Last revised January, 2024.

In September of ’21, as I was contemplating yet another Covid induced lockdown winter, I was thinking I needed a project to keep me busy. Since I am a tournament bridge player, and a retired software/firmware engineer, a computer program related to bridge seemed like the thing to do.

So I started writing a program to make an opening bid, given any 13 cards. A few months later I was reasonably happy with the results. Of course, the next step was to write a program to bid an entire auction from start to finish. Now, after another couple years of tinkering, I’ve got what seems to me like a pretty decent bidding program. This article describes, in Q&A format, the program I wrote and some ideas for further development.

Q: What do you call it?

A: Jethro. If you make it to the bottom of this article, I’ll explain how that name came to be.

Q: How good is it? How well does it bid?

A: Subjectively, my opinion is “pretty well.” What I am aiming for is 100% of the bids to be “plausible,” and I think 99%+ of all bids made are in the plausibility neighborhood. On most hands (~95%+) I believe Jethro passes the Turing test; if you were on the other side of a bidding screen you would have a difficult time distinguishing Jethro from a live person. Jethro gets to a credible strain and level almost all of the time. I think it is safe to say that anyone who has played a fair amount of tournament bridge has played with many a partner who did not bid as well as Jethro.

Jethro is still very much a work in progress. It is the kind of project that is never really “done.” I definitely do not agree with every bid Jethro produces. I do at least a little bit of testing and programming most days, and I like to think I am making improvements.

Q: How do you decide if Jethro has bid to a good contract or not?

A: Some of it is subjective. I won’t claim to be a world class player, but I do have decades of experience to draw on when looking at a bridge hand. There is also a Double Dummy Solver built in to the code, so I can tell at a quick glance if it is possible to make the contract that is bid to. I also have some thoughts (see below) concerning metrics to measure the efficacy of a pair’s bidding.

And this is a good time to give a shout out here to Bo Haglund and Soren Hein, who made their Double Dummy Solver code available for free to the world. The Solver typically takes a second or two to analyze a hand and calculate the results. Once in a great while it may take 15 seconds or more. As far as I know, it has never failed to produce the correct answers. See http://privat.bahnhof.se/wb758135/index.html for more information. A truly amazing piece of software. Thank you, Bo and Soren!

Q: How does it compare to other computer bidding programs?

A: I've got an old copy of Bridge Baron 14, and the BBO bots are free for anyone to use. It would be great to be able to make lots of direct comparisons, but it is not particularly easy to set up to do so.

I also found hands from what I think was the most recent computer bridge championship – 2019 in San Francisco(!) – and spent maybe an hour looking at the bidding. I don't think Jethro would have been embarrassed. Of course, as Mike Tyson famously said, "Everybody has a plan until they get punched in the mouth." I really do not know how Jethro would have fared in a head-to-head matchup.

Jethro likes to bid, and likes to compete. My sense is that Jethro passes less frequently than other computer bidders I have seen. Jethro also likes to bid slams; of course, not every slam makes, so that can be a mixed blessing.

See for yourself. Here are a few examples.

Lighter openings are definitely part of the modern style, and Jethro will open approximately 70% of hands with exactly 11 HCP.

This hand will be opened in first seat:

♠ KQJ87
♥ A743
♦ 64
♣ JT

.

Change the hand slightly, and a different decision is made. Jethro will pass this hand:

♠ KQJ87
♥ A74
♦ 64
♣ JT6

.

Hands with 12 HCP are almost always opened (~97%), but there are exceptions. The algorithms are not so fond of Jacks and Queens. Here is a hand with 12 HCP where Jethro passed:

♠ Q
♥ KJ52
♦ J8542
♣ KQ8

.

Shapely hands with fewer than 11 HCP will also occasionally be opened with 1 of a suit. Here's one:

♠ AQJT6
♥ 3
♦ J4
♣ Q8765

.

Now for a few complete auctions, with a tiny bit of analysis. Jethro is bidding all four hands. There are also more hands included at the end of this document.

Board 17
Dlr: North
Vul: None

♠ KQJ87
♥ A743
♦ 64
♣ JT

♠ T62
♥ KJ
♦ AKT83
♣ Q82

♠ 54
♥ 98
♦ Q97
♣ AK7643

♠ A93
♥ QT652
♦ J52
♣ 95

West	North	East	South
	1♠	2♠	2♠
3♠	Pass	4♠	Pass
Pass	Pass		

4♣ is not, in general, a desirable spot to land in. But on this hand 4♣ is the par contract, after West asks if East has a ♠ stopper, and East cannot oblige.

Board 84
Dlr: West
Vul: Both

	♠ AT5 ♥ J542 ♦ J3 ♣ QT93	
♠ QJ8762 ♥ KQT9 ♦ 85 ♣ J		♠ 93 ♥ A8 ♦ AKT642 ♣ 872
	♠ K4 ♥ 763 ♦ Q97 ♣ AK654	

West	North	East	South
Pass	Pass	1♦	2♠
X	Pass	2♦	Pass
2♠	3♠	Pass	Pass
Pass			

Plenty of interesting decisions to make here. If this hand came up in a tournament, I would expect a lot of different auctions at different tables. Is there a "best" auction for all four hands here? I really don't know. West Jethro's negative double with 6-4 in the majors might not be a consensus first choice, but I would argue it is not implausible.

If, instead, I take over and force West to make a 2♠ bid, this auction ensues:

West	North	East	South
Pass	Pass	1♦	2♠
2♠	3♠	3♦	Pass
Pass			

Board 10
Dlr: East
Vul: Both

	♠ KJ86532 ♥ A ♦ KJ8 ♣ AJ	
♠ T9 ♥ T752 ♦ Q4 ♣ QT976		♠ A74 ♥ KJ86 ♦ T6 ♣ 8543
	♠ Q ♥ Q943 ♦ A97532 ♣ K2	

West	North	East	South
		Pass	1♦
Pass	1♠	Pass	2♦
Pass	3♣	Pass	3♥
Pass	3♠	Pass	3NT
Pass	4♦	Pass	5♦
Pass	6♦	Pass	Pass

North's 3♣ is described as "game forcing ambiguous new minor". North wants to make a forcing bid here, and 3♣ is the only bid available, since bidding 3♥ would show a real ♥ suit.

4 of a minor over 3NT is always a slam try (or better, as in this case).

6♦ is not a sure thing, but judged to be worth bidding.

Board 52
Dlr: West
Vul: Both

	♠ T74 ♥ KQT95 ♦ T ♣ J876	
♠ KQ963 ♥ - ♦ A95432 ♣ K2		♠ AJ ♥ A8642 ♦ QJ87 ♣ A3
	♠ 852 ♥ J73 ♦ K6 ♣ QT954	

West	North	East	South
1♦	1♥	2♥	Pass
2♠	Pass	3NT	Pass
6♦	Pass	Pass	Pass

East's 3NT shows extras, so West bids what they think they can make. With a void and a hand judged to be strong enough this is a fairly common action. Subtlety is not one of Jethro's strengths.

Q: Did you have a master plan? A unified vision, from the beginning, about how everything would fit together?

A: Yeah, right. Sure. And I've got some beachfront real estate you might be interested in….

No, the truth is, to large extent I made it up as I went along. Necessity being the mother of invention, I created the concepts I needed as they became necessary. If I was going to start over today from the beginning I would undoubtedly make many different choices knowing what I know now.

Having said that, I did (and do) have one very broad goal. Whether Jethro is playing as your partner, your opponents, or both, I want it to feel like you are playing in an expert game. Which begs the question, what does that mean? What does it feel like to play with and against experts? What attributes do experts brings to the table? How can a computer program mimic those attributes?

It all starts with hand evaluation. Which leads to:

Q: How does it work?

A: Numbers and rules. LOTS of numbers and LOTS of rules.

Numbers first: every hand gets an initial valuation, which is represented by a number. This initial valuation is a weighted average of three different measures:

- the K&R (Kaplan&Rubens / CCCC) evaluator, as described in the October, 1982 edition of The Bridge World (see https://www.jeff-goldsmith.com/cgi-bin/knr.cgi) for a demo
- "Bergen" points, as defined by Marty Bergen (see https://www.bridgewebs.com/ocala/Hand%20Evaluation.pdf)
- A homegrown method of my own, using what purports to be a more accurate point code method plus extra value for long (5+) suits. Instead of the traditional A=4, K=3, Q=2, J=1 point count method, I use A=4.5, K=3, Q=1.5, J=.75, T=.25; I read an article somewhere that had data to back up the assertion that Aces and Tens are traditionally undervalued, while Queens and Jacks are overvalued. (Bergen points do this as well, without resorting to fractions.)

