



# DSI AITS Newsletter

AUGUST 2021

## A Few More Bits, Please [Abraham John, Executive Director, DSI AITS]

My “fluff” article for this issue is to journey a bit deeper into binary since that is how data is represented in a computer. For this issue, I also wanted to step back for a bit, no pun intended, and get to the basics. Looking at a very basic level of some binary math uncovers the purity of numbers and technology built through principles that have been gleaned by mathematicians and computer scientists. There is a certain joy in just losing oneself in numbers with no considerations other than the sheer beauty that is inherent in them. This is a wonderful way to shake off the vagaries that surrounds all environments and to just think of things that are neither good nor bad but just are.

Computers store data in memory as either on or off or true or false and a binary numbering system is perfect for such a representation method. Bits or Binary Digits are numbered sequentially from the right to the left with the rightmost bit being the zero bit and sequentially increasing powers of 2 as we move to the left. I might entertain the idea of dealing with how x86 processors store and retrieve data from memory in a later issue and fulfill the cravings of the readership that is waiting anxiously for coverage about big- and little-endian approaches. For this article I will not add that to the already “strange” musings 😊.

The leftmost bit is referred to as the Most Significant Bit or MSB and the rightmost bit is called the Least Significant Bit or LSB. Binary integers like their decimal cousins can be either positive or negative. For completeness, a signed integer can be either positive or negative whereas an unsigned integer is by default considered positive. Zero is always considered positive.

In the last issue I covered the positional nature of binary and as such I will not go over that in this article. I will only mention that starting with the LSB each subsequent bit is an increasing power of 2. I also covered the process of converting decimal to binary in the last issue and while I will be showing example of decimal in binary, I will not reintroduce the conversion process in this article. For the process of translating unsigned decimal integers to binary, refer to the last issue of our newsletter.

I want to introduce the idea of binary addition in this article and cover the concept of signed binary addition.

When dealing with binary additions, we proceed bit by bit and we start at the rightmost bit while performing the addition. There are four ways in which we can add two binary digits, where the 0’s and 1’s shown below are binary 0’s and 1’s.

- $0 + 0 = 0$
- $1 + 0 = 1$
- $0 + 1 = 1$
- $1 + 1 = 10$

- o When adding binary 1 and binary 1 think of this as becoming a decimal 2 and this would translate to binary 10. Think of this in the same way we would do decimal arithmetic. When adding a 1 and 9, it yields a 0 in the units or one’s position and a 1 in the ten’s position yielding the decimal number ten.



Enjoy this brain teaser 😊

**If you have a great memory and a big vocabulary you might come up with at least 3 words that have all 5 vowels (A, E, I, O, and U). The vowels don’t have to be in order but they can be and you don’t have to include Y but you can. Can you come up with 6 words that have all 5 vowels?**



The acronym  
CD-ROM stands  
for Compact Disc  
Read Only  
Memory.

For example, when adding the number 5 and 17 would work in the following manner in binary.

	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>
(5)	0	0	0	0	0	1	0	1
(17)	0	0	0	1	0	0	0	1
(22)	0	0	0	1	0	1	1	0

With the rightmost bit or bit position 0 we have 1 + 1 and this generates a zero with carry of a 1 the bit position 1. Bit position 1 addition would be 0 + 1 generating 1, bit position 2 would be 1 + 0 generating 1, bit position 2 would be 0 + 0 generating 0 and so on through bit position 7.

There are situations where a carry is generated at the highest bit position. When this happens, the size of the storage area becomes important. For example, if the storage area is a byte i.e., 8 bits and the value in this byte is 8 binary 1's. Adding a binary 1 to the LSB will generate a carry at the MSB and the 8 bits will all be 0's if there is no 9<sup>th</sup> bit to hold the carried bit. An example of this would be if we were adding 1 to 255.

	2 <sup>8</sup>	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>
(255)	0	1	1	1	1	1	1	1	1
(1)	0	0	0	0	0	0	0	0	1
(256)	1	0	0	0	0	0	0	0	0

The example above is one where we have a byte which is 8 bits, 2<sup>0</sup> - 2<sup>7</sup>. The column in yellow is 2<sup>8</sup> or the 9<sup>th</sup> bit that would not exist in a storage area that is a byte but is shown here to demonstrate the overflow that occurs. In this instance adding 1 to the 0<sup>th</sup> bit generates a carry that results in a carry through the entire byte since all the values for 8 bits are binary 1's. If we did not have the 9<sup>th</sup> bit as shown by the yellow area, the value of the byte would be 0 where in reality when adding 255 + 1, we should get 256. When writing code, the anticipated maximum and minimum values should be checked to guard against an overflow situation and an erroneous value.

Signed binary integers are either positive or negative and the MSB bit value is set to 0 for positive and 1 for negative. Below is an example of decimal +13 and -13.

Pos	0	0	0	0	1	1	0	1
Neg	1	1	1	1	0	0	1	1

The negative integer uses two's complement representation. This is done by inverting or complementing the bits and adding 1. Our example of decimal 13 would have the decimal -13 represented in this manner with two's complement.

Starting decimal +13	00001101
Reverse/invert the bits	11110010
Add 1 to value above	00000001
Two's complement result (-13)	11110011

Applying the two's complement steps to a negative number will reverse it to its positive counterpart. Another little observation is that the decimal value if -13's binary representation is 243. The largest value that can be represented by a byte is 256 (0 - 255). Subtracting 243 from 256 yields 13. As you work with binary arithmetic, you will notice interesting little tidbits like this that is great for the odd trivia now and then.

The magnitude of a signed integer of n bits will need n-1 bits to be represented. Given this, our maximum and minimum value for signed bytes, words, double words and quadwords are going to be necessarily different than that of an equivalent



**Charles Babbage, a British mathematician and inventor, is known as the "Father of the Computer". He designed a mechanical computer called the Analytical Engine and it was an early forerunner to the computer we know today.**

unsigned byte, word, double word and quadword. The ranges for signed integers are as follows.

Type of storage	Range (min – max)	Powers of 2
Signed byte (8 bits)	-128 to +127	$-2^7$ to $2^7 - 1$
Signed word (16 bits)	-32768 to +32767	$-2^{15}$ to $2^{15} - 1$
Signed doubleword (32 bits)	-2,147,483,648 to +2,147,483,647	$-2^{31}$ to $2^{31} - 1$
Signed quadword (64 bits)	-9,223,372,036,854,775,808 to +9,223,372,036,854,775,807	$-2^{63}$ to $2^{63} - 1$

There are many in the readership of this newsletter who are mathematically gifted and will certainly find this treatment extremely basic and there may be others who find a new distraction in pursuing these ideas into something more complex. The following couple of exercises are for both and for those who may want to daydream during their lunch break about binary representations and just maybe even for the readers who may groan (*rightfully so*) at the thought of the word binary 😊.

