Department of Information Studies, University of California, Los Angeles

IS 270: Systems and Infrastructures

January 2017

Course information:

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Title:	*Systems and Infrastructures*
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Location:	*room 111, GSE&IS Bldg.*
Time:	*Tuesdays, 9am-12h30pm*
Web site:	*http://ccle.ucla.edu/course/view/17w-infstd270-1*
Reader:	*Morten Bay (mortenbay@live.com)*

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Office hours:	*Tuesdays, 12h30-14h30 or by appointment*

1. Approach

This course is designed to teach the fundamental concepts of information technology in ways relevant to professional practice in the library, archival, and informatics fields. It is not primarily about programming- or application-specific skills, and the course will not involve any laboratory work. It is also not primarily about the inner workings of the computer considered in isolation. Rather, the course will focus on teaching students computing concepts of enduring value (such as architecture, modularity, and economies of substitution) that can be used in the analysis of networked applications.

Such concepts will be continually accessed by students in their professional life, as they create strategic technology plans, evaluate and acquire applications for their institution, contribute to information policy discussions, participate with software engineers in design discussions, seek to identify and understand social, political and commercial opportunities created by networked information technologies and attempt to communicate this understanding to others. By applying these concepts to your particular area of professional expertise, you will refine your understanding of how information technology participates in social and institutional change and, conversely, how social and institutional dynamics shape technology. In short, you will better equipped to anticipate the curve ahead in the professional areas that matter to you.[1]

[1] "For all the importance of prominent controversies such a multiculturalism, the major tension I encouter in undergraduate teaching is that students come to research universities looking for

The course also provides an introduction to the Department's informatics specialization. Informatics is above all a certain interdisciplinary sensibility to the study of computing. Computing has very much moved beyond its initial domain of office automation and number crunching and today plays an increasingly important role in domains of human experience as historically rich and socially complex as education, the arts, cultural heritage, scholarly communication, or the search for life partners. In such contexts, appreciation and understanding of the contexts of computing — economic, regulatory, cultural, institutional, psychological, professional, symbolic, etc. —can no longer be relegated to after-the-fact studies of the "impact" of technology, nor can "efficiency" be understood in mere engineering terms, as raw computing power for example. Rather, informatics proceeds from the insight that, from conception to reception, information technology operates *simultaneously* across these multiple contexts. Because of this, in spite of its promise of greater interoperability, coordination, and rational planning, the deployment of information technology is a process suffused with more noise, improvisation and drift than we typically like to acknowledge.

2. Course objectives

At the end of this course, participants will be able to:

1. critically appraise utopist and dystopic discourse on the "information technology revolution" and on the dynamics of innovation which drive it.
2. analyze the architecture of a computing device in terms of its requirements for processing power, storage, communication bandwidth, and circulation of data;
3. articulate the role of modularity as a fundamental tool for managing software and network infrastructure complexity;
4. discuss and further research appropriate methodologies for the analysis and design of an information technology project;
5. list the competing standards and standard bodies operating within a given standardization area;
6. articulate the pro and cons of open vs. proprietary standard strategies;
7. analyze the economic conditions driving a specific information technology market;
8. critically appraise the advantages and disadvantages of current government regulation in the areas of telecommunications, intellectual property, and development;
9. appreciate the conceptual and engineering tools used by the computing community to design and implement digital information systems;
10. communicate with peers about complex technical issues, using clear and effective English, in both written and oral form;

vocational educations. … It's a dilemma. I want to teach things that my students want to learn, yet I believe that these students need to be capable of comprehending the institutional change they will face in their lives and careers. And so I have struck an elaborate compromise: giving critical analysis the shape and form of a vocational skill." — Phil Agre, "The Distances of Education," *Academe* **85**(5):37-41, 1999.

11. design an personal strategy for maintaining and updating their information technology literacy, given their projected professional path;
12. evaluate how their projected professional path might be affected by future developments in computing technologies.

