1 Model 1: Decision making under risk

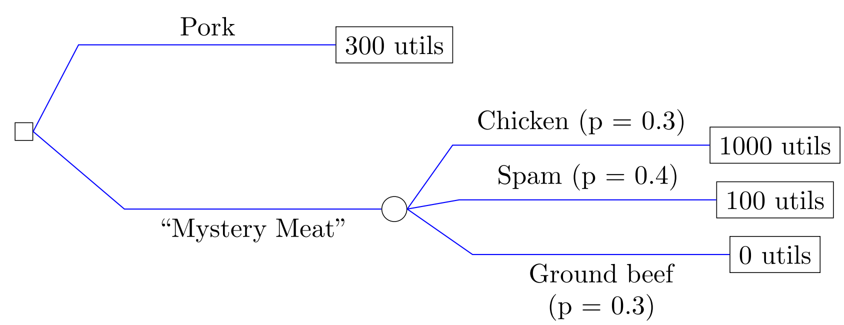
1. Kenneth wants to eat meat for dinner, and sees that he can either buy Pork or "Mystery Meat" at the grocery store. Both are the same price. The "Mystery Meat" could be either chicken, ground beef, or spam. His order of preference in regards to all options: chicken, pork, spam, and ground beef. In particular,

   - u(pork) = 300 utils (this is his *reservation utility*)
   - u(chicken) = 1000 utils
   - u(spam) = 100 utils
   - u(ground beef) = 0 utils

   Using the decision tree below:

   a.) What is Kenenth's expected utility of purchasing "Mystery Meat"?

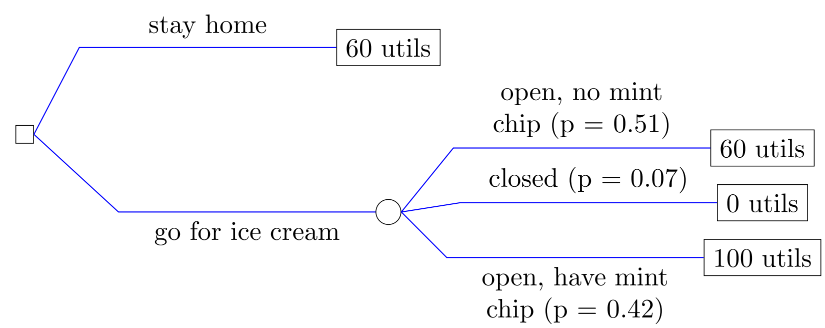
   b.) Should Kenneth buy Pork or "Mystery Meat"?



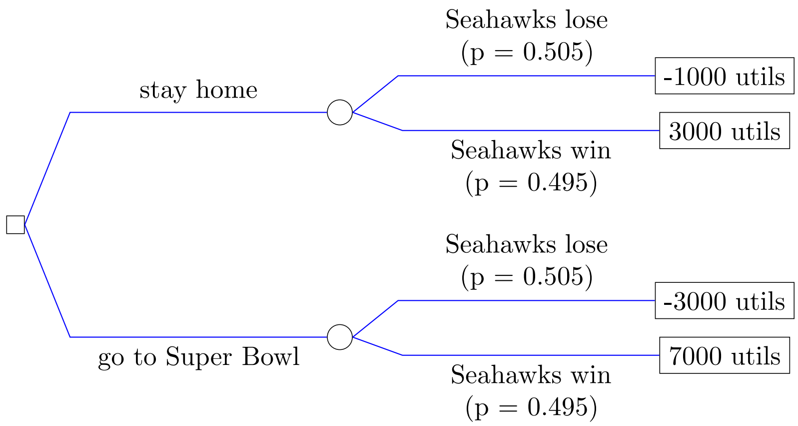
2. Jorge really wants some ice cream. His favorite flavor is mint chip, which they have almost half of the time. Jorge is fine getting ice cream even if they don't have his favorite flavor, but he can't decide whether to go or stay home. Using the decision tree below:

   a.) What is Jorge's expected utility of going for ice cream?

   b.) Should Jorge go for ice cream?



3. Arin is a diehard Seahawks fan. The Seahawks have played well enough to go to the Super Bowl. Should Arin spend the money to go watch the Seahawks play in the Super Bowl? If the Seahawks win, Arin will receive positive utility; if not, negative utility. The highs and lows would be more extreme if Arin witnessed the game in person. Consider the tree below:

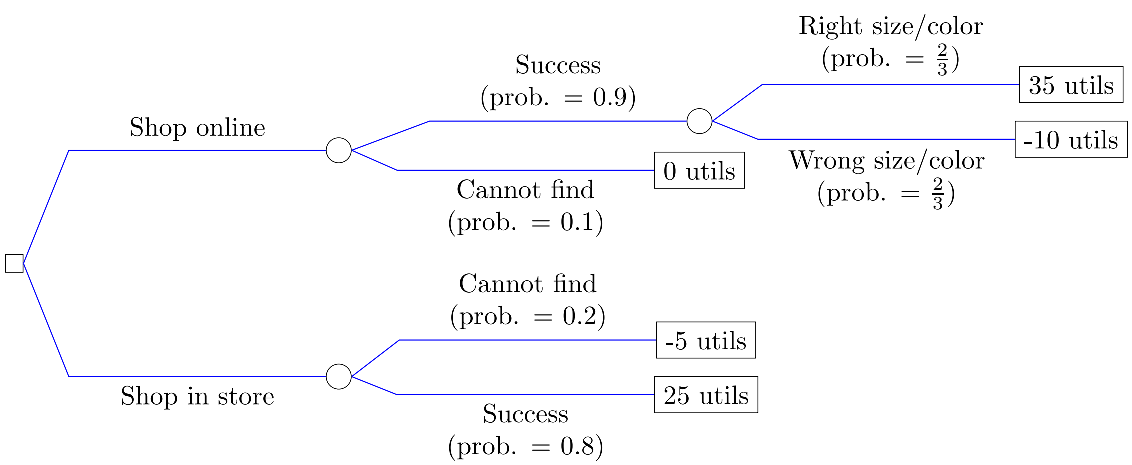


a.) What is Arin's expected utility from going to the Super Bowl?

b.) What is Arin's expected utility from staying home?

c.) What should Arin choose?

4. A consumer aims to buy a product, and must decide whether to shop online or in person. In either case, there is a chance the consumer will not find what she seeks. Additionally, an online shopper may order a product which turns out to fall short of what she expected. Consider the tree below:



This exercise will stress the concept of a **joint probability**, which is the likelihood of two events *both* happening. If the events are unrelated (**independent** in probabilistic terms), then their joint probability is the product of their individual probabilities. Answer the questions below

a.) When the consumer shops online, what is the probability the product can't be found?

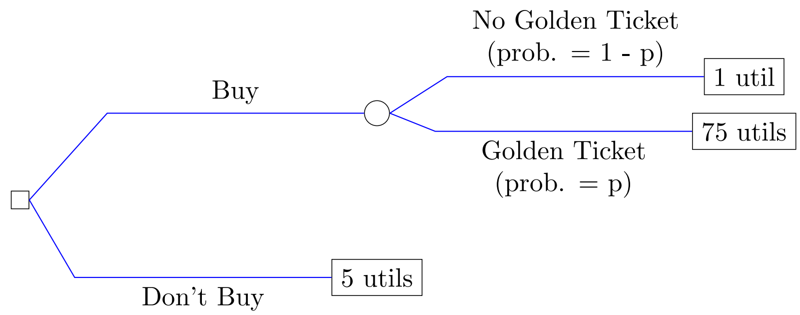
b.) When the consumer shops online, what is the probability the product is found *and that it is the* **right** *size/color*?

c.) When the consumer shops online, what is the probability the product is found *and that it is the* **wrong** *size/color*?

d.) Redraw the game tree by drawing **three** branches coming out of the "shop online" probability node, one for each outcome in parts a.-c..

[If your answers above are correct, the three resulting probabilities should sum up to 1. This is because there are three outcomes in the outcome space (cannot find, success + right size/color, success + wrong size/color), so all three probabilities combined must equal 1.]

5. Tammy is considering whether or not to purchase a Willy Wonka chocolate bar. With probability p, Tammy will win a golden ticket! Her decision whether or not to purchase depends on the expected utility of purchasing, compared to her reservation utility, $\bar{u} = 5$ utils. Consider the tree below:



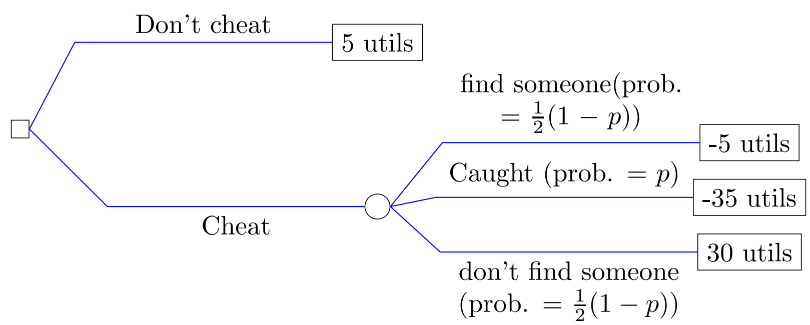
a.) If $p = 0.08$, what is the expected utility of buying the chocolate bar? What should Tammy choose?

b.) For what value of p will Tammy be indifferent between buying and not buying?

c.) For what range of values of p will Tammy prefer **buying**?

d.) For what range of values of p will Tammy prefer **not buying**?

6. John is dating Martyn. John isn't sure Martyn is his soulmate but doesn't want to find out by breaking up and dating again. John has the option to cheat and look for someone online. If he does, he may find someone, or no one. However, if he is caught cheating, Martyn will break up with him and he will be worse off than before. Let p give the probability that John gets caught cheating. Consider John's decision by examining the tree below:



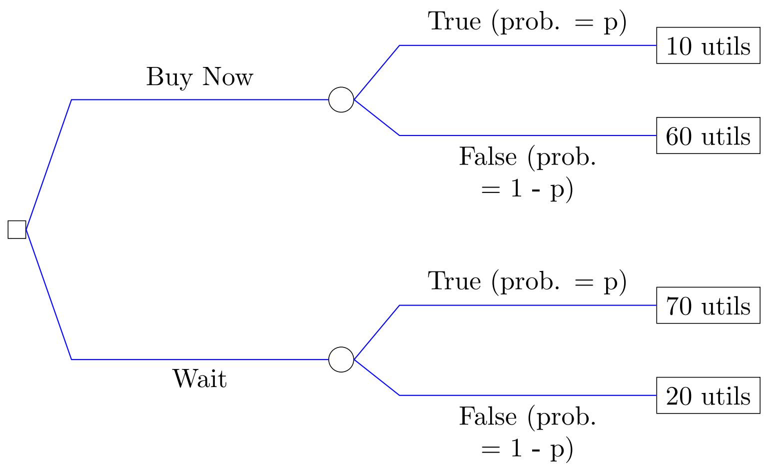
a.) What is John's expected utility of cheating?

b.) For what values of p will John be willing to cheat?

7. Mickey likes to have all of the latest technology (he is a classic "early adopter") and Apple has just released the iPhone 6. Currently, Mickey has the iPhone 5 and he wants the newest version, but he also heard rumors that Apple may be releasing an iPhone 7 next month. If Mickey buys the iPhone 6 now he won't be able to afford the iPhone 7 if it comes out in a month. However, if Mickey waits a month to see if the rumors are false, then all of his friends will already have the iPhone 6 and he won't get the utility from begin the first to get the new technology. There is a probability p that the rumors Mickey heard were true. Consider the following:

- If Mickey buys the iPhone 6 now and the rumors are true, he gets 10 utils; if the rumors are false, he gets 60 utils.
- If Mickey waits for the iPhone 7 and the rumors are true, he gets 70 utils; if the rumors are false, he gets 20 utils.

