PROFESSOR: All right. So today's reading comes from a game designer, Lewis Pulsipher, who traditionally worked on war games. I believe he's done some of the board games, as well. But for the most part, I think, he's recognize for his war gaming work. And there's actually quite a lot of war gaming journals, mostly written by designers for fans or by fans for fans. Things like the [? Compleat ?] Strategist used to be like the *PC Gamer* of war gaming, right? It's like, this is what's happening and these are our thoughts, these are our critiques. And that particular reading I feel is very typical of that era of, maybe, late '80s, early to mid '90s magazine publications.

And it's interesting because already at that time, sure, there are people who, say, wrote the core rulesets for various games, like Axis and Allies, or things like Dungeons and Dragons. But there was going to be this assumption that if you are interested in something like war gaming, you're also interested in creating your own scenarios. You are already halfway a game designer. And so you have to keep all of these things in mind. Particularly if you're a game master, has anyone been like a dungeon master or a game master for a role playing group? OK. You're basically a game designer.

AUDIENCE: Yeah

PROFESSOR: Yeah. You know, you're taking rule sets that somebody else [? came up with ?] and cherry picking the stuff that you really want to work with and discarding the stuff that doesn't and then coming up with your own rules.

So just as and example of reading, I believe this is the first time I've asked you to read anything from the table top book?

AUDIENCE: [? Tic a Tac. ?]

PROFESSOR: [? Tic a Tac? ?]

AUDIENCE: Yeah.

PROFESSOR: OK, all right.

AUDIENCE: You just ran this first.

PROFESSOR: That's true. Yeah. But this particular piece of reading is also a nice little time capsule of how people used to write about game design. It's a fairly modern piece of writing it still has that same sort of style. So there's a lot of examples of, like, this is how this theoretical game is going to be played and I'm going to write it out completely in prose. And even when they refer to games that already exist, like, I believe they do cite [? Vinci, ?] at one point.

AUDIENCE: [INAUDIBLE]

PROFESSOR: Yeah, again the game mechanics that they're discussing are all in prose. It's not like in point form or anything like that, it's just free prose. I don't think there's ever any assumption that if you contributed an essay for something like [? the Compleat ?] Strategist that diagrams that you included would be included in the magazine, right? Because a lot of people who actually created those essays weren't necessarily artists. And that's not to say that you didn't have diagrams in magazines like that, but it was expensive. This was before desktop publishing. So people just got really, really used to describing things in prose, describing core game mechanics in prose, not just in point form or bullet points.

So there were basically two suggestions that he has on how to deal with the whole three player problem. Actually, before I get into it, can anyone quickly sum up what's the main problem with designing a game for three players? Your answer.

AUDIENCE: Well, one of them was [? turning-- ?]

PROFESSOR: Mhm.

AUDIENCE: --where two of the players sort of go at it for most of the game and then they weaken themselves, and then the third player [INAUDIBLE]

PROFESSOR: OK, so, for a certain set of rules, that's one kind of strategy which encourages you to basically not interact with anybody else and then win the game, right?

AUDIENCE: What I going to say is, this is where it's just one player chooses which of the other two players wins.

PROFESSOR: Mhm, so I believe [? kingmating ?] was the name that was given to that. You may not be in a position to win the game but in a game with only three players, you might have enough influence to basically say, I don't like you, therefore you are not going to win. Therefore, the other person is going to win, even though I can't win. There were a few more subtle problems that he described. Anyone remember any of them? [INAUDIBLE] Yes?

AUDIENCE: Politics, so two people decide to team up on the other player and the other player really can't win.

PROFESSOR: Uh--

[INTERPOSING VOICES]

PROFESSOR: --yeah, he brought that up. It does come up in reading. It's not necessarily described as a problem, but something that does happen and it happens often. So you either take advantage of it as a designer, or your game suffers because you hadn't thought about it, right? This whole idea of, somebody's in the lead and two people probably want to do a temporary alliance at the very least to take down that player.

There was one called sandbagging and I actually am forgetting what that means here.

AUDIENCE: If we could set that up, saying that you're [? doing ?] less well off than you actually are.

PROFESSOR: Oh, yeah. Pretending that you are-- like bordering on lying, right? It's like, no I'm not going to win the game in the next turn, don't worry about me, deal with him, he's scarier. And that sort subtle deceit where you have to actively conceal the fact that you are not in the lead. There are some games that say, all right, here are some ways that you can do that.