In addition, the final assignment should:

13. reflect both *substantive analysis* and *effective writing*;
14. use technology concepts from the readings and lectures to highlight the unique issues and requirements of the chosen topic;
15. incorporate relevant outside research to identify and support key issues and themes;
16. reflect a solid technological understanding of the topic;
17. effectively communicate the ideas presented;
18. explain and/or depict complex subjects so that a peer, with equal technical knowledge but lacking topic-specific expertise, could readily grasp the intended points.

3. Assignments and due dates

Final paper will be worth 60%; Write-ups will be worth 5% each; 10% will go to class participation.

Choice of topic and justification (one page): Week 2

Write-up #1: Week 4
Write-up #2: Week 5
Write-up #3: Week 6
Write-up #4: Week 7
Write-up #5: Week 8
Write-up #6: Week 9

Final paper due: Tuesday March 21th, 5pm

4. Course Requirements

- The course presupposes that students have completed or are currently taking "IS260 Information Structures" and are interested in learning how to improve their understanding of information technologies as those will impact their professional practice.
- You should come to class ready to participate in discussions of the readings assigned for that week.
- "To be really good at plagiarism, you need precisely the reading and writing skills that ought to render it unnecessary." — *Jonathan Malesic*
- If you wish to request an accommodation due to a suspected or documented disability, or for any other reason, please inform the instructor and/or contact the Office for Students with Disabilities as soon as possible at A255 Murphy Hall, http://www.osd.ucla.edu. If you are experiencing difficulties in the class, it is important that you communicate as early as possible with the instructor or the readers.

- Because of their impact on other course participants, electronic devices, including smartphones and laptops, must be turned off during class time, except during group work, where one device per group may be used.
- Attend class every week. If you must miss a class, provide me with a 3 pages written summary of assigned readings by the following class. Repeated absence, for whatever reason, is incompatible with successful performance in this course.
- Attend class every week starting at 9am (that is, not 9h15 or 9h30). Late arrivals are highly disruptive to other class participants and will affect your grade.
- Please refrain from eating hot foods in the classroom.
- Participate in discussions. In particular, speak up when you disagree. A classroom is a space for discussion, not just a lecture. This course will explore new and rapidly evolving issues. Often, little consensus has emerged as to the best course of action. You are thus particularly encouraged to question the assumptions of the readings, the instructor, and your fellow students, as long as you do so respectfully. In doing so, you will sharpen your ability for critical thinking, innovation, debate, and public speaking, skills fundamental to your future professional life.
- Written work should be of high quality. If you have concerns about writing, address them early. A useful resource is UCLA's Graduate Writing Center (http://gsrc.ucla.edu/gwc/).
- Electronic recording of lectures and class discussions is not permitted without the consent of all other class participants, including the instructor

5. Course readings

Week 1 — Course Overview/Technological literacy

While information technologies were initially restricted to the automation of business and scientific processes, they have now come to profoundly structure the way we work, learn, socialize, buy, sell, and play. This lecture will set the stage for a theme central to this course —that this evolution is no longer primarily technological, but rather, has become profoundly embedded within economic, regulatory, and cultural processes, as well as the tangled technological legacy of previous information ages.

Read
Wing, Jeannette M. "Computational thinking." *Communications of the ACM* 49.3 (2006): 33-35.

Jean-François Blanchette, "Computing as if Infrastructure Mattered," *Communications of the ACM*, vol. 55, no. 10, 32-34.

Week 2 — Technological change/Material bits

Stories of about information technology and innovation implicitly rely on theories of technological change. In most of the popular press, this theory is that of 'technological determinism': technology flows from applied science, which itself flows from discoveries in pure research, and social change is overwhelmingly driven by the diffusion of technology into society and the 'creative destruction' it fosters. Does this model actually correspond to historical events, and does it accurately predict the future?

Bits constitute the atomic elements of the information age. Blogs, emails, World of Warcraft, Facebook status updates, this syllabus, computer viruses, all digital objects are made of bits. But what are bits made of? In this lecture, we look at bits as physical entities, as they are realized in storage devices, network wires, and processors. We analyze what it means for a device to have more or less power to process bits, more or less capacity to store them, more or less capacity to transmit them.

Core concepts
Sociotechnical systems, technological determinism; binary encoding, processing power; memory hierarchy; communication bandwidth.