Using the two's complement principle what would be the binary two's complement result of decimal -87 look like in signed binary if the starting binary value of +87 is: 01010111

Merging last issue of this newsletter with what we covered in this issue what would decimal  $768_{10}$  be in binary?

For those in the readership who plan to bring two's complement as entertainment to parties, I urge that you have a quick getaway planned because I suspect you may be voted off the "party island" and I urge that you bring the host an expensive and thoughtful gift to stand a chance of being invited again 😊.

Given that this is a "fluff" article, I hope you enjoy this!

# Bring-Your-Own-Device & Agile Workplace Printing

[Richard Sanzone]

The modern workplace and university experience are trending towards mobile computing, bring-your-own-device, and fluid workspaces using “hoteling” workstations. The traditional method of printing through an installed print queue and driver are sometimes not possible in the new dynamic IT environment. Thankfully, UNT’s print management system is full of technology and techniques that support agile methods of printing that do not tie users down to specific computers.

## WebPrint

WebPrint is a feature of the UNT Print Management System that provides printing to any networked printer through a browser interface. A document is uploaded to the [printing.unt.edu](http://printing.unt.edu) website and a printer is selected for the print job. The WebPrint functionality is available on any modern browser with typical internet connectivity. There are no ISP or network restrictions on this service so it can be utilized on and off campus, hard-wired network, WiFi, and even through cell data service. Give it a try at [printing.unt.edu](http://printing.unt.edu).

Print Manager FYI: enable WebPrint on any printer in the PaperCut Admin UI by checking the “Enable WebPrint” option in the Advanced Configuration section.

## Email-To-Print

Email-To-Print technology allows users to print by emailing their documents as an email attachment to a specific email address associated with a printer. No client software or drivers are required, providing a simple way to print from any device that can send an email. Each printer in UNT’s Print Management System can have an associated email address – ask your IT support or [sanzone@unt.edu](mailto:sanzone@unt.edu) for details.

Print Manager FYI: PaperCut monitors a unified mailbox with dynamic in-line aliasing, so no specific email address or mailbox is required to provide Email-To-Print on your printers. Just tag your printers with an email address in the PaperCut Admin UI. Use the format `[anything unique]@printer.unt.edu`

## USB-To-Print

USB-To-Print is a function that has existing for many years and is a native function on most multi-function printer/copiers and some advanced single-function printers. If the printer device supports the function, a USB flash drive can be plugged into the printer and the menu interface on the printer will allow the selection of a document on the flash drive for printing. This USB-To-Print method is very useful when a computer is not available.

## Follow-Me Print / Unified Virtual Queue

Follow-Me printing solves the problem of finding the closest printer from a long list of available printers. Users simply print to a unified virtual queue, then go to the most convenient printer and

release the print job at that particular printer using the Print Management Release function. This is a great option for situations where a user may not know the name of the printers nearby.

Example = You need to print a document on your home computer when you get to campus. You can print your document from home using the “Web Print” function (described above). Select the “Denton Campus Black & White Cloud Queue” unified print queue. Drive to campus and park anywhere you find a spot. Walk into the nearest building, find a printer, and release your document at that printer using the Print Management Release function on that printer.



The first known computer virus was written for an Apple II in 1981. It was called the “Elk Cloner” and it displayed a little rhyme on the screen.

Print Manager FYI: The Follow-Me Print / Unified Virtual Queue requires the printer to be configured with managed release in the PaperCut Admin UI. Furthermore, the unified virtual queue in PaperCut needs to be configured to redirect documents to the physical local printer. See the PaperCut admin for more details.

### **Questions or Comments?**

Please contact the Print Management support team at Host Computing Services ([it.unt.edu/hostcomputing](http://it.unt.edu/hostcomputing)) for assistance.



**The "Tequila" virus was the first polymorphic virus. It was written in 1991. The goal was with each replication it could change its signature i.e. its binary pattern to avoid detection.**

# The Corporate Space Race: SpacxX vs. Blue Origin and NASA

[Christopher Horiates]

Starting in 1957 a Space Race took place. It was the United States of America against the Soviet Union. The two countries wanted to see who get to space the fastest, put satellites in orbit, put a person up in orbit and land on the moon. The two countries put their best scientist and engineers on the project. The estimated cost for the USA from 1958-1991 was about \$170 billion. The largest and most powerful rocket, the Saturn V, was created. It ultimately took us to the moon and back. Having talked to family members about what they remember during that time it seemed to bring a sense of patriotism and pride to be an American to see our country land on the moon. While we me have lost a few of the challenges along the way to the Soviet Union, landing on the moon first was the goal. Since then our countries have joined forces to expand our space exploration. We partner with the International Space Station and up until recently the USA was using Russian rockets to get up and back.

While all this was going on two very famous and wealthy Americans were chasing the dream of going into space with private companies. Elon Musk and Jeff Bezos had started up SpaceX and Blue Origin in the mid 2000's. While private companies in the past had worked with NASA on previous rocket technology the difference was NASA was the main leader of those projects. With these two companies they are truly private, and NASA uses them to get into space. In May of 2020 SpaceX sent NASA astronauts into space. This was historic in that this was this first time ever a private company had sent humans into orbit. While the Corporate Space Race had been going on for years prior, this was the Sputnik moment between the two companies in my opinion.

Why the investment into space by private companies? Are they doing this just because they are rich and have nothing else to do with all their money so they spend it on building rockets? I mean that might be part of it, heck I remember wanting to go to space as young boy and building model rockets to launch. These two just have the money to live out that dream. The other aspect is money, they are making money by doing this. They founded companies that are monetizing space travel.

There will be two types of space travel that come out of this. Recreation space travel, for those who can afford it (until maybe the price comes down) and deep space travel. NASA and these two companies are looking at going to Mars, by first building out a space station both on and around the moon. It's called Artemis, the twin sister to Apollo and goddess of the moon, and the mission is to get us to Mars and beyond. While the primary mission will be headed by NASA the two companies will play a role in the technology and ships that lay the groundwork for the overall mission.

Some ask why bother, why bother going to a planet where we cannot sustain life? What's the point? All the issues we have on this world and we are going to sink trillions into this to find out what? While I understand the thinking behind that I also think that pushing boundaries and technology is how we will progress as a species. The vastness of space and the question of are we alone may never be answered fully but at least we are trying. These are truly amazing times we are in and I fear that with everything else going on the attention that Space X, Blue Origin, NASA and the others involved will just be a blip on the social media feed. To think the Kindergartens of today, a few of them, could well be the first people to step foot on Mars.

[https://youtu.be/\\_T8cn2J13-4](https://youtu.be/_T8cn2J13-4) To see more on the Artemis mission visit this YouTube link.



