

Problem Statement:

Can you derive a method to find the day of the week of any given date between 1901 and 2100 using only basic arithmetic operations?

Process:

We started off by deciding to find January 1st, 1901, and counted the days from October 1st to then. We took mod 7 of that, as there are seven days in a week and we were able to find the day of the week compared to January 1, 1901. At least— that’s what we thought. After getting Monday, we checked in with other groups doing a similar solution; to our surprise, they got Tuesday instead. Looking at our numbers, we realized that since we just subtracted, the original day wasn’t “counted”— so technically, we solved for December 31, 1900 instead. This was fine though, we decided to work off of this value, as it could be looked at as “Day 0”, so Day 1 would satisfyingly land on January 1. Now, we started our actual solution. We decided to first ignore leap years, and take them into account at the end. Step one would be to see where Day 0 would be regarding the chosen year (i.e. For 2000, Day 0 would be December 31, 1999), so we would take the chosen year minus 1900 (taking 1901 into account as well), and multiply by 365 to get the number of days. Modding 7, we would find the day of the week our relative day 0 would fall on. Here, we realized that $365 \bmod 7$ was 1, so we didn’t even need to multiply by 365. After doing that, we needed to find the number of days from the year we arrived to. To do this, we added all the months with the number of days they had in a regular year (January is 31, February is 28, March is 30, etc.) without counting the birthday month, as the date was within the month. Then, we added the day (number) that the birthday was on, and subtracted by 1 to account for the shift from [1 to 7] to [0 to 6]. By doing all that, we figured out how many days were between January 1 of that year and the birthday. The final step in our process was finding out how many leap years there were. To do that, we found out how many years had passed from 1900 to the birth year and divided it by four. We would add that to the other additions and

would find out how many days have passed from December 31, 1900 to the birthday. Everything seemed great! That was, until we realized something– for leap year dates, if the date was within a leap year but before Feb 29th, it would still be counted as one extra. To mitigate this issue, we changed the leap year calculation to using $((\text{chosen year} - 1) - 1900)$, which would be equal to $(\text{chosen year} - 1901)$. This would intentionally count the number of leap years excluding the current year. To then make sure this wouldn't affect the days after Feb 29, we then changed the day-count so if it was a leap year, then Feb 29 needed to be counted as well.

Solution:

It is highly recommended to write the answer to each step down with the step you got it from

- I. Subtract 1900 from your birthday year
- II. Divide that by seven and keep the remainder
- III. Take the number you got in step I, subtract 1, divide by 4 and keep the remainder
- IV. Subtract the remainder from step III from the number you got in step I then subtract 1 again
- V. Divide the result from step IV by 4 (write the answer down)
- VI. Count the days necessary to arrive at your birthday within a year (ex. If you were born on January 17, 17, if you were born on June 2, 1956, then 154)[If leap year is in date, count Feb 29 too if necessary]
- VII. Subtract 1 from your answer from step VI to account for the counter starting from 0 (0 to 6)
- VIII. Add the results from steps I, V, and VII
- IX. Divide the result from step VIII by seven and keep the remainder.
- X. Count the answer from step IX starting from Monday (0 is Monday, 1 is Tuesday, 2 is Wednesday, ..., 6 is Sunday)

We know our solution is correct because it finds all the days between 1900 and the given date, and then compares each number to a day. Therefore, associating the correct day to the given date. We checked it against the birthdays on the list [here](#), as well as testing it on other classmates' birthdays. If still in doubt, try it with your birthday.

Extensions:

Each member of our group tried a different extension.

Hartej: <https://replit.com/@hanand3/Day-of-Week-Calculator?v=1>

This is a replit program, so it is accessible on the internet to anyone.

Adnan & Rishab: [day of the week code](#)

Adnan's App Extension:

<https://studio.code.org/projects/applab/PDDf8AQwHHKL80kP60oGS7x6Nhin46Yckxj7At2vtGE>

Variations:

1. Instead of being given the date and having to find the day of the week, can you be given the day of the week, the month and the year, and have to find the date? (There would be multiple solutions for each question)
2. You could give the day they were born and their age, to find the month via correlation.