Examine the tree below:



a.) Find the expected utility from buying now.

b.) Find the expected utility from waiting.

c.) For what value of p is Mickey **indifferent** between waiting and buying?

d.) For what range of values of p does Mickey prefer **buying now**?

e.) For what range of values of p does Mickey prefer **waiting**?

8. Rosie receives an e-mail from a "Nigerian Prince" who claims to need her help. He promises her riches if she wires him some money. Unfortunately, she has no way of verifying whether or not the e-mail is a fraud. Let Rosie's reservation utility, which she receives if she does not wire money, be $\bar{u} = 0$. If she wires money, and the Prince is a fraud, she receives -2000 utils. However, if she wires money and the Prince is real, she receives 1,000,000 utils. Suppose the Prince is real with probability p.

a.) Draw Rosie's decision tree.

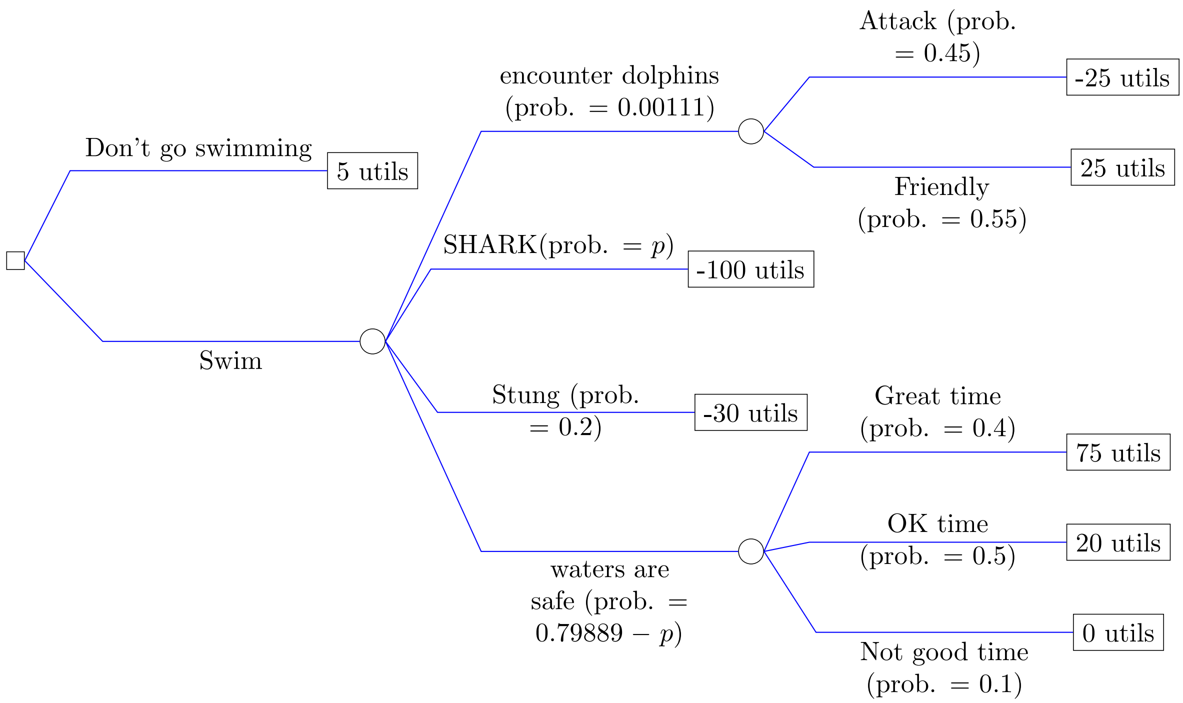
b.) If the probability of the prince being rule is $p = 0.001$, show that it is in Rosie's best interest to not wire the money.

c.) Despite your response in b., many people fall for this scam. This could be a result of their belief that the probability of the prince being rule is much higher than $p = 0.001$. Find the range of probabilities (keep all utility values the same) that would lead a rational individual to prefer wiring money to not wiring money.

9. Consider the choice of Willie, who worries a lot, of whether or not to go swimming in the ocean. Willie considers many possibilities of what could happen if he goes swimming. He could:

- get stung by a jellyfish (-30 utils)
- be attacked by a shark (-100 utils)
- encounter dolphins (25 utils if the dolphins are friendly, -25 utils if the dolphins attack you)
- find the waters safe for swimming (75 utils if he has a great time, 20 utils if he has an OK time, 0 utils if he doesn't have a very good time)

Willie has beliefs over almost all of the probabilities (as shown in the tree below), except for the likelihood of a shark attack (which is given by probability p).



a.) What is the expected utility Willie gets *conditional on Willie encountering dolphins*?

b.) What is the expected utility Willie gets *conditional on Willie finding the waters safe*?

c.) Based on your answers from a. and b., what is the expected utility Willie receives from swimming?

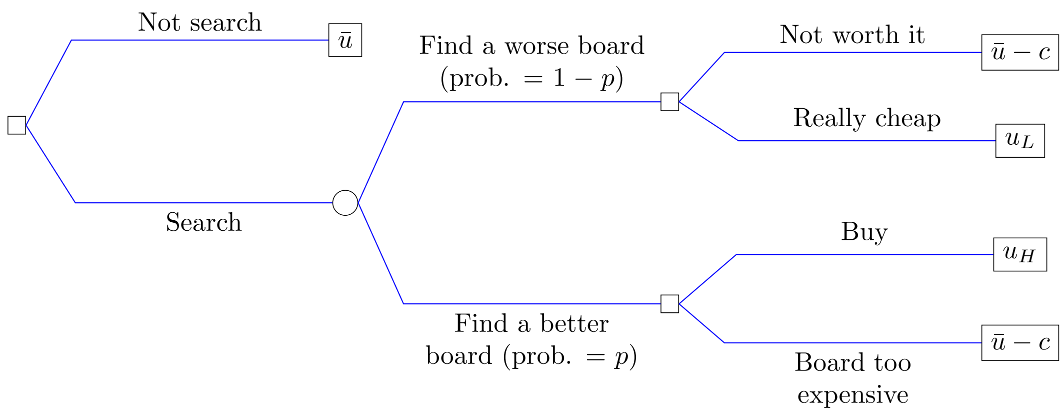
d.) Whether or not Willie is willing to swim depends on how likely he believes a shark attack to be. For what value of p is Willie indifferent between swimming and not swimming?

e.) How high would p need to be to sufficiently scare Willie away from swimming? Find the range of values of p.

f.) How low would p need to be to reassure Willie enough that he'd be willing to swim? Find the range of values of p.

2 Model 2: Search Theory

1. Matt has had his skateboard for 4 years now. He's deciding whether to search for a new one or not according to the search model below:



Assume $u_H > \bar{u}$, $\bar{u} - c > u_L$, and $c > 0$, where u_H and u_L are inclusive of search costs.

a.) If Matt finds a better board, what should he do? Explain.

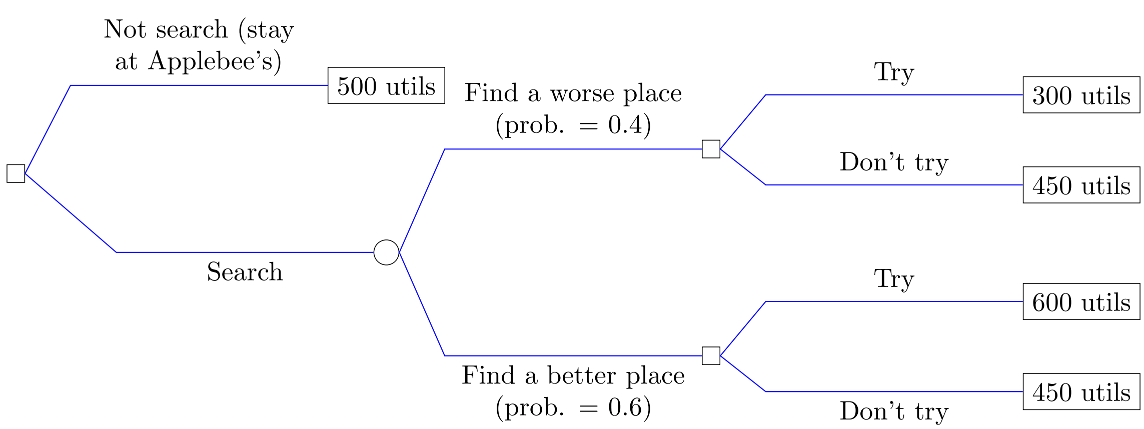
b.) If Matt finds a worse board, what should he do? Explain.

c.) Given your answers above, use backward induction to find Matt's expected utility of searching.

d.) Give the condition under which Matt should search for a new board.

e.) Determine if Matt should search given the following values: $\bar{u} = 1000$, $u_H = 2000$, $u_L = 800$, $c = 100$, $p = 0.2$.

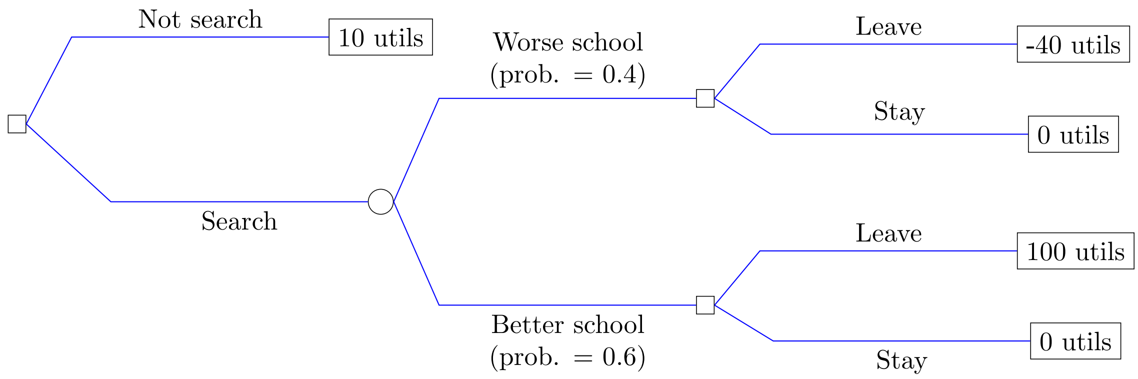
2. Dan loves to go to Applebee's for dinner every night. One night he thinks about searching for a new restaurant to try. Should he search? Or stay at Applebee's?



Based on the tree above, use backward induction to determine whether Dan should search or stay.

[**Bonus question**: How would the presence of Yelp impact this model?]

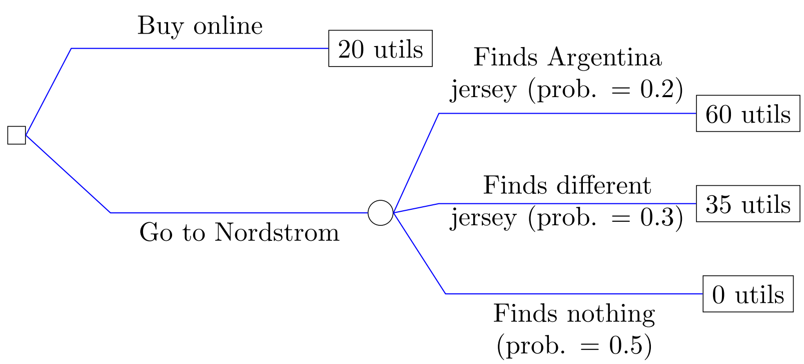
3. Samantha wants to transfer schools, because his current one isn't cool. He is afraid, however, that the one she transfers to will be even worse. Consider the decision tree below:



Based on the tree above, use backward induction to determine whether Samantha should search for a new school or stay at her current one.

[**Bonus question**: Given the tree above, can you determine the value for $\bar{u}$? c? u_H? u_L?]

