

CPSC 155b Solution Set for First Hour Exam

Q1. As Shapiro and Varian say on page 13 of **Information Rules**, “When the value of a product to one user depends on how many other users there are, economists say that this product exhibits *network externalities*, or *network effects*.” There are several reasons that network effects are exceptionally important in e-commerce. First, communication technologies are prime examples of products and services that exhibit strong network effects; the examples that Shapiro and Varian give on page 13 are “telephone, e-mail, Internet access, fax machines, and modems,” all of which are key enablers of e-commerce. Second, e-commerce benefits tremendously from infrastructural standards, both those established by official standards bodies such as the IETF and those established *de facto* in the marketplace. *De facto* standardization often happens as a result of the “positive feedback” that accompanies network effects; in Shapiro and Varian’s words, “as the installed base of users grows, more and more users find adoption worthwhile. Eventually, the product achieves critical mass and takes over the market.” The Netscape browser is a perfect example of a product we discussed in class that exhibited strong network effects. The explosive growth that followed Netscape’s achievement of critical mass led not only to the initial success of its browser product but to the popularization of the Internet and to the “browser-centric” nature of the (mass-market) Internet user experience. Ultimately, this was not enough to save Netscape as a company. Although the browser interface became a *de facto* standard, there was nothing specific to Netscape that users needed; the network effects persisted as long as (almost) all Internet users were using Netscape, Internet Explorer, or any other browser, as long as it displayed HTML and “spoke” HTTP. Other examples mentioned in class and in the assigned reading include the Windows operating system and the Napster file-sharing system.

Q2. As explained in Appendix C of **The Digital Dilemma** (page 265), the Internet “itself is designed to merely transport data from one user to another... [The basic network] services are quite simple and are generally not application specific, so they can support a wide range of old and new applications without modification.” Users are assumed to access the network through “intelligent endpoints” such as general-purpose, programmable computers. E-commerce inventors and entrepreneurs are free to develop new applications and to market them to Internet users. As long as these applications can communicate via standard Internet protocols, individual “endpoint” owners can just install them and use them; the network itself need not be changed, and thus inventors and entrepreneurs need not go through the typically long, difficult process of designing, implementing, and deploying a modification *of the network infrastructure* in order to deploy a new product that’s directed at end users. This makes the marketplace for end-user e-commerce products extremely fast-moving, dynamic, and receptive to wildly successful products that “take over.” Once again, the Netscape browser is a perfect example. Tim Berners-Lee could develop HTML, HTTP, and Mosaic unilaterally, and people could “just start using them.” The Netscape founders could realize the commercial potential of these

inventions, further develop them, and market them, causing even more people to “just start using them.” The innovative products and services could be installed in individual computers, and they were enabled by the standard IP, TCP, and other Internet protocols, which did not have to change.

Q3.

- (a) Publish as many articles as possible in the most prestigious journal in the field. Post each one on a web site, in multiple popular document formats. Include a full citation (author, article title, journal, volume, year, page numbers) at the bottom of each page of each article, so that people who view or print them (or even single pages of them) will know where they appeared. Create a single web page that lists all of his publications (with links to the online documents) and gives helpful metadata (such as short abstracts and keywords), and encourage colleagues to link other important web pages to this publication page.
- (b) In the short term, distribute the film via existing non-Internet channels, including theaters, video cassettes, and DVDs. (Incidentally, convince the motion-picture industry that the DVD technical-protection system should use a good cryptosystem, not CCS.) Distribute free promotional material such as coming attractions via as many channels as possible, including the Internet; use Internet distribution of promotional material in order to experiment with and further develop the technological and business infrastructure needed for Internet distribution of film. Partner with other companies that can produce and distribute complementary products (music CDs, posters, tee shirts, *etc.*), including Internet-based products (screen savers, banner ads, *etc.*). Sue copyright infringers if their actions pose a real threat to the owner’s ability to profit from distributing the film, but take care not to create a PR disaster and fuel public resentment of rights holders. In the medium term, license the film for TV viewing (broadcast, cable, pay-per-view). In the long term, figure out how to charge people for films delivered primarily over the Internet (before high-bandwidth access and a Napster-like service creates a crisis in the movie business).
- (c) Simultaneously develop both the first product and the second; the second could be a “premium version” of the first, or it could later be marketed as such even if it is just a closely related product. Give away the first product and hope that it is widely adopted. Sell service contracts and training courses to large organizations that use the first product. If these organizations look as though they might pay for the second product, consider letting them use “beta” versions of it and have input into the final stages of its development. Sell the second product to all customers if it succeeds with large organizations. Continue to develop a “pipeline” of products and to use this strategy for releasing them. As soon as the first product is released, encourage others to develop complementary products. Publish a User’s Guide for the first product; the best format for this may turn out to be a traditional book, even for a product that is given away, but remember that the goal is to maximize adoption of the product, not book royalties.