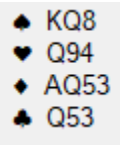
There are also several other ancillary measures computed, but the one above forms the basis for what I call “working points,” which is my main workhorse.

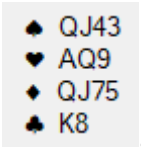
As the auction proceeds each hand is re-evaluated for every subsequent bid. This results in an adjustment (which can be either up or down) depending on the information revealed by the other players’ bids. How much adjustment? Well, that is a very good question! There are a lot of potential adjustments that might be made, including, of course, upgrades if you find a fit with partner. Here is a simple example: suppose your holding in some suit is Qx. That gets some initial valuation. How much is it really worth? Who knows at this point. Now suppose someone at the table makes a bid showing that suit. How does your initial valuation for Qx change, depending on which player made the bid? At the moment it is “what seems right to me” after having looked at a countless number of hands. Frankly, I don’t find that to be a particularly satisfying answer, though what I have done seems to work reasonably well. I’ve got some ideas (below) about how one might go about making improvements to the methodology.

For hands contemplating no trump contracts after the first round of bidding, I invented another measure which I call “NT working points.” Long suits count extra, but shortness hurts the valuation, depending on what one’s partner might have shown.

Opening 1NT bids are defined as 15-17 (traditional) HCP. It’s not a strict requirement. Jethro doesn’t deviate from 15-17 as frequently as Marty Bergen might propose, but exceptions are made. These 14 HCP hands, for example, are opened 1NT,

while these 15 HCP hands are not:





.

As you can see, hands with Queens and Jacks are downgraded, while Aces and long suits are upgraded. This is true for hands considering suit contracts, too. If you are a confirmed high-card point counter, this can take a little getting used to.

What about rules?

Overcalls are based on a combination of suit strength and overall strength. A separate calculation is used for two suited overcalls. Takeout doubles employ yet another calculation. If a hand might qualify for multiple actions, an arbitration routine decides.

The first round or two of bidding is usually about describing one's hand for partner's benefit. Strength and shape may be somewhat fuzzy. In most auctions, by the third round of bidding, both sides strength and shape are coming into focus.

With every bid that is made, strength and shape information is conveyed to everyone at the table. I call this "advertised information." In later bidding rounds this may include "stopper" information, for NT contracts, or "controls" for slam bidding. Most of the time the advertised information will be a reasonably accurate representation of the hand that is actually held. As in real life, however, sometimes the cards do not cooperate, and the advertised information will be less accurate. That's bridge.

In any case, every time before Jethro bids, an estimate is made of partner's strength, based on the strength and shape that has been previously advertised. This is added to the known strength in the hand being looked at, and a bid is chosen. Again, sometimes there are multiple possible bids that need to be arbitrated.

Here is a (freakish) hand that popped up while I was looking for examples:

♠ KQ975
♥ Q2
♦ 32
♣ AJ76

♠ A
♥ AJ97653
♦ AQJ64
♣ -

West	North	East	South
	1♠	Pass	2♥
Pass	2♠	Pass	

South's rebid choice here is between 3♥ and 3♦. With this hand, Jethro chooses 3♥.

But change the South hand just a little bit, to

♠ A
♥ AJ9765
♦ AQJ64
♣ 3

and the same two bids are considered, but this time Jethro's rebid is 3♦. Are those bids "correct"? I don't know – what do you think? -- but I would put both of them in the "plausible" category.

Q: How does a computer bidding program differ from a real live expert bidder?

A: I do not believe human experts typically think in strict numerical terms. They look at their hand, perhaps do some rudimentary calculations, then rely on their experience to guide them to the bid they make. I'm sure a lot of it is unconscious. A common thought might be, "I made that aggressive bid because I liked my hand." Or, "I just didn't like my hand." Sometimes I think experts make the determination without necessarily being able to articulate exactly why.

Computer bidders have to somehow convert that information into numbers, then choose a course of action. The goal, of course, is to have those decisions mimic human experts. For example, you, West, hold this hand,

♠ KT5
♥ JT742
♦ 73
♣ A42

and hear this auction,

West	North	East	South
Pass	1♠	1♥	2♠
?			

If you have a photographic memory, and a lot of unused space in your brain, you might recognize this hand from the February, 2023 ACBL Bridge Bulletin. It is hand #5 from the "It's Your Call" article.

Fourteen out of fifteen experts decided this hand rated a 3♣ bid, which was described as a "limit raise-plus kind of hand." I don't know that this hand qualifies as a "classic" limit raise – good luck, by the way, finding a precise definition of "limit raise" – but the experts almost unanimously agreed it was the best description of this particular hand.

If you want your computer program to mimic human experts, you'd better have an evaluation method that judges this hand worthy of a "limit raise."

How does Jethro do?

Jethro's algorithm gives this hand an initial valuation of 8.86 "working points" and an initial Pass is West's first bid. Before West's second bid, the hand is reevaluated based on the current auction, and the new valuation is 11.42 working points. That is enough for Jethro to make the same 3♣ bid favored by the experts. The difficult part, of course, is deciding how any particular hand should be reevaluated.

Q: What about competitive auctions?

A: Experts are really good at picking their spots to get in – and at least as importantly, get *out* – of competitive auctions. Jethro struggles a bit here. It's not so much deciding when to get into an auction or compete further, as it is to convey the correct information to one's partner, so that partner doesn't get overly excited. If you advertise a certain strength, a computer program will take you at your word, and respond accordingly. Getting partner to slow down is sometimes difficult. The crossover between making a constructive, informative bid, a strictly competitive bid, and a purely tactical or possibly destructive bid can be a fine line.

Q: What other auctions are especially difficult to mimic?

A: High level decisions can be very tricky. Do I compete to the 5 level? When should I double? No one always make the right decision in those situations. Experts are more consistently correct than non-experts. This is another place where I believe computer programs tend to struggle.

Q: What about breaking the rules?

A: First, experts know all the rules that apply to their bidding system. In an expert partnership, both players know exactly what a given bid is intended to convey. They also have a deep understanding of what other bids might have been available, and how to interpret the auction while considering all the bids that were *not* chosen. Second, experts know when and how to break the rules when they deem it necessary.

Computer programs are not good at this. Some bidding situations are ambiguous, and ambiguity is always difficult to deal with.

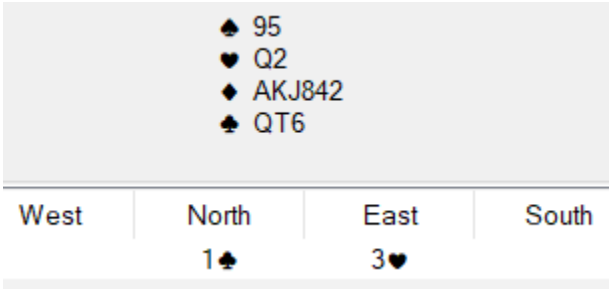
In real life, I have, on occasion, put down the dummy while mumbling that I hope partner can take a joke after I have made a questionable or "imaginative" bid or two. With a computer partner, there is good news and bad news in this situation. The bad news is that, no, a computer partner cannot take a joke. The good news is that they Do Not Care. Do it again on the next hand, and they won't think any less of you, or suggest you find a new partner.

Finally, if you "break the rules" by creating a "new" bid on the fly, an expert partner might have the wherewithal to figure out what's going on. At best, a computer partner is likely to struggle.

Q: What about hands where nothing really fits the situation, or stands out as the right bid to make?

A: These situations are difficult for people, and can be even more difficult for a computer program. It is a common theme in bidding competitions to ask a question that does not have a good answer. Here is Problem #1 from "It's Your Call" in the January, 2019 Bridge Bulletin:

IMPs, E/W vulnerable.

