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Cover art: Andy Whorled, by Rodrigo B. Salvador (2014).
Modification of a confidence map (made with the Leica auto-montage stereomicroscope software; the original map is the central black figure) to resemble the pop-art of Andy Warhol. The shell depicted is the holotype of the fossil land snail species *Cochlostoma salomoni*, housed in the collection of the Staatliches Museum für Naturkunde Stuttgart (Stuttgart, Germany).

The Infinite Fish Playing Pokémon Theorem

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THE INFINITE MONKEY THEOREM

I will start by presenting this little famous theorem. The Infinite Monkey Theorem states that if you have a monkey hitting keys at random on a typewriter keyboard for an infinite amount of time, eventually it will end up reproducing some famous text, like the complete works of William Shakespeare, The Lord of the Rings, or the very article you are currently reading (the process used to write this article is not that far from it, actually).

This is the sort of theorem that clearly became famous because of its funny name. And, while I do find the name amusing, the theorem itself is also quite interesting; well, at least more interesting than the real-life experiment that the University of Plymouth decided to do, which remarkably showed that a monkey with infinite time would probably be able to defecate infinitely and destroy an infinite amount of typewriters (BBC News, 2003). Also, for some reason, friends of mine tend to state the Infinite Monkey Theorem as having an infinite amount of monkeys with an infinite amount of typewriters, instead of the infinite time stuff. Though this would solve the small problem of having to find an immortal monkey, maybe an infinite amount of monkeys would also pose a problem (for more information, you can read "what would happen if you were to gather a mole ($6x10^{23}$) of moles" from Randall Munroe, 2014) – let me simply say that this would make Planet of the Apes a lot more literal.

In any case, recently a small event reminded me of the Infinite Monkey Theorem. I am talking, of course, about Grayson Hopper, and his quest to become a pokémon master. Grayson is a fish who rose to absolute stardom after his owners decided to make him play Pokémon. By swimming in his aquarium, Grayson's position is detected by a camera and a command is sent to the game. You can follow his play on Twitch. Not much is going on right now (or ever).

Grayson is trying to prove by himself that, through a generator of random movements and a lot of time, one should be able to finish a game like Pokémon, which you can play by pressing only one button at a time and not having to rely on timing or stuff like that. I mean, if a ten year old boy can do it, why can't a fish?

And what the Infinite Monkey Theorem states is that he can do it, right? The fish might very well be able to beat the game in his lifetime, since a really large number of combinations of buttons will be generated, and one of them MUST be the correct one. Well, meet Route 22 (Fig. 1).
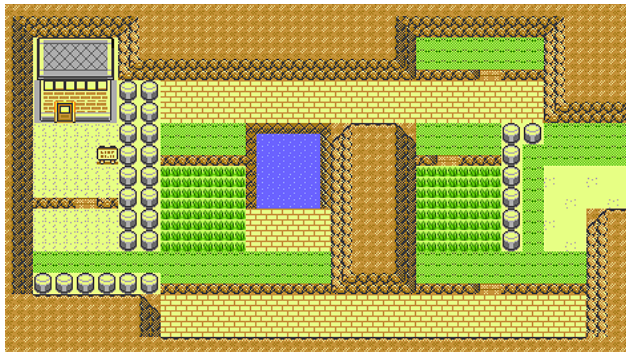
Figure 1. Why, hello there, Route 22. Image taken from: Pokémon Gold/Silver/Crystal.

From now on, I will consider that all of you had a childhood and are thus capable of following the game mechanics.

Route 22 could be called the nightmare of random walking (for more information on random walking, or "why a drunk always come back home while a drunk bird may be lost forever because of extra dimensions and stuff", see Math Explorer´s Club, 2009). The game mechanics of one-side-crossing-only ledges clearly makes this route goddamn awful. Also, Grayson tends to stay still for some seconds on the same area of the aquarium, thus repeating the same command a lot (a "down" command one time more than necessary can be fatal here). So, is it impossible?

Only one way to find out…

THE INFINITE FISH PLAYING POKÉMON SIMULATION MODEL

To simplify, let's say that the movement of the fish in the aquarium is a random process that can be categorized as a Markov chain. A Markov chain is one of the simplest stochastic processes, where the next entry in the chain depends only on the current position (or state), and not on the history of entries (this lack of history is called the Markov property). The random walk is an example of a Markov chain. Though the movement of the fish depends on the history

(usually he will keep swimming on the same direction), let's not waste time trying to model this further, because time is precious and we wouldn't like to waste it on useless stuff like a useless model.

Grayson's aquarium is divided into nine squares (Fig. 2). Each square has a specific command, with one exception, the "randomize!" command, which randomly chooses one of the other eight. Let's consider that one command is chosen after every second.

Thus, the Markov chain describes a process where the random walker is on a position among nine, and has a random probability of going to any of the nine positions (including staying on the same one) after one second.

Figure 2. Grayson's aquarium and control scheme. Screenshot taken from: Twitch – Fish Plays Pokémon.

The matrix that gives the probability of transition to each of the states in a Markov chain is called the transition matrix. The transition matrix can be dynamic or stationary in time. For example, giving the fish more food would make it dynamic, with a higher probability of him going to the surface of the aquarium. But let's consider a stationary matrix for simplicity.

After watching Grayson playing Pokémon for 2 minutes (boy, that was fun!), I generated some numbers for the transition matrix (Table 1). I decided that the probability of him staying still in the same position for one second would be 80% in any of the positions (though I must say that it is probably much higher). Also, I considered that the probability of him going to an adjacent area was higher than crossing the aquarium from one instant to the other. Since the position of the commands changes over time on the twitch play, I decided to generate them

randomly and leave them as such. Admittedly, the fish spends a lot of time near the surface, but let's not focus on the details since the randomization of the commands also contributes to the randomization of the process.

Table 1. Position matrix.

1	2	3
4	5	6
7	8	9

Table 2. Probabilities of the transition matrix.

	1	2	3	4	5	6	7	8	9	
1	80.0%	5.0%	2.0%	5.0%	3.5%	1.0%	2.0%	1.0%	0.5%	100.0%
2	4.0%	80.0%	4.0%	2.0%	4.0%	2.0%	1.0%	2.0%	1.0%	100.0%
3	2.0%	5.0%	80.0%	1.0%	3.5%	5.0%	0.5%	1.0%	2.0%	100.0%
4	4.0%	2.0%	1.0%	80.0%	4.0%	2.0%	4.0%	2.0%	1.0%	100.0%
5	2.0%	3.0%	2.0%	3.0%	80.0%	3.0%	2.0%	3.0%	2.0%	100.0%
6	1.0%	2.0%	4.0%	2.0%	4.0%	80.0%	1.0%	2.0%	4.0%	100.0%
7	2.0%	1.0%	0.5%	5.0%	3.5%	1.0%	80.0%	5.0%	2.0%	100.0%
8	1.0%	2.0%	1.0%	2.0%	4.0%	2.0%	4.0%	80.0%	4.0%	100.0%
9	0.5%	1.0%	2.0%	1.0%	3.5%	5.0%	2.0%	5.0%	80.0%	100.0%

By multiplying the transition matrix by itself a number "n" of times, you can find the accumulated transition probabilities after n events. For instance, if I multiply the matrix by itself twice, I will have the probabilities of Grayson transiting between two states after two seconds.

Since the transition matrix is stationary, aperiodic (no time limitations from transiting from one state to the other) and has no recurrent state (states with probability of 0, transition state, or 1, absorbing state), it is also said to be ergodic, that is, the system has the same average behavior over a long period of time. Multiplying the matrix by itself 128 times, I get to the following matrix (Table 3).

That is, the probability of Grayson being in one of the states after a long period of time is not dependent on his initial state, only on the transition matrix. Looking at this matrix, I can see that the probability of the fish spending some time on the center of the aquarium is slightly higher than on the edges, given the numbers I decided for the transition matrix. Since the distribution among the states is quite similar, I am happy with the transition matrix chosen. After modeling the fish movement, it was time to model the map of Route 22 (Fig. 3).

Table 3. Transition matrix after 128 seconds.

	1	2	3	4	5	6	7	8	9	
1	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
2	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
3	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
4	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
5	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
6	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
7	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
8	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
9	9.5%	11.5%	9.5%	11.5%	15.9%	11.5%	9.5%	11.5%	9.5%	100.0%
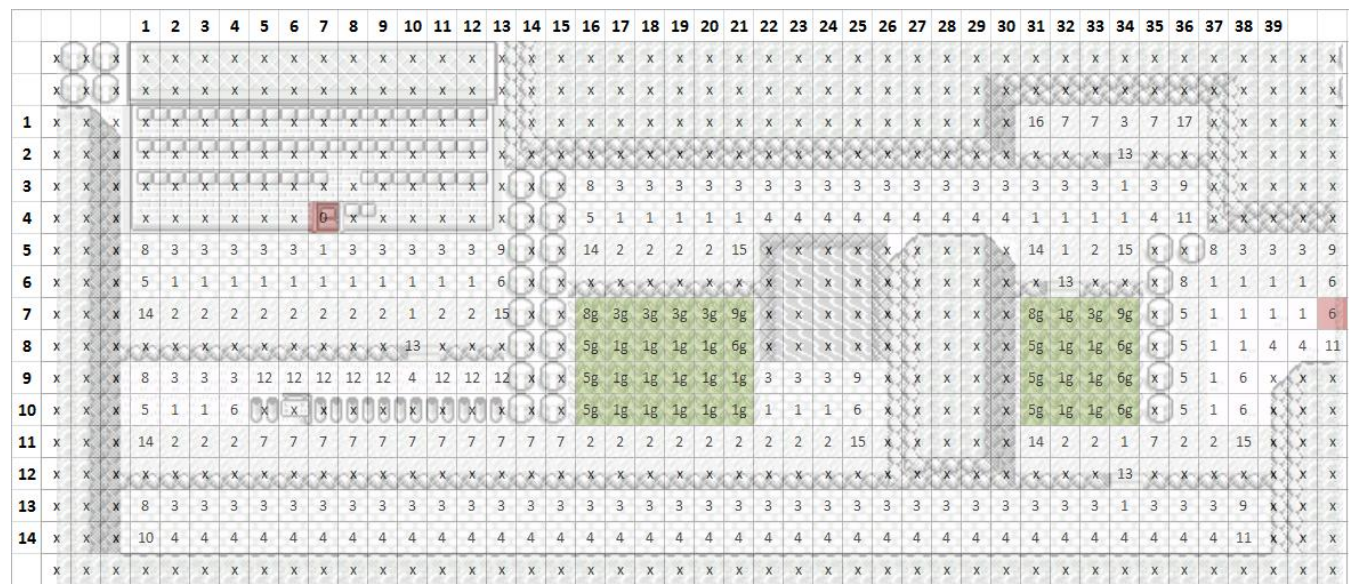
Figure 3. Modelled map of Route 22.

As can be seen on Figure 3, for each coordinate on the map, a number was attributed. This number states movement restrictions or other characteristics. Coordinates with the number "1" have no movement restriction, while coordinates with the number "3" has restrictions with the "up" direction, and coordinates with the number "2" have no restrictions, but the "down" direction skips a square. Once again, to simplify the model I considered that Grayson cannot go to the right of the map, leaving the area of Route 22.

The green area is the "wild grass" area. I decided to count the steps taken on "wild grass" areas to estimate how many pokémon battles Grayson would face in his epic quest. The probability encounter formula, according to Bulbapedia (2014) is defined as $P = x / 187.5$, where x is the encounter rarity variable. Considering a common encounter rate ($x = 8.5$), Grayson should face $S*0.05$ battles, where S is the number of steps taken on wild grass.

The desired results are the number of total commands necessary for Grayson to arrive at his

destination. Other interesting results are the number of battles and the number of commands given while in "paused" state.

As a limit of commands (thus, time), at first I thought that the simulation should go no longer than the average life span of a goldfish. Considering a life span of 25 years, this would be the same as 788,400,000 seconds/commands (if he keeps pressing the A or select button, or moving while on paused state, it still counts as a command for the simulation).

This number of commands, though, is unreasonably high and would probably only increase the entropy of the universe. So, I decided to just let it run for a couple of minutes and see what would happen after the equivalent of one day for the fish.

The model was written in VBA and the program ran on my personal computer.

RESULTS AND DISCUSSION

The results are as follows:

▪ Number of steps to complete: 86400 (1 full day, didn't complete, ended in coordinate 14 x 18);

▪ Number of steps on "wild grass" areas: 351;

▪ Estimated number of battles: approximately 18;

▪ Number of steps taken on paused state: 47796.

Thought I only simulated the equivalent of one "fish day", whenever I stopped to watch the simulation, it was clear that the character in-game was struggling to get out of the lower part of the map. It was expected, almost inevitable, for Grayson to spend most of his time randomly walking around the 76 coordinates that composed this artificial cage (with only one way out, coordinate 13 x 34, and many ways in); more than 99% of the time was spent there.

Positioning the character right in front of the exit and moving "up" twice was a very specific command that happened only twice during the simulation, with the character going back right after. Also, more than half of the commands were given while on paused state.

A DIFFERENT APPROACH

The greatest limitations of the study above are the short simulation time and the fact that the simulation was run only once. Considering how the stochastic process of the fish swimming impacted the results, it would be necessary to run the simulation dozens of times to achieve better and more valid results.

With that in mind, I now propose a different take on The Infinite Fish Playing Pokémon experiment. Instead of simulating the random process of a fish swimming, I will propose some simplifications in the previous model, so that the problem can be solved on a deterministic way. Though the simplification will reduce considerably how well the model represents reality, the results presented will offer valuable information on the magnitude of the problem.

EXPLANATION OF THE NEW APPROACH

On my first attempt to model the Fish Playing Pokémon, I considered that the movement of the fish in the aquarium was a random process which could be represented as a Markov chain. Since the position of the fish in the aquarium was considered a Markov process, this stochastic process was what defined which command was sent to the Pokémon game.

Since the probability of each command being chosen depended on the position of the fish in the aquarium, the modeling of the Pokémon game was a complex process that needed simulation.

This time, I will simply ignore the position of the fish and consider that the command sent to the game is a completely random process, with each of the directional commands having the same probability of being chosen. This way, the movement made on the game depends only on the current position of the character in the map, that is, the game itself can now be modeled as a Markov chain. With this simplification, the probability of the character being in each position can be defined on a deterministic way.

IMPLEMENTATION

Once again, the first step is to attribute a number to each coordinate in the map, and define which the possible movements for them are. There are 305 different possible coordinates in Route 22 (Fig. 4). Considering four possible commands, each command has a 25% chance of being chosen.
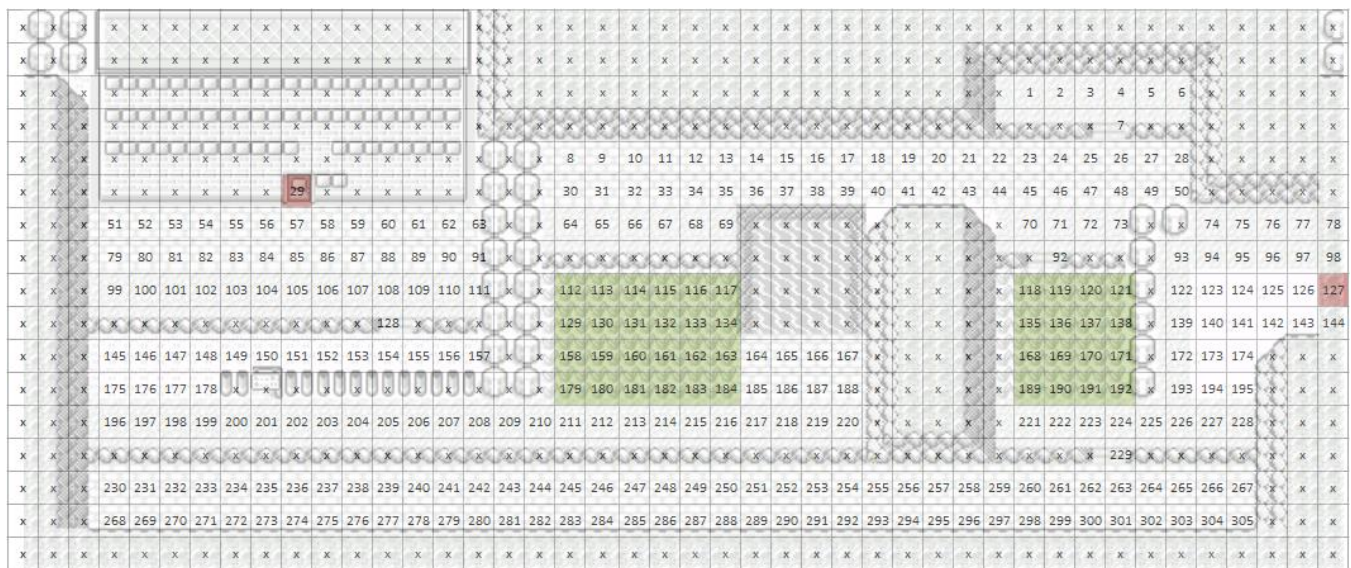
Figure 4. Route 22 with coordinates.