Q4.

- (a) Copyright law gives the owner of copyright certain exclusive rights, including the right “to distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease, or lending.” The first-sale rule is a limitation on this exclusive right; it says that “the owner of a particular copy or phonorecord...is entitled, without the authority of the copyright owner, to sell or otherwise dispose of the possession of that copy or phonorecord.” In the world of analog works, in which content is bound to and delivered in a physical object, the first-sale rule helps maintain balance, because it simultaneously (1) allows libraries, second-hand book and record stores, and friends who give or lend books and records to each other to disseminate works and, as the Constitution says, to “promote progress of science and the useful arts,” and (2) by restricting the set of copies that the same parties can sell or lend, prevents these parties from destroying the ability of the copyright owner to profit from his work. These parties who do not own the copyright are not allowed to *make* copies; once such a party has transferred a particular copy, he no longer possesses it. The only (legal) way for a particular copy to get into circulation in the first place is for the copyright owner to put it there. The only (legal) way for more copies to come into existence is for the copyright owner to produce them, at nonzero unit cost. The fact that each copy is possessed by exactly one party at any given time and that unit production costs are nonzero are crucial to the first-sale rule. It is because analog works are bound to and delivered in physical objects that both of these facts hold. This logic breaks down in the digital world in which “content is liberated from medium.”
- (b) Traditional copyright law gives copyright owners the exclusive right “to reproduce the copyrighted work in copies or phonorecords.” In the analog world, the owner of a work can, by controlling the number of copies that are in circulation, ensure that the supply of copies does not grow excessively relative to the demand for copies, thus preserving his ability to profit from the work. However, he cannot exercise the same control over access to the work. Even if only a small number of copies of a book or painting exist, a large number of people can read or view them over time; people can travel to the work, or the work can be sent to the people, and no additional copies need be made. Thus an owner of the rights to a traditional, printed book cannot say “I will allow only N copies to be printed and only N paying customers to read them.” In the digital world, in which access involves copying, a rights holder with an exclusive right to control copying *could* say this. The right to control all copying would imply the right to control all access, and this would significantly alter the balance that copyright law has traditionally provided between the needs of rights holders and the needs of the general public; it would give rights holders significantly more power than they have traditionally enjoyed. Therefore, the exclusive right to control reproduction should be re-evaluated.

Q5.

- (a) From Appendix E of **The Digital Dilemma** (page 290): “A digital signature scheme involves three procedures: a key generator..., a signing function, and a verification function.

A user who has generated a key pair can feed his secret key and a digital object as input to the signing function, which produces “a signature” (a set of bits) as output. The crucial property of the signature is that it could have been produced only by someone with access to both the digital object and the secret key. Subsequently, anyone presented with the object and the signature can look up the signer’s public key and feed the object, the signature, and the public key into the verification function. The verification function can use this public key to determine whether the signature was produced by the signing function from the object and the secret key that corresponds to the public key.” Both distributors and customers can use digital signatures to obtain “assured provenance” of digital transmissions. When a customer’s player application receives a digital object, it can check that it has received an “official copy” by verifying the signature of an authorized distributor. A distributor can delay transmission of a valuable object until he receives a signed contract and payment authorization from the customer. The technical definition of digital signature ensures that neither party can later deny that he has in fact created a signature that his public key verifies.

- (b) Public-key certificates allow users of public-key schemes to convince themselves that they have “the right public key,” before they use that key to verify a signature or encrypt a message. In their simplest form, these certificates bind the name of a known entity to the public key of that entity. Certificates are signed by trusted parties called “certifying authorities” (CAs). They thus allow users of public-key schemes to “bootstrap” a small amount of trusted information (the “right public key” of a CA) into a larger amount of trusted information (the “right public key” of every entity that has a certificate signed by that CA). More intricate forms of public-key certificates are discussed briefly on pages 292-293 of **The Digital Dilemma** and in more detail in the references given there. In e-commerce today, the most well-known CA is Verisign, and the most well-known use of certificates is in web-based communication between an individual customer and the website of a merchant that has a “real-world” identity. In the content-distribution setting, the merchant would be a well-known distributor, *e.g.*, Disney. It is the distributor to whom Verisign issues the certificate. When the customer’s browser (which must know the Verisign public key) interacts with the distributor’s website, *e.g.*, to exchange personal data or payment information using SSL, it uses the certificate to gain trust that it has the “right public key” for this distributor. This process serves customers’ needs by ensuring that the real-world distributor they know as “Disney” is not being impersonated on the web by someone who puts Mickey Mouse and other familiar characters on the website but cannot legally distribute Disney content. It serves distributors’ needs by ensuring that they are not impersonated on the web by people who could either steal their customers by illegally distributing the real content or ruin their reputations by distributing phony content under the real brands.
- (c) From Appendix E of **The Digital Dilemma** (pages 296-297): “A watermark is a digital signal, added to or removed from the original object, that does not interfere unduly with the intended use of the altered object and yet carries a small amount of information. ‘Invisible watermarks’ are imperceptible to people but can be detected by appropriate software. A technical protection service that uses watermarking can provide a content distributor with a

way to mark content before distribution and track what happens to it subsequently. Users of works [*e.g.*, customers] may also benefit, because successful watermark detection can demonstrate the source of the content and that it has not been altered subsequently.”

