date:

output: xaringan::moon_reader: mathjax: "https://cdn.bootcss.com/mathjax/2.7.1/MathJax.js?config=TeX-MML-AM_HTMLorMML" # rescales math with css changes https://github.com/yihui/xaringan/issues/143 lib_dir: libs

```
#seal: false
css: [custom.css, "hygge"] #, metropolis, metropolis-fonts
nature:
  beforeInit: ["macros.js", "https://platform.twitter.com/widgets.js"] # first is for rescaling images , se
  highlightStyle: ocean #rainbow #monokai rainbow solarized-light #tomorrow-night -blue -eighties zenburn
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  countIncrementalSlides: false
  ratio: "16:9"
  slideNumberFormat: |
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      </div>
    </div>
includes:
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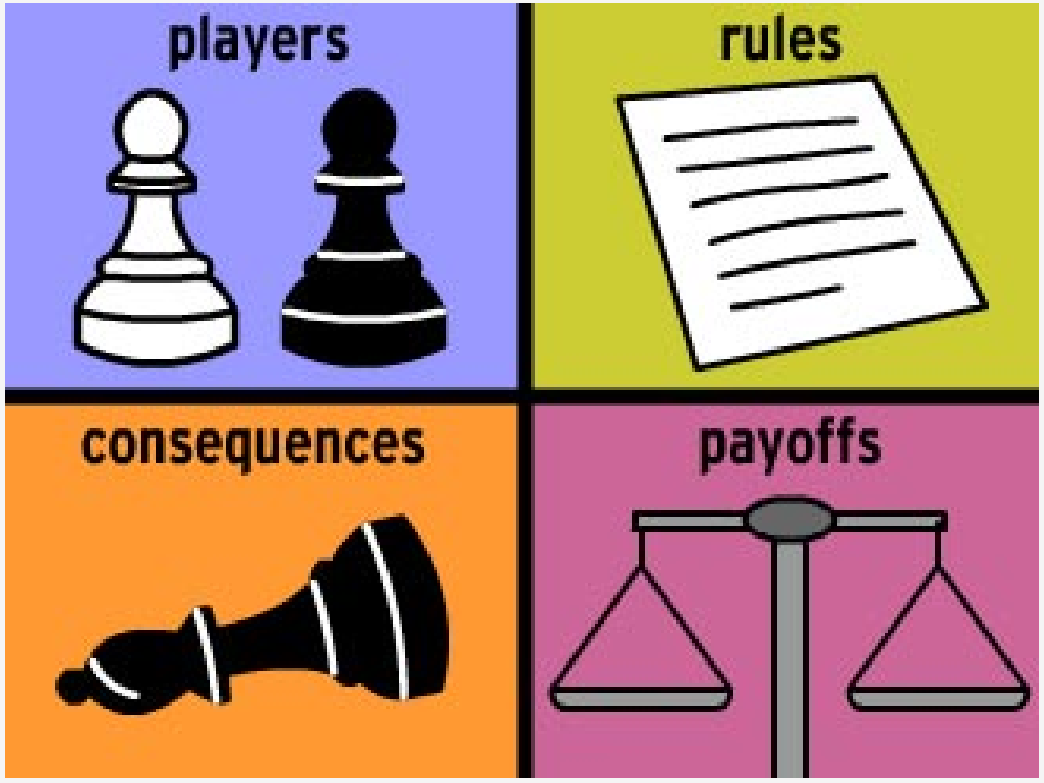
Review of Static Game Theory

Game Theory



- **Game theory**: a set of tools that model **trategic interactions** (**“games”**) between rational agents, 3 elements:
  1. **Players**
  2. **Strategies** that each player can choose from
  3. **Payoffs** to each player that are *jointly-determined* from combination of all players’ strategies

Game Theory vs. Decision Theory Models I

- Traditional economic models are often called **"Decision theory"**:
- **Optimization models** **ignore all other agents** and just focus on how can **you** maximize **your** objective within **your** constraints
    - Consumers max utility; firms max profit, etc.
