Final Essay Project for INTD-290
Incan and Mayan Math

There is a limited record of the people within Southern and Northern America or as Columbus called it the New World before his arrival at approximately around 1492. This is part of the eurocentric point of view that had been brought by the Europeans that was massively projected to justify the actions of conquering unclaimed lands that in reality are occupied with people who were home to them bringing and forcing upon the natives their lifestyles, traditions, and mathematics. The Incan Empire for example which held a large portion of North-West Southern America was one of the many cultures of early Latin America to succumb to specifically Spanish Conquering into what they called a Viceroyalty just like many others within the middle to southern parts of the early Americas. Prior to the mass arrival of Europeans around the 13 Century however, The Incan Empire was one of the largest empires to have maintained land, technology, and lastly one of the most exceptional agricultural and architectural lifestyles to have ever existed within the pre-Columbian time period. This is mostly due in part to the geography and adversity the Incan people had to overcome within the environment, the altitude they were at, and lastly the resources available to them which makes it almost impossible to believe their ability to have such advanced buildings like temples and terraces in Lima which is the current capital of Peru, Cuzco which happened to be the Incan Empire capital, and Machu Picchu, a remote architectural paradise. Another culture with exceptional linguistic capability and architectural capability was the Mayan Civilization who were although not as large and dominant as the Inca, were notably influential through their system of architecture such as their pyramids and temples, their calendar that has influenced the standard calendar, and most importantly their mathematics. These two cultures including the Aztecs and many more go on to prove that the natives of the Americas were advanced in their own way disregarding any presumptions made by Europeans especially through their own mathematical techniques that make them interesting to analyze.

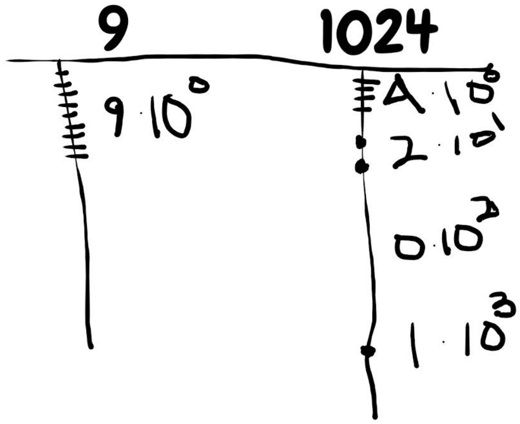
The concept of math and the ownership of mathematics is one that is very blunt in the nature of science. Just like the calendar and age that is associated with people like you and me, the subject of math is cumulative by a multitude of subjects, cultures, and concepts that even to this day we as the human species continue to build upon. When you break down all the components of the different subjects of math, you are given just numbers that seem non-linear, but have infinite potential to diversify in any way such as the Mayans did with their Mathematics and Incans as well with their system of Quipu knots as we will understand later. First, we must understand our mathematical system beginning with the simple numbers that compose it.

The most common system of math during this age that we are taught growing up is the base 10 system derived from the Hindu-Arabic culture/people that we are all accustomed to that corresponds to our ten fingers (4). This system may vary from the infinitely large spectrum that reaches but never is infinity to hundreds like 100 to the tens, ones, to the infinitely smaller spectrum that approaches zero of tenths, hundredths, and thousandths that correspond to 0.001(1). As a matter of fact, it wasn't until the Mayan culture that a value of zero or nothing was created and discovered by Europeans around the early 15 century. The concept of scientific notation emphasized this system to be even more valuable than other base systems as it follows an easy to follow trend of a number times 10 to the power of a number that is flexible with just moving decimal points over. It also makes it superb to express flexible small and large numbers as you do very much in mathematics and science through efficiency of saving numbers like 0.000000005 for example can be expressed as five times 10 to the power of negative nine or 1000000000 expressed as one times ten to the nine. It is also important to mention that any number to the power of 0 is 1. However the concept of numbers gets ever so much more complicated as we explore numbers with bases less than or greater than 10.