Read
Philip E. Agre , "Information and Institutional Change: The Case of Digital Libraries", in Ann P. Bishop, Nancy A. Van House, and Barbara P. Buttenfield, eds, *Digital Library Use: Social Practice in Design and Evaluation*, MIT Press, 2003.

Genevieve Bell & Paul Dourish, "Yesterday's tomorrows: notes on ubiquitous computing's dominant vision," *Personal and Ubiquitous Computing* **11**:133-143 (2007).

> *"In our collective vision of ubicomp's proximate future, the messiness of our local laboratory infrastructures (the nests of cabling hidden in thedropped ceiling or behind the closet door, the jumble of perl, Java, and python code that precariously conspire toproduce results in demos) is replaced by a clean, gleaming infrastructure seamlessly providing well understood services. In practice, though, we see that infrastructures are continually visible and must be consciously attended to in the course of everyday encounters witt ubiquitous computing, from the vagaries of network access to the structure of service billing. The critical property of this messy infrastructural regime in the everyday world is that it is most emphatically not a problem of living on the ''bleeding edge,'' as it often is for research labs. Infrastructures remain messy after decades or centuries, as the user of any transit system from urban subways to international airlines can attest. The lesson of the real world of ubiquitous computing, then, is that we will always be assembling heterogeneous technologies to achieve individual and collective effects."*

Blanchette, J.-F., "A Material History of Bits," *Journal of the American Association for Information Science and Technology* **62**(6):1042-1057 (June 2011).

Week 3 — Architecture

Far from the intangibility suggested by the term "cyberspace", networked information technologies are crafted from the combination of three material resources: processing power, storage, and communication channels. This lecture will illustrate common types of arrangements of these resources for the purpose of information processing (e.g., Von Neumann machine, memory hierarchy, thin clients), and how those arrangements are structured by cost, footprint, and technical constraints.

Core concepts
Mainframe, personal, mobile, cloud computing; client-server, peer-to-peer, three-tie architectures; thin/thick clients; resource trade-offs.

Read
Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine,* Basic Books, 1996, chapters 1 and 2.

Blanchette, J.-F. "Computing's Infrastructural Moment," in *Regulating the Cloud: Policy for Computing Infrastructure* (Christopher Yoo & Jean-François Blanchette, eds.), pp. 1-19. The MIT Press, 2015.

David. G. Messserchmitt, "Computers, Networks, and Organizations", chapter 3 in *Networked Applications,* Morgan Kaufmann, 1999 --- read 3.1 to 3.3.

Google, *20 things I learned about browsers and the web,* 2010.
http://www.20thingsilearned.com/

Week 4 — Interoperability

Information systems can be divided into three major types of components: a*pplications* that provide services to *users* (e.g., word processing); *infrastructure software* that mediate applications' access to shared *computing resources*, i.e., the physical devices that provide processing power, storage, networking. Infrastructure software may be located in operating systems on commodity computing devices, embedded in hardware (e.g., firmware), or execute on specialized computers (web servers, routers, etc.).

The interoperability of applications, infrastructural software, and devices is an extraordinary engineering achievement. The sending of a simple email over the Internet requires the correct functioning of thousands upon thousands of heterogeneous material and logical components, connected together in a network of staggering complexity. Such a system must be able to accommodate, among other things, growth in size and traffic, technical evolution and decay, diversity of implementations, integration of new services to answer unanticipated needs, emergent behaviors, etc. The solution adopted by the software and hardware industry to manage this complexity is the design strategy of *modularity*, a strategy with widespread application in manufacturing (from automobile to

disposable razors), architecture, and education (curriculum design).

Core concepts
Modularity, layering, functionality, interface, implementation, granularity, hierarchy, separation of concerns, interoperability, reusability.

Read
Russell, A. L. (2012). Modularity: An interdisciplinary history of an ordering concept. *Information & Culture*, *47*(3), 257-287.

Karl T. Ulrich, "The Architecture of Artifacts", chapter four of *Design: Creation of Artifacts in Society*. http://www.ulrichbook.org, 2007.

Carliss Y. Baldwin and Kim B. Clark, "Managing in an Age of Modularity," *Harvard Business Review* 75, no. 5 (1997): 84-93.