- **Outcome**: **optimum**: decision where *you* have no better alternatives

Game Theory vs. Decision Theory Models I

- Traditional economic models are often called **"Decision theory"**:
- **Equilibrium models** assume that there are **so many agents** that **no agent's decision can affect the outcome**
  - Firms are price-takers or the *only* buyer or seller
  - **Ignores all other agents' decisions**!
- **Outcome**: **equilibrium**: where *nobody* has no better alternatives

Game Theory vs. Decision Theory Models III

- **Game theory models** directly confront **strategic interactions** between players
  - How each player would optimally respond to a strategy chosen by other player(s)
  - Lead to a stable outcome where everyone has considered and chosen mutual best responses
- **Nash equilibrium**: set of strategy profiles where *nobody* wants to switch strategies

As a Prisoner's Dilemma I

- Suppose we have a simple **duopoly** between **Apple** and **Google**
- Each is planning to launch a new tablet, and choose to sell it at a **High Price** or a **Low Price**

As a Prisoner's Dilemma I

- Payoff matrix represents profits to each firm
  - First number in each box goes to **Row player (Apple)**
  - Second number in each box goes to **Column player (Google)**

		Google	
		High Price	**Low Price**
Apple	**High Price**	$500M $500M	$250M $750M
	Low Price	$750M $250M	$300M $300M

As a Prisoner's Dilemma II

- From **Apple**'s perspective:
  - **Low Price** is a **dominant strategy** for **Apple**

		Google	
		High Price	**Low Price**
Apple	**High Price**	$500M $500M	$250M $750M
	Low Price	$750M $250M	$300M $300M

As a Prisoner's Dilemma II

- From Google's perspective:
  - **Low Price** is a **dominant strategy** for **Google**

		Google	
		High Price	**Low Price**
Apple	**High Price**	$500M $500M	$250M $750M
	Low Price	$750M $250M	$300M $300M

As a Prisoner's Dilemma II

- **Nash equilibrium**: (**Low Price**, **Low Price**)
  - neither player has an incentive to change price, *given the other's price*

		Google: High Price	Google: Low Price
Apple	**High Price**	$500M $500M	$250M $750M
	Low Price	$750M $250M	$300M $300M

As a Prisoner's Dilemma III

- **Nash equilibrium**: (**Low Price**, **Low Price**)
  - neither player has an incentive to change price, *given the other's price*
- A possible **Pareto improvement**: (**High Price**, **High Price**)
  - Both players are better off, nobody worse off!
  - Is it a Nash Equilibrium?

		Google	
		High Price	**Low Price**
Apple	***High Price***	*$500M* *$500M*	$250M $750M
	Low Price	$750M $250M	$300M $300M

As a Prisoner's Dilemma IV

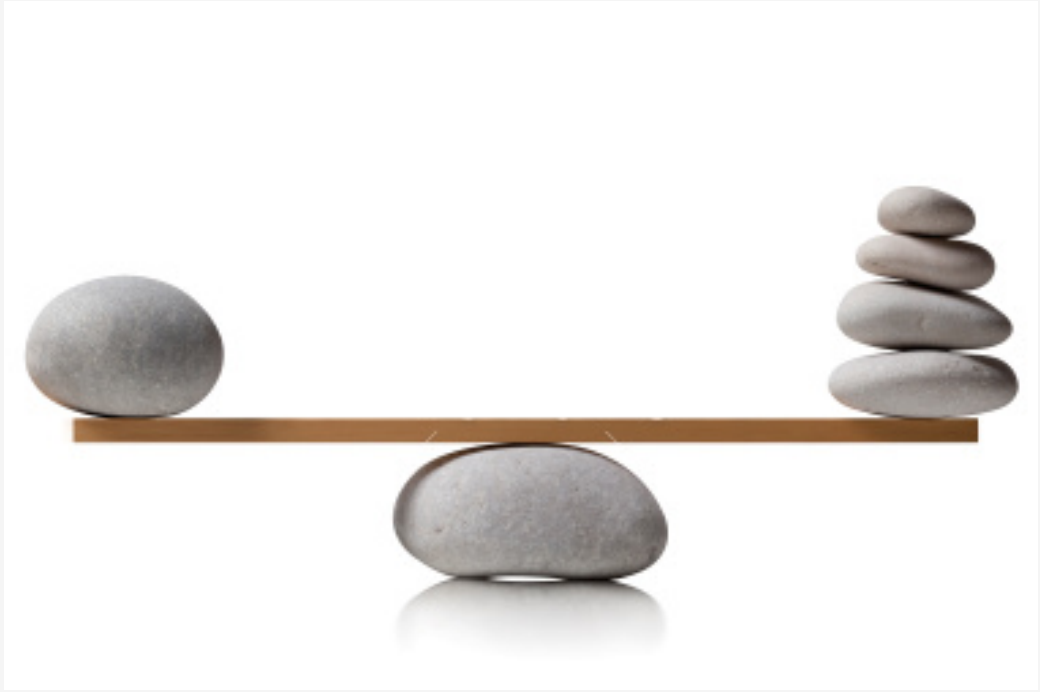
- Google and Apple could **collude** with one another and agree to both raise prices
- **Cartel**: group of sellers coordinate to raise prices to act like a collective monopoly and split the profits

Game Theory: Some Generalizations

There's a *lot* more to game theory than a one-shot prisoners' dilemma:

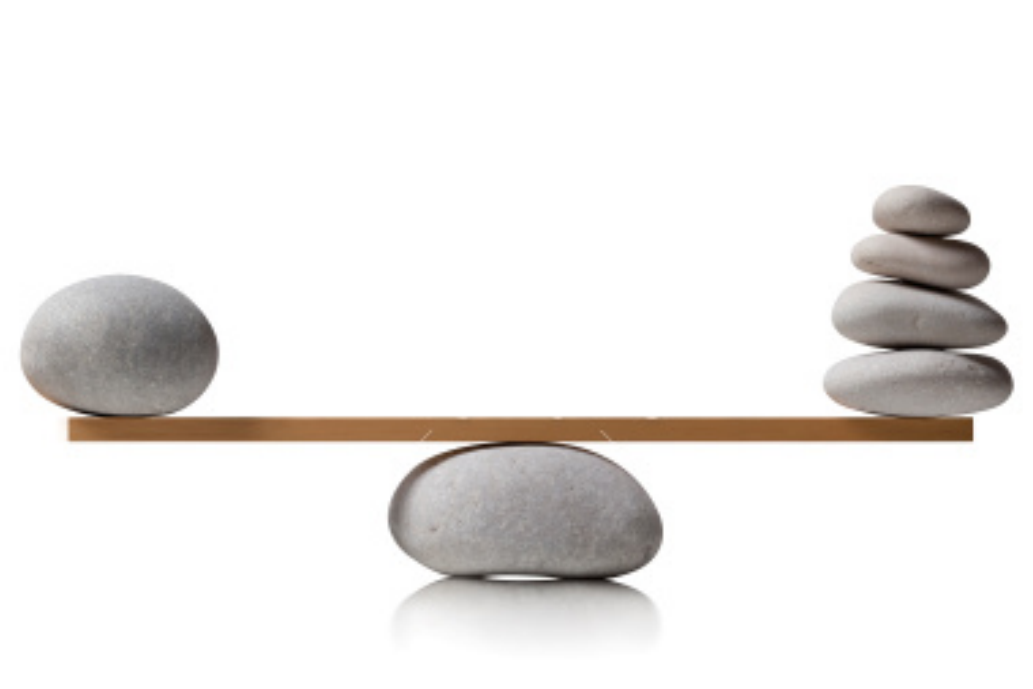
- one shot vs. repeated game
- discrete vs. continuous strategies
- perfect vs. incomplete vs. and asymmetric information
- simultaneous vs. sequential game
- See my game theory course for more (likely taught next in Fall 2021)

Solution Concepts



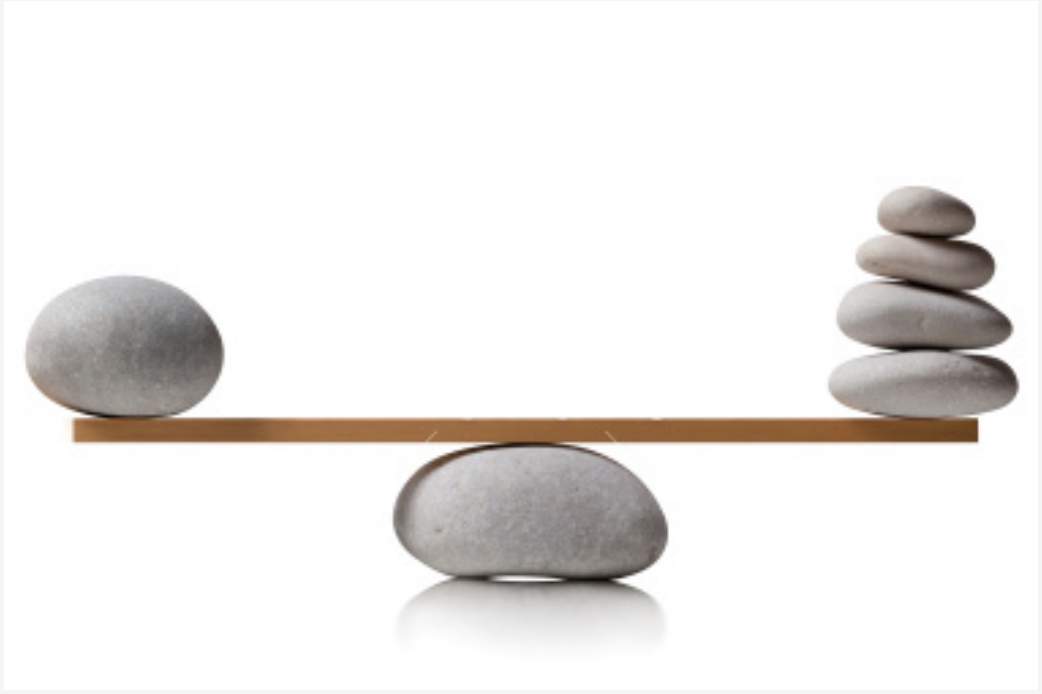
- We use **"solution concepts"** to allow us to predict an **equilibrium** of a game