I'm not sure, are [? we enough ?] for Crunch? I think we are.

[INTERPOSING VOICES]

PROFESSOR: Yeah. So Crunch is a game about being a banker. You're trying to fill up your golden parachute before the market crashes, and you are encouraged to play the game in a three-piece suit so that you can actually actively hide cards. And the idea is that at the end of the game, the amount of money that you've managed to keep yourself for your own personal use, including any cards that you happen to [? have ?] on yourself, will win you the game. It's not about keeping your bank afloat, at all, it's all about leaving with the largest personal fortune. So it's a rye, satirical game, but one that actively encourages you to conceal how well you're performing. Now, it's a two-player game, it's not like a three-player game, so that you are also well aware that your opponent is doing the same sort of thing. You're just trying to do the best that you can in accumulating as much cash as possible because that's what's going to win you the game.

But in the situation with three players, you can imagine a situation where someone could figure out that you're in the lead and that person can catch up. And what can you do? Like, pass cards to the player that you want to win, for instance? And that might be tough because someone might not be able to interfere with that process.

AUDIENCE: In the game [? Junta ?] you're a politician in some Latin American banana republic, and your goal is to embezzle as much foreign aid money as possible. And one of the things is that, the number [INAUDIBLE] drawn each turn is variable, and only the president really knows, and so [INAUDIBLE] is that sometimes the president won't draw very much, which might cause people to launch a coup against him, because they think he's lying and taking a lot for himself and there scared he'll win for that reason. But, basically there's so much uncertainty about how much people have. It's not even computable how much people have in their--

PROFESSOR: It's Junta? With a J, right?

AUDIENCE: Yeah.

PROFESSOR: So, [? this ?] [? is ?] [? be, ?] right? It sort of plays around with this idea that you have this dictator that seems to be amassing a large personal fortune, whether or not the dictator can be successful in a process of amassing a large personal fortune, that game is designed to paint a giant target. And we have another game here called King of Tokyo, which is basically giant monsters trying to take over Tokyo bay. Every sing generic giant robot, giant dinosaur, octopus thing, mecha dinosaur. And whoever happens to be a king of the hill at that point has a giant target on them, and the game mechanics all support that, that's what the game's all about.

So those are some of the problems and he proposed two solution, not necessarily the only two solutions, but these are the ones that occur to him, particularly in war gaming, that might work. And they're actually kind of opposite ends of the spectrum. Does anyone remember one of the two solutions?

AUDIENCE: Equilibrium?

PROFESSOR: Mhm. [INAUDIBLE]

AUDIENCE: If one person gets ahead then they cannot be significantly defeated before they win the game.

PROFESSOR: I think equilibrium was the opposite of that.

AUDIENCE: Opposite?

PROFESSOR: Yeah, so you've actually just completed two answers into one, which is good. [LAUGHTER] So, the equilibrium, if I recall correctly from the reading, the equilibrium design goal method that you can manage to design is taking advantage of things like the balance of power theory, which is, if there is a person who is clearly ahead, everybody else who is weaker is probably going to band up and take you down, and if you just balance the game in a certain way you give them the tools to do that, and that takes anyone who seems to be ahead back to a sort of equal power level. That's a balance of power theory is something from political science. I've only heard about it in passing. If there's anybody here who has taken political science classes, you can tell me if I'm getting this right or wrong. The whole thing is not a far fetched idea, right? If you've got a powerful nation other nations who are bordering that powerful nation are likely to either team up with the powerful nation, or more likely to band their [? nations ?] together, even though they may not be ideologically linked or anything. They're ideologically linked against the powerful nation, so same thing goes for players.

So basically it comes down to giving everybody the tool to take down the leader a notch, and does restore everything to a sort of equilibrium state. And then your success criteria for the game probably isn't who is going to gain such a massive leap, because the game isn't deliberately really designed to wait for everything to equilibrium, you need to have some other kinds of success criteria. Maybe the game is time limited, for instance, maybe the game has different goals for each player, or something. So even though your power levels are about the same you might be able to get victory points on some things faster than others.

The alternative, which you hinted at, which was, basically, making it difficult to take down the person who's in the lead once they're already in the lead. He had one very specific implementation of this, or one particular rule of thumb, on how effective must a person in the lead be in order to prevent the king making, and sandbagging, and [? turtling, ?] and everything. Remember this? Remember?