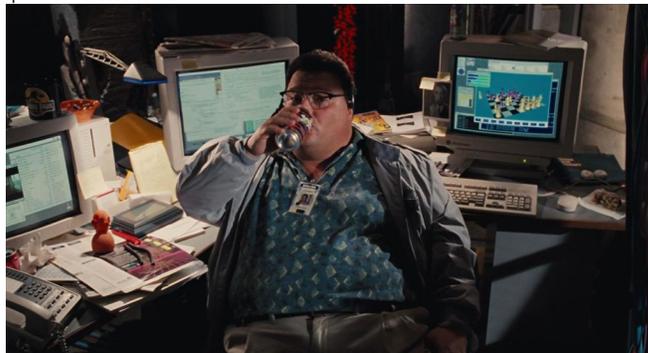
The acronym  
GUI stands for  
Graphical User  
Interface.

## So You Want to Mine Ethereum [Patrick Kennedy]



When I was in high school, cryptocurrencies were relatively niche. I remember trying to convince my dad to buy a little bit of bitcoin when it was practically worthless, and he was put off by how unfamiliar the concept was, only to regret that decision greatly later. I had a casual interest in it and would mine bitcoin and dogecoin just because I thought the concept was cool, and it felt like a fun little side project. These days I hear people talk about crypto such as Bitcoin, Ethereum, Dogecoin, and more fairly often, but it often feels as if people have the unrealistic expectation that if you get a little bit of crypto, you're halfway to picking up your new Aston Martin DBS Superleggera and quitting your job to be a professional stay-at-home rich person.

I stopped mining for quite a while, but somewhat recently picked up mining Ethereum. My interest has remained casual, but my returns were decent enough to help me build a new gaming PC, and as a result, I have had some people ask me if they should get into mining as well. For those unfamiliar with mining, it is (in a nutshell) using a powerful computer graphics card to perform complex calculations to verify transactions and the status of the database for a reward in the form of crypto. The hardware to do this is not only expensive, but extremely difficult to obtain right now due to shortages; I spent many months hunting down my RTX 3060 Ti after it launched because I wanted to try one of the small handful of games that support ray tracing, and then started mining on it when I wasn't using it. The price of Ethereum was around \$4000 per token when I sold off my initial quantity (keep in mind that much like the US dollar, you can have fractional quantities, and I only had a fraction of a token to sell), so I was able to use that in conjunction with the money I made selling my old computer hardware to build a nice gaming PC with an RTX 3090. I now have my 3060 Ti and 3090 mining together at a combined rate of about 170MH/s (Megahash per second). This is the rate at which you are mining (referred to as a hashrate), and at \$4000 a token, 170MH/s was generating about \$600 a month!



The acronym  
USB stands for  
Universal Serial  
Bus.



**You should update your computer's security software daily or at the very least, once a week.**

That all sounds pretty cool if you look at it through the lens of three months ago, but the value of Ethereum fluctuates constantly; At the time of writing this article, Ethereum sits right around \$2000 a token. With the price having been essentially halved, my profitability has gone significantly down. Thankfully the reason I bought all this hardware was to play games, but had I bought it with the intention of being profitable through mining, I would be sweating bullets. As a matter of fact, with the price sitting where it is, I still haven't broken even on my just my RTX 3090 alone, so what's the point? In my opinion, buying a graphics card with the intention of strictly mining with it is a losing battle; card prices are at their highest (my cards were purchased at their original MSRP, but I got VERY lucky. They cost 2-3x their MSRP on eBay, and my 3060 Ti is listed for hundreds more than I paid for it if you can even find one) supply makes it nearly impossible to get one, and Nvidia (the company that designs the RTX series cards) has replaced most of their current offerings with LHR versions. These LHR (or Light Hash Rate) cards are designed to detect when a user is attempting to mine some Ethereum and quite literally halves the hashrate but are identical in performance in every other way.

Furthermore, Ethereum is moving away from the Proof of Work model in favor of Proof of Stake, so you may not even be able to mine by the time you get a card. Proof of Stake is an entirely different way to verify transactions along the blockchain; instead of doing a lot of math, transactions are verified through consensus mechanisms that work by selecting a validator (someone that has staked 32ETH) and using them to validate blocks using when chosen. A validator stakes Ethereum, essentially locking the tokens up to be forfeited partially or fully if they act unfavorably in the interest of the network. The validator will also need a validation node, which can be low-cost consumer grade hardware that is online constantly. If selected, the validator validates the transaction and is rewarded, and staking Ethereum is expected to have a return of up to 10%. Since Ethereum is so hard to mine, people join established pools to work together in order to make it viable for a small fee, and the same applies to Ethereum 2.0. Users can work together if they don't have 32ETH to stake, and only have to stake a fraction of that.

While I strongly advise against purchasing any hardware to try and mine Ethereum specifically, mining with existing hardware is a fun side project, and I encourage you to try it! In order to mine Ethereum, you need a decent GPU, mining software, a pool, and a wallet to store your tokens. Personally, I use T-Rex miner with the Ethernine pool (since the fee is only 1%), and I have it all sent to MEW Wallet on my phone. There are plenty of options, and I am an amateur in every sense of the word, so I strongly consider you to research and see which options work best for you. Because I'm just doing this for fun, I plan to hold onto my tokens long-term and stake them when I feel inclined. Keep in mind that there are a slew of other cryptocurrencies you can mine, so if you are upset about losing the option to mine Ethereum, perhaps research what other coins you can mine, but be wary of fringe alt-coins. A lot of people get caught up in trying to find the next big cryptocurrency and install questionable software, so caution is recommended. Like with any investment, cryptocurrency can be risky, but if you play your cards right and get lucky, you can come out ahead. Good luck!



## Personal Budgeting Technology [Matthew Trammell]

Many years ago, my dad introduced me to Quicken. Quicken was my first attempt to “budget”. I use the term budget loosely because in reality, I was just tracking my spending. I was living by the spend less than you make principle. Don’t get me wrong, I believe that tracking your spending is the first step to gaining control of your personal finances, however; it is most important to create a plan for your money. That is budgeting. In fact, our primary budget file is appropriately, or more likely due to my lack of creativity, named “The Trammell Plan”. It is also important to know that plans change. To quote my 4-year-old daughter, “It is okay. It will be fine.” (I am sure that she got that phrase from me. Hehe!) Therefore, be okay with changing your budget.