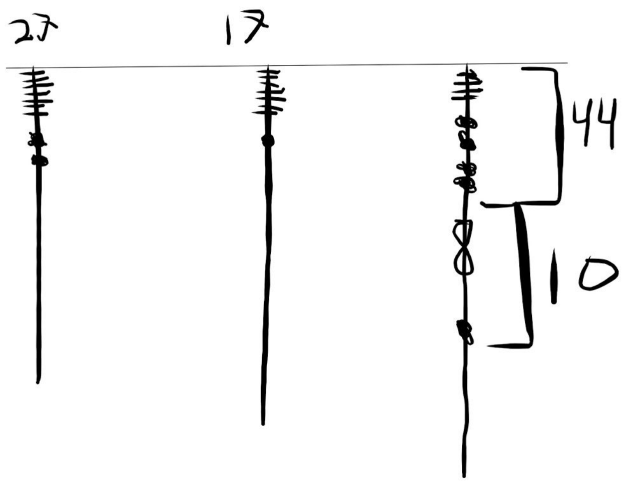
Let us begin the exploration of different base groups with the hexadecimal numeral system that you can deduce of having a base of sixteen. Somewhat similar to the base 10 system, it follows a trend of following place holders in the sense that we can have all single digit numbers varying from one through nine through having a power of 0 like (one through nine) times ten to the 0 power to larger numbers by having greater powers. One example would be the number 256, how would we use hexadecimal notation to derive this value? Well we can understand that based on our system it is to the hundreds place, so in order to reach the hundreds place via a hexadecimal system would be to increase the power to two with the respective placement like one times 16 to the 2 power which gives us 256. The Mayan Culture were one of the most notable to use a nontraditional base system not of 16 or of 10 like the Inca but of 20, a vigesimal number system to their advantage to keeping records of agriculture and architecture. One more example of a base system before we move onto one of the more complex systems is the base 8 system, or the octal number system. This system bares the numbers from one through nine just like the rest but has a base 8 to the power of any number. This time however we are going to vary our initial number of multiplication and the power to get to two hundred and fifty six. To assess the range of our value we multiply one times eight to the power of (one, two, three) and so on to gain an understanding of the power we will need. Through this, it places an area for our desired value of 256 to be within the second power because the third power is too high at five hundred and twelve. Next we can determine our initial placement value to be one through 9 and understand it comes to be 4, giving us an octal value of four times eight to the power of two. Now, computing just numbers by themselves wasn't the only possible way to manipulate them during these times. Through the place holders that are the exponents of every base system, we can create any number that is not zero yet.

Both the Maya and the Inca expressed knowledge in the concept of addition and subtraction within each other's base systems for multiple uses and in fact, the Maya were one of the first people to introduce the concept of zero, which meant nothing and infinity to their culture expressed by an empty shell within their numerical system (2). It was also discovered later that the Inca had their own placement holder for a zero or absence of a number within their quipu system of Knots. They both similarly approached the concept of addition and subtraction with the note that the reader or person visually seeing the math inferring what is going on. An example of a decimal system that the Quipu uses on our terms however would look something like this for lets say the number 1024 would translate to 1x10^3 + 0x10^2 + 2x10^1 + 4x10^0 when using the Incan System. The Mayan System differed by the base that was used for example using the number 1024 would translate to 2x20^2 + 11x20^1 + 4x20^0 in the respective places with the respective symbols they used.

Having now a sturdy understanding of our mathematical background that is a decimal base system, the Incan system of Quipu knots worked similarly to how scientific notation works. The decimal base system of Incan Quipu knots would have never been discovered without the translation of them without Manny Medrano only nearly 20 years ago (3). The system of Quipu knots consisted of long strings with either knots, dashes or lines, a figure 8 knot, and lastly nothing which equated to 0 connected to a long string that connected multiple knots associated as the spine of a piece of string-like object. Within this complex system of numbers that the Incan people of the Andes used, the dots and dashes meant the same thing which was one, but these can accumulate to numbers up to nine dots on end if need be and a placement of a figure 8 knot that resembled 0 only in the ones place of the knot only to differentiate the upcoming not from the first knot. Now, since we are in a base 10 system, the first place you put your first knot that would be a line would be in the beginning of the knot and however many you put that can be up to nine, is multiplied by 10^0. An example of this would be the number nine. There will be nine dashes in the ones place of the knot and that value would be multiplied by 10^0 which is one to give us our outcome of nine. On a bigger scale for numbers that are much bigger than 10 such as 1024, you would express this in Quipu by firstly doing 4 dashes in the ones place, two dots in the tens place, nothing in the hundreds place and 1 dot in the thousands place. The reason as to why the Incan people did not wish to place a figure 8 knot elsewhere besides the ones place was to conserve string for further computations. You can imagine the lengths of large numbers that the Incan population could analyze with the Quipu system that can continue to expand to more complex addition and subtraction especially when it came to agriculture or architecture.



