

Session 4: The place of networking in curriculums

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Session goals:

- ❖ learn about ongoing ACM/IEEE CS2013 curriculum efforts
 - CS2001/CS2013 overview
 - “net-centric computing”
- ❖ discuss updates/changes to current (2001) curricular recommendations in networking
- ❖ identify Sigcomm activities re: CS2013 for Fall 2011

Background: CS2013

- ❖ joint IEEE-CS,ACM joint task force sets curricular guidelines for undergrad programs in CS
 - <http://cs2013.org>
 - international
- ❖ every ~10 years, most recent: 2001 (update 2008)
 - 2013 guidelines now being formulated
- ❖ our (Sigcomm's) knowledge area (KA): *net-centric computing* (likely to be renamed)
 - revised draft networking KA by end of 2011
- ❖ our help is welcome (and needed!) in formulating core and elective topics
 - *now is the time to do something!*

CC2001 Knowledge Areas

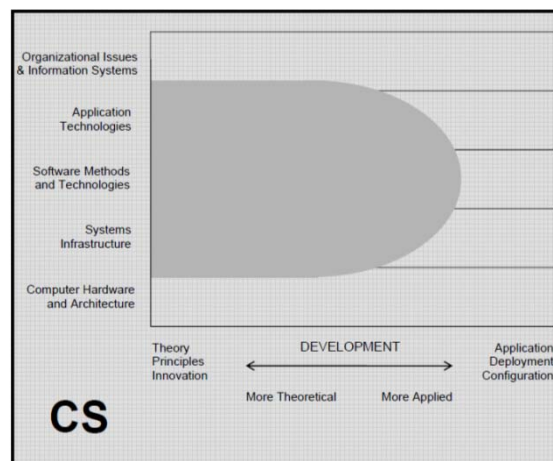
Min # hours	Knowledge Area
43	❖ Discrete Structures (DS)
38	❖ Programming Fundamentals (PF)
31	❖ Algorithms and Complexity (AL)
36	❖ Architecture and Organization (AR)
18	❖ Operating Systems (OS)
15	❖ Net-Centric Computing (NC)
21	❖ Programming Languages (PL)
8	❖ Human-Computer Interaction (HC)
3	❖ Graphics and Visual Computing (GV)
10	❖ Intelligent Systems (IS)
10	❖ Information Management (IM)
16	❖ Social and Professional Issues (SP)
31	❖ Software Engineering (SE)
0	❖ Computational Science and Numerical Methods (CN)

CC200 I: the “core”

- ❖ those units *required* of all students in all computer science degree programs
- ❖ *not* a complete curriculum
- ❖ must be supplemented by additional material
- ❖ not necessarily taken in intro courses, early in UG curriculum

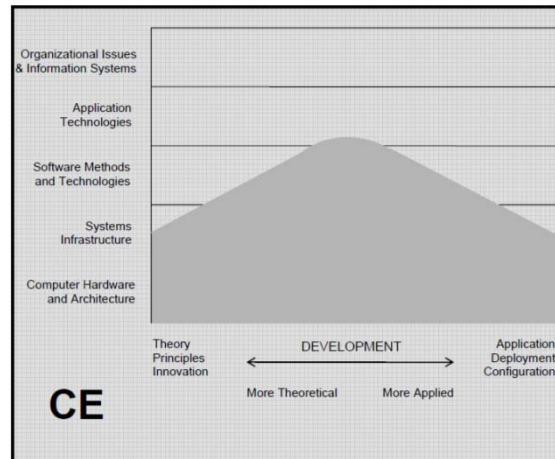
*“audience” for CS20***: broad set of students in wide range of colleges and universities

Theory versus practice (CS)



The ACM/IEEE view of Computer Science

Theory versus practice (CE)



The ACM/IEEE view of Computer Engineering

NC KAs: related KAs for 2013

- ❖ operating systems (15 hours)
- ❖ parallel and distributed computing (4 hours)
- ❖ systems fundamentals (30 hours)
 - computational paradigms, parallelism, cross-layer communications, state and state transition, resource allocation and scheduling
- ❖ information assurance and security (8 hours)
 - much of which was in net-centric computing in CS2001/2008

Thinking about the NC KA

- ❖ networking and communication: 10 core hours, plus 5 more core hours in security
 - core: loosely, what all UG CS majors should know
 - elective: for those desiring more depth, breadth
 - arguing for more hours won't get us anywhere
- ❖ CS2013 desire: smaller core, "small footprint" curriculum
 - "promote flexible curricula models, without losing essence of rigorous CS education"
 - 2001 curriculum smaller than 1991, 2013 to be smaller than 2001
 - < 1/3 semester course

NC: current status (handout)

