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WILL MA:

OK, guys, I guess I'll get started. So I guess one quick announcement is, so I guess everyone has taken a look at the prizes. If you can take a look at the prizes and, especially, if you're near the top and expect yourself to be getting some prizes. So we haven't announced the final ordering yet, because it'll also depend on the homework and then we'll decide how much.

It'll mostly just be number of points, but we might give a bit of weighting to people who have like a high points per game or something. But if you think you have a decent chance of getting prizes, it'd be good if you looked them over for when you research who this Mike McDonald guy is, how much is his coaching worth-- you can do that beforehand so that people don't take forever deciding which prize you want on Friday.

OK, so I'm going to get started then. So this is going to be the last class I'm going to teach. So the final class, on Friday, is going to be guess-lectured by Bill Chen. So I want to go through an in-depth combinatorial hand analysis of a cash-game hand-- go very in depth on a hand where you have deep stacks, and there's a lot of action, and there's a lot of deduction that can take place. And then I'll finish with some general poker stuff and answer any questions you guys might have about the poker economy, how certain things work, the history of poker-- I'm happy to answer whatever questions.

OK, so first, I'll do something more technical and more practical to the game. So an in-depth combinatorial hand analysis in cash games. So I'm going to look at the following hand. And the board is visible? It's good? OK. So this is a cash game. This is no longer a tournament now. And everybody has 100 big blinds.

So the blinds are \$1 and \$2, and everyone starts with \$200. So it's 100 big blinds. The cutoff opens near six, and we have eight-seven suited on the button. And when it's this deep stacked-- so in a tournament, this might not be a good situation to call, because it just puts a lot of risk on you to bust. And also, you're not really that deep stacked. But here, with 100 big blinds, we can really realize a lot of our implied odds given that we're both in position, and we have a hand that plays very well-- a suited connector-- that can make straights and flushes.

So we decide to call, and the big blind also calls. OK, so the flop is 10, eight, six with a club, and the cutoff continuation bet's 14. So one thing I'll talk about first is, continuation bet sizing.

So I said a bit about this, but I wanted to talk a bit more about bet sizing. And this is really just a review of what I've been talking about all class. It's the same principles when deciding your flop and turn bet sizing.

So you don't want to bet so small that your opponent has the odds to call with anything, but you don't want to bet so big that you are risking a lot of chips when you're bluffing. And also, if your raise size commits your entire stack anyway, like if you're roughly, let's say, betting 40% or more of your remaining chips, then you might as well go all-in if it's the flop or the turn because you probably aren't going to fold. Given that your hand is good enough to put in 40% of your chips, you probably have enough equity that you're OK putting in 100% of your chips.

Remember that raising your bet gives them the option to reraise, so that's always an incentive against raising a flop bet. The sizing should be bigger on dry boards and smaller on dry boards. We talked about this. And you want to bet? Bet a bit bigger when they're out of position. So he's kind of out of position here against us, and he bets 14 into 19, which is a reasonably big bet, but I think it's fine. So with our hand here, eight-seven of clubs, I think we definitely don't want to be folding.

So let's talk about the differences between raising and calling. So we decide to call, and so what's the analysis? So we're definitely not folding. Raising, I think, is a bit suicidal when we have a medium-strength hand that can play well in position on a lot of turns. And we have a backdoor flush draw; and our straight draw's very legitimate when there is no flush draw out there. So we decide to just call. We have to be a bit worried about a big blind check-raise, but I think it's OK. It's not that big of a deal, especially when there's no flush draw.

So the big blind folds. And on the turn is the queen of clubs, and he bets 30. OK, so this is sort of a tougher decision now than the flop, I'd say. So let's analyze this. So he bets 30 into 47, we've got 180 behind, which is about four times the pot, and we've got a pretty bad hand right now, but we still have a pair, and we have lots of chances to hit a straight, or hit a flush, or hit three of a kind or hit two pairs. So tons of outs-- tons of river cards that help us.

And so what are the benefits of each? OK, so I think it's fairly clear we're not going to fold here with this much equity. So what are the benefits of calling? Well, we get to see the river for sure, right? If the river's a club, then we don't want to fold in situations and not see the river when it could be a club, which is the best card for us, essentially. Yeah, so we really want to see the river because if we raise, then maybe they could reraise all-in, and then we would

have to fold. So that's one clear benefit.

And another sort of benefit is, we already have a pair to start with. So we don't really need to bluff to win a hand. So this is something I've been talking about a lot, too. If you don't need to raise to win the hand because you already have a pair, then there's a lot more incentive to call. So what are some benefits of raising? Well, if you get him to fold something like pocket jacks-- if we think he might have like pocket jacks-- it can definitely get him to fold some better hands. And we can bet the river and win a bigger pot when we hit. And we can also maybe make some bigger bluffs when we miss.

So we'll go through a more detailed analysis in a bit, but I like calling in this situation. I think with a draw that has no showdown value, like say I had nine-five of clubs instead of eight-seven of clubs, which has a pair, I think I would raise for two reasons. One is, I would need to bluff the river anyway if I miss the river. So if I raise now, I just give myself a chance to win the pot right now. And another benefit of raising is that I can-- I'm not that unhappy if he goes all-in because my jaw is less strong than eight-seven of clubs is.

OK, and then maybe with a hand like ace-jack of clubs, I would raise just because we can maybe get it in against weaker flush draws. OK, so yeah, this is a general principle that I haven't really talked about for playing on flops and turns. And this sort of goes along with most of the stuff we've talked about in this class but, in general, when you have like the stone-cold nuts and when you have weaker draws, you want to be the one-- you want to be betting and raising in a way such that your opponent gets the last bet in.

So one person is always going to go all-in first, right? If you're raising each other or betting and raising, one person is going to go on first, and the other person, basically, has to decide whether to call or fold and play for your stack. So if you have the stone-cold nuts, then you want to be the person having your opponent go all-in first. Because obviously, you have a very easy decision. You just call and you're going to win.

On the other hand, if you have like a weaker draw, which is, essentially, your bluff-- because we don't want to be bluffing with absolutely nothing. We want to be bluffing, basically, with our weaker draws. That's also an easy decision because if, let's say, we have a gutshot straight draw. So we have four outs only. We're not that sad if our opponent goes all-in on the flop or all-in on the turn. We just fold. We have an easy decision; whereas if we have a more vulnerable good hand-- like you have top pair with a medium kicker, then it's a tough decision.

If our opponent goes all-in, we have a tough decision. We're not sure what to do. And same if we have a stronger draw-- like say we have a flush draw, and we have nine outs, and then our opponent goes all-in on the flop, and we have like 1.61 odds to call or something. It's a difficult decision. And so in these hands, you definitely want to-- you generally want to bet and raise in a way that allows you to get the last bet in. Because with a stronger draw, your opponent gets to make a decision.

But even if they have the nuts, you still have nine outs. And with a more vulnerable good hand-- I mean, if your opponent has the nuts, I guess you're kind of dead, but you're sort of protecting the times you go all-in with your stronger draws. So following that principle, I decide to just call here because if I raise, then I have to make a decision when he goes all-in-- whether to call with my medium-strength hand and pretty good draw.

OK, so we call, and the river's an ace of spades. So we completely miss, and our opponent checks to us. So we decide to bluff the river for 70. And this is sort of the main decision I want to analyze, and it's going to be quite a complicated decision. So let's do some quick analysis. So yes, we do have some chances of winning with our pair of eights. So maybe you can make a case that there's no need to bluff because we do have a pair, but there's a lot of reasons to bluff.