If the chosen command is impossible to be made, the character stays on the same coordinate. For example, if the character is on square 305, there is a 25% chance of him going to coordinate 267, 25% of going to 304, and 50% chance of staying in the same place. These probabilities, as stated, do not vary.

Having defined the coordinates and the possible movements, I can define the transition matrix. Since I have 305 possible positions, the transition matrix will be a 305 x 305 matrix (Figure 5). From each position, the character can do, at most, 4 different movements. That way,

at least 301 movements will have a zero (for instance, the probability of going from position 127 to 29 in a single step is zero).

By multiplying the transition matrix by itself a number "n" of times, you can find the accumulated transition probabilities after n events.

Another simplification adopted is that the end of route 23 is not an absorbing coordinate, that is, if the character arrives at the end, it is possible for him to go back. This simplification is necessary for the transition matrix to be ergodic, and thus stabilize after a long period of time.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	0.50	0.25																				
2	0.25	0.25	0.25																			
3		0.25	0.25	0.25																		
4			0.25	0.25	0.25		0.25															
5				0.25	0.25	0.25																
6					0.25	0.50																
7				0.25			0.50															
8								0.50	0.25													
9								0.25	0.25	0.25												
10									0.25	0.25	0.25											
11										0.25	0.25	0.25										
12											0.25	0.25	0.25									
13												0.25	0.25	0.25								
14													0.25	0.25	0.25							
15														0.25	0.25	0.25						
16															0.25	0.25	0.25					
17																0.25	0.25	0.25				
18																	0.25	0.25	0.25			
19																		0.25	0.25	0.25		
20																			0.25	0.25	0.25	
21																				0.25	0.25	0.25
22																					0.25	0.25
23																						0.25
24																						
25																						
26						0.25																

Figure 5. An example of a small subset of the transition matrix.

Multiplying the matrix by itself 64000 times (since there were many coordinates, it took a while for the probabilities to stabilize), I get to the matrix shown in Figure 6. This stabilized matrix shows that, after a long time, the probability of the character being in each coordinate does not depend on the starting point. This is true because of the ergodic property of the system. When stabilized, it is said that the system achieved stationary regime.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
2	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
3	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
4	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
5	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
6	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
7	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
8	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
9	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
10	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
11	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
12	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
13	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
14	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
15	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
16	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
17	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
18	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
19	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048
20	0.000003	0.000005	0.000013	0.000033	0.000013	0.000007	0.000074	0.000004	0.000005	0.000007	0.000010	0.000015	0.000023	0.000035	0.000048

Figure 6. A small part of the transition matrix, after 64000 commands.

RESULTS OF THE DIFFERENT APPROACH

Another way of interpreting the stationary regime matrix is that, instead of the probability of the character being in each state, it represents the percentage of time the character will spend in each of the 305 coordinates. That way, it is possible to calculate how many iterations are necessary, on average (after achieving stationary regime), for the character to pass through a defined coordinate.

The probability of the character being in coordinate 29, thus, is $4.11*10^{-13}$, that is, a little

more than 0.000000000041%. If we divide 1 by this probability, we see that, on average, we would need $2.43*10^{12}$ iterative steps to pass through coordinate 29.

Since each command (or step) is made every 1.5 seconds, this number of steps would take around 115.700 years to be made. This time should be at least doubled, if we considered the possibility of the commands that are not movement commands (the "A", "B" and "Pause" commands).

Interestingly, the percentage of time spent in the lower part of the map (coordinates 230 to 305) is 96.36%, and the time spent in the initial part of the map (up to coordinate 92) is 99.42%.

CONCLUSION

What are the odds of the universe taking form as it did? What are the odds of you being conceived? These questions were made many times by many different scientists from different areas. Binazir (2011) shows through an interesting chart, which went viral on the internet, that the odds of you existing are the same as two million people throwing a trillion-sided dice and all of them getting the same result. As usual, the best answers are from Douglas Adams (1979), who shows that the whale and the bowl of petunias are not impossible as you initially thought, just as impossible as anything else.

The more specific the event, the more impossibly low are the odds of it happening.

This study only started as a joke, but the more I thought about it, more it made sense in this world of impossible improbabilities happening.

Grayson will clearly never finish this game, not before the heat death of the universe. He probably won't even get close to the Safari Zone, from where he would never come out as well anyway. But maybe, only maybe, something impossible might happen, and the fish might be able to achieve his impossible dream of becoming a Pokémon master.

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Praise Helix!

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It is not everyday that I manage to join two of my main interests, mollusks and mythology. So rejoice!, for today is one of those days. I bid you welcome to the Cult of the Helix.

So how was this cult born? Nature-worshipping barbarians coping in a dangerous environment? An old bearded guy receiving revelations in the desert? A bald hermit meditating in the mountains? Well, none of the above. The Cult of the Helix was born in a most unorthodox manner: on the first iteration of Twitch Plays Pokémon. Wait, what?

TWITCH PLAYS POKÉMON

Twitch Plays Pokémon (henceforth "TPP") was a crowdsourced event in which everyone could type commands through the website's chat window and try to finish the game that was being streamed, namely Pokémon Red. It took a little more than two weeks for the players to complete the game and this was more than enough time for the birth of an entirely new religion. But how exactly did that happen?

With thousands of people giving commands at the same time, there was a huge confusion and progress was very slow at the beginning. Then some programmer had the idea of initiating a system (named "Democracy Mode") in which the game compiled votes every 10 seconds and the command inputted on the game was the one with most votes. People could vote to switch between Democracy and the original mode (hence renamed as "Anarchy Mode") at any time. Most people preferred Anarchy, because it was supposedly more fun, and turned to Democracy only when it seemed otherwise impossible to advance in the game.

TPP is a very boring way of playing Pokémon and the players soon turned to other stuff in order to make it a little more exciting. They started to interpret whatever was happening in the game in a way that it would make sense from a cosmic point of view. And, as a matter of fact, many bad things were happening in the game – in the Anarchic world of TPP, bad moves and poor strategies were running amok. Not intentionally, mind you, but as a result of the way in which commands were given and computed. This way, items were discarded, pokémons were released and, even worse, eevees turned into flareons.

THE HELIX FOSSIL

But let's return to the Helix. One item in particular could not be discarded; it was the Helix Fossil (the fossilized shell of a ammonite-like pokémon). And, boy, people spent a lot of time in the inventory clicking on the Helix Fossil

(and thus receiving in return the message "This isn't the time to use that"). It did not take long for people to decide that the fossil was a god and that Red, the protagonist, was consulting it as a sort of oracle in order to discover the best way to proceed on his adventure.

Lord Helix. Artwork by Chlorine17 (http://chlorine17.deviantart.com/).

From this point onwards, the mythology of the Helix developed really fast. The Helix Fossil had been previously chosen by the players in spite of the Dome Fossil, which then became the Enemy, or the Devil, if you will. The Helix represented Anarchy Mode, while the Dome represented Democracy. The pidgeot, the most reliable pokémon in battle, became Bird Jesus; flareon became the False Prophet, a servant of the Dome Fossil; and many other pokémons received places in the mythology, accompanied by a lot of fanart on the internet. Long story short, eventually the players revived the fossil (yes, that's possible in the game in a very Jurassic Park style) and received the pokémon omanyte in return. He was the resurrected god, Lord Helix. And then they went on to beat the game, but that's not important – let's take a closer look at the whole religion thing.

THE RELIGION

The Church of the Helix was born in a very short time span and possibly already have more followers than many of the world's "true" religions. In a sense, Helixism has itself become a true religion and, more than that, it was created consciously through the consensus of a tribe (here defined as a group of people sharing the same interests and symbols). This is perhaps an example of Durkheim's totemism. According to him, this is the most fundamental and primitive style of religion. The totem (here, the Helix) is a reflection of the tribe's consciousness, chosen as a symbol to represent it. Symbols are an important part of any religion and the main pillar of totemism. Symbols are the representation (or perhaps translation) of the abstract principles of a religion in material form and, thus, allow the cult to develop and flourish.

Durkheim's ideas were much disputed, of course (despite having received certain revival now in the light of research on the evolutionary roots of religious behavior), but the parallel was too strong to be ignored here. For Lévi-Strauss, for instance, the totem is a kind of animal with which a particular tribe identify themselves. In this case, it is not consciously chosen. Therefore, this view does not accommodate so nicely with the TPP's Helix cult, since it was consciously (albeit somewhat accidently) chosen by its followers, which supposedly don't identify themselves as an omanyte.

Granted, there are yet further difficulties: to begin with, Helixism was not born "naturally", like a totemic religion developing in a group of humans some tens of thousands years ago. Rather, it was in a large part built on the common features of Christianity (including its symbology and usual artistic depictions). This, of course, merely reflect the cultural background of most players, but make comparisons with

theoretical works more complicate and perhaps even more tenuous.

The Helix mythology. Artwork by Twarda8 (http://twarda8.deviantart.com/).

Of course, this is not a serious foray into the origins of religions in general or the meaning of a peculiar newborn religion. These are just some random thoughts that came to me when I first saw the Helix cult in all its glory. Helixism will probably never be treated seriously by its followers (well, at least I hope so). Still, the Church of the Helix functioned in its own

manner as a true religion does, giving an identity to a group, making them stick together and driving them forwards (there was even a petition to make March 1st the National Helix Day in the USA). As such, it is a unique and amazing event and I do hope that somebody will someday seriously study it.

THE MOLLUSKS

The Helix Fossil and the pokémons you get from it, omanyte and its evolved form omastar, are based on actual mollusks: the ammonites.

Top row: the helix fossil (left) and omastar (right), as they appear in official Pokémon artwork. Bottom row: *Asteroceras* sp. (left), an actual fossil ammonite shell from the Jurassic of England, and an artistic reconstruction of the animal (right), by N. Tamura (http://ntamura.deviantart.com/).

The ammonites are a completely extinct branch of cephalopod mollusks – besides ammonites, the class Cephalopoda comprises squids, octopuses, cuttlefish, nautiluses and the also extinct belemnites. Ammonites once ruled the seas and diversified in thousands upon thousands of species, but unfortunately, they died together with the dinosaurs in the great extinction event at the end of the Cretaceous.

They received their name in ancient Rome, for the fossil shells were compared to the ram's horns of the Egyptian god Ammon.

By the image above, one can see that both the fossil item and the pokémon are reasonably representative of ammonites (although the pokémon's shell is positioned like a snail's shell, not like a cephalopod's!). But I do have an issue with the name: "helix" comes from the Greek, through Latin, and simply means "spiral". Up to here, it is a fitting name. However, *Helix* (notice the italics) is already the name of a genus of land snails, which includes common garden snails and edible snails.

A *Helix* snail: *Helix lucorum*. Image taken from: Wikimedia Commons.

Land snails are, of course, gastropods, which is an entirely different class of mollusks altogether and only distantly related to the cephalopods (and thus to ammonites). They could at least have chosen a better name; a good deal of ammonites have names ending in "ceras", for instance (which means "horn" in Greek). But Pokémon is a complete failure for names – gastrodon is another poorly named molluscan pokémon. But I'll let this whole name deal slide just this once, since this fossil has spawned the first mythology ever based around a mollusk – and that is truly something to be happy about.

But since they have chosen the name Helix, I have a final comment to make (which may be somewhat disturbing for the faithful), for one must be consistent with his choices. "Helix" is feminine, so we would have a Lady Helix, not a Lord Helix. Unfortunately, pokémons still did not have genders in Pokémon Red (this feature was only introduced in the so called Generation II, *i.e.*, the Gold/Silver games), so we will never know Helix's gender for sure. In any case, I bet it would have been a surprise for the followers to discover that their god was actually a goddess.

Last but not least, if you have any important questions, feel free to do like Red and consult the Helix Fossil, in this charming website: http://askhelixfossil.com/#313usi.

Praise the Helix!

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Robins, robins, robins

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Since Pokémon is a recurrent topic on this journal, I would like to call your attention to this little fellow: the fletchling.

Fletchling (yayakoma, in Japanese), as it appears in official Pokémon artwork.

Fletchling is a tiny normal/flying-type robin pokémon with an orange head and grey body. Both Pokédex and Bulbapedia tell us that they sing beautifully, send signs using chirps and tail movements and are also merciless to intruders in their territory. It evolves to a fire/flying peregrine falcon (how a robin becomes a falcon is a topic for further discussion) that is a very common sight in competitions.

Back to fletchling. Even though I like all sorts of birds (I am an ornithologist after all), we always have our favorites; mine is the robin. And so, the tiny robin fletchling became my all-time-favorite pokémon. Now let us take a look at the robin I find in my garden.

European robin (*Erithacus rubecula*). Could you really be a fletchling?

Well, they look somewhat similar, but the color differs. Could my garden robin and fletchling be the same thing then? Are there any other robins outta there?

Teen Titans Go! Image taken from: http://www.cartoonnetwork.com/tv_shows/teen-titans-go/characters/index.html

No no, I meant bird robins.

American Robin (*Turdus migratorius*). Image taken from: Wikimedia Commons.

Japanese robin (*Erithacus akahige*). Image taken from: Wikimedia Commons.

So it is finally clear that fletchling was based on the Japanese robin and not on the European one from my garden (even though the entire Pokémon XY games supposedly been based on France – good job, Game Freak Inc.).

Now let us take a closer look at the bird robins (please refer to the figures above). We can see that the Japanese and European robins are very similar between themselves, especially when you compare them to the American and Australian robins (see figure below). This is expected, since the former share the same genus (*Erithacus*), meaning that they are more closely related. That is why they are so similar in appearance despite the difference in color. There is yet another *Erithacus* robin in Japan which has even more distinct plumage color (the Ryukyu robin, see figure below), but that is still very similar in shape to the European and Japanese robins.

Ryukyu robin (*Erithacus komadori*). Image taken from: Wikimedia Commons.

American robins, on the other hand, are much more different. They belong to another genus (*Turdus*), which also includes blackbirds, song thrushes and fieldfares. As such, they are only distantly related to the species belonging to *Erithacus*. Actually, *Turdus* might even belong to a completely different family – this is a hotly debated topic in ornithological circles, but I will not dwell on it.

Australian robins (*Petroica rosea*) are part yet another very distinct group. Image taken from: Wikimedia Commons.

So why we call all these different birds "robins"?

Robin is a popular English name to refer to passerines with red breast. The first one to be named as such was the European robin and the name was later on "exported" by colonizers and travelers for the birds in other continents. In other languages, the red breast feature of the European robin is always the focus: "Rotkehlchen" (German), "pisco-de-peito-ruivo" (Portuguese), "rouge-gorge familier" (French), "petirrojo" (Spanish), "pettirosso" (Italian) etc. Folklore says the red breast was earned by the

brave small European robin as a token for its heroic acts (Greenoak, 1997).

European/Japanese and American/ Australian robins all share the red breast feature, being, thus, all called "robins". However, as we saw, one pair is not closely related to the other – they do not share the same genus. This is because their popular name is not based on any evidence of how closely related they are. Popular names are just useful tools for people's everyday life. Scientific names, however, are more than that. As we saw, color is not the only characteristic that make a bird a *Turdus* or an *Erithacus* – The other Japanese robin (the Ryukyu robin) does not even have an orange breast; what makes it an *Erithacus* is its body shape, skeleton, anatomy etc. Giving a name is not an easy matter in science (this branch of Biology is called Taxonomy, by the way). The act of classifying and naming a species is based on studies that analyze the morphology and even the DNA of living beings to decide who is more related to whom (and therefore belong to the same genus or family). Therefore, scientific names also contains information on the relationship between species and will never confuse someone as popular names like "robin" do.

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The munchkin dilemma

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As most of you might have already guessed by the title, I am a nerd. As such, a relatively large part of my life was invested in hours of playing video games, reading nerdish stuff and playing tabletop role-playing games (RPGs).

RPGs should not be confused with board games, card games or board wargames. RPGs require players to "create fictional personas (...) within the rules and genre specified by the game, and then collectively engage in protracted storytelling" (Williams *et al.*, 2006). As such, though the dungeon master might give some rules, background information and create a whole world for the players to explore, playing RPGs and creating your character is quite an open experience, where the player can and should use his/her creativity to have as much fun as possible together with the other players.

My experience with RPGs is mostly restricted to the Dungeons & Dragons system (D&D), which is probably the most famous tabletop RPG in the world. It was created in 1974 by Gary Gygax and Dave Arneson and, through the years, had many revisions of the rules, with new editions being published. Literally hundreds of books (Wikipedia, 2014) with new rules and classes were written to expand the ever-growing options for the players and dungeon masters. Also, D&D is remarkably less controversial than Storytelling RPG systems, with fewer parents blaming D&D for some sort of small disorder their children have, like a tendency to murder goats, summon cosmic horrors or whatever.

On a D&D game, players form a group of adventurers (or party) and embark on a journey for wealth and glory. Inside a world created by the dungeon master, the players are free to explore dungeons, destroy castles, build cities, save princesses and be awesome. Obviously, this never happens, as players inevitably ends up doing stupid actions which usually gets them (and everyone near them) killed; but this is the fun of RPG, probably.

