



PROPOSAL FOR A
**NEW COPTIC
CALENDAR**

 newcopticcalendar.org

PREPARED BY



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OVERVIEW

Detailed herein is a proposal for a New Coptic Calendar. This document provides the motivation, guiding principles, methodology, and results of the proposal, and links to the Python computer program used to perform the calculation. In addition, the document links to a database which contains the dates for fixed and variable feasts and observances in the Coptic Orthodox Church, based on the New Coptic Calendar, for 500 years. It also provides sample dates for several years.



SUMMARY OF PROPOSAL

1. **ONE TIME CHANGE:** A one-time adjustment to realign 1 Thout, the start of the Coptic year, to its original corresponding date of 29 August in the Gregorian calendar.
2. **LEAP YEARS:** A change to the method for computing leap years to prevent drift between the New Coptic Calendar and the Gregorian Calendar, and maintain their alignment in perpetuity.
3. **FIXED FEASTS:** No changes to the dates of the fixed feasts and observances in the liturgical calendar of the Coptic Orthodox Church. For example, the Feast of the Nativity remains on 29 Kiahk. Only its corresponding date in the Gregorian Calendar changes to 25 December.
4. **EASTER:** A new unified Computus — the calculation of the Feast of the Resurrection — for all of Christendom. It abides by the rule for calculating Easter established by the Council of Nicaea, but forgoes ancient estimations for the Vernal Equinox and the Paschal Full Moon in favor of precise astronomical modeling, as would be observed from the Great City of Our God Jerusalem.



SOURCE CODE

The computer program used to compute the New Coptic Calendar is open source, and is available for review, feedback, and modification at the following GitHub repository:

<https://github.com/sherifhanna700/new-coptic-calendar>



MOTIVATION

The current Coptic Calendar, which has been in use for nearly two millennia, and the even more ancient Egyptian Calendar on which it is based, are marvels of ancient ingenuity. Ancient Egyptians were able to estimate the length of the [tropical year](#) with stunning accuracy, given the rudimentary tools they had at

their disposal. The Church of Alexandria prided itself on its astronomical prowess, and thus guided the world in calculating Easter after the Council of Nicaea.

As time has passed, astronomical tools and mathematical modeling improved, and with them came refinements to the estimates for the duration of the year. The current calendar that is in use by the Coptic Orthodox Church is based on a refinement to the more ancient Egyptian Calendar. Once it was realized that the year in the Ancient Egyptian Calendar was about $\frac{1}{4}$ day shorter than the tropical year, circa 25 BC an additional epagomenal day was added every 4 years to prevent the calendar from drifting.

Since that time, further refinements have occurred to other calendars that rely upon the tropical year, as estimates for its true duration have become more accurate. Most important to our discussion was the change instituted by Pope Gregory XIII of the Roman Catholic Church in 1582 AD. Advancements in astronomy revealed that the tropical year is actually slightly shorter than 365.25 days. Thus a new system was put in place for calculating leap years, to bring the average duration of the calendar year to 365.2425 days.

The point of the prior discussion is this: calendars change. They don't change often, but when they do, they do so based on advances in science and mathematics.

It is a factual, true statement to say that the average duration of the year in the Coptic Calendar — 365.25 days — is not correct. The Coptic Calendar never underwent the one-time correction of the Gregorian Calendar, which is the most used civil calendar around the world today. As a result, the Coptic Calendar will continue to drift away from the Gregorian Calendar.

To illustrate why this is a problem, consider the Feast of the Nativity. In the year 1583 AD, 29 Kiahk in the Coptic Calendar corresponded to 4 January in the newly minted Gregorian Calendar (as opposed to 25 December, as it used to). These days, 29 Kiahk corresponds to 7 January (most of the time). That means since 1583, the Coptic Calendar has already drifted by 3 additional days from the Gregorian Calendar. Why?

