Hallo everyone, this is Ye Yuan. The topic I chose for my bachelor thesis is an explainable AI for poker bidding.
So my presentation consists of 5 parts. At first, I will talk about the motivation, the reason why I am interested in this topic and why it could be linked with computer science. Then I will talk about the structure of the project and after that, I will introduce the work I have done so far. And at last, I will make a time schedule to estimate the time I need for this project and thus to help myself better work on it.
So we will talk about the motivation first. Why doing this project? First of all, I am a fan of poker, which is also called as Texas Holdem. It is a very popular card game all over the world. I will first introduce the rules briefly so that you could have a better understanding. Texas Holdem is a poker game that could be played by 2 -10 players, to simplify the problem, we will only focus on 2 players here. And there are maximal 4 phases in each game, which is pre-flop phase, flop phase, turn phase, and river phase. Each player would have 2 handcarts initially and there will be five community cards. And the best five card poker hand formed from the hand cards and the community cards wins the game. The winner will take all the chips in the prize pool.
And I will then introduce the 4 phase one by one. In the preflop phase. The players will be given two random hand cards at first. And players bet. There are three possible options when betting , which is raise, call and fold. Call simply means follow, which means that the player would bid the same amount of bet as the current bet. If a player raises the bet, each player must now call the new amount. Fold simply means fold the card and quit this game, and of course lose the all the bet that have already been thrown into the prize pool. We will come to another phase if everyone calls.
The second phase is called flop phase, which means 3 community cards are dealt face up. And the remaining players will bet again based on their current hand. When all the remaining players call, we will come to the Turn phase, a new community card is dealt face up and players bet again, and in the River phase, the last community card is dealt face up. Players will bet and show down. Who has the best five card poker hand wins the game and all the prize pool.

Having talked about the rules, we will then talk about the property of the poker. Poker is a game with imperfect information since the players' cards are hidden and it is dealing with the uncertainty about the future events we would not know what the hidden community cards will be. And a good poker player would use some deceptive strategies to bluff the opponents which made the players' move more unpredictable.

Inspired by the the facts above, I then made my mind to do it as my bachelor project, which is to explore the bidding strategy of the top poker players. I would like to know how will the professional players making decisions when meeting different situations. I chose Deep Stack AI as my research target. DeepStack is an AI invented by University of Alberta. It is the first AI capable of beating professional poker players in 2017 so we could consider it as a top professional player. Another reason that we chose Deepstack AI as our research target is that there is a lot of gaming data of him playing with other professional players on its homepage, which may facilitate our work to find the data. To simply the problem, my research would focus on the PreFlop phase because in the preflop phase, community cards will not be involved in the decision making and players will only make decisions based on the current two hand cards they have. I will try to use rule based algorithm to explore the factors that influence the players' decision.

Then I will talk about the structure of my project. Since I am going to use rule -based algorithm to explore the bidding strategy, I would first use CN2 Rule induction. It is a propositional rule learner and it is designed to work even when the training data is imperfect. The algorithm must be given a set of examples, Training Set, which have already been classified in order to generate a list of classification rules.
Then I will adopt the probfoil algorithm to the same data and look at the statistics data for example accuracy and recall. Probfoil uses a first order logic and could also learn the relational rules of the poker. and since all the card information is deterministic, here the probfoil would have no difference with foil algorithm. We use it because it is based on the problog environment and thus would let us easier to continue the work later.
Then with the Rules we have learnt by the probfoil, we will use problog to get a probabilistic output. That will be for example 70 percent possibility to raise, 20 percent possibility to call, and 10 percent possibility to fold. In the real poker world, a lot of professional players will do some

unexpected move to bluff the opponents and to win the prize pool even they have a bad hand. It is a probabilistic inductive logic programming approach and also a statistical relational learning method. Alternative can be SLIPCOVER and LEMUR, but problog + probfoil would be great because they share the same environment.

I will then compare the statistical data get from different methods and analyze it and try to get a feasible conclusion. For example, if probfoil performs much better than cn2 rule induction, then I could say that there may exist a relation between the attributes, if the PILP performs better, then I could say that instead of playing normally, professional players sometimes tend to play unexpectedly, which make them hard to predict.

Now I would like to introduce my current progress. The first part, analyzing the data in CN2 Rule Induction, has been finished completely on the platform orange. Here is what the part of the work flow looks like: at first is the data I got from the internet, leak Phil, box Alexander and Bachmann jurger are all professional players and the files here have documented the games they play with deep stack. And then to make our sample larger, I concatenate them together, which makes it contains now more than ten thousands hands. And the second part is the data cleaning part. The attribute SameSuit will test if the cards are in the same suit. The suit information is very important because it would tell us if we have a flush or not. Then I define another attribute Preflopfirstaction which will tell us how the players will make their first decision. The chips will not be taken into consideration first so I have removed them. I then selected position is small blind in order to select the hands where deepstack ai made decision first and after that I selected the wanted columns for training. The data was then fed to the CN2 Rule induction learner after the data cleaning process.
The csv file here is what I have found at the homepage of deepstack AI, which has recorded the details of thousand of hand when the AI playing with the professional players. Since we are focusing on the preflop phase, I have circled out the attributes that we concern, which are chips, Deepstack Hand and Pre-flop. In the attribute deepstack hand, it contains the information of the two different hand cards, namely their rank and their suits. I split it into three new attribute: handcard1 handcard2 and same suit. The hand card1 and handcard2 contain the rank of two hand cards and samesuit indicates whether the cards are in same suit. I then feed this information into the CN2 Rule learner and got the following rules. For example the first rule said if handcard2 is A and handcard1 is 6, then we will raise. The second rule said if we have a pair of ace, we will raise. Which is quite reasonable. And another picture shows the statistics data of the CN2 rule inducer models. As we could see, our first model has got a precision of around zero point seven and a recall value of around zero point seven two, which is not a bad result. The next step is then to make another model using probfoil method and I would like to see how it would perform when it could compile a relational concept.

Then I will share my estimated time schedule with you. I would spend next four weeks on the probfoil algorithm and I will start doing the PILP part in the middle of February. The project is estimated to finish before middle of March and then I will start writing the bachelor report. This is my plan for this project.

At last are the references and thank you for your attention!