The basic idea is that you must be able to do it in one turn, in a single turn. If you are in the lead, you should be able to complete the game and win the game in a single turn. I'm not so sure whether I agree with that. And I don't think he means win it on your turn. I think it means in a round of people. If you're in the lead in the game, you should be able to do something to cement that lead so that within that turn no one's going to be able to do anything about [? changing ?] the [? turnout of ?] the game. This is for games where there is a clear win condition that is based on overpowering your opponents. That you don't want to have the situation where, yeah, I'm in the lead but everybody else still has enough time to take me down to the point that somebody else can then catch up and be in the lead, because that basically means that the first person to get in the lead will probably lose, and that's sad.

But we see that in certain computer games. We've seen games where whoever who is in the lead has a giant target painted on their back and you're expected to be taken down. If you're the first one in the lead you are probably going to get hit, but then that now [? there's ?] enough time to be able to pull ahead. So that's closer to the equilibrium style, right? So I think I heard someone give--

AUDIENCE: Oh, *Mario Kart.*

PROFESSOR: *Mario Kart* being the obvious one. You get increasingly powerful weapons the further behind you get, or useful things. There's an example in this book here, the *Rules of Play*-- this is the hardback version-- of *Super Monkey Ball.* And, basically, all their weapons face forward. So again, number one, you can only shoot forward, there's nothing to shoot, there's nobody ahead of you. It's not actually a technical disadvantage, it's not like a weapon that slows you down, but it's useless thing. You get these powerups that are useless.

So a lot of these feed into a different way of looking at games that is a very formal, very [? technique, ?] and one day you've probably heard of, mentioned multiple times in this class and in other classes, as well, and that's just feedback systems. I don't care about UI feedback, I'm talking about feedback from the cybernetic [? sense. ?] Anyone here has heard about cybernetics from another class? Yeah.

AUDIENCE: Oh, I was going with the feedback systems that you used in your other class, like we did [? in the engineering one. ?]

PROFESSOR: Yeah, yeah. I definitely brought it up in there.

AUDIENCE: Yeah, where you had a forward feedback system and a backward feedback system, and, basically--

PROFESSOR: Mhm, positive and negative. Yeah.

AUDIENCE: --If you were winning, you either start winning by more, or your losing, you start to catch up. For example, [INAUDIBLE]

PROFESSOR: Right. So, the whole basic idea of cybernetics is based on, sort of, automated control. You create systems, mechanical or electronic, or with a set of rules that basically are going to either accelerate or snowball the performance of the system, or bring it back to equilibrium. If this sounds very familiar to something [? Mech-E ?] or [? EE ?] or something, that's completely expected because this all originally came from that.

So, the basic model is that you have some sort of sensor, something that detects an environmental change. It could be something that detects the state of your game, some way of telling you this is the current state that you're looking at. Then goes to a comparator-- which needs more space because it's a longer word, comparator-- which performs some sort of logical assessment on the state of the system that you're looking at. And then you're going to an actuator, which performs some sort of action. And it's called feedback because the thing just keeps feeding back, all right?

Real life systems that do this, what are some of the simplest real-life systems that do this, electronically or mechanically, without human intervention?

AUDIENCE: Washing machine.

PROFESSOR: Washing machine?

AUDIENCE: Thermostat.

PROFESSOR: Thermostat. Washing machine? That would watch water levels I think, right?

AUDIENCE: Well, the [INAUDIBLE]

PROFESSOR: Oh, yeah, yeah. That's true. So, thermostat, things get too hot, turn on the cooling system or shut off the heating system.

AUDIENCE: Wonder if that emergency [INAUDIBLE]

PROFESSOR: Emergency?

AUDIENCE: [INAUDIBLE] There's a hole at the top of sinks where if the water--

PROFESSOR: Yeah.

AUDIENCE: [INAUDIBLE]

PROFESSOR: Yeah. The sensors, whether the water has actually hit that hole. [INAUDIBLE] I guess the sensor is the level of the water, the comparator is the height of the hole, and then the actuator is if it's at the height of the whole, go out the hole, right? So, it's actually just like physics is the entire system for you, but it's engineered in a way to take advantage of that.

AUDIENCE: Systems like autopilot.