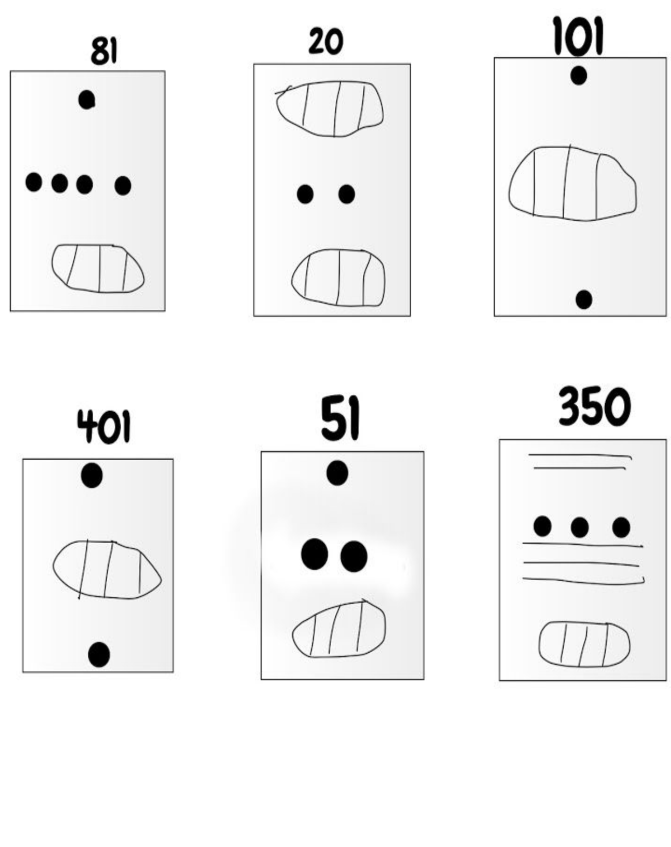

Working similar to Arabic or how we are all accustomed to doing this sort of math, addition and subtraction can be broken down into three or more parts that can either all fit onto one string that was normally done by Mayans or as it is more easily visually, within multiple Quipu strings. The most difficult part to understand however was the assumption of the computation that has occurred especially when it is not being told to you and you're decoding it yourself. Since the computation is mostly visual, it is difficult to give an example of this process through words but we will be using the standard 3 string method to perform this and then alternate to other methods of addition and subtraction. Since we have the same decimal base system, it is easy to compute values. An example of this process would be to add and subtract 27 to 17 which would normally be 44 and 10 within our numerical system. We would express 27 in quipu by 7 dashes in the ones place and 2 dots in the tens place representing 27 followed by a separate string of 7 dashes in the ones place and 1 dot in the tens place representing 17. The next string will both compute the process of addition being four dashes in the ones place and four dots in the ones place representing 44 and follow that string down leaving a gap, we would use our place holder of a figure 8 representing the both the beginning of a new computation and a zero in the ones place followed by a dot in the tens place representing 10 respectively. The concept of the three symbol system maintained by Incan Quipu translates similarly to the three respective mathematical symbols of the Mayans.