So one is, there's a lot of higher cards on the board now. The pair of eights-- they looked pretty good on the flop, but now it's a lot worse after a queen turn and an ace river. So we can get him to fold a queen. He can have a queen, and he could very willingly be able to fold it. Also, the pot is big. They bet the flop and the turn, and we called the flop and the turn. So both ranges are just very strong because so much money has already gone in. So a pair of eights is not so good.

If you knew that he had two random cards, sure, a pair of eights will win a decent percent of the time. But when you know you're up against a hand that was willing to bet the flop and bet the turn, it's less likely the pair of eights is good. And then, the ace is always a scary card. And another advantage of bluffing is-- this is why position is so great-- especially when it's deep stacked in a cash game. We're in position, and we know that he checked the river. So maybe he's trapping with like king-jack, but it's more likely than not that it's a sign of weakness that he checked the river. So we could try to bluff him off his hand.

OK, so what about river bet sizing? So okay, so one thing is whether the bluff. Two, is if you

bluff, how much do you bet? So I decided to bet 70 into 107. And so what are the things to consider when you're deciding your river bet sizing? So one is, there's no more cards to come on the river. So in some sense, there's less of a worry to betting really, really small, because there is no such thing as letting your opponent see a draw. But it still has a disadvantage. Like if your opponent checks to you and you bet small, it still does give them the option to check-raise.

So that is one thing you worry about if you're trying to bet really small. And another thing is, you should bet big if your hand is polarized. By polarized I mean, you either have the stone-cold nuts or you have a bluff. Basically, if you bet small and your range is polarized, your opponent can just call with a very wide range of hands because their odds are too good. By betting big, you give your opponent worst odds to call, and since you have a stone-cold bluff some percent of the time, you don't want your opponent to have the odds to call with like third pair.

OK so, it doesn't matter what they did, because our decision is betting 70. OK, so now what I sort of want to do is, a lot happened this hand, right? We know they raised the preflop, bet flop, bet turn, checked river. So in some sense, we have a ton of information. So in the tournaments that you play, maybe a hand like this doesn't show up that often because often it's just an all-in preflop, and you can't really deduce that much about your opponent's hand. It's just like, he has the top 30% of hands or something.

But here, we can actually do a lot of deduction. So let's replay the hand from our opponent's perspective and sort of exploitatively put them on a range. So let's go put ourselves in our opponent's shoes and consider all the actions they did. So I'm going to use exploitative analysis here.

So there are some flaws with this. We are sort of arrogantly assuming we're one step ahead of our opponent-- we can build a mathematical model for our opponent. But still, this is a useful exercise even though, yes, there are flaws. Maybe he's one step ahead of us. Maybe there's flaws in our probabilistic model. But let's just assume for the sake of the exercise that we can do this pretty well.

OK, so first of all, preflop, what's our opponent's range? Let's just say, roughly, he's opening from the cutoff. Let's say he's opening about 30% of hands. I think that's about reasonable for like an average player, and I think it's consistent with the guidelines I gave in the first lecture.

So this includes any pair, any suited ace, any two Broadway cards, which are cards 10 and higher. It includes suited hands as bad as five-three suited. This is maybe one difference between cash games and tournaments, where five-three suited is a pretty bad hand in tournaments when it's so short; but when it's 100 big blinds deep, a hand like five-three suited is a lot better than a hand like 10-8 offsuit.

So yeah, so it includes five-three suited, but not like nine-eight off or like king-seven off, which are just terrible hands when it's 100 big blinds deep. So OK, so what's our opponent's range here? So they decided to continuation the bet. They continuation bet into the flop against two players after the big blind check.

So what can we put him on? OK, so this is a complicated analysis, and you can't really do this during the game itself, but it's very useful to do it after the hand. So let's review the factors of why a player would continuation bet and then consider why he continuation bets.

OK, so this is also sort of a review class since the last class. So what are the incentives for continuation betting? Well, your hand is good enough that it beats most of their calling hands. So you're betting for value or your showdown value is poor, but you have some equity. You have some backdoor equity. You have some overcards or draws, and you're, essentially, bluffing. Another incentive is, you're out of position like he is, and it's not like he can see a free turn card by checking because I can still bet if he checks. So you want to bet-- few opponents, you want to bet.

Incentives against continuation betting-- one is, your hand is so dominant that you need to give him a turn card to hope that he improves. So this is like the trap-- the slow play. You have decent showdown value, but not amazing showdown value-- so like, middle pair.

You don't want a continuation bet if you have like zero equity on a reasonably dry board like this one. And there's too many people for you to fold out or-- like you're in position, and you can see a free turn by checking. So there's a lot of things but, still, let's look at the situation again keeping some of those factors in mind.

He continuation bet into 10, eight, six rainbow, which means three different suits. OK, so actually, before I show this slide, I'm going to use the annotate feature, and we'll try to write on here what hands we think he can have. So this is going to take a while, but I plan on spending the next 20, 25 minutes discussing this hand.

OK, so does someone want to say a hand that you think is in this range at this point in the hand? Pretend we don't know what he's going to do on the turn. Yeah, just at this point in the hand, can someone tell me a hand you think is in his range? Yeah?

AUDIENCE: Ace-jack.

WILL MA: OK, yeah, ace/jack. OK, I think that's reasonable. It's actually, I think, a bit weak. But let's say like ace/jack suited with a backdoor flush draw. OK, I'll write down ace-jack for now. OK, so someone go and tell me another hand. Yeah?

AUDIENCE: [INAUDIBLE] pair. Maybe 9-10, 10-jack suited? Ace-10?

WILL MA: OK, ace-10-- sure, jack-10-- 10-9-- OK. Someone want to tell me another type of hand maybe? Yeah?

AUDIENCE: [INAUDIBLE] pocket jacks?

WILL MA: OK, good. Pocket jacks, yeah. So that's a clear value hand. Someone want to tell me another type of hand?

AUDIENCE: What about queen-jack?

WILL MA: Queen-jack. OK, that's a good idea. Yeah, that's a good one. So Queen-jack I think is one of the best draws-- not the best draw-- what is the best draw, would you say?

AUDIENCE: Queen-jack of clubs?

WILL MA: Queen-jack of clubs, yeah, but queen of clubs only-- it's not the best straight draw, right? Yeah, what's--

AUDIENCE: Jack-nine.

WILL MA: Yeah, jack-nine. Jack-nine or queen-nine. I wrote some hands here. OK, jack-nine, or queen-nine, or like five-seven. OK.

AUDIENCE: One pair of sixes. Is it possible?

WILL MA: Pocket sixes?

AUDIENCE: Yeah.

WILL MA: Yeah, yeah, OK, that's good. So I'll write that down. So pocket sixes, good. OK, here's a question, what do you guys want to put him on if he has a really, really good hand? So this is open ended. I didn't come with a [INAUDIBLE]. You guys want to assume that he checks with pocket 10s and like nine-seven-- basically the absolute best hands on this board to trap us? Or do you want to assume that he bets? Yeah?

AUDIENCE: I think if he has nine-seven, he'd probably bet because someone might get a better straight if he doesn't bet.

WILL MA: OK, yeah that's a reasonable assumption. I think it can go either way with nine-seven and like pocket 10s-- depending on our opponent. Pocket sixes, I think, is a clear bet, whereas pocket 10s is not. Because pocket 10s-- you're taking away so many of the top hands from your opponents, whereas pocket sixes just gets so much value when you bet. OK, so roughly speaking, I sort of categorized all the hands he could have into five categories.