PROFESSOR: Mhm, keeping you on the path that you're supposed to be on, always just doing minute little corrections. The majority of these things are real-world applications of these negative feedback systems. And the idea is that if there is a change in one direction, pull it back. If goes in the other direction pull it forward so it always hovers around the same point. These are deliberately designed systems trying to do this all the time. But there are a lot of real-world systems that do the opposite, right? Stuff that snowballs. For instance, a snowball rolling down the hill. As it goes down it gets larger and it makes it slightly easier to continue rolling. I think some of the area in contact to snow actually decreases by a proper ratio [? required ?] to make it easier to keep going. It picks up more snow and gets larger and larger. Another positive feedback system in the real world?

AUDIENCE: I don't know the name of the game, but there's this [INAUDIBLE] game where you start off as an asteroid.

AUDIENCE: [? Astrobrah. ?]

AUDIENCE: Is that what it is?

PROFESSOR: Astro-what? [INAUDIBLE]

AUDIENCE: You start off as a small asteroid, and what happens is you meet other small asteroids and you grow up to be a planet, and then, at that point, asteroids become fairly easy to gobble up, but you want to go after other smaller planets than you, and then [INAUDIBLE] and then keep on getting bigger until you become a black hole.

PROFESSOR: Hm.

AUDIENCE: And then, eventually you get so large that you can just eat everything up afterwards.

PROFESSOR: There are two games that reminds me of. One is*Orbital,* which was a Nintendo game. Do you know?

AUDIENCE: Wait, which one? Which game were you saying?

AUDIENCE: That sounds like *Katamari Damacy.*

PROFESSOR: It sounds like *Katamari Damacy.*

AUDIENCE: I think that sounds like a genre.

PROFESSOR: Yeah.

AUDIENCE: So, get bigger so you can get bigger.

PROFESSOR: Yeah. Let's see. What's the game done by Andy Nealen?

AUDIENCE: *[? Orthos? ?]* No. *Osmos.*

PROFESSOR: *Osmos.* Yeah, I think that's a PC and portable device game. So, *Osmos* is an interesting situation because yes, the bigger you get, the bigger you can get, because the idea of *Osmos* is like you're just a little amoeba-like blob, so asteroid, amoeba-like blob. You can eat anything smaller than you, and everything that you eat makes you bigger, so you can eat even bigger things. But actually it makes it more difficult for you to navigate because you're more massive now. So you actually have both negative and positive loops going on at once.

AUDIENCE: I have another possible one.

PROFESSOR: Mhm?

AUDIENCE: Bombs.

PROFESSOR: Bombs?

AUDIENCE: Yeah, because then [INAUDIBLE] exploding and--

PROFESSOR: It makes other things explode?

AUDIENCE: Well there's that, but there's also some bombs where--

AUDIENCE: Nuclear bombs.

AUDIENCE: Yeah, nuclear bombs.

PROFESSOR: Oh, so like you're using an atomic bomb to set off a hydrogen bomb, that sort of thing?

AUDIENCE: Something like that.

PROFESSOR: OK, yeah. Positive feedback often happens in military conflict, right? If you've got overwhelming forces every engagement just makes the ratio, if everything goes according to military doctrine, every engagement is going to give you yet a greater advantage. [INAUDIBLE]

So, the way this has been applied in games is-- just to make it literal-- you have some sort of state of the game. Am I getting this right? Yeah. You have the state of the game. Wait, hold on, let me just make sure I've got this perfectly right. Here we go. You have some sort of scoring function. It doesn't have to be the literal score, but it has to be some way of assessing how close you are to some sort of goal. So either the short term goal or the overall goal of the game, some sort of scoring function. And that goes into some set of [? prior ?] input. There are some versions of this diagram that separate this into two things, that's kind of like the player decides what they're going to do and then actually executes the input. Actually, there is one more stage, sorry. There is one more stage, and that's the kind of the mechanical bias.

So the state of the game can be revealed in some sort of scoring function. A player assesses what they want to do and then tries to execute it. That is filtered within the computer's or the board game's or the card game's interpretation of what that input is going to do, and then that feeds back into game state, right? So for games like *Mario Kart,* you perceive that you are doing badly because you are the last one at the back of the races. You drive your vehicle into one of those rotating boxes because you're deliberately steering to them because they're probably your only chance to be able to catch up again. You get usually something really, really sweet because you're all the way behind and the way the game is designed, if you're all the way behind you get all the best toys. Every single tool that you need to be able to catch up is given to you when you are all the way at the back. That's the mechanic bias, all right? It gives you the right tool and that affects game state because now you have this wonderful tool and you use it, hopefully it works, and then you gain a couple of places up in the race.

