## The Doomsday rule

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## 1 Introduction

What days of the week are:

- January the first of 2011 ?
- June the 6, 1944
- July the 14,1789
- May 1st, 2012?


## The Doomsday rule

If you do not know the answer, could you compute it?

Could you devise an efficient algorithm to calculate the day of the week of any given date (say from year 1 to 9999 ) in the Gregorian calendar?

Goal: being able to calculate it mentally in a few seconds

## 2 The Gregorian calendar

- The calendar we use today
- Introduced by Pope Gregory XIII on 1582
- Similar to the previous Julian calendar; main difference: leap years


### 2.1 Leap years in the Gregorian calendar

Every year that is exactly divisible by four is a leap year, except for years that are exactly divisible by 100; the centurial years that are exactly divisible by 400 are still leap years. For example, the year 1900 is not a leap year; the year 2000 is a leap year.

## 3 Doomsday

Day of the week of "march 0" (last day of february)
Doomsday for 2011: Monday, for 2012: Wednesday.
Doomsdays every year:

- $4 / 4,6 / 6,8 / 8$ and $10 / 10$
- $5 / 9$ and $9 / 5 ; 11 / 7$ and $7 / 11$
- Normal years: january 3 and february 0
- Leap years, january 4 and february 1

The Doomsday rule

## Applications: In 2011, what is the day of the week of

- December, 25?
- October, 17 ?
- July, 14?
- November, 11?


## 4 Doomsday formula

Number the day of the week from 0 to 6 , starting with Sunday.
Then the Doomsday of year $y$ is

$$
\left(2+y+\left\lfloor\frac{y}{4}\right\rfloor-\left\lfloor\frac{y}{100}\right\rfloor+\left\lfloor\frac{y}{400}\right\rfloor\right) \quad \bmod 7
$$

Why?

Not very easy to compute mentally.

## 5 Doomsday method

Python code for doomsday of year $y$ (does it work? why?)

```
s = floor(y / 100)
x = y % 100
# % is modulo in python
if odd(x):
    x = x + 11
x = x / 2
if odd(x):
    x = x + 11
x = x + 2 * (s mod 4)
return ((2 - x) % 7)
```


### 5.1 Applications

What days of the week are:

- January the first of 2011 ?
- June the 6, 1944
- July the 14,1789
- May 1st, 2012?


## The Doomsday rule

## 6 Conclusion

- Doomsday rule is easy
- Practice, practice, practice
- Next challenge: convert calendar dates to ISO week dates (see Wikipedia, ISO_8601)

