

The Impact of the World's Strongest Mahjong AI Suphx

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Translated by anon

Foreword

On 2019 March, Microsoft Suphx (Super Phoenix, hereafter referred to as Suphx) was released as [Ⓝ]Suphx on the online mahjong platform Tenhou. After reaching the tokujou lobby, Suphx had steadily accumulated both point sticks and rank points, and after 6 months was the first mahjong AI to achieve the rank of 10 dan. Subsequently, it also easily reached 10 dan a second time. Its total score in the 6000 hanchans it played over 4 months rivaled that of Tenhou players. During this time, the developers of Suphx were kept secret, but in August it was revealed that Suphx was developed by Microsoft. Suphx's unparalleled strength had surely convinced everyone that this was the case.

This book is a mahjong strategy book using Suphx as an inspiration. Knowledge of game AI has been applied to real life problems before, but I am not well versed in AI and machine learning, so I will not be discussing the significance of Suphx as a game AI. Rather, I will be looking at Suphx's game logs from the perspective of a competent player, picking up good plays, and explaining them for the sake of accurate learning. Since there are strong players around, let's put this technology to use. Practical isn't it?

Please entertain Suphx's complex plays and my dense explanations for a while.

Oshirase

Special thanks

Mahjong gives the impression of being a popular game that is easily played by many people. However, mahjong is actually a difficult to master international sport.

Mahjong is one of the most complicated imperfect information games. The game contains vast amounts of hidden information, and is filled with randomness and uncertainty.

At Microsoft Research Asia, our researchers are driven by curiosity. We are always seeking the unknown and searching for answers to unsolved problems. Accordingly, we decided to tackle an imperfect information game using a mahjong AI.

On 2019 June, Suphx was the first AI to achieve the rank of 10 dan on Tenhou, one of the world's most professional mahjong platforms. Development of Suphx started by learning from human players and was continually refined through self play.

Suphx has developed a unique playstyle, but as AI researchers, we only understand a small fraction of its actions. This time, we are honored to have Oshirase, one of the highest ranking Tenhou players to explain Suphx's actions in detail. We hope that if the mahjong community understands Suphx's actions, we can broaden the horizons of our knowledge and technology. This is strong evidence that AI can learn from humans and amplify human ingenuity. We are deeply grateful towards Tenhou and Tsunoda Shingo for providing us with professional game logs and an online mahjong platform for our experiments. We also express great thanks for all the Tenhou players who faced Suphx and all of the Suphx fans for their support and comments. Last but not least, we thank Oshirase for penning this book and providing incredible amounts of assistance and professional comments.

We hope that by conquering mahjong, the advances made in AI for imperfect information games are useful for tackling the complex decision problems that arise in reality, and that these advances can help humanity address bigger problems.

Please enjoy this book!

Microsoft Research Asia Suphx Team

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Chapter 1

Getting good

1.1 Suphx's performance

In this book, the ruleset used is assumed to be those of Suphx's main playing field, Tenhou tokujou aka ari east south (hereafter referred to as tokujou south) with a 9 dan point spread. That is, the point spread below based solely on placement.

1st: +75 **2nd:** +30 **3rd:** 0 **4th:** -165

For 8 dan, placing 4th gives -150 points and for 10 dan placing 4th gives -180 points. An additional 15 points are lost when placing 4th for every 1 dan increase in rank. The points for placing 1st to 3rd do not change with rank. For 5 dan, placing 4th gives -105 points. Placing 1st to 4th 1 time each is net 0 in terms of points, so the average rank in the lobby is around 5 dan.

With these rank dependent point spreads, Tenhou is a competition where accumulating a certain amount of points will result rank promotion, and falling under 0 points will result in rank demotion.

Rank	4th place points	Starting points	Promotion points
5 dan	-105	1000	2000
8 dan	-150	1600	3200
9 dan	-165	1800	3600
10 dan	-180	2000	4000

Suphx's overall performance in tokujou south is as follows.

Total games played: 5760 hanchan

1st: 29.3% **2nd:** 27.5% **3rd:** 24.4% **4th:** 18.7%

Stable rank: 8.75 dan

Highest rank: 10 dan (achieved 2 times)

This stable rank of 8.75 dan ranks an undisputable 1st amongst all players with over 5000 games played in tokujou south, and far exceeds the performance of all mahjong AI up until now. Even including players from houou, the highest level lobby, out of the 112 players with over 5000 games played, only 5 players have a stable rank over 8.75 dan (as of 2020 March 31).

Suphx performs well enough to rival Tenhoui players, and has been acknowledged by many top players in regards to its play. As of now Suphx is offline for improvements and is not playing games, but if Suphx gets even stronger there is no doubt that it will exceed the pinnacle of human performance. At the time of this book's publishing I believe that I can speak of Suphx as an equal. After a few more of its naps, it may become an existence that I can no longer handle. I look forward to Suphx's improvements, but for now let's enjoy the strength of the current version of Suphx.

1.2 Part with misconceptions of AI

"Digital mahjong plays the same way every time and is boring." These words aren't heard so often anymore, but were very common around 10 years ago. Setting aside that the fact that "digital mahjong" is becoming an obsolete term, just from its epithet of "the strongest mahjong AI," Suphx can be called the epitome of digital mahjong.

Concepts associated with the obsolete idea of digital mahjong are speed, calling, head start tenpai, betaori, and so on. In reality, mahjong is an extremely complicated game, so for the sake of immediately getting better, it is unavoidable that some simplifying assumptions are made. Until Suphx's release, all mahjong AIs were imagined as such simple systems.

"It plays like a human."

"It doesn't feel like a machine."

Many such comments have been made regarding Suphx's play. Particularly in regards to its tendency to slim its hands and aim for value, Suphx has often received such evaluations. However, I see the opposite.

“Suphx’s play is extremely mechanical.”

As for why, it is because Suphx seems like it can precisely account for very minute details. When a human player faces choices during play, it is natural for them to make some amount of simplifying assumptions. In my book *A Tenhoui Grinder’s Mahjong Mechanisms* (鬼打ち天鳳位の麻雀メカニズム), I list systematic treatments for situations that come up during play. To make complex plays, it is first necessary to address simple situations quickly and correctly.

However, the human brain has limits. It is not a stretch to say that it is impossible to correctly address every minute factor in a game. In contrast, Suphx’s play seems to surpass such human limits and is able to precisely account for every minute detail that arises during play. Such precision is what makes me label Suphx as “mechanical.”

To learn mahjong from Suphx is to endlessly seek detail and correctness; perhaps it can be called a romantic pursuit. Let us face the domain of *correctness* in mahjong, real, yet unreachable even through a lifetime of effort, and advance, even if only by a single step.

The act of learning from AI may bring to mind the image of learning a few simple rules, but the content of this book will focus on examining Suphx’s game logs. The fact that this much can be written just from its game logs shows how truly impactful Suphx is. Is there anyone that can truly imitate Suphx—the cutting edge of digital play? Is this boring? The time where digital play was considered boring has long since passed.

1.3 Studying mahjong

Suppose that you are a student who on average scores 50% on exams. Your options for studying are listed below. Which would you choose?

1. Examine the answers of students who score 70% to 80% on average. There are no explanations.
2. Ask for instruction by friends who score 50% to 80% on average.
3. Use study guides written by students who score 70% to 80% on average.

4. Grind practice questions
5. Self study

Studying mahjong is also more or less like this. When writing this book, I also recalled some slight feelings of despair. Roughly speaking, in regards to mahjong, the choices correspond to 1: reviewing logs of strong players, 2: discussing with others, 3: strategy books, 4: grinding, 5: reviewing your own logs.

The troublesome part is that in your answers with a score of 50%, which answers were incorrect and how many marks were deducted are completely unknown. The scores of the answers being used as study material, the study guide authors' scores, and the veracity of the information are also all unclear.

Unfortunately, the reality is that these are the only methods available for studying mahjong. All we can do is wrack our brains, organize the information available to us through repeated comparisons of what is correct or incorrect, and use these methods to their fullest extents.