So, there are a couple of other examples that are a little bit clearer. So, say, basketball. If you've got a situation where you've got five people on each side, you could do a game where if you start to have a lead of five points, you lose a player. Someone's benched. [LAUGHTER] So is that negative or is positive?

AUDIENCE: Negative.

PROFESSOR: That's negative, right? Because you're saying, all right, you are far enough ahead, we're going to take away one of the advantages. Is there another way to do negative feedback on that example? Instead of taking away a player?

AUDIENCE: Add another player to the others.

PROFESSOR: You could add another player to the other side. That's also negative feedback, even though you're adding something, what you're really doing is you're going to give an advantage to someone who's not doing so well, and that's trying to bring things to equilibrium. The positive feedback version of this would be-- [LAUGHTER] [INTERPOSING VOICES] What?

AUDIENCE: Turn the three-point line into a four-point line [INAUDIBLE]

PROFESSOR: Oh, OK. All right.

AUDIENCE: Every time you score a point the other team loses a player.

PROFESSOR: Yeah, OK. [LAUGHTER]

AUDIENCE: Do you ever play basketball? [LAUGHTER]

PROFESSOR: I was thinking something more literal like just giving the team that's ahead extra players. Right, that's right. You could do it, every five point that you get, you get one more player. Then pretty soon you've got two more players, then pretty soon you've got three more players, and then--

AUDIENCE: Pretty soon you have too many players.

PROFESSOR: --and then you just have more people than anyone can move on a basketball court, and as a result of that you kind of win by default.

AUDIENCE: Some game have a similar mechanism, like, somebody's on fire, they make three shot in a row, and all of a sudden they're just way better at playing.

PROFESSOR: They run faster, they jump a little higher. Yeah, and the computer games can totally do that.

AUDIENCE: [INAUDIBLE] [LAUGHTER]

PROFESSOR: Well-- [INTERPOSING VOICES]

AUDIENCE: Being on fire is the same as momentum.

PROFESSOR: Yeah. Yeah.

AUDIENCE: Statistically, if you're throwing a good game and you're doing more and more pitches, better and better pitches, you are playing better.

PROFESSOR: But I'm wondering whether that's correlation or causation. Is the reason why you're doing better because--

AUDIENCE: Right now they're thinking it's causation.

PROFESSOR: It's causation?

AUDIENCE: They thinking it. There's a new study that just came out.

PROFESSOR: But it definitely comes up in sports psychology, right? You're sort of building on the mental momentum of doing well. And similarly a team that's not doing well can lose hope. Again, that's positive feedback, I just want to be extremely clear about the use of positive, if there's anything that amplifies differences that already exist.

So, there are a couple of things to think about when it comes to feedback, especially as a problem solving technique for design. We've already talked about how negative feedback tries to bring things down to equilibrium, so it's a stabilizing force. If your game is out of control and unpredictable and chaotic, negative feedback can rein things in a little bit. Sure, it may be unpredictable, but it's not going to hurt me so bad. Or if somebody gets and advantage it's not going to be a runaway advantage.

Similarly if your games just actually always hovering at equilibrium and nobody seems to be getting an advantage, then positive feedback will destabilize that. It will make it more likely that somebody who gets an advantage will actually get a large advantage, and that could be a good thing if your game is kind of dull and it's always just kind of hovering at the same level.

But there's a trade-off with that, because any amount of feedback that you're adding into your game, especially this kind of automated feedback, this is something that your rules are automatically generating, can actually be taking control away from players, and as a result of that might actually make the game less engaging. So even a game with like, all right, this game is too stable, we're going to add some positive feedback mechanisms so that people who have an advantage can capitalize on that advantage. But if that's not done right, then you've just got a situation where once someone starts winning everybody else loses interest because there's no way that they can catch up. So it destabilizes it in a point that, yeah, someone's going to win this game whereas previous it was always stuck at equilibrium. But it's very easy to lose people in that process because you're just creating and automated system to take control away from them. So that's one danger of putting in a feedback system.

Also we talked about bringing things down to equilibrium to make things a little bit easier for people to catch up or to make advantages a little bit less drastic. That can also make our game much more, right? Because nobody gets an advantage, and depending on your win conditions, depending on your end of game conditions, could actually just make it interminably long. You could take a half an hour game and make it a one hour game. So on the flip side, the positive feedback game can actually help rein in the length of the game. So if your game is currently taking an hour long [INAUDIBLE] and your victory conditions happen to be on gaining an advantage over your opponents, then a positive feedback system can help speed that along. Right? OK, maybe we can cut it down by half by just giving some advantages the the person who's ahead or penalizing the people who are behind.

