Problem statement:

The main problem that we are trying to solve is creating a list of simple instructions that will allow any person to figure out what day of the week their birthday was on. Those using our method were allowed to use a calculator, a calendar of the month of October of the current year, and the charts for the months and days shown in the instructions. We were also given a list of 5 birthdays, and their corresponding day of the week, for each day Sunday through Saturday.

Process and methods:

Our first step was to find a general strategy we wanted to follow for finding the day of a week. We saw that each week has 7 days, so if 2 dates were a multiple of 7 days apart, they would be the same day of the week. We then turned to finding how the number of years between two dates would affect the number of days of the week we would have to "shift". The idea of shifting is because years do not always start on the same day of the week, so your birthday will shift across the week between years. We can see that every year has 365 or 366 days, depending on whether or not it's a leap year. Because of this, we can see that every year we go back is 1 day shift, or a 2-day shift if it is a leap year. This is because 365 mod 7=1 and 366 mod 7 = 2. Since every four-year cycle is the same and contains a total shift of 5 days back when you go 4 years back, we can note that –5(mod 7) = 2, so a 2-day shift forward. This is how we get the 2*Q in our equation for finding the date of January 1st of a year. We decided to go with a strategy of finding the January 1st of the given year by calculating January 1st, 2024, ourselves and accounting for this in our calculations. We would then also have to subtract the remainder of division by 4 if it wasn't a leap year due to the additional shift of January 1st in that year. After we found the day of the week of January 1st of the birth year, we then simply add the number of days between January 1st and the birthday and then take mod 7 to find the day of the week. We then simply add these up to determine the day of the week of the birthday.

After coming up with an initial set of instructions, we had to simplify the steps to meet the criteria of the problem which involved making the instructions only use basic math operations. With this, steps that included MOD had to be broken down into quotients and remainders to make it more understandable. Also, we incorporated various color-coded variables for different values to make the instructions easier to follow along with. The "days of the week chart" and the "months" chart also helped with simplifying the instructions and ease of use. Overall, each initial step had to be broken down as much as possible to simplify the instructions.

Solution:

D = difference in years

Q = quotient after division

R = remainder after division

1. Know the exact date of your birthday (day, month, and year)
2. 2024 – birthyear = D
3. Use your third-grade long division skills to determine the quotient (Q) and the remainder (R) when dividing D by 4
4. If R = 0, then multiply 2 *Q (refer to THIS number in step 9), if not move on to the next step
    a. If R ≠ 0, then solve (2*Q) -R (refer to THIS number in step 9)
5. Determine which months come prior to your birthday month, starting from January
6. Refer to the "Month chart" below to determine how many days are in each month prior to your birthday month
7. Add up the total amount of days prior to your birthday month(use 29 for February if your birthday was in a leap year)
8. Calculate: (your answer from step 7) + (the day of the month of your birthday) - 1
9. Add: (the designated value in step 4 or 4a) + (result step 8)
10. Using your third-grade long division skills once again, determine the quotient and remainder when dividing: (the result from step 9) / 7
11. The remainder from step 10, corresponds to the day of the week, which is the day you were born, in the "days of the week" chart below

Days of the week chart

0	1	2	3	4	5	6
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

Months chart

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

Extensions:

One extension of this problem that we considered was looking into further centuries into the past. This would be a bit more difficult due to the extra rules that apply to leap year every 100 and 400 years.

We also considered attempting to predict the day of the week for dates in the future. This would be about the same level of difficulty as the current problem until we hit the same 100-year leap year issue.

Another potential idea would be to look at converting days of the week back into a month, for example finding what the date of the 23 Thursday of 2016 was. This would probably be similarly difficult to the current problem.