This proposal includes the twenty basic Mayan vigesimal numerals from zero to nineteen, with horizontal bars. Though these and related glyphs (including the corresponding vertical-barred forms) were used in ancient Mayan petroglyphs and prehispanic codices, the use case for these glyphs is much stronger than the full hieroglyphs, as the numerals are in modern use, as part of text, not simply as "figures". For instance, all Guatemalan banknotes have their denomination written in Mayan numerals in one corner and Arabic numerals in another.
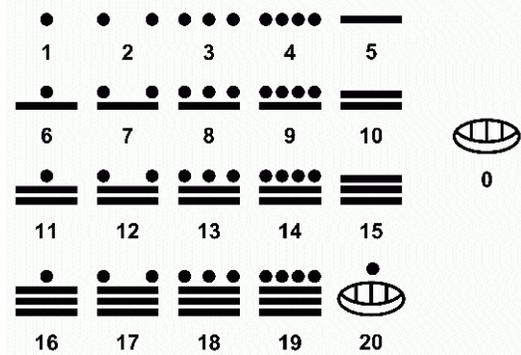
These numbers form a true vigesimal (base-20) positional number system. Thus, in a 4-digit number, the positional multipliers for the digits are 8000, 400, 20, and 1, respectively; that is, $20^3$, $20^2$, $20^1$, and $20^0$. For instance, the number 5124 would be written as follows:

5124 = 12x20x20+ 16x20 + 4 =
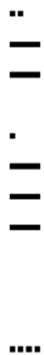


The numerals are, in order:

MAYAN NUMERAL ZERO: In hieroglyphic texts, this is typically represented in variants of one of three forms: shell form, quatrefoil or partial quatrefoil, or face form. The face form is clearly associated with a hieroglyphic style, and may have separate semantics; it is probably not appropriate for encoding separately from the rest of the hieroglyphic script, and will not be considered further in this proposal. Any of the shell or quatrefoil variants may be used for this glyph, as appropriate for a given font. The most common form, and the one to base the standard on, is a shell-based form. The overall shape is a horizontal leaflike form made of two similar arcs which meet in a point at either end, with two parallel lines to define the arc of the bottom edge, a single line to define the arc of the top edge, and multiple vertical or near-vertical lines between these, as in the upper left of the first figure below.

Shell form variants: (image source, http://www.veralistcenter.org/engage/event/220/art-and-science-transdisciplinary-lectures-anna-blume-art-historian/)
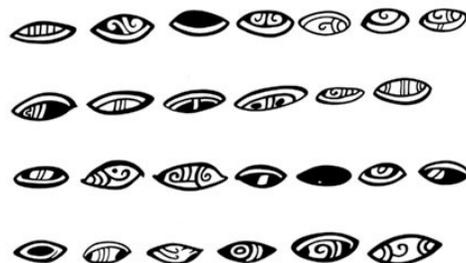
MAYAN NUMERAL ONE: This is most commonly represented by a simple dot. In some cases, by a dot with two placeholder shapes on either side.

MAYAN NUMERAL TWO: This is represented by two dots, horizontally. In some cases, there is a placeholder shape in between the two of them.

MAYAN NUMERAL THREE: This is represented by three dots, horizontally.

MAYAN NUMERAL FOUR: This is represented by four dots, horizontally.

MAYAN NUMERAL FIVE: This is represented by a single horizontal bar.

MAYAN NUMERAL SIX: This is represented by a single dot (or mayan numeral one) above a horizontal bar.

MAYAN NUMERAL SEVEN: This is represented by two dots (or a mayan numeral two) above a horizontal bar.

MAYAN NUMERAL EIGHT: This is represented by three dots (or a mayan numeral three) above a horizontal bar.

MAYAN NUMERAL NINE: This is represented by four dots (or a mayan numeral four) above a horizontal bar.

MAYAN NUMERAL TEN: This is represented by two horizontal bars.

MAYAN NUMERAL ELEVEN: This is represented by a single dot (or mayan numeral one) above two horizontal bars.

MAYAN NUMERAL TWELVE: This is represented by two dots (or a mayan numeral two) above two horizontal bars.

MAYAN NUMERAL THIRTEEN: This is represented by a three dots (or a mayan numeral three) above two horizontal bars.

MAYAN NUMERAL FOURTEEN: This is represented by a four dots (or a mayan numeral four) above two horizontal bars.

MAYAN NUMERAL FIFTEEN: This is represented by three horizontal bars.

MAYAN NUMERAL SIXTEEN: This is represented by a single dot (or mayan numeral one) above three horizontal bars.

MAYAN NUMERAL SEVENTEEN: This is represented by two dots (or a mayan numeral two) above three horizontal bars.

MAYAN NUMERAL EIGHTEEN: This is represented by three dots (or a mayan numeral three) above three horizontal bars.

MAYAN NUMERAL NINETEEN: This is represented by four dots (or a mayan numeral four) above three horizontal bars.


