Introduction

- Can or should the law provide incentives for vendors to build better software?
- Are vendors currently liable for software defects of any sort?
  - It depends, but in general, the answer is No.
  - Sound strange? What about McDonald's coffee?
- Q: Would holding them liable make the world a better place?
  - How do we even answer this question?

Overview

- Basic substantive law: tort, contract, property, criminal law.
- Simple economic model for understanding/evaluating different legal regimes.
  - Economic analysis of property law.
  - Economic analysis of tort law.
- Apply lessons learned to the software security problem.

Basic Substantive Law

- Property
  - Rights of exclusion, bundle of rights
  - Generally enforced by injunctive remedy, as between private parties
  - Real property, personal property, intellectual property
- Contract
  - Enforceable promises, between private parties
  - A mechanism for allowing people to rearrange rights
  - Generally enforced by damages remedy,

More Substantive Law

- Tort
  - Civil wrongs for which the law provides a remedy
  - Intentional torts, negligence, strict liability
- Criminal
  - State enforced prohibitions against certain actions
- Sources of law:
  - Common law
  - Statutes
  - Constitutions
  - Regulations

Law and Economics

- Using ecomomic models to understand and evaluate various legal regimes.
  - it gives us some basis/model for discussing the relative (dis)advantages of various legal rules/regimes.
  - Reductionist, cost-benefit approach...
- Alternative basis: "rights approach" -- focuses on concepts such as justice, liberty, fairness, equality, fundamental rights, etc.
- Good books:
  - Posner & Landes, "Economic Analysis of the Law"
  - Cooter & Ulen, "Law & Economics"
  - Polinsky, "Introduction to Law and Economics"

L & E

- Two considerations:
  - Maximize social welfare (efficiency): make the pie bigger
  - Distributional equity
- Example:
  - Allowing a factory to pollute might make the factory owner much better off, at the “expense” of the surrounding community.
  - Is this an efficient rule?
  - Does it address distributional concerns?

Very Simple Example

- Imagine a legal regime that assigns property at birth.
  - Person A is assigned an executive jet, but develops poor eyesight and cannot pilot the plane. How does A value the jet?
  - Person B would love to fly, but doesn't own a jet. How does B value A's jet?
- Could A and B make a trade that would make both parties better off?

Property: Nuisance Law

- Definition: an unreasonable interference with the use and enjoyment of a person's property.
- General Rule: you can do pretty much whatever you want with your property, so long as it doesn’t interfere with another's use & enjoyment of their property.
- This means: If the neighbor is creating a nuisance, then you can enjoin him from burning garbage.
- Is this a good rule? An efficient rule?

Entitlements and Remedies

- Decouple the assignments of entitlements/rights from the enforcement mechanism.
- Entitlements/rights:
  - An entitlement to pollute, or
  - An entitlement to clean air
- Remedies / enforcement mechanisms:
  - Property rule: the entitlement is enforced by an injunction
  - Liability rule: the entitlement can be taken, but the taker must pay damages

Four Possibilities

- Entitlement to clean air, protected by property rule
  - Nuisance: neighbor can enjoin (stop) the polluter from polluting, but polluter can buy this right!
- Entitlement to pollute, protected by property rule
  - No nuisance: polluter may pollute at will, but neighbor can always buy this right!
- Entitlement to clean air, protected by liability rule
  - Polluter may pollute at will, but must pay damages suffered by neighbor.
- Entitlement to pollute, protected by liability rule
  - Neighbor can stop polluter, but must pay damages suffered by polluter.

Property Rules

- Suppose:
  - P values pollution at $1000
  - 100 Ns each suffer $3 harm if there is pollution.
- What happens if the Ns are entitled to clean air?
- What happens if P is entitled to pollute?

Coase Theorem

- In *absence of transaction costs*, the placement of initial entitlements is irrelevant, because the parties will bargain to shift the entitlement to achieve the most efficient result.
  - Transaction costs: getting parties together, gathering information, enforcing agreements.
  - There are almost never zero transaction costs…
- Lubrication: If you believe in markets, the job of the law should be to clearly define rights and enforce agreements, so that those rights can be shifted to those who value them most.

Again, With Transaction Costs

- Suppose:
  - P values pollution at $1000
  - 100 Ns each suffer $3 harm if there is pollution.
  - Transaction costs = $400 on each side
- What happens if the Ns are entitled to clean air?
- What happens if P is entitled to pollute?
- Lesson: when transaction costs are high, the entitlement should be given to the party that values the entitlement the most.