4. Chester is faced with a dilemma. He really wants to buy an Argentina soccer jersey which he has found online at a rather high price. Chester has had luck in the past finding soccer jerseys at a local Nordstrom about half of the time, but doesn't want to use up all of the gas in his car. However, if he does find the jersey at Nordstrom, it would be worth it. Chester ponders whether he should search for the Argentina jersey at Nordstrom with the possibility of finding another jersey at a great price. Chester's decision is modeled below.



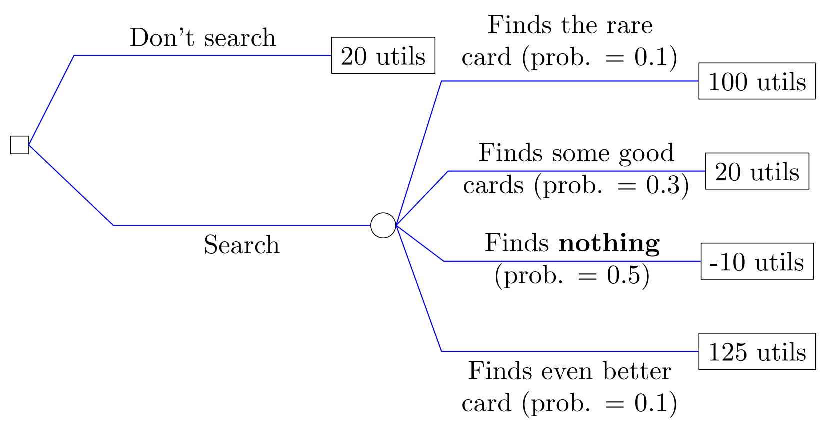
a.) What is Chester's expected utility from searching for the jersey at Nordstrom?

b.) Should Chester search or buy online?

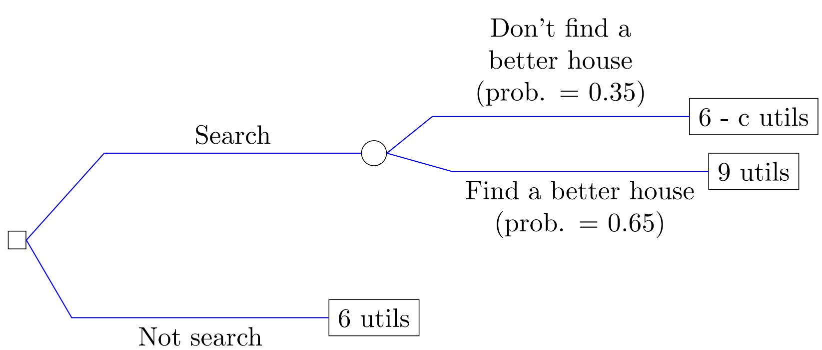
5. Steph considers whether or not to search for a rare baseball card. In doing so, Steph considers four possible outcomes from the search:

- Steph finds the rare card he is seeking (100 utils);
- Steph doesn't find the rare card but finds some good cards he nevertheless enjoys (20 utils);
- Steph searches for a while and gives up because he can't find anything good (-10 utils)
- Steph unexpectedly finds an even better card than the original one (125 utils)

Given the tree below, should Steph search for the card?



6. Oliver is thinking of buying a new house, but isn't sure if the cost of looking is worth it. Consider the tree below, where $\bar{u} = 6$ utils, $u_H = 9$ utils, and $c > 0$.



a.) What is Oliver's expected utility from searching?

b.) What is the maximum value of the cost of searching c under which Oliver would still be willing to search for a new house?

7. Mark Helfrich, the head football coach at the University of Oregon, has had an amazing 2-year career thus far. He has been contacted by several NFL teams who are interested in hiring him as a head coach.A career in the NFL is a dream, but what if it's not all it's cracked up to be? Should Helfrich choose to search for a better job in the NFL, or should he stay at Oregon where he is doing well? Consider the following parameter values:

- Helfrich's reservation utility from staying at Oregon is $\bar{u} = 300$ utils;
- Helfrich's utility from taking an NFL job is $u_H = 700$ utils;
- the probability that the NFL job Helfrich takes is better than being at Oregon is $p = 0.35$;
- the cost of search is unknown, given by $c > 0$;
- Assume if the search results in a better job, that Helfrich takes the job and receives u_H; if not, assume Helfrich stays at Oregon and receives $\bar{u} - c$.

Answer the following:

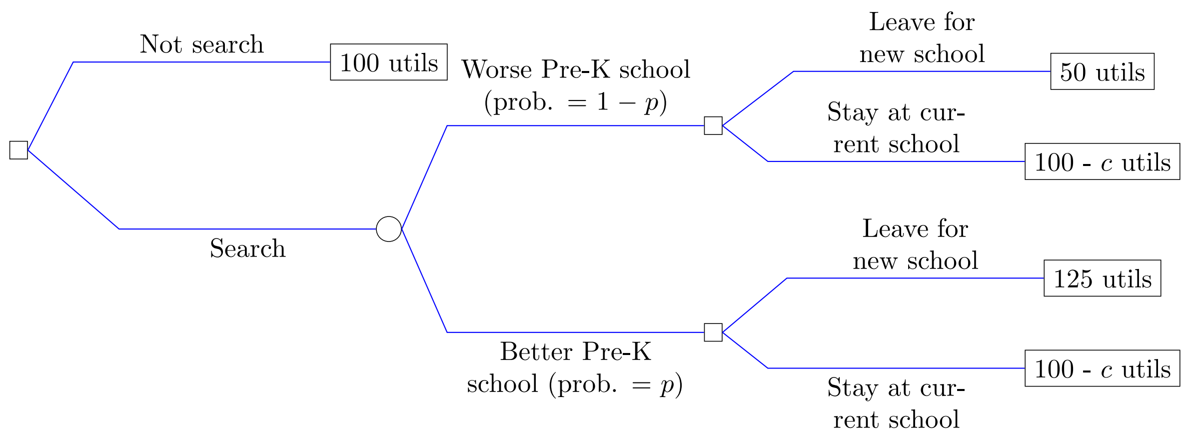
a.) Build a decision tree to capture Helfrich's decision to search or not search.

b.) What is Helfrich's expected utility from searching?

c.) Under what condition will Helfrich search? How does this decision depend on the search cost, c?

d.) Search costs may be different across NFL franchises. Based on your answer to the previous question, what should an NFL franchise do to encourage Helfrich to engage in a search for an NFL job?

8. Leslie and Ben are searching for a preschool for their child, Tom. In particular, the child is already enrolled in a preschool, in which Tom can stay if his parents so choose. However, Leslie and Ben can continue searching for the perfect preschool for Tom. Searching for a new preschool is costly ($c > 0$), and only with some likelihood p will Leslie and Ben find a better school than the one in which Tom is currently enrolled. The search decision is modeled below:



a.) Under what condition will Leslie and Ben choose to leave for a new school *if the search leads to a better school*?

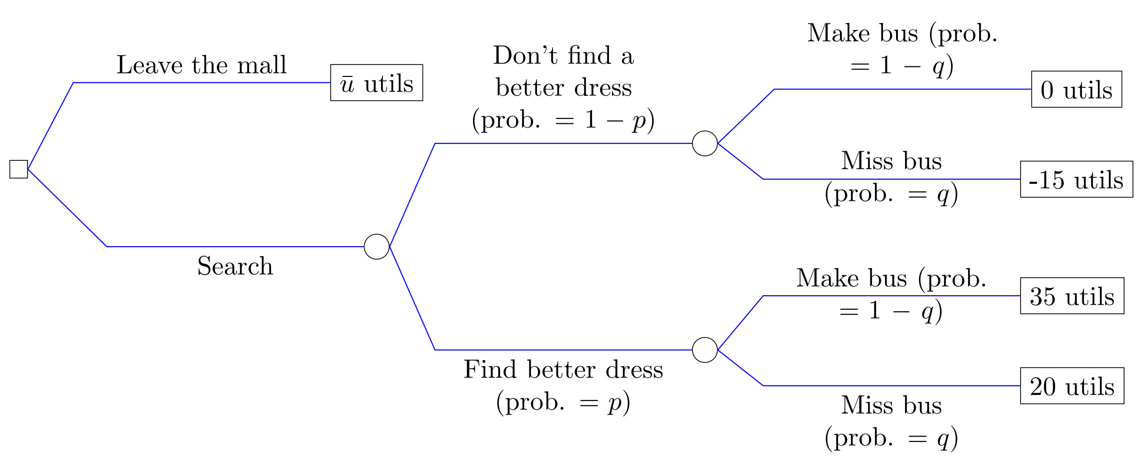
b.) Under what condition will Leslie and Ben choose to stay at their current school *if the search leads to a worse school*? [Assume this condition is satisfied in the remainder of the question.]

c.) Let $p = 0.4$. Under what condition on variable c will Leslie and Ben decide to search for a new school for Tom?

d.) Fix $c = 40$, and leave p as a variable. Under what condition on variable p will Leslie and Ben decide to search for a new school for Tom? Interpret your answer.

e.) If studies show the future monetary benefits to a better Pre-K school (over an already good Pre-K school) are smaller than many parents think, how would this impact the prediction of this model?

9. Latoya is at the Tacoma Mall looking for a dress. She found one at Forever 21 but she doesn't love it - she only likes it. Latoya has the choice of leaving the mall and keeping the dress she found. Or, she can search for another dress. However, if she stays at the mall, she has a chance of missing her bus home. Notice that $\bar{u}$ gives her reservation utility, p gives the probability of finding a better dress, and q gives the probability of missing her bus. Assume the chance of missing the bus is independent of the chance she finds a better dress.



a.) Notice that the search can result in four distinct outcomes. What is the probability that Latoya ...

i.) finds a better dress **and makes her bus**?
ii.) finds a better dress and misses her bus?
iii.) doesn't find a better dress and makes her bus?
iv.) doesn't find a better dress and misses her bus?

b.) If $p = 0.45$, and $q = 0.40$, what is the probability that Latoya ...

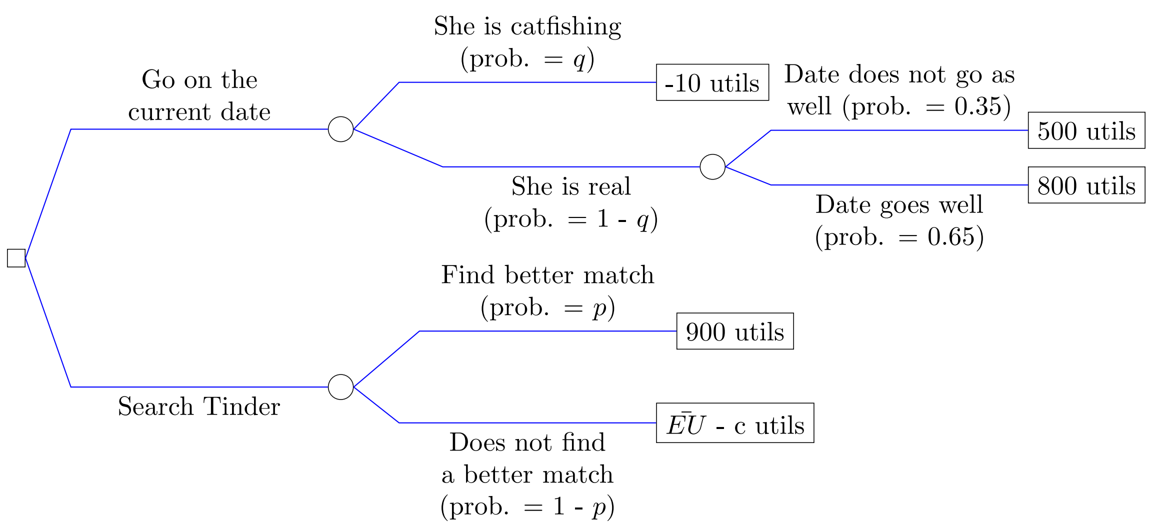
i.) finds a better dress **and makes her bus**?
ii.) finds a better dress and misses her bus?
iii.) doesn't find a better dress and makes her bus?
iv.) doesn't find a better dress and misses her bus?

c.) If $p = 0.45$ and $q = 0.40$, what is her expected utility of searching for a better dress?

d.) If $p = 0.45$ and $q = 0.40$, under what condition will Latoya search for a better dress? On what does the condition depend?