So the first-- the top is hands that are so good that he checks to trap or check-raise. The second category is like the hands that are good but not that good-- he value bets. Then it's like medium-strength hands that he checks to check-call. So this doesn't agree with exactly what we wrote, but that's OK. But this is just roughly-- and then the next category is hands that he bluffs. And then the last category is hands that he just check-folds because they have no equity-- like pocket threes, where he would just give up the hand.

So we basically crossed off these three categories because with these three categories, he would check, whereas the top one, he's checking to trap; the second one, he's checking for a showdown; and the last one, he's checking to give up. And then the two types of hands he's betting are, essentially, value bets and like draws or bluffs. OK, so now let's consider the situation on the turn.

OK, so once again, let's consider his incentives first for betting again on the turn. Sorry if this is a bit hard to read. Maybe I should do it on notepad so that the annotate isn't annoying. Sorry, just give me a sec.

OK, so what are the incentives for betting again on the turn? So one is, you bet a good hand for value on the flop, and your hand is still good on the turn. So you're getting for more value. Two is, you bluffed a speculative hand on the flop and now you either hit the turn-- like the queen helped you-- so like if you had jack-nine or you improved your draw-- or like an

overcard to the board came, which was the case, and maybe you thought bluffing the turn could be good.

So OK, so he bet the turn. OK, so let's maybe put the hands we think he could have into PokerStove. So yeah, I think that's the easiest way to do it. OK, so let's do this. OK, so roughly speaking-- can everyone see this? This is easy enough to see, right? OK, so let's do this. So bear with me. This is a meticulous exercise.

OK, so let's say preflop, 30%-- OK, this is about reasonable. Actually, let me give him a few more pairs. I'll take away ace-six off. Let's say he goes suited connectors down to five-four suited, suited one gappers down to five-three suited-- suited two gappers.

So suited two gappers means suited cards that are three apart, essentially. Yeah, you have like eight-five suited, something like this. Something like this is fine, probably, but let's say he plays 10-6 suited. OK, something like this-- maybe take away some of the worst offsuit hands. OK, so something like this. OK, good. So on the flop, what happened? On the flop-- we said, OK, so let's eliminate hands. What can we eliminate? So this is his entire range of possibilities, preflop.

OK, so on the flop, we're going to eliminate pocket twos, threes, fours, and fives because he just gives up. Pocket sevens and nines we're going to eliminate because we're going to assume he checks. Five-three is bad enough we can assume he gives up. Let me just display the flop so that we can see.

OK, so what else? OK, so let's go through everything. I'll deal with this a bit fast. OK, let's say all the middle pairs-- he's going to check. So I'm going to remove most of the hands with an eight in them-- yeah, so ace-eight, king-eight, queen-eight, jack, OK, so 10-8 he's going to bet.

AUDIENCE: You do that just because you have an eight?

AUDIENCE: Pretty much.

WILL MA: Yeah, so we will take that into account. But he could still have an eight, right? But yeah, you're right. It is less likely, and we will take it into account at the very end. So ace-five, let's assume-- let's assume a lot of these offsuit aces, he gives up because even with overcards but with no backdoor flush draw on a dry board, I think is kind of scary. OK, so let's say something like this on the flop-- eight-five, let's eliminate that. Eight-seven, I think he'll check. So nine-seven, we're going to assume he bets.

Let's assume he checks pocket 10s. Let's assume he also checks some of the weaker 10s-- like jack-10, let's suppose he checks. Maybe 10-9, he checks as well. 10-7, he checks. OK, nine-eight he checks. OK, am I missing anything? Did someone see something you disagree with? King-queen off, king-jack off-- I think those are too weak, too-- that end of this board-- queen-nine, king-nine suited, ace-nine down here.

OK, I think this is roughly-- it'll get easier on the turn, basically. OK, So let's say this is what he's going to have on the flop. Actually, some of these weaker aces probably should be eliminated. OK, let's eliminate everything down to ace-five and below. Ace-seven and ace-nine we'll keep in because he has a straight draw. OK, so on the turn, he bets again. So did someone want to suggest a hand that maybe we should eliminate because he bet the turn? Yeah?

AUDIENCE: Only weak 10s, I guess?

WILL MA: OK, good. Yeah, I think that's a very good answer. So let's get rid of ace-10 and king-10 because those are no longer good hands-- or they're no longer, I think, hands that you want to really continue betting for value, right? Queen-10 is good because you hit two pair. OK, is there another hand that's of a similar category?

So I guess pocket jacks is of a similar category, right? It's not as good as it once was. OK, so what are some other hands maybe you don't want to bluff with-- you don't want to bet with anymore? Are there any hands you think maybe he would just give up because--

AUDIENCE: The six-five.

WILL MA: Yeah, I think that's reasonable. Most of these, we can assume he's going to give up on the queen, like five-four, especially. So on the flop, he didn't even have a great hand. It was just drawing to a seven. But now, it's sort of worse. So yeah, let's get rid of five-four. Do you think they would continue betting like nine-six or seven-six?

Yeah, even seven-five is a pretty bad-- is a lot worse after the queen because seven-five was like drawing to a nine. But now, when the queen comes, the nine is not a good card because you still lose to a jack. So maybe we can get rid of that one. Do you think they definitely continue betting with ace-king, ace-queen, ace-jack in all those? Yeah?

AUDIENCE: Maybe if they had ace-queen, they would keep it [INAUDIBLE] pretend to [INAUDIBLE].

WILL MA:

Yeah, so ace-queen, I think, is good. All right, so I think this is [INAUDIBLE] good. Ace-nine-- some of these hands, I think they would probably stop bluffing with. Like I think jack-seven suited is pretty-- maybe some of the sixes also, I think, it's hard to-- even like ace-seven suited, I think it's hard to continue bluffing. Because as we see, there's already enough hands with draws, right? There are already a lot of bluffs here like king-jack, ace-king-- I guess like queen-nine, nine-six, some of these-- so yeah, maybe he'll bluff with these, but OK, let's get rid of these. OK, so we've sort of cut down his range a bit. So now it's a river situation, and he checks. So what does this mean?

Well, it seems improbable that their opponent would be trying to trap us with this check because he's already been showing plenty of aggression. So it's hard for him to pretend he suddenly has a bad hand by checking. And with the pot already so big, he can get a large percent of our remaining stack into the pot just by betting instead of check-raising. So it seems like it's less likely he's checking as a trap.

And also, the ace is sort of a better card for his range than ours because he's the one who's been betting, so having draws, having overcards like aces-- and for us, we're much less likely than him to have an ace. So if it's a better card for his range, he should be betting both for value and with his bluffs. So that being said, so let's suppose we assume it's sort of unlikely he has a really, really good hand, but he could so easily have a hand that beats ours and calls our potential bluff. So OK, so now let's go back to PokerStove and eliminate some more hands. OK, so what are some hands we can eliminate after he checks the river?

AUDIENCE:

Aces.

WILL MA:

Aces, yeah. I think that's a good one. I think aces, pretty clearly, he'll bet again on the river. What's another hand?

AUDIENCE:

King-jack.

WILL MA:

Yeah, king-jack I think he might. OK, so let's eliminate all other good hands that we think he's going to continuation bet, right? I think with any straight, I think it's reasonable to assume they're just going to keep betting. Like nine-seven-- even though it's nowhere near the monster it was on the flop, it still only loses to jack-nine and king-jack. So let's get rid of that one.