*Before I proceed further, I want to disclose that I am not a Certified Public Accountant (CPA) or financial expert by any means. I am simply writing to share my knowledge of what I have learned about personal budgeting through my journey using the YNAB and EveryDollar applications. If you have any questions about your personal finances, please contact a financial advisor or someone that you are comfortable talking about your finances with. Thank you.*

Fast forward to nearly two years ago – my wife and I were Christmas shopping in October. It should have been a fun time, but it ended up being stressful because we had no amount set aside for Christmas money. I was in the background working on my phone, checking our bank balance, and crunching numbers on an Excel spreadsheet that I had pulled up on my phone. I was attempting to quickly determine how much we could spend on Christmas and still cover upcoming expenses for the remainder of the month. Ugh! From that day forward, I decided that I will start planning for our finances. Later that evening, I did some online research, found YNAB or You Need a Budget, and started budgeting, for real. I am proud to say that we are nearly two years in and still going strong.

Recently, back in April, UNT announced that the SmartDollar program, along with its companion app, EveryDollar, is available to full time faculty and staff. I was excited about this offering and registered for access on the same day that of the announcement. Having completed Dave Ramsey’s Financial Peace University class through church, I knew about Ramsey’s program to financial success. I think that his baby steps are a solid solution to financial freedom. I definitely wanted to be on the road to checking off those baby steps. However, even then, I still had difficulty applying Ramsey’s principles to our situation.

One reason for my difficulty, is that I depended on our desktop with Quicken. Maybe it was Excel at the time. At one point, I had abandoned Quicken and tried designing my own Excel budget spreadsheets. My brother-in-law provided me with a template of his budget spreadsheets. Now, unlike me, he is a financial expert, a Chartered Financial Analyst (CFA) even. The creativity and complexity of the spreadsheet that he sent me was mind blowing! I am sure that a fellow financial person would have appreciated it, but I needed something simpler, something that a non-finance guy could use. I also needed a mobile device to access our personal finances. Thank you iPhone!

Today, it is a rarity to find someone without a cell phone. I am someone who not only has a phone, but for good or for bad, I keep it close by. I like to tell myself that it is primarily due to my role as an Information Technology professional and wanting to be accessible. However, it is more because I enjoy having quick access to the Internet and applications at my fingertips. It is amazing that I can have our bank app, budget app, and calculator app all together in one place. Mobility has definitely made managing personal finances much easier.

A second reason for my difficulty is because I did not have that one experience yet, that one experience that creates a desire in you to achieve your set goal. Simply setting a goal is not enough!



**HDMI stands  
for High  
Definition  
Multimedia  
Interface.**



**To generate a pair of RSA encryption keys you need 2 prime numbers – at least 256 bits each.**

A final reason for my difficulty is that I did not have the right tools for me to accomplish my goal. I was trying to use Quicken and Excel to solve my problem. Please note that I am not knocking Quicken and Excel. If you are comfortable with those software packages and they work for your needs, that is awesome! For my problem, YNAB was the tool that I needed at the time.

When I started planning this article, I intended to make it a battle, YNAB vs. EveryDollar. Who will win? However, the more I thought, the more I realized that I, an avid YNAB user and fan, would unfairly favor YNAB. EveryDollar had no chance. I tried to make EveryDollar work like YNAB because that is what I am familiar with. I am nearly two years set into my ways! Hehe! I will say that both YNAB and EveryDollar actively share training documentation and videos on social media and on their respective websites. Thus, no matter which software application you pick, if any, you will have access to a community with a wealth of training information. Even though we are not going to battle it out, I do want to share a few things that I noticed while trying to turn EveryDollar into YNAB.

YNAB and EveryDollar are both zero-dollar budget methods. YNAB encourages you to assign each dollar a job so that you have \$0 available in the to be budgeted category. I like to think of assigning each dollar to an “envelope”, for those of you familiar with the envelope budgeting method. YNAB makes it easy to virtually see the amounts in each envelope. Imagine having to move \$1.17 cents, for example, from one physical envelope to another physical envelope, from the Shopping envelope, to the Dining Out envelope. With YNAB, I do that all of the time. Remember how I mentioned that budgets can change? Spent too much on Dining Out? Now, I cannot shop as much. No problem! EveryDollar encourages you to zero out your budget by the end of the month so that your [planned income – planned expenses] equals [\$0]. If you fall short of or are over \$0, you do not have an EveryDollar budget.

EveryDollar’s default configuration has an income category and 10 expense categories. Within the income category, you can add multiple income streams and within each expense category, you can add multiple items. You can choose to make an item a fixed expense (default option) or turn the item into a fund. Fixed items are the same each month and the remaining amount does not carry over into the next month. With funds, the remaining amount does carry over into next month’s budget. YNAB, by default, starts with 5 groups and each group has numerous categories. When you enter your income, YNAB will add it to the to be budgeted category. Like EveryDollar, you have the option to add additional groups and categories. I found it much more intuitive to add new groups and categories using the YNAB app. I noticed, and I was impressed with the fact, that the app is very similar to the website environment. Both complement each other. In EveryDollar, I gave up and eventually had to log on to the website to create additional expense categories. I think that the EveryDollar website gives you more functionality than the app does. That is great, yet my goal is to be mobile. YNAB defaults to treat every category like a fund. If there is a remaining amount, it carries over into the next month.

One thing that I really did not like about EveryDollar is that it asks you to create a new budget for each month. Even though EveryDollar allows you to copy the previous month budget template, I still ran into trouble getting started budgeting with EveryDollar. Honestly, I never got it working how I would have preferred it to. I was trying to use the phone app only. I may have had better luck via the website. With YNAB, you initially start budgeting with what you have in the bank. YNAB is a continuous budgeting tool, which means that your budget continues into the next month and so forth. Because EveryDollar starts a new budget each month, I remember feeling discouraged after seeing that one month we were down \$500, give or take. What EveryDollar failed to quickly show me was that in the previous month, we were up that same amount. In reality, we had not overspent on our overall budget because we had saved the funds during the previous month.

Reconciliation is a very important part of any budget method. It is the process of making sure that your financial accounts are consistent. Back before personal budgeting technology applications, the only option was to do this by hand, pencil and paper. I do not know about you, but I am thankful for being able to access



finances on our desktops, laptops, and mobile devices! Imagine not being able to check your bank balance online?! I suppose that you would visit the bank when it was time to deposit your check, find out what your balance is, make note of it, and then keep detailed records so that you did not overspend. Fast forward to now, YNAB and EveryDollar can securely link to your bank accounts. Both apps allow you to manually enter transactions. I encourage you to do that. I am now in the habit of collecting the receipt, entering it into YNAB, and then throwing away the receipt. If asked, I will decline the receipt or choose the email it option. Of course, there are still some receipts that you want to keep, such as medical receipts. Still be mindful of that. If you do not want to link bank accounts, you can choose to do that too. However, the secure link to your bank is helpful in the event that you miss entering a transaction. Even for the best of us, numbers can blend together! YNAB and EveryDollar will also match transactions. So, if you already manually entered a transaction, there is no need to worry about creating duplicate transactions! Both apps also allow you see your bank balance without having to check your bank app. I found that YNAB does a better job at keeping the bank balance accurate. In some cases, YNAB is more accurate, because it takes into account uncleared and pending expenses. Unfortunately, with EveryDollar it was rare that our bank balances matched.