10. Joe, a heterosexual male, is browsing his Tinder account, and is matched with a woman near where he lives. They begin to chat with each other, and she asks if he wishes to meet up to go on a date. Joe can continue searching on Tinder to find another match, or he can meet up with his current match for a date. Consider the following parameters:

- With probability p, a search on Tinder will produce a better match for Joe.
- With probability q, Joe's current match is **catfishing** Joe, and she is not in fact the woman she claims to be on Tinder.
- Searching is costly to Joe: $c > 0$.



a.) There is risk involved if Joe goes on the current date. What is Joe's expected utility of going on this date? Call this Joe's **expected reservation utility**, and denote with $\bar{EU}$.

b.) Evaluate $\bar{EU}$ when there is a 1 in 5 chance Joe is being catfished: $q = 0.2$.

c.) What is Joe's expected utility from searching Tinder?

d.) When $q = 0.2$, what is Joe's expected utility from searching Tinder?

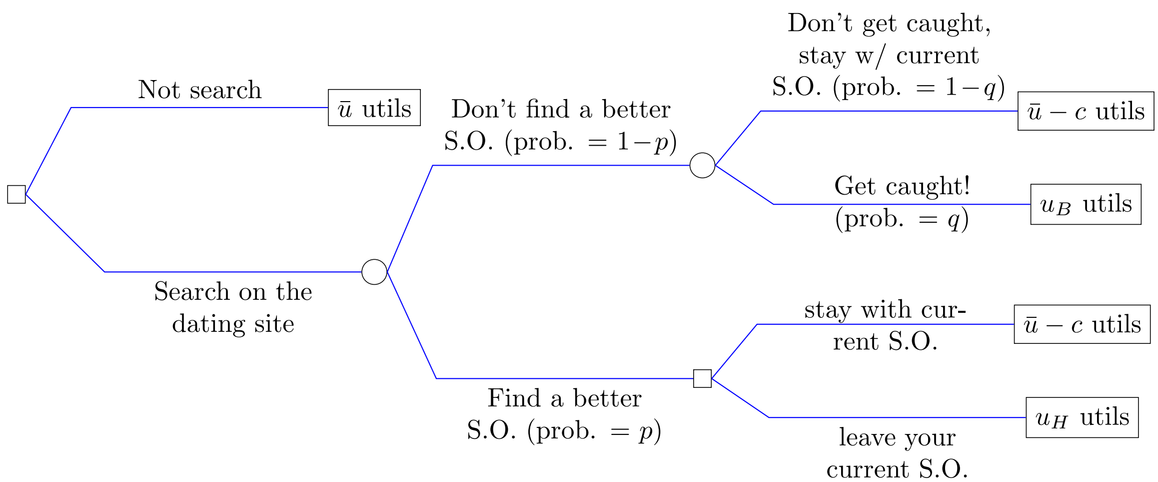
e.) When $q = 0.2$ and $p = 0.65$, under what condition should Joe continue searching on Tinder? On what variable does this condition depend?

f.) If Joe searches on Tinder for another match, **his next match might be catfishing him as well!** How would you adapt this model to incorporate the potential untrustworthiness of Joe's new match? Be specific.

11. You are currently dating your significant other (your S.O.) ... but you are thinking about trying to find someone new. You don't want to break up with your current significant other until you're sure you found someone better, so you join a very secretive online dating site. If you find a better match there, you can confidently leave your current significant other. However, if you don't find a better match, there is a chance you will get caught and dumped! Assume:

   - searching is costly: $c > 0$;
   - $u_H > \bar{u} > u_B$;

   The search decision is modeled in the tree below:



   a.) What is the probability that you will find a better S.O.?

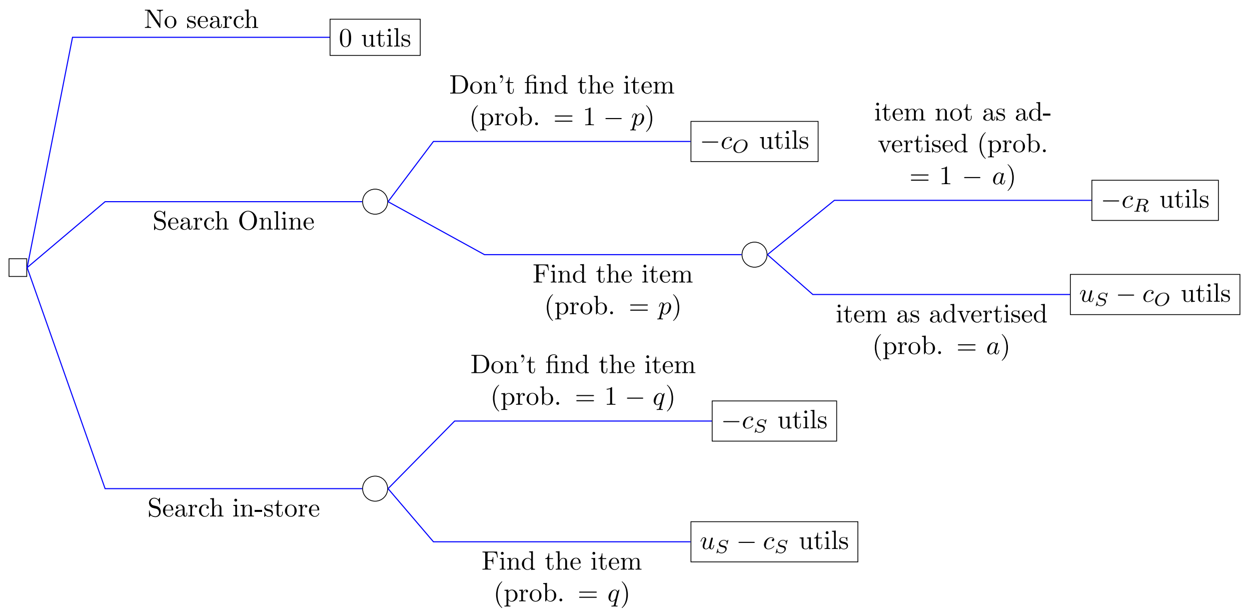
   b.) What is the probability that you will not find a better S.O. and you won't get caught?

   c.) What is the probability that you will not find a better S.O. and you get caught?

   d.) What is the expected utility of the search for a better S.O.?

   e.) Under what condition should you search? Interpret this condition with respect to the model's parameters.

12. Shopping online and shopping in-store for an item might entail two different types of searches. This model explores a 3-headed decision: no search versus search online versus search in-store. Consider the tree below, with reservation utility set to $\bar{u} = 0$:



In the model above:

- The cost of returning the item is greater than the cost of shopping for the item in-store, which is greater than the cost of searching online; that is, $c_R > c_S > c_O > 0$.
- If the item is found successfully, the result is the *success utility*, u_S.
- p is the probability of finding the item via online search; q is the probability of finding the item via in-store search.
- a is the probability that the online search delivered an item as advertised; this captures an additional risk associated with shopping online.
- All probabilities are independent.

Consider the following questions:

a.) What is the probability that searching online will result in a successful search?

b.) What is the probability that searching online will result in the item not being as advertised?

c.) What is the expected utility from searching online?

d.) What is the expected utility from searching in-store?

e.) What is the best option for the shopper if: $u_S = 100$; $p = q = a = \frac{1}{2}$?

3 Model 3: Static games (with complete and incomplete information)

1. Brother and Sister are playing together, and somehow a window gets broken. They are both technically responsible for breaking the window, but their parents sit them each down individually and privately to see who will confess to having broken the window. The associated game matrix is below, where payoffs are measured in the number of days of TV privileges revoked for each child.

		Brother	
		Confess	Don't Confess
Sister	Confess	7, 7	0, 14
	Don't Confess	14, 0	2, 2

Brother-Sister Game

   a.) What does it mean for a player to have a weakly dominant strategy?

   b.) Does either player have a weakly dominant strategy here? Explain why.

   c.) What is the Nash equilibrium of the game?

   d.) What familiar game does this one resemble?

2. Barry and Ross are workout partners for their football team. The coaches have given them the option to lift at 6 am or 4 pm. Ross likes lifting early, but Barry hates lifting early. However, both Ross and Barry workout better when they are working out together. Consider the game below:

		Ross	
		6am	4pm
Barry	6am	2, 3	1, 1
	4pm	3, 2	2, 2

Workout Game

   a.) Highlight all best responses in the game matrix.

   b.) Find all Nash equilibria in the game.

   c.) If there are multiple Nash equilibra in the game, which do you think is most likely to be the outcome of the game? Support your answer.

3. George and Jane love seeing each other when they take their dogs to the dog park. But when should they each go? Neither goes to the dog park every day, but when they do go, they generally go at the same time of day. They both would get pleasure from going and seeing one another. In fact, Jane has a crush on George - if George doesn't go, Jane doesn't want to go. Consider the game matrix above:

		George	
		Go	Don't Go
Jane	Go	6, 10	-2, 0
	Don't Go	0, 2	0, 0

Dog Park Game

   a.) Does either player have a weakly dominant strategy here? Explain why.

   b.) Highlight all best responses in the game matrix.

   c.) Find all Nash equilibria in the game.

		Kendra: Go	Kendra: Stay Home
Kendrick	Go	100, a	0, 10
	Stay Home	10, 0	10, 10

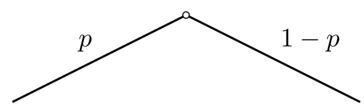
Dating Game

4. Kendrick and Kendra met online and set up a date. However, they are unsure whether they want to follow through and go on the date or stay home. They must decide individually what to do.

   a.) Highlight all best responses in the game matrix. For Kendrick's best response to Go, find how his best response depends on a.

   b.) For each range of values of a, find all Nash equilibria in the game. Explain in words what happens in each scenario.

5. Tim and Eric are roommates and have scheduled a time over the weekend to clean their house. Tim and Eric are both debating whether or not to show up. Eric has **private information** about whether he is a clean guy (type t_C) or a dirty guy (type t_D); Tim does not know Eric's type, and only knows (or forms a belief about) the probability with which he is a clean type: p. Consider the game below:



		Eric: Go	Eric: Bail
Tim	Go	-1, 1	-5, 0
	Bail	2, 1	0, 0

When Eric is t_C (clean)

		Eric: Go	Eric: Bail
Tim	Go	-1, -1	-5, 2
	Bail	2, -1	0, 0

When Eric is t_D (dirty)

   a.) What is optimal for Eric to play in this game? Recall that Eric has private information about his own type.

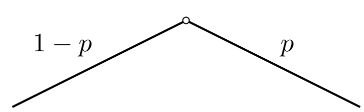
   b.) Given Tim does not have private information, what is his expected utility from playing Go?

   c.) What is Tim's expected utility from playing Bail?

   d.) When should Tim Go? How does this depend on p?

   e.) Illustrate your answer from the previous part numerically when $p = 0.80$?

6. Johnny and I are supposed to meet up today at 5:00, but we neglected to say whether we would meet at the **dining hall** or the **music building**. My phone just died, so I can't get in touch with Johnny. With some probability p, Johnny is hungry, and while I know p, whether or not Johnny is hungry *is private information I do not have.* However, I myself am hungry. In fact, neither of us will get any positive utility if we go to the music building by ourselves. Consider the game below:



		Me: Dining	Me: Music
Johnny	Dining	2, 3	0, 0
	Music	0, 2	3, 2

When Johnny is t_{NH} (not hungry)

		Me: Dining	Me: Music
Johnny	Dining	3, 3	2, 0
	Music	0, 2	2, 2

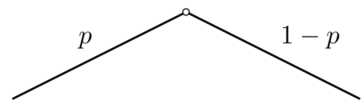
When Johnny is t_H (hungry)

   a.) Even though I lack private information about Johnny's type, where should I choose to go? Explain.

b.) What is optimal for Johnny when he is hungry? Explain. Is this choice a dominant strategy?

c.) What is optimal for Johnny when he is not hungry? Explain. Is this choice a dominant strategy?