AUDIENCE: Certainly like ace-queen-- all those.

WILL MA: Yeah, I think most strong two pairs I think, definitely, he'll keep betting. So let's get rid of that. Let's get rid of ace-queen. Let's get rid of queen-queen. Let's get rid of queen-10. I think queen-10 is good enough. Ace-eight-- let's get rid of that one-- yeah, that's good enough. Pocket eights, pocket sixes I think is good enough. OK, good. So OK, we've got some hands here-- basically, all the good hands we removed-- all the really good hands that he bets again.

What do you guys think about 10-8? I guess it doesn't matter too much. Let's assume he checks 10-8 because by this river, 10-8 is no longer the powerhouse it was. Oh, I've got to get rid of jack-nine. OK, what are some other hands you think we can eliminate? So there there's actually another category of hands we could, potentially, eliminate here. Yeah?

AUDIENCE: He would probably bet an ace.

WILL MA: Well an ace isn't that good of a hand. So this is one problem with this analysis is, it is very subject to debate what we think about our opponent. But for the sake of this exercise, I'd say-- I mean also I think in practice-- I think it's not clear that you should value bet an ace here. Because there's just a lot of stuff that beats you-- a lot of straights, a lot of two pairs. I think that even if you have a ace-king, you shouldn't really be confident enough in your hand to bet. Like maybe ace-king is marginal but definitely not like ace-seven. Yeah?

AUDIENCE: Bluff bets-- so like weak hands, maybe six-four.

WILL MA: Great, great. Yeah, exactly, so that's what I wanted to hear. So we can also eliminate some of his really weak hands. This is crucial. This is an easy thing to miss. We can probably assume he's not going to have king-seven because the ace is a reasonable card to bluff. It's not great-- it's not like the ace of clubs, which would be a better card for him to bluff, but if he's got nothing-- like if he just completely missed-- probably-- I mean, let's assume you know these guys are pretty good players. He's probably going to bluff. So let's assume he at least has a pair. He has some showdown value, because if he had zero showdown value, he would have bluffed.

So let's get rid of king-seven, let's get rid of king-nine. Six-five six-four-- I think, definitely, he should be bluffing, but maybe some players will see a pair of sixes and say, oh I have enough showdown value. So let's get rid of one of them but not the other. Maybe that's reasonable. So let's get rid of two. So let's get rid of six-four and seven-six but keep in six-five and nine-six. OK,

so we leave ourselves with these.

OK, so this seems about reasonable, I think. Let's eliminate ace-seven. I think we should have eliminated it on the turn. Maybe like ace-seven of clubs we can-- oh no, ace-seven of clubs he can't have because we have the seven of clubs. I think any other ace-seven other than the ace-seven of clubs is kind of bad to bet on the turn because the seven isn't really that good of a card to-- isn't that good of a draw. So let's get rid of ace-seven. So let's just suppose it's this. OK, so that was a lot of work.

OK, so now roughly speaking, we can conclude his range on the river is something like this. So let's assume that he's going to call with top pair or better. Once again, this is a pretty strong assumption, but let's suppose this is the way we think he's going to play. He's going to call if he has an ace or better and fold other ones. So we're risking 70 to win 100. So let's do an exact calculation now of how many combinations of these hands. I'll do this on Notepad. OK, let me pull up the board. OK, hopefully, people can see this.

So when I said combinatorial hand analysis, I mean we're going to, basically, count the combinations. And like you pointed out, this is-- oh crap, did I accidentally get rid of that? Oh, that's not good. OK, let me quickly put it back. So OK, we had kings left, ace-king, ace-jack, ace-nine, king-queen, queen-jack, queen-nine, what else? 10-8, 10-6, eight-six-- we had some sixes, right? Seven-six, six-five-- and is there something else I'm missing? Does anyone remember if there's something I'm forgetting to check off? I knocked queen-nine off, I guess. I think this about right. Maybe I'm missing like one or two things. No one sees anything? I think this is approximately what we had, right?

OK, hopefully I didn't miss enough that it drastically changes. It shouldn't. OK, so let's count the combinations. Because you can look at the square on the PokerStove and-- let me clear this annotation-- sorry, I should've done that a while ago. OK, so you can see the yellow hands on the square and roughly see how many hands of each type. There's, essentially, three types of hands he could have. There's hands that call, there's hands that beat us and call, there's hands that beat us and fold, and there's hands that we beat and fold.

But the thing is, if you just look at these yellow squares, it won't give you the right probabilities because we have certain cards in our hand. And also, because of the specific ways suited combinations work, there's different combinations of each hand. So OK, let's go through this. So how many combinations of ace-king suited are there that-- so we assume he had a

backdoor flush draw on the flop, but-- so how many combinations of ace-king suited are possible?

Don't worry about the backdoor flush draw part. It doesn't matter for this example. So how many combinations of ace-king suited, Will? Three. Because it has to be suited. And it can't be spades because the ace of spades is on the board. So it's three combinations. OK, ace-jack suited?

AUDIENCE: Three.

WILL MA: Three, OK, good. Ace-nine suited?

AUDIENCE: Three.

WILL MA: Three. OK, good. All right, pocket kings?

AUDIENCE: About six?

WILL MA: Right, so pocket kings is six. Because there's no kings; we don't see any kings, and there's no such thing as suitedness. So yeah, so one thing you realize in this-- oh, so pocket kings we're assuming he's going to fold-- one thing you will realize in this exercise is, you've got to put a lot of weight on the offsuit hands instead of the suited hands. Because the offsuit hands, combinatorially, have way more possibilities-- essentially three times as many possibilities-- as the suited hands.

So like this queen-jack offsuit in here has a huge weight in our calculation. That's by far his most likely hand. Because it's the only offsuit hand we're putting him on. Yeah, it's the only offsuit-- is it really only the offsuit hand that he could have? I guess according to our analysis, we're assuming the only offsuit hand he could have is queen-jack off. So how many combinations of queen-jack off are there?

AUDIENCE: 12.

AUDIENCE: 12.

WILL MA: OK, so let's just say queen-jack in total. Queen-jack suited plus offsuit is 12. Because we see a queen, so there's four jacks, three queens, three times four is 12. It could be suited or not suited. So OK, that counts for both of those. What about king-queen suited?

AUDIENCE: Three as well?

WILL MA: So it's three as well, but I'm going to put it as two because I can assume if he had king-queen of spades, which has no flush draw-- like no runner-runner flush draw on the flop-- I'm going to assume that he would have folded king-queen of spades on the flop. So I'm going to give it two. OK, so which ones haven't we done? Queen-nine suited, how many combinations? Three?

AUDIENCE: Yes.

WILL MA: OK, 10-8 suited, these get five. So the reason why 10-8 is suited is because we're assuming he doesn't raise 10-8 offsuit preflop from that position. So that's why 10-8 has to be suited. So how many combinations of 10-8 suited? Two. OK, how many combinations of 10-6 suited?

AUDIENCE: Two as well.

WILL MA: Two. How many combinations of eight-six suited?

AUDIENCE: One?

WILL MA: One, yes. OK. I miscategorized this one. So queen-nine is in this category that he's folding. These are all the hands that call our bluff and beat us. And so the last category is the hands that we can actually beat if we check it down. So it's very small. It's just seven-six and six-five suited. OK, so seven-six suited, how many combinations?

AUDIENCE: Two?

