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 protocol) 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.

The course also provides an introduction to the Department’s informatics specialization. Informatics is above all 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.

**Course objectives**

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

1. communicate with peers about complex technical issues, using clear and effective English, in both written and oral form;
2. design an personal strategy for maintaining and updating their information technology literacy, given their projected professional path;
3. critically appraise utopist and dystopic discourse on the “information technology revolution” and on the dynamics of innovation which drive it.
4. analyze the architecture of a computing device in terms of its requirements for processing power, storage, and communication bandwidth;
5. articulate the role of modularity as a fundamental tool for managing software and network infrastructure complexity;
6. discuss and further research appropriate methodologies for the analysis and design of an information technology project;
7. list the competing standards and standard bodies operating within a given standardization area;
8. articulate the pro and cons of open vs. proprietary standard strategies;
9. analyze the economic conditions driving a specific information technology market;
10. critically appraise the advantages and disadvantages of current government regulation in the areas of telecommunications, intellectual property, and development;
11. appreciate the conceptual and engineering tools used by the programming community to design and implement software;
12. evaluate how their projected professional path might be affected by future developments in computing technologies.
In addition, the final report 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.

Method

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 “business intelligence report” of about 20 pages. The report will be directed at managers seeking to make an informed decision regarding the evaluation and/or acquisition of a given technology (one that you that is relevant to your particular area of expertise) for their organization. The report will follow a fixed structure, covering the technology from several angles explored in the class, including architecture, design, standardization, market, and future evolution.

Examples of potential topics include digital rights management, online education technologies, electronic repositories for scholarly publishing, course management software, storage of authentic electronic records, PDF/A, or electronic delivery of government services. Students should confirm their chosen topic with the instructor or the course reader in order to verify that it has the required breadth and depth.

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

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](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.

Plunkett — 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.

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.

You should learn how to type diacritical characters using text-processing software (see http://en.wikipedia.org/wiki/Diacritic).

You should abide by the spirit of the “E-Tool Bill of Rights”.

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

Description and due dates of write-ups:

Term paper requirements:
“To be really good at plagiarism, you need precisely the reading and writing skills that ought to render it unnecessary.” — Jonathan Malesic

Required, Suggested, and Additional Readings

Required
All weekly readings are required and available on the course website (most can only be accessed from a UCLA connected computer, or using a proxy server mechanism).

One significant challenge in teaching this course is that the level of exposure to IT varies greatly from student to student. For each weekly discussion, I offer a wide range of additional reading suggestions, some of which are guaranteed to challenge you.

Suggested (copies in reserve)

This textbook was written with LIS and Management audiences, and is being used at LIS schools at Michigan and Berkeley among others. It is out-of-print, but should be easily available through online booksellers or used bookstores. There is a more extensive companion volume, from which some readings will be assigned.


A book which attempts to explain the inner working of a computer in a non-technical way (also on reserve in the MIT lab).

Course schedule

(Please note that for reason of international conference, only the Tuesday section will be taught on Week 4, and only the Thursday section on Week 5. Class audio will be available online).

**Week 1 (January 5 & 7):** Course Overview & Information Technology Literacy

What exactly are “computing skills” made of? What does it mean to be “computer literate” or “fluent”? How does one become knowledgeable about computers? Is it sufficient and/or necessary to be able to program computers? In this class, we will discuss the kinds of information technology knowledge performances that are relevant and appropriate to the field of LIS, as well as the kind of pedagogical approaches this entails.

Core concepts
Skills-based literacy, information technology fluency, knowledge performances.
Read
D. Scott Brandt, “Information Technology Literacy: Task Knowledge and Mental Models”, *Library Trends* 50(1):73-8

“Since computerized and networked information resources are an integral part of information seeking, there is a knowledge area which must be dealt with—some expertise in using the technology. Learners must have an understanding of the technological environment in which information resources are set, integrated, and used. Simple skills are not enough. Without some conceptual understanding, it is likely they will not attain a level of comfort and familiarity that can lead to expertise. ... The goal of information technology literacy is to move from simply following steps to applying concepts when using technology. Conceptual understanding is solidified in a model that learners use to anticipate and solve problems in other situations and settings.” (pp. 75, 81).