Because while the Coptic Calendar has continued to add a leap day every 4 years without exception, the Gregorian Calendar did not do so in the years 1700, 1800, and 1900 AD. Looking forward, after the year 2100 AD, 29 Kiahk — the Feast of the Nativity — will occur on 8 January. And after 2200 AD, it will correspond to 9 January. The drift will never cease.

A careful, holistic, one time change that permanently fixes these issues, and synchronizes the calendars in perpetuity is possible, all while applying the necessary honour and dignity due to this venerable calendar. Doing so would allow the Coptic Orthodox Church to celebrate fixed feasts, such as the Feast of the Nativity, at the same time as other churches in Christendom that rely on the Gregorian Calendar.

A more complex topic is the question of when to celebrate the Feast of the Resurrection / Pascha / Easter. In 2017, His Holiness Pope Tawadros II and His Holiness Pope Francis of the Roman Catholic Church [expressed a desire to unify the date for all Christendom](#). What would be a proper, methodical way of answering this desire?

Here we turn, once again, to current scientific tools, as our forebears did to improve the calendars previously. Abiding by the rule of the Council of Nicaea for calculating Easter, while at the same time leveraging the most accurate astronomical modeling afforded to us by our modern observational and computational capabilities, we obtain a refinement which we believe can gain the consensus of all Christendom.

The Coptic Orthodox Church once embraced contemporary astronomical sciences to guide its liturgical calendar. It is time for Her to embrace contemporary methods once again.



GUIDING PRINCIPLES

In setting out to work on this proposal for a New Coptic Calendar, we adhered to several guiding principles.

FIXED FEASTS AND OBSERVANCES

The proposal does not modify the dates of fixed feasts and observances in the liturgical calendar of the Coptic church. By adhering to this principle, there is no need to modify the daily readings from the Katameros and the Synaxarium. For example, the date of Feast of the Theophany remains as 11 Tobī without change. What does change is its corresponding date in the Gregorian calendar.

HOLISTIC APPROACH

The proposal does not solely focus on realigning the date of The Feast of the Nativity/Christmas to 25 December in the Gregorian calendar while neglecting a holistic change to the entire calendar. There is no decoupling of a single feast from the totality of the architecture of the liturgical calendar of the Church.

The actual date for the Feast of the Nativity in the Coptic Orthodox Church is 29 Kiahk. Therefore, shifting 29 Kiahk in the Coptic Calendar to 25 December in the Gregorian calendar requires a similar shift to all other dates in the entire Coptic Calendar.

PERPETUAL SYNCHRONIZATION

The proposal maintains alignment between the New Coptic Calendar and the Gregorian Calendar in perpetuity, which necessitates a new method of computing leap years for the Coptic Calendar. This way, 1 Thout in the New Coptic Calendar always corresponds to 29 August in the Gregorian calendar, in perpetuity.

ACCURATE ASTRONOMICAL MODELING FOR CALCULATING EASTER

The proposal does not change the rule set forth by the Holy Fathers of the First Ecumenical Council of Nicaea for computing the date of the Feast of the Resurrection/Easter: Easter is the first Sunday after the first full moon on or after the Vernal Equinox.

To this day, the Coptic Orthodox Church relies on the brilliant Easter calculation first devised by our father among the saints, Pope Demetrius I in the year 214. The calculation utilizes the [lunar epacts](#) and the [Metonic cycle](#) to estimate the date of the Paschal Full Moon, and uses March 21 as a fixed date for the Vernal Equinox.

While the epacts and the Metonic cycle are astonishing in their accuracy given the time period in which they were devised, they do differ substantially from the accuracy afforded to us today by precise astronomical observation and computer modeling.

Therefore, the proposal for the New Coptic Calendar relies on accurate astronomical modeling for the dates and times of the Vernal Equinox and the Paschal Full Moon, in place of the ancient tables of the epacts. The dates for these celestial events are computed from freely available data sets created by the Jet Propulsion Laboratory (JPL) at NASA - the National Aeronautics and Space Administration of the United States.