WILL MA: Two. Six-five suited, three? OK. Did I miss anything? I think this is it, right? OK, so basically we have to tally it up. So here, there's 14. Here, there's 23. And here, there's five. OK so now that we've done this calculation, we need to, basically, run the numbers with these calculations. So essentially, roughly speaking, they're going to fold more than half the time.

So the numbers-- I think this will actually come out close because with the way we did this specific calculation, I think we gave him a lot of combinations of hands that we can actually check and beat. But I think this is still-- this will still definitely call for a bluff. But it close. If you've done the homework, the homework sort of addresses this, right? It's not just the probability he's calling our bluff, it's the probability he's calling our bluff versus the probability we win the hand by checking. And the probability we win the hand by checking is roughly 5 out

of 42-- so which is pretty small, and he folds more than half the time.

So if you run the numbers, you'll see that bluffing is overwhelmingly profitable. And I think this is a good example of why this combinatorial analysis is good-- is because if you look at PokerStove and you look at this, you might actually think bluffing is bad because you look at most of the hands-- ace-king, ace-jack, ace-nine, 10-8, 10-6, 8-6-- it's hands that call us and beat us, but when you do this combinatorial analysis, you'll realize there's way more combinations of queen-jack than there are eight-six. So looking at this itself isn't quite enough because this doesn't weight the probabilities of each one correctly.

So this is a good exercise to do, I think. Even though we made a lot of assumptions in our model, but it's a very good exercise to do after the fact to sort of just analyze what are the different-- all the different possibilities. OK, so I'm going to take a quick break here.

And then for the last half of the class, I'm going to just talk about some general poker topics. So no math. No poker hands. But just some general stuff about poker and some ending remarks since this is the last time I'm teaching since Bill Chen is coming next time. If you want to, during the break, think about any question you might want to ask me about poker in general-- or specific-- and-- yeah-- so we'll take like a 10-minute break. Make sure you hand in the homework.

All right, so I'm going to wrap up with some general thoughts about poker and poker in general. So one question that I get asked a lot is, it's called the Moneymaker effect. So what happened-- and this is sort of a big catalyst for poker becoming really popular-- was, I think in 2003, Chris Moneymaker, that's actually his name-- Moneymaker is his last name-- he spent like \$1 playing in this satellite on PokerStars, won a seat to the World Series of Poker main event, and then went there, and then won the whole thing for like \$2.5 million. It was a beautiful Cinderella story, and then people heard this.

And also, they made it seem like, you know, it's not like the lottery where you've got to get really, really lucky to become rich. It's literally, this guy's really smart. He can read people, and it's all skill. And he did this. And it's sort of like, anyone can become a poker star just like Chris Moneymaker. And this was a huge driving force in the popularity of poker.

So a question that I wondered myself is, how could there actually be so much money? Because someone has to be losing this money for you to be winning this money, right? So where is the money coming from? Can anyone smart and motivated succeed in poker? Et

cetera.

OK, so what's unique about poker? Why can't you make this much money playing like chess or something? Why can't you make this much money playing hockey? So what's unique about poker? So I guess four unique aspects that allows for there to be so much money. So I'm going to talk about them individually.

One is, I think everyone is overconfident, myself included. Two is, gambling self-control-- aspects of that. Three is, it's a very fast-evolving game. And four is, what I sort of started the class-- the very first class I talked about being credit card roulette-- not being results-oriented. And I think that's very hard.

So I'll go through each one of them separately. So yeah, one is this huge overconfidence thing, which is very prevalent. So it's normal, in general, for people to be overconfident. I don't know how many of you have seen the experiment where it's like, you know, write down your 95% confidence intervals for all these things. So if they're actually 95% confidence intervals and they're correctly calibrated, then actually 19 out of 20 of your intervals should contain the real thing.

But like you do this for a normal person, it'll be like, 30% of their things actually lie neutral. So they're just drastically overconfident. And so yeah, it's normal to be overconfident, but especially in poker. I think poker is among the things I know where it's easiest to overestimate your own abilities. Does someone want to suggest any others? Is there something else you think where like, everyone thinks they're good at this thing?

So I can think of two examples that I think are sort of true. Raise your hand if you think you're a below medium driver. No, but some people actually are willing to do it. Because I very rarely talk to someone who admitted to being bad at driving. Everyone I've ever asked about their driving skill thinks they're really good at driving a car, myself included. I definitely don't think I'm a below medium driver. Another thing is teaching. I've also barely talked to someone who thinks they're worse than medium at teaching. I guess maybe Professor [INAUDIBLE] can speak about this.

Most things someone will admit to being bad at this, but poker is similar to these two examples I thought of-- driving, teaching, sort of. Where it's just very easy to think you're really good at it, and it's hard to admit to yourself that you're not good at it. Yeah, so one saying in poker is, if you can't spot the fish at the table-- the fish is like the losing player that everyone is trying to

win money from-- then you are the fish. This is sort of a popular saying.

So why is overconfidence so common in poker? It's like a mental battle. Your mentally battling against your opponent. Is he bluffing? Is he not? And it's just easy to always assume-- which I do throughout a lot of this class, right? I talk about exploitative play. I'm building a model for our opponent and assuming that they behave as a probabilistic machine according to my model. I'm assuming that I'm ahead of my opponent. I'm assuming I'm better.

There's also a lot of selective memory, I think. It's easy to remember your bad beats-- the time they hit a king on the river and beat your aces-- and it's easy to forget the times you got really lucky on the river and beat them. So selective memory, I think, is a big aspect. I think lack of clear benchmarks is a big aspect as well.

So it's not like running 100 meters. No one who takes 30 seconds to run 100 meters is going to think, oh, I can compete in the Olympics, right? Because it's very clear. There's a very clear benchmark how fast you need to be.

But in poker, even if you don't win tournaments, it's easy to complain about luck. And there's different types of tournaments. And it's easy to like bend the benchmarks in a way to convince yourself that you're better than you are. It's easy to hit a lucky streak and consider it all skill, and you can blame all your losing streaks on luck. So those are some reasons I think. I think poker is just a very well-designed game for this purpose and to, basically, tricking and deceiving people into overestimating their own ability.

And another aspect of it is, and this is what's really tough poker, I think, is, even though it's so easy to be overconfident, and it's such a flaw to be overconfident, it's also, in some sense, necessary. You know, if you're not confident, how can you take risks? Poker-- you're gambling, essentially, and you have to do risky things. And if you're not confident, how can you do risky things, right? And also, if you're trying to mentally read your opponent, if you're constantly remind yourself that you're dumber than you think you are, then how can you actually think that you can outread your opponent?

And I talked about this results-oriented. You need to be confident to trust that you made a good decision even though your result was you lost \$10,000 on the day. So confidence is also necessary, but it's also so easy to be overconfident. So this balance of being exactly the right confidence is something that I think even like professional poker players strive to try to strike

the balance between every day. And I think it's very tough. And it's something I struggle with a lot, too, to try to figure out when I'm being overconfident and when I'm being underconfident.

So I think one good mentality-- so back to this driving thing is, I think it's a good mentality-- you know, if you play poker and you enjoy it. I think it's a great game. It's a beautiful mathematical game and a fun game to play with friends if you're just willing to admit, you know, I play in this home game every Friday night. I'm probably a below average player. I probably lose, on average, \$10 every time I play. I think that's totally fine. It's just like spending your Friday night going to see a movie. You pay \$10 and you're happy to take \$10 out of your wallet and not see it again, right?

