

Doomsday Algorithm

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December 13, 2013

- ¶ The Doomsday Algorithm calculates the day of the week of a given date.
- ¶ There are certain dates in every year that always share the same day of the week. This day of the week is called the “doomsday” of the year.
- ¶ Using the anchor day of a century (the doomsday of the first year of the century), the doomsday of a given year can be calculated.
- ¶ After this, the day of the week of a given date can be found by counting away from the doomsday.

Definition

Find the day of the week for February 11, 1978.

- ¶ The doomsday for 1900 is Wednesday. This means Wednesday is the anchor day for the 1900's.
- ¶ Using the algorithm on a later slide, the doomsday for 1978 is calculated to be Tuesday.
- ¶ The doomsday that is closest to February 11 is the last day of February. 1978 wasn't a leap year, so this would be February 28.
- ¶ Counting back from Tuesday, February 28, we see that the day of the week of February 11 is Saturday.

Example

- ¶ In 1887 Zeller created a formula to calculate the day of the week, but it was not an easy task for people to do
- ¶ John Conway devised the Doomsday Algorithm in 1973
- ¶ It's based off of Lewis Carroll's work on a perpetual calendar algorithm, published in 1887. Carroll could calculate the day in 20 seconds.
- ¶ Conway improved Carroll's algorithm, making it even easier and faster to figure out the day of the week.
- ¶ With his own algorithm, John Conway can mentally figure out the day of the week of a date in less than 2 seconds

History

- ¶ The big-O for the Doomsday Algorithm is n
- ¶ Although most of it is algebra, the computer does sort through an array to find the closest doomsday to the inputted date
- ¶ Otherwise, certain adjustments have to be made in the algorithm for leap years
- ¶ Adjustments also have to be made based on whether the closest doomsday is before or after the inputted date

Complexity of the Algorithm

Doomsday Dates

- ¶ January 3 or 4, depending on Leap Year
- ¶ Last day in February
- ¶ April 4
- ¶ May 9
- ¶ June 6
- ¶ July 4
- ¶ July 11
- ¶ August 8
- ¶ September 5
- ¶ October 10
- ¶ October 31
- ¶ November 7
- ¶ December 12

1.Jan(31st)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4		
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

2.Feb(28th)

Su	Mo	Tu	We	Th	Fr	Sa
	2	3	4	5	6	7
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

7.Jul(11th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

8.Aug(8th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

3.Mar(7th)

Su	Mo	Tu	We	Th	Fr	Sa
	1					
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

4.Apr(4th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

9.Sep(5th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

10.Oct(10th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

5.May(9th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3			
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

6.Jun(6th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

11.Nov(7th)

Su	Mo	Tu	We	Th	Fr	Sa
	1					
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

12.Dec(12th)

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Calendar of Doomsdays in 1997

Century	Anchor Day
1400-1499	Friday
1500-1599	Wednesday
1600-1699	Tuesday
1700-1799	Sunday
1800-1899	Friday
1900-1999	Wednesday
2000-2099	Tuesday
2100-2199	Sunday

Anchor Days for Centuries

- ¶ Once you have the anchor of a century, you set it equal to an integer value from 0-6. (Sunday=0, Monday=1, etc.)
- ¶ Every twelve years the anchor day of a year changes, so the last two digits of the year of the given date are divided by 12. This value, the remainder, and the remainder divided by 4 are all added up, and then the integer value of the anchor is added.
- ¶ Seven is subtracted from this number until it reaches a number from 0-6.
- ¶ This number is the doomsday of the year.

Algorithm for Finding Doomsday

Find the doomsday for 1978. The anchor for the 1900's is Wednesday.

¶ Set the anchor day equal to an integer.

$$\text{Wednesday} = 3$$

¶ Divide the last two digits of the year by 12.

$$78/12 = 6$$

¶ Calculate the remainder of the above operation.

$$78 \% 12 = 6$$

¶ Divide the remainder by 4.

$$6/4 = 1$$

¶ Add these four numbers up.

$$3+6+6+1 = 17$$

¶ Subtract multiples of 7 until it's an integer between 0-6.

$$17-7 = 10$$

$$10-7 = 2$$

Therefore, the doomsday of 1978 is Tuesday.

Example

- ¶ To find the day of the week, the program searches through all of the doomsdays to find the closest one to the inputted date.
- ¶ Once it finds the closest one, it finds the absolute value of the date from the doomsday. 7 is subtracted from this value until it's an integer between 0 and 6.
- ¶ If the date is before the doomsday, this integer is subtracted from the doomsday integer to find the date's day of the week. If the date is after, it's added to the doomsday integer.

Algorithm for Calculating Day of the Week

What's the day of the week of February 11, 1978?

The doomsday of 1978 is Tuesday. Since 1978 isn't a leap year, the closest doomsday to February 11 is February 28.

- ¶ Set the doomsday of 1978 to an integer.

$$\text{Tuesday} = 2$$

- ¶ Find the difference between the doomsday date and the given date.

$$28 - 11 = 17$$

- ¶ Subtract multiples of 7 from this difference until it's an integer between 0 and 6.

$$17 - 14 = 3$$

- ¶ Since February 11 is before February 28, subtract this number from the doomsday integer.

$$2 - 3 = -1$$

Since -1 isn't from 0-6, add 7

$$-1 + 7 = 6$$

Therefore, February 11, 1978 is a Saturday.

Example

- ¶ The year is divided by twelve because every twelve years, the doomsday of the year advances one year.
- ¶ Division by twelve allows the computer to figure out what the section of twelve in the century the date is, to figure out the doomsday of the year.
- ¶ By adding the remainder of 12, it figures out specifically which year in the section of 12 the date is in.
- ¶ Dividing by four takes into account the leap years.

Explanation of Algorithm

- & <http://firstsundaydoomsday.blogspot.com/2009/12/quick-start-guide.html>
- & <http://www.scientificamerican.com/article.cfm?id=calendar-algorithm>
- & http://en.wikipedia.org/wiki/Doomsday_rule
- & <http://rudy.ca/doomsday.html>
- & <http://rudy.ca/doom1997.html>
- & <http://www.timeanddate.com/date/doomsday-weekday.html>
- & <http://www.timeanddate.com/date/doomsday-rule.html>

Sources