It is important to note that while the Vernal Equinox and the Paschal Full Moon occur at one instant astronomically, the corresponding date and time of that instant depends on the location where the observation is made. Two observers in different time zones would observe the Paschal Full Moon at the same instant, but the local date and time for that observation would correlate with their time zones

Given that Christians are dispersed across the world, the proposal uses the dates and times for the Vernal Equinox and the Paschal Full Moon as observed from the Great City of our God Jerusalem.

GLOBAL CHANGE

The intention is for the New Coptic Calendar to be used by the entirety of the Coptic Orthodox Church across the whole world, including Egypt. It is not intended for use by Copts in Western societies only.



METHODOLOGY

To perform the calculations, we wrote a program using the Python 3.7 language, utilizing several open data sets and open source libraries. The output of the program is a database which houses an interlinear collection of 500 years' worth of dates in the Gregorian Calendar, the Old Coptic Calendar, and the New Coptic Calendar. Additionally, the database contains the dates for fixed and variable feasts and

observances in the New Coptic Calendar, as well as the true astronomical Vernal Equinox and Paschal Full Moon.

The code for all the computation behind the New Coptic Calendar is open source, and is available for review, feedback, and modification at the following GitHub repository:

<https://github.com/sherifhanna700/new-coptic-calendar>

CALCULATING THE SYNCHRONIZATION

Currently, 1 Thout in the Old Coptic Calendar corresponds to either 11 September or 12 September in the Gregorian Calendar. However, this was not always the case. Prior to the institution of the Gregorian Calendar in October 1582, 1 Thout used to correspond to 29 August.

The New Coptic Calendar proposes a one-time shift, either 13 days or 14 days (depending on whether the preceding year is a leap year in the Old Coptic Calendar) that sets 1 Thout in the New Coptic Calendar as 29 August in the Gregorian calendar.

For example, if the one-time shift were to take place in 2019, 1 Thout 1736 AM in the New Coptic Calendar would correspond to 29 August 2019 AD, as opposed to 12 September 2019 AD.

CALCULATING LEAP YEARS

An entirely new methodology is proposed for computing leap years in the New Coptic Calendar. The intent is to maintain synchronization with the Gregorian Calendar in perpetuity.

The new method is as follows:

1. *Let Y be the year in the New Coptic Calendar.*
2. $\overline{Y} = Y + 284$
3. *If $\overline{Y} \bmod 400 = 0$, Y is a leap year.*
4. *Else if $\overline{Y} \bmod 100 = 0$, Y is not a leap year.*
5. *Else if $\overline{Y} \bmod 4 = 0$, Y is a leap year.*
6. *Else Y is not a leap year.*

Stated more simply, take the Coptic year and add 284 to it. If the corresponding year in the Gregorian Calendar is a leap year, then that Coptic year is a leap year as well.

For example, consider the the year 1736 AM. It is not a leap year in the Old Coptic Calendar.

But following the proposed leap year calculation for the New Coptic Calendar, $1736 + 284 = 2020$. The year 2020 is a leap year in the Gregorian calendar. Therefore, 1736 is also a leap year in the New Coptic Calendar.

This means that an additional epagomenal day is inserted at the end of the year 1736 in the New Coptic Calendar, which results in the Little Month (Pikouji enAvot) having 6 days instead of 5.

CALCULATING THE FEAST OF THE RESURRECTION (EASTER)

The Council of Nicaea set the following rule for the calculation: Easter is the first Sunday after the first full moon on or after the Vernal Equinox.

The Vernal Equinox is the instant at which “the Sun is exactly above the Equator and day and night are of equal length” [[Encyclopedia Britannica](#)].

In the Northern Hemisphere, 21 March is nominally considered to be the date of the Vernal Equinox. However, the true astronomical Vernal Equinox can be substantially different. In fact, it can occur as early as 19 March.