- **Nash Equilibrium** is the primarly solution concept
    - Note it has *many* variants depending on if games are sequential vs. simultaneous, perfect vs. imperfect information, etc.

Solution Concepts: Nash Equilibrium



- Recall, **Nash Equilibrium**: no players want to change their strategy given what everyone else is playing
  - All players are playing a best response to each other

Solution Concepts: Nash Equilibrium



- Important about Nash equilibrium:

1. N.E. $\neq$ the "*best*" or *optimal* outcome
    - Recall the Prisoners' Dilemma!
2. Game may have *multiple* N.E.
3. Game may have *no* N.E. (in "pure" strategies)

Example: Coordination Game

		Player 2: Standard A	Player 2: Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

- A **Coordination Game**
  - No dominant strategies

Example: Coordination Game

		Player 2: Standard A	Player 2: Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

- **Two Nash equilibria**: (A,A) and (B,B)
  - Either just as good
  - Coordination is most important

Example: Coordination Game

		Player 2	
		Standard A	Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

- Two general methods to solve for Nash equilibria:

1) Cell-by-Cell Inspection: look in each cell, does either player want to deviate?

- **If no: a Nash equilibrium**
- If yes: *not a Nash equilibrium*

Example: Coordination Game

		Player 2	
		Standard A	Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

- Two general methods to solve for Nash equilibria:

2) Best-Response Analysis: take the perspective of each player. If the other player plays a particular strategy, what is your strategy(s) that gets you the highest payoff?