That being said, in this book, I, a student scoring $\times\times\%$ on average, identify and explain answers from Suphx, a student scoring $\circ\circ\%$ on average, that I deem to be good study material. This book is something of a combination of methods 1 and 3, so I would like to discuss the topic of learning mahjong from game logs as a preface.

Riichi judgment, push/fold, hand building, folding—there are many aspects of another player's play to consider. No matter we examine, without properly understanding the other player's intentions, we cannot properly absorb the other player's playstyle.

For example, suppose that a player M when faced with a given board state judges pushing to be worth 90 points and folding to be worth 70 points and thus chooses to push. Suppose then that another player S , when viewing M 's logs, interprets the situation such that pushing is worth 76 points and folding is worth 74 points. What might occur due to such an inconsistency? In a similar board state that slightly favors folding, M will continue to push, whereas S will fold. S had intended to imitate M 's playstyle, yet ended up making different plays.

Moreover, suppose that M and S both interpret pushing to be worth 90 points and

folding to be worth 90 points. This is still not enough. For example suppose that, M judges pushing to be worth 90 points through emphasis on the point situation, and S judges pushing to be worth 90 points based on the table situation and ease of winning. In the case that the point situation changes, M will fold, whereas S will continue to push, and in the case that table situation changes and it becomes slightly harder to win, S will fold and M will continue to push. Such inconsistencies will occur. In situations like with university math exams, where example solutions and processes are fixed, it is possible to correctly recognize what to imitate. However, in a game like mahjong, where example solutions and processes are all ambiguous, imitating another person is rather difficult.

To learn mahjong from game logs—comprehending the decisions made by another player when faced with a given board state and applying it to your own play, many things must be understood.

- The factors to account for when making a choice given a particular board state
- The importance of each factor
- The difference in the choices given these factors
- The similarities between your board state and the referenced board state
- The differences between your board state and the referenced board state

And lastly, all of the above must be ingrained onto the subconscious mind—a daunting task. All of this requires a sense of aesthetics for different plays; such a sense is necessary to properly recognize that “this is a play to be learned from.” By the time that you are able to learn from game logs, your skill level is already high.

I follow my own sense of aesthetics to record what I think are good aspects of Suphx’s play, but whether these judgments are truly correct will remain forever unknown. As we delve into the depths of mahjong, the path becomes thorny and twisted, constantly weaving forward and backward. The process of getting good is inseparable from such risks. Are you prepared?

1.4 Making more adaptive plays

“Adaptive play” is also an overused term, but it may be appropriate to refer to such plays as handling of exceptions to established standards, adding detailed rules, or adding complexity to existing systems. For example, in most cases ryanmen is kept over kanchan, and mangan tenpai on east 1 is pushed, but there are of course exceptions to these rules. A playstyle is “adaptive” when adjustments for such exceptions are frequently made.

Considering and correctly accounting for detailed criteria is necessary for precise plays, but doing so comes with risks.

For example, in an even point situation, the standard is to push. Let’s suppose that we add a case where we fold if some specific criteria are met.

Establishing this criterion may lead to properly folding a mangan tenpai when appropriate to do so, but conversely may also lead to incorrectly applying the criterion and folding a mangan tenpai that should not be folded.

To benefit from adding this criterion, it is *necessary* but *insufficient* that the benefit from folding mangan tenpai when appropriate exceeds the loss from folding mangan tenpai that should be pushed. This is since establishing additional rules demands extra attention, and divided attention leads to more mistakes in other aspects of play. The losses from such mistakes must also be accounted for and the gain from the additional rules must exceed these total losses.

Depending on the person, performing these sorts of detailed adjustments may come with a type of joy, a sense of self satisfaction that comes from “thinking carefully and making all sorts of adjustments.” The pleasure of seeing a good outcome after thinking and making a conclusion different from the established standard is addictive. Occasionally players can be seen rapidly gloating that a play was “my own original play,” It is of course important to have fun, but ultimately I am writing this book with success in mahjong as an objective.

Thinking and adapting are means to improving the quality of plays and not objectives on their own. When evaluating complex factors, it is important to be able to correctly judge whether or not to overturn conclusions drawn from the simple rules. Are your

fine grained situational analyses truly better than coarse guidelines?

Lastly, it is unavoidable that detailed situational analyses be made for the sake of getting good, as the applying only the coarse rules has its limits. Why do you want to learn new adaptive plays? Is it to show off, or do you actually want to get good?

1.5 Making no misplays

AI does not make mistakes. It makes its decisions based on predetermined algorithms. Perhaps within these algorithms are behaviors unintended by the developers, but such actions are still based on established rules. Even actions that appear irregular at first glance are based on logic and situational analyses too complex to be recognized by humans.


Here let us define *misplay* as *plays that do not follow established rules and are understood by the player to be inferior to other plays*. This does not refer to analyses based on hindsight like backfires, dealing in, or missing wins, and also does not refer to the case where a play has a worse expected value in the limit of infinite trials. For example, suppose that a player has a rule to 100% dama with pinfu dora 1, and said player understands plays that go against this rule to be inferior. For this player, calling riichi with a pinfu dora 1 hand is a misplay. In contrast to an AI that makes no mistakes, humans are constantly making them. Insufficient brainpower, impaired judgment, operational mistakes—there is no end to the examples. It is rare for a human to play a hanchan perfectly. When learning from a human player's game logs and seeing an unexpected play, what might be thought of as a decision made by a strong player may turn out to just be a misplay. Such possibilities are ever present, and can lead to learning the wrong things. Moreover, people may make different plays when presented with essentially the same situation (setting aside the issue that no two situations are exactly the same). If there is no big difference between the choices, then there is nothing wrong with making such plays, but as study material they have questionable value.

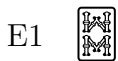
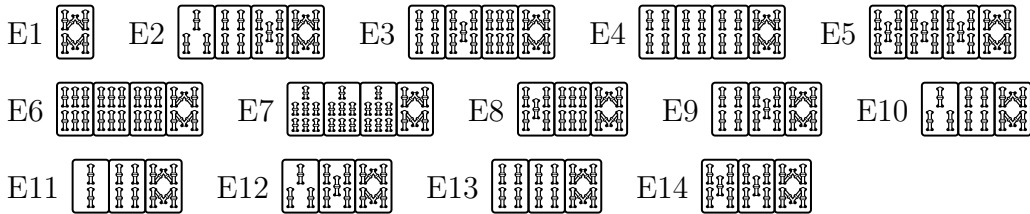
These matters are irrelevant for an AI's game logs. If not updated, an AI's judgments are consistent. When presented with a situation identical to one from a game log, it will always make the same play. In the case of an unskilled player, this leads to repeating the same mistakes, but there is no need to doubt Suphx's skill. At the very least,





since learning Suphx’s playstyle is to learn how Suphx holds on to its tiles. In regards to various situations, Suphx adjusts its play to keep certain tiles or not, and adapts to slim its hand or not. Tile efficiency is prerequisite knowledge for making such adjustments.

Moreover, simply understanding this information is clearly insufficient; it must be ingrained onto the subconscious mind. During live play, it is necessary to react to the situation on reflex. Without having reached such a level, there is not enough time to consciously think about every play, and the chance of mistakes vastly increases.



Here a time limit of 5 seconds was applied to each hand. Information that cannot be noticed without spending more time cannot be appropriately reacted to in live play. Despite having the knowledge, it cannot be understood on an instinctive level. When nervous in an important game, the available information further decreases. Such matters are irrelevant for an AI, but as this is not the case for humans, all that one can do is to take tile efficiency as a given and understand it deeply. Beyond that, judgment is required during live play. Before the next section, let us consider one more question.

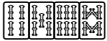
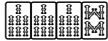
Q: Please consider the worth of  in the following shapes. The time limit is 30 seconds.



This is a simple isolated tile. Drawing  results in kanchan, ryanmen, pair, and penchan, respectively. This is the basic function of an isolated . From E2 onwards, the nature of the  starts to differ from that of a simple isolated .



Drawing  into E2 and drawing  into E3 results in a better shape than E1.