In YNAB, the reconcile process is really fun. It is a daily game that I play. Does our YNAB balance match our bank balance? No? Time to investigate and compare the YNAB and bank balances to find that missing \$0.01. Usually within a short time period (15 minutes or less), I am able to switch between our bank app and our YNAB app and match up the balances. Sometimes, for the really tough ones, I pull out the calculator app. I complete all this on my phone, mind you. No desktop or laptop required. Earlier, I mentioned that YNAB is more accurate than our actual bank account. In YNAB, you can mark each transaction as cleared or not cleared. Easy-peasy. If the transaction appears in the bank app, I mark it cleared. If not, I mark it not cleared. This is especially useful for checks. Yes, some of us still write checks! Occasionally. Once I write the check, I will manually add the transaction to YNAB and leave it set to not cleared. Once the bank clears the check, I will update the transaction accordingly. I also have noticed that restaurant tips often take a few days to clear. So, it is helpful to see a projected balance with tips taken into account. Another culprit, our auto insurance, \*cough\* Allstate \*cough\* is set to auto withdrawal on the first of the month. However, it sometimes will not clear the bank until a few days later. So, I use the cleared toggle button for those cases too. I have found it interesting to watch our bank accounts regularly. Before, I would never have picked up on these little nuisances. Good stuff!

Goodness, there is so much that I could write about YNAB... and EveryDollar too. I could go into details of how I organize our budget groups and categories and much more. However, I will let the YNAB and EveryDollar experts do that. The primary purpose of this article was to introduce you to personal budgeting technology, to show you how convenient it is, and to encourage you to start budgeting if you have not already. Until next time, happy budgeting!

# How Submarine Communications Cables Work – Signal Transmission

[James Taylor]

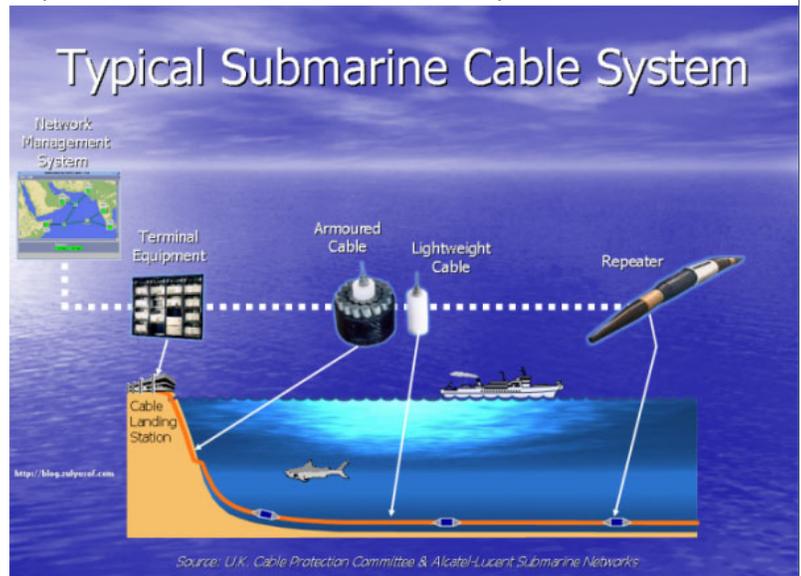
In the previous issue of the AITS Newsletter, I described how submarine communications cables are made and of what materials. The complex layers within the cable are there to support and protect the flawless glass strands at their core. Those strands of glass, a little thicker than a human hair, are the component in these ocean-spanning cables that actually carry the information from one end to another.

Unlike the green or gray Ethernet cables that many of us are accustomed to seeing or using in our everyday lives at work, fiber optic cables do not transmit information using electricity. Instead, light signals transmitted by solid-state lasers are sent along the strands of fiber to convey information.

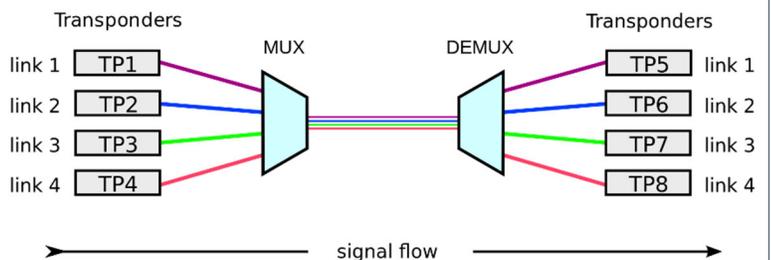
There are two main types of submarine fiber cables: repeatered and unrepeatered. In other words, cables that use repeaters along certain intervals of the cable run and those that do not use them at all. A repeater is a device that amplifies and retransmits a signal. Since optical signals spread out as they travel along the fiber, long distance fiber runs use repeaters every 100-150km along their length. Regenerative repeaters and optical amplifiers are two types of repeaters that are used in modern day fiber lines. Regenerative repeaters work by receiving the optical signal, converting it into an electrical signal, amplifying it, and then retransmitting it as an optical signal (light) by using a laser. These repeaters are powered by an electric current that travels along the copper sheath inside the submarine cable. Optical signals can also be strengthened by using remote optical pre-amplifiers which can operate without the need for electrical power. These

amplifiers work by using a few meters of fiber at each repeater interval that has been doped with a rare-earth element, usually erbium. A source of laser light, known as pump light, travels along the cable in a separate fiber from the data-carrying strands. The pump light excites the short section of doped fiber and causes an amplification of the signal. Unrepeatered cables are typically preferred for short cable routes since their maximum transmission distance is limited.

Since each undersea cable only contains a few strands of glass, one might wonder how so much information can be carried at once. One way this is accomplished by using wavelength-division multiplexing (WDM). Due to the natural properties of light,



## wavelength-division multiplexing (WDM)



Gorillas can catch human colds and other illnesses.

each wavelength of visible light exists as a different color. Separate channels of information can therefore be transmitted at different wavelengths along a single strand of fiber. Separate data lines arrive at a terminal station at one end of the fiber run where they enter a device called a multiplexer. The multiplexer combines the separate channels of data onto a single strand of fiber that are then transmitted along the entire undersea cable at different wavelengths. Once the signals arrive at the terminal station at the other end of the route, the fiber enters a demultiplexer where the different wavelengths of light are split apart to different cables where they continue their journey to their destination. This solution greatly increases the bandwidth of fiber without a need to add additional lines and, thanks to the physical properties of light, the different wavelengths, or colors, are unable to interfere with one another.

