Counting the number of days in any Year
Cariño's dy-Algorithm

Dave Ryan T. Cariño
MSU – GSC Alumni, Mathematician
January 10, 2018
carinodaveryan@gmail.com

Abstract. This study is an algorithm of calculating the number of days in any given Year in Gregorian & Julian calendar using simplified formula. It consists of seven algebraic (3 for Julian) expression, six of it are integer function by substituting the year. This formula will calculate the number of days which gives a number from 365 to 366 that determines the exact number of days in a given Year. This algorithm has no condition even during leap-year and 400-year cycle.

1 Introduction

1.1 This algorithm is devised using basic mathematics, without any condition or modification to the formula. This algorithm will provide a direct substitution to the formula, without referring to a table.

1.2 For any calendar year, y denotes for calendar year in either Gregorian & Julian calendar.

2 The Formula

Formula for Gregorian calendar in original form,

$$dy = 365 + \left\lfloor \frac{y}{4} \right\rfloor - \left\lfloor \frac{(y-1)}{4} \right\rfloor - \left\lfloor \frac{y}{100} \right\rfloor + \left\lfloor \frac{(y-1)}{100} \right\rfloor + \left\lfloor \frac{y}{400} \right\rfloor - \left\lfloor \frac{(y-1)}{400} \right\rfloor$$

where

- dy is the number of days in a Year
- y is the Gregorian year

3 Simplified Formula

3.1 Original form,

$$dy = 365 + \left\lfloor \frac{y}{4} \right\rfloor - \left\lfloor \frac{(y-1)}{4} \right\rfloor - \left\lfloor \frac{y}{100} \right\rfloor + \left\lfloor \frac{(y-1)}{100} \right\rfloor + \left\lfloor \frac{y}{400} \right\rfloor - \left\lfloor \frac{(y-1)}{400} \right\rfloor$$

3.2 Simplified form,

$$dy = 365 + \lfloor a \rfloor - \lfloor b \rfloor - \left\lfloor \frac{a}{25} \right\rfloor + \left\lfloor \frac{b}{25} \right\rfloor + \left\lfloor \frac{a}{100} \right\rfloor - \left\lfloor \frac{b}{100} \right\rfloor$$

where

- $a = \frac{y}{4}$
- $b = \frac{(y-1)}{4}$

4 Examples

Several examples are presented/shown to illustrate the algorithm.

4.1 1583, first full year of Gregorian calendar.

$$y = 1583$$

$$a = \frac{1583}{4} = 395.75$$

$$b = \frac{(1583-1)}{4} = \frac{1582}{4} = 395.5$$

$$\begin{aligned} dy &= 365 + \lfloor 395.75 \rfloor - \lfloor 395.5 \rfloor - \left\lfloor \frac{395.75}{25} \right\rfloor + \left\lfloor \frac{395.5}{25} \right\rfloor + \left\lfloor \frac{395.75}{100} \right\rfloor - \left\lfloor \frac{395.5}{100} \right\rfloor \\ &= 365 + \lfloor 395.75 \rfloor - \lfloor 395.5 \rfloor - \lfloor 15.83 \rfloor + \lfloor 15.82 \rfloor + \lfloor 3.9575 \rfloor - \lfloor 3.955 \rfloor \\ &= 365 + 395 - 395 - 15 + 15 + 3 - 3 \\ &= \mathbf{365} \end{aligned}$$

So, 1583 has 365days

4.2 1900, latest centennial that is not a leap-year

$$y = 1900$$

$$a = \frac{1900}{4} = 475$$

$$b = \frac{(1900-1)}{4} = \frac{1899}{4} = 474.75$$

$$\begin{aligned} dy &= 365 + \lfloor 475 \rfloor - \lfloor 474.75 \rfloor - \left\lfloor \frac{475}{25} \right\rfloor + \left\lfloor \frac{474.75}{25} \right\rfloor + \left\lfloor \frac{475}{100} \right\rfloor - \left\lfloor \frac{474.75}{100} \right\rfloor \\ &= 365 + \lfloor 475 \rfloor - \lfloor 474.75 \rfloor - \lfloor 19 \rfloor + \lfloor 18.99 \rfloor + \lfloor 4.75 \rfloor - \lfloor 4.7475 \rfloor \end{aligned}$$

$= 365 + 475 - 474 - 19 + 18 + 4 - 4$

$= 365$

So, 1900 has 365days

5 The Algorithms

- $a = \frac{y}{4}$
- $b = \frac{(y-1)}{4}$

5.1 Gregorian Calendar:

$$dy = 365 + \lfloor a \rfloor - \lfloor b \rfloor - \left\lfloor \frac{a}{25} \right\rfloor + \left\lfloor \frac{b}{25} \right\rfloor + \left\lfloor \frac{a}{100} \right\rfloor - \left\lfloor \frac{b}{100} \right\rfloor$$

5.2 Julian Calendar:

$$dy = 365 + \lfloor a \rfloor - \lfloor b \rfloor$$

5.3 Common year with 365days:

$$dy = 365$$

Acknowledgements

This work is dedicated to my family especially to my wife Melanie and two sons, Milan and Mileone.

References

1 https://en.wikipedia.org/wiki/Gregorian_calendar
2 https://en.wikipedia.org/wiki/Julian_calendar