One can divide a typical D&D game in different stages. There are moments when the party is exploring a forest, gathering information in the middle of a big city, furtively invading a well-guarded castle or fighting a horde of beasts. The party, thus, usually have different characters with different roles to fulfill each task (or not, since teamwork usually is not part of the average D&D party). Battles are inevitable and an important mechanics of the game, with whole chapters of the rule books devoted to it. Because of all the above, some players end up reading lots of books to find nice abilities and build a good and useful character. Being a hopeless nerd, of course I've done that.

THE MUNCHKIN DILEMMA

Today, I will present what I like to call the "Munchkin Dilemma".

The word munchkin originated with the famous "The Wonderful Wizard of Oz" novel (often called simply "The Wizard of Oz" on the numerous reprints and the 1939 movie, which, by the way, recently made 75 years), written by Lyman Frank Baum in 1900. Munchkins are the natives of the Munchkin Country, and were originally said to be about Dorothy's height. On the famous movie adaptation, though, the Munchkin Country was called "Munchkinland", and the munchkins were depicted as being much shorter than the other Oz residents, being played by either children or adults with dwarfism. The word munchkin ended up entering the English language due to the popularity of the movie, as a reference to small children, dwarfs and anything of small stature, much like the Oompa Loompas.

In RPG jargon, however, munchkin is a pejorative term used to depict the "power player", meaning the player who tries to make optimized characters, using the many different books to conceive the most efficient, overpowered killing machine instead of a character fun to play with. I guess the reason they are called munchkins is because they play like children, though it would make a lot more sense if it was because they like to play with dwarves. They are despised by the other serious and mature adults who play RPG.

There is a lot of prejudice associated with this term, of course. I expect no one likes making an useless character, but I guess that players that for some reason want to play with monks or bards tend to feel bad when a wizard does their job (much) better, and then they start complaining about not wanting to make a "power" character because they prioritize the

roleplaying part of the game (they should be happy, though, since they are true to the uselessness of their characters). A card game created in 2001, where the player's objective is to get to a high level while preventing the opposing characters of doing the same, was named Munchkin with the intent of making fun of such playing style (it is a great card game, by the way).

"And my axe!" Art by Todd Lockwood. Image taken from: Dungeons & Dragons Player's Handbook (3.5 ed.).

Though there are many ways one player can be a munchkin, most of the times the munchkin's objective is simple: to be a damage dealing, powerhouse chucknorresque machine. And to do so, he wants to have the strongest class, with the best configuration of feats and the strongest weapon.

Usually, the best way to do so is with a complex combination of many classes, or with a cleric or wizard. An optimized fighter, for

example, might fight with a spiked chain and use the Improved Trip and Improved Disarm feats to become a very strong, overpowered and forever alone hated fighter.
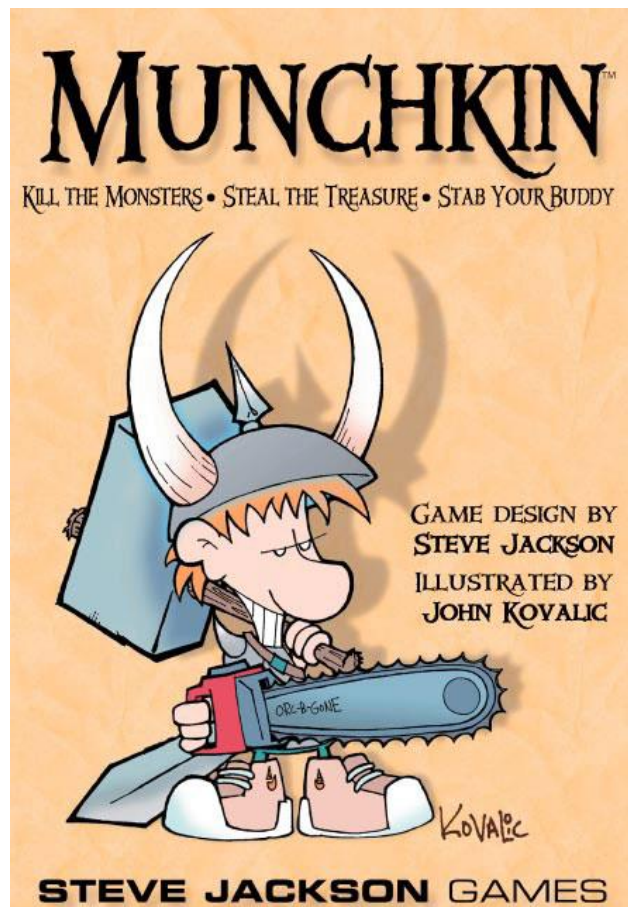
Cover art of the Munchkin card game, by Steve Jackson Games. Image taken from: http://www.worldofmunchkin.com/game/

With all that in mind, I decided to create my own version of the Munchkin Dilemma D&D 3.5 edition, which I will try to answer here. The dilemma is stated as: "Which of the basic classes from the D&D Player's Handbook v.3.5 (Cook *et al*., 2003a) is the best melee class when it comes ONLY to one-on-one combat? No multiclassing, no dips, no fancy stuff, just blood, death and violence."

The dilemma may be rewritten as: "Which class should I take if I want to kick some monster ass?"

SIMULATION PROCESS

In an attempt to answer one of humanity's most pressing questions, I decided to create characters with the melee classes from the Player's Handbook, at different levels, with normal progressions (focusing on being strong at 1x1 combat) and equipment that corresponds to their expected treasure. The characters would then be tested against each other to see which one would have the best victory/defeat rate.

The first classes chosen were: Fighter, Barbarian and Ranger. Though the morphed Druid is said to be the strongest melee, it is also: (1) not a usual munchkin class; (2) difficult to simulate because of the many resources (wild shape strategies, such as grappler, trampler and defender; animal companion; spells). So I decided to leave druids for later. At first, I wanted to add the Rogue just to see how well it would fare, but at lower levels he wouldn't be able to use the keen rapier + telling blow combo and at higher levels he would likely face fortified armors, so it wouldn't make sense. I added the Monk just for the fun. The Paladin and the Cleric were not chosen at first because they were either too specific against some enemies or way too complicated to simulate. The levels chosen were: 1, 6, 12, 20. Though it makes absolutely no sense to have a level 20 pure melee Fighter with a two-handed sword, I stipulated that there would be no multiclassing for the first experiment. The race for all characters was decided as human, so no one would have any obvious advantage.

The fights are 1x1, with each character starting close to each other (avoiding charges

and strategies of allowing the opponent to attack first and later using full attacks).

The ability scores for each character were decided by using the "Elite Array" distribution suggested on the Dungeon Master's Guide (Cook *et al.*, 2003b: p. 169). The distribution of the scores is 15, 14, 13, 12, 10, 8 among the abilities, whichever way the player wishes. The abilities and the extra ability points gained on levels 4, 8, 12, 16 and 20 were chosen according to the classes' strengths. Similarly, the feats were chosen in accordance to the classes' characteristics. The money for each level was

also taken from the Dungeon Master´s Guide (Cook *et al.*, 2003b: p. 135), with the exception of the 20th level, where a random large amount of money was chosen (usually, a lot of the money at this stage goes to other random stuff not really necessary for battle).

Also, there are different strategies the fighter might have. He can be the typical sword & board user, the two-handed weapon user, or the two weapons user. All three were considered in this study. The stats of each characters, as well as the feats chosen, are displayed on Table 1.

Table 1. Character stats. I decided to leave it small because no one will read it anyway.

	Fighter s&b				Fighter 2h				Fighter 2s				Barbarian				Ranger 2s				Monk			
Lvl	1	6	12	20	1	6	12	20	1	6	12	20	1	6	12	20	1	6	12	20	1	6	12	20
BAB	1	6	12	20	1	6	12	20	1	6	12	20	1	6	12	20	1	6	12	20	0	4	9	15
Str	15	16	16	18	15	16	18	20	14	14	14	14	15	16	18	20	14	14	14	14	12	12	12	12
Dex	12	12	12	12	12	12	12	12	15	16	17	19	12	12	12	12	15	16	17	19	15	16	17	19
Cons	14	14	16	16	14	14	14	14	13	13	14	14	14	14	14	14	13	13	14	14	14	14	14	14
Int	13	13	13	13	13	13	13	13	12	12	12	12	13	13	13	13	12	12	12	12	8	8	9	9
Wis	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	13	14	14	14
Cha	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	10	10	10	10
HP (nat)	12	50	107	175	12	50	95	155	11	44	95	155	14	57	108	176	9	37	82	134	10	43	82	134

Feats	Fighter s&b	Fighter 2h	Fighter 2s	Barbarian	Ranger 2s	Monk
Human	Weapon focus (bast.)	Weapon focus (greatsword)	Weapon focus (short)	Power Attack	Weapon focus (short)	Weapon Finesse
1st	Exotic weapon prof. (bast. Sword)	Power Attack	Two weapon fighting	Reckless Rage	Weapon Finesse	Imp. Initiative
3rd	Power Critical	Power Critical	Power attack	Leap Attack	Power attack	Weapon Focus (unarmed)
6th	Cleave	Quick Draw	Power Critical	Cleave	Power critical	Superior Unarmed Strike
9th	Imp. Critical	Imp. Critical	Imp. Two weapon fight	Imp. Toughness	Imp. Critical	Snap Kick
12th	Greater Weapon Spec	Greater Weapon Spec	Imp. Critical	Power Critical	Imp. Toughness	Imp. Toughness
15th	Melee Weapon Mastery Slashing	Melee Weapon Mastery Slashing	Melee Weapon Mastery Slashing	Greater cleave	Imp. Initiative	Improved I
18th	Iron Will	Iron Will	Iron Will	Imp. Initiative	Extra favoured enemy	Iron Will
Fighter 1	Combat Expertise	Cleave	Weapon finesse			Stunning fist
Fighter 2	Power attack	Imp. Initiative	Imp. Initiative			Combat reflexes
Fighter 4	Weapon spec.	Weapon spec	Weapon spec		Improved Favoured Enemy	
Fighter 6	Imp. Combat Expertise	Prone Attack	Two weapon def			Improved trip
Fighter 8	Greater Weapon Focus	Greater Weapon Focus	Greater weapon focus			
Fighter 10	Imp. Toughness	Imp. Toughness	Imp. Toughness			
Fighter 12	Imp. Initiative	Close quarter fighting	Greater weapon spec			
Fighter 14	Close quarter fighting		Combat reflexes	Combat reflexes		
Fighter 16	Greater Cleave		Greater Cleave	Greater Two weapon def	Eyes in the back of your head	
Fighter 18	Greater Fortitude		Greater Fortitude	Dual strike		
Fighter 20	Weapon Supremacy		Weapon Supremacy	Greater two weapon fight		
$$	-	13,000	88,000	510,000	-	13,000	88,000	510,000	-	13,000	88,000	510,000	-	13,000	88,000	510,000	-	13,000	88,000	510,000	-	13,000	88,000	510,000

Some considerations and strategies were assumed for the character building (the characters' detailed information, relevant for combat, can be seen on Table 2–7):

▪ The sword & board fighter is mainly a defensive character. His strategy consists of not being hit (with the Combat Expertise feat) and using his superior BAB to get some attacks each turn. He will use his money on good shield and armor, decent weapon and

rings of protection and/or amulets of natural armors. Each turn, if no attacks connect, he will slowly reduce the BAB penalty spent on Combat Expertise;

▪ The two-handed sword fighter uses power attacks with his great sword, trying to do the most damage possible each turn. His money will be heavily invested on a powerful weapon and strength boosters. If some money remains, he might get a

decent full-plate and a flying shield. Each turn, if no attacks connect, he will slowly reduce the BAB penalty spent on the Power Attack feat;

▪ The two-weapon fighter uses the "two-weapon fighting" feat tree, and tries to hit as many attacks as possible each turn. Pretty much all his money will go to his expensive weaponry;

Table 2. Fighter (sword & board).

Fighter s&b — Lvl 1

		Stats 2	Mod
Lvl	1		
BAB	1	Stats 2	Mod
Str	15	15	2
Dex	12	12	1
Cons	14	14	2
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	12	$$	-
Init	1	Dmg red	-

	To hit	Dmg	No at.
Attack 1	4	1d10+2	1
Crit =19	4	2d10+4	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	17		

Feats	
Weapon focus (bast.)	
Exotic weapon prof. (bast. Sword)	
Combat Expertise	

Equip	Cost
Bastard Sword	35
Scale mail	50
Heavy wooden shield	7

Fighter s&b — Lvl 6

		Stats 2	Mod
Lvl	6		
BAB	6	Stats 2	Mod
Str	16	18	4
Dex	12	12	1
Cons	14	14	2
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	50	$$	13,000
Init	1	Dmg red	-

	To hit	Dmg	No at.
Attack 1	12	1d10+7	2
Crit =19	16	2d10+12	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	24		

Feats	
Weapon focus (bast.)	
Exotic weapon prof. (bast. Sword)	
Power Critical	
Weapon spec.	
Imp. Combat Expertise	

Equip	Cost
Bastard Sword +1	2,350
Full plate +1	2,650
Heavy steel shield +1	1,150
Ring of Protection +1	2,000
Gloves of Strenght +2	4,000

Fighter s&b — Lvl 12

		Stats 2	Mod
Lvl	12		
BAB	12	Stats 2	Mod
Str	16	18	4
Dex	12	12	1
Cons	16	18	4
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	131	$$	88,000
Init	7	Dmg red	-

	To hit	Dmg	No at.
Attack 1	19	1d10+14	4
Crit =17	23	2d10+24	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	30		

Feats	
Weapon focus (bast.)	
Exotic weapon prof. (bast. Sword)	
Power Critical	
Weapon spec.	
Imp. Combat Expertise	
Imp. Critical	
Greater Weapon Spec	
Greater Weapon Focus	
Imp. Toughness	
Imp. Initiative	

Equip	Cost
Bastard Sword +1 collision	18,350
Full plate +4	17,650
Heavy steel shield +4	16,150
Ring of Protection +1	2,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Gloves of Strenght +2	4,000

Fighter s&b — Lvl 20

		Stats 2	Mod
Lvl	20		
BAB	20	Stats 2	Mod
Str	18	24	7
Dex	12	12	1
Cons	16	22	6
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	255	$$	510,000
Init	7	Dmg red	-

	To hit	Dmg	No at.
Attack 1	34	1d10+21+1d6	5
Crit =17	38	3d10+38+1d6	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	37		

Feats	
Weapon focus (bast.)	
Exotic weapon prof. (bast. Sword)	
Power Critical	
Weapon spec.	
Imp. Combat Expertise	
Imp. Critical	
Greater Weapon Spec	
Greater Weapon Focus	
Imp. Toughness	
Imp. Initiative	
Weapon supremacy (2nd attack full bonus)	

Equip	Cost
BS +5 collision shok burst	162,350
Full plate +5 heavy fort	101,650
HSS +5 Death Ward Element	100,150
Belt of Battle	12,000
Boots of Speed	12,000
Ring of Protection +5	50,000
Amult of Constitution +6	36,000
Gloves of Strenght +6	36,000

▪ The barbarian rages as soon as he can and uses the same strategy as the two-handed sword fighter. The Leap Attack feat is pretty much default for the barbarian, so I felt like he needed to have it even though there are no charges in the simulation. His money is better spent on weapons and damage / HP boosters, since there is no point in getting a good light/medium armor for a raging barbarian. He always use maximum points for the full attack no matter what;

▪ The ranger was a big question mark. I decided right away to ignore the animal companion and go for the Distracting Attack variant or something, but had some doubts as for the favored enemy, which could turn out to be a bit overpowering for this simulation. I decided that he should have the favored enemy "humanoid (human)" since this is a common choice among players and is an important characteristic of the ranger (not having it would make this class way inferior on this competition). The favored enemies were chosen in order of my preference: arcanist (1st), undead (2nd), human (3rd), construct (4th), elemental (5th). The ranger spells

were replaced by the Champion of the Wild variant from Complete Champion (Stark *et al*., 2007: p. 50). His money will be spent similarly to the two-weapon fighter;

▪ Though the monk was included just for fun, I had some problems on creating the character. Since this is an all-out damage battle, I excluded feats of disarming and tripping, which are great (though the monk is never great, thanks to his horrible BAB). So, to make things fair, I used some feats from the Tome of Battle book, which we usually don't use because of the overpower stuff in there. Since the monk suffers from MAD (Multiple Ability score Dependency; damn, the monk is horrible), his money is spent on items for pretty much all abilities. One good equipment for the monk would be the Monk's Belt, but it takes away the monstrous Belt of Battle. Damn monk, I hate thee.

Table 3. Fighter (two-handed sword).