- Ties are allowed
- **Any cell where both players are playing a best response is a Nash Equilibrium**

Example: Coordination Game

Player 1 \ Player 2	Standard A	Standard B
Standard A	2, 2	1, 1
Standard B	1, 1	2, 2

Player 1's best responses

- Two general methods to solve for Nash equilibria:

2) Best-Response Analysis: take the perspective of each player. If the other player plays a particular strategy, what is your strategy(s) that gets you the highest payoff?

- Ties are allowed
- **Any cell where both players are playing a best response is a Nash Equilibrium**

Example: Coordination Game

		Player 2	
		Standard A	Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

Player 2's best responses

- Two general methods to solve for Nash equilibria:

2) Best-Response Analysis: take the perspective of each player. If the other player plays a particular strategy, what is your strategy(s) that gets you the highest payoff?

- Ties are allowed
- **Any cell where both players are playing a best response is a Nash Equilibrium**

Example: Coordination Game

		Player 2: Standard A	Player 2: Standard B
Player 1	Standard A	2, 2	1, 1
	Standard B	1, 1	2, 2

N.E.: each player is playing a best response

- Two general methods to solve for Nash equilibria:

2) Best-Response Analysis: take the perspective of each player. If the other player plays a particular strategy, what is your strategy(s) that gets you the highest payoff?

- Ties are allowed
- **Any cell where both players are playing a best response is a Nash Equilibrium**

A Change in the Game

		Player 2: Standard A	Player 2: Standard B
Player 1	Standard A	3, 3	1, 1
	Standard B	1, 1	2, 2

- Two Nash equilibria again: (A,A) and (B,B)
- But here (A,A) $\succ$ (B,B)!

A Change in the Game

		Player 2: Standard A	Player 2: Standard B
Player 1	Standard A	3, 3	1, 1
	Standard B	1, 1	2, 2

- **Path Dependence**: early choices may affect later ability to choose or switch
- **Lock-in**: the switching cost of moving from one equilibrium to another becomes prohibitive
- Suppose we are currently in equilibrium (B,B)
- **Inefficient lock-in**:
  - Standard A is superior to B
  - But too costly to switch from B to A

Some Games Have No Nash Equilibrium

		Goalie	
		Dive Left	**Dive Right**
Kicker	**Kick Left**	-1 1	1 -1
	Kick Right	1 -1	-1 1

Some Games Have No Nash Equilibrium

		Goalie: Dive Left	Goalie: Dive Right
Kicker	Kick Left	-1, 1	1, -1
	Kick Right	1, -1	-1, 1

- Best responses
- No strategy profile where both players are playing a best responses
- No Nash Equilibrium in “pure strategies”
- But there is (always) a Nash Equilibrium in “mixed strategies”

Property

Why Do We Need Property Law?

- A solution to the tragedy of the commons
- Imagine two neighboring farmers (from Cooter & Ulen)
    - game theoretic interaction
    - each farmer can either **Farm** or **Steal**

Why Do We Need Property Law?

- Suppose:
  - crops are valued at 15
  - planting & watering costs 5
  - stealing costs 2
- With no legal system, the game looks like:

		Farmer 2	
		Farm	**Steal**
Farmer 1	**Farm**	10 10	-5 12
	Steal	12 -5	0 0

Why Do We Need Property Law?