**Similarity to existing Unicode characters:**

Several of the Mayan numerals, and most especially the numeral one, are similar to existing unicode characters. However, their use as a coherent numeric system, including in mathematical computations and sorting, would be greatly facilitated by encoding all of them together in a new block. Ideally, the numeral zero would be encoded such that its final five bits were all 0 (last hexadecimal digit 0, and penultimate digit even); in that case, the numeric value

of each digit could be obtained by a simple bitmask operation, or in the case of the UTF8 representation, a bitmask and bit-shift.

**Modern as opposed to ancient use:**

Encoding a full set of ancient Mayan hieroglyphs in Unicode is a daunting task. Not all hieroglyphs have been deciphered; their rules for combining are complex and variable; the textual styles evolved over more than a thousand years of use and a broad and diverse geographical area; and it is not even always fully established when two different extant glyphs should be thought of as examples of the same hieroglyph. However, the numerals are a separate case. Their meaning is well-understood, and indeed they are used in modern text in several contexts:

Guatemalan banknotes:

The denomination of each banknote is written in Arabic numerals in one corner, and Mayan numerals in another corner (top left for the 1 Quetzal bill; top right for the 5, 10, 20, 50, and 100 Quetzal bills; and bottom left for the 200 Quetzal bill). The now-defunct 25 and 50 centavo bills also had Mayan numerals.



School textbooks: In Mexico and Central America, elementary and/or middle schools typically have a unit on Mayan mathematics, in which the numerals and vigesimal (base-20) system are explained and several simple arithmetic problems are posed using the numerals.

Books on Mayan subjects: For over 40 years, books on Mayan subjects have occasionally used Mayan numerals for page numbers. This practice has grown more common and is now the rule for Mayan-centric publishers, who also often use the numerals for numbering chapters, sections, and subsections, as well as in the table of contents. Examples of such publishers include, in Guatemalam Cholsamaj, Maya' Wuj, and PRODESSA; and in Mexico, Uady, Sedeculta, and Editorial Dante. The combined catalogues of these publishers now include well over a hundred such books. These include books in Spanish as well as in Mayan languages (languages which collectively have over 6 million native speakers.)

Other: Similar to the case with books, usage of Mayan numerals has extended to ephemera such as school worksheets and newspaper inserts. Also of note is the Mayan numeral thirteen in the logo of the Mexican television channel "Azteca Trece".

**Other Mayan characters?**

As already noted, encoding all Mayan hieroglyphs into Unicode would require extreme expertise, and even then, might be impractical at this time. The numerals are clearly the best place to start. The question is, does this open the door for requests for other Mayan characters?

After the numerals, the most commonly-used and widely-known Mayan characters are the calender-related glyphs, and in particular the day signs and month signs. These are important in traditional Mayan belief systems, as well as being used for modern dates, and of course by Mayan archaeologists and epigraphers. Jewelry involving these glyphs is a popular item for sale to tourists at Mayan archeological sites.

However, the number of people who could recognize even the 20 day signs, which are the most common calender-related glyphs, is undoubtedly tiny compared to the number who can read the numerals. At least tens of millions of

schoolchildren have studied the Mayan numerals; whereas it would be surprising if more than ten thousand people could name all the day glyphs. Furthermore, even when used in books, the day glyphs serve more as "figures" or graphical elements, rather than being incorporated into the text or serving textual functions as the numerals often are.

Thus, this proposal takes the position that the need for the numerals to be in unicode is urgent, while that for the calender-related glyphs is far less so.


**Presentation:**

The Mayan numerals, in modern use, exist in both vertical-barred form, written left-to-right, and horizontal-barred form, written top-to-bottom. In both cases, the most significant digits are written first. The horizontal-barred form is most common, and is thus the focus of the current proposal. Although this means that multi-digit numbers would be written top-to-bottom, the current proposal does not contemplate including this text flow as part of the standard; users of the glyphs would be responsible for positioning them correctly using their own tools. For instance, note that CSS has a writing mode that can be used to specify the vertical versus horizontal layout of text.

Thus, the vertical orientation for the characters should be "U", so that if text is changed to a vertical orientation, the number won't rotate [see UTR #50 Unicode Vertical Text Layout].

Stacking should not be done within the glyphs 1-19; higher-level protocols should be used to handle vertical stacking to represent the positional system (for powers of 20). For instance, although MAYAN NUMERAL THIRTEEN consists of 3 points above two bars, it is not the same as a vertical sequence of MAYAN NUMERAL THREE, MAYAN NUMERAL FIVE, MAYAN NUMERAL FIVE, or of MAYAN NUMERAL THREE, MAYAN NUMERAL TEN.

If users wish to use the numbers in their vertical-barred form — for instance, in a context such as a table of contents, where vertical stacking is impractical — higher-level protocols may be used to rotate the glyphs 90 degrees counterclockwise.


**Nd or No?**

These numerals are true positional digits, but rather than decimal, they are vigesimal (base-20). For instance, the digit MAYAN NUMERAL ONE can signify the number 1, or 20, or 400, or 8000, etc., depending on how many other digits follow it (that is, in the most common layout, come below it). Since they are not decimal digits, they cannot be given category Nd (numeric decimal digit). Thus, each digit is in category No (numeric:other), with the numeric value for the digit when alone. Nonetheless, it is important that the digits should be encoded in a contiguous range, like the decimal digits, and unlike any of the numeric:other glyphs such as Roman numerals.