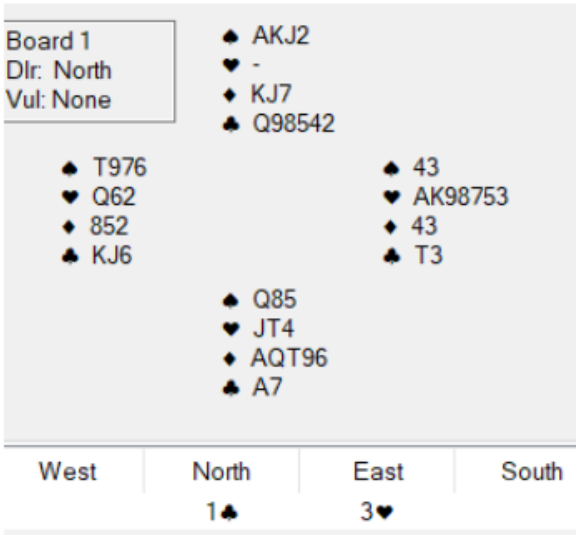


What should South bid? The answer favored by 9 out of 15 experts was "Double." Larry Cohen explained: *"Marty Bergen called this a 'thrump' double, with 'thrump' an abbreviation for 3NT – which is what partner should bid with Hearts stopped, even with four spades. Of course, if partner disappoints me as usual and doesn't bid 3NT, I can retreat to diamonds."* Two more experts bid 3NT on their own. The other four experts chose 4♦. No one Passed.

In this auction, holding this hand, Jethro won't consider Double without 4 spades, and won't consider 3NT without a full stopper. Jethro, in fact, chooses Pass as their bid, which no expert did. All I can say is, when bidding works, it works; bidding something will get you to game or slam when it is right. But is bidding something clearly better than Passing? I asked Jethro to generate hands for 20 auctions that started 1♣ – 3♥, while holding the South hand constant. In 14 of those hands, according to the Double Dummy analysis, Passing was the only way to get a plus score. Maybe Jethro's criteria for overcalling 3♥ vulnerable at IMPs are more stringent than the experts are used to playing against.

Or maybe this hand is subtly different from other hands where "thrumping" or directly bidding 3NT is the right action. Case in point:

In the September, 2021 Bridge Bulletin, Mike Lawrence wrote an article he called, "My Personal Headache." Here is the hand from that article:



The similarities to the previous hand are obvious: the auction is identical, and South holds a hand where it feels like you ought to bid … something. Mike's advice on this hand was for South to bid 3NT. (Mike is consistent – he was one of the 3NT bidders on the other hand, too.) On this particular layout, 3NT does not fare well, assuming E/W don't tangle up the Hearts. An off-shape negative double might have led to a Moysian 4♠, which works like a charm here. Or perhaps, on another layout, 4♦ would lead to the best spot.

Once again, I asked Jethro to generate 20 hands that fit this auction while holding the South hand constant. In those 20 hands,

- 3NT made: 11 times
- X led to a plus score: 9 times
- 4♦ led to a plus score: 4 times
- Nothing works; 3♥ goes down: 5 times
- No plus scores; 3♥ makes: 1 time

The total is more than 20, because sometimes multiple actions led to plus scores. E.g., 3NT or X leading to 4♠ both worked.

In any case, Mike's recommendation of 3NT looks like sound advice here. So what's different between these two South hands, and how does that impact the successful action? Looking at the "headache" hands generated, South's ♥JT4 makes it less likely that East's Heart suit will run; sometimes the suit is blocked, or East lacks a late entry. Next, compared to the first hand, South's ♠Q85 makes the Spade suit a much more likely source of tricks. South's ♥Q2 on the first hand may well be wasted. In fact, when it is South's turn to bid, Jethro reevaluates the "headache" hand to be worth about 1.5 more "working points" than the first hand. On game-marginal hands, that is a substantial difference. Bridge is full of subtleties.

As for Jethro? I added a line to one of my bidding tables to handle this exact "headache" hand, holding JTx (or better) in Hearts, and 13+ working points. Jethro is a 3NT bidder on this one, but not on the first hand.

Q: What about conventions?

A: Conventions are well and fine, and there are definitely times when a specific convention built to handle a specific situation will make your life easier. But experts are still experts even when playing a very limited number of conventions. Judgment is far more important that any convention.

As you will see below, Jethro has a few dozen optional conventions. But it's not really a particular point of emphasis.

Q: Are there other approaches one might try when creating a bidding program?

A: Sure. I won't claim to know a lot about neural networks, but that is one approach I have heard suggested. I do know that neural networks depend upon training data to "teach" themselves how to recognize and respond to certain situations. Where that training data for bidding bridge hands comes from and how it is assessed for "accuracy" would seem to me to be extremely difficult if not impossible. After all, one can look in any bridge magazine and see a bidding contest where experts disagree about the "right" bid to make. Training data would also have to take into account which conventions and treatments are in use, both by you and your opponents.

I'm not sure exactly how GIB (Matthew Ginsberg's bridge playing program, the brain behind the BBO bots) makes bidding decisions, but there is some information here, written by Professor Ginsberg in approximately 1998: https://www.ijcai.org/Proceedings/99-1/Papers/084.pdf

Concluding remarks in that paper include:

"There are a variety of straightforward extensions to GIB that should also improve its performance substantially. Principal among these is the further development of GIB'S (i.e., Meadowlark's) bidding database, and the inclusion of a facility that allows GIB to think on its opponents' time. None of these modifications requires substantial technical innovation; it's simply a matter of doing it. Martel has predicted that GIB will achieve expert levels of performance around 2000, and be stronger than any human player within two or three years after that. The prospects for doing this seem fairly bright."

In retrospect, Ginsberg's conclusion seems overly optimistic. If it was just a matter of "putting in the work" one would think that someone would have done so by now. I am not aware of

any bidding program being equally compared, much less favorably compared, to human experts.

Since the "Meadowlark database" is mentioned, here is another article featuring an interview with Rodney A. Ludwig, creator of Meadowlark Bridge: https://greatbridgelinks.com/chatting-with-meadowlark/

I don't know exactly what is meant by "bidding database". Is it, literally, a gazillion different bridge hands used for pattern matching? Or a database of possible bids that might fit a given situation? Or something else? I just don't know.

There is also mention of "Monte Carlo" simulation, which is creating random hands that fit the information gleaned from the auction and using those hands to inform subsequent bidding decisions. Jethro does not do any of that on the fly, but I actually did do some "pre-investigation" outside of Jethro to inform certain decisions. For example, I randomly created 50,000 preempt (2 or 3 level opening) hands and used the data to decide how the preemptor's partner should respond, based on the shape and strength of responder's hand.

Bottom line: I don't think "numbers and rules" is necessarily the best way to go, but it was the only method I could wrap my head around when I started coding, so that's what I did. In any case I think a "numbers and rules" approach is the most intuitive (at least it is to me) and I now have a program that can provide a good benchmark for comparison to other potential solutions.

And a final observation. Just in case you are wondering, ChatGPT isn't quite ready for bridge bidding contests yet. A friend sent me this email:

> I submitted one of your old questions to ChatGPT and here is the response:
>
> *Playing duplicate bridge You hold: S J92 H AT986 D T7 C AQ6 The opps pass throughout:*
>
> *Partner You*
> ---
> *1D 1H*
> *2D ?*
>
> *What do you bid?*
>
> *Here is the answer from ChatGPT:*
>
> *Given your hand, you should bid 2S. This is a constructive bid, telling partner that you have a good hand with 6+ sp ades and likely more than 8 points.*

I am impressed that ChatGPT correctly recognized this as a bridge bidding question. And the answer is certainly positively asserted. But very, very, wrong. No. Just no.

Q: Any other guiding principles?

A: It is important to me that I understand why every decision is made. The evaluation algorithm might not be "correct" (whatever that means) but however a hand is evaluated, I need to be easily able to determine the factors that went into the calculation. I don't want there to be any "magic" involved.

Q: Will Jethro win bidding contests, like the ones they have in The Bridge World or the ACBL Bulletin?

A: Highly unlikely. Bidding contests seem to invariably ask experts to pick a bid in a situation where there is no good answer. In other words, where rules don't apply, or aren't helpful. Sometimes it seems as though the experts' suggested action is always either a nebulous cue bid or double, expecting partner to successfully field anything you throw at them. Jethro will take a stab at every problem, and the result won't be random, but The Master Solver's Club is unlikely to be threatened. To further quote Matthew Ginsberg in the article referenced above: "*When faced with a situation that it does not understand, GIB's bidding deteriorates drastically.*" I think that is likely to be true for most if not all bidding programs.

Q: Are there bugs in the code?

A: Yep. Certainly. Anyone who tells you they write bug free code is qualified for membership in the George Santos Club. The program will flag obvious errors, like passing a forcing bid, or making an insufficient bid, or doubling a doubled contract. When that occurs I take a look and fix whatever it was that caused the problem.

There are still some occasional auctions that slip through the cracks and go completely off the rails. Those are definite failures of the Turing test. I hate it when that happens….

On the bright side, Jethro has never caused my operating system to crash. But I won't say it is impossible.