Math within the Mayan Empire was something that was remarkable alongside the linguistics that was portrayed up on their language, calendar, and hieroglyphics upon their architecture. As I mentioned before, the concept of zero that was represented by a shell was created by the Mayan culture to be both nothing and an infinite amount. This concept would continue to give the value of nothing onto all boards of mathematics around the 15 century (1). In relation to the Incan Quipu knot system. Their numerical system was also composed of a placement number hold type of system where there was a ones and tens place altogether, followed by a hundreds place, a thousands place and so on. The Mayan system was unique also with their numerical representations of a dot that equaled one, a dash that equaled 5, and a shell that equaled zero so you may picture how they would express their digits in terms of one through nineteen. You would express 14 by four dots followed by two dashes and 19 by four dots and 3 dashes within the ones/tens place of Mayan mathematics. What tends to vary putting it simply is the initial number, and the exponent of 20 within this system. An example of the varying initial number would be the 5 in 5x20^1 while the base would consistently be 20 and the final varying number would be the exponent of 20. The numbers one through four could be represented by dots, multiples of 5 up to 15 would be represented as dashes and the reason we would not go to twenty would be the same reason within our standard notation of mathematics we write 1x10^4 and not 10x10^3. The Mayans were very clever for their reasoning to use a base 20 system as they included not only the base 10 system of ten fingers, but also incorporated all 10 toes. It is the reason that they chose 5 to be representative of a bar as well because each limb was harbored to 5 of the 20 total they would use. This system wasn't like any other in the world at the time of the 14 century and attributed greatly their measurement of the calendar. The Mayan culture were also very aware of the properties of giving and taking away and also expressed them similarly to how the Incan's expressed their mathematical computations, with inference.

0 1 2 3 4

Mayan mathematical addition and subtraction can be broken down into three parts and only three parts unlike the Quipu who can have one string that can equal one computation. The first box may have a certain number of dots, dashes, and shells in their respective places followed by a second box of similar nature and a third one as well. Only the third box would be a computation of the first two having being addition or subtraction. An example of such a process that incorporates all the parts of Mayan symbols would be 81 + 20 that equals 101 wherein one box one dot would be placed in the ones place, four dots in the tens/hundreds place followed by a separate box containing a shell in the ones place, a dot in the tens/hundreds place, and another empty shell in the thousands/ten thousands place. The final box would represent the computation that is occurring, in this case that would be a dot in the ones place, a dash in the tens/hundreds place, and a shell in the thousands/ten thousands place representing addition since the value increased if we hadn't already had an understanding of what might happen. An example of subtraction using only Mayan computation would be a box surrounding one dot within the ones/tens place, an empty shell within the tens/thousands place, and one dot in the thousands/ten thousands place followed by a box surrounding one dot in the ones place and a singular bar in the tens/thousands place and a shell in the thousands/ten thousands place. The final box would be two dashes within the ones place signifying 10 plus three dots above three dashes signifying 17 within the tens/hundreds place and lastly a shell within the thousands/ten thousands place giving us a final answer of 350! Although the Mayans and Incans had the powerful tool of mathematics, they were limited by the framework of their minds and exploration of their time period. However, the Mayans and the Incas made the most of the tools they were given through calendars, hieroglyphics, architecture, and much more.



The Incan and most notably Mayan cultures used math as a foundation for their society. They used mathematics mostly as a source of maintaining record keeping of knowledge of values like the Incans keeping track of how much Quinoa, which was an old Incan edible seed, was planted in a farming cycle upon their plateaus of farm land within the valleys of the Andean mountains or by manipulating their system to become more self aware of time itself like the Mayans. Indeed, the Mayans are most recognized for their advanced assumptions that are fairly correct that have to do with their calendar and their base system of 20. The Long Count which was the reference point of their calendar that used a variation of the vigesimal number system they used for math had removed the powers past the first power of 20 to align with their assumption of a yearly cycle of 360. Although they were aware of the 360 day calendar, they broke it down into a ritual cycle of 260 days that was thirteen months of the year and 5 months that they associated with the nameless months of the year that they created as they called the calendar round. They associated the last 5 months of the year as the most extremely unlucky because the rituals they would usually conduct to their gods would not be conducted. (5) The ritual cycle was based on a form of the vegismal numerals of 13x20 that equated to 260 and 18x20 that equalled 360, or a full calendar year that never surpassed that value. Under their system of a grasp of the seasons and time, they created a base 20 calendar with 18 months that made up the year given the limited technology and resources at hand that make these cultures so impressive.

In conclusion, The mathematical systems of the Inca and the Mayan people give us more information about the nature of human kind that is consistently trying to make sense of what is given around them. Although there is no definite source to reinforce the cultures of the Inca, Aztecs, Mayan, Nahualt, and many more cultures that were victim to the imperialist forces of the Europeans, this did not limit their ability to contribute much more to aspects of math and sciences as I’ve learned first hand.

Citations: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