- **Nash Equilibrium**: (Steal,Steal)
- Pareto-improvement: (Farm,Farm)

		Farmer 2: Farm	Farmer 2: Steal
Farmer 1	**Farm**	10 10	-5 12
	Steal	12 -5	0 0

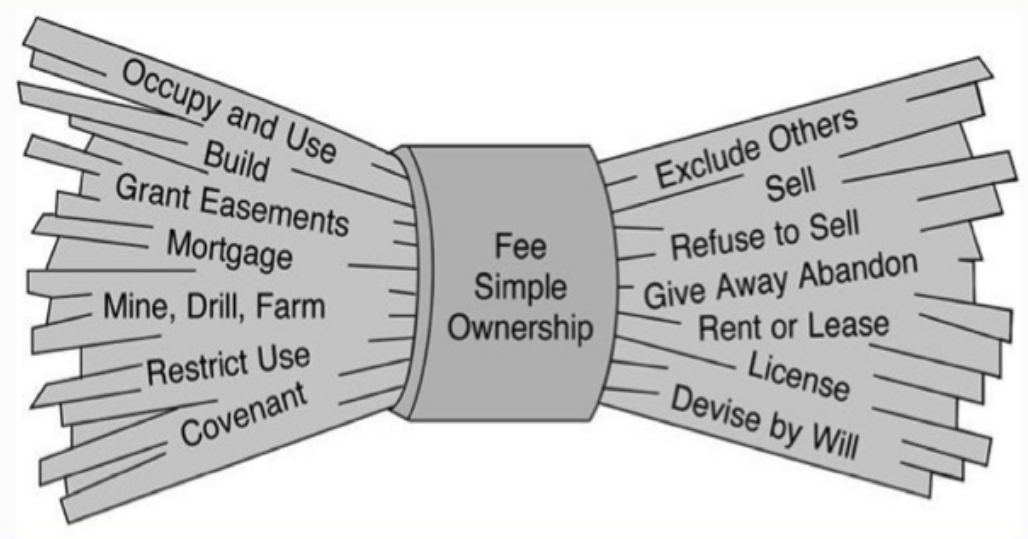
Why Do We Need Property Law?

- Suppose there are many farmers that face the same problem
- They recognize that establishing rules of property and punishing theft gets them the Pareto improvement
  - Setting up a property law system (and someone to enforce it) has costs c
  - The punishment to theft is P
- If $10 - c > 12 - P$, then (Farm,Farm) becomes an equilibrium

		Farmer 2	
		Farm	**Steal**
Farmer 1	**Farm**	10 10	-5 12
	Steal	12 -5	0 0

Property Rights

> "Property is a bundle of legal rights over resources that the owner is free to exercise and whose exercise is protected from interference by others" (Cooter and Ulen, p.73)



- This bundle contains a lot of rights, to:

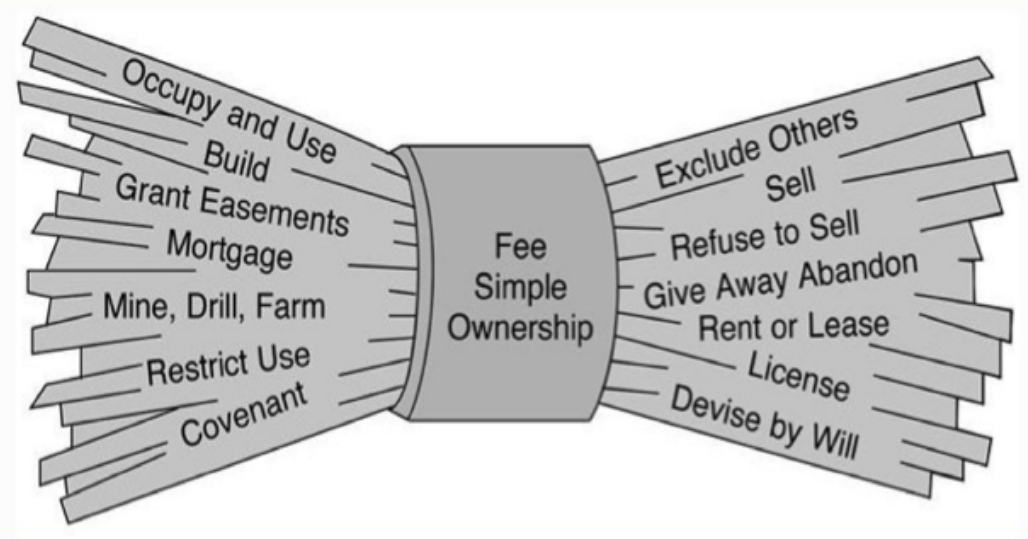
> possess, use, develop, improve, transform, consume, deplete, destroy, sell, donate, bequeath,

Property Rights

- Three important legal points about property rights:
  1. These rights are **impersonal** — they attach to property, not persons
  2. Owner is free to exercise rights over her property (law neither forbids nor obliges)