Fighter 2h			
Lvl	1		
BAB	1	Stats 2	Mod
Str	15	15	2
Dex	12	12	1
Cons	14	14	2
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	12	$$	-
Init	1	Dmg red	-

	To hit	Dmg	No at.
Attack 1	4	2d6+3	1
Crit =19	4	4d6+6	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	15		

Feats
Weapon focus (greatsword)
Power Attack

Equip	Cost
Greatsword	50
Scale mail	50

Fighter 2h			
Lvl	6		
BAB	6	Stats 2	Mod
Str	16	18	4
Dex	12	12	1
Cons	14	14	2
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	50	$$	13,000
Init	5	Dmg red	-

	To hit	Dmg	No at.
Attack 1	12	2d6+9	2
Crit =19	16	4d6+16	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	22		

Feats
Weapon focus (greatsword)
Power Attack
Power Critical
Imp. Initiative
Weapon spec

Equip	Cost
Greatsword +1	2,350
Full plate +1	2,650
Amulet of Natural Armor +1	2,000
Ring of Protection +1	2,000
Gloves of Strenght +2	4,000

Fighter 2h			
Lvl	12		
BAB	12	Stats 2	Mod
Str	18	22	6
Dex	12	12	1
Cons	14	16	3
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	119	$$	88,000
Init	7	Dmg red	-

	To hit	Dmg	No at.
Attack 1	22	2d6+20	4
Crit =17	26	4d6+36	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	22		

Feats
Weapon focus (greatsword)
Power Attack
Power Critical
Imp. Initiative
Weapon spec
Imp. Critical
Greater Weapon Spec
Greater Weapon Focus
Imp. Toughness

Equip	Cost
Greatsword +2 collision	32,350
Full plate +1	2,650
Amulet of Natural Armor +1	2,000
Ring of Protection +1	2,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Gloves of Strenght +4	16,000

Fighter 2h			
Lvl	20		
BAB	20	Stats 2	Mod
Str	20	28	9
Dex	12	12	1
Cons	14	20	5
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	235	$$	510,000
Init	7	Dmg red	-

	To hit	Dmg	No at.
Attack 1	36	3d6+27	5
Crit =17	40	5d6+50+1d10	-
Attack 2	-	-	-
Crit =19	-	-	-
AC	30		

Feats
Weapon focus (greatsword)
Power Attack
Power Critical
Imp. Initiative
Weapon spec
Imp. Critical
Greater Weapon Spec
Greater Weapon Focus
Imp. Toughness
Weapon Supremacy

Equip	Cost
GS +5 collis shok burst magebane	200,350
Full plate +5 heavy fort	101,650
Belt of Battle	12,000
Boots of Speed	12,000
Ring of Protection +5	50,000
Amult of Constitution +6	36,000
Tome of Strenght +2	55,000
Gloves of Strenght +6	36,000

SIMULATION VS. ANALYTICAL ANALYSIS

I decided to use a simulation method instead of analytically solving probability equations, because doing it analytically takes an absurd amount of time, since the number of combinations are enormous. To exemplify, I tried to make the Barbarian vs. Fighter (two swords) level 1 fight analytically. The terrible result is shown on Tables 8–11. The problem is that each attack has three possible outcomes (hit, miss or critical), the two-swords fighter, for instance, generate 2 to the third power possible outcomes with each attack. When considering more attacks and more health points, the number of combinations grow considerably. Imagine a fight of a level 20 monk against a level 20 ranger: the monk's 7 attacks and the ranger's 8 all have three possible outcomes. Considering

the total HP, it is possible for the ranger to hit the monk 11 times without defeating him, while the monk can hit the ranger 14 times without defeating him. After the fighter's second attack, I decided to extrapolate the results previously found to the remaining rounds. I believe I got close enough to the answer, but it took some effort. Thus, the barbarian defeats the two-swords fighter more than 4 out of 5 times.

Table 4. Fighter (two swords).

Fighter 2s			
Lvl	1		
BAB	1	Stats 2	Mod
Str	14	14	2
Dex	15	15	2
Cons	13	13	1
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	11	$$	-
Init	2	Dmg red	-

	To hit	Dmg	No at.
Attack 1	2	1d6+2	1
Crit = 19	2	2d6+4	-
Attack 2	2	1d6+1	1
Crit = 19	2	2d6+2	-
AC	16		

Feats
Weapon focus (short)
Two weapon fighting
Weapon finesse

Equip	Cost
Short sword	35
Short sword	35
Scale mail	50

Fighter 2s			
Lvl	6		
BAB	6	Stats 2	Mod
Str	14	14	2
Dex	16	18	4
Cons	13	13	1
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	44	$$	13,000
Init	8	Dmg red	-

	To hit	Dmg	No at.
Attack 1	10	1d6+5	2
Crit = 19	14	2d6+8	-
Attack 2	10	1d6+4	1
Crit = 19	14	2d6+6	-
AC	21		

Feats
Weapon focus (short)
Two weapon fighting
Weapon finesse
Power Critical
Weapon spec
Two weapon def
Imp. Initiative

Equip	Cost
Short sword +1	2,350
Short sword +1	2,350
Mithral Chainshirt +1	2,100
Ring of Protection +1	2,000
Gloves of Dexterity +2	4,000

Fighter 2s			
Lvl	12		
BAB	12	Stats 2	Mod
Str	14	16	3
Dex	17	21	5
Cons	14	16	3
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	119	$$	88,000
Init	11	Dmg red	-

	To hit	Dmg	No at.
Attack 1	18	1d6+13	4
Crit = 17	22	2d6+22	-
Attack 2	18	2d6+6	2
Crit = 17	22	3d6+8	-
AC	24		

Feats
Weapon focus (short)
Two weapon fighting
Weapon finesse
Power Critical
Weapon spec
Two weapon def
Imp. Initiative
Imp. Two weapon fight
Imp. Critical
Greater weapon focus
Imp. Toughness
Greater weapon spec

Equip	Cost
Short sword +1 collision	18,350
Short sword +1 ice	8,350
Mithral Chainshirt +3	10,100
Ring of Protection +1	2,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Bracers of Strengh + 2	4,000
Gloves of dex +4	16,000

Fighter 2s			
Lvl	20		
BAB	20	Stats 2	Mod
Str	14	20	5
Dex	19	25	7
Cons	14	20	5
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	235	$$	510,000
Init	13	Dmg red	-

	To hit	Dmg	No at.
Attack 1	32	2d6+19	5
Crit = 17	36	3d6+34	-
Attack 2	32	2d6+16	3
Crit = 17	36	3d6+28	-
AC	35		

Feats
Weapon focus (short)
Two weapon fighting
Weapon finesse
Power Critical
Weapon spec
Two weapon def
Imp. Initiative
Imp. Two weapon fight
Imp. Critical
Greater weapon focus
Imp. Toughness
Greater weapon spec
Greater Two weapon def
Dual strike
Greater two weapon fight

Equip	Cost
Short sword +5 collision flame	128,350
Short sword +5 collision ice	128,350
Padded armor +5	25,000
Ring of Protection +5	50,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +6	36,000
Animated Shield +5	49,000
Gloves of dex +6	36,000
Gloves of Strenght +6	36,000

RESULTS

In this section, I will present the results of the simulation (which was made in VBA), as well as some considerations regarding critical aspects of D&D combat. For each fight, I will present what was the winning percentage of each build, the average percentage of remaining Health Points of the winner, the average number of rounds it took for the winner to defeat the opponent, and how many times the winning party had the initiative of the fight. Each table shows the result of a build against each of the other builds. The information shown are:

▪ Number of victories and percentage of victories: out of 1000 fights, how many were won by each build;

▪ Remaining HP and percentage of remaining HP: on average, how much HP this class had left in the fights it won;

▪ Average number of rounds: on average, how many rounds it took for this class to win the fights it won;

Table 5. Barbarian (with rage, +6 level 1 and 6, +8 level 12, +10 level 20).

Barbarian			
Lvl	1		
BAB	1	Stats 2	Mod
Str	15	21	5
Dex	12	12	1
Cons	14	20	5
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	17	$$	-
Init	1	Dmg red	-

	To hit	Dmg	No at.
Attack 1	6	2d6+7	1
Crit = 19	6	4d6+14	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	11		

Feats	
Power Attack	
Reckless Rage	

Equip	Cost
Greatsword	50
Scale mail	50

Barbarian			
Lvl	6		
BAB	6	Stats 2	Mod
Str	16	24	7
Dex	12	12	1
Cons	14	20	5
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	75	$$	13,000
Init	5	Dmg red	-

	To hit	Dmg	No at.
Attack 1	14	2d6+11	2
Crit = 19	14	4d6+22	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	15		

Feats	
Power Attack	
Reckless Rage	
Leap Attack	
Cleave	

Equip	Cost
Greatsword +1	2,350
Breastplate +1	1,150
Amulet of Natural Armor +1	2,000
Ring of Protection +1	2,000
Gloves of Strenght +2	4,000

Barbarian			
Lvl	12		
BAB	12	Stats 2	Mod
Str	18	30	10
Dex	12	12	1
Cons	14	24	7
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	180	$$	88,000
Init	7	Dmg red	2

	To hit	Dmg	No at.
Attack 1	23	2d6+21	4
Crit = 17	27	4d6+42	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	16		

Feats	
Power Attack	
Reckless Rage	
Leap Attack	
Cleave	
Imp. Toughness	
Power Critical	
Greater Rage	
Damage Reduction 2/-	

Equip	Cost
Greatsword +1 keen collision	32,350
Breastplate +2	4,150
Amulet of Natural Armor +1	2,000
Ring of Protection +1	2,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Gloves of Strenght +4	16,000

Barbarian			
Lvl	20		
BAB	20	Stats 2	Mod
Str	20	40	15
Dex	12	12	1
Cons	14	30	10
Int	13	13	1
Wis	10	10	0
Cha	8	8	-1
HP	356	$$	510,000
Init	7	Dmg red	5

	To hit	Dmg	No at.
Attack 1	40	3d6+32	5
Crit = 17	44	5d6+64+1d10	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	16		

Feats	
Power Attack	
Reckless Rage	
Leap Attack	
Cleave	
Imp. Toughness	
Power Critical	
Greater Rage	
Damage Reduction 5/-	
Imp. Initiative	
Mighty Rage	

Equip	Cost
GS +5 collis shok burst keen	200,350
Mithral Full plate +4 heavy fort	92,650
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +6	36,000
Tome of Strength +4	110,000
Gloves of Strenght +6	36,000

▪ Initiatives won and percentage of initiatives: out of 1000 fights, how many had this build winning the initiative roll;

▪ Winning with initiative: how many fights this build won AND had the initiative.

Also, henceforth, the sword & board Fighter, the two-handed sword Fighter and the two-weapons Fighter shall be called, respectively, S&B Fighter, THS Fighter and TW Fighter.

LEVEL 1

On level 1, it is possible to see that the Barbarian had little trouble dominating all the other builds, with winning percentages higher than 70% against any opponent and an average of less than two rounds to finish a combat. This result is not unexpected, since the Barbarian acquires the very strong Rage ability on level 1. The Ranger and the Monk, on the other hand, performed poorly against all the opponents, and

had a technical draw when faced against each other. This result also is not unexpected, since both classes have low hitting rates at the first level – the Monk's flurry of blows is still underdeveloped and the Ranger does not yet acquired his first Combat Style class ability (two-weapon fighting).

In the middle of the pack are the three fighter builds. The S&B Fighter, with his high armor class, managed to defeat the TW Fighter and the THS Fighter, while the TW Fighter defeated the THS Fighter. The three fights were relatively close. Table 11 shows the detailed results of the fights.

Also, it is interesting to compare the results of the simulation with the ones calculated analytically on the first part. It was calculated that the Barbarian would defeat the TW Fighter more than 80% of the time, while in the simulation, it is seen that the Barbarian would

win around 70% of the time. This difference shows that some of the simplifications adopted in the first part were probably incorrect.

Table 12 shows some averages and consolidated results. It is interesting to see how having the initiative impacts the outcome of the fights. The Ranger and the Monk had most of their wins when they had the initiative, while the Barbarian had a very low number of defeats when having the initiative.

Table 6. Ranger, two swords (favored enemy human: +2 lvl 12, +4 lvl 20).

Ranger 2s			
Lvl	1		
BAB	1	Stats 2	Mod
Str	14	14	2
Dex	15	15	2
Cons	13	13	1
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	9	$$	-
Init	2	Dmg red	-

	To hit	Dmg	No at.
Attack 1	0	1d6+2	1
Crit = 19	0	2d6+4	-
Attack 2	-4	1d6+1	1
Crit = 19	-4	2d6+2	-
AC	16		

Feats	
Weapon focus (short)	
Weapon Finesse	
1st fav enemy (arcanist) +2	
Equip	**Cost**
Short sword	35
Short sword	35
Scale mail	50

Ranger 2s			
Lvl	6		
BAB	6	Stats 2	Mod
Str	14	14	2
Dex	16	18	4
Cons	13	13	1
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	37	$$	13,000
Init	4	Dmg red	-

	To hit	Dmg	No at.
Attack 1	10	1d6+3	2
Crit = 19	14	2d6+6	-
Attack 2	10	1d6+2	2
Crit = 19	14	2d6+4	-
AC	20		

Feats	
Weapon focus (short)	
Weapon Finesse	
1st fav enemy (arcanist) +4	
Power attack	
Power critical	
Improved Favoured Enemy	
Imp. Initiative	
2nd fav enemy (undead) +2	
Combat style TWF	
Improved combat style Improved TWF	
Equip	**Cost**
Short sword +1	2,350
Short sword +1	2,350
Mithral Chainshirt +1	2,100
Ring of Protection +1	2,000
Gloves of Dexterity +2	4,000

Ranger 2s			
Lvl	12		
BAB	12	Stats 2	Mod
Str	14	16	3
Dex	17	21	5
Cons	14	16	3
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	106	$$	88,000
Init	7	Dmg red	-

	To hit	Dmg	No at.
Attack 1	17	1d6+14	4
Crit = 17	21	2d6+23	-
Attack 2	17	2d6+7	3
Crit = 17	21	3d6+9	-
AC	24		

Feats	
Weapon focus (short)	
Weapon Finesse	
1st fav enemy (arcanist) +4	
Power attack	
Power critical	
Improved Favoured Enemy	
Imp. Initiative	
2nd fav enemy (undead) +4	
Combat style TWF	
Improved combat style Improved TWF	
Imp. Critical	
Imp. Toughness	
Two weapon Defense	
Greater Two weapon def	
3rd fav enemy (human) +2	
Combat style mastery Greater TWF	
Equip	**Cost**
Short sword +1 collision	18,350
Short sword +1 ice	8,350
Mithral Chainshirt +3	10,100
Ring of Protection +1	2,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Bracers of Strengh + 2	4,000
Gloves of dex +4	16,000

Ranger 2s			
Lvl	20		
BAB	20	Stats 2	Mod
Str	14	20	5
Dex	19	26	8
Cons	14	20	5
Int	12	12	1
Wis	10	10	0
Cha	8	8	-1
HP	214	$$	510,000
Init	14	Dmg red	-

	To hit	Dmg	No at.
Attack 1	32	2d6+22	5
Crit = 17	36	3d6+37	-
Attack 2	32	2d6+19	3
Crit = 17	36	3d6+31	-
AC	34		

Feats	
Weapon focus (short)	
Weapon Finesse	
1st fav enemy (arcanist) +4	
Power attack	
Power critical	
Improved Favoured Enemy	
Imp. Initiative	
2nd fav enemy (undead) +4	
Combat style TWF	
Improved combat style Improved TWF	
Imp. Critical	
Imp. Toughness	
Two weapon Defense	
Greater Two weapon def	
3rd fav enemy (human) +4	
Combat style mastery Greater TWF	
Imp. Initiative	
Extra favoured enemy (evil outsider) +2	
4th favoured enemy (constructs) +4	
5th favoured enemy (elemental) +2	
Equip	**Cost**
Short sword +5 collision flame	128,350
Short sword +5 collision ice	128,350
Padded armor +5	25,000
Ring of Protection +4	32,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +6	36,000
Animated Shield +4	36,000
Gloves of dex +6	36,000
Gloves of Strenght +6	36,000
Tome of dex +1	27,500

LEVEL 6

On level 6, once again the Barbarian defeated all the opponents. This time, though, he had a much harder time against all the Fighters, and the THS Fighter in particular. By level 6, the Fighter builds gained a lot of feats, mainly the Weapon Specialization, Power Attack, Power Critical and Improved Initiative ones, which made them considerably stronger.

The S&B Fighter and the THS Fighter did very well against the other classes, and had a technical draw when they fought against each other.

The Ranger and the Monk, on the other hand, dragged terribly behind the other classes. The Ranger's strongest resource in a fight lies with her Favored Enemy ability and, for this simulation, this ability is only acquired against

humanoid (humans) on level 12. The Monk suffers because of his lower Base Attack Bonus; by level 6, all the other classes have acquired their second attack, while the monk still has only one (without considering the flurry of blows). The detailed results can be seen on Table 13.

Table 7. Monk (considering 100% flurry of blows and Snap Kick on level 20).

