Introduction:

I am “Lucandor158”, a speedrunner of Mike Tyson’s Punch-Out. Over the past weeks, my brother “Zoxsox” and I have been investigating how RNG works in the game and how it can be manipulated. We now have a solid basis for how the RNG works, and are looking for ways to exploit it. This is an explanation of our understanding of the game’s RNG and a guide for our first discovery, how to manipulate King Hippo. A big thanks to Zoxsox for helping with a lot of the programming and other data processing needed to gain all this knowledge. With my game knowledge and his computer knowledge we were able to make a lot of progress in understanding how this game works.

Background info on how RNG works in MTPO:

RNG in MTPO is based off the memory address 0018 in RAM. This value changes every frame based on 2 other memory locations: 0019 and 001E. All these locations are 1 byte, or 8 bits (0s or 1s). Fighters will look at 0018 and decide which action to perform.

0019:
This memory location is based off the player’s inputs. Pressing each button will add a certain number to 0019 each frame it is pressed. These are the values each button adds per frame pressed:

Right: 1
Down: 2
Start: 4
B: 8
A: 16
Up: 32
Select: 64
Left: 128

For example if 0019 was at 100, and you pressed Right for 5 frames, 0019 would end up at 105. This holds true for pressing multiple buttons at once, so if you hold Up and B for 2 frames, it would increment 0019 by 80 (2 * (32+8)). When 0019 reaches 256, it wraps back around to 0, since it is 8 bits so it can only hold numbers up to 255.

001E:
This one is more simple, it is a frame counter that counts from 0 to 255 (0 to FF in hex), incrementing every frame, then resets back to 0. For example, 260 frames after 001E is 0, it will be 4 (260-256).

How 0018 is calculated:
0018 is based off 0019 and 001E, and knowing both will allow you to know what 0018 will be on that frame. It is not extremely important how this transformation is done, only that it is predictable. It is quite complicated so if you do not care about the specifics of how it is done, you can skip the next section.

The specifics:
0019 and 001E are both manipulated in different ways and then added together. The bits are basically “shuffled” to make a new number. I will show where each bit ends up. The transformation for 0019 is:

Bit in 0019	Bit added to 0018
1	1
2	4
4	16
8	64
16	2
32	8
64	32
128	128

The transformation for 001E is:

Bit in 001E	Bit added to 0018
1	128
2	1
4	64
8	2
16	32
32	4
64	16

128	8

These converted numbers are then added to create the 0018 value for that frame.

Example:
If 0019 was 83, or in binary 01010011, then it would be converted to 00100111, or 39.
If 001E was 156, or in binary 10011100, then it would be converted to 01101010, or 106.
These values would then be added so 0018 on that frame would be 145.

Shifting:
This information is not necessary to understand the strategy, but it relates to how MTPO RNG works. Every time 0018 is accessed, it is rotated right by 3 bits, as if it were a 9 bit number (the 256 bit being a 0). For example 00001000 would become 00000001, 10000000 would become 00010000, and 00010010 would become 10000010. This shift occurs when 0018 is accessed, whether it is by the opponent, little mac, or the crowd. Luckily, 0018 is read for the opponent before the crowd, meaning the crowd's shift of 0018 does not mess up 0018 for the opponent, allowing it to be predictable.

The strat:

The first iteration of this strategy will allow hippo to open his mouth on his first punch 100% of the time. It is likely to be improved, but currently we do not understand hippo well enough to apply it to the second punch and not enough research has been done about other fights to apply it there. Hippo was our first target for obvious reasons.

How to get 100% first open:
Play through the game normally, but do not press Right or Down at all before hippo. This has little effect on gameplay, the only downside is no ducking on kaiser. When you get to hippo, you must start the fight on an 8 frame window, that repeats every 256 frames. This means each window comes around every ~4.3 seconds. You can hit this window using a timer you start when you reset. Before the first punch, you cannot use the normal 3 right dodge buffer because you are not allowed to press Right. Instead, manually time the punch just like any other, and he will always open. After this, press any buttons you like for the rest of the run. Some testing is needed for this strategy to see if it can work consistently in real time, but the preliminary results are that it can be consistent with practice. Another benefit of this strategy is that if you miss the 8 frame window in either direction (early or late) by 8 frames or less, hippo will have a 50% chance to open on his first punch rather than 37.5%, which is still an improvement.

When you should start the fight/Working with the timer:
There are different methods to start the timer, but the best I've found is to hold down the reset button, and then let go and start the timer at the same time. With this method the most convenient time to start the hippo fight is at 5:04, since this is the only time where a round

second (x:xx.00) evenly divides the window. You should get to hippo by 5:04 as long as you don't pause too much between fights. I will also add a list of other time windows you can use.