**Character properties:**

These characters should have the following properties:

U+1D2E0;MAYAN NUMERAL ZERO;No;;L;;;;0;N;;;;
U+1D2E1;MAYAN NUMERAL ONE;No;;L;;;;1;N;;;;
U+1D2E2;MAYAN NUMERAL TWO;No;;L;;;;2;N;;;;
U+1D2E3;MAYAN NUMERAL THREE;No;;L;;;;3;N;;;;
U+1D2E4;MAYAN NUMERAL FOUR;No;;L;;;;4;N;;;;
U+1D2E5;MAYAN NUMERAL FIVE;No;;L;;;;5;N;;;;
U+1D2E6;MAYAN NUMERAL SIX;No;;L;;;;6;N;;;;
U+1D2E7;MAYAN NUMERAL SEVEN;No;;L;;;;7;N;;;;
U+1D2E8;MAYAN NUMERAL EIGHT;No;;L;;;;8;N;;;;
U+1D2E9;MAYAN NUMERAL NINE;No;;L;;;;9;N;;;;
U+1D2EA;MAYAN NUMERAL TEN;No;;L;;;;10;N;;;;
U+1D2EB;MAYAN NUMERAL ELEVEN;No;;L;;;;11;N;;;;
U+1D2EC;MAYAN NUMERAL TWELVE;No;;L;;;;12;N;;;;
U+1D2ED;MAYAN NUMERAL THIRTEEN;No;;L;;;;13;N;;;;
U+1D2EE;MAYAN NUMERAL FOURTEEN;No;;L;;;;14;N;;;;
U+1D2EF;MAYAN NUMERAL FIFTEEN;No;;L;;;;15;N;;;;
U+1D2F0;MAYAN NUMERAL SIXTEEN;No;;L;;;;16;N;;;;
U+1D2F1;MAYAN NUMERAL SEVENTEEN;No;;L;;;;17;N;;;;
U+1D2F2;MAYAN NUMERAL EIGHTEEN;No;;L;;;;18;N;;;;
U+1D2F3;MAYAN NUMERAL NINETEEN;No;;L;;;;19;N;;;;

Supporting documents: Scans from the following books and educational materials which use Mayan numerals as textual elements. Note that this is merely a few examples of the available items, with a focus on older works, as the number of works in recent years which use these numerals is far to large to enumerate.

Morley, Sylvanus G., *The Ancient Maya*. Stanford University Press, 1946. Each page has a chapter number as a (single-digit) Mayan numeral underneath the page number in Arabic numerals. The copyright year is given on the copyright page in Mayan numerals, above the full copyright information in English. (The copyright year is actually written incorrectly; with an error of 800, that is to say, missing the top 4 dots in the first of three digits.)

Sánchez, George I., *Arithmetic in Maya*. 1961. Page numbers are given in both Arabic and Mayan numerals, and Mayan numerals are used extensively in the text. Note: the "zero" is just an empty circle, and the numerals are much taller than a line of text.

Wright, Ronald. *Time Among the Maya: Travels in Belize, Guatemala, and Mexico*. Grove Press, 1989. Mayan day counts are given throughout the text as section heads for each day of travel. These day counts, as with all traditional day counts, include a single Mayan digit in vertical format, along with a day sign.

Jorge Raymundo Velásquez ... [et al.]; ed. Flavio Mucía Patal. *K'amöl rub'ey ri tijonel, richin rokisaxik ri kaqchikel wuj : richin ri ruka'n tanaj chi rij ri retamaxik rusik'ixik chuqa' ri rutz'ib'axik ruwäch wuj.* Universidad Rafael Landívar, Instituto de Lingüística, 1999. Book of testimonies in Kaqchikel, with Arabic and Mayan page numbers.

Montgomery, John. *How to Read Maya Hieroglyphs*. Hippocrene Books, 2002. Each chapter has the appropriate Mayan numeral on its first page.

B'alam Rodríguez, Pakal; Rodríguez, Raxche'. *Maya' Ajilab'al/Cuadrícula Matemática.* Cholsamaj/Maja' Wuj 2007. Teaching aid; large table-mat for forming and doing arithmetic with "Mayan numerals" made of sticks and beads. Includes tables of Mayan numerals, of positional multipliers, and of the Kaqchikel suffixes associated with these positional multipliers.

Nerei (pseud.), *Los Hermanos Que Se Volvieron Micos.* Piedra Santa, 2010. A children's book in Spanish with Arabic and Mayan page numbers.

Saquimux, Herminia. *Lucha política de mujeres mayas kaqchikeles y ch'orti's en defensa del territorio : (historia y memoria de vida)* Centro para la Acción Legal en Derechos Humanos, 2010. Book in Spanish with Arabic and Mayan page numbers.

Ruth Moya. *Del tiempo y los nawales ... : testimonios de la tradición oral en boca de niños maya k'iche', kaqchikel y tz'utujil de Guatemala* Asociación Maya Uk'ux B'e / Ibis, 2012. Book in Spanish with Arabic and Mayan page numbers.