In this case the influence was correctly recognized as small, but can you recognize at what point do differences start to have an effect? For example, the difference between  and  whilst already having 2 pairs is fairly significant.

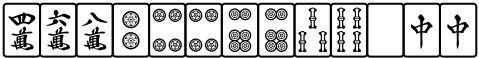
Furthermore, the efficiency of the shapes presented will change with the point situation, your discards, your opponents' discards, and the turn. I don't really understand the concept of tile efficiency. I recognize that there are few people who have a better understanding than I do, but even so I don't understand what I don't understand. Do you understand tile efficiency?


The discussion of tile efficiency ends here, but everything discussed in chapter 2 and beyond is built upon the foundation of tile efficiency. Whether this foundation is built atop sand or sturdy ground will change the structure of your mahjong.


1.7 Mahjong is about flow

Mahjong is a game about flow. There is no winning in mahjong when neglecting the flow. A big strength of Suphx is its ability to read the flow. For example, consider the following hand.

East 1 West seat Turn 4 dora 



Suppose that kamicha discards . After calling and after not, what developments might await?

In the case of calling, the hand might become good to fight with upon drawing dora  or drawing good shapes. Perhaps it will lose the initiative and get stuck, or it might complete despite losing the initiative.

In the case of not calling, the hand seems less likely to immediately get stuck, but as an effect the hand is less likely to seize the initiative. Drawing another pair enables chiitoitsu, and depending on the draws it might also become tanyao.

Entering the mid game, the sound of *riichi* is often heard. What kind of hand you face this with greatly determines your skill level. Suphx builds hands that prioritize seizing

the initiative to some extent and are good for both pushing and folding in the case that initiative is lost. In mahjong it is always possible to lose the initiative regardless of how wide a hand is, so while it is important to think about *what to do upon losing the initiative*, it is also important to think about *how to prepare for losing the initiative*. Suphx's answer to *what to do upon losing the initiative*, in other words, whether to push or fold, is fairly standard; Suphx slightly favors folding. However, Suphx keeps specific tiles during the early and mid game to enable such a standard style of pushing and folding.

It is rare to see the flow take Suphx to a hand stuck being neither able to push nor fold. For example, against a hand worth 6000 points on average, being forced to discard a tile with an 8% deal in rate is a 500 point loss. Even though such a tile would be carelessly discarded in a simplified WWYD, plays expected to lose 500 points are unusual. Plays that do are blunders. Players win because there are others who would commit such blunders, but a hand is stuck when faced with a situation that forces such a blunder to be made.

In order to win, it is of course necessary to have wide acceptance and progress the shanten of a hand, but upon hearing *riichi*, the value of pushing most noten hands vanishes, and the measure of the hand's value becomes the number of safe tiles it contains. Since such a reversal in a hand's value occurs rather frequently, the need to keep safe tiles often arises, particularly in the mid game and later.

Moreover, even with hands worth pushing, the costs and benefits of such hands differ wildly depending on whether the hand has 1 dangerous floating tile, 2 tiles, or 0. A hand 2 shanten for mangan that has 2 floating genbutsu is a decent hand to fight with, but the same hand with 2 floating dangerous tiles is worthless. Upon drawing another dangerous tile and having a hand with 14 dangerous tiles, depending on the turn and remaining live suji, it may be preferable to break kokushi than to have such a hand. Even with a good hand, Suphx often slims its hand in anticipation of losing the initiative.

Of course, Suphx's play cannot be imitated by merely building narrow hands. The value of tiles that are kept, what is drawn and what is discarded, the danger level of floating tiles, how much to prioritize taking the initiative—some turns of foresight are necessary. In this book, Suphx's push/fold decisions in situations with few branch points will be

examined, and from there its decisions in the mid and early game. First, standard push/fold decisions and the ways that Suphx slims hands and keeps tiles to enable such decisions will be considered, followed by how Suphx makes expensive hands.

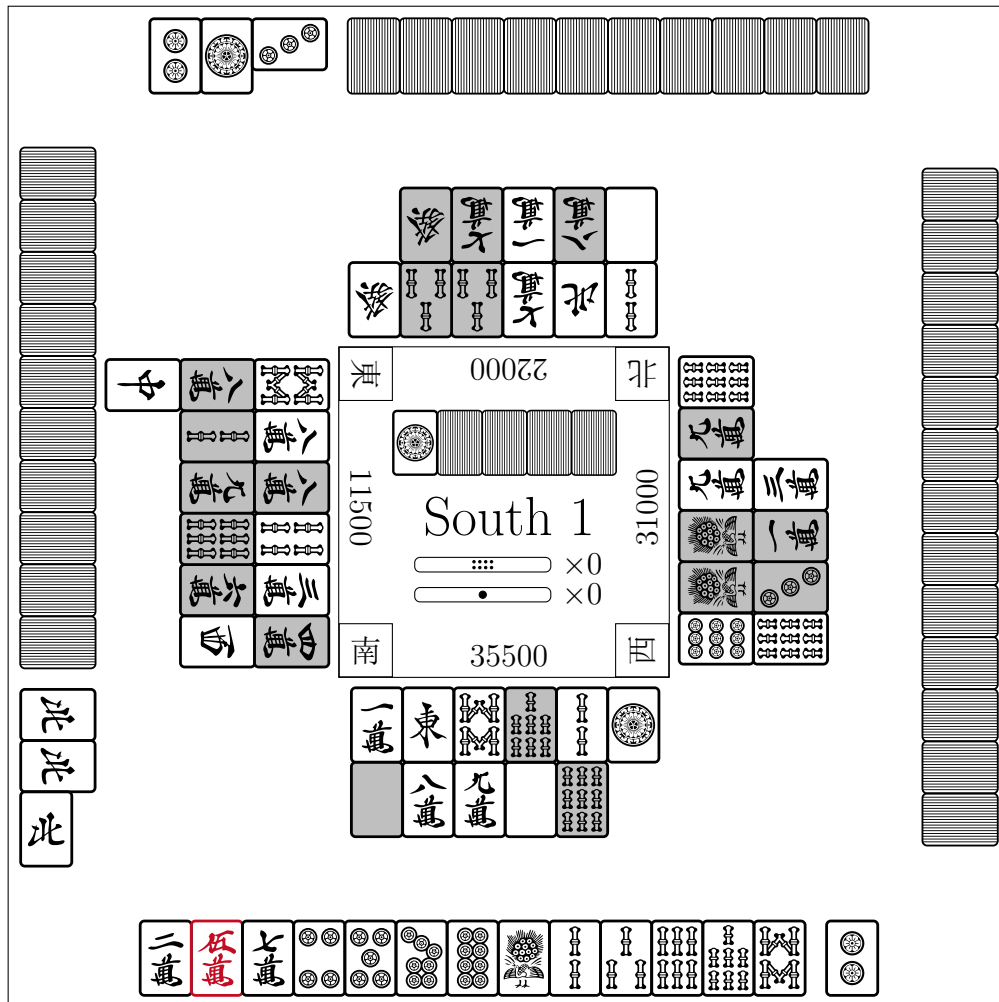
By the way, I'm sorry to say, but I do not discuss the belief that "good flow will bring good draws," a characteristic defect of human brains. I won't deny the necessity to account for the fact that the human brain is riddled with flaws though.

Chapter 2

Standard push/fold


2.1 Insignificant hands

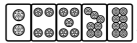
2.1.1 A hand that is not pushed






The east player called pon on and discarded , the north player called chii on and discarded . Dimmed tiles were discarded by tsumogiri.





Anyone can recognize that tanyao is not possible from the two players' calls and that pinzu is difficult to discard against this board. Is it fine to do anything other than discard pinzu then?

No, it is not. Suphx folds with . Insignificant hands like these must be thoroughly abandoned.