- ❖ NC. Net Centric Computing (possible rename: Networking and Communications) (10 core hours)
 - NC/Introduction [3 core]
 - NC/NetworkCommunication [7 core; elective]
 - NC/WebOrganization [elective]
 - NC/NetworkedApplications [elective]
 - NC/NetworkManagement [elective]
 - NC/NetworkInterfaceArchitecture [elective]
 - NC/MobileComputing [elective]

NC Introduction (3 hours)

Topics:

- ❖ background, history of networking, Internet
- ❖ network architectures
- ❖ range of specializations within net-centric computing
- ❖ networks and protocols
- ❖ networked multimedia systems
- ❖ client/server and Peer to Peer paradigms
- ❖ mobile and wireless computing
- ❖ multimedia servers and file systems (removed 2008)
- ❖ storage standards (Magneto Optical disk, CD-ROM, DVD) (removed 2008)

Learning Outcomes:

- ❖ Discuss evolution of early networks and Internet.
- ❖ Demonstrate ability to use common networked applications including e-mail, telnet, FTP, wikis, and web browsers, online web courses, and instant messaging.
- ❖ Explain hierarchical, layered structure of typical network architecture.
- ❖ Describe emerging technologies in net-centric computing, assess their current capabilities, limitations, and near-term potential.

NC/ Network communication (7 hours)

Topics:

- ❖ network standards, standardization bodies
- ❖ ISO 7-layer reference model, instantiation in TCP/IP
- ❖ overview of Physical and Data Link layer concepts (framing, error control, flow control, protocols)
- ❖ data Link layer access control concepts
- ❖ internetworking and routing (routing algorithms, internetworking protocols, congestion control)
- ❖ transport layer services (connection establishment, performance issues, flow and error control)

Learning Outcomes:

- ❖ Discuss important network standards in their historical context.
- ❖ Describe responsibilities of first (lowest) four layers of ISO reference model.
- ❖ Explain how a network can detect and correct transmission errors.
- ❖ Explain how a packet is routed over the Internet.
- ❖ Install a simple network with two clients and a single server using standard host configuration software tools such as DHCP.

Breakout discussion notes

Marwan

- ❖ Identify what separates networking from other disciplines – scale, decentralized
- ❖ Series of problems – layering/abstraction, reliability, resource sharing, addressing, routing/forwarding
- ❖ Devote time in core to wireless/mobility (fixed model is being broken)
- ❖ Why not just HOW
- ❖ Learning outcome: day in the life of a packet (e.g., web request)
- ❖ What are the tradeoffs
- ❖ Architectural principles: smart edge, end-end

Jay

- ❖ Naming/addressing, translation (DNS)
- ❖ Introducing network of networks concept (how are players, who pays...) get a grip on reality. Economics, social aspect
- ❖ How is internet different from other networks (what are/were alternatives)
- ❖ Packet switching v circuit switching
- ❖ TCP
- ❖ Multiplexing and resource allocations
- ❖ Internetworking and routing.
- ❖ Christos – BGP and why we have that (policy)
- ❖ CDN and content providers – why
- ❖ X-ities. Teach students early on. Scale
- ❖ End-end principle versus smarts IN the core
- ❖ http
- ❖ Learning outcomes: how is Internet different from older nets; security (secure content v secure path). Principles and mechanics

Breakout discussion notes

Olivier

- ❖ Name different components (LAN, router, switch, link)
- ❖ Bottom up – links, framing, error control, multiple access, switching and forwarding (PC v CS)
- ❖ Routing – static. Key principle is aggregation (layer 2 v layer 3)
- ❖ DNS, naming/translation
- ❖ Socket API
- ❖ Congestion (optional – not core)
- ❖ Learning outcome: day in the life of a web request

What can we do?

- ❖ suggest “Sigcomm-blessed” KAs and learning outcomes
 - 10 core hours
 - electives
 - working with AC/IEEE task force (who welcome our input)
- ❖ provide input, commentary on closely related KAs
 - networking aspects appropriate?

What else can we do?

- ❖ model networking curriculum recommendation (informal, informational)
 - 2002 Sigcomm education workshop: “What would we be deeply embarrassed by, if our students did not know?”
<http://www-net.cs.umass.edu/sigcomm/education/workshop1.html>
- ❖ "NSF/IEEE-TCPP curriculum initiative on parallel and distributed computing - core topics for undergrads
 - <http://www.cs.gsu.edu/~tcpp/curriculum/>

What can we do *today*?

- ❖ discussion of NC core
 - what's missing?
 - what's "extraneous" given 10-hour limit?
- ❖ discuss fall 2011 activity, *after that, it's too late*
 - core
 - electives
 - related KAs
- ❖ on beyond CS2013
 - graduate, lab courses
 - reference
 - best practice