Cheapest Cost Avoider

- Suppose:
  - P values pollution at $1000
  - P could abate for $100 by installing smokestack.
  - 100 Ns need to pay $2 each to buy gas masks, or suffer $3 harm.
- What happens if P is entitled to pollute?
- What happens if N is entitled to clean air?
- What if transaction costs are high (no bargaining)?
- Lesson: place the entitlement *against* the cheapest cost avoider.

General Problems

- *Holdout problems*: when injurer is attempting to buy an entitlement from a potential victim.
- *Freeloader problems*: when victims are attempting to buy an entitlement from injurer(ers).
- *Endowment effect*: people commonly over-value entitlements (asking price >> offer price)
- *Information assymmetries*
- *Relative bargaining positions:* the wealthy have a greater willingness to pay for entitlements than do the poor.

Liability Rules

- Suppose:
  - N has an entitlement to clean air, protected by liability rule
  - P values pollution at $1000
  - P could abate for $100
  - 100 Ns each suffer $3 harm.
- Result? If P pollutes, she must pay $300 in damages. P will therefore rather pay $100 and abate, owing no damages.
- What if each N can avoid the harm for $.50?
  - Depends on whether N has a duty to mitigate and whether the parties can cooperate...

Liability Rules Again

- Same facts, except that P entitled to pollute, protected by liability rule.
- N will enjoin P from polluting, but will have to pay damages, which in this case is the cost of abatement, or $100.
- Examples: ecological easements – developer forced to give up a portion of their land, in return for the right to increase density on remaining land.

Liability Rule Issues

- Liability rules are preferrable when transaction costs are high, and when we do not know who values the entitlement most, BUT:
- Courts are an inefficient mechanism for recovering damages: for every dollar recovered, it costs a dollar.
- Determining damages can be difficult:
  - Underestimation of damages leads to inefficiently high levels of activity
  - Overestimation (e.g. Punitive damages) leads to inefficiently low levels of activity
- Lots of parties with small injuries (who will go to court to recover $5?)

Externalities

- A cost (or a benefit) of an activity by one party that is imposed on (or received by) another party without compensation (or payment).
  - Positive externalities: Vaccinations, education, bee keeping, improving property, etc.
  - Negative externalities: Pollution, accidents, defective products, etc.
- Assuming we agree that negative externalities are bad, legal regimes should seek to force parties to internalize the external costs of their actions.

Interlude

- Where we've been:
  - Entitlements
  - Property rules (injunctions) v. liability rules (damages)
  - Coase theorem and it's problems
- In this unit, we'll look at some classic legal doctrines:
  - Negligence
  - Strict liability
  - Warranties
  - Products liability

Tort: Negligence

- Four elements of a negligence claim:
  - Duty
  - Breach of duty (did the injurer behave “reasonably”?), proxies:
    - Custom
    - Statutory violation
    - Cost-benefit analysis
  - Causation: proximate cause
  - Injury: generally there is no recovery of purely economic loss
- Negligence (if the standard of care is set correctly) leads to efficient outcomes, unless activity level is important