7. Down to the last card in the game Cards Against Humanity (CAH), John is tasked with playing what could be the funniest card for the win. However, Anne, the one to decide whether or not to choose John's choice of card, has two types: she can be more funny (type t_F), and prefer a funny or outrageous card, or she can be more reserved (type t_R), and prefer a more conservative card. **Anne's type is private**: only she knows whether she is t_F or t_R. Anne can decide to Accept or Reject John's card. John only knows the probability with which Anne is either type: she is type t_R with probability p. John can choose to either play a reserved card (R) or a funny card (F).



Anne	John: R	John: F
Accept	10, 15	-10, 10
Reject	0, -6	0, -6

CAH when Anne is t_R

Anne	John: R	John: F
Accept	-10, 10	10, 15
Reject	0, -6	0, -6

CAH when Anne is t_F

a.) How does Anne's type affect her payoffs?

b.) What are Anne's best responses in each scenario? Does she have dominant strategies in either scenario?

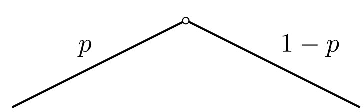
c.) If John assumes Anne will best respond to him, what is John's expected utility from playing the reserved card R? From playing the funny card F?

d.) When should John play which card? How does this depend on p?

e.) If $p = \frac{1}{4}$, what strategy will John play? Based on this, what strategy should Anne play?

f.) Bonus question: Here, Anne's optimal strategy *also depends on the value of p!* What is Anne's optimal strategy, and how does it depend on p?

8. Victor and Robert commit a crime. They are interrogated separately and can **confess** (C) and have their prison sentence reduced or **don't confess** (DC). Robert does not know if Victor is malicious, and if he will retaliate with violence if Robert chooses to confess. There is a probability p (known to both individuals) Victor is a malicious type (type t_M) and will retaliate and harm Robert. However, Victor's actual type is *private information known only by Victor*. Payoffs are measured in utils, where $h < 0$ is the cost of the harm Victor will inflict on Robert. The more negative the number, the greater the harm. Consider the game below:



Robert	Victor: C	Victor: DC
C	$h-5$, -5	h, -20
DC	-20, 0	-1, -1

P. Dilemma when Victor is malicious (t_M)

Robert	Victor: C	Victor: DC
C	-5, -5	0, -20
DC	-20, 0	-1, -1

P. Dilemma when Victor is not malicious

a.) What is Victor's optimal strategy? How does it depend on whether or not Victor is malicious?

b.) For this part of the question only, *imagine Robert knew Victor's type*. What would his optimal strategy choice be when Victor isn't malicious? When Victor is malicious?

c.) Robert does not know Victor's type. What is Robert's expected utility from playing DC?

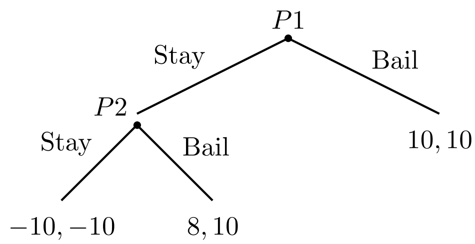
d.) What is Robert's expected utility from playing C?

e.) Notice that Robert's optimal choice depends on both p and h. What if Victor's retaliation results in a broken leg, and $h = -10$? What is Robert's optimal strategy and how does it depend on p?

f.) What if Victor's retaliation is murder, and $h = -100$? What is Robert's optimal strategy and how does it depend on p?

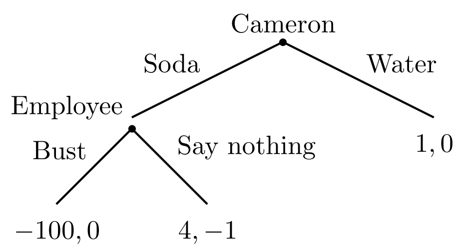
4 Model 4: Dynamic games

1. Kendrick (P1) and Kendra (P2) are on a date and both hate it. They must each decide whether to stay or to bail. Kendrick gets to act first. As much as he doesn't like the date, Kendrick will be slightly offended if he gets bailed on.



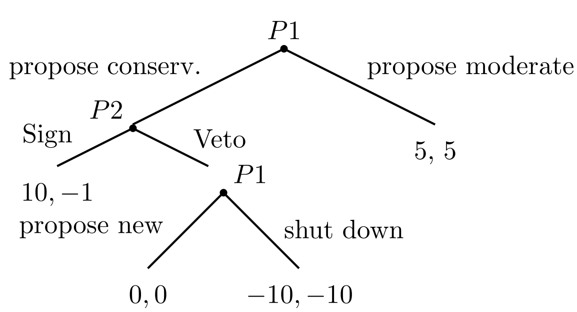
   a.) Define Kendrick's and Kendra's available strategies.
   b.) If Kendrick stays, what choice is optimal for Kendra?
   c.) Given your answer above, what is the subgame perfect equilibrium here?

2. Cameron (P1) got a water cup from a fast food restaurant for free, and is tempted to steal a soft drink from the restaurant. He is faced with the choice of filling up the cup with water or with soda. The decision can be monitored by an employee (P2) in a back room, who, once Cameron has chosen the soda, can then either *bust* Cameron or *say nothing*. Consider the tree below:



   a.) Define Cameron's and the employee's available strategies.
   b.) If Cameron takes the soda, what choice is optimal for the employee?
   c.) Given your answer above, what is the subgame perfect equilibrium here?
   d.) How would your prediction (SPE) change if the employee got a payoff of -1 from saying nothing? A payoff of 0?
   e.) If you managed a fast food restaurant and wanted to incentivize your employees to report theft, how could this model help inform your workplace policies?

3. Consider the dynamic game below, which models the strategy involved in passing the federal budget. Player 1 is a conservative Congress, while player 2 is a liberal President.



a.) Define the available strategies for each player.

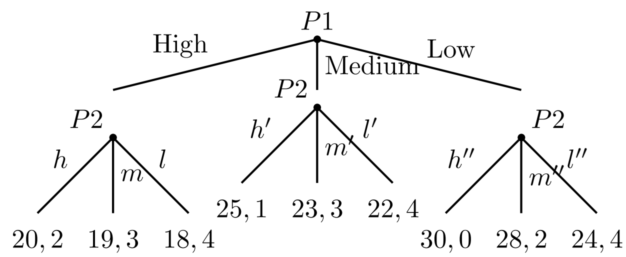
b.) If the President were to veto the budget, what choice would be optimal for Congress?

c.) If the President anticipates this choice, is it optimal for the President to Sign or to Veto?

d.) If Congress can anticipate this choice, what is the subgame perfect equilibrium of the dynamic game? Identify the strategies. How much is each party's payoff at the SPE?

e.) Is Congress's threat of a shutdown credible? Is the President's threat of a veto credible? Explain.

4. In paper sales, Staples (P1) has more market power than independent chain Dunder Mifflin (P2). This means that Staples will always be able to set their price in the market (High, Medium, or Low) first, while Dunder Mifflin will choose second. Consider the tree below:



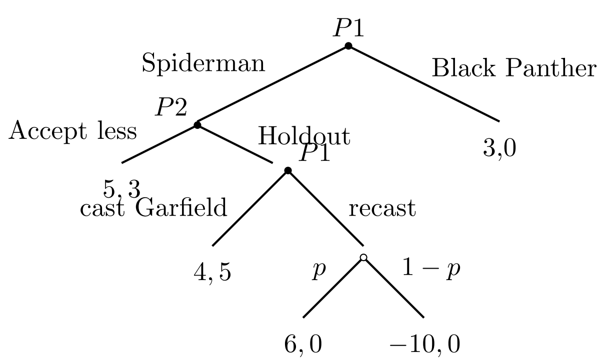
a.) Define Staples' available strategies. How many are there?

b.) How many available strategies does Dunder Mifflin have? Give 3 examples of available strategies.

c.) Which choice is optimal for Dunder Mifflin at each of its nodes?

d.) Given your answer above, define the subgame perfect equilibrium of the dynamic game.

5. Marvel is writing and casting its newest film, *Captain America: Civil War*. Captain America is in need of a sidekick, and Marvel (P1) must decide whether to use Black Panther or Spiderman, most recently played in his own film by Andrew Garfield (P2). If Marvel goes with Spiderman, Garfield has the potential to hold out for more money, forcing Marvel to consider re-casting the role of Spiderman. If they recast, public perception is uncertain, and may be positive (+) with probability p or negative ($-$) with probability $1-p$. That is, the final node in the tree is a nature node. Consider the game below:



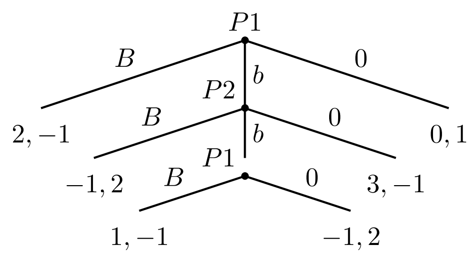
a.) Define all available strategies for Marvel (P1) and Andrew Garfield (P2).

b.) If AG were to hold out for more money, under what condition would Marvel recast the role of Spiderman? How does this condition depend on p?

c.) Given your answer to b., under what condition would AG actually hold out?

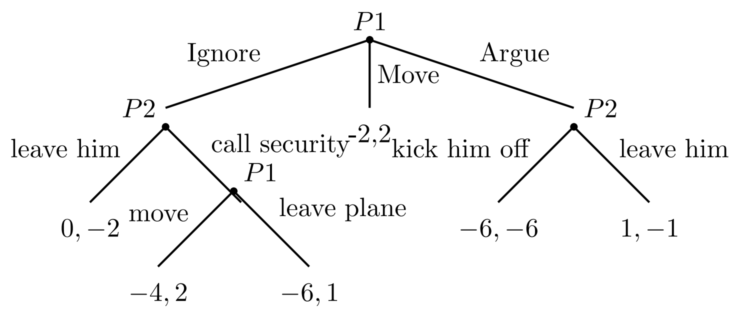
d.) Finish the backward induction here and give how the subgame perfect equilibrium of the dynamic game depends on the value of p.

6. Players 1 and 2 are bidding on an antique bracelet at an auction. The dynamic game below captures the sequence of potential bids by each player. Let B indicate a "big bid," b indicate a "small bid," and 0 indicate no bid.



Find the subgame perfect equilibrium of the dynamic bidding game above.

7. Joe (P1) is a passenger on Mistake-Free Airline, and Karen (P2) is a flight attendant. Unfortunately, Karen has made a mistake with the seating on Joe's flight, and asks Joe to move. How should Joe respond?

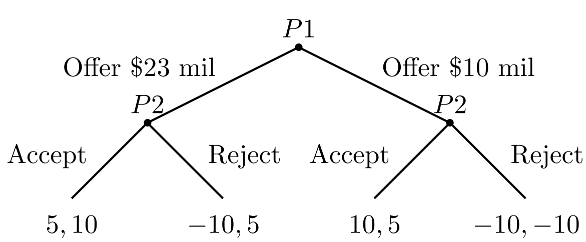


a.) Define the available strategies for Karen, the flight attendant.

b.) Using backward induction, find the subgame perfect equilibrium. Should Joe choose to ignore Karen's request, move seats, or start an argument?

c.) How would this game differ if the initial node belonged to Karen, who could choose to Ask or Not Ask Joe to move seats? Draw out a new tree, and find the SPE.

8. Russell Wilson (P2) is in the final year of his contract with the Seahawks. The Seahawks (P1) do not want to spend a ton of money on Russell, but they really want him to resign with the team. They can offer him a contract that pays either \$23 million or \$10 million per year. If the Seahawks do not offer Russell enough money, Russell could walk away from the offer and explore signing with another team.