Week 5 — Standards

While information technologies are constantly evolving, they must also remain compatible to some degree with previous generations of hardware and software. An important role of standards is to coordinate this compatibility across time and space. The spread of the Internet has been accompanied by the emergence of several new standardization institutions (e.g., W3C and IETF), as well as new procedures for reaching consensus over complex socio-technical issues (e.g., the semantic web). This lecture will provide a map of this new standardization environment, and emphasize the important role of standards as strategic tools for structuring markets.

Core concepts
Interoperability; *de facto*/*de jure* standards; standard bodies, organizations and consortiums (ISO, IETF, W3C, ANSI, NISO, etc.), open/proprietary standards, lock-in.

Read
Timo de Rijk, "Man and Measure," and "Consumption and Systems," in *Norm = Form: On Standardisation and Design*, The Hague, Netherlands: Thieme, 2011.

"Setting Standards," in Marc Levinson, *The Box: How the shipping container made the world smaller and the world economy bigger*, Princeton University Press, 2006.

Shapiro, C., & Varian, H. R. (1999). The art of standards wars. *California management review*, *41*(2), 8-32.

Week 6 — Markets

Markets for information technologies and products behave markedly differently than that for physical goods. For example, while it is very costly to produce the first copy of OS X for the Macintosh (high fixed costs), it is virtually free to produce every other copy (zero marginal costs). In this lecture, we will examine

the behavior of information technology markets, the various methods producers use in order to extract value from intangible products, and what institutions must consider when acquiring off-the-shelf or custom-designed software.

Core concepts: network effects; natural and serial monopolies; first-to-market; barriers to entry; economies of scale and scope; tipping point; fixed, sunk, and marginal costs; platform market; productivity paradox.

Read
Jonathan E. Nuechterlein and Philip J. Weiser, "The Big Picture", in *Digital Crossroads: American Telecommunications Policy in the Internet Age*, MIT Press, 2005.

Carl Shapiro and Hal Varian, Chapters 1-3 in *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, pp. 1-81.

Rodney S. Tucker, "Australia's (Less Super) Super-Highway," *IEEE Spectrum*, December 2013, 46-52.

Week 7 — Regulation

The increasingly central role of information networks in social life has made it necessary to rethink and reform many of the fundamental regulatory systems of Western societies, including those dealing with copyright, universal access to telecommunication services, privacy, and antitrust. In this lecture, we will review some of those reforms and how they have affected values dear to the library, archival and computing professions, such as intellectual freedom, collective memory, and the digital divide.

Core concepts
Convergence; networked industries; universal service; antitrust; copyleft; technology blending.

Read
Richard R. John, "Recasting the Information Infrastructure for the Industrial Age," in *A Nation Transformed by Information*, (Chandler & Cortada, eds), Oxford University Press, 2000.

Longstaff, P. H., "Networked Industries: Patterns in Development, Operation, and Regulation." http://pirp.harvard.edu/pubs_pdf/longsta\longsta-p00-2.pdf (read pages 1-31).

Marijke Visser and Mary Alice Ball, "The Middle Mile: The Role of the Public Library in Ensuring Access to Broadband," *Information Technology and Libraries*, December 2010, 187-194.

Crabtree, A., Rodden, T., Tolmie, P., Mortier, R., Lodge, T., Brundell, P., & Pantidi, N. (2015). House rules: the collaborative nature of policy in domestic networks. *Personal and Ubiquitous Computing*, *19*(1), 203-215.

Week 8 — Design

As information technologies are introduced in ever more complex contexts, in the service of ever more elaborate social interactions (from dating to collaborative science), traditional methods of systems analysis and design have shown serious limitations. This lecture will highlights the challenges faced by software engineers as they attempt identify, articulate, predict and respond to users' needs, behaviors and interaction with information technologies, as well as their fit within organizations.

Core concepts: requirements analysis, "conduit" metaphor, participatory and iterative design, unintended consequences, qualitative research methods, situated design.

Read
Donald A. Norman, "Being Analog", chapter 7 in *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution.* MIT Press, 1999.