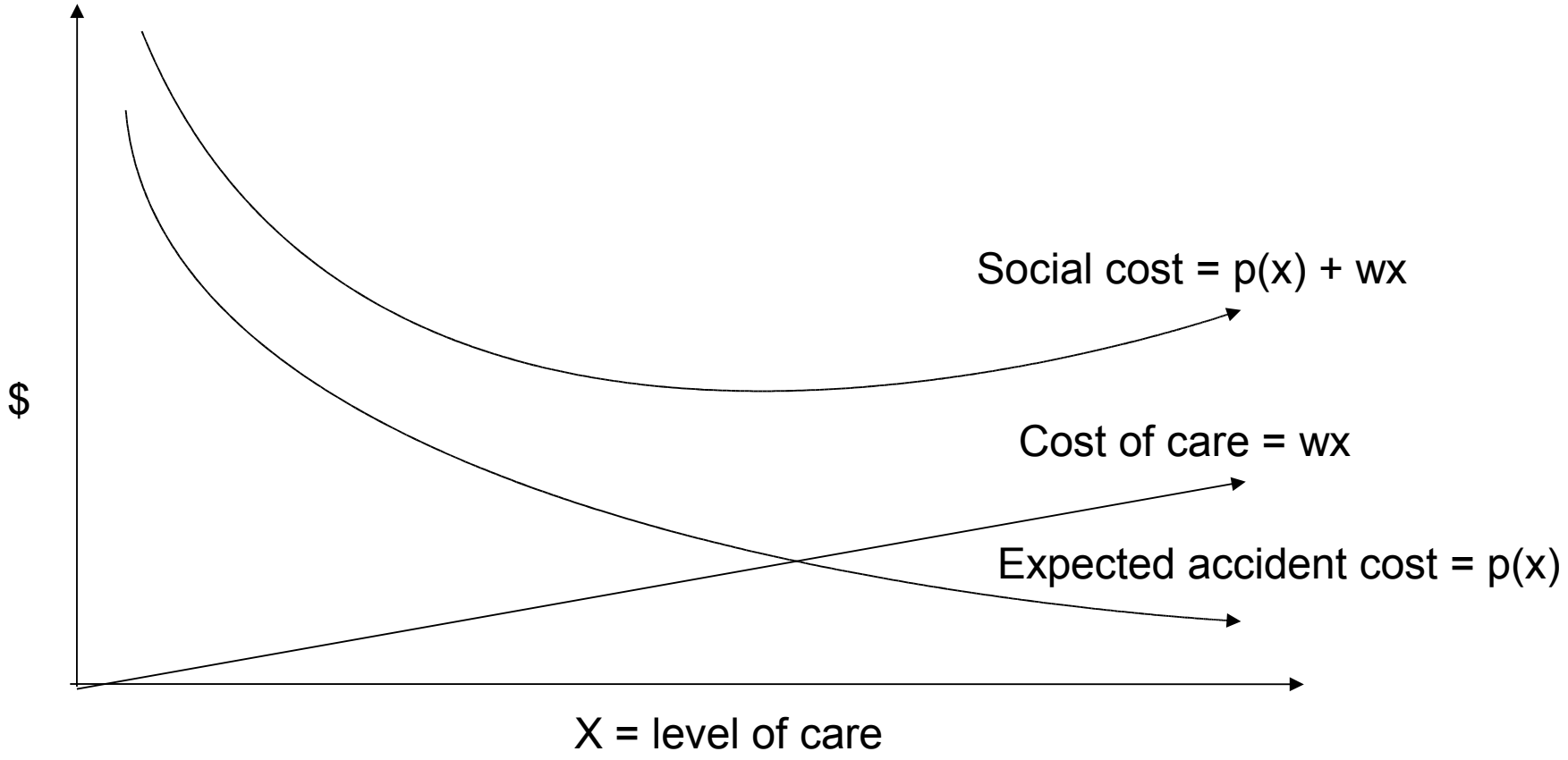
Some Fake Numbers

Speed (Level of care)	***Benefit***	***Expected Accident Costs***	***Social Welfare***
Slow	50	10	40
Medium	100	30	70
Fast	150	100	50

What is the optimal level of care?

Optimal Standard of Care

- We want a level of care that will minimize social cost:



Tort: Strict Liability

- History: ultrahazardous activity – dangerous animals, blasting, etc
- The injurer is liable for any damages they cause.
- Think of it as negligence, without the breach of duty inquiry:
  - Not as crazy as it sounds: leads to efficient outcome, even when activity level matters. Why? Because the injurer is forced to internalize the negative costs of their activity, and will therefore settle on the most efficient standard of care.

Strict Liability Example

Speed	*Benefit*	*Expected Accident Costs*	*Social Welfare*
Slow	50	10	40
Medium	100	30	70
Fast	150	100	50

Compare the distributional effects of SL and Negligence...

What about Victim's level of care?

- Under SL, victims won't take care.
  - Why? Because the injurer is liable for all accident costs, so there is no incentive for victims to take care.
- Under Negligence, victims will take care.
  - Why? Because victims will take care to minimize the cost of those accidents that occur where the injurer took due care (and therefore would not have been liable for the cost of the accident).
- Under SL + contributory negligence, victims will take care.
  - Why? Because the injurer is only liable if the victim failed to take due care, so victims will take care to force the injurer to pay for any accidents.

Activity Levels

- Under the negligence approach, the injurer will often over-engage in the activity because as long as they meet the standard of due care, they will not be liable for any accidents they cause.
  - NOTE: This is really more due to the fact that courts are generally not capable of folding activity level (e.g. miles driven) into the standard of care.
- Under strict liability, however, injurers must pay for all accidents they cause, and will therefore engage in the optimal level of activity.

Activity Levels

Speed & Amount of Driving	*Benefit*	*Expected Accident Costs*	*Social Welfare*
Slow (a little)	50	10	40
Slow (a lot)	80	20	60
Medium (a little)	100	30	70
Medium (a lot)	130	70	60
Fast (a little)	150	100	50
Fast (a lot)	180	140	40

Compare the results under negligence and strict liability.

