13
Markov networks	13
Factor graphs	13
Decision diagrams	13
Equational models	13
Causal networks	13
Stochastic differential equations	13
Nonparametric representations	13
Kernel density estimators	13
Spline models	13
Bayesian nonparametric models	13

Probabilistic inference problems	13
Maximum likelihood estimation	13
Bayesian computation	13
Computing most probable explanation	13
Hypothesis testing and confidence interval computation	13
Density estimation	13
Quantile regression	13
Max marginal computation	13
Probabilistic reasoning algorithms	13
Variable elimination	13
Loopy belief propagation	13
Variational methods	13
Expectation maximization	13
Markov-chain Monte Carlo methods	13
Gibbs sampling	13
Metropolis-Hastings algorithm	13
Simulated annealing	13
Markov-chain Monte Carlo convergence measures	13
Sequential Monte Carlo methods	13
Kalman filters and hidden Markov models	13
Resampling methods	13
Bootstrapping	13
Jackknifing	13
Random number generation	13
Probabilistic algorithms	13
Statistical paradigms	13
Queueing theory	13
Contingency table analysis	13
Regression analysis	13
Robust regression	13
Time series analysis	13
Survival analysis	13
Renewal theory	13
Dimensionality reduction	13
Cluster analysis	13
Statistical graphics	13
Exploratory data analysis	13
Stochastic processes	13
Markov processes	13
Nonparametric statistics	13
Distribution functions	13
Multivariate statistics	13
Mathematical software	13
Solvers	13
Statistical software	13
Mathematical software performance	13
Information theory	13
Coding theory	13
Mathematical analysis	13
Numerical analysis	13
Computation of transforms	13
Computations in finite fields	13
Computations on matrices	13
Computations on polynomials	13
Gröbner bases and other special bases	13

Number-theoretic computations	13
Interpolation	13
Numerical differentiation	13
Interval arithmetic	13
Arbitrary-precision arithmetic	13
Automatic differentiation	13
Mesh generation	13
Discretization	13
Mathematical optimization	13
Discrete optimization	13
Network optimization	13
Continuous optimization	13
Linear programming	13
Semidefinite programming	13
Convex optimization	13
Quasiconvex programming and unimodality	13
Stochastic control and optimization	13
Quadratic programming	13
Nonconvex optimization	13
Mixed discrete-continuous optimization	13
Submodular optimization and polymatroids	13
Integer programming	13
Differential equations	13
Ordinary differential equations	13
Partial differential equations	13
Differential algebraic equations	13
Differential variational inequalities	13
Calculus	13
Lambda calculus	13
Differential calculus	13
Integral calculus	13
Functional analysis	13
Approximation	13
Integral equations	13
Nonlinear equations	13
Quadrature	13
Continuous mathematics	13
Calculus	13
Lambda calculus	13
Differential calculus	13
Integral calculus	13
Topology	13
Point-set topology	13
Algebraic topology	13
Geometric topology	13
Continuous functions	13
Information systems	
Data management systems	15
Database design and models	15
Relational database model	15
Entity relationship models	15
Graph-based database models	15
Hierarchical data models	15

Network data models	15
Physical data models	15
Data model extensions	15
Semi-structured data	15
Data streams	15
Data provenance	15
Incomplete data	15
Temporal data	15
Uncertainty	15
Inconsistent data	15
Data structures	15
Data access methods	15
Multidimensional range search	15
Data scans	15
Point lookups	15
Unidimensional range search	15
Proximity search	15
Data layout	15
Data compression	15
Data encryption	15
Record and block layout	15
Database management system engines	15
DBMS engine architectures	15
Database query processing	15
Query optimization	15
Query operators	15
Query planning	15
Join algorithms	15
Database transaction processing	15
Data locking	15
Transaction logging	15
Database recovery	15
Record and buffer management	15
Parallel and distributed DBMSs	15
Key-value stores	15
MapReduce-based systems	15
Relational parallel and distributed DBMSs	15
Triggers and rules	15
Database views	15
Integrity checking	15
Distributed database transactions	15
Distributed data locking	15
Deadlocks	15
Distributed database recovery	15
Main memory engines	15
Online analytical processing engines	15
Stream management	15
Query languages	15
Relational database query languages	15
Structured Query Language	15
XML query languages	15
XPath	15
XQuery	15
Query languages for non-relational engines	15
MapReduce languages	15