Van Campenhout, L. D. E., Frens, J., Hummels, C., Standaert, A., & Peremans, H. (2016). "Touching the dematerialized." *Personal and Ubiquitous Computing*, *20*(1), 147-164.

Genevieve Bell and Joseph Kaye, "Designing Technology for Domestic Spaces: A Kitchen Manifesto," *Gastronomica* **2**(2):46-62 (2002).

> *"We argue that in order to get it right, to create spaces and technologies that people will want to use, not just admire from a distance, the domestic must be disentangled from the digital. One way to do this is to see the kitchen not just as a collection of wires, appliances, and Internet points, but as a space in which people really live. As researchers working at sites of technology production and innovation—Intel Corporation and MIT's Media Lab—we find ourselves increasingly preoccupied with the question of how one designs, not for efficiency, but for experience, affect, and desire."* (p. 48)

Week 9 —The Cloud and the Internet of Things: architecture II

Successive waves of computerization have proposed various configurations of processing power, communication networks, and data storage — from the age of the centralized mainframe, of the personal computer, to peer-to-peer networks. The flavor these days is the "The Cloud." This lecture will examine the profound changes to our notion of computing that the development of such an infrastructure entails.

Core concepts
On-demand, cloud, ubiquitous, pervasive computing, IoT.

Read
Yan Han, "Cloud Computing: Case Studies and Total Costs of Ownership," *Information Technology and Libraries*, December 2011, 198-206.

Jonathan Cave et al., "Understanding Regulatory and Consumer Interest in the Cloud," in *Regulating the Cloud: Policy for Computing Infrastructure* (Christopher Yoo & Jean-François Blanchette, eds.), pp. 1-19. The MIT Press, 2015.

"The Internet of Things," MIT Techology Review Business Report, May-June 2014, pp. 68-78.

Sterling, B. (2014). *The epic struggle of the Internet of things*. Strelka Press.

Week 10 — Data and Algorithms

Core concepts

Read
Grimmelmann, J. (2008). The Google Dilemma. *NYL Sch. L. Rev.*, *53*, 939.

Page, L., Brin, S., Motwani, R., & Winograd, T. (1997). *PageRank: Bringing order to the web* (Vol. 72). Stanford Digital Libraries Working Paper.

Granka, L. A. (2010). The politics of search: A decade retrospective. *The Information Society*, *26*(5), 364-374.

"Data-Driven Health Care," MIT Technology Review Business Report, Sept-Oct. 2014, pp. 65-70.

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IS 270—Systems and Infrastructures: Final Paper Requirements

1. Substance

Because of the rapid pace of evolution of information technologies, it is important to identify ways in which you can keep your skills fresh. This course will help you to identify, access and use resources (e.g., trade press, research journals and conferences, field experiences, etc.) for keeping up-to-date with the field of information technology, through writing a **4-page policy brief** (example are available at: http://www.parliament.uk/postnotes)

A policy brief is one of the primary sources of information for decision-makers such as politicians and business leaders. It is a short, yet comprehensive description of a certain policy challenge, event or phenomenon, about which the reader must make a decision or take a position on. For that reason, policy briefs are highly synthetic and concise, using language and graphical conventions in a manner that is easy to understand and gets the point across quickly. In politics, policy briefs often include advice on which policies to adopt. The policy briefs in this course are NOT to include this kind of advice. Rather, your task is to describe your chosen topic in a way that would let the reader decide a course of action based on the information you provide. This means that you are to approach your subject in an objective and balanced manner, and argue for both the qualities and the disadvantages of the technology you have chosen to write about.