The first full moon after the Vernal Equinox is also referred to as the Paschal Full Moon for the purposes of the Easter calculation.

To obtain the precise astronomical dates and times for these two celestial events, we relied on the following:

- The [DE435 ephemeris](#) from [NASA JPL](#) (itself a refinement of the [DE430 ephemeris](#)), which models the movement of the planets of the solar system. The DE435 dataset is the most recent one available as of January 2019.
- [Skyfield](#), an astronomical computation library for Python. Skyfield takes ephemeris files from NASA JPL and allows for highly accurate computation of planetary positions and other celestial events in the solar system. Skyfield’s API has built-in functions for calculating seasons on planet Earth (including the Vernal Equinox) and moon phases. Examples of both can be found in the [Almanac](#) section of the Skyfield website.

The algorithm for calculating Easter is as follows:

1. *Set a boundary between 17 March and 23 March in the Gregorian calendar*
2. *Call Skyfield `almanac()` API to determine the date and time of the Vernal Equinox inside that boundary*
3. *Set a boundary between the date/time of the Vernal Equinox and 29 days and 20 hours later*
4. *Call Skyfield `almanac()` API to determine the date and time of the Paschal Full moon inside that boundary*
5. *Convert the date and time of the Paschal Full Moon from the GMT time zone to the Jerusalem time zone*
6. *Determine the date of the Sunday that follows the Paschal Full Moon, all in the Jerusalem time zone.*
 - a. *If the Paschal Full Moon is on a Sunday, then Easter is the following Sunday.*
7. *Compute the other variable feasts and events that are tied to the date of the Feast of the Resurrection.*



SAMPLE DATES

Sample dates for Easter between the years 2020 and 2070 AD in the Gregorian calendar are listed in Appendix A.

Samples dates for all fixed and variable feasts and observances for the year 2020 AD in Gregorian calendar are listed in Appendix B.



FULL DATABASE OF DATES

The fully calculated MongoDB database of dates for the New Coptic Calendar is available at:

https://github.com/sherifhanna700/new-coptic-calendar/tree/master/new_coptic_calendar

Alternatively, refer to the [GitHub repository](#) to download and execute the code necessary to generate your own own MongoDB database.



FEEDBACK

Please send all feedback and suggestions to feedback@newcopticcalendar.org.



APPENDIX A

PROPOSED UNIFIED EASTER DATES, BETWEEN 2020 AND 2070 AD GREGORIAN

YEAR	ORTHODOX EASTER	CATHOLIC EASTER	UNIFIED EASTER	CATHOLIC VS. UNIFIED EASTER
2020	12 April	12 April	12 April	Same
2021	4 April	4 April	4 April	Same
2022	17 April	17 April	17 April	Same
2023	9 April	9 April	9 April	Same
2024	31 March	31 March	31 March	Same
2025	20 April	20 April	20 April	Same
2026	5 April	5 April	5 April	Same
2027	28 March	28 March	28 March	Same
2028	16 April	16 April	16 April	Same
2029	1 April	1 April	1 April	Same
2030	21 April	21 April	21 April	Same
2031	13 April	13 April	13 April	Same
2032	28 March	28 March	28 March	Same
2033	17 April	17 April	17 April	Same
2034	9 April	9 April	9 April	Same
2035	25 March	25 March	25 March	Same
2036	13 April	13 April	13 April	Same
2037	5 April	5 April	5 April	Same

2038	25 April	25 April	28 March	Different
2039	10 April	10 April	10 April	Same
2040	1 April	1 April	1 April	Same
2041	21 April	21 April	21 April	Same
2042	6 April	6 April	6 April	Same
2043	29 March	29 March	29 March	Same
2044	17 April	17 April	17 April	Same
2045	9 April	9 April	2 April	Different
2046	25 March	25 March	25 March	Same
2047	14 April	14 April	14 April	Same
2048	5 April	5 April	5 April	Same
2049	18 April	18 April	25 April	Different
2050	10 April	10 April	10 April	Same
2051	2 April	2 April	2 April	Same
2052	21 April	21 April	21 April	Same
2053	6 April	6 April	6 April	Same
2054	29 March	29 March	29 March	Same
2055	18 April	18 April	18 April	Same
2056	2 April	2 April	2 April	Same
2057	22 April	22 April	25 March	Different
2058	14 April	14 April	14 April	Same
2059	30 March	30 March	30 March	Same
2060	18 April	18 April	18 April	Same
2061	10 April	10 April	10 April	Same