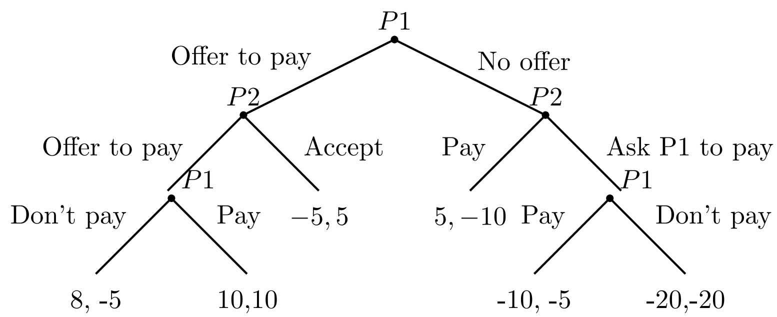


a.) Define the available strategies for the Seahawks and for Russell.

b.) What is the subgame perfect equilibrium here? Use backward induction to find.

c.) Rejecting the offer and heading to the open market is risky for Russell. How would this model change if rejecting the model led to a **nature node** which captured the likelihood of subsequent offers? Draw an expanded tree, and solve for the SPE.

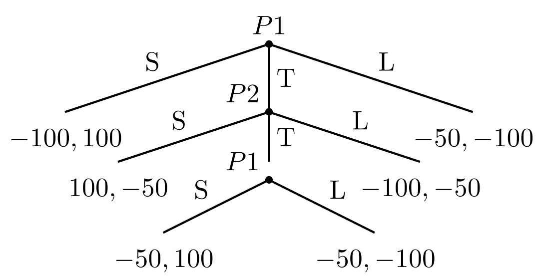
9. Imagine a dynamic game which models the awkward situation of picking up a check at the end of a dinner between Player 1 and Player 2. Here, payoffs are measured in utility values, to capture not just the monetary gain/loss of paying for the meal, but also the utility received from, say, coming off as "cheap." Consider the tree below:



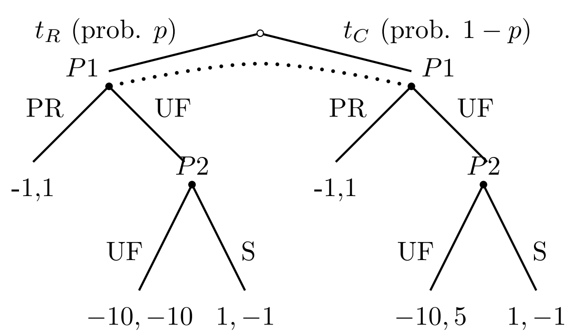
a.) What are the available strategies for each player?

b.) Use backward induction to identify the subgame perfect equilibrium in the game.

10. A conflict between India (P1) and Pakistan (P2) over the region of Kashmir escalates into a nuclear confrontation. Consider the tree below, where S = surrender, T = threaten the use of nuclear weapons, and L = launch a nuclear attack. What is the subgame perfect equilibrium? How do you anticipate the showdown to play out?



11. Consider this modified version of the hostage taker game, where the negotiator (P1) must develop a strategy to deal with hostage taker (P2). However, the hostage taker has private information on his type: he can be rational (type t_R) with probability p, or crazy (type t_C) with probability $1-p$. A rational hostage taker prefers surrender to death, but a crazy hostage taker prefers death. The negotiator's actions include PR = pay ransom and UF = use force, while the hostage taker's actions include UF = use force and S = surrender. Consider the tree below:



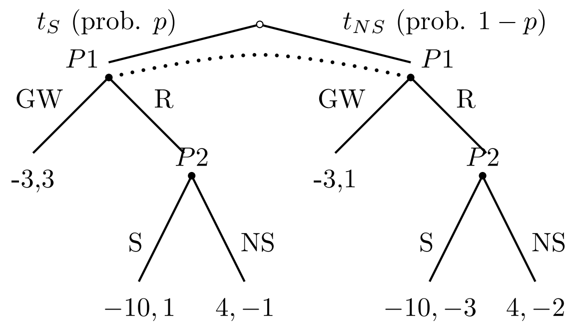
In the game tree, the dotted curved line represents two nodes in the same information set. Answer the questions below:

a.) Define the available strategies for each player.

b.) What choice is optimal for a **rational** hostage taker? What choice is optimal for a **crazy** hostage taker? What strategy, therefore, is optimal, for player 2? Remember that P2. can condition on type.

c.) Given your answer to b., under what conditions on p should the negotiator pay the ransom? Calculate mathematically, and explain in words.

12. Olivia (P1) is walking down a dark alleyway after work and is approached by a mugger (P2) at knifepoint. Olivia is unsure if the mugger is the type to actually follow through on his threat to stab her. This is private information to the mugger: he can be the stabbing type (type t_S) with probability p, or the not stabbing type (type t_{NS}) with probability $1-p$. Olivia's actions include GW = give wallet and R = refuse to give wallet, while the mugger's actions include S = stab and NS = no stab (leave.) Consider the tree below:



In the game tree, the dotted curved line represents two nodes in the same information set. Answer the questions below:

a.) Define the available strategies for each player.

b.) What choice is optimal for a **stabbing type** mugger? What choice is optimal for a **not stabbing type** mugger? What strategy, therefore, is optimal, for player 2? Remember that P2. can condition on type.

c.) Given your answer to b., under what conditions on p should Olivia give her wallet? Calculate mathematically, and explain in words.

5 Model 5: Network Externalities

1. Bobby and Johnny are finally giving in to social media, but they aren't sure whether to go to Facebook or MySpace. Facebook has most of their friends already on it, incentivizing them to go, but MySpace is making a comeback. Bobby and Johnny also want to be on the same social media site. Their social media game is given below:

		Bobby	
		Facebook	MySpace
Johnny	Facebook	10, 10	6, 3
	MySpace	3, 6	7, 7

Social media game

   a.) Find Bobby's and Johnny's best responses by underlining them in the game matrix.

   b.) What are the Nash equilibria of the game?

   c.) If there are more than one, which NE would be preferred by both players?

2. K and P want to get gym memberships. They like working out together so they will mutually benefit from joining the same gym. Consider the game below:

		K	
		LA Fitness	Gold's Gym
P	LA Fitness	12, 12	6, 4
	Gold's Gym	7, 8	10, 10

Membership game

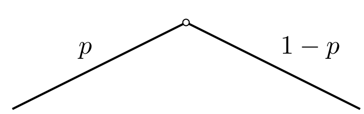
   a.) Find P's and K's best responses by underlining them in the game matrix.

   b.) What are the Nash equilibria of the game?

   c.) If there are more than one, which NE would be preferred by both players?

   d.) Discuss how you might determine **a single prediction** in a game with multiple NE.

3. Two friends, Rachel and Monica, recently joined the world of internet social media. Most of their friends are on Facebook, but some are on Google Plus. Rachel and Monica are trying to decide which to join. However, Rachel has *private information about her preference over sites.* In particular, Rachel is a Facebook type (t_F) with probability p, and a Google Plus type (t_G) with probability $1 - p$. Monica does not know which type Rachel is, but she does know p. Consider the game below:



		Monica	
		Facebook	G+
Rachel	Facebook	10, 10	8, 5
	G+	5,4	8, 8

Game when Monica is Facebook type (t_F)

		Monica	
		Facebook	G+
Rachel	Facebook	9, 9	12, 0
	G+	3, 1	12, 12

Game when Monica is Google Plus type (t_G)

   a.) When Rachel is t_F, what is Rachel's optimal choice?

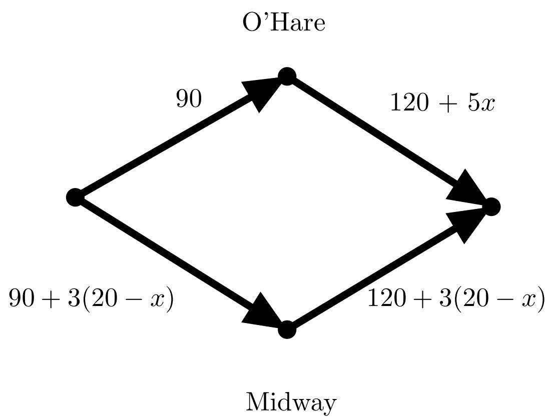
   b.) When Rachel is type t_G, what is Rachel's optimal choice?

   c.) *If Monica had access to Rachel's private information*, what would be optimal for Monica?

   d.) Given the fact Monica *does not actually have access to Rachel's private information*, what is Monica's expected utility from choosing Facebook? Google Plus?

e.) Under what condition will Monica join Facebook? How does this condition depend on p?

4. Travelers who wish to fly from JFK airport in New York to Los Angeles' LAX are likely to connect in Chicago via one of Chicago's two airports: O'Hare and Midway. O'Hare airport is a hub for United, meaning it is larger, generally more crowded, and suffers from higher average delays per passenger due to this congestion. Midway is smaller and slightly less convenient due to a lack of amenities. Let x give the number of travelers who travel to O'Hare. For simplicity, assume there are 20 total passengers: notice this gives $20 - x$ as the number of passengers who travel through Midway. Travel times are given in the traffic network below, where the travel time along each path is labeled. Some paths incur congestion.



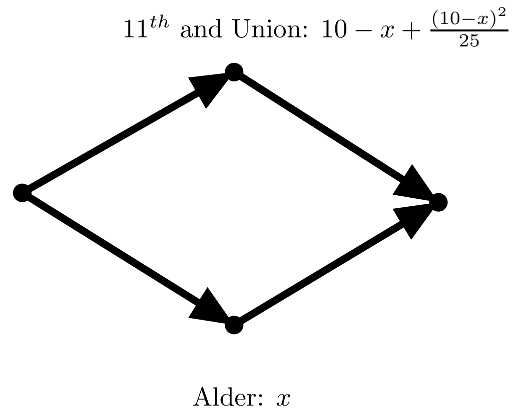
a.) If 5 travelers go through O'Hare, how much time does it take each traveler on that route?

b.) If 12 travelers go through Midway, how much time does it take each traveler on that route?

c.) At the Nash equilibrium, the distribution of travelers should be such that no traveler would want to switch paths. What does this mean about travel time through O'Hare and travel time through Midway?

d.) Solve for the Nash equilibrium of the game. How many travelers take each path?

5. Taylor (like many students) is looking to get home from campus, and he wants to take the shortest route possible. Unfortunately, there is possible congestion on both routes Taylor can take. If he takes the Alder St. route, travel time is given by x, where x is the number of students on the Alder St. route. Taylor can also take the 11^{th} and Union route. For simplicity, let there be 10 total students traveling: this gives $10 - x$ as the number of students taking the 11^{th} and Union route. Travel time on that route is given by $10 - x + \frac{(10-x)^2}{25}$: with at least a few drivers on the route, Taylor is sure to catch the traffic light; but with too many drivers, the congestion is too great. The traffic network is given below:



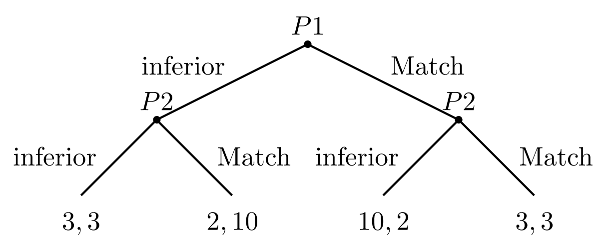
a.) If 3 students take Alder St., how much time does it take each traveler on that route?

b.) If 6 students take 11^{th} and Union, how much time does it take each traveler on that route?

c.) If 3 students take Alder St., and 6 students take 11^{th} and Union, which route should Taylor take? Show your calculations.

d.) Solve for the Nash equilibrium of the game. How many students take each path?