Q: Does Jethro cheat?

A: No. Where is the fun in that? What would be the point? Every decision Jethro makes is based on the same information that would be available to a person sitting at the table holding those cards, with full knowledge of the bidding systems used by both pairs. Having said that, there is one situation I am aware of which can be difficult to diagnose and replicate. There are

sometimes multiple pathways that might result in the same bid being made with different holdings. When that might occur, it seems to me it is not impossible that different information might be advertised, depending on which path was taken. That is wrong. Whatever bid is made, the same information should be advertised for the same bid. This is akin to "unauthorized information." If and when I come across such situations I fix them.

Q: What bidding conventions are available?

A: I have included options for most of the conventions I play with my regular partners, and a few more, too. Adding new conventions is not high on my "to do" list. Feel free to ask for additional conventions, but don't hold your breath.

Here is the current "Convention Card" screen, along with Jethro's default choices:

And here are the included "Bidding Notes." There are undoubtedly many situations not explicitly mentioned. In those cases I tried to program what I think are "standard" bidding sequences. And, no, my definition of "standard" might not match yours.

Defense to Gambling 3NT: 4♣ = Majors, 4♦ = Major+minor, 4M = Natural, X = Penalty

Defense to Flannery: 2♥ = ♠+minor (Michaels), X = Takeout of ♥, everything else natural

Defense to Namyats: Direct X for takeout of major shown; delayed X for penalty

Defense to Strong 2♣: X = Majors, 2NT = minors

1NT Openers

1NT-3♠ = 5♠+5♥, GF; 1NT-3♥ = 5♠+5♥ inv.

If not playing minor suit transfers, 1NT-2♣-?-3m is natural, slammish, and denies a four card major.

Major Suit Openers

1NT Forcing by unpassed hand

Jacoby 2NT GF, Jacoby Transfers, Texas Transfers

When playing NATURAL, 1M-3M = limit raise, 1M-3NT = 13-15, 2 card support

When playing BERGEN, 3♦ limit, 3♣ constructive, 3NT = 4333, 3 card support

Minor Suit Openers

When playing NATURAL, 1m-2m = constructive, 1m-3m = limit raise

When playing INVERTED, 1m-3m = preemptive, 1m-2m = limit+, JS in other m = constructive

Over Opponents Takeout Double

When playing STANDARD, 2NT = limit+ over majors; 3+ card support

2NT = limit+ over minors (always); 5+ card support over ♣, 4+ over ♦

Simple Kokish: 2♣-2♦-2♥-2NT = 25+

Over Weak 2s, RONF

NOTE: Most conventional bids are OFF in competition. Except responses to Flannery, or Texas, if it is over 3♦ or lower.

NT Overcalls

1? - 1NT or 2? - 2NT = Direct Range from CC; systems on

1? - P - P - 1NT = Balancing Range from CC; systems on/off (CC)

1? - P - P - 2NT = 19-21 HCP; systems on/off (CC)

2? - P - P - 2NT = Balancing Range from CC +1; systems on/off (CC)

1? - 2NT = Unusual NT for 2 lowest unbid suits

Q: How many different kinds of bids will Jethro make and respond to?

A: At last count there were 200+ different kinds of bids made and responded to by Jethro, ranging from the mundane, e.g., “Natural and Constructive” to the somewhat more esoteric “Do Something Intelligent” double.

Q: What ideas do you have about deciding if a program (or, really, any partnership) is bidding well? What makes a world class bidder?

A: As alluded to above, one of the pie in the sky ideas I had in the back of my head when I started this project was to create a world class bidding program. (Why not aim high? And, no, for the record, I do not believe Jethro is remotely close to that level, however a “world class bidder” might be defined.)

But then I started wondering, what metrics could one use to measure the efficacy of a bidding program? There are some things that are objectively easy to tabulate, when looking at all 52 cards: How the HCPs are distributed, what fit (or lack thereof) might exist, etc. The Double Dummy Solver gives an objective measure of how many tricks can be taken by each hand. These elements could be combined into a table(s) showing the probability, for example, of taking 10 tricks in a spade contract where the partnership has a total of 8 spades and 23 high

card points. Above a certain threshold, you want to be bidding that game. Does the program get there?

There are, needless to say, a nearly unlimited number of permutations one might pursue in "scoring" a bidding program along the lines suggested above. What about defensive bidding? What about sacrifices? Competing for part scores? Slam bidding? Etc., etc. I am under no illusions that it would be easy to assign appropriate "scores" to all the potential actions. But the idea intrigues me; I'm all ears if anyone wants to discuss something further in this area.

What I do know is that it would be absolutely great to have a library, of say, 100,000 deals to use for testing a bidding program. (Creating hands for testing is not a problem.) Run the deals through the program and get a total "score." Make some changes to the bidding program, run the same deals through again and get a new score for comparison. If the score is higher, keep the changes. One serious concern is that the scoring would influence the programming so that the program was geared toward getting a good score – kind of like "teaching to the test" – not necessarily bidding well.

One of problems I am now experiencing is making a change to the program to handle a problem hand (it often *appears* to be obvious what the change should be) only to discover some days or weeks later that the change I made creates a new problem elsewhere, often in a place that previously worked just fine. I hate playing whack-a-mole with fixes. Having a test suite would be hugely helpful.

Q: Can I use Jethro to practice my own bidding?

A: Yes. But it wasn't easy to get there. I made a serious mistake when I began programming. I will explain below.

I picked on the BBO bots a little bit above, but they really do provide some nice features. One of the very best things about the BBO bots is that they provide instant feedback about potential bids you might make. When the BBO bot is your partner, and it is your turn to bid, you can mouse-over the bids in the bidding box, and see how your bot partner will interpret any bid you might be considering.

I don't know how GIB solved this problem. Is there really a database of thousands of bidding sequences, and a table of possible bids in each sequence? That would be one way to do it. Since GIB plays only GIB's system, and GIB's conventions are all baked in, it might be doable. Once one starts adding optional conventions the problem scales up very quickly. If anyone knows the answer to the question of how GIB solved this problem, I would very much like to know.

In any event, I have some advice for anyone thinking about writing their own bidding program. For every bid to be made, I started from the premise, “Here is my hand. Taking in all of the previous information gleaned from the auction, and our partnership agreements, what bid should I make in the current situation?” This is not the approach I would take if I were starting today. The right question is not, “What bid should I make?” but rather, “For all possible current legal bids, what would each of those bids show in the current context?” If you can answer that question, then you can answer the question of how any bid will be interpreted by everyone else at the table. It’s ok for the answer to be ambiguous, i.e., “This bid might show (a) or (b) or (c).”

But, sad to say, that’s not how I programmed Jethro. I did not build in any way of keeping track of the possible bids that were *not* made, and what those bids would advertise. When Jethro makes a bid, strength and shape information is advertised to the table by the program. This is public information, based on the bidding system and conventions/treatments you are playing, so it is available to everyone. Think of it as kind of like a “self-alert” for every single bid. Since Jethro’s partner (also Jethro) knows, in intimate detail, what bidding system the partnership is playing, there is no unauthorized information. But programmatically, it only occurs because the bidder publishes information to everyone at the table when the bid was made.

If, however, I was playing as Jethro’s partner, and I made a bid, Jethro had no capacity to interpret my strength/shape on its own, since I was not explicitly advertising anything. Similarly, if a bid was made by an external agent, either a person or a different computer program, Jethro was in the dark. Solving this problem for any particular bid that might be made by not-Jethro is really just the one special case of solving for all possible bids that might be made, i.e., that mouse-over information mentioned above. Unfortunately, there was no way, given how I had written the program to keep track of what bids were possible, but *not* made, and what those alternate bids might have advertised.

Since, at some point it became clear that I would very much like to be able to use Jethro as a partner for practice bidding, or possibly to compete against other people or programs, I had to do some serious retro-fitting. I embarked on a path that I consider somewhere between insane and semi-brilliant. Before every single bid is made, I play a “what if” game. What if I held this hand, or this hand, or … any of ~7000+ test hands of various shapes/strengths. What bid would I make? So, literally, before any bid is made I run every hand in my universe of “test hands” through the bidding algorithm to see what bid would be made with each of those hands. I keep track of all the different possible bids made. I now know, for example, a 3♣ bid at a particular point of the auction means <something> and a 3♠ bid means <something else>. This exercise had the side effect of exposing a **lot** of bugs; there were plenty of times when I wanted to make the same bid but advertise slightly different hands. That shouldn’t happen.