Q6.

(a)

Application
Transport
IP
Physical

(b) IP

(c) Application

(d) Transport

(e) The answer to this question is largely the same as the answer to Question 2 above. There, we saw how open standards and well understood network protocols facilitated innovation and entrepreneurship “at the endpoints.” If an important innovation is developed for a particular layer L, the same principal applies; as long as the innovation does not require a change to the layer directly below L and it allows L to continue to provide the necessary functionality to the layer directly above L, it can be deployed without a lengthy, painful redesign of the entire network.

Q7.

(a) The answer to this question is simply the “flip side” of the answer to part (b) below. On the one hand, merchants can collect lots of data about their customers, and this *may* help them target particular customers more effectively, make general improvements in their products and services, and have more to offer potential strategic partners. On the other hand, web-shopping data give very incomplete information about people, and merchants could wind up drawing wrong conclusions and alienating their customers with inappropriate targeted offers. They could also suffer reputation damage if they are accused of violating people’s privacy by collecting data that they don’t need for their business, of selling it, or of using it for nefarious purposes. They could be forced to reveal data that they’ve collected if they are sued. (Recall Napster and Metallica.) Finally, if a high-volume web merchant collects *everything* that he possibly can, he will eventually have an unmanageable data-warehousing problem on his hands. Some high-volume service companies, *e.g.*, telephone companies, already have big enough data sets that they can’t use off-the-shelf data-warehouse products to manage them; they need trained computer scientists and custom-built software for the job. This is not a position that most merchants want to be in.

(b) Ways in which data-collection can help customers include:

- Data can be aggregated and used for market research that results in better products or better service. (“Better service” could include more efficient web-site operation.)

Aggregate data sets need not include anything that identifies individual customers and hence need not threaten customer privacy.

- Merchants can use data about an individual customer to design attractive personalized offers for that customer. Some “real world” merchants have always done this for their high-end customers, but, in the “web world,” more of the process is automatable, and hence more customers could potentially benefit.
- Server-side database entries, client-side “cookies,” and other means of remembering what a customer did in previous visits to a merchant site can be used to (automatically) speed up the same customer’s future visits to that site. For example, a long sequence of menu choices can be recorded the first time a customer makes them and short-circuited in future visits.

Ways in which data-collection can harm customers include:

- “Personalized offers” are not always attractive. Excessive numbers of useless personalized offers are distracting and annoying; they are like the “junk mail” one gets as a by-product of using credit cards, but they can be a much larger-scale problem if their production is fully automated.
- Identity-revealing transaction data can be collected by or sold to unscrupulous organizations. It can then be used for purposes more nefarious than junk mail and “personalized offers,” *e.g.*, blackmail, insurance blackballing, employment blackballing, and general reputation damage.
- Although the data that can be gathered about an individual by observing his web-shopping habits are sometimes voluminous, they almost always give a highly incomplete picture of him. Many wrong conclusions can be drawn by merchants if they over-interpret these data. The consequences for the individual customer can range from mildly annoying (*e.g.*, irrelevant junk mail) to highly damaging (*e.g.*, unjustified denial of credit or other important service.)

- (c) There is no one right answer to this question. How many points you get will depend on how well you support your position. The most common reason that people give for agreeing with the statement that “The Internet empowers consumers” is that it is fundamentally and qualitatively easier for consumers to “go to a different website” than it is for them to “go to a different [bricks and mortar] store.” Clicking away or typing a different URL is trivial compared to driving to a different location, particularly one that is further away. If different web merchants ultimately offer the same products or even products that are easily and meaningfully compared, this seems to be a fairly compelling argument that the Internet empowers consumers. One could even go further and say that comparison shopping could be largely automated; this would be *far* easier for consumers than driving from store to store.

The most common reason that people give for disagreeing with the statement that “the Internet empowers consumers” is that they do not believe different web merchants will offer the same products or facilitate comparison shopping. They believe that many popular mass-market products will be sold only by monopoly producers and that each producer will make an exclusive deal with one web merchant so that both can benefit from monopoly prices. This view could be supported by the observation

that, because few B2C retailers are profitable in these early days, the few that survive may require financial backing that can only be obtained through deals with deep-pockets producers, not through better service to consumers.