For those interested in a deeper dive on wavelength-division multiplexing, readers might enjoy the Youtube video lecture at this [link](#).



**A tarantula  
spider can  
survive for more  
than 2 years  
without food.**

# Migrating an Enterprise to the Cloud

## [Alexandra Martinez]

To better understand what the cloud and a cloud migration is I will be going over the types of cloud-models, advantages, and disadvantages of these models and how they fit into an organization's needs.

### What is the Cloud? Why migrate?

Cloud computing is where servers, storage, application, etc. are accessible through the internet.

Examples of the cloud that you probably have heard or used are OneDrive, AWS, google drive, and Azure. Instead of organizations having to invest in hardware or software, and having to provide ongoing maintenance, these needs can be handled by a cloud service provider. Cloud migration is the process of moving data, applications, or other resources to a cloud environment. Many organizations decide to make this move to a cloud

environment for many reasons such as performance, cost, capabilities, security, and compliance. When considering a strategy for migrating to the cloud, it is important for organizations to understand that it is not just about transferring information to a new location, but it is also about what you do with that information when you get there.

### Benefits of the Cloud

There are many benefits to moving to the cloud, like allowing organizations to reduce operational costs while increasing the effectiveness of IT processes. Another benefit of a cloud environment is the flexibility and scalability, meaning the organizations won't need to pay or maintain IT assets that they may only use occasionally. The cloud also allows organizations to access applications and work remotely, but the main benefit is being able to host applications and data in the most effective IT environment.

### Disadvantages of the Cloud

While it would be nice to say that the cloud is perfect, we all know that in the technological world, there is no such thing. Here are a few disadvantages that come with the usage of the cloud.

#### Applications

- Prior to moving applications to the cloud, organizations need to confirm the applications that are used are compatible with a cloud environment. Since not every application is supported by a cloud environment. The last thing you want is to move all your



During WWII  
Americans tried  
to train bats to  
drop bombs.



A group of owls is called a parliament.

applications to the cloud just to discover that the applications don't work as well in the cloud as they did when they were on-premises. Another thing to consider is the requirement for an application. If the application requires additional infrastructure, a move to data center virtualization would be a better choice.

#### Cloud Management

- Once all the resources are transferred to a cloud environment, we got to ask what's the best way manage these resources, and who's going to manage them. Organization also must consider how to manage the technical transition and then how to address any business or legal issues that may arise because of the reverse migration

#### Complexity of migrating

- Understanding the migration and the amount of effort to get it done.

### **Does a Cloud Environment fit the organization's needs?**

Before moving to the cloud, an organization needs to consider if a cloud environment will work for them and if it supports their needs. Organizations should also consider which cloud model will best fits their needs. The cloud environment offers organizations to choose a public cloud, private cloud/on-premises, or a hybrid cloud.

#### Public Cloud

- With a public cloud, organizations are using an internet connection to access the resources. Public cloud is also managed by a third-party cloud service provider, rather than owning and maintaining these resources on-premise. One benefit of a public cloud is it provides the organization scalability through a pay-per-usage model.

#### Private Cloud/On-Premises

- This cloud model is great for organizations concerned about sharing resources on a public cloud. With a private cloud/on-premises, the organizations can have more control over data and security to meet compliance requirements. Private cloud are basically servers that the organization owns and maintain. That are accessible over the internet or a private internet network.

#### Hybrid Cloud

- With a hybrid cloud, organizations can have the best features of both types. Allowing organizations to have a combination of public cloud and private cloud, frequently in combination with some on-premise infrastructure. For example, if UNT was to move to a cloud environment, in my opinion, a hybrid cloud model would best fit the University's needs because it allows the organization to gradually transfer information into a cloud. This not only benefits the organization in the long run, but it allows for the accessibility of the information transferred to be managed and shared more efficiently.

#### Multi-Cloud

- Is when an organization uses IaaS options from more than one public cloud provider.

Even though the cloud has so much to offer and is high in demand. It's doesn't mean to jump in the change. Every aspect of the migration need be look at. Before decision are made there need to be a deep understanding and knowledge of the infrastructure and applications an organization runs to fully understand the complexity, challenges, and costs involved.

## Apple vs. Facebook [Kris Selby]

Have you ever had a conversation about something that you have never searched for on the web, and have that product start to show up in your Facebook ads? I think at this point everyone has. You can search and find all kinds of examples online. Targeted ads, have become a large portion of revenue for companies like Facebook, Instagram, Twitter, Tik Tok, pretty much all of the social media apps. And as someone much wiser than myself said, "If you don't pay for the product, you are the product." These companies make billions of dollars each year selling your data to companies all over the world. You may be to a point like many others and just say, well they already know, so what's the difference? And to that end, it may all depend on how you feel about your digital privacy. Some value it much more than others, but what Apple has done is step in and say that you, as the consumer should have the choice whether or not these apps should be able to track what you're doing, not just in their app, but at any point you're on your phone.

What did Apple do? If you have an iPhone, or iPad you may have noticed after you updated to iOS 14.5 when you opened an app there was a prompt that says: Allow "App name" to track your activity across other companies' apps and website? Your data will be tracked and sold to other companies." Then two options: 1. Ask App Not to Track or 2. Allow. They even made a quirky, but catchy ad that you may have seen some time recently, you can watch it here:

<https://www.youtube.com/watch?v=8w4qPUSG17Y>

As you may guess, Facebook and other social media outlets were not thrilled about these new changes. Facebook and Instagram (which are both owned by Facebook, in case you didn't know) even put pleas to allow them to collect your data. Without being able to track you they can't:

- Show you ads that are more personalized
- Help keep Facebook/Instagram free of charge
- Support businesses that rely on ads to reach customers

Realistically I don't expect these apps to try to start charging a monthly fee any time soon, ultimately that would be more detrimental to them than losing the sale of personal information, but this is their attempt to scare you into allowing them to still track you.

Time will tell whether this will be a big deal or not, but I suspect that Facebook and the like will still be able to make plenty in advertising no matter what. Also, I think it's nice that a major corporation is for once deciding to allow us privacy vs exploiting it.