Monk			
Lvl	1		
BAB	-2	Stats 2	Mod
Str	12	12	1
Dex	15	15	2
Cons	14	14	2
Int	8	8	-1
Wis	13	13	1
Cha	10	10	0
HP	10	$$	-
Init	2	Dmg red	-

	To hit	Dmg	No at.
Attack 1	0	1d6+1	2
Crit = 19	0	2d6+2	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	14		

Feats
Weapon Finesse
Imp. Initiative
Unarmed Strike
Flurry of blows
Stunning Fist

Equip	Cost

Monk			
Lvl	6		
BAB	3	Stats 2	Mod
Str	12	12	1
Dex	16	18	4
Cons	14	14	2
Int	8	8	-1
Wis	14	14	2
Cha	10	10	0
HP	43	$$	13,000
Init	8	Dmg red	-

	To hit	Dmg	No at.
Attack 1	9	1d10+2	2
Crit = 19	13	2d10+4	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	19		

Feats
Weapon Finesse
Imp. Initiative
Unarmed Strike
Flurry of blows
Stunning Fist
Weapon Focus (unarmed)
Superior Unarmed Strike

Equip	Cost
Bracers of Armor +2	4,000
Gloves of dex +2	4,000
Necklace of Natural attacks +1	2,000

Monk			
Lvl	12		
BAB	9	Stats 2	Mod
Str	12	14	2
Dex	17	21	5
Cons	14	16	3
Int	9	9	0
Wis	14	16	3
Cha	10	10	0
HP	106	$$	88,000
Init	9	Dmg red	-

	To hit	Dmg	No at.
Attack 1	16	4d8+8	4+1
Crit = 19	16	8d8+16	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	24		

Feats
Weapon Finesse
Imp. Initiative
Unarmed Strike
Flurry of blows
Stunning Fist
Weapon Focus (unarmed)
Superior Unarmed Strike
Improved Natural Attack
Imp. Toughness
Greater Flurry

Equip	Cost
Bracers of Armor +4	16,000
Gloves of dex +4	16,000
NNA +1 collision	18,000
Tiara of Wisdom +2	4,000
Monks belt	13,000
Boots of Speed	12,000
Amult of Constitution +2	4,000
Something of Strengh +2	12,000

Monk			
Lvl	20		
BAB	13	Stats 2	Mod
Str	12	20	5
Dex	19	26	8
Cons	14	20	5
Int	9	9	0
Wis	14	20	5
Cha	10	10	0
HP	214	$$	510,000
Init	14	Dmg red	-

	To hit	Dmg	No at.
Attack 1	27	4d8+15+1d6	6+1
Crit = 19	27	8d8+30+1d6	-
Attack 2	-	-	-
Crit = 19	-	-	-
AC	37		

Feats
Weapon Finesse
Imp. Initiative
Unarmed Strike
Flurry of blows
Stunning Fist
Weapon Focus (unarmed)
Superior Unarmed Strike
Improved Natural Attack
Imp. Toughness
Greater Flurry
Snap Kick

Equip	Cost
Bracers of Armor +7	49,000
NNA +5 collision element	128,000
Ring of Protection +3	18,000
Belt of Battle	12,000
Boots of Speed	12,000
Amult of Constitution +6	36,000
Tiara of Wisdom +6	36,000
Gloves of dex +6	36,000
Gloves of Strenght +6	36,000
Tome of str +2	55,000
Tome of dex +3	82,500

Table 8. Combat data.

Initiative		
	F start	B start
1	1	19
2	3	17
3	4	16
4	5	15
5	6	14
6	7	13
7	8	12
8	9	11
9	10	10
10	11	9
11	12	8
12	13	7
13	14	6
14	15	5
15	16	4
16	17	3
17	18	2
18	19	1
19	19	1
20	20	0
400	227	173
	56.75%	43.25%

Fighter hit	bab	ac	
	2	11	
1st att	2nd att	n combin	outcome
1	1 to 20	20	miss 2
2 to 8	1 to 8	56	miss 2
2 to 8	9 to 18	70	miss r + hit l
2 to 8	19 to 20	14	miss r + crit l
9 to 18	1 to 8	80	hit r + miss l
9 to 18	9 to 18	100	hit 2
9 to 18	19 to 20	20	hit r + crit l
19 to 20	1 to 8	16	crit r + miss l
19 to 20	9 to 18	20	crit r + hit l
19 to 20	19 to 20	4	crit 2

Confirm critical			
conf crit	9 a 20	12	60.0%
no conf crit	1 a 8	8	40.0%

Total outcomes		
outcome	comb	%
miss 2	76	19.0%
hit r miss l	86.4	21.6%
miss r hit l	75.6	18.9%
crit r miss l	9.6	2.4%
miss r crit l	8.4	2.1%
crit r hit l	12.8	3.2%
hit r crit l	12.8	3.2%
hit 2	116.96	29.2%
crit 2	1.44	0.4%
		100.0%

Barbarian	bab	ac	
	5	16	
1st	Comb	outcome	
1 to 10	10	miss	
11 to 18	8	hit	
19 to 20	2	crit	

Confirm critical			
conf crit	11 to 20	10	50.0%
no conf crit	1 to 10	10	50.0%

Total outcomes	
Miss 1	50.0%
Hit 1	45.0%
Crit 1	5.0%

Brb HP	17	Fgt HP	11
Brb dmg	2d6+9	Fgt dmg r	1d6+2
Brb crt dmg	4d6+18	Fgt crt dmg r	2d6+4
		Fgt dmg l	1d6+1
		Fgt crt dmg l	2d6+2

2d6 possible results			3d6 possible results			4d6 possible results		
2	1	3%	3	1	0%	4	1	0%
3	2	6%	4	3	1%	5	4	0%
4	3	8%	5	6	3%	6	10	1%
5	4	11%	6	10	5%	7	20	2%
6	5	14%	7	15	7%	8	35	3%
7	6	17%	8	21	10%	9	56	4%
8	5	14%	9	25	12%	10	80	6%
9	4	11%	10	27	13%	11	104	8%
10	3	8%	11	27	13%	12	125	10%
11	2	6%	12	25	12%	13	140	11%
12	1	3%	13	21	10%	14	146	11%
			14	15	7%	15	140	11%
			15	10	5%	16	125	10%
			16	6	3%	17	104	8%
			17	3	1%	18	80	6%
			18	1	0%	19	56	4%
						20	35	3%
						21	20	2%
						22	10	1%
						23	4	0%
						24	1	0%

Table 9. Battle begins. Notice how each branch where the fighter survives after a barbarian attack results in other 8 branches, with 8 possible fighter outcomes.

Fighter 1st attack

	F ms 2	19.0%	Brb stand	100%	becomes same probability as barbarian starting			
			Brb falls	0%				
Branch 1	F ht r ms l	21.6%	Brb stand	100%	brb attacks	fgt stands	50.0%	
			Brb falls	0%		fgt falls	50.0%	6.1%
Branch 2	F ms r ht l	18.9%	Brb stand	100%	brb attacks	fgt stands	50.0%	
			Brb falls	0%		fgt falls	50.0%	5.4%
Branch 3	F crt r ms l	2.4%	Brb stand	100%	brb attacks	fgt stands	50.0%	
			Brb falls	0%		fgt falls	50.0%	0.7%
Branch 4	F ms r crt l	2.1%	Brb stand	100%	brb attacks	fgt stands	50.0%	
			Brb falls	0%		fgt falls	50.0%	0.6%
Branch 5	F ht 2	29.2%	Brb stand	100%	brb attacks	fgt stands	50.0%	
			Brb falls	0%		fgt falls	50.0%	8.3%
Branch 6	F crt r ht l	3.2%	Brb stand	63%	brb attacks	fgt stands	50.0%	
			Brb falls	38%	fgt wins	fgt falls	50.0%	0.6%
Branch 7	F ht r crt l	3.2%	Brb stand	74%	brb attacks	fgt stands	50.0%	
			Brb falls	26%	fgt wins	fgt falls	50.0%	0.7%
Branch 8	F crt 2	0.4%	Brb stand	16%	brb attacks	fgt stands	50.0%	
			Brb falls	84%	fgt wins	fgt falls	50.0%	0.0%

Branch 0 — Fgt starts 56.75%

Fighter 2 s vs Barbarian

	Fgt wins	1.32%		
	Brb wins	22.3%		

Branch 201	Brb ms	50.0%	Fgt stand	100%	fgt attacks, becomes same as Branch 0		
			Fgt falls	0%			
Branch 202	Brb ht 1	45.0%	Fgt stand	0%			
			Fgt falls	100%	Brb wins	19%	
Branch 203	Brb crt 1	5.0%	Fgt stand	0%			
			Fgt falls	100%	Brb wins	2%	

Branch 200 — Brb starts 43.25%

Table 14 shows again some averages and consolidated results. Compared to the level 1 combats, the ones on level 6 took much longer due to the increase in Health Points, without much damage dealing improvement (which usually comes with stronger equipment at higher levels). The builds that did better at level 6 were the ones that were capable of consistently dealing high damage with few attacks (THS Fighter and Barbarian), instead of many, easier-to-miss attacks and low damage.

Once again, the initiative had a lot of impact on the results of the fights. The only outlier would be the Ranger who won most of her fights without the initiative (though most of them were against the monk).

LEVEL 12

On level 12, once more the Barbarian defeated all opponents without much trouble. Most of the merit can be given to a much higher number of Health Points, and mainly to the much higher damage output per round of the build (Greater Rage, Gloves of Strenght +4, Collision Weapon, Boots of Speed), which reduced his average number of rounds to finish a combat to less than two. In fact, at this stage the equipment starts playing a much larger role on the combats, allowing all classes to finish their fights in a much shorter time.

The Ranger, once again, struggles to win even a small number of fights. The favored enemy ability is still underdeveloped and the two weapons are very expensive to upgrade. For this reason, the TW Fighter also does very poorly on this scenario where equipment is so relevant.

Table 10. Fighter's second attack.

Fighter 2nd attack

Br 1 — 6.13% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 1 if fails*				
			Brb falls	0%					
Br 09	F ht r ms l	21.6%	Brb stand	100%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	0%		fgt falls	50.0%	B wins	0.66%
Br 10	F ms r ht l	18.9%	Brb stand	100%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	0%		fgt falls	50.0%	B wins	0.58%
Br 11	F crt r ms l	2.4%	Brb stand	50%	brb attacks	fgt stands	50.0%	F wins	0.07%
			Brb falls	50%		fgt falls	50.0%	B wins	0.04%
Br 12	F ms r crt l	2.1%	Brb stand	74%	brb attacks	fgt stands	50.0%	F wins	0.03%
			Brb falls	26%		fgt falls	50.0%	B wins	0.05%
Br 13	F ht 2	29.2%	Brb stand	63%	brb attacks	fgt stands	50.0%	F wins	0.67%
			Brb falls	38%		fgt falls	50.0%	B wins	0.56%
Br 14	F crt r ht l	3.2%	Brb stand	10%	brb attacks	fgt stands	50.0%	F wins	0.18%
			Brb falls	90%	fgt wins	fgt falls	50.0%	B wins	0.01%
Br 15	F ht r crt l	3.2%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.16%
			Brb falls	84%	fgt wins	fgt falls	50.0%	B wins	0.02%
Br 16	F crt 2	0.4%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	99%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 2 — 5.36% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 2 if fails*				
			Brb falls	0%					
Br 17	F ht r ms l	21.6%	Brb stand	100%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	0%		fgt falls	50.0%	B wins	0.58%
Br 18	F ms r ht l	18.9%	Brb stand	100%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	0%		fgt falls	50.0%	B wins	0.51%
Br 19	F crt r ms l	2.4%	Brb stand	63%	brb attacks	fgt stands	50.0%	F wins	0.05%
			Brb falls	38%		fgt falls	50.0%	B wins	0.04%
Br 20	F ms r crt l	2.1%	Brb stand	84%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	16%		fgt falls	50.0%	B wins	0.05%
Br 21	F ht 2	29.2%	Brb stand	74%	brb attacks	fgt stands	50.0%	F wins	0.41%
			Brb falls	26%		fgt falls	50.0%	B wins	0.58%
Br 22	F crt r ht l	3.2%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.14%
			Brb falls	84%	fgt wins	fgt falls	50.0%	B wins	0.01%
Br 23	F ht r crt l	3.2%	Brb stand	24%	brb attacks	fgt stands	50.0%	F wins	0.13%
			Brb falls	76%	fgt wins	fgt falls	50.0%	B wins	0.02%
Br 24	F crt 2	0.4%	Brb stand	2%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	98%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 3 — 0.68% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 3 if fails*				
			Brb falls	0%					
Br 25	F ht r ms l	21.6%	Brb stand	50%	brb attacks	fgt stands	50.0%	F wins	0.07%
			Brb falls	50%		fgt falls	50.0%	B wins	0.04%
Br 26	F ms r ht l	18.9%	Brb stand	63%	brb attacks	fgt stands	50.0%	F wins	0.05%
			Brb falls	38%		fgt falls	50.0%	B wins	0.04%
Br 27	F crt r ms l	2.4%	Brb stand	5%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	95%		fgt falls	50.0%	B wins	0.00%
Br 28	F ms r crt l	2.1%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	84%		fgt falls	50.0%	B wins	0.00%
Br 29	F ht 2	29.2%	Brb stand	10%	brb attacks	fgt stands	50.0%	F wins	0.18%
			Brb falls	90%		fgt falls	50.0%	B wins	0.01%
Br 30	F crt r ht l	3.2%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	99%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 31	F ht r crt l	3.2%	Brb stand	2%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	98%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 32	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 4 — 0.60% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 4 if fails*				
			Brb falls	0%					
Br 33	F ht r ms l	21.6%	Brb stand	74%	brb attacks	fgt stands	50.0%	F wins	0.03%
			Brb falls	26%		fgt falls	50.0%	B wins	0.05%
Br 34	F ms r ht l	18.9%	Brb stand	84%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	16%		fgt falls	50.0%	B wins	0.05%
Br 35	F crt r ms l	2.4%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	84%		fgt falls	50.0%	B wins	0.00%
Br 36	F ms r crt l	2.1%	Brb stand	34%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	66%		fgt falls	50.0%	B wins	0.00%
Br 37	F ht 2	29.2%	Brb stand	24%	brb attacks	fgt stands	50.0%	F wins	0.13%
			Brb falls	76%		fgt falls	50.0%	B wins	0.00%
Br 38	F crt r ht l	3.2%	Brb stand	2%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	98%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 39	F ht r crt l	3.2%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	99%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 40	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 5 — 8.30% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 5 if fails*				
			Brb falls	0%					
Br 41	F ht r ms l	21.6%	Brb stand	50%	brb attacks	fgt stands	50.0%	F wins	0.90%
			Brb falls	50%		fgt falls	50.0%	B wins	0.45%
Br 42	F ms r ht l	18.9%	Brb stand	63%	brb attacks	fgt stands	50.0%	F wins	0.59%
			Brb falls	38%		fgt falls	50.0%	B wins	0.49%
Br 43	F crt r ms l	2.4%	Brb stand	10%	brb attacks	fgt stands	50.0%	F wins	0.18%
			Brb falls	90%		fgt falls	50.0%	B wins	0.01%
Br 44	F ms r crt l	2.1%	Brb stand	24%	brb attacks	fgt stands	50.0%	F wins	0.13%
			Brb falls	76%		fgt falls	50.0%	B wins	0.02%
Br 45	F ht 2	29.2%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	2.04%
			Brb falls	84%		fgt falls	50.0%	B wins	0.19%
Br 46	F crt r ht l	3.2%	Brb stand	2%	brb attacks	fgt stands	50.0%	F wins	0.26%
			Brb falls	98%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 47	F ht r crt l	3.2%	Brb stand	2%	brb attacks	fgt stands	50.0%	F wins	0.26%
			Brb falls	98%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 48	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.03%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 6 — 0.57% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 6 if fails*				
			Brb falls	0%					
Br 49	F ht r ms l	21.6%	Brb stand	10%	brb attacks	fgt stands	50.0%	F wins	0.11%
			Brb falls	90%		fgt falls	50.0%	B wins	0.01%
Br 50	F ms r ht l	18.9%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.09%
			Brb falls	84%		fgt falls	50.0%	B wins	0.01%
Br 51	F crt r ms l	2.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 52	F ms r crt l	2.1%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	99%		fgt falls	50.0%	B wins	0.00%
Br 53	F ht 2	29.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.17%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 54	F crt r ht l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 55	F ht r crt l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 56	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 7 — 0.67% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 5 if fails*				
			Brb falls	0%					
Br 57	F ht r ms l	21.6%	Brb stand	16%	brb attacks	fgt stands	50.0%	F wins	0.12%
			Brb falls	84%		fgt falls	50.0%	B wins	0.01%
Br 58	F ms r ht l	18.9%	Brb stand	24%	brb attacks	fgt stands	50.0%	F wins	0.10%
			Brb falls	76%		fgt falls	50.0%	B wins	0.02%
Br 59	F crt r ms l	2.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 60	F ms r crt l	2.1%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.01%
			Brb falls	99%		fgt falls	50.0%	B wins	0.00%
Br 61	F ht 2	29.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.20%
			Brb falls	99%		fgt falls	50.0%	B wins	0.00%
Br 62	F crt r ht l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 63	F ht r crt l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.02%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 64	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Br 8 — 0.02% — Fighter 2nd

Br	Type	%	Brb	%	attack	Fgt	50.0%	result	%
	F ms 2	19.0%	Brb stand	100%	*same probability as barbarian starting, repeating Br 6 if fails*				
			Brb falls	0%					
Br 65	F ht r ms l	21.6%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 66	F ms r ht l	18.9%	Brb stand	1%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	99%		fgt falls	50.0%	B wins	0.00%
Br 67	F crt r ms l	2.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 68	F ms r crt l	2.1%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 69	F ht 2	29.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%		fgt falls	50.0%	B wins	0.00%
Br 70	F crt r ht l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 71	F ht r crt l	3.2%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%
Br 72	F crt 2	0.4%	Brb stand	0%	brb attacks	fgt stands	50.0%	F wins	0.00%
			Brb falls	100%	fgt wins	fgt falls	50.0%	B wins	0.00%

Table 11. Extrapolating the results and final result.