The objective of the policy brief will be to provide up-to-date information to campus leaders, e.g., members of the UCLA Information Technology Planning Board, or University Librarian Virginia Steele, or Faculty Senate Chair Susan Cohen, regarding technologies that might be adopted on campus or, more broadly, have an impact on the future of higher education, or on the university as a place where student, staff, and faculty spend considerable time. Briefs must focus on one of the technologies listed below:

1. **E-readers**: Amazon Kindle; Barnes and Noble's Nook
2. **Word processing software**: Google Docs; Microsoft Word; LibreOffice
3. **Mapping services**: GoogleMaps; Apple Maps; OpenStreetMap
4. **Social media**: Facebook; Twitter, Google Plus; Diaspora; Snapchat;
5. **Cloud storage services**: Box, iCloud; Dropbox
6. **Activity trackers**: Fitbit; Jawbone; Nike+ FuelBand
7. **Smartwatches**: Apple Watch/watchOS, Android Wear, Samsung GEAR/Tizen
8. **Smartglasses:** Snapchat Spectacles, Google Glass/Aura
9. **Mail clients**: Mail.app; Gmail; Zimbra

10. **Video chat**: Skype; FaceTime; Google hangout
11. **Virtual Reality:** Oculus Rift, Samsung GEAR VR, PlayStation VR
12. **Augmented Reality:** Pokémon Go, Microsoft HoloLens.
13. **360 Degree videos**: Facebook Live 360, YouTube 360
14. **Live video sharing**: Periscope, Facebook Live, YouTube Live
15. **Peer-to-peer file sharing**: BitTorrent; eD2k
16. **Smart tv boxes**: AppleTV; Chromecast; Roku
17. **Streaming video/tv services:** Netflix, Hulu, Amazon Prime Video, Sling TV, Playstation Vue
18. **Bibliographic management**: Zotero; EndNote
19. **Content management software:** Wordpress; Drupal; Joomla; Tumblr
20. **Collection management:** ArchiveSpaces; Archivematica
21. **Course management sofware:** CourseSites (by BlackBoard); Moodle; eDX
22. **MOOC software:** Google Course Builder; OpenMOOC
23. **Library management system**: OCLC Amlib; Evergreen; ExLibris Alma
24. **Digital collection management**: OCLC CONTENTdm; ExLibris Rosetta
25. **Digital personal assistants:** Siri; Cortana; Echo/Alexa; Google Assistant
26. **Citation and indexing services:** Google Scholar; Web of Science; PubMed; Scopus
27. **Web browsers**: Safari; Chrome; Opera; Firefox
28. **Search engines:** Google; Bing; Baidu; DuckDuckGo
29. **Open access scientific search engines:** Sci-Hub; Library Genesis
30. **Music streaming services:** Spotify; Apple Music; Google Play Music
31. **Internet of Things:** Nest suite, Belkin WeMo, Samsung Smart Hub, Apple HomeKit, Amazon Echo
32. **Big Data tools:** Hadoop, CouchBase, MongoDB

Each week, you will be asked to apply the concepts covered in class to your chosen topic, in the form of a 1000 words write-up. In this way, by the end of the semester, you will have already gathered much of the material relevant to your policy brief.

Submit your choice of topic along with a one page justification of your interest on **week two**.

2. Form

The brief should be exactly 4 pages long, with one additional page for citations. Style for citation is left to the choice of the author, but it should be *consistent* with accepted standards for academic writing, i.e. APA, MLA, Chicago, etc.

The policy brief is due Tuesday March 21, 5pm. When **submitting**, attach the graded copies of the six write-ups to your final paper.

The report should follow the following structure:

Cover Letter: A one-page formal letter to your chosen campus leader, describing the context and mandate for the report.

Title

Overview: five bullet points with key issues addressed by the report

Introduction (three to four sentences maximum)

Background (1/2 page)

What is/are ... Technical description of the technology (3/4-1 page)

1 box, describing one particular instance of the technology (e.g., specific software package)

Key challenges and issues: the meat of the brief will outline the 3-4 key issues facing the design, development, adoption, and/or future evolution of technology. These issues will vary depending on the chosen technology. In some cases, these will be about the structure of the market, in others, on interoperability, in others on regulation or standardization (1½ - 2 pages).