The good news is that I can now interpret bids that are made by not-Jethro. The not-so-good news is that I have to assume every bid has the same meaning as if Jethro made it. Since Jethro will not make every legal bid in every situation, there are times when a bid might be made that Jethro does not have an interpretation for. Hopefully those circumstances are rare. But when they occur, I make my best guess based on the current situation and move on.

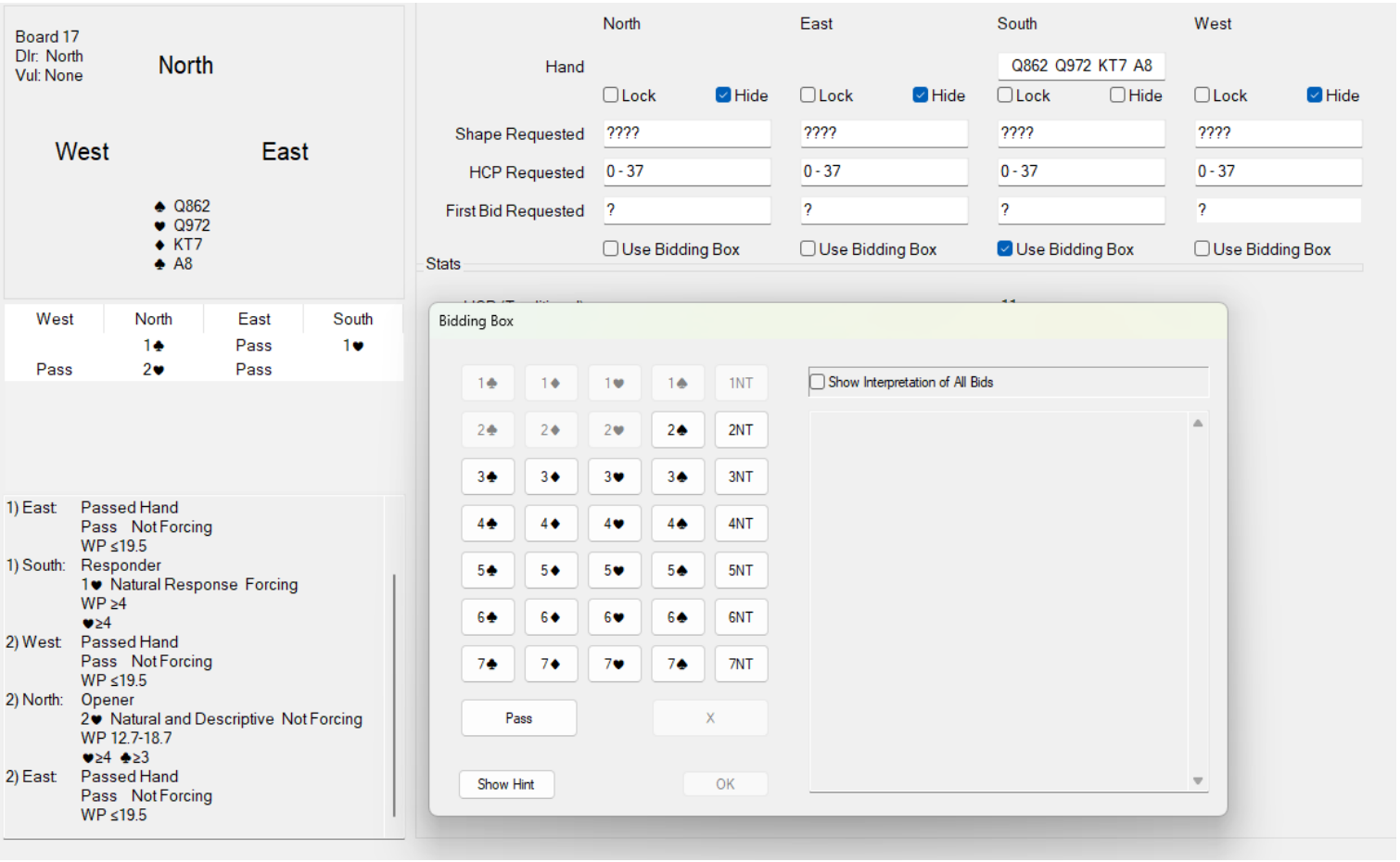
There are some other ramifications of these assumptions. Jethro plays 2/1 GF with 5 card majors and strong (15-17) NT openers, which is what passes for "Standard American" these days. The "Convention Card" allows different options and treatments on top of that basic system. Every bid that is made, whether by a robot or a person is interpreted in that context. After every bid, information is advertised to the table about the hand that just bid. That information is everything that is publicly available to all players: shape, strength, forcing/non-forcing, what kind-of-bid, stoppers (where applicable), keycards, etc. Robot opponents also have a "convention card," which, of course, can be configured however one wants. This is how the program knows, for example, what a 2♦ overcall of our 1NT opening means.

If you want to practice some other system, say Precision or a Canape style, it just isn't going to work. A 1♣ opener, for example, means what it means to Jethro, and that is that. Anything else would require changes to the convention card, and (likely) significant additional work. Adding weak NT is on my to-do list, but I haven't gotten around to it; I confess I don't feel like I have a good enough grasp on the whole weak NT system to be confident programming it.

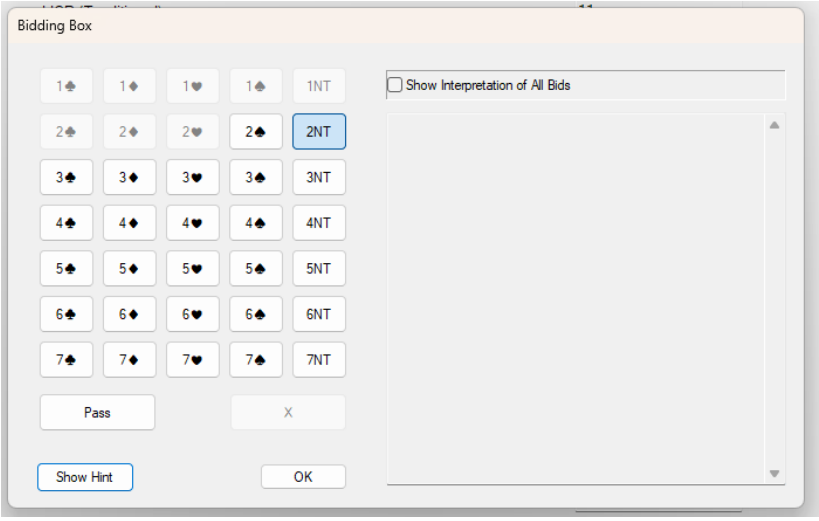
If you want to practice *against* some other system, that is possibly doable, but would require extra work that I haven't really contemplated. It would have to go something like this: A bid is made by an external agent, either a person or a different program. An extra step would be required, where the external agent would have to explicitly advertise the shape/strength/etc. information the program is entitled to know about.

I don't know how this situation is handled by computer opponents in a computer bridge tournament, but it seems something along those lines would be necessary. Either the conventions/treatments allowed would have to be proscribed, or there would have to be a mechanism to relay that information. Requiring all programs to know about all other programs' possible foibles would be impossible, or so it seems to me.

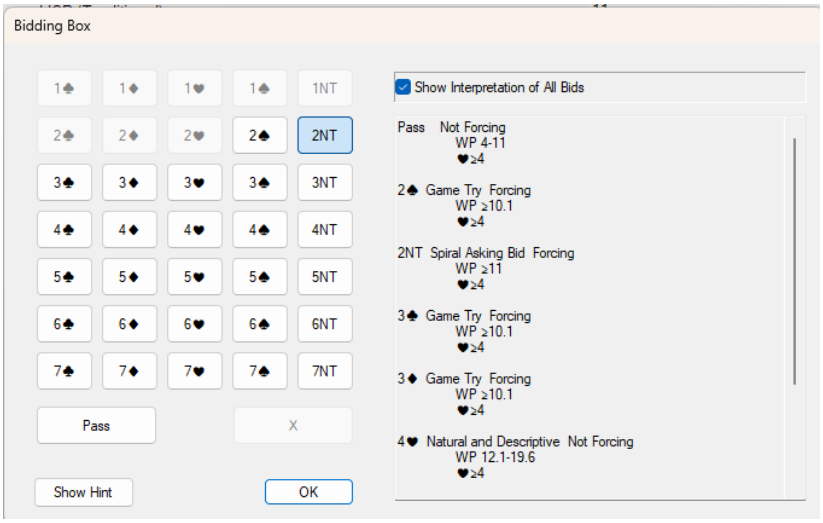
Here is a screenshot showing how you might set up to bid as South, with the other hands hidden. When it is your turn to bid, a “bidding box” pops up:



Clicking on “Show Hint” tells you what Jethro would bid in this situation:



Checking the “Show Interpretation of All Bids” box tells you how every bid you might make will be interpreted by Jethro. Every legal bid will be listed, even the bids that Jethro would not consider in the current situation. If you choose a bid Jethro would never make, a warning box pops up, and Jethro will make a guess as to how to interpret your bid.