Branch 0		Extrapolating		Branch 201		Branch 202 + 203		Total	
Fgt wins	9.17%	Branch 0		21.63%		Fgt wins	0.00%	Fgt wins	19.64%
Brb wins	27.44%	Fgt wins	14.22%	Fgt wins	5.42%	Brb wins	21.63%	Brb wins	80.36%
		Brb wins	42.53%	Brb wins	16.21%				
			56.75%		21.63%				

Table 12. Results of the fights for the level 1 builds.

Fighter Sword & Board	Lvl 1						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Sword & Board	614	61.4%	7.3	60.5%	3.4	490	49.0%	329
Fighter 2 handed sword	386	38.6%	6.4	53.2%	3.4	510	51.0%	225
Fighter Sword & Board	567	56.7%	7.1	59.5%	3.2	417	41.7%	273
Fighter Two Weapons	433	43.3%	6.4	57.8%	3.5	583	58.3%	289
Fighter Sword & Board	250	25.0%	8.0	66.3%	3.0	490	49.0%	162
Barbarian	750	75.0%	11.4	67.1%	1.9	510	51.0%	422
Fighter Sword & Board	905	90.5%	9.4	78.7%	3.5	428	42.8%	396
Ranger	95	9.5%	4.7	52.6%	4.8	572	57.2%	63
Fighter Sword & Board	855	85.5%	8.3	69.2%	3.0	422	42.2%	376
Monk	145	14.5%	4.9	49.4%	3.6	578	57.8%	99

Fighter Two Handed Sword	Lvl 1						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Handed Sword	386	38.6%	6.4	53.2%	3.4	510	51.0%	225
Fighter Sword & Board	614	61.4%	7.3	60.5%	3.4	490	49.0%	329
Fighter Two Handed Sword	401	40.1%	6.1	51.0%	3.0	423	42.3%	204
Fighter Two Weapons	599	59.9%	6.5	59.4%	3.2	577	57.7%	380
Fighter Two Handed Sword	162	16.2%	7.9	66.1%	2.7	500	50.0%	107
Barbarian	838	83.8%	12.0	70.7%	1.8	500	50.0%	445
Fighter Two Handed Sword	739	73.9%	7.9	65.6%	3.6	406	40.6%	322
Ranger	261	26.1%	4.7	52.3%	4.0	594	59.4%	177
Fighter Two Handed Sword	677	67.7%	7.1	59.2%	3.1	396	39.6%	291
Monk	323	32.3%	5.3	53.3%	3.4	604	60.4%	218

Fighter Two Weapons	Lvl 1						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Weapons	433	43.3%	6.4	57.8%	3.5	583	58.3%	289
Fighter Sword & Board	567	56.7%	7.1	59.5%	3.2	417	41.7%	273
Fighter Two Weapons	599	59.9%	6.5	59.4%	3.2	577	57.7%	380
Fighter Two Handed Sword	401	40.1%	6.1	51.0%	3.0	423	42.3%	204
Fighter Two Weapons	291	29.1%	6.8	61.8%	2.8	568	56.8%	211
Barbarian	709	70.9%	10.7	63.2%	1.7	432	43.2%	352
Fighter Two Weapons	823	82.3%	8.0	72.5%	3.3	477	47.7%	407
Ranger	177	17.7%	4.6	50.8%	3.4	523	52.3%	107
Fighter Two Weapons	825	82.5%	7.5	68.0%	2.8	511	51.1%	436
Monk	175	17.5%	4.9	49.1%	2.9	489	48.9%	100

Table 12. (cont.).

	Barbarian			Lvl 1				
	Number of victories	**% victories**	**Remaining HP**	**% Remaining HP**	**Average no of rounds**	**Initiatives won**	**% Initiatives**	**Winning with Initiative**
Barbarian	750	75.0%	11.4	67.1%	1.9	510	51.0%	422
Fighter Sword & Board	250	25.0%	8.0	66.3%	3.0	490	49.0%	162
Barbarian	838	83.8%	12.0	70.7%	1.8	500	50.0%	445
Fighter Two Handed Sword	162	16.2%	7.9	66.1%	2.7	500	50.0%	107
Barbarian	709	70.9%	10.7	63.2%	1.7	432	43.2%	352
Fighter Two Weapons	291	29.1%	6.8	61.8%	2.8	568	56.8%	211
Barbarian	878	87.8%	11.9	70.0%	1.8	409	40.9%	381
Ranger	122	12.2%	6.7	74.6%	3.1	591	59.1%	94
Barbarian	901	90.1%	12.5	73.7%	1.6	464	46.4%	431
Monk	99	9.9%	6.1	60.9%	2.8	536	53.6%	66

	Ranger			Lvl 1				
	Number of victories	**% victories**	**Remaining HP**	**% Remaining HP**	**Average no of rounds**	**Initiatives won**	**% Initiatives**	**Winning with Initiative**
Ranger	95	9.5%	4.7	52.6%	4.8	572	57.2%	63
Fighter Sword & Board	905	90.5%	9.4	78.7%	3.5	428	42.8%	396
Ranger	261	26.1%	4.7	52.3%	4.0	594	59.4%	177
Fighter Two Handed Sword	739	73.9%	7.9	65.6%	3.6	406	40.6%	322
Ranger	177	17.7%	4.6	50.8%	3.4	523	52.3%	107
Fighter Two Weapons	823	82.3%	8.0	72.5%	3.3	477	47.7%	407
Ranger	122	12.2%	6.7	74.6%	3.1	591	59.1%	94
Barbarian	878	87.8%	11.9	70.0%	1.8	409	40.9%	381
Ranger	526	52.6%	5.2	57.8%	3.7	520	52.0%	295
Monk	474	47.4%	5.6	56.0%	3.6	480	48.0%	249

	Monk			Lvl 1				
	Number of victories	**% victories**	**Remaining HP**	**% Remaining HP**	**Average no of rounds**	**Initiatives won**	**% Initiatives**	**Winning with Initiative**
Monk	145	14.5%	4.9	49.4%	3.6	578	57.8%	99
Fighter Sword & Board	855	85.5%	8.3	69.2%	3.0	422	42.2%	376
Monk	323	32.3%	5.3	53.3%	3.4	604	60.4%	218
Fighter Two Handed Sword	677	67.7%	7.1	59.2%	3.1	396	39.6%	291
Monk	175	17.5%	4.9	49.1%	2.9	489	48.9%	100
Fighter Two Weapons	825	82.5%	7.5	68.0%	2.8	511	51.1%	436
Monk	99	9.9%	6.1	60.9%	2.8	536	53.6%	66
Barbarian	901	90.1%	12.5	73.7%	1.6	464	46.4%	431
Monk	474	47.4%	5.6	56.0%	3.6	480	48.0%	249
Ranger	526	52.6%	5.2	57.8%	3.7	520	52.0%	295

The Monk, on the other hand, performs surprisingly well (I definitely did not expect the Monk to win a single fight!). Thanks to a fully developed Flurry of Blows and the Monk's Belt, he is capable of dealing a lot of damage to builds with low Armor Class, losing badly only to the S&B Fighter and the Barbarian.

Finally, the S&B Fighter convincingly defeats the THS Fighter and all the other opponents but the Barbarian. Thanks to stronger equipment,

the S&B Fighter is capable of defeating the opponent quickly, while keeping a very high Armor Class. The detailed results can be seen on Table 15.

Table 16 shows again the averages and consolidated results. The fights are much shorter thanks to the increase on damage output with the better equipment. It is clear that the initiative factor becomes even more impacting than in the two previous scenarios. A high percentage of the fights won by the Ranger and the Monk are when they have the initiative. This effect is also a consequence of the higher damage output.

Table 13. Some consolidated results for the level 1 combats.

Lvl 1	Builds defeated	Fights won	Avg no turns	Initiatives won	Winning with Initiative
Fighter Sword & Board	4	3,191	3.2	2,247	1,536
Fighter Two Handed Sword	2	2,365	3.2	2,235	1,149
Fighter Two Weapons	3	2,971	3.1	2,716	1,723
Barbarian	5	4,076	1.7	2,315	2,031
Ranger	1	1,181	3.8	2,800	736
Monk	0	1,216	3.3	2,687	732

LEVEL 20

Finally, on level 20, the Barbarian is once more completely dominant. With a monstrous amount of Health Points and damage output, he easily defeats all other classes and completely destroys the S&B Fighter, who is incapable of dealing enough damage.

The S&B Fighter, though completely defeated by the Barbarian, overpowers all the other classes through consistent damage and very high Armor Class. The TW Fighter and the Ranger, with enough money to equip themselves, perform very similarly, defeating both the Monk and the THS Fighter.

The Monk, once again, is crushed by the other classes. The Monk's interesting feats and abilities are not enough to deal with increasingly powerful weapons and armors. The detailed results can be seen on Table 17.

Table 18 shows the averages and consolidated results. The fights are still short, with high damage output by all classes. The information of the consolidated results were used to generate the three graphics presented on Figures 1–3.

Once again, the initiative factor is more important than in the previous three scenarios. Most of the fights won by the Ranger, Monk and TW Fighter happened when they had the initiative, while the Barbarian almost did not lose when she had the initiative.

Table 14. Results of the fights for the level 6 builds.

Fighter Sword & Board	Lvl 6						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Sword & Board	478	47.8%	23.3	46.5%	4.2	345	34.5%	199
Fighter 2 handed sword	522	52.2%	23.8	47.5%	3.9	655	65.5%	376
Fighter Sword & Board	852	85.2%	26.7	53.5%	3.9	196	19.6%	176
Fighter Two Weapons	148	14.8%	16.3	37.0%	5.1	804	80.4%	128
Fighter Sword & Board	358	35.8%	20.3	40.7%	3.8	335	33.5%	172
Barbarian	642	64.2%	31.6	42.1%	3.1	665	66.5%	479
Fighter Sword & Board	966	96.6%	32.7	65.5%	3.3	337	33.7%	332
Ranger	34	3.4%	9.0	24.3%	4.9	663	66.3%	29
Fighter Sword & Board	979	97.9%	34.5	69.0%	3.4	186	18.6%	183
Monk	21	2.1%	9.5	22.1%	4.5	814	81.4%	18

Fighter Two Handed Sword	Lvl 6						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Handed Sword	522	52.2%	23.8	47.5%	3.9	655	65.5%	376
Fighter Sword & Board	478	47.8%	23.3	46.5%	4.2	345	34.5%	199
Fighter Two Handed Sword	873	87.3%	26.5	53.1%	3.1	358	35.8%	335
Fighter Two Weapons	127	12.7%	18.0	40.9%	4.1	642	64.2%	104
Fighter Two Handed Sword	439	43.9%	19.6	39.3%	3.0	525	52.5%	298
Barbarian	561	56.1%	31.0	41.4%	2.5	475	47.5%	334
Fighter Two Handed Sword	948	94.8%	33.2	66.4%	2.7	542	54.2%	528
Ranger	52	5.2%	12.5	33.7%	4.0	458	45.8%	38
Fighter Two Handed Sword	959	95.9%	34.6	69.2%	2.8	328	32.8%	319
Monk	41	4.1%	10.6	24.6%	4.5	672	67.2%	32

Fighter Two Weapons	Lvl 6						
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Weapons	148	14.8%	16.3	37.0%	5.1	804	80.4%	128
Fighter Sword & Board	852	85.2%	26.7	53.5%	3.9	196	19.6%	176
Fighter Two Weapons	127	12.7%	18.0	40.9%	4.1	642	64.2%	104
Fighter Two Handed Sword	873	87.3%	26.5	53.1%	3.1	358	35.8%	335
Fighter Two Weapons	126	12.6%	13.8	31.3%	3.9	655	65.5%	107
Barbarian	874	87.4%	37.8	50.4%	2.5	345	34.5%	326
Fighter Two Weapons	779	77.9%	20.9	47.4%	3.5	713	71.3%	584
Ranger	221	22.1%	11.2	30.3%	3.8	287	28.7%	92
Fighter Two Weapons	862	86.2%	22.7	51.7%	3.7	508	50.8%	461
Monk	138	13.8%	13.4	31.1%	4.3	492	49.2%	91

Table 14. (cont.).

	Barbarian		Lvl 6					
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Barbarian	642	64.2%	31.6	42.1%	3.1	665	66.5%	479
Fighter Sword & Board	358	35.8%	20.3	40.7%	3.8	335	33.5%	172
Barbarian	561	56.1%	31.0	41.4%	2.5	475	47.5%	334
Fighter Two Handed Sword	439	43.9%	19.6	39.3%	3.0	525	52.5%	298
Barbarian	874	87.4%	37.8	50.4%	2.5	345	34.5%	326
Fighter Two Weapons	126	12.6%	13.8	31.3%	3.9	655	65.5%	107
Barbarian	964	96.4%	48.2	64.2%	2.2	525	52.5%	519
Ranger	36	3.6%	10.1	27.4%	3.8	475	47.5%	30
Barbarian	997	99.7%	49.8	66.4%	2.4	306	30.6%	306
Monk	3	0.3%	7.7	17.8%	4.3	694	69.4%	3

	Ranger		Lvl 6					
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Ranger	34	3.4%	9.0	24.3%	4.9	663	66.3%	29
Fighter Sword & Board	966	96.6%	32.7	65.5%	3.3	337	33.7%	332
Ranger	52	5.2%	12.5	33.7%	4.0	458	45.8%	38
Fighter Two Handed Sword	948	94.8%	33.2	66.4%	2.7	542	54.2%	528
Ranger	221	22.1%	11.2	30.3%	3.8	287	28.7%	92
Fighter Two Weapons	779	77.9%	20.9	47.4%	3.5	713	71.3%	584
Ranger	36	3.6%	10.1	27.4%	3.8	475	47.5%	30
Barbarian	964	96.4%	48.2	64.2%	2.2	525	52.5%	519
Ranger	652	65.2%	15.6	42.1%	3.8	338	33.8%	254
Monk	348	34.8%	14.4	33.5%	3.9	662	66.2%	264

	Monk		Lvl 6					
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Monk	21	2.1%	9.5	22.1%	4.5	814	81.4%	18
Fighter Sword & Board	979	97.9%	34.5	69.0%	3.4	186	18.6%	183
Monk	41	4.1%	10.6	24.6%	4.5	672	67.2%	32
Fighter Two Handed Sword	959	95.9%	34.6	69.2%	2.8	328	32.8%	319
Monk	138	13.8%	13.4	31.1%	4.3	492	49.2%	91
Fighter Two Weapons	862	86.2%	22.7	51.7%	3.7	508	50.8%	461
Monk	3	0.3%	7.7	17.8%	4.3	694	69.4%	3
Barbarian	997	99.7%	49.8	66.4%	2.4	306	30.6%	306
Monk	348	34.8%	14.4	33.5%	3.9	662	66.2%	264
Ranger	652	65.2%	15.6	42.1%	3.8	338	33.8%	254

Table 15. Some consolidated results for the level 6 combats.