“... we sometimes cannot specify our objectives clearly. We may believe that we are training people for an unknown future. We do not know what we want them to know, because we cannot specify the problems and situations they will have to cope with. This may be because the situations that lie ahead of them are too complicated for us to deal with in detail or because we believe the world is going to change so much that we cannot forecast how things will be and thus what a person will need to know to act effectively. Given such a diagnosis, we generally settle for inculcating proper orientations from which students will be able to deduce correct lines of action in specific circumstances, general skills which can be used in a variety of situations, and an ability to learn new material as it becomes available. (p. 104)

Browse

“What ‘everyone should know’ about technology cannot be a static list of prescriptions to use word processing programs or e-mail. Instead, fluency goals must allow for change, enable adaptability, connect to personal goals, and promote lifelong learning. ... As described by a National Research Council report, fluency with information technology requires the acquisition of three kinds of interdependent knowledge that must be taught in concert: skills, concepts, and capabilities. Skills are necessary for job preparedness, productivity, and other aspects of fluency. They include such things as using the Internet to find information, or setting up a personal computer. Skills change as technology advances ... . Concepts explain how and why information technology works. Capabilities, essential for problem solving, include managing complex systems as well as testing solutions.” (p. xi)


People fluent with information technology (FIT persons) are able to express themselves creatively, to reformulate knowledge, and to synthesize new information. ... Fluency with
information technology requires three kinds of knowledge: contemporary skills, foundational concepts, and intellectual capabilities. ... Foundational concepts, the basic principles and ideas of computers, networks, and information, underpin the technology. Concepts explain the how and why of information technology, and they give insight into its opportunities and limitations. Concepts are the raw material for understanding new information technology as it evolves. (from the executive summary).

ALA / ACRL’s “Information Literacy Competency Standards for Higher Education,” (January 18, 2000).

“‘Fluency’ with information technology may require more intellectual abilities than the rote learning of software and hardware associated with "computer literacy", but the focus is still on the technology itself. Information literacy, on the other hand, is an intellectual framework for understanding, finding, evaluating, and using information--activities which may be accomplished in part by fluency with information technology, in part by sound investigative methods, but most important, through critical discernment and reasoning.”

SAA’s “Guidelines for a Graduate Program in Archival Studies,” (January 2002).

“Graduate archival education, in contrast to archival training, is both academic and professional; therefore, it includes both original research and experiential learning. Ultimately, archival education creates an intellectual framework that enables students to understand the ideas on which their profession is founded, to engage in the development of archival principles, and to apply this knowledge in a wide variety of settings. In contrast, archival training focuses on building skills or acquiring practical knowledge according to a replicable pattern, or on developing a specialization in certain areas.”

Additional Readings


“The comparison of users’ definitions of their IT competencies and definitions of computer literacy presented in the literature made visible the perspectives through which information technology and computing expertise are commonly approached, and that are influential in a wide range of contexts: in technology design, institutions of teaching and education, and workplaces. These perspectives can be defined as the user-psychological approach and the sociocultural approach. Statements stressing the importance of positive computer-related attitudes, and the necessity for all to learn independent use skills, exemplify the first approach, also characterized above as the generic skills approach. Statements stressing the importance of gaining a critical understanding of the inherently social and cultural nature of technical artifacts, language, and knowledge, exemplify the latter approach, also characterized above as the context- or domain-oriented approach.” (p. 20)

“Computer literate: competent in the use of computers (Chambers English Dictionary)” (p. 225)


“… it is learning rather than information, and sociotechnical fluency rather than literacy, that comprise the agenda for tomorrow.” (p. 21)


“ ‘Knowledge,’ I would propose – at least in terms of personal knowledge expression – can be seen as a culturally recognized set of performances called “knowing” that suggest that a person “has” the potential for further performances like these kinds and, thus, is said to have “knowledge” of a certain form.” (p. 631)

Week 2 (January 12 & 14): Computer-Supported Cooperative Work and Play

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.

Core concepts
Sociotechnical systems, technological determinism, symbolic engineering.

Read

“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)

Additional readings

“The instability that rapidly changing technology brings, however, often lies less in the technology itself than in the enthusiastic expectations that everything being “just a click away” or “at your fingertips” will make life easy. Battered by such hype, it’s easy to believe that everyone except you knows how to use this stuff without a problem.” (p. 76)


“We have to accept the fact that although the use of metaphors is not a particularly elegant or sophisticated technique, it is perhaps the only conceptual tool we have for understanding the development of a new technology. We should therefore direct our energies towards understanding the peculiarities of this tool: How can we leverage it to maximize the potential payoff? What are the pitfalls and how can we avoid them?” (p. 293).