2062	26 March	26 March	26 March	Same
2063	15 April	15 April	15 April	Same
2064	6 April	6 April	6 April	Same
2065	29 March	29 March	29 March	Same
2066	11 April	11 April	11 April	Same
2067	3 April	3 April	3 April	Same
2068	22 April	22 April	22 April	Same
2069	14 April	14 April	7 April	Different
2070	30 March	30 March	30 March	Same



APPENDIX B

SAMPLE CALENDAR OF FIXED FEASTS AND OBSERVANCES FOR 2020 AD GREGORIAN / 1736-1737 AM NEW COPTIC CALENDAR

GREGORIAN CALENDAR	NEW COPTIC CALENDAR	FEAST OR OBSERVANCE
1 January	6 Tobi	The Feast of the Circumcision
6 January	11 Tobi	The Feast of the Theophany
8 January	13 Tobi	The Feast of the First Miracle at Cana of Galilee
16 January	21 Tobi	Dormition of the Theotokos
22 January	27 Tobi	The Feast of Archangel Suriel
2 February	8 Meshir	The Feast of the Presentation of the Lord in the Temple
15 February	21 Meshir	Monthly Commemoration of the Theotokos
24 February	30 Meshir	The Appearance of the Head of St. John the Baptist
5 March	10 Parmhat	The Appearance Of The Glorious Cross
16 March	21 Paremhat	Monthly Commemoration of the Theotokos
24 March	29 Paremhat	The Feast of the Annunciation
15 April	21 Paramouti	Monthly Commemoration of the Theotokos
17 April	23 Paramouti	The Martyrdom of St. George of Cappadocia
23 April	29 Paramouti	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
24 April	30 Paramouti	The Martyrdom of the St. Mark
25 April	1 Pashons	Nativity of the Theotokos
15 May	21 Pashons	Monthly Commemoration of the Theotokos
18 May	24 Pashons	The Feast of the Lord's Entrance into Egypt
23 May	29 Pashons	Monthly Commemoration of the Annunciation, Nativity, and Resurrection

26 May	2 Paoni	The Commemoration of the Appearance of the Bodies of St. John the Baptist and Elisha the Prophet
5 June	12 Paoni	The Feast of Archangel Michael
14 June	21 Paoni	The Commemoration of the First Church for The Virgin Mary in the city of Philippi
19 June	26 Paoni	The Consecration of the Church of Archangel Gabriel
22 June	29 Paoni	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
23 June	30 Paoni	The Nativity of St. John the Baptist
28 June	5 Epip	The Feast of the Apostles / Martyrdom of the Apostles Peter and Paul
14 July	21 Epip	Monthly Commemoration of the Theotokos
20 July	27 Epip	The Feast of Archangel Raphael
22 July	29 Epip	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
24 July	1 Messori	First Day of the Fast of the Theotokos
5 August	13 Messori	The Feast of the Transfiguration
8 August	16 Messori	Assumption of the Theotokos
13 August	21 Messori	Monthly Commemoration of the Theotokos
21 August	29 Messori	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
25 August	3 Pikouji enAvot	The Feast of Archangel Raphael
29 August	1 Thout	The Feast of Nayrouz (Coptic New Year)
14 September	17 Thout	The Consecration of the Church of the Honorable Cross
18 September	21 Thout	Monthly Commemoration of the Theotokos
26 September	29 Thout	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
7 October	10 Paopi	Monthly Commemoration of the Theotokos
18 October	21 Paopi	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
26 October	29 Paopi	The Consecration of the Church of St. Mark the Evangelist and the Appearance of His Holy Head.
27 October	30 Paopi	The Consecration of the Church of St. George of Cappadocia
3 November	7 Hathor	The Feast of the Four Incorporeal Living Creatures
4 November	8 Hathor	The Feast of Archangel Michael