Lvl 6	Builds defeated	Fights won	Avg no turns	Initiatives won	Winning with Initiative
Fighter Sword & Board	3	3,633	3.7	1,399	1,062
Fighter Two Handed Sword	4	3,741	3.1	2,408	1,856
Fighter Two Weapons	2	2,042	4.1	3,322	1,384
Barbarian	5	4,038	2.5	2,316	1,964
Ranger	1	995	4.1	2,221	443
Monk	0	551	4.3	3,334	408
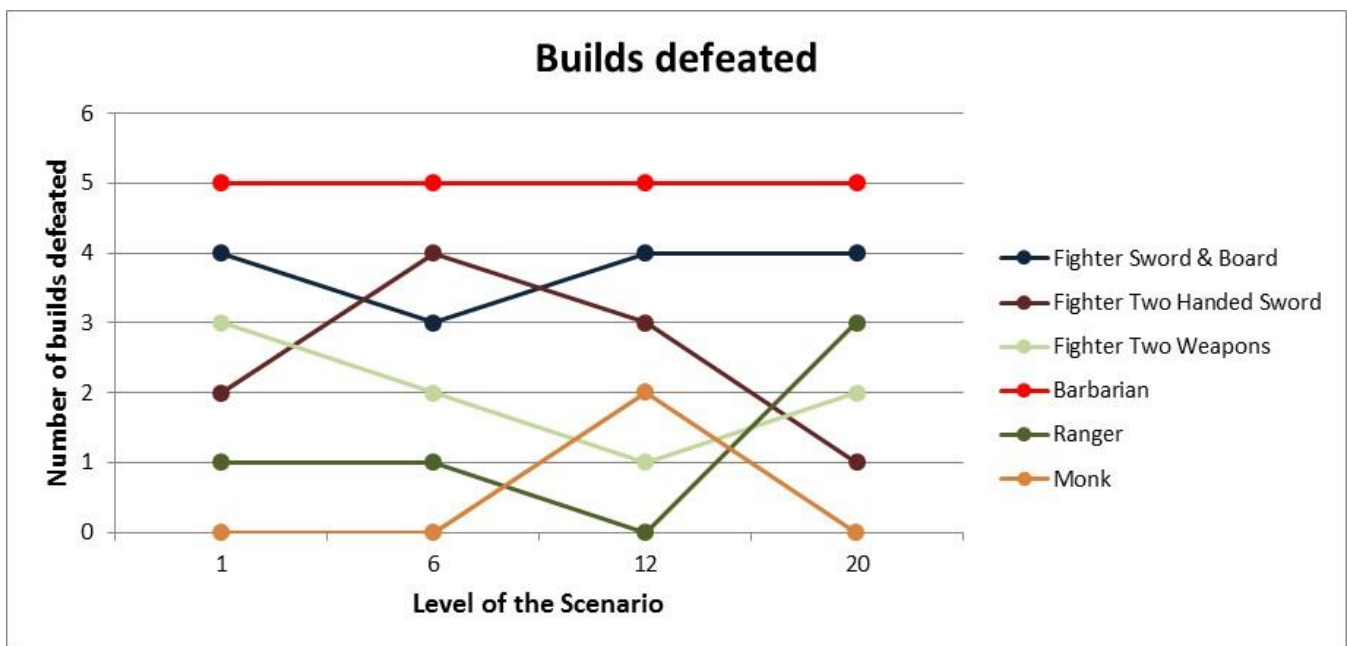
Figure 1. Number of builds defeated.

Table 16. Results of the fights for the level 12 builds.

	Fighter Sword & Board			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Sword & Board	614	61.4%	58.3	44.5%	2.3	524	52.4%	400
Fighter 2 handed sword	386	38.6%	46.4	39.0%	2.1	476	47.6%	262
Fighter Sword & Board	886	88.6%	68.1	52.0%	2.7	332	33.2%	317
Fighter Two Weapons	114	11.4%	31.9	26.8%	3.4	668	66.8%	99
Fighter Sword & Board	342	34.2%	49.1	37.5%	2.6	496	49.6%	241
Barbarian	658	65.8%	75.5	42.0%	2.2	504	50.4%	403
Fighter Sword & Board	949	94.9%	78.1	59.6%	2.5	478	47.8%	470
Ranger	51	5.1%	25.6	24.2%	3.3	522	52.2%	43
Fighter Sword & Board	810	81.0%	70.9	54.1%	2.4	370	37.0%	333
Monk	190	19.0%	34.0	32.1%	2.7	630	63.0%	153

	Fighter Two Handed Sword			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Handed Sword	386	38.6%	46.4	39.0%	2.1	476	47.6%	262
Fighter Sword & Board	614	61.4%	58.3	44.5%	2.3	524	52.4%	400
Fighter Two Handed Sword	631	63.1%	51.5	43.3%	1.7	311	31.1%	285
Fighter Two Weapons	369	36.9%	45.1	37.9%	2.0	689	68.9%	343
Fighter Two Handed Sword	291	29.1%	39.0	32.8%	2.0	497	49.7%	252
Barbarian	709	70.9%	99.8	55.5%	1.5	503	50.3%	464
Fighter Two Handed Sword	731	73.1%	67.1	56.4%	1.5	482	48.2%	444
Ranger	269	26.9%	42.8	40.4%	1.9	518	51.8%	231
Fighter Two Handed Sword	550	55.0%	64.5	54.2%	1.4	379	37.9%	309
Monk	450	45.0%	59.7	56.3%	1.5	621	62.1%	380

	Fighter Two Weapons			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Weapons	114	11.4%	31.9	26.8%	3.4	668	66.8%	99
Fighter Sword & Board	886	88.6%	68.1	52.0%	2.7	332	33.2%	317
Fighter Two Weapons	369	36.9%	45.1	37.9%	2.0	689	68.9%	343
Fighter Two Handed Sword	631	63.1%	51.5	43.3%	1.7	311	31.1%	285
Fighter Two Weapons	243	24.3%	37.5	31.5%	2.1	676	67.6%	230
Barbarian	757	75.7%	91.0	50.6%	1.6	324	32.4%	311
Fighter Two Weapons	629	62.9%	54.1	45.5%	2.2	663	66.3%	511
Ranger	371	37.1%	40.6	38.3%	2.2	337	33.7%	219
Fighter Two Weapons	422	42.2%	49.7	41.8%	2.1	586	58.6%	335
Monk	578	57.8%	48.6	45.9%	1.9	414	41.4%	327

Table 16. (cont.).

	Barbarian			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Barbarian	658	65.8%	75.5	42.0%	2.2	504	50.4%	403
Fighter Sword & Board	342	34.2%	49.1	37.5%	2.6	496	49.6%	241
Barbarian	709	70.9%	99.8	55.5%	1.5	503	50.3%	464
Fighter Two Handed Sword	291	29.1%	39.0	32.8%	2.0	497	49.7%	252
Barbarian	757	75.7%	91.0	50.6%	1.6	324	32.4%	311
Fighter Two Weapons	243	24.3%	37.5	31.5%	2.1	676	67.6%	230
Barbarian	851	85.1%	109.0	60.6%	1.4	483	48.3%	470
Ranger	149	14.9%	32.5	30.6%	2.1	517	51.7%	136
Barbarian	710	71.0%	98.5	54.7%	1.3	369	36.9%	338
Monk	290	29.0%	46.7	44.1%	1.9	631	63.1%	259

	Ranger			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Ranger	51	5.1%	25.6	24.2%	3.3	522	52.2%	43
Fighter Sword & Board	949	94.9%	78.1	59.6%	2.5	478	47.8%	470
Ranger	269	26.9%	42.8	40.4%	1.9	518	51.8%	231
Fighter Two Handed Sword	731	73.1%	67.1	56.4%	1.5	482	48.2%	444
Ranger	371	37.1%	40.6	38.3%	2.2	337	33.7%	219
Fighter Two Weapons	629	62.9%	54.1	45.5%	2.2	663	66.3%	511
Ranger	149	14.9%	32.5	30.6%	2.1	517	51.7%	136
Barbarian	851	85.1%	109.0	60.6%	1.4	483	48.3%	470
Ranger	310	31.0%	45.7	43.1%	2.0	422	42.2%	214
Monk	690	69.0%	56.9	53.7%	1.8	578	57.8%	482

	Monk			Lvl 12				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Monk	190	19.0%	34.0	32.1%	2.7	630	63.0%	153
Fighter Sword & Board	810	81.0%	70.9	54.1%	2.4	370	37.0%	333
Monk	450	45.0%	59.7	56.3%	1.5	621	62.1%	380
Fighter Two Handed Sword	550	55.0%	64.5	54.2%	1.4	379	37.9%	309
Monk	578	57.8%	48.6	45.9%	1.9	414	41.4%	327
Fighter Two Weapons	422	42.2%	49.7	41.8%	2.1	586	58.6%	335
Monk	290	29.0%	46.7	44.1%	1.9	631	63.1%	259
Barbarian	710	71.0%	98.5	54.7%	1.3	369	36.9%	338
Monk	690	69.0%	56.9	53.7%	1.8	578	57.8%	482
Ranger	310	31.0%	45.7	43.1%	2.0	422	42.2%	214

Table 17. Some consolidated results for the level 12 combats.

Lvl 12	Builds defeated	Fights won	Avg no turns	Initiatives won	Winning with Initiative
Fighter Sword & Board	4	3,601	2.5	2,200	1,761
Fighter Two Handed Sword	3	2,589	1.8	2,145	1,552
Fighter Two Weapons	1	1,777	2.4	3,282	1,518
Barbarian	5	3,685	1.6	2,183	1,986
Ranger	0	1,150	2.3	2,316	843
Monk	2	2,198	2.0	2,874	1,601
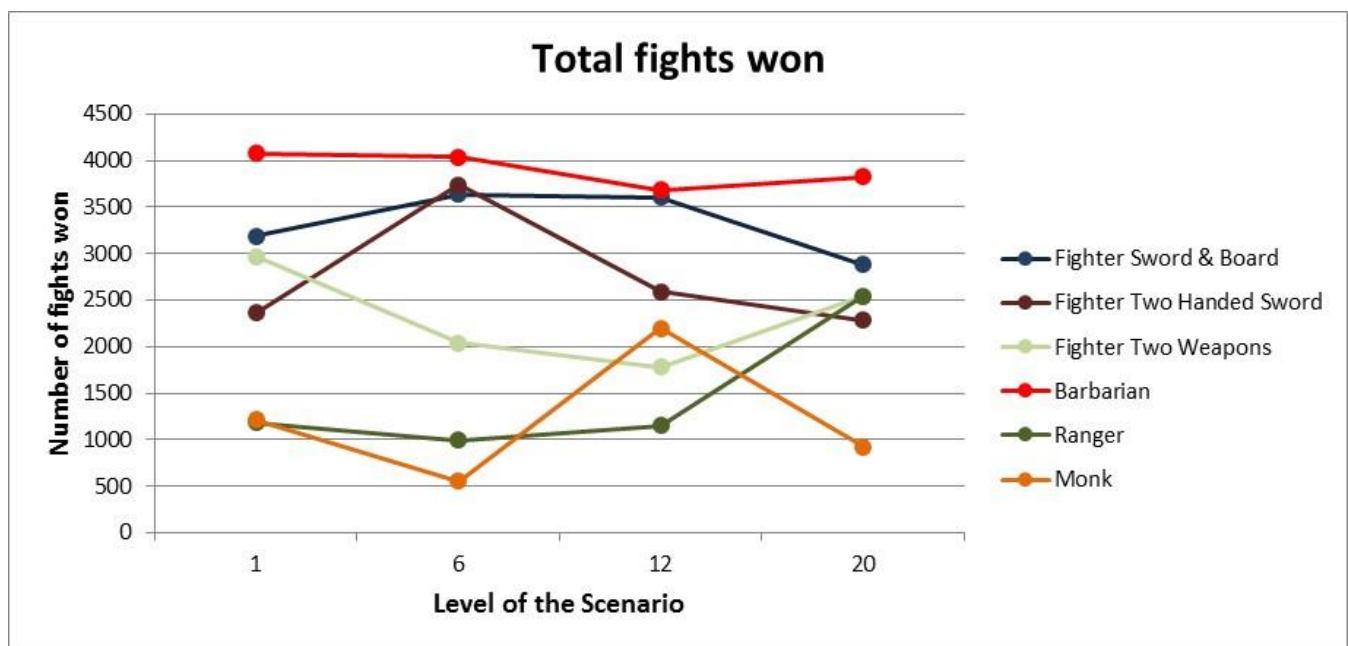
Figure 2. Total fights won.

Table 18. Results of the fights for the level 20 builds.

|	Fighter Sword & Board			Lvl 20			
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Sword & Board	577	57.7%	99.4	39.0%	2.2	521	52.1%	401
Fighter 2 handed sword	423	42.3%	88.3	37.6%	2.3	479	47.9%	303
Fighter Sword & Board	672	67.2%	93.2	36.6%	2.4	240	24.0%	219
Fighter Two Weapons	328	32.8%	70.5	30.0%	2.8	760	76.0%	307
Fighter Sword & Board	78	7.8%	61.5	24.1%	3.1	468	46.8%	68
Barbarian	922	92.2%	150.7	42.3%	2.2	532	53.2%	522
Fighter Sword & Board	655	65.5%	91.0	35.7%	2.1	175	17.5%	155
Ranger	345	34.5%	69.9	32.7%	2.5	825	82.5%	325
Fighter Sword & Board	898	89.8%	140.1	54.9%	2.0	384	38.4%	370
Monk	102	10.2%	65.5	30.6%	2.5	616	61.6%	88

	Fighter Two Handed Sword			Lvl 20			
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Handed Sword	423	42.3%	88.3	37.6%	2.3	479	47.9%	303
Fighter Sword & Board	577	57.7%	99.4	39.0%	2.2	521	52.1%	401
Fighter Two Handed Sword	444	44.4%	84.0	35.7%	1.8	219	21.9%	185
Fighter Two Weapons	556	55.6%	83.6	35.6%	2.1	781	78.1%	522
Fighter Two Handed Sword	331	33.1%	57.4	24.4%	2.1	515	51.5%	291
Barbarian	669	66.9%	162.5	45.6%	2.0	485	48.5%	445
Fighter Two Handed Sword	442	44.2%	91.9	39.1%	1.6	201	20.1%	176
Ranger	558	55.8%	72.5	33.9%	2.0	799	79.9%	533
Fighter Two Handed Sword	646	64.6%	122.5	52.1%	1.4	377	37.7%	335
Monk	354	35.4%	93.0	43.5%	1.8	623	62.3%	312

	Fighter Two Weapons			Lvl 20			
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Fighter Two Weapons	328	32.8%	70.5	30.0%	2.8	760	76.0%	307
Fighter Sword & Board	672	67.2%	93.2	36.6%	2.4	240	24.0%	219
Fighter Two Weapons	556	55.6%	83.6	35.6%	2.1	781	78.1%	522
Fighter Two Handed Sword	444	44.4%	84.0	35.7%	1.8	219	21.9%	185
Fighter Two Weapons	313	31.3%	77.2	32.9%	2.1	797	79.7%	308
Barbarian	687	68.7%	183.8	51.6%	1.5	203	20.3%	198
Fighter Two Weapons	484	48.4%	93.3	39.7%	2.0	415	41.5%	327
Ranger	516	51.6%	85.1	39.8%	2.0	585	58.5%	428
Fighter Two Weapons	859	85.9%	155.9	66.3%	1.6	671	67.1%	633
Monk	141	14.1%	82.8	38.7%	2.1	329	32.9%	103

Table 18. (cont.).

	Barbarian			Lvl 20				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Barbarian	922	92.2%	150.7	42.3%	2.2	532	53.2%	522
Fighter Sword & Board	78	7.8%	61.5	24.1%	3.1	468	46.8%	68
Barbarian	669	66.9%	162.5	45.6%	2.0	485	48.5%	445
Fighter Two Handed Sword	331	33.1%	57.4	24.4%	2.1	515	51.5%	291
Barbarian	687	68.7%	183.8	51.6%	1.5	203	20.3%	198
Fighter Two Weapons	313	31.3%	77.2	32.9%	2.1	797	79.7%	308
Barbarian	720	72.0%	179.6	50.4%	1.3	168	16.8%	164
Ranger	280	28.0%	70.8	33.1%	2.1	832	83.2%	276
Barbarian	827	82.7%	209.2	58.8%	1.2	384	38.4%	374
Monk	173	17.3%	73.9	34.5%	2.0	616	61.6%	163

	Ranger			Lvl 20				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Ranger	345	34.5%	69.9	32.7%	2.5	825	82.5%	325
Fighter Sword & Board	655	65.5%	91.0	35.7%	2.1	175	17.5%	155
Ranger	558	55.8%	72.5	33.9%	2.0	799	79.9%	533
Fighter Two Handed Sword	442	44.2%	91.9	39.1%	1.6	201	20.1%	176
Ranger	516	51.6%	85.1	39.8%	2.0	585	58.5%	428
Fighter Two Weapons	484	48.4%	93.3	39.7%	2.0	415	41.5%	327
Ranger	280	28.0%	70.8	33.1%	2.1	832	83.2%	276
Barbarian	720	72.0%	179.6	50.4%	1.3	168	16.8%	164
Ranger	844	84.4%	155.6	72.7%	1.4	718	71.8%	659
Monk	156	15.6%	105.6	49.3%	1.8	282	28.2%	97

	Monk			Lvl 20				
	Number of victories	% victories	Remaining HP	% Remaining HP	Average no of rounds	Initiatives won	% Initiatives	Winning with Initiative
Monk	102	10.2%	65.5	30.6%	2.5	616	61.6%	88
Fighter Sword & Board	898	89.8%	140.1	54.9%	2.0	384	38.4%	370
Monk	354	35.4%	93.0	43.5%	1.8	623	62.3%	312
Fighter Two Handed Sword	646	64.6%	122.5	52.1%	1.4	377	37.7%	335
Monk	141	14.1%	82.8	38.7%	2.1	329	32.9%	103
Fighter Two Weapons	859	85.9%	155.9	66.3%	1.6	671	67.1%	633
Monk	173	17.3%	73.9	34.5%	2.0	616	61.6%	163
Barbarian	827	82.7%	209.2	58.8%	1.2	384	38.4%	374
Monk	156	15.6%	105.6	49.3%	1.8	282	28.2%	97
Ranger	844	84.4%	155.6	72.7%	1.4	718	71.8%	659

Table 19. Some consolidated results for the level 20 combats.