Call level interfaces	15
Database administration	15
Database utilities and tools	15
Database performance evaluation	15
Autonomous database administration	15
Data dictionaries	15
Information integration	15
Deduplication	15
Extraction, transformation and loading	15
Data exchange	15
Data cleaning	15
Wrappers (data mining)	15
Mediators and data integration	15
Entity resolution	15
Data warehouses	15
Federated databases	15
Middleware for databases	15
Database web servers	15
Application servers	15
Object-relational mapping facilities	15
Data federation tools	15
Data replication tools	15
Distributed transaction monitors	15
Message queues	15
Service buses	15
Enterprise application integration tools	15
Middleware business process managers	15
Information storage systems	15
Information storage technologies	15
Magnetic disks	15
Magnetic tapes	15
Optical / magneto-optical disks	15
Storage class memory	15
Flash memory	15
Phase change memory	15
Disk arrays	15
Tape libraries	15
Record storage systems	15
Record storage alternatives	15
Heap (data structure)	15
Hashed file organization	15
Indexed file organization	15
Linked lists	15
Directory structures	15
B-trees	15
Vnodes	15
Inodes	15
Extent-based file structures	15
Block / page strategies	15
Slotted pages	15
Intrapage space management	15
Interpage free-space management	15
Record layout alternatives	15
Fixed length attributes	15
Variable length attributes	15

Null values in records	15
Relational storage	15
Horizontal partitioning	15
Vertical partitioning	15
Column based storage	15
Hybrid storage layouts	15
Compression strategies	15
Storage replication	15
Mirroring	15
RAID	15
Point-in-time copies	15
Remote replication	15
Storage recovery strategies	15
Storage architectures	15
Cloud based storage	15
Storage network architectures	15
Storage area networks	15
Direct attached storage	15
Network attached storage	15
Distributed storage	15
Storage management	15
Hierarchical storage management	15
Storage virtualization	15
Information lifecycle management	15
Version management	15
Storage power management	15
Thin provisioning	15
Information systems applications	15
Enterprise information systems	15
Intranets	15
Extranets	15
Enterprise resource planning	15
Enterprise applications	15
Data centers	15
Collaborative and social computing systems and tools	15
Blogs	15
Wikis	15
Reputation systems	15
Open source software	15
Social networking sites	15
Social tagging systems	15
Synchronous editors	15
Asynchronous editors	15
Spatial-temporal systems	15
Location based services	15
Geographic information systems	15
Sensor networks	15
Data streaming	15
Global positioning systems	15
Decision support systems	15
Data warehouses	15
Expert systems	15
Data analytics	15
Online analytical processing	15
Mobile information processing systems	15

Software and application security	19
Software security engineering	19
Web application security	19
Social network security and privacy	19
Domain-specific security and privacy architectures	19
Software reverse engineering	19
Human and societal aspects of security and privacy	20
Economics of security and privacy	20
Social aspects of security and privacy	20
Privacy protections	20
Usability in security and privacy	20
Human-centered computing	
Human computer interaction (HCI)	20
HCI design and evaluation methods	20
User models	20
User studies	20
Usability testing	20
Heuristic evaluations	20
Walkthrough evaluations	20
Laboratory experiments	20
Field studies	20
Interaction paradigms	20
Hypertext / hypermedia	20
Mixed / augmented reality	20
Command line interfaces	20
Graphical user interfaces	20
Virtual reality	20
Web-based interaction	20
Natural language interfaces	20
Collaborative interaction	20
Interaction devices	20
Graphics input devices	20
Displays and imagers	20
Sound-based input / output	20
Keyboards	20
Pointing devices	20
Touch screens	20
Haptic devices	20
HCI theory, concepts and models	20
Interaction techniques	20
Auditory feedback	20
Text input	20
Pointing	20
Gestural input	20
Interactive systems and tools	20
User interface management systems	20
User interface programming	20
User interface toolkits	20
Empirical studies in HCI	20
Interaction design	20
Interaction design process and methods	20
User interface design	20
User centered design	20