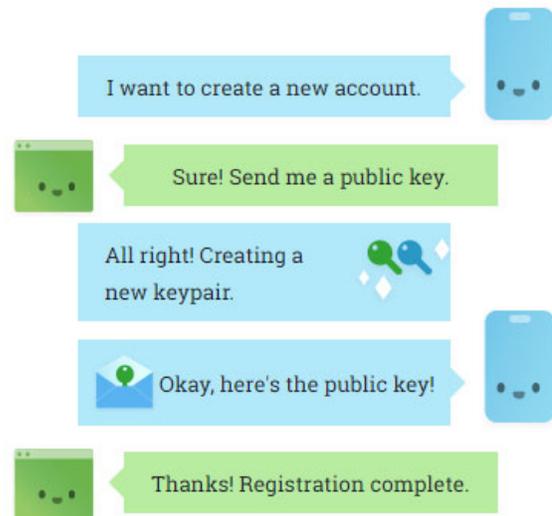
**African giant  
swallowtail  
butterflies have  
enough toxin to  
kill 6 average  
house cats.**

## WebAuthn [Matthew Berry]

Over the entire lifetime of the computing field one staple has been a direct cornerstone: the password. The password was an innovation by MIT in 1961 when they were designing a method of verification, and thus the first authentication was born. Within the year someone had already leaked the passwords via a large printer sheet.

Passwords used in the conventional way aren't very good. If you ask the average person to pick a password, no requirements, they'll pick something trivial to guess. Even if you give them a set of requirements (Symbols, length, banning certain words) you'll bump the complexity. This bump in complexity generally results in a frustrated user experience and them writing down the secret. Add regular password expirations into the mix and you have a broad collection of poorly crafted secrets being incidentally shared. Password managers have recently really hit their stride but feel like a band aid fix on a consistent problem as old as computing itself.

Enter [WebAuthn](#): a newer specification for web-based Public/Private key authentication. If you're ever set up SSH keys this will feel extremely familiar. Upon registration rather than sharing a secret (your password) with the server and hoping it stores it securely you instead generate a Public/Private key pairing and transmit the public key. The private key will be stored on your device. Your secret never leaves your device and authentication turns into an extremely streamlined interaction with absolutely no passwords. Additionally brute forcing this method to get into a web service using this format of registration is going to be *much* harder.



Of course, new standards are never easy to implement or push to wide adoption without a real hefty SHOVE. This is where the tech giant, Apple, comes in. In their most recent WWDC Apple advocated for a [passwordless future](#). Starting with the next iOS and MacOS version WebAuthn will be integrated in a preview state, allowing developers to test out the new security standard and integrate it into existing apps. Hopefully with the weight of an entire platform behind the tech we can fondly look back on this period of human history years later and wonder how we ever got along with passwords as the standard at all.



Tigers have striped skin as well as fur.

## Digital Currency and Proof of Space. Proof of What?

[Chuck White]

Proof of Space (PoS) is a means of showing that one has a legitimate interest in a service (such as sending an email) by allocating a non-trivial amount of memory or disk space to solve a challenge presented by the service provider. The concept was formulated in 2013 and has recently been incorporated into a digital currency called [Chia](#) which was created by Bram Cohen who's best known as the author of the peer-to-peer (P2P) BitTorrent protocol.

Chia is using the first new [Nakamoto consensus algorithm](#) since Bitcoin based on Proof of Space and Time - a proof that shows the prover has spent an amount of time keeping the reserved space unchanged. Its creators reason that the cost of storage is inextricably linked not only to its capacity, but to the time in which that capacity is used.

Proof of space can be thought of as a way to prove that you are keeping some storage unused on your hard-disk drive. Users of the Chia blockchain will "seed" unused space on their hard-disk drive by installing software which stores a collection of cryptographic numbers on the disk into "plots." These users are called "farmers." When the blockchain broadcasts a challenge for the next block, farmers can scan their plots to see if they have the hash that is closest to the challenge. A farmer's probability of winning a block is the percentage of the total space that a farmer has compared to the entire network.

Proof of time requires a small period of time to pass between blocks. Proof of time is implemented by a Verifiable Delay Function that takes a certain amount of time to compute, but is very fast to verify. The key idea of a VDF is that they require sequential computation, and since having many parallel machines does not yield any benefit, electricity waste is minimized. There will likely be relatively few VDF servers ("Timelords"), as the fastest one will always finish first and it takes only one fast and fair Timelord on the network to complete a block and move the chain forward. Chia has the potential of becoming the replacing current cryptocurrencies due to the lower cost of operating a Chia farm. You only need a storage device to start mining so the new concern is Chia do to the hard drive and SSD market what more traditional crypto-currencies like Bitcoin and Ethereum have done to GPUs. Chia farmers will want to prioritize both storage size and storage speed—which means the technology will prioritize the largest, fastest SSDs, especially those that use the NVMe interface.

If this article has got you interested in Chia farming as side hustle, recommended reading is the Chia plotting basics blog posted [here](#).



**A moth has  
no stomach.**

## Looking Under the Keyboard Case

[Jason Huff]

I know, right? The only thing more boring than a keyboard is understanding how one works. Perhaps you say, “Just give me a keyboard that works” and that’s completely fair. However, consider this: according to Lifehack.org, the average person spends at least three hours per day using a keyboard. And that’s just the average. Think about how much more a person who works at their computer all day uses a keyboard. Shouldn’t the experience of typing be as enjoyable as possible?

### The Switch

There exist many types of keyboards, and you probably realize this though you might not know how to explain it. We will not cover every type of keyboard because that would take too long and most of the information would not apply. When we talk about how different keyboards feel, we are usually talking about the switch type. While around 10 distinguishable types of keyboard switches exist, we are concerned with only three of them: dome-switch, scissor-switch, and mechanical-switch. You have most likely encountered each of these types of keyboards, or at least one.

### Dome-Switch Keyboard

You are most likely familiar with this type of switch from the Dell chiclet style keyboards that often come with your work computer. These type of keyboards are hybrids of membrane (a type we will not be discussing) and mechanical-switch keyboards. On these keyboards, the keycap and switch press down on a (usually rubber) dome, and when the dome compresses it brings the circuit board traces together and completes a circuit, sending a signal to the computer to enter the correct character. Because of the rubber switches, these types of keyboards can often feel mushy to type on and are often not preferred.

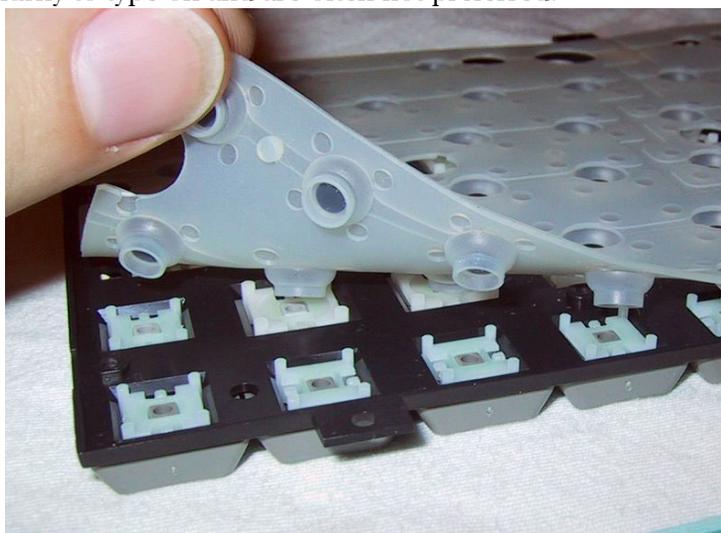


Photo of Dome Switches mesh with keys.