Due
Write up #1

Week 3 (January 19 & 21): 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 technological evolution.

Core concepts
Processing power; memory hierarchy; communication bandwidth; client-server, peer-to-peer, three-tier architecture; thin/thick clients; Von Neumann architecture.
Read


This set of articles deal with a crucial component of networked computing, the telecommunication links that bring the data home. Those links are very different from the "backbone", the main conduit that carry the data between major areas of the country, insofar as they must reach each individual home, and thus, necessitate extensive investments in costly infrastructures, and also, depend on right-of-ways. These articles are from 1999, so they are a bit dated, but in a useful way. Back then, it was far from clear by which conduit data would reach homes — cable, telephone lines, wireless, satellites, etc. The articles will provide you with some useful info about the technical characteristics of each type of link, as well as give you the opportunity to think about why cable and DSL emerged as the winners.

Additional Readings


The chapter traces the transition between punched-card machinery-based information processing and that using digital computers, and provides another explanation of the stored-program computer — another term for Von Neumann architecture.


Architecture is a term that has different acceptions in the computing literature. In the class, I use to term to refer to the organization of processing, storage, and communication within networked information systems. For example, in Smith’s “A Historical Overview of Computer Architecture”, architecture refers to the organization of processing, storage, communication and instructions within individual computers. Smith's is a great overview, and will introduce you to the 'Von Neumann' architecture, conceived by Von
Neumann very early in the history of computers. 99.9 % of all computers in use today are built following this architecture.


“In our collective vision of ubicomp’s proximate future, the messiness of our local laboratory infrastructures (the nests of cabling hidden in the dropped ceiling or behind the closet door, the jumble of perl, java, and python code that precariously conspire to produce 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 with 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.”

**Week 4 (January 26): Modularity and Layering**

(note: only one class this week, for reason of international conference. Class audio will be available online).

How do programmers break down the enormous complexity of software systems and coordinate the operation of the different parts of such systems? What does it mean to say that the Internet is a “shared platform for information services”?

**Core concepts**

*Modularity*: functionality, granularity, hierarchy, separation of concerns, interoperability, reusability; *modules*: interface, implementation, actions, parameters and returns, data types, protocols; *layering*: middleware, spanning layer.

**Read**


Week 5 (February 4): Design

(note: only one class this week, for reason of international conference. Class audio will be available online).

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


“Although video undoubtedly captures more of the experience of an event than a photograph, it does no follow that a video clip serves as a better trigger for memory, narrative or the presentation of identity.” (p. 109)
Additional Readings


**Due**
Write up #2

**Week 6 (February 9 & 11): 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**

“We slice the ontological pie the wrong if we see software over here and organizational arrangements over there. Each standard in practice is made up of sets of technical specifications and organizational arrangements. … The question is how to distribute qualities between the two – what needs to be specified technically and what can be solved organizationally are open questions to which there is no one right answer.”


**Additional Readings**


“We expect to be fair to people, groups of people, institutions, companies — things the security community would call ‘principals’. But a flow is merely an information transfer between two applications. Where does the argument come from that information transfers should have equal rights? It’s equivalent to claiming food rations are fair because the boxes are all the same size, irrespective of how many boxes each person gets or how often they get them. Because flows don’t deserve rights in real life, it is not surprising that two loopholes the size of barn doors appear when trying to allocate rate fairly to flows in a nonco-operative environment. If at every instant a resource is shared among the flows competing for a share, any realworld entity can gain by i) creating more flows than anyone else, and ii) keeping them going longer than anyone else.”


“This document suggests that it is important to retain the class of ‘simple best-effort traffic’ (though hopefully augmented by a wider deployment of other classes of service). Further, this document suggests that some form of rough flow-rate fairness is an appropriate goal for simple best-effort traffic. We do not argue in this document that flow-rate fairness is the "only possible" or "only desirable" resource allocation goal for simple best-effort traffic. We maintain, however, that it is an appropriate resource allocation goal for simple best-effort traffic in the current Internet, evolving from the Internet’s past of end-point congestion control. [...] For simple best-effort traffic with rough flow-rate fairness, the quote from Winston Churchill about democracy comes to mind: ‘Democracy is the worst form of government except all those other forms that have been tried from time to time.’


**Browse**

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**


Hal Varian, “*Economics of Information Technology*” (you can skip section 7, and any material that is overly mathematical or that refers to economic concepts you are unfamiliar with — e.g., Nash equilibrium, or Pareto efficiency).