Lvl 20	Builds defeated	Fights won	Fights Lost	Avg no turns	Initiatives won	Winning with Initiative
Fighter Sword & Board	4	2,880	2,120	2.4	1,788	1,213
Fighter Two Handed Sword	1	2,286	2,714	1.8	1,791	1,290
Fighter Two Weapons	2	2,540	2,460	2.1	3,424	2,097
Barbarian	5	3,825	1,175	1.7	1,772	1,703
Ranger	3	2,543	2,457	2.0	3,759	2,221
Monk	0	926	4,074	2.0	2,466	763
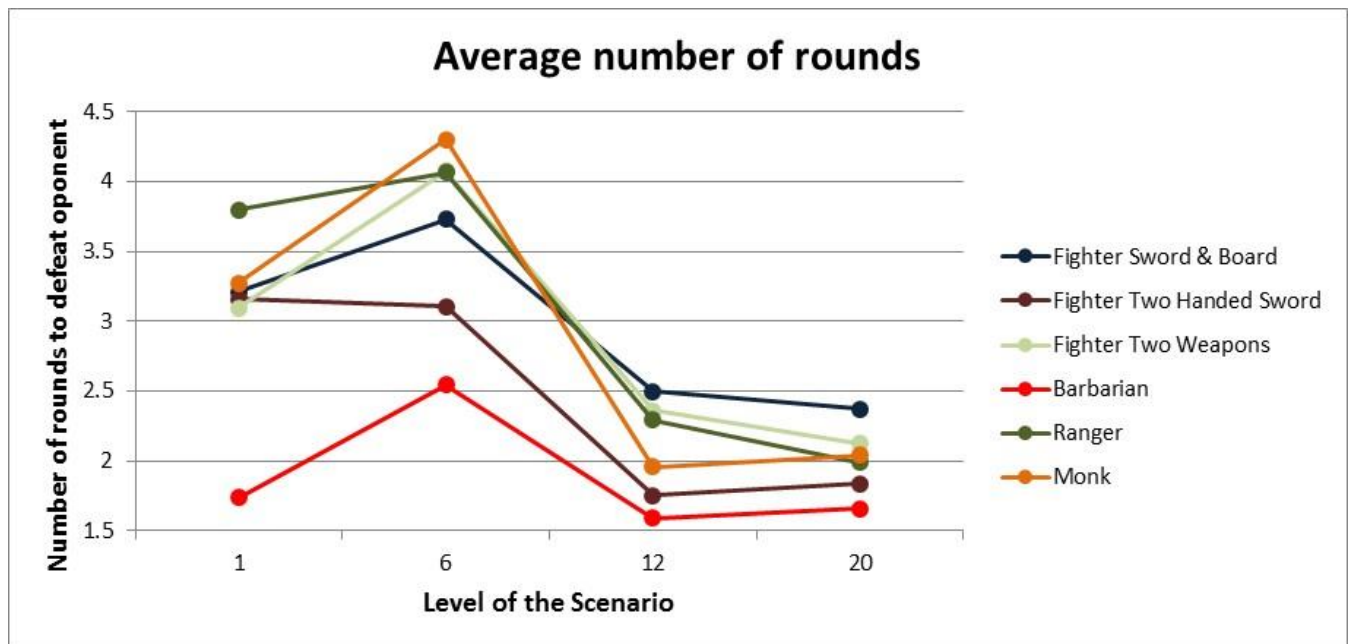
Figure 3. Average number of rounds taken to defeat the opponent.

CONCLUSION

First and foremost, I find it important to state clearly that the combat is but a small part of the D&D game. Though it might be tempting to create an efficient character for battles, there are many different ways a character can be truly powerful, useful and, most important of all, fun to play with. Secondly, 1x1 melee combats are (thankfully) rare in D&D games. Most battles involve many characters and enemies, making them much more fun and challenging, requiring some amount of team work, planning and creativity. Thirdly, even on 1x1 melee combats, only going for full attacks is not that common. Characters can (and should) have different tactics that involve disarming, tripping,

sundering or any other resource that allow them to overpower the opponent. Having said that, this small simulation shows some interesting points.

The Barbarian is clearly the strongest build of the ones simulated when considering raw power. The high attack bonus and damage output surpass the most solid defenses, while the enormous amount of Health Points protects against the fiercest attacks. The Barbarian is clearly superior to the THS Fighter, when it comes solely to melee fights.

Monks, Rangers and TW Fighters, builds that use a large number of attacks, have trouble against defensive characters, since many of the attacks do not connect. On the other hand, they can consistently defeat characters with low Armor Class, making them interesting choices against Wizards and other spellcasters.

The most interesting finding of this simulation, though, is the increasing impact of the initiative on the melee combats, when considering the possibility of a "full attack", as the characters grow stronger.

Due to powerful items such as Boots of Haste and Belt of Battle (or, even better, spells such as Haste or Righteous Wrath of the Faithfull), winning or losing the initiative can be more important than a careful planning of the attack or the careful creation of a character. This might not be relevant in situations where, as stated above, many characters are fighting at the same time, but it can be a problem when 1x1 melee fights affect the whole outcome of the adventure.

As such, some adaptations of the initiative rule may be interesting when such fights are necessary (gladiator fights, generals meeting in the battlefield, among others). One interesting alternative is the one presented by the Shadowrun system (Hardy *et al.,* 2013) where,

instead of rolling initiative once for all your actions of the round, you roll initiative to define an "initiative gauge". The character to act is the one with the highest "initiative gauge" and each action taken depletes this gauge by some amount.

With the release of D&D 5th edition, many changes were made, including combat rules. Soon enough, I shall play it to give my take on it!

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Geeky nature

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Everybody knows that each species on the planet eventually receives a so-called "scientific name", a two-piece Latin-like name that serves the purpose of scaring people away from science – even more than they already naturally are. So what good do scientific names do?

Cyanocitta cristata, the blue jay. Image taken from: Wikimedia Commons.

Well, for starters, having an official name assures that every single scientist in the world will refer to a species by its scientific name. This makes it a lot easier to find information about a given species in the vast scientific literature. Just imagine how easier it is to simply search the literature for information on *Cyanocitta cristata* instead of looking for citations of its popular names: blue jay (in English), arrendajo azul or urraca azul (in Spanish), Blauhäher (in German), geai bleu (in French), ghiandaia azzurra americana (in Italian), gaio azul (in Portuguese) etc.
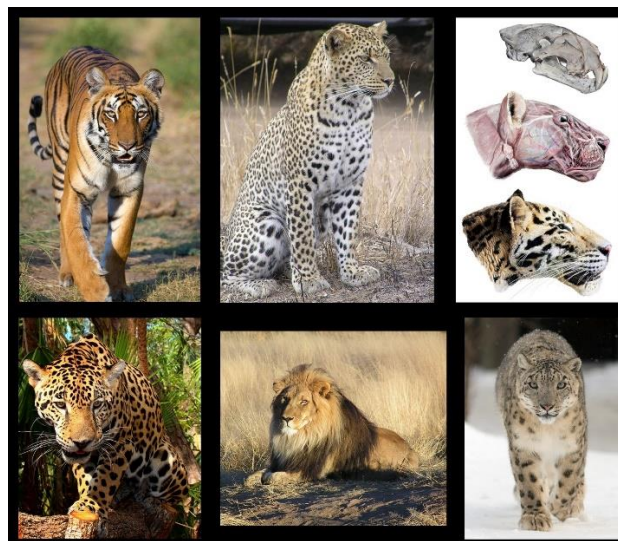
Species in the genus *Panthera* are all closely related to each other and, thus, all have similar characteristics. Top row, from left to right: tiger (*P. tigris*), leopard (*P. pardus*) and a reconstruction of the fossil Longdan tiger (*P. zdanskyi*). Bottom row, from left to right: jaguar (*P. onca*), lion (*P. leo*) and snow leopard (*P. uncia*). Image taken from: Wikimedia Commons.

Moreover, by stating that a tiger (*Panthera tigris*) belongs in the genus *Panthera*, we are saying that it is more closely related to the other species in the same genus (such as the lion, *Panthera leo*, and the jaguar, *Panthera onca*)

than to any other member of the cat family (called Felidae), such as the Canadian lynx (*Lynx canadensis*) or the saber-toothed cat (*Smilodon fatalis*). These statements are the basis for organizing the tree of life.

Now, let us take a moment to review how scientific names work. They have two parts. The first one is the name of the genus, like *Panthera* in the example above. The second part is called the "specific epithet", like *tigris* for the tiger. Now mind you that the species name is not simply *tigris*. The word *tigris* means nothing by itself, unless accompanied by the genus name. As such, the complete name of the tiger species is *Panthera tigris*.

The specific epithet (the *cristata* of the blue jay example) is usually not a random word. It may help describing a species, giving an idea of what it is like or where it comes from. Let's take a look now at some useful specific epithets:

▪ Take the snail species called *Eoborus rotundus*, for instance. The specific epithet implies that this particular snail is rotund or round and this is something that makes it different from other species in the same genus. For instance, the species *Eoborus fusiformis* is, like the name implies, spindle-shaped. As such, the specific epithet serves to point out a feature that makes the species easy to distinguish (diagnose, in the jargon) from other closely related species.

▪ The specific epithet can also reflect the place where the species lives or, at least, where it was first found. For instance, we expect to find a bird named *Tangara brasiliensis* in Brazil and a slug called *Arion lusitanicus* in Portugal. Sometimes this fails though: the bird *Tangara mexicana* is not found in Mexico – perhaps a lack of geographical knowledge of the person who named it.

▪ An epithet may also reflect the kind of habitat where the species lives in or its mode of life. The snail *Cepaea hortensis* received this epithet because it is commonly found in groves and orchards.


The round *Eoborus rotundus* (left) and the spindle-shaped *Eoborus fusiformis* (right) are fossil land snails species from the Paleocene/Eocene of Brazil.

Also, there are the not-so-useful names, the ones that are given in honor of someone, commonly a great scientist who usually worked with that group of animals before. For instance, there are loads of species, such as the snail *Bulimulus darwini*, named after Charles Darwin. Of course, Darwin deserves all the honors possible, but sometimes this habit of naming can become more a matter of ass-kissing than anything else. It is thus common (and useless) to name species after the person who funded the research or even after people who are completely irrelevant to science, such as the zoologist's wife or children. Therefore, we have lots of women's proper names, especially in the butterflies. Even worse, almost all birds of paradise are named after European nobility or royalty. It might be cute, be it is useless.

Sometimes, a species is named after a mythological being. This is often also useless,

despite being way more awesome, like the owl genus named *Athene*. Yet, it might also be useful sometimes. For instance, the snail *Brasilennea arethusae* was named after the nymph Arethusa. This snail was the first fossil land snail found in Brazil and naming it after a forest-dwelling nymph made this very clear (at least to people who know their mythology), in a manner similar to the example of *Cepaea hortensis* above. Another example is *Pseudotorinia phorcysi*, a snail that lives in the deep sea, named (by myself and two colleagues) after the Greek deity *Phorcys*, the god of the hidden dangers of the deep sea.
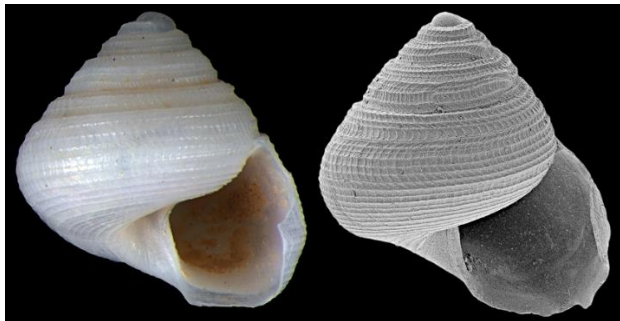
Halystina umberlee. The photo on the left was taken on a light stereomicroscope. The one on the right was taken using a scanning electron microscope, which reveals much more details about the structures of tiny creatures.

And now, finally, I arrived where I wanted: the geek names. Some species have received names coming from geek culture. As the first example, there is *Halystina umberlee*. This is also a deep-sea snail named by myself and the same two colleagues, but this time, instead of the Greek god Phorcys of the example above, we used the goddess Umberlee. She is also a goddess of the dangers of the deep sea, but she is a fictitious deity, coming from the so-called Faerûnian pantheon of the Dungeons & Dragons RPG. To my knowledge, I was the first geek to name a species after something D&D-ish. But

I'm far from being the first geek in the history of zoological nomenclature.

The goddess Umberlee rising from the waves (taken from the book Faiths & Pantheons by Eric L. Boyd & Erik Mona, 2002, published by Wizards of the Coast).

Back in the 19th century, geek zoologists did not have Tolkien or Star Trek yet, so they named their species after the geeky literature of their time. For instance, the jumping spider *Bagheera kiplingi* – the genus named after the character and the specific epithet after the writer.

From the middle of the 20th century onwards, geekness became much more pervasive. Just to exemplify, we have the spiders *Pimoa cthulhu* and *Aname aragog*, the fossil plant *Phoenicopsis rincewindii*, the mussel *Ladella spocki*, the fish *Bidenichthys beeblebroxi*, the dinosaur *Dracorex hogwartsia* and a whole lot from the Tolkienverse: the weevil *Macrostyphlus gandalf*, the fossil mammals

Protoselene bombadili and *Mimatuta morgoth*, the leafhopper *Macropsis sauroni* etc.

The dinosaur *Dracorex hogwartsia*, from the late Cretaceous of North America. Its skull really looks like that of a "typical" dragon, but the animal was disappointingly an herbivore. Image taken from: Wikimedia Commons.

Genera (this is the plural of genus!) have also been named after geek culture: the worm *Yoda*, the slug *Smeagol* (which has its own precious family, Smeagolidae), the crustacean *Godzillius*, the snail *Cortana* (this one is also my fault), the lizard *Smaug*, the fish *Batman* (why not an outright bat is something that also baffles me) and the tardigrade (microscopic creatures also known as sea-bears) *Beorn*, among many others.

One species that deserves a full paragraph here is *Han solo*. Yes, exactly, I'm talking about the Chinese trilobite. In the official description (from 2005), the author Samuel T. Turvey says that the name comes from to the Han Chinese (by far the most numerous ethnic group in China today) and that the specific epithet solo is because the species is the youngest fossil in the family (meaning the last or sole survivor). Still, Turvey later said that it was all a bet; some friends dared him to name a species after a Star Wars character. But Turvey was rather cowardly in this. He could have stated up front (and

proudly) where the name came from. There is no rule in the International Code of Zoological Nomenclature (the code that regulates the names) against this. I have done it myself and lots of geeks before me have been doing it for a long time. The official description of the fossil turtle genus *Ninjemys* reads: "Ninja, in allusion to that totally rad, fearsome foursome epitomizing shelled success; emys, turtle." And no editor or reviewer can prevent the name being given. Well, perhaps they could back in 1900-something, where everybody was worried with proper-this and proper-that, but, come on, not in 2005! Dr. Turvey, you have made geekdom both proud and disappointed at the same time. Please get things right from the start next time.

Skull of the fossil teenager ninja turtle *Ninjemys oweni*, from the Pleistocene of Australia. Those are some pretty badass spikes and it actually looks a little bit like Slasher. Image taken from: Wikimedia Commons.

OK, I grant you that geek names are not very useful, but they sure give a little color to zoological (and sometimes also botanical) nomenclature. Taxonomy (the science of naming and classifying living creatures) is very nice and all, but the scientific papers in the area can be very arid and lifeless. Therefore, I think

that it is a very valid endeavor to try to have some fun while doing taxonomy, especially if you are a geek and have a whole pantheon of heroes, gods and monsters to get your inspiration from.

REFERENCES & FUTHER READING

If you want to know exactly how species are formally described and get their official names, this is the best guide out there: **Winston, J.E.** (1999) Describing Species: Practical Taxonomic Procedure for Biologists. Columbia University Press, New York.

A less academic approach to the whole naming process can be found in: **Wright, J.** (2014) The Naming of the Shrew: A Curious History of Latin Names. Bloomsbury Publishing, London.

For a more philosophical view and musings about the importance of naming species for scientists and non-scientists alike, try this one (you might want to skip chapter 9 though, which is far too exaggerated on its glorification of molecular taxonomy): **Yoon, C.K.** (2010) Naming Nature: The Clash Between Instinct and Science. W.W. Norton & Company, New York.

If you want a taste of what a real taxonomic paper looks like, try this one (where *Halystina umberlee* came from): **Salvador, R.B.; Cavallari, D.C.; Simone, L.R.L.** (2014) Seguenziidae (Gastropoda: Vetigastropoda) from SE Brazil collected by the Marion Dufresne (MD55) expedition. Zootaxa 3878(6): 536–550.

For the ones who like rules and want to take a look at the "laws" presiding over animal names, the **International Code of Zoological Nomenclature** (ICZN, for the intimate) is the one and only guide: http://iczn.org/iczn/index.jsp.

Last but not least, Mark Isaak has compiled a lot of geeky scientific names on his website: www.curioustaxonomy.net/etym/fiction.html. I must confess that I did not know most of them, since they are insect names (rather removed from my area of study). In any case, it is always good to know that I am not alone – there are many other geek zoologists and paleontologists out there. Just take a look at the sheer amount of Lord of the Rings and Silmarillion names; it's amazing!