6. A husband (player 1) and wife (player 2) are going through a nasty divorce. Both plan on creating online dating profiles, but the husband makes the move first while the wife would prefer to wait until the divorce is final. Each can choose between creating either a Match.com profile or a profile on an inferior site. There is a positive network externality to joining Match.com; even though they would rather not run into each other on the same site, the network benefits to joining Match.com are large. Examine the dynamic game below:



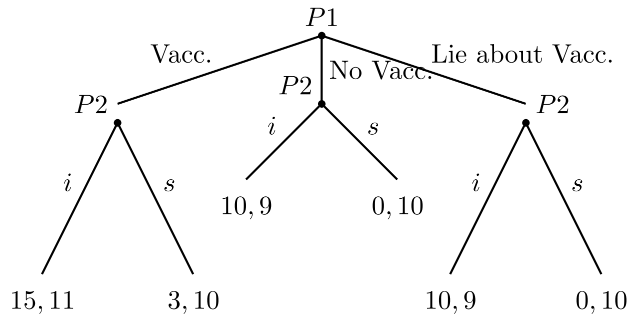
a.) When the husband joins Match, what is the wife's optimal choice?

b.) When the husband joins an inferior site, what is the wife's optimal choice?

c.) What is the subgame perfect equilibrium here?

d.) Does the husband enjoy a **first-mover advantage** in this game? *Construct this game as a static game and find the NE.* Does it differ from the SPE? Explain why or why not in words.

7. Janet (player 1) is deciding whether or not to vaccinate herself, and interacts strategically with the herd (player 2). Janet will have more protection from disease if she is accepted into the herd, but her vaccination choice also has an impact on the overall health to the herd. In particular, a vaccinated Janet generates a **positive externality** to the herd (increases payoff to the herd from 10 to 11), while an unvaccinated Janet generates a **negative externality** to the herd (decrease herd payoff from 10 to 9.) Janet can choose three actions at the top of the tree: vaccinate, not vaccinate, and lie about being vaccinated. Following Janet's choice, the herd can choose to either **invite** (i) or **shun** (s) Janet. Consider the tree below:



a.) What is the herd's optimal action at each of its three nodes?

b.) What is the subgame perfect equilibrium of the game?

c.) Does the externality generated by the vaccination play a role in the outcome at the SPE? Explain.

For questions 8-10, please reference the "demand and network externality" framework in the model discussed in class.

8. Each sorority on campus has a price to join, which represents the sorority member's dues. Demand for sorority membership is characterized by a positive network externality, since the value of joining increases as more members join. Suppose the demand for the sorority is given by $P = 100f = 100f^2$, where $0 \leq f \leq 1$ is the fraction of all potential members who join.

    a.) Graph the demand curve for sorority membership. Recall that fraction of users f serves as the quantity demanded.

    b.) What are the quantities demanded at $P = 16$, f^*_{LOW} and f^*_{HIGH}? Show calculations and on your graph.

    c.) Interpret f^*_{LOW}. What does it tell us?

    d.) Is it a stable equilibrium? Mathematically support your answer.

    e.) Interpret f^*_{HIGH}. What does it tell us?

    f.) Is it a stable equilibrium? Mathematically support your answer.

9. Consider the market for Google Chrome, which is characterized by a positive network externality: as more people use Google Chrome, more user-friendly features are developed. Give the demand for Google Chrome as $P = 100f = 100f^2$, where $0 \leq f \leq 1$ is the fraction of all potential consumers who use Google Chrome. P is the price of Google Chrome, measured in the cost to the consumer of learning to use a new web browser.

    a.) Graph the demand curve for Google Chrome. Recall that fraction of users f serves as the quantity demanded.

    b.) What are the quantities demanded at $P = 9$, f^*_{LOW} and f^*_{HIGH}? Show calculations and on your graph.

    c.) Interpret f^*_{LOW}. What does it tell us?

    d.) Is it a stable equilibrium? Mathematically support your answer.

    e.) Interpret f^*_{HIGH}. What does it tell us?

    f.) Is it a stable equilibrium? Mathematically support your answer.

    g.) Using your answers above, describe how Google Chrome could increase its usership.

10. A small town in Washington only has one night club. Every Friday, youths decide between going to the club and staying at home. There is a positive network externality when they go to the club, because there is added benefit socializing at a busy club. Suppose the demand for entry to the club is given by $P = 200f - 200f^2$, where $0 \leq f \leq 1$ is the fraction of potential consumers who go to the club.

    a.) Graph the demand curve for the small town club. Recall that fraction of users f serves as the quantity demanded.

b.) What are the quantities demanded at $P = 15$, f^*_{LOW} and f^*_{HIGH}? Show calculations and on your graph.

c.) Interpret f^*_{LOW}. What does it tell us?

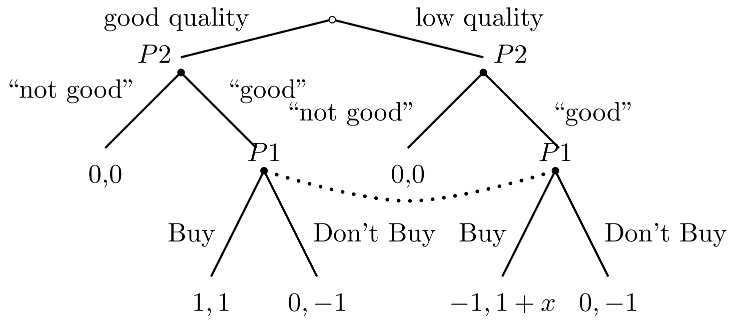
d.) Is it a stable equilibrium? Mathematically support your answer.

e.) Interpret f^*_{HIGH}. What does it tell us?

f.) Is it a stable equilibrium? Mathematically support your answer.

6 Model 6: Signaling and Cheap Talk

1. On your way to campus in the morning, you (P1) stop at your local coffee shop. The barista (P2) offers you a recommendation on a particular blend of coffee you've never heard of before. The quality of this new blend is unknown to you, and is probabilistically determined, but the quality *is known to the barista.* The barista's recommendation is **cheap talk**; in particular, the barista has an incentive (in the form of a bonus x) to sell you coffee if it is low quality, since his manager is pushing the sale of low-quality blends. Consider the tree below:



If the barista says the coffee is not good, then you never buy. *In the game tree, the dotted curved line represents two nodes in the same information set.* Answer the questions below:

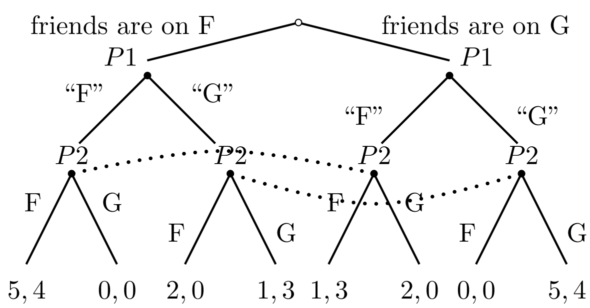
a.) Define the available strategies for each player.

b.) If you (P1) believe the barista is honest, what strategy is optimal for you?

c.) Given your belief in honesty and your best response from b., will the barista indeed be honest? Explain.

d.) Can there be a cheap talk equilibrium with truthful communication? Explain why and describe the degree of alignment of the two players' interests.

2. Two best friends are joining social media together, and must decide between Facebook (F) and Google Plus (G). One friend, Rachel (P1), has private information and knows which site others have joined, while the other friend, Monica (P2), does not. Rachel can engage in cheap talk, and declare her intent to join one of the two sites, denoted "F'' and "G''. The game tree is below:



In the game tree, a dotted curved line represents two nodes in the same information set. Answer the questions below:

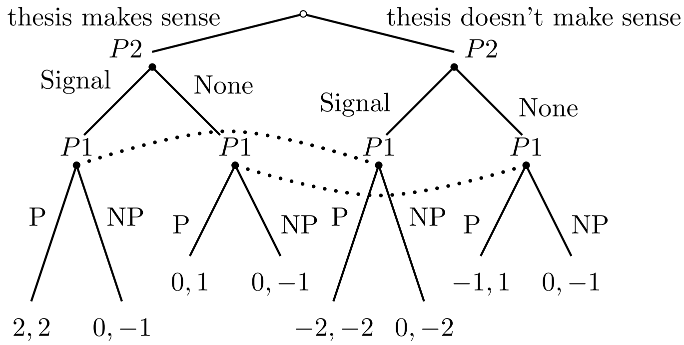
a.) Define the available strategies for each player.

b.) If Monica (P2) believes that Rachel is honest, what strategy is optimal for Monica? Show this.

c.) Given Monica's belief in honesty and her best response from b., is Rachel's best response to indeed be honest? Explain.

d.) Can there be a cheap talk equilibrium with truthful communication? Explain why and describe the degree of alignment of the two players' interests.

3. Jame (P1) is writing his senior thesis. In writing his thesis, it may or may not make sense to Jame's Advisor (P2), and this is private information to the advisor. After reading the thesis, the Advisor can use cheap talk to express that she approves (Signal) of the thesis content, or not express her approval (None). This is cheap talk, representing an informal thumbs up or thumbs down on the progress of the thesis. After receiving this cheap talk, Jame can either present (P) or not present (NP) his thesis to a thesis committee. If Jame doesn't present the thesis, it reflects poorly on both him and his advisor. However, if Jame does present, it can increase his payoff if the paper makes sense, or damage his (and his advisor's) reputation if it doesn't. The game is captured below:



In the game tree, a dotted curved line represents two nodes in the same information set. Answer the questions below:

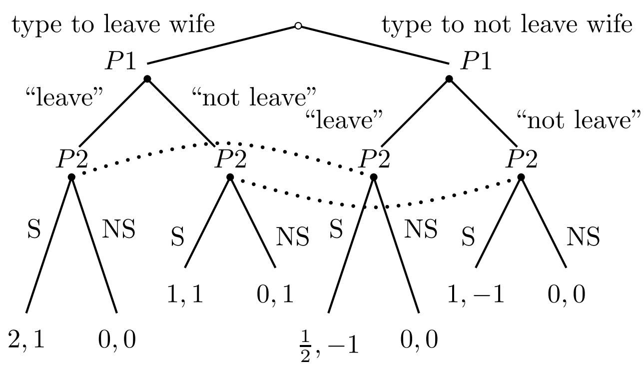
a.) Define the available strategies for each player.

b.) If Jame believes that his advisor is honest, what strategy is optimal for Jame? Show this.

c.) Given Jame's belief in honesty and his best response from b., is the Advisor's best response to indeed be honest? Explain.

d.) Can there be a cheap talk equilibrium with truthful communication? Explain why and describe the degree of alignment of the two players' interests.

4. Brad (P1) and Jen (P2) met online and are both interested in each other, but they are both married. They are considering moving forward in their relationship and having sex. Jen only wants to have sex if they are both single, while Brad doesn't care whether or not they are single. Brad can be one of two types, and this is private information: he can be the type who would leave his wife for Jen, or the type who would not leave his wife for Jen. Jen gets lower payoffs from having sex when Brad has no intentions of leaving his wife. Brad can engages in cheap talk about his type, and promises to either "leave" or "not leave" his wife. The communication is costless; upon hearing Brad's promise, Jen must decide to either have sex (S) or not have sex (NS) with Brad. The game is captured below:



In the game tree, a dotted curved line represents two nodes in the same information set. Answer the questions below:

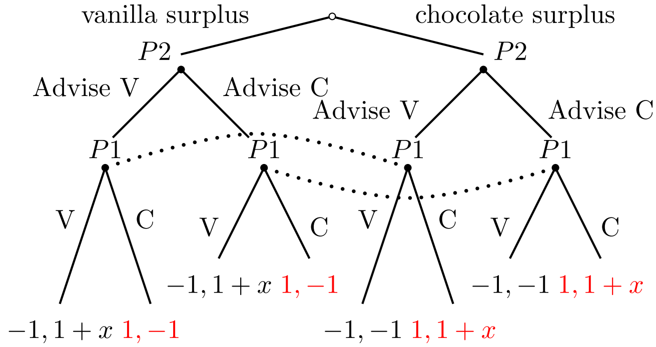
a.) Define the available strategies for each player.

b.) If Jen believes that Brad is honest, what strategy is optimal for Jen? Show this.

c.) Given Jen's belief in honesty and her best response from b., is it Brad's best response to indeed be honest? Explain.

d.) Can there be a cheap talk equilibrium with truthful communication? Explain why and describe the degree of alignment of the two players' interests.