Start of window	End of window
4:51.17	4:51.287
4:55.43	4:55.547
4:59.69	4:59.806
5:03.949	5:04.066
5:08.209	5:08.326
5:12.469	5:12.585
5:16.728	5:16.845
5:20.988	5:21.105
5:25.248	5:25.364
5:29.507	5:29.624
5:33.767	5:33.883
5:38.027	5:38.143
5:42.286	5:42.403
5:46.546	5:46.662
5:50.806	5:50.922
5:55.065	5:55.182
5:59.325	5:59.441
6:03.585	6:03.701
6:07.844	6:07.961

These times will only work if you start the timer when you release the reset button. If people find other methods where they can start the timer more consistently, I can find the windows for that too. One example is going from power on and starting the timer when the blue opening screen appears. Another is resetting and buffering Start, then starting the timer when the glove disappears on the opening screen.

Why this strategy works:

There are quite a few things going into this strategy. The general idea is that we can know a lot of information about the 0019 and 001E values on the frame where hippo decides to open his mouth, enough to guarantee he will open.

How we know 001E:
In MTPO, much like in Super Mario Bros., there are frame rules. In SMB1, you can only be transported to the next level every 21 frames. Similarly, you can only be transported to the start each fight in MTPO every 8 frames. Since 001E repeats every 256 frames, the window comes around every ~4.3 seconds for you to hit start. This means if you hit the 8 frame window(0.133 seconds) to start the fight, we know exactly what 001E will be when hippo decides whether or not to open his mouth.

How we know 0019:
If you look back at what each button adds to 0019, you will see that Right adds 1 and Down adds 2. This means if we never press Right or Down, the 2 rightmost bits of 0019 will stay at 0. All we need to know about 0019 is that these 2 bits will be 0.

Why this is enough information:
When hippo decides whether or not to open his mouth, he looks at the 3 rightmost bits of 0018. If these bits are 001, 011, or 110, he will open his mouth. Any other combination will result in no open. Normally this is “random” and is a ⅜ chance. However, since we know the 2 rightmost bits in 0019 are 0, we know the 1 bit and 4 bit added will be 0, since the 1 and 2 bits in 0019 are transformed into the 1 and 4 bit before being added to 0018. This means as long as 001E adds a 0 to the 4 bit and a 1 to the 1 bit of 0018, we can guarantee the 3 rightmost digits of 0018 will be 001 or 011, which means hippo will open. Basically, we can guarantee an open by hitting an 8 frame window and not ever pressing Down or Right before hippo’s decision.

Possibilities for future of RNG manip:

Little mac:
When little mac is not doing anything during a fight, he does tiny little movements to the left and right. These movements are based on the 0018 value and we have figured out how they are determined. It is a little too complicated to explain here, but it can be used to know the probability of future events occurring.

The crowd:
The crowd is also based on 0018 values, however we have not figured out how it works yet. This is probably one of the areas where research is needed most. For example, watching certain guys in the crowd before the fight starts could possibly tell you information about the RNG/patterns.

Not pressing down/right:
The same principles used in the hippo strategy could potentially transfer to something like guaranteeing an uppercut with short delay in p1 of soda. However, it is unlikely to transfer to random events in the middle of a fight, such as lucky stars on don 2. It could only be translated easily to other fights if there is a buffer up to the decision point of the opponent, meaning it is a consistent number of frames after the fight starts.

For ILs:
Tighter frame windows can be hit and inputs can be more exact, so it is possible that we can create strategies to get better luck on ILs that are not doable in single segment.

Questions on what the rules will allow:

I am assuming it is not against the rules to have a timer going during the run, which this strategy requires. Most speedruns already have timers going and it is not exactly a sketchy technique that would be used to cheat. However, I can imagine other tools that could be used to gather information about the RNG that are more sketchy, and a discussion will have to be had at some point to decide what is and is not allowed.

The most pressing issue on the rules is what kind of timer can be used. This strategy is able to be pulled off with a simple stopwatch, started manually by the player. However, there could be additions made to the timer to help the player be more consistent. There could be a timer that starts automatically when it sees a reset, taking out the human error, there could be a timer that counts down “3 2 1 start” when you are supposed to start the hippo fight, allowing for more consistently hitting the 8 frame window, or other advanced features on a timer. I think all of these should be allowed, but I could also see some concerns. I don’t want to put too much of my opinion here but rather in discussions with the community.

What this means for the tournament:

My recommendation is that no one uses this strategy during the tournament for several reasons. The first is that it would hinder in how we want to start each fight simultaneously. In order to hit the 8 frame window, specific timing would be needed which could hinder the watchability and organization of the tournament. The next is that it would give an unfair advantage to people that could put the time in quickly to learn the strategy before their opponents. Finally, since I have known about this strategy and currently understand it better than anyone else in the tournament, it would give me an unfair advantage no one else has. However, the community can decide if it should be allowed for the tournament.

Conclusion:

This strategy is quite powerful, but I think it is just scratching the surface of RNG manipulation in MTPO. Guaranteeing the first punch as an open should bring the average hippo time down by a couple seconds and also reduce the overall variation in times. Future places of research include: extending this strategy to the 2nd or even 3rd punch of the hippo fight, investigating the

crowd, and manipulating RNG in other fights in a similar way. If you have any questions about what we have found or want to help discover more, you can contact me. The best way is probably in the Punch Out discord or message me on twitch, username: lucandor158.