Calculating Number of Days Passed Since the Introduction of Gregorian Calendar
Cariño's dp-Algorithm

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Abstract. This study is an algorithm of calculating number of days passed since the introduction of Gregorian Calendar for any given date using simplified formula. It consists of nine algebraic expressions, five of which are integer function by substituting the year, month and day. This formula will calculate the n^{th}days which gives a number from 1 to ∞ (October 15, 1582 being the day one), that determines the exact number of days passed. 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, it will provide a direct substitution to the formula.

1.2 For any calendar date, m denotes for month, d for day and y for year; m is the number of months in the calendar year, i.e., m = 1 for the month of January, m = 2 for the month of February and m = 12 for the last month of the year which is December; d on the other hand, is the day in a given calendar date, i.e., 1 until 31. Lastly, y is the calendar year in Gregorian calendar.

2 The Formula

Formula for Gregorian calendar in original form,

$$dp = 31m + 365y + d - 578131 - \left\lfloor \frac{3m}{7} \right\rfloor - 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + \left\lfloor \frac{(12y+m-3)}{48} \right\rfloor - \left\lfloor \frac{(12y+m-3)}{1200} \right\rfloor + \left\lfloor \frac{(12y+m-3)}{4800} \right\rfloor$$

where

- dp is the number of days passed (1 to ∞)
- m is the month (1 = January, 2 = February, ………, 12 = December)
- d is the day of the month
- y is the Gregorian year

3 Simplified Formula

3.1 Original form,

$$dp = 31m + 365y + d - 578131 - \left\lfloor \frac{3m}{7} \right\rfloor - 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + \left\lfloor \frac{(12y+m-3)}{48} \right\rfloor - \left\lfloor \frac{(12y+m-3)}{1200} \right\rfloor + \left\lfloor \frac{(12y+m-3)}{4800} \right\rfloor$$

3.2 Simplified form,

$$dp = 31m + 365y + d - 578131 - \left\lfloor \frac{3m}{7} \right\rfloor - 2\left\lfloor \frac{(m+7)}{10} \right\rfloor + \lfloor p \rfloor - \left\lfloor \frac{p}{25} \right\rfloor + \left\lfloor \frac{p}{100} \right\rfloor$$

where

- $p = \frac{(12y+m-3)}{48}$

4 Examples

Several examples are presented/shown to illustrate the algorithm.

4.1 October 15, 1582, first day of Gregorian calendar.

$m = 10, \quad d = 15, \quad y = 1582$

$$p = \frac{(12\{1582\} + 10 - 3)}{48}$$

$$= \frac{18991}{48}$$

$$= 395.6458\overline{3}$$

$$dp = 31(10) + 365(1582) + 15 - 578131 - \left\lfloor \frac{3(10)}{7} \right\rfloor - 2\left\lfloor \frac{(10+7)}{10} \right\rfloor + \lfloor 395.6458\overline{3} \rfloor - \left\lfloor \frac{395.6458\overline{3}}{25} \right\rfloor + \left\lfloor \frac{395.6458\overline{3}}{100} \right\rfloor$$

$$= 310 + 577430 + 15 - 578131 - \lfloor 4.29 \rfloor - 2\lfloor 1.7 \rfloor + \lfloor 395.6458\overline{3} \rfloor - \lfloor 15.83 \rfloor + \lfloor 3.95 \rfloor$$

$$= 310 + 577430 + 15 - 578131 - 4 - 2 + 395 - 15 + 3$$

$$= \mathbf{1} \,;\, nth\ day$$

So, October 15, 1582 is the 1st day of Gregorian Calendar

4.2 February 28, 1900, latest centennial that is not a leap-year

$m = 2, \quad d = 28, \quad y = 1900$

$$p = \frac{(12\{1900\} + 2 - 3)}{48}$$

$$= \frac{22799}{48}$$

$$= 474.97916\overline{6}$$

$$dp = 31(2) + 365(1900) + 28 - 578131 - \left\lfloor\frac{3(2)}{7}\right\rfloor - 2\left\lfloor\frac{(2+7)}{10}\right\rfloor + \lfloor 474.9791\overline{6}\rfloor - \left\lfloor\frac{474.9791\overline{6}}{25}\right\rfloor + \left\lfloor\frac{474.9791\overline{6}}{100}\right\rfloor$$

$$= 62 + 693500 + 28 - 578131 - \lfloor 0.86\rfloor - 2\lfloor 0.9\rfloor + \lfloor 474\rfloor - \lfloor 18.999\rfloor + \lfloor 4.75\rfloor$$

$$= 62 + 693500 + 28 - 578131 - 0 - 0 + 474 - 18 + 4$$

$$= \mathbf{115919}\ ; nth\ day$$

So, February 28, 1900 is the 115919th day since the introduction of Gregorian Calendar

5 The Algorithms

- $p = \frac{(12y+m-3)}{48}$

5.1 Gregorian Calendar:

$$dp = 31m + 365y + d - 578131 - \left\lfloor\frac{3m}{7}\right\rfloor - 2\left\lfloor\frac{(m+7)}{10}\right\rfloor + \lfloor p\rfloor - \left\lfloor\frac{p}{25}\right\rfloor + \left\lfloor\frac{p}{100}\right\rfloor$$

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References

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