Future trends: How is the technology and its market likely to evolve? What particular trends (social, economic, cultural), if any, favor or impede the development and adoption of the technology? (1/2 page)

3. Resources

The Anderson library provides access to many databases containing lots of information and examples of business intelligence reports: http://www.anderson.ucla.edu/x14520.xml

- *Gartner Research IntraWeb* & *Faulkner Advisory for Information Technology Studies* — Gartner in particular will be useful because it specifically covers tech analysis and is geared towards IT decision makers. Faulkner has really useful overview reports of various technologies plus competitive landscape, company profiles.
- *Business Insights* — BI as a technology section, but is global in focus. Probably not as useful, but worth checking definitely.
- *eMarketer* — Excellent for e-commerce topics, has statistical data, articles and some lengthier reports. Somewhat more focused on consumer goods.
- *Plunckett* — Good overall industry database.
- *Business Source Premier* & *Factiva* — Article databases covering trade journals, business periodicals and academic literature. These will definitely be worth searching because coverage is so broad, sources are updated daily. BSP includes some library literature as well.

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IS 270—Systems and Infrastructures: Write-ups Requirements

1. Rationale

Each week, you will be asked to apply the concepts covered in class to your chosen topic, in the form of a 1000 words write-up. In this way, by the end of the semester, you will have already gathered much of the material relevant to your policy brief. The purpose is to force you to spread the research, analysis and writing of your brief over the entire term, rather than cram during the last two days of the term.

2. Process

- Each write-up is worth 5% of your final grade. The grading schema is as follows:

Grade	0	2	3-4	5
Explanation	Not received / inacceptable	0-25%	26-74%	75-100%

- Three of the write-ups will be returned to you without any comments but the grade itself. Three will be returned to you with comments. The choice will be made by the reader, who will decide when you particularly need feedback.
- Submit the write-ups on paper, printed **single-sided**, **space-and-a-half**, with **your name** on the top of the first page. **Staple** the pages together.
- Submit the write-ups **exclusively** during class or in my mailbox. Anything submitted after Tuesday 12h30pm of the due week will be **ignored**. **Submissions by email will not be accepted.**
- The write-ups will be returned to you in **your folder** in the Commons at the latest the following Tuesday, 9am**.**
- Should you have questions regarding write-ups, please consult with the course reader.

3. Substance

The write-ups should answer the following questions:

Write up #1: Architecture (due week 4)

- Describe how the technology organizes the fundamental elements of processing, storage, networking, and data? (use diagrams to clarify the architecture or complement the discussion).
- Describe all devices used for processing, storage, and communication (embedded computers, mobile devices, internet, etc.)

- Which kind of network does the technology rely on? How much bandwidth is required? Is there any particular pricing structure involved for the network resource?
- Where are the users located in this architecture? How do they interact with the system?
- How does the data flow inside, within, and outside the system? (illustrate with a diagram).

Write up #2: Interoperability (due week 5)

- How does the technology interoperate with the rest of the computing ecosystem? Is there for example an API? Physical interfaces, such as USB or SCSI? File formats?
- Can the system be extended through the acquisition of additional modules?
- Is interoperability used as a mechanism to restrict or open markets?

Write up #3: Standards (due week 6)

- What are the major standards operating with regard to your topic? From which other standardization efforts did they grow from?
- Who are the major participants in the standardization process? What interests do they represent?
- What are the major elements of tension in the development of the standards?

Write up #4: Markets (due week 7)

- What is the market structure (competition, monopoly, etc.) of the technology?
- On what features are the different market players competing?
- Does the technology exhibit direct/indirect network effects, lock-in and switching costs?
- How is the technology priced — e.g., versions, licensing, bundling, customization, etc.?

Write up #5: Regulation (due week 8)

- What rules and regulations effectively govern the development, sale and use of the technology you describe?
- Do these rules operate at the institutional level (e.g., internal guidelines), the professional (e.g., best practices), legal/administrative (municipal, state, national, international), or cultural levels (e.g., social norms)?
- What makes the regulation necessary? What are the objectives of the regulation?
- Which various stakeholders groups are represented in the regulatory process, and what positions do they defend?

Write up #6: Design (due week 9)

- How has the technology you describe been designed? How did the designers find out about users' needs and expectations? Was there a specific methodology used?
- How does (has) the technology evolve(d) in order to better fit user's needs? What are designers'claims regarding the technology's fit to user's needs?

- What are planned improvements, new services/features to the technology? Is there a mechanism for involving users in the design process (participation, feedback)?
- Are there features that enable users to customize the technology to fit their particular needs?