I think it would be a healthy mentality for more people to be willing to do this and just admit to themselves, yeah, I enjoy playing poker, and I lose a bit of money, but you know, I have fun doing it. And it's the same as seeing a movie but, in reality, I think this isn't the case. Even at these friendly Friday night games for low stakes, probably, if you ask all the people there, do you think you're beating your friends? Everyone's going to say yes.

Everyone's not saying, oh, I'm going there, essentially, paying \$10 to play poker with my friends. Everyone's saying, I'm winning a bit of money or whatever, right? So I think that's an important mentality to try to have that. And I think it's fine. You don't have to be the best at everything, right?

So one story I like to tell is, so David Einhorn-- he's like a billionaire. I think he founded Greenlight Capital or something. And he actually won \$4 million in a \$1 million buy-in poker tournament and donated it all to charity. And after the fact-- he's always like a super smart guy-- so he played a \$1 million buy-in tournament.

So everyone else playing this tournament is like a poker professional-- the best in the world-- and he's just like this rich billionaire who doesn't really-- like he wasn't bad, but he just started playing poker. Like, he's a smart guy, and he got coaching to play it, but he was the clear loser in the tournament. And he just admitted it. He just said you know, I'm a billionaire. I'm happy to spend a million dollars playing this tournament. I understand I'm probably expecting to lose like \$200,000 or whatever playing this tournament with all these guys, but I'm fine with it. I got a million dollars, who cares, right? And he was just very honest.

And even after he actually won \$4 million, he didn't come first, he came like third-- he just admitted, you know, he said like, I was very lucky. I came in expecting to just lose this \$1

million that I don't care about, and then he just donated all his winnings to charity, anyway. But I wish more people were like him. I think that's a very good mentality to have to just admit that you're playing poker for fun, and that's totally fine.

OK, so the second thing I want to talk about is gambling self-control. So I think this can also be the downfall of a lot of smart and motivated people trying to get into poker. So these are some things that can happen. So after getting unlucky in the previous hand, you play the next hand poorly because you're upset. You're tilted, as poker player say.

Or playing when you're tired just to get unstuck. I've definitely done this many times before in my poker career. If I lost money, especially when I feel like I'd gotten unlucky playing against someone who I'm better than and just like, I've lost money because I got unlucky, I won't stop playing until I get unstuck, which is like, win back the money I lost until I'm in the black, essentially. And it's terrible because even if I'm a bit better, if I'm playing with this mentality trying to get unstuck, I'm just going to be making below average decisions, and it's just not a good thing to do.

And also from the other side, it can be hard to rationalize gambling. So it's hard to stop yourself from gambling too much, but it's also sometimes hard to rationalize that, you know, gambling-- there is a lot of stigma around gambling. You have to convince yourself that, I shouldn't be too scared.

I'm playing this game that involves-- you know, you can call it gambling-- I'm playing this game with a lot of luck. And you've got to convince yourself that, this is what I'm fine with doing. It's like a lottery. And you've got to sometimes make decisions under pressure as well. And you've just got to rationalize to yourself that, yeah, there's a lot of luck in this, but this is the game I chose to play.

The third thing is-- so fast evolution, I think, is another big aspect of how there was so much money in Texas hold 'em for so long. So it was a relatively new game, also with a lot of hidden depth. So something like this can never happen in chess, where chess has been studied for hundreds, thousands of years, and it's not like a new game. And even though the best player today is still better than the best player 20 years ago, it's not like the game is evolving super fast, whereas hold 'em was like a new game-- a relatively new game at the time. And just-- there was so much hidden depth, and the best players just kept improving so fast that-- so like you say, like the best player in the year 2000 would be like a terrible player by 2004. And like

the best player in 2004 would be a bad player by 2008, et cetera. So it's just, even if you're on top of the game right now, if you stop studying, you're going to be nowhere near the top of the game in like a year. So it was just so fast. Can anyone else think of other examples of things that are kind of like this?

AUDIENCE: CrossFit was-- well, if you get like-- the winner of the 2009-2010 games wouldn't even compete.

WILL MA: Oh, wow. OK I didn't know that. That's cool. I didn't know CrossFit was that good, yeah. That's pretty crazy. There's one other thing I can sort of think of. How many you guys have done math contests as a kid? I think those, to my knowledge, have gotten a lot harder, just in terms of how good you need to be to say, be on the United States national team is way harder now than it was, say, 30 years ago from what I've heard.

But yeah, so this aspect of Texas hold 'em-- so this was also a huge driving factor. Because it would be easy to tell yourself, I was the best player in the world four years ago. I could obviously sit down at this \$1/\$2 game and make money, right? And the answer would often be, no.

So this was another reason why there was a lot of money in it. Because it's easy to just remember that you were the best a year ago and just forget that the tides are rising so fast. So that being said, so I wanted to also take this opportunity to suggest some further readings for-- I know I've been asked this. Yeah?

AUDIENCE: So why is that? Based on your understanding? I think because of your strategies-- you have to improve your strategy?

WILL MA: Yeah, yeah, I also think there was a lot of hidden depth. So I mean, I think with any new thing, this will be the case. But I think in poker, there were many times where the consensus amongst the top players was that they were close to solving the game. And then a year later, they would realize they missed completely viable strategies that completely messed up all their calculations, and they had to start over. So I think that was big.

It's easy to think that you've solved the game and then suddenly realize, oh, I'm nowhere near solving the game because I forgot about all of these different strategies. This might be sort of true with a lot of-- I'm trying to think, I mean-- the biggest thing is, it's a new thing. Like it's hard for this to happen like-- I think in most sports that people have done for a long time, people get

gradually better, right? You look at like, the 100-meter sprint. It's like, yeah, the world record is getting broken, but it's not like it's going to go from 10 seconds to five seconds. It'll go from 10 seconds to 9.99 seconds or something like that.

So I think just the fact that it's new is a big aspect. But yeah, Texas hold 'em would be the equivalent to the world record in the 100 meters being 10 seconds then like five seconds a year later, then like two seconds like two years later, it was just insane. OK, so that being said, so some people have asked me, if I want to continue learning about poker and reading poker, what should I do? So that being said, I think the best resources, by far, are online.

A lot of people have asked me about books, and I will recommend some books, but I think books, basically, blew out of date way too fast. So I think, in general, the best resources are online. So cardrunners.com is a website where, basically, poker pros can make videos of themselves while playing and talking. You do have to pay to get a subscription. OK, so this is a bit of a biased advice, just a warning, because I'm a pro at CardRunners, but, I mean, amongst like 50, 60 other pros. They also donated some free memberships to students in the class if you guys looked at the prizes.

So you can get some free memberships to CardRunners. A good free resource is Two Plus Two forums. I think there's a lot of garbage on those forums nowadays but, still, most of the best poker players in the world still do use those forums and posts on those forums-- so twoplustwo.com. There is a lot of garbage and banter, but if you are just trying to improve, there is good content on there. You just have to find it.

So this is a new thing, but on Twitch streams-- so Twitch is a website you can go on to watch, essentially, poker pros play in real time. They share their screens and talk through their hands. It's a pretty good free resource. It's sometimes more entertaining than educational, but I think it's quite good. And they would do like a 10-minute delay so that you can't watch them and you know what cards they have. In case anyone was considering trying to do that to get an advantage.

So these are some online resources, and I will suggest some books, although I do think most of these books, I think, are reasonably outdated. But I do think they're very-- in my opinion, out of the books I've read, these are the best-written books. And even if they're a bit outdated, I think the theory and the way they're written is very good and also somewhat entertaining and sort of gives you an idea on the history of poker and the evolution of the game.