8 November	12 Hathor	First Day of the Nativity Fast
12 November	16 Hathor	Monthly Commemoration of the Theotokos
17 November	21 Hathor	The Feast of the Twenty Four Presbyters
20 November	24 Hathor	Monthly Commemoration of the Annunciation, Nativity, and Resurrection
25 November	29 Hathor	Presentation of the Theotokos in the Temple
29 November	3 Kiahk	The Feast of Archangel Raphael
9 December	13 Kiahk	Monthly Commemoration of the Theotokos
17 December	21 Kiahk	The Feast of Archangel Gabriel
18 December	22 Kiahk	The Feast of the Nativity
25 December	29 Kiahk	The Feast of the 144,000 Slain Children of Bethlehem
29 December	3 Tobi	The Feast of the Circumcision

SAMPLE CALENDAR OF VARIABLE FEASTS AND OBSERVANCES FOR 2020 AD GREGORIAN / 1736-1737 AM NEW COPTIC CALENDAR

WEEKDAY	GREGORIAN CALENDAR	NEW COPTIC CALENDAR	FEAST OR OBSERVANCE
Friday	3 January	8 Tobi	Paramoun of Theophany
Saturday	4 January	9 Tobi	Paramoun of Theophany
Sunday	5 January	10 Tobi	Paramoun of Theophany
Monday	3 February	9 Meshir	Fast of Ninevah
Tuesday	4 February	10 Meshir	Fast of Ninevah
Wednesday	5 February	11 Meshir	Fast of Ninevah
Monday	17 February	23 Meshir	First Day of Lent
Sunday	23 February	29 Meshir	First Sunday of Lent
Sunday	1 March	6 Paremhat	Second Sunday of Lent

Sunday	8 March	13 Paremhat	Third Sunday of Lent
Sunday	15 March	20 Paremhat	Fourth Sunday of Lent
Friday	20 March	25 Paremhat	Vernal Equinox
Sunday	22 March	27 Paremhat	Fifth Sunday of Lent
Sunday	29 March	4 Paramouti	Sixth Sunday of Lent
Friday	3 April	9 Paramouti	Last Day of Lent
Saturday	4 April	10 Paramouti	Lazarus Saturday
Sunday	5 April	11 Paramouti	Palm Sunday
Monday	6 April	12 Paramouti	Holy Monday
Tuesday	7 April	13 Paramouti	Holy Tuesday
Wednesday	8 April	14 Paramouti	Holy Wednesday / Paschal Full Moon
Thursday	9 April	15 Paramouti	Great and Holy Thursday
Friday	10 April	16 Paramouti	Great and Holy Friday
Saturday	11 April	17 Paramouti	Great and Holy Saturday
Sunday	12 April	18 Paramouti	The Feast of the Resurrection
Sunday	19 April	25 Paramouti	Thomas Sunday
Sunday	26 April	2 Pashons	Second Sunday of Pentecost
Sunday	3 May	9 Pashons	Third Sunday of Pentecost
Sunday	10 May	16 Pashons	Fourth Sunday of Pentecost
Sunday	17 May	23 Pashons	Fifth Sunday of Pentecost
Thursday	21 May	27 Pashons	Feast of the Ascension
Sunday	24 May	30 Pashons	Sixth Sunday of Pentecost
Sunday	31 May	7 Paoni	Feast of the Pentecost
Monday	1 June	8 Paoni	Apostle's Fast Begins
Thursday	24 December	28 Kiahk	Paramoun of Nativity