Q: How else might I use the program?

A: I use Jethro regularly to help me decide if a bid I made when playing with friends was reasonable or ill advised. There are tools built in that make it easy to ask for hands of specific strength and shape. If that isn't enough, you can also ask for hands where specific bids were made on the first round of bidding.

For example, here is a hand that came up recently, and led to a lengthy discussion. You are South, and it is your turn to bid:

♠ 9
♥ KQ3
♦ T74
♣ AJT542

West	North	East	South
	1♠	2♦	

You might bid 3♣, you might Pass, you might even make an off-shape negative double. If you pass and partner reopens with a double you will have another decision to make; if partner does not reopen, you might wish they had done so. It's not clear at all how any of those actions might eventually work out. It is possible that defending 2♦ is your last chance for a plus score. Alternatively, Passing might lead to a poor result.

Jethro may be able to help. Lock in the South hand to this specific holding, then ask for hands with auctions that start 1♠ - 2♦ - ? It only takes a few seconds to generate each hand. After you've looked at 15 or 20 hands with this auction, and having seen the Double Dummy analysis, you will likely have a better sense of the possibilities.

Q: What about creating test hands?

A: A useful feature is the ability to save hands to a file. There are a lot of options for getting exactly the hands you want, based on shape, strength, and other parameters. Hands can be saved to a human readable file, from which they can be printed, and in .PBN notation (a kind of de-facto standard for documenting bridge hands.)

Q: How might Jethro's bidding be improved?

A: New rules can be introduced to deal with those situations that have slipped through the cracks. I find this tedious, but often necessary. One of the things that makes bridge infinitely challenging is the fact that special cases abound. Programmers don't like special cases; we prefer generalized algorithms that magically handle all possible inputs. Bridge bidding is very uncooperative in this regard. There will always be room for new rules to handle specialized situations, since bridge bidding can be extremely context dependent. In that regard, the programming will never be "done."

And about all those numbers mentioned above. There are literally hundreds of numbers baked into the code. From initial hand evaluation, to dynamic hand evaluation as the auction proceeds, to the threshold values that used to decide if/how much to bid, and lots of other places, there are numbers everywhere. Are those numbers "correct?" Certainly not. They are a bunch of best guesses, based on Double Dummy analysis and my experience. As I said at the top, my initial goal was "plausibility." Plausible and optimal may not live in the same zip code.

How might those numbers be improved? I created another program which allows me to run bridge matches of Jethro vs. Jethro. One of the Jethro partnerships gets a slightly altered version of the software. Maybe a bit different on some of the rules and some of the numbers. Run a 1000 board match; it's a computer so it won't take that long. Compare the results. Keep the winning code as the new baseline, and try again.

If I am really, really clever – and I admittedly do not know how realistic this is – I will be able to automate the process so that some of the numbers are changed randomly without requiring manual intervention. I have read just enough about "Genetic Algorithms" to be foolishly and optimistically over-confident. See https://www.britannica.com/technology/genetic-algorithm for a (very brief) overview of this topic if you are interested.

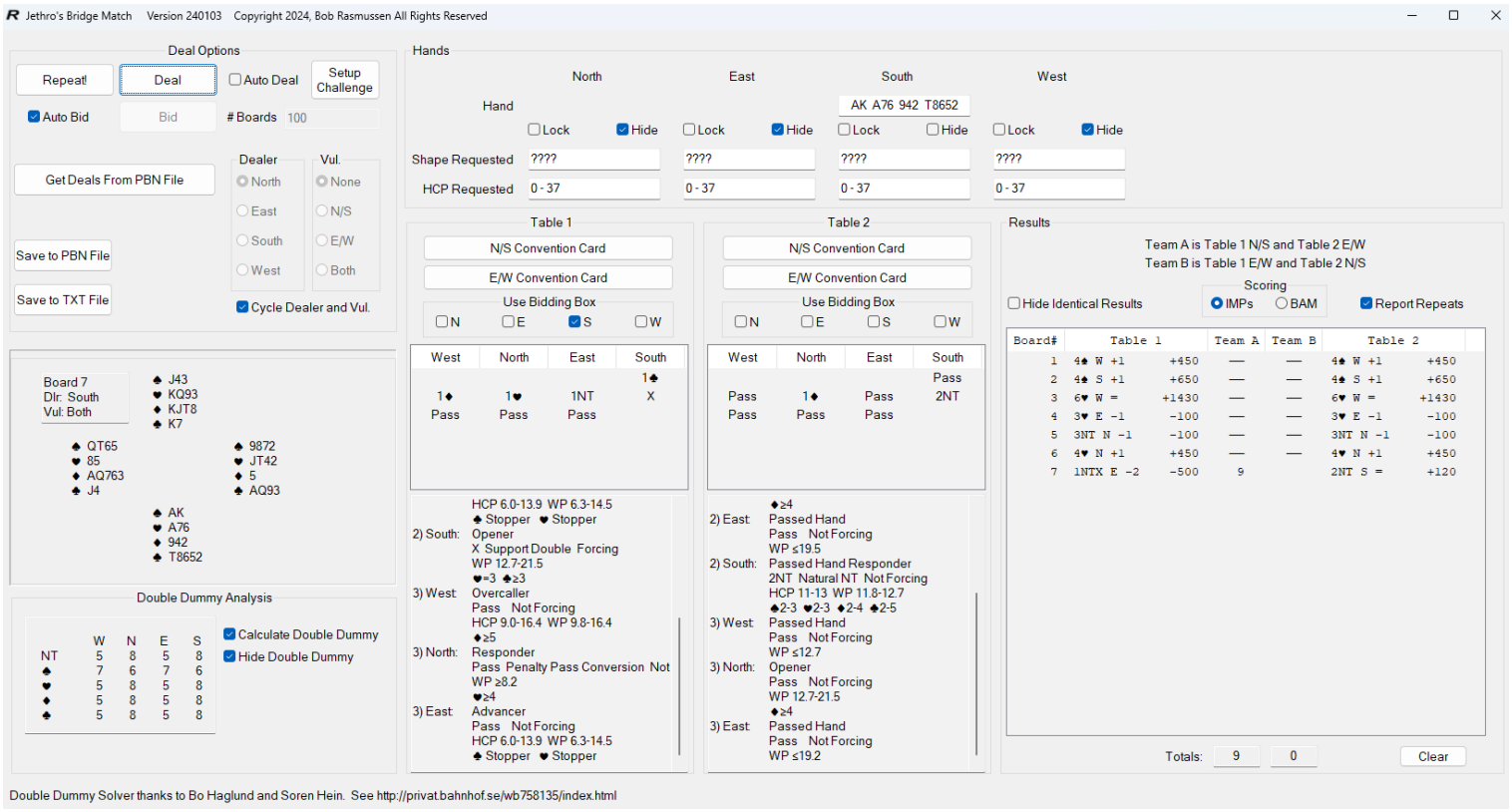
Q: Can I practice my bidding by playing with/against Jethro?

A: Yes. In the "Jethro vs. Jethro" program mentioned above, you can set up a bridge match where you bid as one or more of the players. Then the same hand is bid at a table populated entirely by "Jethros." A comparison is made, just as if you were playing a team game. If you

want to try the same hand again, and bid it differently, or try out different conventions (either yours or your opponents) that's easy to do.

Here is a screen shot from that program, showing a hand where I bid the South hand at Table 1. On Board 7 my bidding differed from Jethro's, resulting in a 9 IMP gain for me. On the other hands the bidding was identical, so the results were also identical.

Results are calculated using the Double Dummy analyzer, assuming perfect play by both the declarer and the defenders; if the hands were actually played out, there would undoubtedly be many more disparate results.



Q: What about declaring or defending?

A: Not on my radar at this time. That is a very different problem. Maybe someday I will take a stab at it, but apart from "create random hands that fit the auction and use the Double Dummy solver" I haven't really thought about it.

Q: What platform(s) does it run on, and can it be ported to different platform(s)?