That's an interesting little side effect, which is because positive feedback builds on itself, if you have an advantage early on, like you have early success, then positive feedback is going to be the mechanism that's going to help build on that. On the other hand, if you have a negative feedback system in your game, which means everything is kind of being brought down to an equilibrium, but everyone's getting closer to actually finishing the game, but no one really has a huge lead, then late successes mean a lot more. That last boost when you are near the final-- What's it called?

AUDIENCE: The finish line.

PROFESSOR: The finish line! That last boost before you hit the finish line on the very last round of *Mario Kart* means a lot because the whole game is designed with a huge amount of negative feedback, and could make all the difference. People have played *Mario Kart* where that was pretty much the game, there was this last fight [INAUDIBLE] Someone just got hit with a blue shell in the last five seconds and [INAUDIBLE] So negative feedback prioritizes what happens late in the game, whereas positive feedback prioritizes what happens earlier on in the game, the strategies that you pick, the cards that you have which you draw in play right at the beginning of the game [INAUDIBLE] Positive feedback stresses that.

And finally, , always keep in mind that any interactional game systems probably create emergent feedback loops even if you had [INAUDIBLE] So what you want to do is you want to try to find that. There is a tool out there that I've seen some student teams use, and I don't know whether it's going to be useful for you, I'm just going to give you it. Has anyone heard of causal loop diagrams? It's from economics. You have?

AUDIENCE: [INAUDIBLE]

PROFESSOR: It's a very simple concept. You just basically write in your variables in your game, and you can add in a few in between variables if you know how players are thinking about your game. I've been using *Mario Kart* too much for an example. Let's pick another game with a obvious [? defect ?] in it that everyone in this room probably knows.

AUDIENCE: Chess.

PROFESSOR: Chess? Chess, does our piece-- OK, so, [? our ?] [? pieces ?] in chess sort of influence the number of attack [? patterns. ?] Which means the number of pieces will influence the number of pieces being threatened. Of your opponents pieces being threatened. And so it's just the number of opponent pieces taken. Now, if I flip this around a little bit, I think I could make an argument that if I switched it to the number of my own pieces, rather than my opponents pieces, then it connects. But not everything is a positive connection. Number of pieces that I have means if I have more pieces I have attack power, sort of. It's not exactly a linear connection, but [INAUDIBLE] chess set, right? I have more pieces than you, I have more ways to attack than you. If I have more ways to attack than you, then actually I have fewer pieces threatened because I get also more ways to defend. So I'm going to say, defend attack [? powers. ?] Anything that I can attack, I can prevent from-- I say, well, if you take this piece, then I'm just going to take the piece that you just moved, and with a one for one trade, I also have more pieces than you.

And if you fewer of my pieces are threatened, that means I can-- let's see, if number of pieces that are threatened goes down, then the number of pieces that I can take goes up.

AUDIENCE: Wait. [INTERPOSING VOICES]

PROFESSOR: I think, yeah.

AUDIENCE: [INAUDIBLE] be ignored

PROFESSOR: Hm?

AUDIENCE: If the number of your pieces threatened goes down then the number of your pieces taken goes down, as well.

PROFESSOR: Yes.

AUDIENCE: Those two are positively correlated.

PROFESSOR: Yes, yes, that's right. You are right. And that should just decrease. And if the number of pieces taken goes down-- If the number of pieces taken goes up, then I have fewer pieces. If I have fewer pieces taken, then I have more pieces. So we have two classes and we have two minor [? suspicions. ?] Over all, this entire loop is called a reinforcing loop. Right? This is part of the feedback loop. You can connect this to other things. Maybe in chess I'm not terribly good at causal loop diagrams to begin with, but in chess you might be able to connect it to other things like positioning of pieces, or the value of pieces. So those might be reinforcing, and reinforcing is basically another way of saying it's a positive feedback loop.

Another way that you can say is that it's a balancing loop, which means actually a negative feedback loop, and that's usually you put that with [? another ?] [? B. ?] [? Just remember ?] that thing used as well as students from economics and management who have actually done that because they're trying to study things like supply chains and how a system [INAUDIBLE] and industry. That's why they've already used the tool and then they can put it in. But, it might be worth looking up, it might be a useful diagnostic tool for your game if you're just trying to figure out what are all the different loops and just write down all of your variables and figure out whether things even up. Two negatives and two positives give you a reinforcing loop; positive, positive, positive, positive gives you a reinforcing loop; positive, positive, negative, and that's it, gives you a balancing loop. Basically, [INAUDIBLE] add up to positive, positive, [INAUDIBLE] negative.