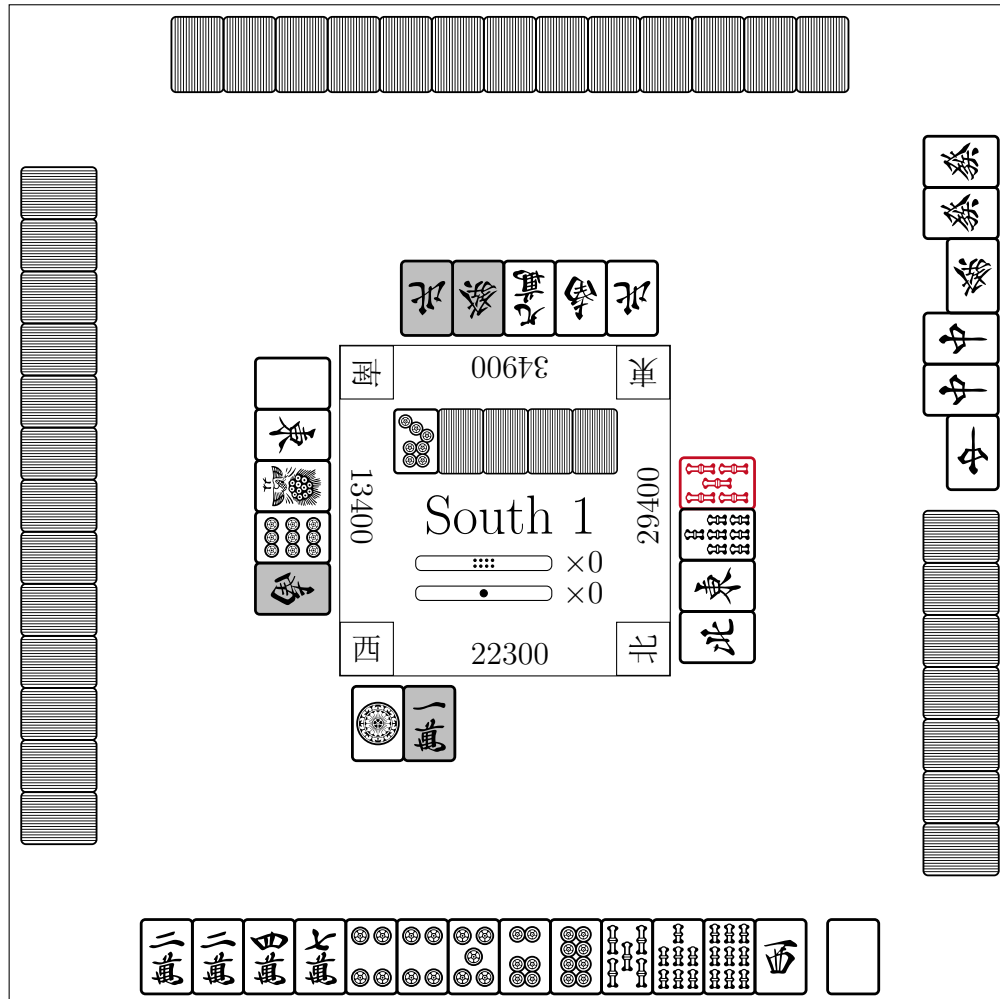
There is a certain probability that an ankou of yakuhai completes in mahjong. In this situation, discarding pinzu on the 3rd row from a hand that seems unlikely to amount to anything more than keiten is not an option. Assuming that pinzu will not be discarded, then 3 blocks must be made from . Souzu contains 2 blocks, so manzu blocks end up being unnecessary.



However, this plan to take tenpai is also rather difficult. With this in mind, it seems good to deem this hand insignificant. A closer look shows that the north player had discarded  after an honor, so there is no value in pushing . At the very least,  should be pushed after a group in pinzu completes and tenpai looks possible.



These factors force a reevaluation of the value of keiten, but this is ultimately about finding safety with a noten hand. There is value in pushing a tenpai hand that cannot win by tsumo, but there is no value in pushing from a hand that seems unlikely to reach tenpai.

If the possibility for tenpai is to be preserved then  should be discarded. Instead of discarding , which would leave safe tiles against the west player, Suphx chooses to discard . Most likely Suphx thinks that the hand would be worth fighting with after drawing  and someone passes a floating tile, or perhaps Suphx is cautious against possible dama from the west player.



2.1.2 An early game red flag






The north player has called 2 sets of dragons. It is still early, but this hand is 4 shanten, does not have enough blocks, and might become riichi nomi. Dora  and  are floating. This is important, so it bears repeating.



- The hand is 4 shanten and does not have enough blocks
- The hand may become riichi nomi and dora  and  are floating

Against an opponent who has called 2 sets of dragons and does not need a joint containing aka, this hand ends here and now. There is no room for making reads or anything

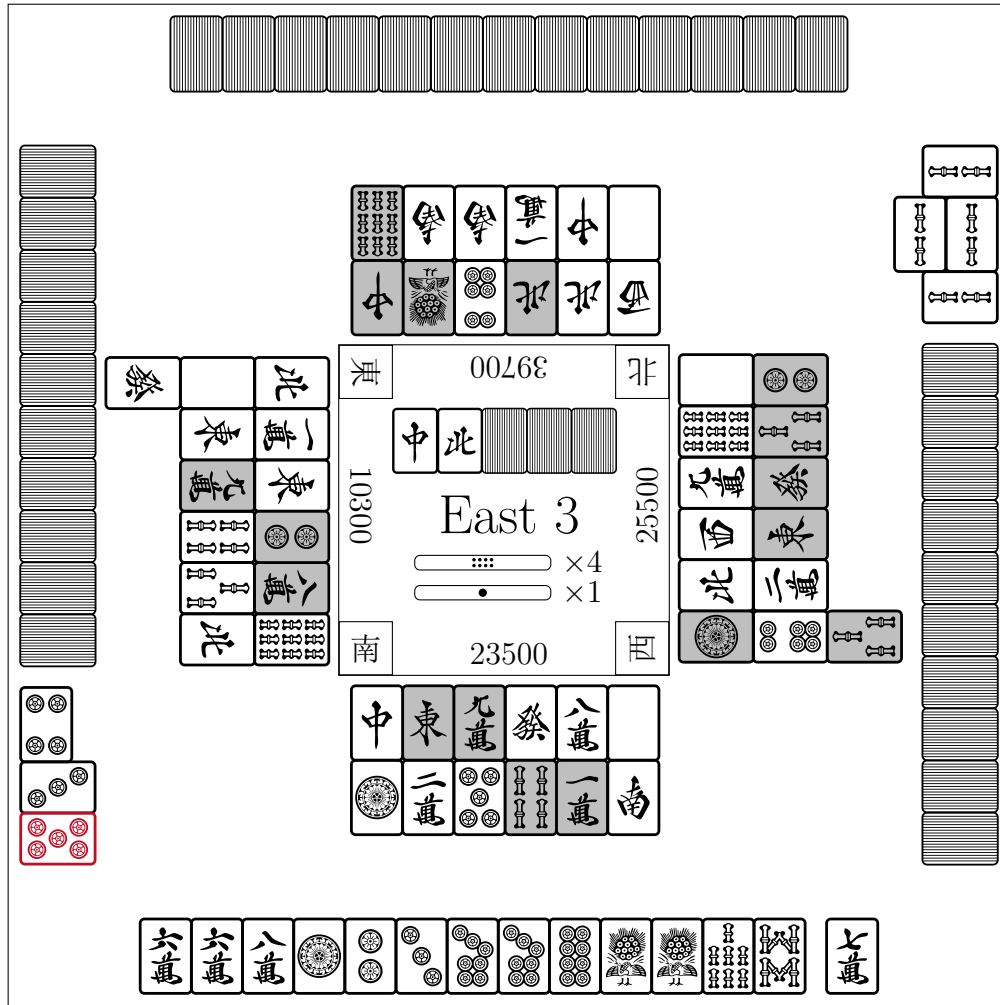
else. Calling has no relevance here. Suphx of course discards . There is no question of whether or not to first push  or whether or not to pass tiles that can be passed while making careful reads and maintaining the shape.

Maintaining a hand and persevering only has value when chances of winning the hand or reaching tenpai are affected by doing so. How good of a hand might this hand become after 9 turns? How many tiles must be pushed until then? If certain tiles are tied down and not pushed then the number of effective tiles further decreases. If this can be recognized then there is no value to pushing anything other than .