### Scissor-Switch Keyboard

This type will be most familiar to laptop and Apple users as this is the most common kind of switch in laptop keyboards and is used in Apple’s Magic line of wireless keyboards. This is an offshoot of the Dome-switch where instead of a typical switch connecting to the dome under the keycap, there is a scissor type mechanism that connects the keycap directly to the dome. These type are slightly



Finally, scientific proof about shopping – the average male gets bored of shopping after 26 minutes.... This one was so good and may be plaque material that I am leaving it in for another issue! Wonder if this will get me out of shopping trips 😊

more expensive than the typical dome-switch and harder to clean, but also less likely to trap debris as the keycap mounts directly to the dome. Another aspect of this style is the shorter actuation distance (actuation distance is how far down the key must be pressed to register) which is why this type is used in laptops.

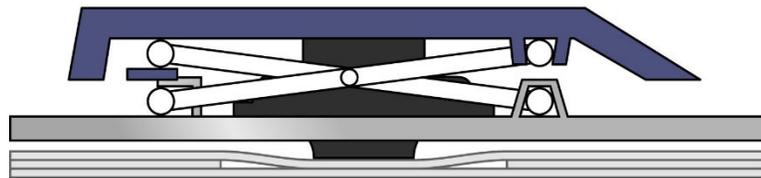
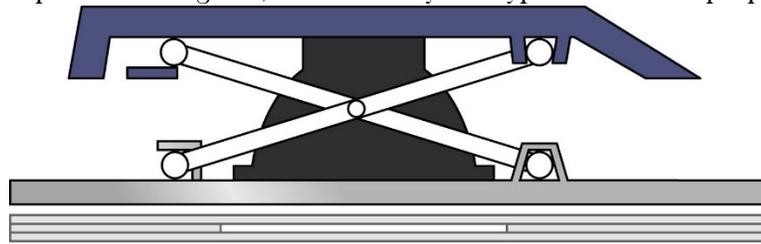


Diagram of a Scissor-Switch mechanism.

### Mechanical-Switch Keyboard

This is perhaps the most popular type of keyboard among keyboard enthusiasts (yes, they exist) and for good reason. Where the dome and scissor switch variants can feel mushy due to the rubber membrane component of the switch running under the complete length of the keyboard, under each keycap of the mechanical board is a complete switch connected directly to the PCB (printed circuit board). Mechanical switches are able to be fine-tuned and move precisely, and due to this, mechanical switches come in a variety of different types. The standard is the MX Cherry switch by which all other switches are measured. Typically, Cherry switches come in three different types: Linear, Tactile, and Clicky. Clicky switches are probably the most familiar as they produce a distinct click when pressed. Linear have no click sound and have smooth motion, Tactile are a middle road, with no click, but a distinct bump in feel. Typically, clicky and tactile switches are thought to be best for writers as there is no mistaking the actuation of the keys. It should be noted, however, linear switches are not soundless, though sound-dampening accessories can be purchased for those not afraid to open up their keyboard. All mechanical keyboards have a distinct sound caused by the keycap hitting the plate, usually a metal such as aluminum or brass, between the cap and the PCB.



The Lonomia Obliqua caterpillar is dangerous to humans and is responsible for many human deaths in southern Brazil.



Dogs have sweat glands in between their paws.



An assembled and disassembled mechanical switch. Left is MX Cherry Blue (clicky) and right is MX Cherry Brown (tactile).

### Keycaps

While most keyboards come preassembled with keycaps, it is possible to buy and customize your own. While the consumer electronics market moves more toward chiclet style keycaps (such as on Dell or Apple keyboards), the enthusiast market moves more toward the mechanical style and into more and more custom keyboards. As such, a market for custom handmade keycaps, emboldened by the proliferation of 3D printers and craftmaker how-tos on YouTube among other technologies, has sprung up on sites such as etsy.com where you can buy a wide array of creative keycaps. Some stores offer custom lettering or font styles and colors, where others create 3D still life sculptures captured in resin, and some boast completely hand-shaped keys. If there's something you're looking for, you will either find it or find someone who will do it for you. For a price. As an enthusiast space, this level of customization does not come cheap. On other sites, however, you can join in group buys for various keycaps among other keyboard parts. A group buy allows for a small-scale mass production, with many people paying a small share. You then each receive a single share of the order (or more if you paid for it) once the minimum production amount has been reserved.

### Cases and PCBs

Okay, here we get into the nitty gritty. Chances are, your keyboard case is plastic. Most of them are. But in the enthusiast market, there are many different materials and ways to make a keyboard case. Like keycaps, some choose to 3D print a case to their exact specifications. Still others prefer a metal case, such as aluminum, because of the sturdy feel. Some choose to purchase the case and PCB separately and solder everything on their own for a unique item no one else in the world could claim to have. Either way, the PCB must be made to fit the case. The PCB is the most important piece of hardware in the keyboard as that translates the physical action of pressing the key into the digital language of the computer. If your keyboard lights up, it is because someone soldered the LEDs to the PCB. If you are able to customize your key layout, it is because the PCB is able to handle a custom layout. For this reason, many enthusiasts choose to buy PCBs separately and with hot-swappable connections that do not require soldering. That's right, you don't have to break out the hardware tools to get what you want out of a keyboard. Hot-swappable connections mean you can pull the switch out and replace with another (this also makes repair a lot easier).

I hope this article has given you a bit more information on what you are looking at when you purchase a keyboard. This is but a taste of the larger world of enthusiast keyboarding. While all I have gone through may seem excessive, remember, you use your keyboard constantly through the day. Shouldn't it be the keyboard you want?

### References

[How to Save 21 Days Per Year By Typing Fast](#) by Wen Shan  
<https://commons.wikimedia.org/w/index.php?curid=53240016> By Aaron Siirila, CC BY-SA 2.5,  
[http://deskthority.net/wiki/File:Scissor\\_switch\\_mechanism.svg](http://deskthority.net/wiki/File:Scissor_switch_mechanism.svg) , CC0,  
<https://commons.wikimedia.org/w/index.php?curid=27599231> By User:Daniel beardsmore



**The  
placement of the  
eyes of a donkey  
allows them to  
see all 4 of their  
legs at all times.**

## Solution to last newsletter's brainteaser

*Only the maker knows the cost of one, worthless if bought, but is sometimes bartered. The penniless or destitute may give one as easily as an emperor or king. When one is broken, pain and deceit are assured.*

*What is it?*

*Answer: A Promise*