So, the one thing to keep in mind is that occasionally what happens is that you have something like a time delay, and that's notation for a time delay. And that means things sometimes won't end up oscillating because of your [? timeline. ?] So you get a better state in some things. We had a game, for instance, which was about climate change and you can invest money into research. Yeah, at some point of time in the far, far future that pays off, right? But that doesn't necessarily mean that it's going to pay off right away. So that may end up in situations where you can make money, big fluctuations around the [? store, ?] so balancing in terms of equilibrium. But just like a thermostat that's very slow to respond. You might have something like a heater that warms up a room and it makes the room too warm before the sensor actually realizes that it's warm enough and then shuts it off and then the room becomes really, really cold before the sensor realizes that it's too cold and then turns it back on again. And that can lead to these oscillations.

So keep in mind also things like timelines when you're drawing out these diagrams. How long does it take this advantage to turn into that advantage, or this increase to turn into that decrease? Yeah, any questions? Yes.

AUDIENCE: So isn't [? a change in ?] negative and positive feedback usually-- it seems really weird because usually positive means a multiplier greater than one and negative means a multiplier between zero and one, in the sense that, how much does your point [? mean ?] really near? If I had a one point lead right now, positive feedback means that it's really like a two point lead--

PROFESSOR: Hm.

AUDIENCE: --because the points provide more for me later and, even though, [INAUDIBLE] negative loop that wins but it will often mean that it's actually more like a half point lead because it means less than it really does, whereas--

PROFESSOR: Yeah.

AUDIENCE: --it means power differences definitely have a case where sometimes if it's negative then that can literally be negative in the sense that taking this lead right now could actually hurt me because in the game it could actually hurt me in the long run.

PROFESSOR: Yeah, I think positive and negative signals originally inherited from math, cybernetics. It's actually referring to a differential, rather than the-- it's referring to the rate of change, rather than the actual multiplier. That's some baggage that we've taken on. It's funny because some people think negative feedback means bad, right? And it's like, no, negative feedback could mean good, and could mean that negative feedback for someone who's behind could be an advantage. So the terminology doesn't quite make it easy for everyone to use, but it's something that is currently in use, so it's good to know that game designers do use these terms. Hm?

AUDIENCE: Talking about flight control systems and positive feedback. Bad.

PROFESSOR: A control system where positive feedback would be bad. Yeah, I think that's kind of the opposite of the word control. [LAUGHTER] Chain reaction might be a great way to describe that, for instance. Any other questions about these ideas? A lot of the stuff that I've been talking about is known as first order cybernetics, which is basically the system is doing its own thing happily, and if I'm taking a look at the system from the outside I don't really have any influence on how it's going to perform. But, there is a second order, a whole school of second order cybernetics that I'm totally unfamiliar with, which actually takes into account having a person in the loop, which you would think would be a lot more applicable for games, especially games being played by people. But I don't know much about second order cybernetics. So, if you're interested in a research project or something like that, a thesis or something like that, come and talk to me. I would love to [INAUDIBLE] because I don't know about that just yet. All right.

One final word, this is a very formal way of looking at game systems. Just as I have [INAUDIBLE] I just admitted that it doesn't take people's involvement in the process very well, it is not necessarily the case that the formal ways of looking at a system, just looking at how the rules interact, is necessarily always the best way to look at games. In many ways, in many occasions, it is actually not a useful technique. I can have [? all these systems ?] in my rules, but if people are going to read my rules and interpret my rules, as you've already seen happen in this class, differently, then they may be motivated to do things that operate against my assumptions because that's something else in my narrative, my aesthetic, in their own individual motivations. If somebody wants to take down somebody else in a game just because they happen to hate that person and it's outside of the game rules then nothing in the rules are going to tell me that. But it's still going to affect how that game gets played, and I might want to take that into account.

The Game of Diplomacy, for instance, has to take into account the fact that you're probably playing it with people that you know, and you have some sort of existing relationship with them. I don't think it does a very, very good job of insulating you from the fallout of the game. [LAUGHTER] Everyone knows what I'm talking about, right? OK. Just unfriend the people that you play diplomacy with anymore. That's why I don't like playing that game, but I like talking about it.