  3. Others are forbidden to interfere with owner's exercise of her rights

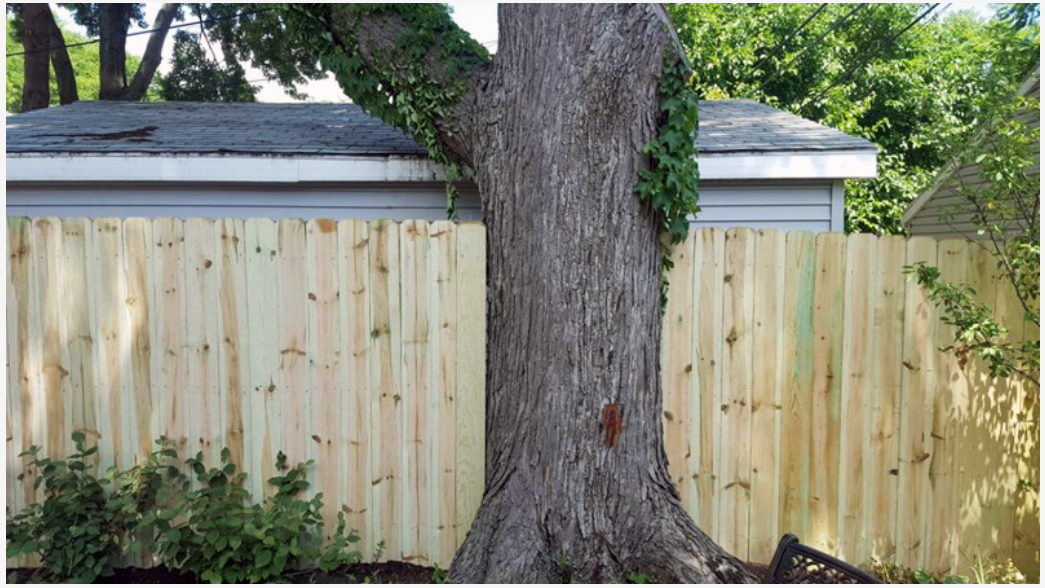
Property Rights

- Any property system must answer:
  1. What can be privately owned?
  2. What can (and can't) an owner do with her property?
  3. How are property rights established?
  4. What remedies are available when property rights are violated?



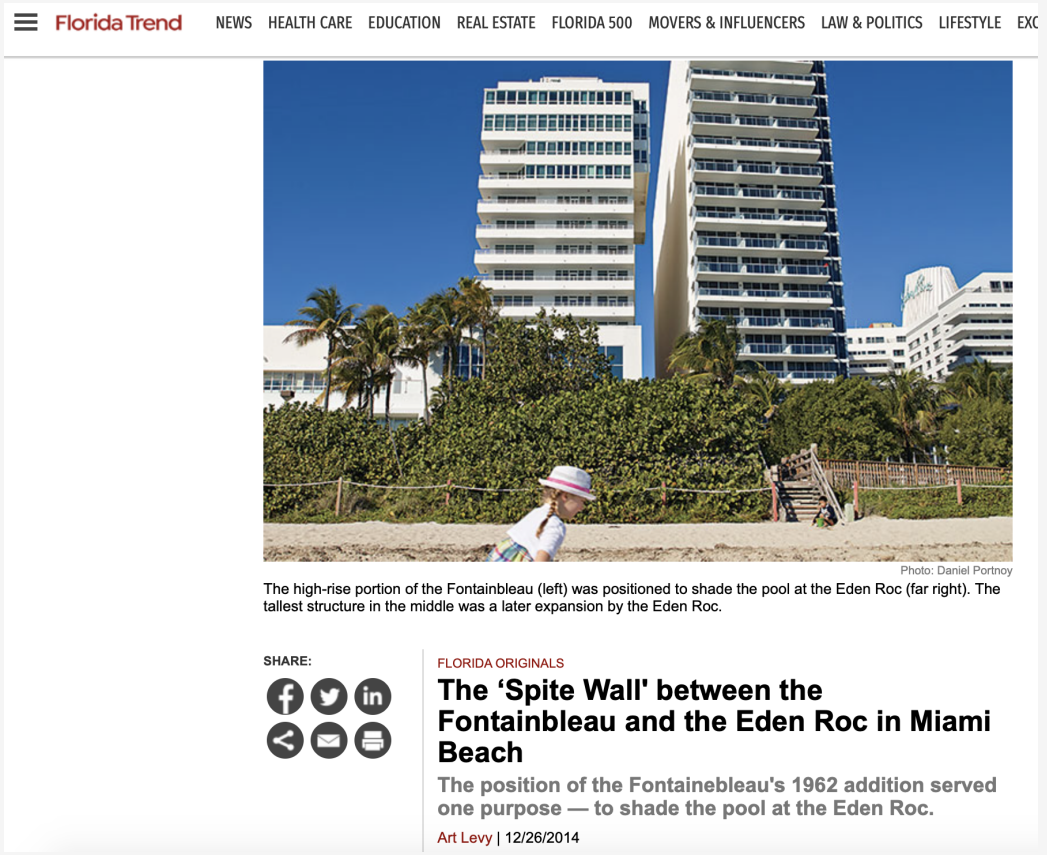
It's Not So Simple: A Story

It's Not So Simple: A Story



This Story Has Million Dollar Implications

Fontainebleau Hotel Corp. v. Forty-Five Twenty-Five, Inc (1959) 114 So. 2d 357, 1959 Fla. App.



Florida Trend NEWS HEALTH CARE EDUCATION REAL ESTATE FLORIDA 500 MOVERS & INFLUENCERS LAW & POLITICS LIFESTYLE EXC

Photo: Daniel Portnoy

The high-rise portion of the Fontainbleau (left) was positioned to shade the pool at the Eden Roc (far right). The tallest structure in the middle was a later expansion by the Eden Roc.

SHARE:

FLORIDA ORIGINALS

The 'Spite Wall' between the Fontainbleau and the Eden Roc in Miami Beach

The position of the Fontainebleau's 1962 addition served one purpose — to shade the pool at the Eden Roc.

Art Levy | 12/26/2014

Source: Florida Trend (2014)

“The Fox Case”

- In 1802, **Lodewick Post** organized a fox hunt in Southampton, NY
    - His dogs caught the scent, and he gave chase to a fox
- **Jesse Pierson** appears “out of nowhere,” kills, and claims the fox for his own
    - Claims not to have seen Post
- **Post** sued **Pierson** to get the fox back
    - Lower court sided with **Post**; **Pierson** appealed to NY Supreme Court

“The Fox Case”

- Legal question: When do you own an animal?
- NY Supreme Court ruled for **Pierson** (who killed fox)

> “If the first seeing, starting, or pursuing such animals…should afford the basis of actions against others for intercepting and killing them, **it would prove a fertile source of quarrels and litigation**”

“The Fox Case”

- Legal question: When do you own an animal?
- The dissenting opinion sided with **Post**:
  - a fox is a “wild and noxious beast”
  - killing foxes is of “meretorious and of a public benefit”
  - ruling for **Post** would incentivize fox hunting

What Rule?

- If **Pierson** gets the fox
  - simpler rule: “finders keepers”
  - bright-line, easy to implement, discourages disputes
- If **Post** gets the fox
  - better incentives for hunting hard-to-catch noxious animals (like foxes)
- Same tradeoff between simplicity and good incentives as the whaling cases!