A: Well. About that. It's a problem.

Jethro is a Windows 11 program. It might or might not work on Apple or Linux systems with Windows emulators; I've heard mixed messages about that. There is no web based version.

Jethro's GUI (Graphical User Interface, the part of the program you directly interact with) is written using Microsoft Foundation Classes (MFC). This is 20+ year old technology that I taught myself back in the day. It is now obsolete, but, fortunately for me, the programming tools still support it, at least for now. None of the clients I had in my 30+ years of running a one-man programming shop called on me to create web interfaces for anything, and I never bothered to teach myself. And, to be bluntly honest, I have no interest in doing so.

Geek alert: Feel free to skip the next part.

The bridge-y part of Jethro is written in straight C++ code. I expect it could be easily ported anywhere with a C++ compiler. There is nothing particularly tricky going on.

MFC is all C++. There is a very thin interface between MFC's C++ GUI code and Jethro's C++ code.

The point is that if someone was interested in putting a different front end on to Jethro, be it web based, or other platform based, I think it would be non-trivial, but relatively straightforward. If this idea piques your interest, and you have the requisite expertise, please contact me.

Q: How much does it cost, and can I get a copy?

A: I am not trying to make any money. Jethro is free for the asking. Send me email at JethroTBW@gmail.com and I will send you the latest version.

Q: Is there a way for other people to help?

A: Sure. Ask for your own copy of Jethro and try it out. I'm sure there are plenty of situations that have slipped through the cracks. Let me know when you find them.

If any of the ideas or thoughts above spark some interest, let me know. I have been working more or less in a silo of my own for a good long time. I am at a point now where it would be extremely useful to have broader discussions than the ones occurring between my own ears.

You are encouraged to send this Q&A document to anyone and everyone you think might be interested.

If it was not clear from the above, I do not have a personal website, or a place where the program could be downloaded from. If you do, and would be willing to be a host site for Jethro downloads, I would be honored.

Q: Are you going to release the source code?

A: Not at this time. Maybe someday. One of my primary reasons for not releasing it is because I have no desire to write up the documentation that would be necessary to let others successfully make changes and additions. There is a lot going on. Having spent several professional decades looking at and modifying/fixing code that I did not write, I can pretty confidently say it would not be easy for someone else to dive into the Jethro code. Not impossible, but there would be a distinct and steep learning curve.

Having said that, I do think there are plenty of opportunities for others to contribute to the various algorithms. Here is one specific case in point:

There is a software function called "`WeExpectToBeatOppContract.`" Before a penalty double is made, or partner's "Do Something Intelligent" double is converted to a penalty double, this function is called to see if Jethro thinks the double will be successful. If not, a penalty double will usually be eschewed. There are a lot of factors considered inside this function. I am confident the function could be made better. Obviously you don't want the opponents outbidding you and stealing you blind. Just as obviously, no one enjoys writing -530 or -790 on their scorecard.

Here are the factors currently considered by the algorithm in this function. Jethro puts 'em all together somehow and calculates a number representing the number of tricks you expect to beat the current contract.

- The current contract and vulnerability
- Your hand
- Partner's advertised shape, including "Did they advertise a two-suiter?" or "Did they advertise a single-suited hand?"
- Partner's advertised strength
- Did partner make a preemptive bid?
- Both opponents' advertised shape, including "Did they advertise a two-suiter?" or "Did they advertise a single-suited hand?"
- Both opponents' advertised strength
- Did an opponent make a preemptive bid?
- Did our side previously make a penalty oriented double?
- Did the opponents have a game forcing auction, or did they get to game without one?
- Was partner's last bid a "Do Something Intelligent" double, or some other kind of ambiguous strength showing bid?
- Is partner a passed hand?
- Have the opponents advertised an 8+ card fit in their suit?
- Do we have an 8+ card fit anywhere?

- What was the contract, and who was the declarer, before and after partner's most recent bid?
- Did the opponents take us out of game, or were we in a game forcing auction when they outbid us?

If you want other information about the auction, it is probably easy to get.

The question is, "Can you do better than Jethro?" I would love to see what other people come up with. The software tools I created make it easy to try out new algorithms and compare them to the existing code.

This is just one of many, many places where new ideas could be tried and tested.

Q: Future plans?

I think I've got enough to keep me busy for the foreseeable future. And who knows what else might pop up. I'm not holding my breath waiting for BBO or anyone else to contact me about making Jethro available (for free, of course) in some bridge related product, but one never knows.

Q: And finally: why did you name your program "Jethro"?

A: Very early in the development, when I was working on opening bids, I was having trouble with a specific problem. It goes something like this. You pick up a hand that you think of as an obvious 3♥ opener, say,

♠ 86
♥ AQT9854
♦ 9
♣ QT4

.

If the hand was a bit better, you would have opened it 1♥ instead, perhaps with,

♠ K6
♥ AQT9854
♦ 9
♣ KT4

.

The point is that somewhere in between, you have to decide if a hand is a preempt, a one level opener, or in some very few cases, neither a preempt nor an opener. When I was talking to a friend I referred to this as the Jethro Tull problem, because it made me think of their song, Too Old To Rock 'N' Roll, Too Young To Die. The next time I was talking to my friend, he asked, "How is Jethro doing?" and the name stuck.

For the record, I went searching for hands that Jethro put in this category: too good to preempt, not good enough to open. Here are a few I found:

♠ Q3 ♥ 85 ♦ QJ95432 ♣ AJ	♠ A ♥ JT98653 ♦ K96 ♣ Q3
♠ KQ ♥ T76 ♦ 3 ♣ AT76543	♠ QJT6432 ♥ A53 ♦ Q7 ♣ 4

.

To which I say, "Ok, I'm not 100% sure that's what I would have done, but I think it's plausible."

♣ ♦ ♥ ♠

More hands bid by Jethro:

Board 123
Dlr: North
Vul: None

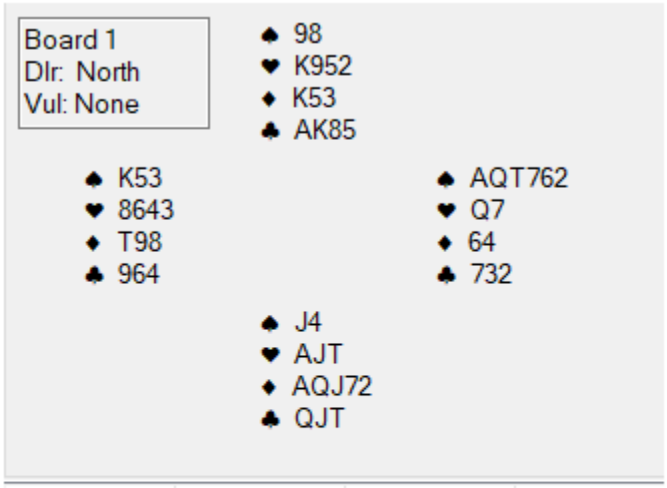
	♠ KQJ87 ♥ A74 ♦ 64 ♣ JT6	
♠ A94 ♥ QT965 ♦ AT73 ♣ K		♠ 53 ♥ KJ8 ♦ KJ982 ♣ 742
	♠ T62 ♥ 32 ♦ Q5 ♣ AQ9853	

West	North	East	South
	Pass	Pass	Pass
1♥	1♠	2♥	2♠
Pass	Pass	3♥	Pass
Pass	Pass		

On this hand, North chose not to open 1♠, but backs in later with an overcall.

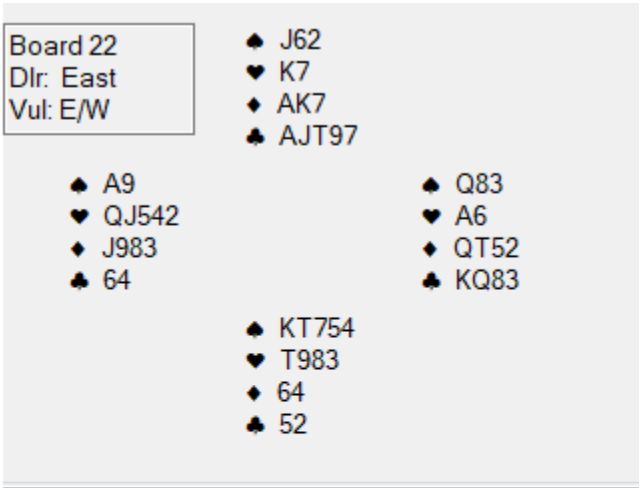
E/W can make 4♥, but it's not clear how to bid it. (It's always easier when looking at all four hands!)