There are those who take interest in discarding the 3rd dragon without a single glance, but try to refrain from doing that. Hypothetically, with an 1 shanten hand for tanyao pinfu aka in the early game, there is value to pushing live  before the other player can draw a pair of it. There are generally few hints in the early game, and there are many cases where the other player does not have ; the longer it is kept for the harder it becomes to discard. Will this hand work out if the dangerous tiles are taken care of ahead of time then? The benefit to discarding dangerous tiles in time is that doing so leads to winning hands, and that doing so increases the success rate of folding.

When given insignificant hands like this, can you say that you will discard   100 times out of 100? Your play and Suphx's play will differ in accordance to whether your number is 95, 90, or 80 compared to Suphx's 100. How often do you deal in against open hands with hands that are 2 shanten or farther away in your game logs?

2.1.3 3rd row noten

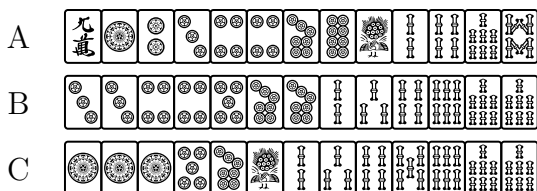


Hands that are still noten at the 3rd row are generally insignificant. Such hands have extremely low win rates and generally do not reach tenpai. In the best case pinfu san-shoku is possible, but Suphx takes a detour with . Although the dora are honors, discarding against opponents whose discards heavily suggest open tanyao is reckless. It is especially unthinkable against the east player who has revealed the aka for 5800. Keiten is still very possible after dropping a pair; this late into the round having such an option is more than enough.

2.2 Supplement 1: Recognizing hand value

Abandon insignificant hands—obvious, right? Dealing in with a 2 shanten hand against a player with 2 calls. Dealing in to an open hand during the late game with a noten hand. All strong players have in common the fact that they rarely play the deal in lottery with insignificant hands, but Suphx is particularly remarkable in this regard. To begin with, can you correctly recognize what an “insignificant hand” is?

A hand has a lot of ryanmen, so it seems good. A hand looks expensive, so it seems good. Somehow things will work out. Not mistakenly recognizing hands as such is another strong point of AI.



What might be recognized when presented with A? Although it is dora 0, it might work if it takes the initiative. If an opponent calls riichi, pushing is difficult even with dora 2. It still seems possible to make it in time with such a hand in the mid game, but after turn 10 it is too late. The value of a hand decreases as the turns progress and plummets upon losing the initiative.

Anyone can recognize that B is markedly better than A, but even B is insignificant when it is turn 15. How to safely reach keiten, and if this is deemed not possible, folding—all effort is put into making such considerations. B has guaranteed yaku, but with only a slim chance of winning, there is no issue with calling it keiten. If it is turn 15, C is clearly superior to B.

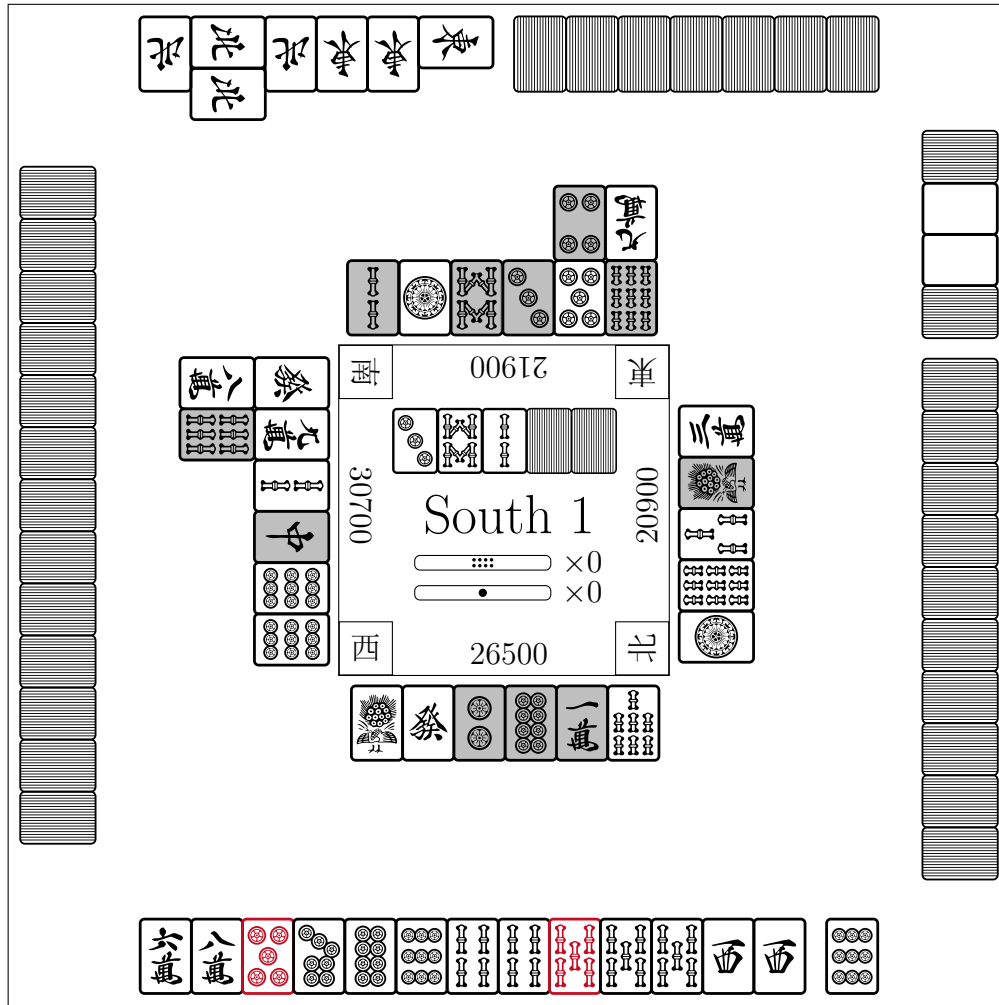
It is obvious that a hand’s value plummets when faced with an opponent’s riichi. The riichi is a sign after all. In contrast, open hands tend to have lower value on average and are unclear as to whether they are tenpai, making it more difficult to realize that your own hand has already lost its value when facing an opponent’s open hand.

The sections in this book consider situations with small but important differences in play that accumulate for differences in results. However, in the sections regarding

insignifncant hands, situations where not folding results in a big difference are covered, as such content is related to a large source of losses for many people, and reflects Suphx's precision. Taking into account the turn and other players' calls, can a hand still be said to have value? Can you correctly recognize the changes in your own hand's value?

2.3 Adaptive plays against open hands



2.3.1 Deal in shape and deal in points



The east player called pon on 此 and discarded 東, pon on 東 and discarded 南, kan on 此 and discarded 北. The north player called kan on 南 and discarded 東.




When deciding whether to push or fold against open hands, other than the knowledge of whether an opponent is tenpai, more information is available compared to what is available when facing riichi. Information about an opponent's wait candidates and hand value must be accounted for.

Unless the east player has a single suit hand, this 南 is fairly likely to deal in, but














Suphx chooses to discard  instead of the aka  genbutsu. Confirming the available hand value information suggests that pushing is feasible even from a 1 shanten hand. The factors to check against an opponent with an open hand are mainly


- Toitōi
- Honitsu
- Dora (especially if multiple copies are used)
- Yakuhai




and such. Make sure to confirm whether aka and ittsumi are present for single suit hands, and whether yakuhai and sanshoku are present for terminal based hands. The average value of a hand will greatly differ depending on whether these are visible or not. Especially when the possibility of a high value hand can be eliminated, the ease of pushing skyrockets. Whether an opponent's hand is known to be expensive, cheap, or whether its value is unclear—even for hands with similar deal in rates, the rough cost of (deal in rate) \times (deal in points) and ease of pushing are completely different.

Assuming that  deals in against these calls, the only other yaku that the opponent might have would be something like chanta. Whether or not the opponent is using multiple tiles of the dora  should be confirmed, but 2 tiles out of the 7 in the opponent's hand are known:  + (1 head) + (1 group).