Activity centered design	20
Scenario-based design	20
Participatory design	20
Contextual design	20
Interface design prototyping	20
Interaction design theory, concepts and paradigms	20
Empirical studies in interaction design	20
Systems and tools for interaction design	20
Wireframes	20
Collaborative and social computing	21
Collaborative and social computing theory, concepts and paradigms	21
Social content sharing	21
Collaborative content creation	21
Collaborative filtering	21
Social recommendation	21
Social networks	21
Social tagging	21
Computer supported cooperative work	21
Social engineering (social sciences)	21
Social navigation	21
Social media	21
Collaborative and social computing design and evaluation methods	21
Social network analysis	21
Ethnographic studies	21
Collaborative and social computing systems and tools	21
Blogs	21
Wikis	21
Reputation systems	21
Open source software	21
Social networking sites	21
Social tagging systems	21
Synchronous editors	21
Asynchronous editors	21
Empirical studies in collaborative and social computing	21
Collaborative and social computing devices	21
Ubiquitous and mobile computing	21
Ubiquitous and mobile computing theory, concepts and paradigms	21
Ubiquitous computing	21
Mobile computing	21
Ambient intelligence	21
Ubiquitous and mobile computing systems and tools	21
Ubiquitous and mobile devices	21
Smartphones	21
Interactive whiteboards	21
Mobile phones	21
Mobile devices	21
Portable media players	21
Personal digital assistants	21
Handheld game consoles	21
E-book readers	21
Tablet computers	21
Ubiquitous and mobile computing design and evaluation methods	21
Empirical studies in ubiquitous and mobile computing	21

Visualization	20
Visualization techniques	20
Treemaps	20
Hyperbolic trees	20
Heat maps	20
Graph drawings	20
Dendrograms	20
Cladograms	20
Visualization application domains	20
Scientific visualization	20
Visual analytics	20
Geographic visualization	20
Information visualization	20
Visualization systems and tools	20
Visualization toolkits	20
Visualization theory, concepts and paradigms	20
Empirical studies in visualization	20
Visualization design and evaluation methods	20
Accessibility	20
Accessibility theory, concepts and paradigms	20
Empirical studies in accessibility	20
Accessibility design and evaluation methods	20
Accessibility technologies	20
Accessibility systems and tools	20
Computing methodologies	
Symbolic and algebraic manipulation	12
Symbolic and algebraic algorithms	12
Combinatorial algorithms	12
Algebraic algorithms	12
Nonalgebraic algorithms	12
Symbolic calculus algorithms	12
Exact arithmetic algorithms	12
Hybrid symbolic-numeric methods	12
Discrete calculus algorithms	12
Number theory algorithms	12
Equation and inequality solving algorithms	12
Linear algebra algorithms	12
Theorem proving algorithms	12
Boolean algebra algorithms	12
Optimization algorithms	12
Computer algebra systems	12
Special-purpose algebraic systems	12
Representation of mathematical objects	12
Representation of exact numbers	12
Representation of mathematical functions	12
Representation of Boolean functions	12
Representation of polynomials	12
Parallel computing methodologies	12
Parallel algorithms	12
MapReduce algorithms	12
Self-organization	12
Shared memory algorithms	12
Vector / streaming algorithms	12
Massively parallel algorithms	12
Parallel programming languages	8

