Problem Statement:

People know what their birthday is, but they might not know what day of the week it was. Therefore, it is imperative that we pose the question: how can we determine what day of the week a person was born on, given only a calendar of the current month and a four-function calculator, in a manner that is understandable to the average person?

Process:

To begin, we brainstormed the different factors that would play a role in this problem. These included *the number of days in a month*, *if the year was a leap year*, and *the date of birth of the person*.

To determine the day of the week a person was born, given only the day of the week of the days of this month, we decided to find what day January 1st of this year (2024) was as a starting point for all our future calculations. We did this by adding the total number of days per month from January to October, and then dividing this number by the number of days per week (7). By doing this, we found that the quotient was 39 with a remainder of 1. To clarify, a remainder is the number left over after performing long division until the decimal point. So, by using this remainder, we could subtract 1 day from the day of October 1st, Tuesday, to get that January 1st, 2024, is a Monday.

Then, we had to figure out how to go from January 1st, 2024 to any other date. We elected to split this into two parts: how to go to January 1st of any other year and how to go from January 1st to the date of the person's birthday.

For the first part, we noticed that the day of week would go back one day for every year, and two days for every leap year. This is because 365 (the number of days in a normal year) divided by 7 has a remainder of 1, which means that you would go back one day when going from one normal year back to another normal year. For example, going back one day from Monday would be Sunday. However, leap years have 366 days, which leaves a remainder of 2 instead. Therefore, you would go back two days with a leap year. Since a leap year happens every four years, we found that every 4 years, you would go back 5 days.

After this, we had to figure out how to go from month to month. The distance from the first day of a month to the first day of the next month is the length of the former month. So, we found the remainder of the number of days in the first month when divided by 7. We performed this calculation for every month to find the constant shifts from the date in January for each target month. However, this calculation actually returns the constant shift + 1, since the starting date is January 1st, and a remainder of one should refer to the day of week of January 1st, meaning a shift of 0. Therefore, the

constant shift is actually the result of this calculation - 1. Then, we can finally add the date to that constant shift to get our answer, a number from 0-6 (with 0 referring to Monday and 6 to Sunday).

However, we evaluated that the average person may not be able to perform remainder division. To communicate our solution in a way that they would understand, we had them perform normal division using a four-function calculator and listed what day of week the decimal portions correspond to.

Therefore, by following the process outlined above, we came up with a 5-step solution that would be able to answer our question.

Solution:

1. Subtract the current year from the year you were born in (answer should be negative).

2. Take the difference, multiply by 5, and divide by 4. Ignore the decimal portion of the result.

3. Take the result from step 2 (without the decimal portion) and add the date of the month of your birthday.

4. Then, add or subtract the number specified in the table below for the month you were born in, considering if you were born in a leap year or not, to the result from step 3.

	Birth Year is <u>NOT</u> a Leap Year	Birth Year is a Leap Year
January	-1	- 1
February	+ 2	+ 2
March	+ 2	+ 3
April	- 2	- 1
May	+ 0	+ 1
June	+3	+ 4

July	- 2	- 1
August	+ 1	+ 2
September	- 3	- 2
October	- 1	+ 0
November	+ 2	+ 3
December	- 3	- 2

5. Take your result after step 4 and divide by 7. If your result is negative, add 100 to your answer until it is positive. Use the table below to determine what day your birthday is.

Decimal After Dividing by 7	What day your birthday is
.0	Monday
.142857…	Tuesday
.285714…	Wednesday
.428571…	Thursday
.571428…	Friday
.714285…	Saturday
.857142…	Sunday

Extensions:

First Extension: What day will someone's birthday fall on in a specific year in the future?
How we would attempt it: The current solution works if you swap out the birth year for a specific year in the future (in step 1)

Second Extension: What day of the week will someone's 50th birthday be?**How we would attempt it:** Add in a step to calculate the year that someone will turn 50 (their birth year + 50) and then follow the solution to extension 1.

Third Extension: What if we needed to find the date of someone's birthday given their day of week, week of month, month, and year of birth? For example, my birthday was on the 3rd Wednesday of August 2002; when is my birthday?
How we would attempt it: To solve, follow the original process, skipping the step involving the date. The resulting day of the week is the day.