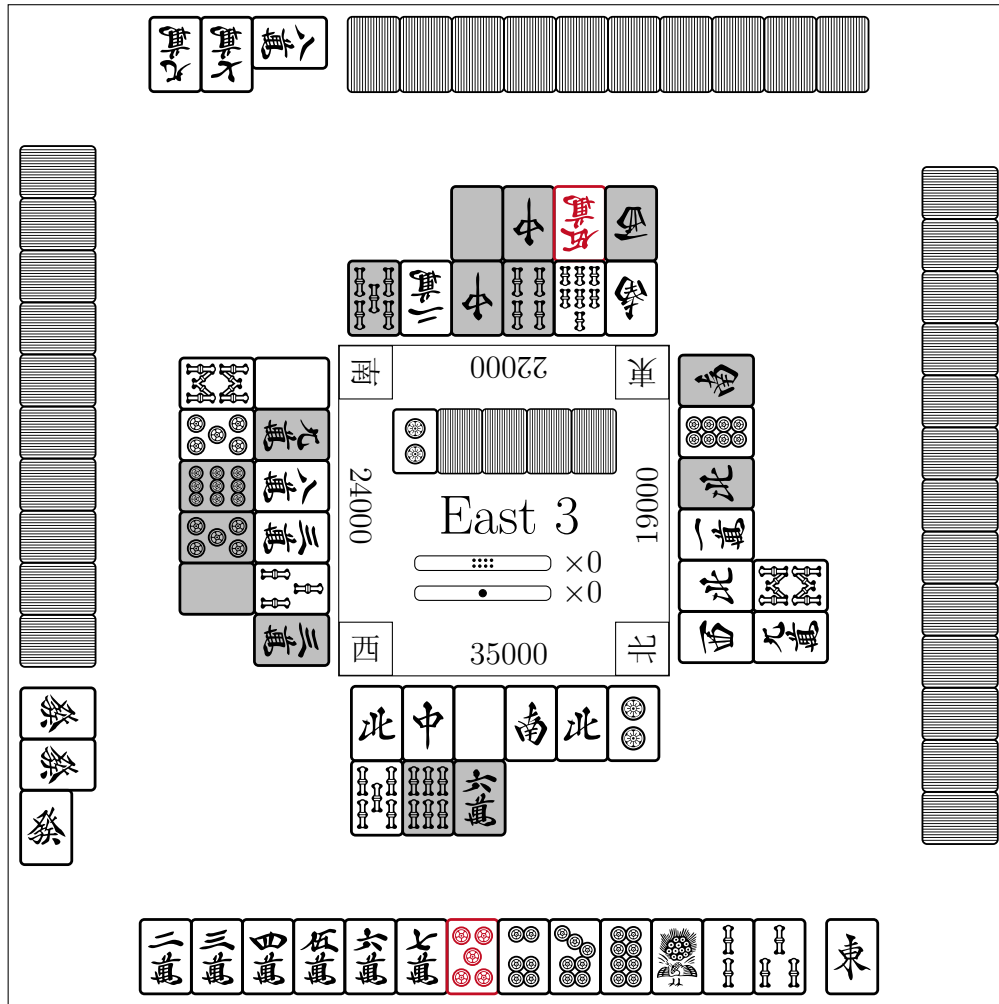
How likely, then, is it that 2 or more dora are present in the opponent's 1 head and 1 group? Based on the opponent's discard order, none of the dora are the head. The basic fact that *it is unusual to cut tiles present in multiple copies early* suggests that the east player likely has at most 1 dora. Since the opponent is most likely waiting on ryanmen, even a 4800 point hand is unlikely when dealing in. It is possible that this deals into a hand worth 1 order of magnitude more though.

the opponent's hand must be confirmed. For example, in this case,  was discarded early, so there are few cases where it came from a complex shape in upper souzu.  is not an isolated tile for good shape improvement either, so the configurations in which  can function in the hand are , , or  (karagiri). It was too early to discard  from  for , and deliberately discarding  by karagiri only attracts suspicion, so discarding  from  and then drawing  seems the most likely.

The more possible configurations there are in which  is useful, the more likely it is that an opponent does not have a single suit hand. The fewer configurations, the more likely it is that an opponent took the risk to camouflage their hand.

Since 4 copies of  are visible and pinzu are divided, it is unlikely that the east player has made it all the way to chinit-su. However, since the likelihood of camouflage is high, and the 2 calls in pinzu were rather forced, honitsu with  or  ankou should also be of concern. Passing for now and playing around the east player, hoping for tanyao or riichi seemed good to me here. Regarding matters that depend on personal preference like the reading of reverse order discards here, opinions are still split amongst top level players.....it seems.

2.3.3 What to start pushing from











The east player called chii on and discarded and is the only remaining live yakuhei. The south player called pon on and discarded .

Suphx reaches tenpai on of which 4 tiles are visible. Since improvement for a 3 sided wait in manzu is fairly strong, Suphx chooses damaten. While doing so, Suphx draws . This yakiless damaten is a difficult spot to be in, but note that Suphx chooses to discard . Against riichi, honors are usually pushed before number tiles, but whether to push starting from honors or number tiles needs special treatment.

Against riichi, there is a 100% chance that the opponent is tenpai, so there is no need to deliberately push starting from the more dangerous tile. However, against an open






hand, since the opponent may not yet be tenpai, the following possibilities must be considered.


- The opponent can call pon into tenpai
- Discarding tiles too late might result in dealing in






Yakuhai are often vital for calling pon into tenpai and also often become the wait. Here the only yakuhai remaining is double , and it is likely that the sound of pon or ron will be heard upon discarding it. Suppose that  is discarded and  kept. If  gets called, then even if manzu becomes a 3 sided wait, a dangerous pinzu tile must be pushed, and the much awaited 3 sided improvement might be wasted. In contrast, if  is discarded first, then it is enough to gamble with . Discarding  first risks turning an opponent tsumo into a ron, but even if such a risk is taken, the difficulty of pushing when drawing a manzu 3 sided wait only increases. Moreover, depending on the draws, there is also the option to hold the  until the very end.

When facing an open hand with a hand that has a floating yakuhai that seems likely to be called by the opponent for tenpai and a floating number tile, if the criteria “it is conceivable to push either” and “the hand seems to be worth fighting with” are both satisfied, the general rule is to discard in the order *number tile* \implies *yakuhai*.