So my favorite book is the first one. It's called, *Small Stakes Hold 'em*. It's by Ed Miller, who's a MIT graduate; David Sklansky; and Mason Malmuth. So this is actually limit hold 'em, which is, in some sense, a solved game nowadays, and no one plays limit hold 'em anymore.

So limit hold 'em is where you can't bet any amount. You have to bet a very specific size. But I think this is one of the classic books. So this is one of the classic books in poker. It's very well written and written by mathematicians. And it just goes through the basic concepts of poker, I think, very, very well, even though it's for limit hold 'em. And it's a good read. Yeah, it might even be a collector's item nowadays.

So one story I'd like to tell about this book is-- so my good friend, Mike McDonald, he was-- so he's the guy who got me into poker. He's probably read this book, he says like-- maybe like 20 times. And then he's also a guy who doesn't really like reading. So I think there was a point in his life where he's read less than 20 different books in his life but then this specific book more than 20 times.

So it's a very good book. *Harrington on Hold 'em* is on tournaments. It's outdated. It's really, really badly outdated, but I still think it's very well written and has some good concepts. That's how I first started learning to play tournaments is *Harrington on Hold 'em* 1 and 2.

Kill Phil/ Kill Everyone I think is pretty good, pretty up to date-- it's decent, I think. *Every Hand Revealed* is-- Gus Hansen's a very famous poker player who's been around forever. So it's a book where he goes through every hand he played in this tournament that he won. And I think it's more entertaining than educational, but he's definitely a really good player. *Mathematics of Poker* by Bill Chen. It's not that practical-- don't tell Bill this when he comes Friday-- it's theoretically very interesting if you like math-- if you like game theory. It's theoretically very interesting.

Building a Bankroll is a recent book that-- this year, he didn't have any leftovers to donate to our class but, in the past, he's supported our class and donated a lot of copies of the book. And I think it's pretty up to date, and it's for cash games, so I think it's very good. OK, so back to the four things about poker that I think makes it unique.

So the fourth point is this idea of not being results-oriented. So yeah, so we talked about this a lot in the first class already-- this decision mentality, where you need to care about the decision you made, not the result you got. And I think this actually is a barrier to a lot of smart and motivated people getting into poker because it's almost antithetical.

If you're a smart and motivated person, you're used to like-- you study hard, and then you get a good result on your tests, right? If you get a failing grade in your test, you're never going to be able to go up to your parents and be like, oh, I make good decisions, but I just got really unlucky and failed the test, right? No one's going to believe you.

In poker, this can happen all the time. So it is a bit antithetical to sort of being motivated. One thing poker players like to laugh at is, I don't know if you put the word, results-oriented on your resume?

I've seen seminars that teach you to become "results-oriented," and advertising this as being a great thing. You achieve results. You work hard, make decisions, and you achieve results. But we always laugh at this. Because results-oriented is always a negative term in poker. If a poker player says someone is results-oriented, they don't respect them very much.

But I've seen resume's where people say, I'm very results-oriented. So a related thing is, it's easy to underestimate the variance in poker. And this is a big aspect, too, that goes on with being results-oriented.

So this statistical experiment involving making up sequences of coin flips-- I've heard of this where a professor would ask students to make up a sequence of 200 coin flips. Can we get half the class to do this? And then can we get the other half to actually flip 200 coins and write down like heads, tails, heads, heads, heads, tails? And he could tell with like 100% certainty which ones are made up and which ones were real.

And the way he did this is basically looking at which of the-- what's the longest sequence of heads in a row or tails in a row? And basically, in reality, if you flipped 200 coins-- I forget the exact numbers, but I think it's something like, you're like 99% to get at least like six or seven of the same thing in a row, whereas in all the made-up ones that people would be like, oh if there was heads seven times in a row, that can't be random, right? So we can't put seven heads in a row.

So I think it's known that it's easy to underestimate how long you can get unlucky looking for. Like it's easy to think, I've been unlucky the last three times; that means I must deserve to get lucky now. But this is not true, mathematically. And it's just very easy to underestimate variance and underestimate how likely it is that you're just actually going to lose 10 coin flips in a row in poker. It's going to happen to you, and you're going to get tilted. And it's very

important to control tilt.

And yeah, pretty much every poker player thinks they're unluckier than mathematically possible. I've definitely felt like this in many parts of my career. I still feel like this sometimes now. It's very easy to get this feeling where you just, how can it be possible? How could I actually lose 20 coin flips in a row? Well, it can happen.

And one of my poker players that I was talking to, John Cannon, he plays a lot of online poker, and this is actually a picture of his desk. He, basically, was so angry I think he smashed his mouse and made a big hole in his desk. So it can really frustrate you.

And I hate to say this, but I think even if you're working very hard, you do need some lucky big scores along the way, especially at the start to get into it, even if you're very smart and working in the right way. And this is also antithetical and smart. Antithetical to smart and motivated people, right? Because we want to believe that if you work hard and you're smart, then you'll make it for sure.

But I wouldn't say this is true in poker. I mean, I think I'm willing to admit that I think I was very lucky at the start. I had some big scores at the start that really drove my interest in the game and really propelled me into professional poker.

And I think there probably, in a parallel universe, could be another copy of me that did the exact same things and just didn't get as lucky as I did at the start and just never got into poker. So this fact that you do still need to get lucky, even if you make all the right decisions [INAUDIBLE] make it is-- It's sort of a tough thing to swallow.

This is sort of a different story, but I'd like to argue that that's sort of true in life, too-- the fact that being smart and working hard doesn't guarantee success by any means. So although that's a negative thing for poker, I'd like to end with what I call, "the joy of making good decisions." So even though not everyone makes it in poker, but poker players-- we like to talk about sort of, you're not really there. You shouldn't be trying to think about making money or whatever. You're sort of just there to enjoy the game, and have an honest opinion on your ability, and calibrate your confidence.

I've told the Bill Gates/Doyle Brunson story but yeah, basically, Bill Gates, I think, was a pretty good poker player for quite a while. And he would make money. And clearly, it was not his best way to make money. He could probably just go to his company and make like \$500 a second

or something like that. But when asked about it, Bill Gates would just say, I love making good decisions. I love thinking about this game and making decisions. And even though, clearly, the money means nothing to me, it's still important to me, as a personal goal, to succeed at this game and make money, even though it doesn't mean anything.

So it's about this joy of making good decisions. And I think part of the reason Bill Gates was able to be quite good was because the money meant nothing to him. He didn't really care about his results and how much he made or lost, clearly. He just focused on making the best decisions.

And so it is true that there's a decent amount of luck in poker but, yes, I would argue, life is luck, and you only live once-- there's all these sayings but, overall, the thing to keep in mind is, like Jennifer Shahade talked about this with the "Goldilocks" video-- so you want to think of your life and/or your poker career or whatever as one long session where you're just trying to make the best decisions. And even if you don't get the best results today, hope that you get better results throughout the course of your life.

So yeah, that's the end of what I wanted to say about the general poker and what I hope you take away from this class from a non-mathematical, non-poker point of view. I guess there is a bit of time for questions. There's a lot of things I didn't talk about, but I'm happy to answer questions about. Yeah, I'm happy to answer any questions, now. Yeah?

AUDIENCE:

Now that there are no longer any class tournaments, where can I go to play to get better and improve?

WILL MA:

So there's an MIT poker club, and they run tournaments on PokerStars similar to the way the class works. The way you can get into the poker club is so [INAUDIBLE] is part of it. She's like one of the execs. Maybe you should ask her. Send her an email. I can ask her. I'll ask her, and I'll send something to the class if you guys are interested in continuing playing poker on PokerStars and-- yeah, so there's the MIT Poker Club.