Warranties

- Generally taught as a contract theory, but has its origin in the tort of misrepresentation
- The Uniform Commercial Code (UCC) governs commercial transactions in all 50 states. Article 2 covers sales.
- 3 important, overlapping warranties in Article 2:
  - Express warranties created by words or conduct
  - Implied warranty of merchantability
  - Implied warranty of fitness for a particular purpose
- Warranties can be disclaimed.

Products Liability

- Producers are liable for injuries caused by manufacturing defects, design defects, failures to warn. Applies to *products*:
  - tangible personal property distributed commercially for use or consumption [sometimes includes real property and electricity; doesn't include blood or human tissue...]
- Based on 3 separate legal theories:
  - Warranty:
  - Negligence: manufacturer was negligent in design or manufacture
  - Strict liability: becoming the dominant theory
- Product price signals users to switch to less dangerous alternatives.

But the Consumer will Pay more!

- If someone tells you this, they are usually taking you for a fool.
  - Large car company: “If we have to install seatbelts, the prices will be passed on to the consumer, and our cars will be more expensive. That can't be good!”
  - Need to compare:
    - World without seatbelts (additional 1000 people per year die, social cost = $1B)
    - World with seatbelts (must pay for seatbelts (cost = $10M), but reduce deaths by 1000 people/year)
    - Is society as a whole better off with or without seatbelts?
    - Who can install them most efficiently?

Enforcement Mechanisms

- Private enforcement
  - Individual parties bring actions for damages or injunctions in courts
  - Courts are expensive and not good at assessing damages or performing cost-benefit analyses
  - Common law is flexible (“behave reasonably”), but blunt...
- Public Enforcement
  - The state enforces the rules.
  - Mechanisms: criminal/civil penalties enforceable in court; zoning; taxes; rules enforceable in administrative proceedings
- Self Regulation

Administrative Agencies

- Traditional Justification: correcting market failures
  - Need to control monopoly power
  - Compensate for inadequate information
  - Collective action problems
  - Correct externalities or the existence of high transaction costs
- Examples:
  - Environmental: Clean Air, Clean Water, Superfund, etc.
  - Energy regulation
  - FCC

Agencies: Costs and Benefits

- Benefits:
  - Agencies tend to have more expert knowledge
  - Regulation can respond flexibly to changing conditions (compared to legislation)
  - Fine-grained rules/enforcement
- Disadvantages:
  - Limited enforcement (small staffs)
  - Agency capture (toothless rules, toothless enforcement, rent-seeking)
  - Path dependence / lock in
  - Agencies aren't as expert as they could be...

Self Regulation

- Benefits
  - The regulators are the experts
  - Flexible, fine-grained controls
  - High rates of compliance
- Costs
  - Rent seeking behavior
  - Toothless rules / toothless enforcement
  - Less likely to focus on the “cost” side of problems with externalities
- Examples
  - IETF
  - Better Business Bureau

Fact Pattern

- SQL Slammer worm of 2003
  - Exploited buffer overflow vulnerability in MS-SQL server.
  - Infected 75,000 hosts in just 15 minutes
  - Doubled in size every 8 seconds
  - Scanned 55 million hosts/s at peak
- Impact
  - Disrupted ATM networks
  - 911 problems
  - Flight cancellations
  - Westpac Australia
  - $1B in damages

Fact Pattern Analysis & Discussion

- Please describe, in one bluebook, all possible causes of action by all possible plaintiffs and the defenses that might be raised...
- Remember the basic analysis for any cause of action:
  - Duty
  - Breach
  - Causation. Who or what caused the injury?
  - Injury/Damage

Software Security

- Issues to ponder in the software security space:
  - Parties: vendors, consumers, ISPs, etc.
  - Name the entitlement. Do courts recognize it?
  - Transaction costs?
  - Who is the cheapest cost avoider?
  - How do we value damages?
  - Causation issues?
  - Victim's level of care?
  - Why won't the market solve the problem?
    - High switching costs, monopoly issues
    - Every person who chooses to buy insecure software becomes a potential “polluter”

Some Numbers to Ponder

- Market for network security is ~$20B/yr.
- Network insecurity damages are ~$10-20+B/yr.
- Microsoft proudly announced in 2002, that they spent over $100M on improving security of the Windows OS.
- In fiscal year ending June 31, 2002, MS announced ~$10B/yr in revenue from the Desktop Platform group (~5B/yr in income).
- R&D spending at MS in 2002 = ~$4B/yr.