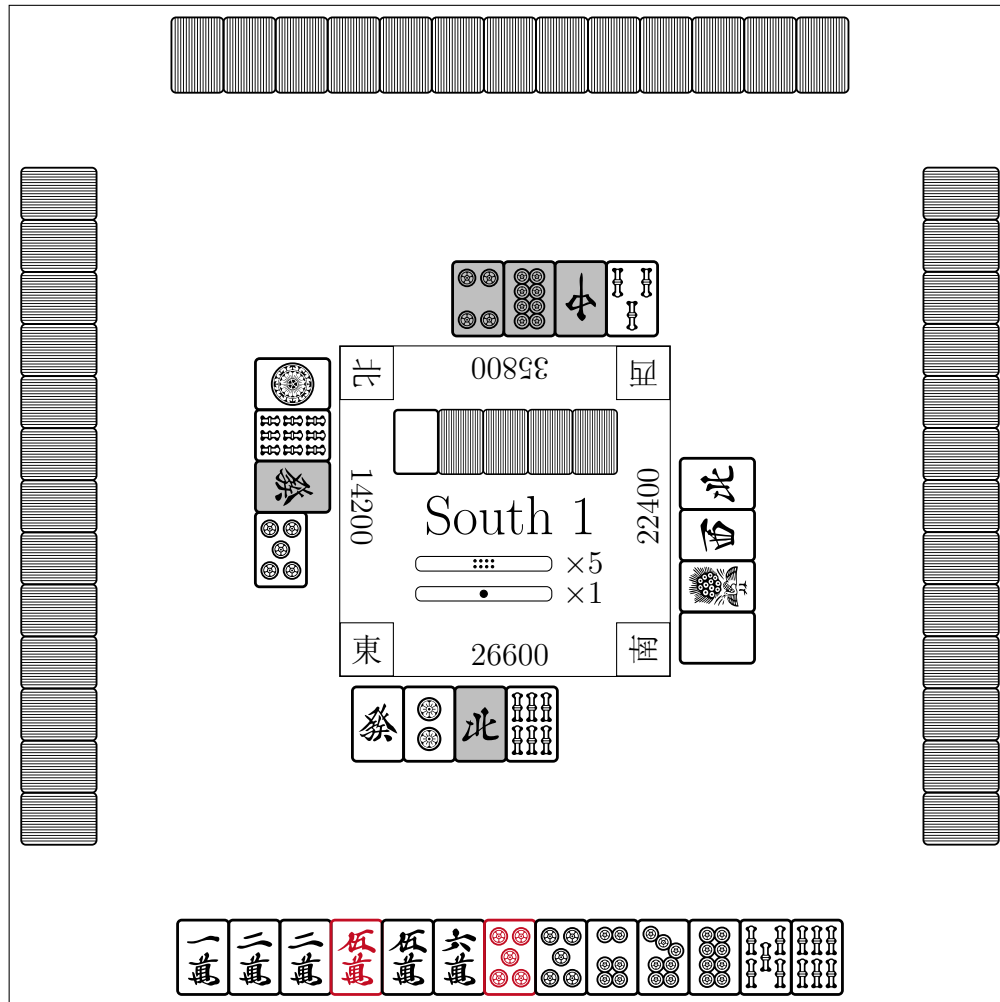
Suphx builds its hands such that dangerous tiles are not floating when it loses the initiative, but this discussion will be deferred until sections about the mid game.

Now then, this  is no chance and seems fairly safe. Should  be pushed? Suphx's answer is no. To reach tenpai while using the , 1 to 2 suji in souzu must be pushed assuming no useless draws. However, despite discarding  increasing, doing so allows for tenpai to be smoothly taken, requiring only that  be pushed assuming no useless draws.



This difference of 1.5 suji that must be pushed is fatal. A 2 shanten hand with 1.5 types of floating suji is difficult even as the dealer; in such situations betaori tends to be preferable. In contrast, a 3 shanten hand with 0 floating suji leaves some chance of winning. When pushing against an existing tenpai, the latter is clearly superior. As such, there is no reason to take the trouble to push  and maintain the shape here.

Of course, discarding  here is good for folding, but doing so also seems strong for winning the hand. While dropping 3 copies of , 9 other tiles will have been discarded by other players. Based on this information, choices such as completely destroying the hand or choosing a joint to drop to safely counterattack can be made. This of course can also be done after discarding , but by discarding  first, the choice to keep  until the very end can also be made. With a 2 shanten hand containing many floating tiles, such an option must be preserved.

2.4.2 Pon against riichi



14 suji remaining.

Suphx calls pon on the riichi declaration tile  and discards . As the dealer with a moderately expensive hand in the early game, this may seem like an obvious play, but calling pon when an opponent has called riichi is special; let us remember this.

It is widely known that folding is the basic play with a noten hand against riichi. If this is understood, then it should also be clear that calling pon and expending 2 safe tiles to push incomparably harder than calling chii, as the success rate of betaori vastly decreases after calling pon. This is not something that can be done with a hand that has tiles that only seem somewhat safe.

Moreover, if $\boxed{\text{北}}\boxed{\text{南}}$ are held back and not pushed after pushing $\boxed{\text{東}}$, it is possible that at least 3 suji must be pushed from a noten hand. With a 1500 or 2900 point hand, even against an opponent who is not in last place, the choice to fight is only made after withstanding the riichi and making good draws. With no more than that, expending 2 safe tiles and being forced on a complete offensive is a fatal disadvantage.

The special act of calling pon after riichi is seen less as the skill level of opponents increases.

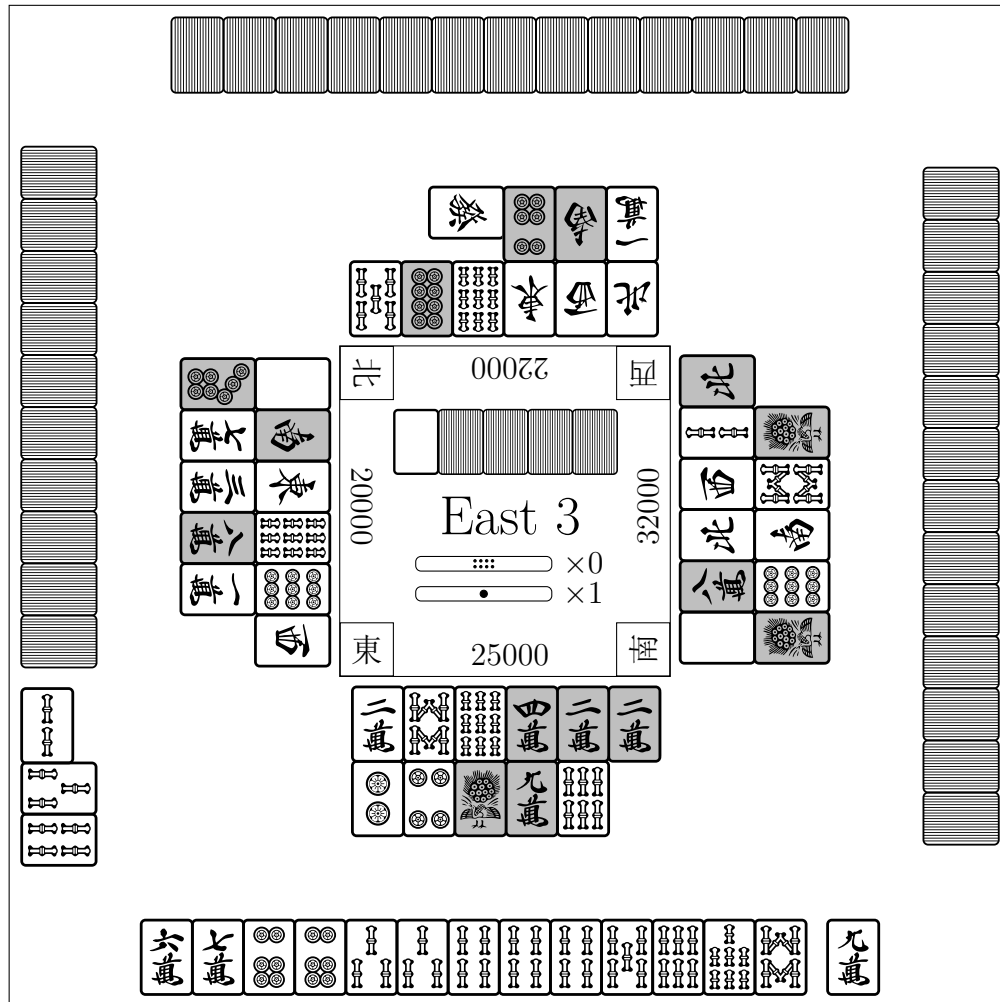
- Tenpai
- Many safe tiles (especially safe tiles against all players like honor ankou)
- Good shape high value 1 shanten

Calling pon against riichi with a hand that does not fulfill at least one of these criteria is almost certainly not an option. Such is the case in Suphx's game log.





Moreover, if an opponent's skill level is reliable, the possible configurations of the opponent's hand can be narrowed down if pon is called after riichi. It is possible that an opponent pushing with a closed hand has no safe tiles. When an opponent calls pon, this possibility is eliminated.


Pon being called after riichi changes the situation of the game no less than the 1st riichi to be called by a player does. Do not fail to notice when an 1 shanten that can be pushed becomes one that can no longer be pushed.

2.4.3 Effective shanten of a hand from behind









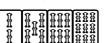

10 suji remaining.


The suji that are not matagi to early discards are manzu and , so pushing this  on the ippatsu turn is difficult. As such, genbutsu must be discarded, but even if 2 different tiles can both be discarded as genbutsu, the choices must of course be compared. Discarding  gives 1 shanten, but Suphx chooses to discard .