**Additional Readings**

Vaughan, Jason, “*A library's integrated online library system: assessment and new hardware implementation*”, *Information Technology and Libraries* 23(2):50-7 (June 2004).


“We propose that an incremental approach to bringing technology to the classroom in the developing world is the direction to take ahead. Instead of building new devices that require both expensive R&D and a greater threshold of arguing for adoption, considering the institutional buying modes these projects operate in, it is far easier to work within the realm of ‘off-the-shelf’ computers, as we propose here. The shared-computer use model that we propose here may not have the best case benefits of an ideal “laptops for all” scenario, but our argument is that it is not feasible to think of the former, and besides the core economic arguments, we have also provided learning gain potentials and parental attitudes toward shared computer use to support our position. This approach to shared computing thus explores how we can best maximize the benefits of computers for children that are likely to be used in primary schools in the developing world and in small computer centers where children sit in groups.”

Due
Write up #4: Standards

Week 8 (February 23 & 25): 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


“One of the surprising aspects of the whole network neutrality debate – and a fascinating irony – is that those who typically oppose “Internet regulation” are broadly in favour of legislation designed to safeguard net neutrality. However, the answer to this apparent contradiction is obvious if one adopts a broad concept of regulation. Far better to have a freely debated, transparent and ubiquitous public regulation, argue the proponents of net
neutrality, than a series of commercial and opaque private relationships determining the nature of the Internet. Both outcomes “regulate” the net in the sense that they constrain or promote particular types of behaviour, so it’s less a question of if we regulate, than how we regulate.”


“There is a good policy argument in favor of doing nothing and letting the situation develop further. The present situation, with the network neutrality issue on the table in Washington but no rules yet adopted, is in many ways ideal. ISPs, knowing that discriminating now would make regulation seem more necessary, are on their best behavior; and with no rules yet adopted we don’t have to face the difficult issues of line-drawing and enforcement. Enacting strong regulation now would risk side-effects, and passing toothless regulation now would remove the threat of regulation. If it is possible to maintain the threat of regulation while leaving the issue unresolved, time will teach us more about what regulation, if any, is needed.”

Additional readings


A summary of Zitrain’s argument in *The Future of the Internet (and How to Stop It)*: “The most plausible path along which the Internet might develop is one that finds greater stability by imposing greater constraint on, if not outright elimination of, the capacity of upstart innovators to demonstrate and deploy their genius to large audiences. Financial transactions over such an Internet will be more trustworthy, but the range of its users’ business models will be narrow. This Internet’s attached consumer hardware will be easier to understand and will be easier to use for purposes that the hardware manufacturers preconceive, but it will be off limits to amateur tinkering. Had such a state of affairs evolved by the Internet’s twenty-fifth anniversary in 1994, many of its formerly unusual and now central uses would never have developed because the software underlying those uses would have lacked a platform for exposure to, and acceptance by, a critical mass of users.” (p. 1977).

Due
Write up #5: Markets
Week 9 (March 2 & 4): Architecture (part two): The Cloud

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”. One proposed future configuration is that of a “computing grid”, an infrastructure providing processing power on-demand. This lecture will examine the profound changes to our notion of computing that the development of such an infrastructure entails.

Core concepts
Grid, on-demand, cloud, ubiquitous, and pervasive computing.

Read

"I have no idea what anyone is talking about," said Oracle Corp. Chief Executive Larry Ellison, when talking about cloud computing at a financial analyst conference in September. "It's really just complete gibberish. What is it?" He added: "When is this idiocy going to stop? … The computer industry is the only industry that is more fashion-driven than women's fashion."


David Talbot, “Security in the Ether: Information technology's next grand challenge will be to secure the cloud — and prove we can trust it” Technology Review January/February 2010.


Additional readings


Browse
Help locate the aliens by sharing your idle processor cycles! Download and install the SETI client.

Due:
Write up #6: Regulation
Week 10 (March 9 & 11): Programming

How are real-world problems and their contexts conceptualized, modeled, and encoded in a form suitable for computer processing? What kinds of tools have programmers and mathematicians developed in order to perform such representations?

Core concepts
Algorithmic complexity; rate of growth; pseudo-code; low/high level languages; imperative, functional, object-oriented languages; modularity.

Read
Daniel Hillis, Chapter 5, “Algorithms and Heuristics” and 3, “Programming.”


Additional readings


Due:
Final paper.