Artificial intelligence	22
Natural language processing	22
Information extraction	22
Machine translation	22
Discourse, dialogue and pragmatics	22
Natural language generation	22
Speech recognition	22
Lexical semantics	22
Phonology / morphology	22
Language resources	22
Knowledge representation and reasoning	22
Description logics	22
Semantic networks	22
Nonmonotonic, default reasoning and belief revision	22
Probabilistic reasoning	22
Vagueness and fuzzy logic	22
Causal reasoning and diagnostics	22
Temporal reasoning	22
Cognitive robotics	22
Ontology engineering	22
Logic programming and answer set programming	22
Spatial and physical reasoning	22
Reasoning about belief and knowledge	22
Planning and scheduling	22
Planning for deterministic actions	22
Planning under uncertainty	22
Multi-agent planning	22
Planning with abstraction and generalization	22
Robotic planning	22
Search methodologies	22
Heuristic function construction	22
Discrete space search	22
Continuous space search	22
Randomized search	22
Game tree search	22
Abstraction and micro-operators	22
Search with partial observations	22
Control methods	22
Robotic planning	22
Computational control theory	22
Motion path planning	22
Philosophical/theoretical foundations of artificial intelligence	22
Cognitive science	22
Theory of mind	22
Distributed artificial intelligence	22
Multi-agent systems	22
Intelligent agents	22
Mobile agents	22
Cooperation and coordination	22
Computer vision	23
Computer vision tasks	23
Biometrics	23
Scene understanding	23
Activity recognition and understanding	23
Video summarization	23

Visual content-based indexing and retrieval	23
Visual inspection	23
Vision for robotics	23
Scene anomaly detection	23
Image and video acquisition	23
Camera calibration	23
Epipolar geometry	23
Computational photography	23
Hyperspectral imaging	23
Motion capture	23
3D imaging	23
Active vision	23
Computer vision representations	23
Image representations	23
Shape representations	23
Appearance and texture representations	23
Hierarchical representations	23
Computer vision problems	23
Interest point and salient region detections	23
Image segmentation	23
Video segmentation	23
Shape inference	23
Object detection	23
Object recognition	23
Object identification	23
Tracking	23
Reconstruction	23
Matching	23
Machine learning	24
Learning paradigms	24
Supervised learning	24
Ranking	24
Learning to rank	24
Supervised learning by classification	24
Supervised learning by regression	24
Structured outputs	24
Cost-sensitive learning	24
Unsupervised learning	24
Cluster analysis	24
Anomaly detection	24
Mixture modeling	24
Topic modeling	24
Source separation	24
Motif discovery	24
Dimensionality reduction and manifold learning	24
Reinforcement learning	24
Sequential decision making	24
Inverse reinforcement learning	24
Apprenticeship learning	24
Multi-agent reinforcement learning	24
Adversarial learning	24
Multi-task learning	24
Transfer learning	24
Lifelong machine learning	24
Learning under covariate shift	24

Modeling methodologies	25
Model verification and validation	25
Uncertainty quantification	25
Simulation theory	25
Systems theory	25
Network science	25
Simulation types and techniques	25
Uncertainty quantification	25
Quantum mechanic simulation	25
Molecular simulation	25
Rare-event simulation	25
Discrete-event simulation	25
Agent / discrete models	25
Distributed simulation	25
Continuous simulation	25
Continuous models	25
Real-time simulation	25
Interactive simulation	25
Multiscale systems	25
Massively parallel and high-performance simulations	25
Data assimilation	25
Scientific visualization	25
Visual analytics	25
Simulation by animation	25
Simulation support systems	25
Simulation environments	25
Simulation languages	25
Simulation tools	25
Simulation evaluation	25
Computer graphics	26
Animation	26
Motion capture	26
Procedural animation	26
Physical simulation	26
Motion processing	26
Collision detection	26
Rendering	26
Rasterization	26
Ray tracing	26
Non-photorealistic rendering	26
Reflectance modeling	26
Visibility	26
Image manipulation	26
Computational photography	26
Image processing	26
Texturing	26
Image-based rendering	26
Antialiasing	26
Graphics systems and interfaces	26
Graphics processors	26
Graphics input devices	26
Mixed / augmented reality	26
Perception	26
Graphics file formats	26
Virtual reality	26

Any other topics	
Any topic which does not fit into the above categories	33