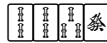


In the case that  is discarded, even if the hand reaches tenpai, the wait is shanpon with 2 remaining tiles. If there are only a few draws remaining then such a tenpai can be pushed as keiten, but here there are quite a few draws remaining, and pushing tenpai for the moment is rather questionable.

If so, then such a shape is not something that can be called 1 shanten; it is an 1 shanten that is quite close to 2 shanten.

That being the case, there is no problem with firmly returning to 2 shanten. If  is discarded, the souzu shape becomes divided, and discards that increase shanten would have to be made upon drawing live suji in souzu (especially ).

If  is kept by discarding , improvements in pinzu can be accepted, and the majority of souzu draws result in a shape better than what would result from discarding . The dangerous  can be accepted, and comparing the shapes should make it evident that what results after drawing  is better. Although both choices give 2 shanten, discarding  gives a good 2 shanten.

Keeping complex shapes makes it easier to make strong shapes—the basics of tile efficiency. If an 1 shanten results in a tenpai that is ultimately not taken (or difficult to accept), then such a hand cannot be called 1 shanten. With knowledge of this perspective towards shanten, the play of discarding  should be a possible choice.

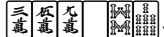



Additionally, although  is matagi to early discards and will not deal into a hand using dora  as the head ( will not be used as the head from ), it is still double musuji and the aka is not visible. Since the dora honor riichi declaration tile is often kept even if it has been discarded early by other players, it is far better to push  than to push .



acceptance. Likewise, when a hand contains a dangerous floating musuji tile, it can sometimes be effective to push a less dangerous musuji even if doing so slightly narrows acceptance.







From this situation, Suphx takes the half measure of discarding ⑧ . It is currently South 2 and there is a clear division between the players high in points and the players low in points. Preventing the 3rd place south player from winning is extremely valuable, and this time the north player appears to have tanyao and has revealed 2 dora. It would not be bad if the north player can win this hand, but from their discards they do not seem to have made any big movements and had just finished performing a call swap (calling ② from ②③④⑤ and discarding ⑧ the following turn). The north player's speed is difficult to judge. If hand shape is to be prioritized then ④ should be pushed, and ⑧ should be discarded if the choice is to fold completely. Discarding ⑧ is a half measure, but it seems to be the best choice.



This hand is currently a decent 1 shanten, and since it is unknown whether the north player is pushing or folding, it is better to avoid completely giving up and discarding ⑧ . Discarding ④ is indeed wider, but ④ is double musuji against riichi and is also dangerous against the north player. Discarding ④ only gives 2 tiles of acceptance for ④⑤⑥⑦ kanchan tenpai that would result in ⑧ being discarded. If so, then it is not strange at all to think that the difference in deal in rate of ⑧ , which is safe against the player who has called and musuji against riichi, makes up for the 2 tiles of acceptance lost.

Immediately afterwards, Suphx calls chii on ⑧ and discards ④ , showing that Suphx had maintained 1 shanten in preparation to fight. Depending on the next tile drawn and the north player's actions, perhaps Suphx will also consider folding.




First, in ascending order, the ranking of tiles in this hand by deal in rate is .  was discarded on turn 2 and the riichi declaration tile is an honor; such sakigiri is uncommon. Shanpon with the live suji  and  seems more likely.

Suphx choice is neither folding completely nor pushing completely; it is a choice similar to discarding a pair of live honors to maintain the shape of a hand when faced with a situation like this. After this, the plan will generally be to fold if more safe tiles appear. Even if more safe tiles do not appear, if a head cannot be secured then the plan is also generally to fold. If the dora  is drawn and the shapes work out then pushing  or souzu are also be options.


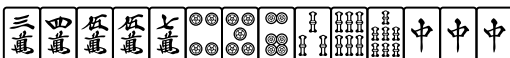
Incidentally, although I do not like to introduce hindsight into my considerations, this  dealt in. Even if a tile seems likely to pass, this of course does not mean that it is guaranteed not to deal in, so if the hand was worse, for example, if the hand did not have aka, had  instead of , or had an incomplete block in manzu, the choice would be to fold with . The next tiles to discard would be  or , but it is also possible to draw another safe tile instead of needing to discard an unsafe tile and dealing in. It is important not to overlook this possibility.

dangerous musuji for which nearby relevant tiles are not visible, are also dangerous. This time all of lower souzu are as such. Upon drawing lower souzu,  can be fixed as the head and  discarded to absorb a dangerous tile reach tenpai safely.

The ability to discard safe tiles while absorbing dangerous tiles makes it easier to push when not in tenpai. Making even 1 unnecessary discard significantly worsens the odds of success, and is a large detriment when considering whether to push or fold.


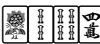
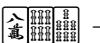
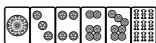




The ability to absorb dangerous tiles is a much more important factor than being able to draw the 2 remaining tiles of kanchan  for tenpai or draw  and being forced to push yet another tile for an extremely weak wait. Especially for the case of drawing , where folding is preferable even if the hand is in tenpai, losing the option to take such tenpai is not a problem.

Regarding the absorption of dangerous tiles, especially when there is bias towards a particular suit in the discards of a player who has declared riichi, the perspective of increasing win rate without increasing deal in rate is important. Doing so allows for the shape of a hand to be maintained upon drawing a dangerous tile that would normally make it preferable to fold and allows for an increase in win rate at the expense of some loss in tile acceptance.


EX2 Discards	
Hand	



This time pushing would essentially require discarding 2 musuji, so let us arbitrarily apply the condition “at most 2 musuji can be pushed before tenpai.”

What happens to this hand if this condition is applied? Omitting the direct acceptance for tenpai, as it is not changed much by applying the conditions, the following acceptance results.

- Discard 
 - 1 shanten  + genbutsu, suji, honor
 - 2 shanten  + 
- Discard 
 - 1 shanten  + genbutsu, suji, honor
 - 2 shanten  + 

When an opponent has declared riichi, there are draws that cause a hand to lose progress, i.e. tiles that cannot be pushed which result in reversion in shanten or folding. Minimizing the acceptance for such draws allows for more effective counterattacking.

A lackluster description is that “discarding  would mean that all of lower souzu must be pushed.” Such commentary might be heard on mahjong shows, but the principles are based in conditional tile efficiency.

Incidentally, the direct acceptance for tenpai was omitted, but it goes without saying that this is the most important factor. Here the acceptance for tiles that allow the shape of a hand to be maintained was discussed as a tiebreaker for borderline situations. The ability to absorb tiles near  is a much smaller factor than the danger levels of . If tenpai cannot be taken directly, then the hand is most likely not going to complete.

It is often said that it is important to look closely at the board and make comprehensive

judgments. As for what should be done after looking at the board, the following 3 points should be reviewed

- Confirm the acceptance for tiles that fulfill any conditions
- Set appropriate conditions taking the previous point into account
- Confirm any changes in the conditions

In live play, the conditions change with every tile that is drawn and every tile that passes. This is a difficult point when making push/fold decisions in the mid game, and marks the difference between intermediate and high level players.

The most widely applicable conditions are “tenpai can be pushed but noten cannot” and “nothing can be pushed.” The former is the most basic criterion for mid game push/fold judgment and is an easy to understand way to recognize the quality of a hand’s tile acceptance. The latter is effective for taking keiten in the late game. In the information rich late game, tile efficiency changes completely depending on this condition, and satisfying it is highly valuable.

As an example of applying a condition and making a decision, consider the progression “acceptance is low for tiles that satisfy the condition of not pushing any tiles” → “discard genbutsu starting from the inside to keep safe tiles against multiple players.” When an opponent has declared riichi, whether or not there is value in maintaining the shape of a 2 shanten or further hand or a low value 1 shanten hand is determined by how tenpai can be reached without pushing. Will maintaining the shape of a hand that cannot reach tenpai without pushing cause the hand to be stuck with neither a good way to push nor a good way to fold?

2.7 Late game decisions

2.7.1 Winning and keiten