And I know in the past, sometimes the classes continued playing tournaments after the class is over. We would have like a tournament every Saturday or something for people to play, but I don't know if-- they didn't last very long. I think people quickly lost interest in it. But yeah, I think just the poker club. Actually, Martin, you're in the Poker Club, right? So maybe you can something to answer that question.

AUDIENCE: So sometimes we have [INAUDIBLE] games where people can play like \$0.25, \$0.50 [INAUDIBLE]. So there's like a million you can get on.

WILL MA: OK, I'll find some information from [INAUDIBLE] and Martin. I'll send something to the class, and I'll give you guys some pointers.

AUDIENCE: How do you, personally, deal with downswing?

WILL MA: Yeah, so definitely, I've gone through bad downswings and times where I really hated the game. I think I mostly just took a break. So yeah, I mostly just took a break. My first couple of downswings when I was first starting, I just took a break from the game for a while, like a month or something, and then came back. That's sort of what I did.

Nowadays, I'd say like the last four years, I've been-- I'd like to think I was fairly good at dealing with downswings. I sort of went through enough downswings where I kind of was able to just keep it together through it for the most part. Like maybe I'd play slightly less, but I wouldn't quit altogether.

AUDIENCE: So for small cash games online, what kind of edge do you think you have?

WILL MA: For small?

AUDIENCE: And then what kind of edge-- what is your like, borderline edge where it suddenly wouldn't become worth it anymore?

WILL MA: Oh, so how much edge do I think I have? So in online cash games-- the thing is, I don't really specialize in cash games, so I never really play them. So I'd say it's probably very little. I mean, I'm sure I can find low enough stakes where I'll have a significant edge--

AUDIENCE: Or even in tournaments, then? Online small stakes tournaments?

WILL MA: Yeah, yeah, so in tournaments, I'd say there's still a decent edge, and I'll play it for-- but mostly, I'd I'll play poker, mostly, for fun nowadays. I rarely force myself to do it for making money, I'd say. Most of the time I'm playing, I'm still trying to make good decisions because I enjoy doing that, but I'm not really doing it for the power degree or whatever.

AUDIENCE: So what about maybe the best cash-game player in the world, how much would they make in about \$0.25/\$0.50 online?

WILL MA:

Oh, \$0.25/\$0.50 online? So I don't have a great sense of this, but let me think. So the thing is, the players who are sort of considered the top players in the world who play like very high stakes-- like nosebleeds stakes with like \$100/\$200 big blinds or something-- it's sort of, the variance is so high that it's not really accepted who's the best because if it was accepted, you know, someone had a win rate over someone else, then the guy who was worse just wouldn't be playing.

So the only reason those games run is because they all think they have a win rate. So it's hard for me to say the number because I'm not going to know better than what they're true win rates are against each other. And they're all going to tell me something different, because they all think they're beating the other guys.

As far as how much a really top player can win at a low-stakes game, it's still going to be very significant. I think making something maybe like, five or six big blinds per 100. Yeah, five or six big blinds per 100, I think, is maybe doable at a reasonably low stakes-- if you're like one of the very best. It's quite a lot. It's quite generous.

But let's say every 100 hands you make five big blinds. So let's say you play \$0.25/\$0.50, five big blinds is \$250. You make that every 100 hands. If you play six tables, you can get in about 100 hands per hour, 120 hands per hour. So that's 600 hands per hour. So it's six times \$250; so it's like \$15.

So it's not a lot, but I mean those guys can play stakes way higher than \$0.25/\$0.50 and still have a slightly smaller edge. So if you imagine they play 250/\$5. Then suddenly, you multiply, then that'll give me about \$10. I mean you would be decreasing it because they probably wouldn't make five big blinds per hour-- five big blinds per 100. But I think those numbers are ballpark correct, yeah. All right, yeah?

AUDIENCE:

What's a good for playing at a casino, like exploiting people?

WILL MA:

What's a good strategy for playing at a casino and exploiting people? One general thing that's going to do is, you go there-- you sleep at night, and you go there at like 7:00 AM and play against people who have been tilted and angry for--

[LAUGHTER]

And you just woke up at 7 AM in the morning. And you're in such a good mood, and they're all in a bad mood, and you can win a lot of money. In terms of specific strategy, I think it depends

a lot on the player. I think, in general, playing tight is pretty good. At least I'd say I consider myself, in general, a tight player, and I think a decent amount of money can be made at casinos against recreational players just by them getting bored.

Like at a nine-headed table, you're only paying the blinds-- 1 and 1/2 blinds every nine hands. You can easily get away with only playing like pocket nines plus, ace-queen plus. I mean, that's extreme, but they'll probably still call you because they're bored. They're not going to think like, this guy's-- I'm going to just fold-- so one disadvantage of that strategy is, they're just always going to fold to you. But in practice, I don't think that's what happens. So I think, in general, playing tight will always be a pretty good strategy at casinos against recreational players.

AUDIENCE: Yeah? Do you have any advice for avoiding this pitfall of thinking you're good and you're not actually?

WILL MA: Not really, because I think it's happened to me a lot of times. Yeah, I think it really is hard to judge, especially in tournaments. In cash games, it's slightly easier to judge because you can just look at your data points, and it'll converge faster. In tournaments, the variance is so high you can't really use your tournament results. I think the most important thing, for me personally, was just talking to players and having very honest friends who would tell me if they thought I was worse than someone else and tell them not to play them.

And I think that's probably the thing that benefited me the most-- just being able to talk to players better than me or at a similar level to me and just getting their opinion from them talking to me. If they think I'm not good enough, I want them to tell me. And I think that's one of the most important things is just getting good feedback from your friends and honest feedback. Yeah?

AUDIENCE: Since we can't play online here, and we can't do it at the casino like every weekend-- so we can't play for money-- what's some good motivation to keep the Saturday game? Is this like poker mentality, and these kids will have development in whatever they like [INAUDIBLE] jobs?

WILL MA: OK, so I'll address a few things. So one thing that I didn't really formally announce-- but yeah, so one thing you pointed out is, playing online poker for money is illegal in Massachusetts. The police can't come arrest you, but the website will take all your money if they find out you're playing from Massachusetts. But I don't believe it's written in Massachusetts law or something.

To my knowledge, the police can't arrest you. But yeah, so the question was, if we can't play online, what can we do? So I think it is legal in New Jersey and Nevada. So you can move to New Jersey or Nevada.

OK, yeah, so if you don't want to go to the casino every weekend, so what else can you do? OK, so what's the motivation to keep playing? So I think I've tried in this class to give examples of where I think poker is very useful, just in terms of how poker is related to nonpoker stuff, like calibrating your confidence, figuring out what your biases are, and stuff like that.

And I also think it's a fun game. It's a very fun game. It's mathematically interesting. But yeah, I mean, if you don't enjoy playing the game much, and sense you can't really make money playing it in Massachusetts, yeah, then, if both of those are true, then there's not that much reason to play it if you don't enjoy it. I think that's just the biggest thing. If you enjoy it and you enjoy the decision-making, I think it's very fun, and it's also very good for you.

AUDIENCE: Thank you.

WILL MA: All right, cool. Yeah, so if there's no more questions, then I guess we'll call it here, and then Friday will be the last class. There's two more nights of tournaments left. And yeah, I'm excited for Friday for Bill's lecture and to hand out the prizes.