Jethro gets to 5♦, despite some annoying interference:



West	North	East	South
	1♣	2♠	3♦
3♠	4♦	Pass	5♦
Pass	Pass	Pass	

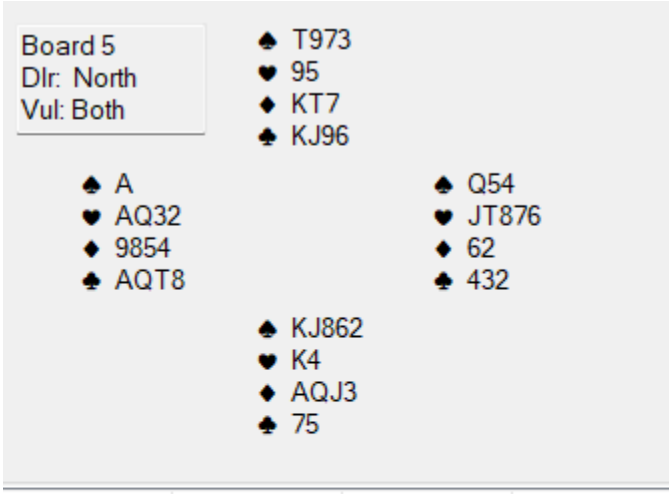
West's cheeky 3♠ bid might not be everyone's first choice, but it definitely gives N/S some difficult decisions to make. 5♦ turns out to be a good spot.



West	North	East	South
		1♦	Pass
1♥	2♣	Pass	Pass
2♦	Pass	Pass	2♠
3♦	3♠	Pass	Pass
Pass			

Getting to the par spot. 3♦ can make, 3♠ is down 1, according to the DDS. Personally, I would have sold out to 3♦ with the N hand.

On this hand I believe a BBO bot sitting North would choose to get in the auction with a strong NT overcall. In that sequence I don't think a BBO South bot would take a subsequent bid, and E/W are likely to buy the contract at 2♦. Jethro will not make a strong NT overcall when both opponents have been bidding and have shown two suits.



West	North	East	South
	Pass	Pass	1♠
X	2♠	Pass	Pass
X	Pass	3♥	Pass
Pass	3♠	Pass	Pass
Pass			

A win for the Law of Total Tricks. Each side has a 9 card fit, and each side can take 9 tricks in their own suit.

On this one, North balanced with 2NT, asking South to bid a minor. South opted for their 6 card Heart suit instead. Double dummy, each side can take eight tricks in their major.

Board 32
Dlr: West
Vul: E/W

	♠ J4 ♥ JT ♦ JT865 ♣ AK82	
♠ A7632 ♥ K5 ♦ AQ2 ♣ 973		♠ Q98 ♥ Q76 ♦ K94 ♣ QT54
	♠ KT5 ♥ A98432 ♦ 73 ♣ J6	

West	North	East	South
1♠	Pass	2♠	Pass
Pass	2NT	Pass	3♥
Pass	Pass	Pass	

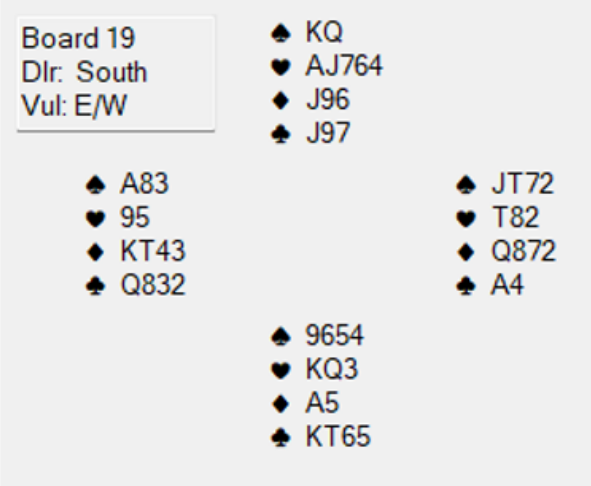
Board 44
Dlr: West
Vul: N/S

	♠ Q643 ♥ KT85 ♦ QT5 ♣ 74	
♠ JT82 ♥ 942 ♦ K3 ♣ T653		♠ A ♥ J7 ♦ J987642 ♣ KQ2
	♠ K975 ♥ AQ63 ♦ A ♣ AJ98	

West	North	East	South
Pass	Pass	1♦	X
Pass	1♠	2♦	3♠
Pass	4♠	Pass	Pass
Pass			

Judging what to bid rebid after making a takeout x can be difficult, since partner could be completely broke. 3♠ seems about right.

There are several different treatments and conventions available to compare. This hand was judged to be just a hair too light to force to game. I probably would have bid game anyway, and likely gone down.



Bidding with one-way nmf:

West	North	East	South
			1♠
Pass	1♥	Pass	1♠
Pass	2NT	Pass	Pass
Pass			

vs. bidding with XYZ:

West	North	East	South
			1♠
Pass	1♥	Pass	1♠
Pass	2♣	Pass	2♦
Pass	2♥	Pass	Pass
Pass			

Board 29 Dlr: North Vul: Both	♠ 952 ♥ 8654 ♦ QJT7 ♣ Q2	
♠ 3 ♥ AQJT ♦ 85 ♣ AK9843		♠ QJT8764 ♥ K73 ♦ K9 ♣ T
	♠ AK ♥ 92 ♦ A6432 ♣ J765	

West	North	East	South
	Pass	Pass	1♦
2♠	Pass	2♠	Pass
3♠	Pass	3♠	Pass
Pass	Pass		

With a couple of Kings outside their suit, East is unlikely to preempt, especially in 2nd seat.

Misfits can be hard to deal with. With a 7th spade, East bids one more time. Turns out 4♠ played by East can't be beat, since North can never get in to lead a ♦ through. But it sure doesn't seem like it is biddable.

Aggressive bidding to a good slam:

Board 26
Dlr: East
Vul: Both

	♠ AQ76 ♥ 4 ♦ 85 ♣ T87543	
♠ K943 ♥ AT983 ♦ Q4 ♣ A6		♠ T82 ♥ KQ76 ♦ AKJT9 ♣ 9
	♠ J5 ♥ J52 ♦ 7632 ♣ KQJ2	

West	North	East	South
		1♦	Pass
1♥	Pass	3♥	Pass
3♠	Pass	4NT	Pass
5♥	Pass	6♥	Pass
Pass	Pass		

Board 23
Dlr: South
Vul: Both

	♠ A73 ♥ K986 ♦ T7 ♣ A864	
♠ KT852 ♥ Q5 ♦ J43 ♣ Q97		♠ 6 ♥ AJ732 ♦ AQ52 ♣ KJ3
	♠ QJ94 ♥ T4 ♦ K986 ♣ T52	

West	North	East	South
			Pass
Pass	1♠	1♥	X
1NT	X	2♦	Pass
2♥	Pass	Pass	Pass

South makes a negative X, showing 4 exactly spades. North makes a support X of spades, showing exactly 3, not knowing if this will be useful information for South.

East bids their 2nd suit, and West takes a preference to ♥ on a doubleton. East is not tempted to bid more, despite clearly having the best hand at the table.

And, of course, the obligatory long auction to a Grand Slam:

Board 19
Dlr: South
Vul: E/W

	♠ AKQT9 ♥ 3 ♦ A954 ♣ Q32	
♠ 5 ♥ T76542 ♦ Q32 ♣ J87		♠ 8643 ♥ KJ98 ♦ T76 ♣ T4
	♠ J72 ♥ AQ ♦ KJ8 ♣ AK965	

West	North	East	South
			1♠
Pass	1♠	Pass	2NT
Pass	3♦	Pass	3♠
Pass	4NT	Pass	5♥
Pass	5NT	Pass	6♠
Pass	6♦	Pass	7♠

3♦ is game forcing "Wolff Checkback." If you choose not to play that treatment, then 3♦ still would have been the bid made, but then it would have been described as "New Minor Forcing." (On this particular hand, it's really a distinction without a difference.)

The option was set so that 5NT asked for specific Kings, so South bid 6♣ to show the ♣K. Had the option been set to show the number of Kings, South would have shown 2 Kings by bidding 6♥.

No worries; 6♦ asks for the ♦K. South has it, so bids 7♠. Either way, the grand slam is reached.

There are certainly hands South might hold for this auction where 13 tricks will not make. But the algorithm judged -- correctly, in this case -- that bidding 7 was a risk worth taking.