So, we'll be going into things like games for social play, and the social function of games, how you interact with people, right? Some other topics are going to be things like games of simulation, games that have a slightly flawed mirror to the real world, but an interesting one. It could be a fun house mirror which could be fun. So, we'll be looking at that in weeks ahead. This is probably about as formal as we get. We've been talking about things like information systems, that's also very formal. Just keep in mind that's just one school of game design and writing about game design.

OK. So we have games that all have an interesting way of dealing with this. Some of them, you're going to see these problems come up, like especially in [? Imperiums. ?] How many people do we have in class today? One, two, three, four, five, six, seven, eight, nine, 10, 11. OK. So, 11, that's like one four-person game-- [INTERPOSING VOICES]

PROFESSOR: OK.

AUDIENCE: [INAUDIBLE]

PROFESSOR: So we'll get about three games going on at once. Some games like King of Tokyo is very much a king of the hill game, so it's deliberately trying to ask you to take down the person who's in the lead, and the game mechanics make wonder whether being in the lead is really all that great. So, it's playing around with [INAUDIBLE] Small World is occupying territory with your army. Yeah?

AUDIENCE: [INAUDIBLE] when he talked about Vinci, Small World is a update of Vinci.

PROFESSOR: Yeah, though faster to play, which fits in this class. We have Vinci too if anybody wants to take a look at that. We have that at home but we don't play that often because it takes like two hours. Unless, of course, you already know it. Lifeboats is just about a bunch of sailors trying to get to safety. Basically, their boats are sinking and they're all trying to get to safety and everyone's jumping on and pushing people out of lifeboats, and swimming to lifeboats, and stuff like that. So it's all about knocking people out.

Hoity Toity and--

AUDIENCE: El Grande and [INAUDIBLE]

PROFESSOR: Yeah, I actually know relatively little about these ones. I forget--

AUDIENCE: Bluffing.

PROFESSOR: Yeah. Hoity Toity's a game about bluffing? OK. These were recommended by somebody's [? father ?] when I shared with them the [? syllabus. ?] And El Grande is a Spanish game about being territorial?

AUDIENCE: Yeah.

PROFESSOR: No, I totally [? made this up. ?]

AUDIENCE: Do you have English rules in here?

PROFESSOR: Yes, the English rules are in there. The box is just [INAUDIBLE] but I'm pretty sure I looked in there earlier and I saw British or English rules.

Intrigue is the game that I like the thing the most. It's basically, you're running a university and you're trying to put your foot down with another university. That's not what the game says in the box, but I would like you to try playing the game with that theme in mind. [LAUGHTER] So, yeah, it's interesting game because you are doing exactly the same thing that everybody else is trying to do, but in order to succeed in the game you have to put your troops, your colors, into other people's territory, and they're trying to put into yours. And there's some mutual benefit [INAUDIBLE] So a lot of opportunity for you-- It's a pretty good negative feedback game because it gives you a whole bunch of tools to basically take [INAUDIBLE] take the lead.

Take a look at which games hide the progress of players from you. Some of these games, you can easily see who's ahead, and some of these games it's really hard to tell, but that's deliberate so that you don't have these situations where someone all gang up on the people who are in the lead. Look at how they're avoiding things like [? turtling ?] and how they discourage [? stuff like ?] sandbagging, or maybe sometimes encourage them and use them in favor of them. Like Intrigue definitely encourages sandbagging.

All right. And then we'll have these boxes out at three o'clock, working on teams, [INAUDIBLE] I think we're going to see your teams before spring break so you might want to give each other tasks to work on during spring break. If you can't think of anything, test over spring break. A good number of you are going to see people who haven't seen your game yet. And--

AUDIENCE: So that you can have written rules, a first draft of your written rules. It's a great opportunity to take the test then.

PROFESSOR: Yeah. And if you don't have a first draft of the written rules then this last hour of class is probably a good time to bring out the laptop and just start editing that text so that you can go into spring break with something that you can test with. All right?

AUDIENCE: And for the game King of Tokyo the people will probably be able to play twice, maybe you can play another game. But yet again they're all about 40 minutes.

PROFESSOR: Yeah.

AUDIENCE: Is El Grande longer?

AUDIENCE: Yeah, El Grande is probably 90 minutes or so.

AUDIENCE: Small World is 40 to 80. [INAUDIBLE]