5. Ted (P2) works at an ice cream shop, and Mike (P1) is a customer. Ted offers advice on which flavor, vanilla or chocolate, is particular good today. However, Ted is privy to private information as to which flavor is in surplus at the ice cream shop; as a result, Ted can receive a bonus of x if he helps to sell the flavor in surplus. After hearing this (cheap talk) recommendation from Ted, Mike decides to get vanilla (V) or chocolate (C) ice cream. Mike has a preference for chocolate.



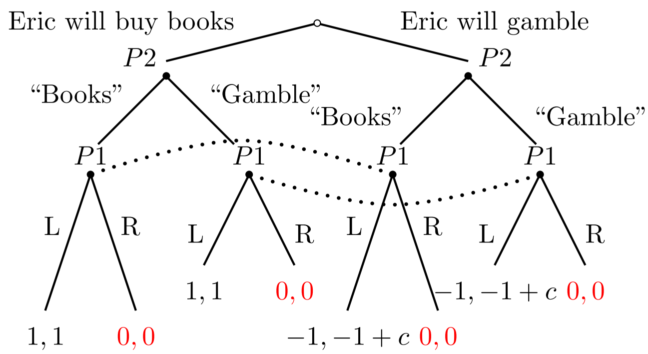
In the game tree, a dotted curved line represents two nodes in the same information set. Payoffs for the cases where Mike chooses chocolate are given in red for clarity. Answer the questions below:

a.) Define the available strategies for each player.

b.) What strategy is optimal for Mike? How does this strategy depend on Mike's beliefs about Ted's ice cream advice?

c.) Given your answer in b., can there be a cheap talk equilibrium with truthful communication? Explain why and describe the degree of alignment of the two players' interests.

6. Eric (P2) asks his buddy Tim (P1) for a loan. Eric can either use this money to buy school books or to gamble, and this is private information to Eric; Eric has the opportunity to use cheap talk to express his intent for the loan. He can either say he will buy books, "Books," or say he will gamble, "Gamble." After receiving the message, Tim can either loan Eric the money (L) or refuse the loan (R). If the loan is used for gambling, Tim receives a payoff of -1, while Eric also receives a payoff of -1 for disappointing his friend; however, parameter c represents the bonus payoff Eric receives from gambling.



In the game tree, a dotted curved line represents two nodes in the same information set. Payoffs for the cases where Tim refuses the loan are given in red for clarity. Answer the questions below:

a.) Define the available strategies for each player.

b.) Suppose Tim believes Eric is honest. Under what condition on c will there be a cheap talk equilibrium with truthful communication? What strategies are chosen? Show mathematically and explain.

c.) Suppose Tim ignores Eric's cheap talk. Under what condition on c will this lead to a babbling equilibrium? What strategies are chosen? Show mathematically and explain.

7 Model 7: Matching Models

1. Suppose there are three doctors looking for jobs at three hospitals. Since each hospital only has one opening, and each doctor can only hold one job at a time, the market is two-sided and requires a one-to-one matching. Consider the preferences below, with rankings stacked top to bottom from best to worst:

Doctors			Hospitals		
D_1	D_2	D_3	H_1	H_2	H_3
H_1	H_1	H_1	D_1	D_1	D_1
H_2	H_2	H_3	D_2	D_3	D_2
H_3	H_3	H_2	D_3	D_2	D_3

   a.) Does each participant (both doctor and hospital) find each potential match *acceptable*? Explain.

   b.) Apply the deferred acceptance algorithm when the hospitals offer to doctors. Is the resulting match stable?

   c.) Apply the deferred acceptance algorithm when the doctors apply to hospitals. Is the resulting match stable?

2. There are three songwriters and three artists. Each songwriters can offer up one song for sale, and each artist only has enough budget to buy one song. The songs are offered at the same price, but have different levels of desirability across the artists. As a result, this is a two-sided one-to-one matching market. Consider the preferences below, with rankings stacked top to bottom from best to worst:

Songwriters			Artists		
s_1	s_2	s_3	a_1	a_2	a_3
a_1	a_3	a_1	s_1	s_2	s_3
a_3	a_2	a_3	s_3		s_2

   a.) Apply the deferred acceptance algorithm when the artists offer to songwriters. Is the resulting match stable?

   b.) Apply the deferred acceptance algorithm when the songwriters offer to artists. Is the resulting match stable?

   c.) Now consider a fourth artist, a_4, entering the market. Analyze the new preferences below. How does this change the matches which result from the deferred acceptance algorithms? Does the new imbalance in the market generate an advantage for one side? Explain.

Songwriters			Artists			
s_1	s_2	s_3	a_1	a_2	a_3	a_4
a_4	a_3	a_1	s_1	s_2	s_3	s_2
a_1	a_2	a_3	s_3		s_2	s_1
a_3						

3. Mark and Jodie are planning their wedding ceremony. Mark has 5 groomsmen, while Jodie has 3 bridesmaids. They've decided to let the groomsmen and bridesmaids pair up at the beginning of the ceremony; however, 2 groomsmen will have to walk out by themselves. Given this two-sided one-to-one matching market, who will walk down the aisle with whom? Consider the preferences below, with rankings stacked top to bottom from best to worst:

   a.) Does each participant find each potential match *acceptable*? Explain.

   b.) Apply the deferred acceptance algorithm when the groomsmen offer to bridesmaids. Is the resulting match stable?

   c.) Apply the deferred acceptance algorithm when the bridesmaids offer to groomsmen. Is the resulting match stable?

Groomsmen					Bridesmaids		
G_1	G_2	G_3	G_4	G_5	B_1	B_2	B_3
B_1	B_2	B_2	B_1	B_3	G_4	G_5	G_2
B_2	B_1	B_3	B_2		G_1	G_3	G_5
B_3	B_3				G_2	G_2	G_1

4. It is prom season, and people are starting to decide who they want to ask. A group of friends, with both a's and b's, will end up going with each other - but they don't know who they'll be matched with. Each person knows their own preferences, as given below in Table 1 (with rankings stacked top to bottom from best to worst):

a's				b's			
a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4
b_3	b_3	b_1	b_1	a_3	a_3	a_2	a_2
b_2	b_1	b_3	b_2	a_2	a_4	a_4	a_1
b_4		b_2	b_4		a_1	a_3	
			b_3			a_1	

Table 1: Preferences before a_3 and b_3 start dating.

a.) Does each participant find each potential match *acceptable*? Explain.

b.) Apply the deferred acceptance algorithm when the a's offer. Is the resulting match stable?

c.) Apply the deferred acceptance algorithm when the b's offer. Is the resulting match stable?

d.) Now, a_3 and b_3 have started dating. Given the adjustment in preferences (shown below in Table 2), how has the stable matching produced from the deferred acceptance algorithm changes? Show.

a's				b's			
a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4
b_2	b_1	b_3	b_1	a_2	a_4	a_3	a_2
b_4	b_4		b_2	a_4	a_1		a_1
b_1	b_2		b_4	a_1	a_2		a_4

Table 2: Preferences **after** a_3 and b_3 start dating.

5. In many sororities, the process of pairing big sisters and little sisters ("bigs" and "littles") is a two-sided one-to-one matching market. Typically, each party will make a list ranking potential matches, and a third party will attempt to match them. Most often, preference is given to the preferences of the littles. Consider the preferences below:

Bigs										Littles							
B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	B_{10}	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
L_1	L_2	L_7	L_3	L_8	L_4	L_3	L_4	L_6	L_1	B_3	B_2	B_2	B_8	B_{10}	B_3	B_1	B_5
L_2	L_5	L_5	L_8	L_3	L_5	L_1	L_7	L_4	L_5	B_{10}	B_3	B_1	B_2	B_7	B_6	B_3	B_6
L_3	L_1	L_4	L_5	L_2	L_3	L_8	L_2	L_7	L_4	B_1	B_4	B_{10}	B_7	B_9	B_{10}	B_8	B_7
L_8	L_3	L_1	L_2	L_5	L_2	L_7	L_3	L_2	L_7	B_2	B_9	B_3	B_1	B_2	B_7	B_4	B_8
L_7	L_4	L_8	L_1	L_7	L_8	L_2	L_6	L_1	L_3	B_5	B_1	B_9	B_9	B_3	B_4	B_{10}	B_2

a.) Does each participant find each potential match *acceptable*? Explain.

b.) Apply the deferred acceptance algorithm when the littles offer.

6. A manager (M) and general manager (GM) do not agree on who should start the next baseball game at the Pitcher and Catcher positions. There are three sides to this match: the manager and general manager each have preferences over who to start; each pitcher and catcher has a preference over who to play for. Consider the preferences below, and find a stable matching:

		Pitchers		Catchers	
GM	M	X_1	X_2	Y_1	Y_2
(X_1, Y_2)	(X_2, Y_2)	GM	M	M	GM
(X_1, Y_1)	(X_2, Y_1)	M	GM	GM	M
(X_2, Y_2)	(X_1, Y_2)				
(X_2, Y_1)	(X_2, Y_1)				

7. In this three-sided matching market, individuals with one of three skills must be grouped in threes. Each group, to operate fully, must have one person with skill X, one with skill Y, and one with skill Z. Each potential group member has preferences over matches. Consider the table of preferences below, and find a stable matching. Support your answer intuitively and logically.

		X's			Y's			Z's
X_1	X_2	X_3	X_4	Y_1	Y_2	Y_3	Z_1	Z_2
(Y_1, Z_2)	(Y_2, Z_1)	(Y_2, Z_2)	(Y_3, Z_1)	(X_2, Z_1)	(X_3, Z_2)	(X_3, Z_2)	(X_1, Y_1)	(X_3, Y_2)
(Y_2, Z_2)	(Y_1, Z_1)	(Y_2, Z_1)	(Y_2, Z_2)	(X_1, Z_1)	(X_4, Z_2)	(X_2, Z_1)	(X_1, Y_2)	(X_4, Y_2)
(Y_3, Z_2)	(Y_2, Z_2)	(Y_3, Z_1)	(Y_3, Z_2)	(X_1, Z_2)	(X_3, Z_1)	(X_1, Z_2)	(X_3, Y_2)	(X_4, Y_3)

8. There was a wheelbarrow race among a group of five friends. Each pair had to be composed of one guy and one girl. However, Chris (X_3) and Jane (Y_2) hooked up recently. Jane states that she is ok with being matched with Chris, but in reality, she does not find a match with Chris acceptable. Consider the stated preferences (Table 3) and actual preferences (Table 4) below:

	X's		Y's	
X_1 (Pat)	X_2 (John)	X_3 (Chris)	Y_1 (Lisa)	Y_2 (Jane)
Y_2	Y_2	Y_1	X_1	X_2
Y_1	Y_1	Y_2	X_3	X_3
			X_2	X_1

Table 3: Stated preferences.

	X's		Y's	
X_1 (Pat)	X_2 (John)	X_3 (Chris)	Y_1 (Lisa)	Y_2 (Jane)
Y_2	Y_2	Y_1	X_1	X_3
Y_1	Y_1	Y_2	X_3	X_1
			X_2	

Table 4: Actual preferences.

a.) Use the deferred acceptance algorithm to find a stable match given the friends' stated preferences.

b.) Given the participants *actual preferences*, will this match actually be stable?

c.) Does Jane have an incentive to misrepresent her preferences in this way?