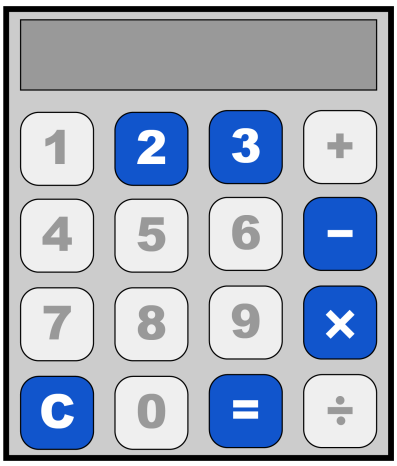
Problem of the Week
Problem A and Solution
Calculator Catastrophe

Problem

I dropped my calculator and my dog stepped on it. Now, most of the buttons are broken. The only working buttons are the ones with the dark background in the image below:



I want to have the calculator display each of the numbers from 1 to 12, by using only the unbroken buttons. The easiest ones to display are the numbers 2 and 3 since I can just enter them alone. However, all the others will need more buttons pressed. For example, to display a 7, I could use the fact that $7 = 3 \times 3 - 2$.

This is a very simple calculator, so I have to press the $\boxed{=}$ button after each part of the calculation. If I want to complete the calculation for $7 = 3 \times 3 - 2$, I would press the $\boxed{3}$ button, then the $\boxed{\times}$ button, then the $\boxed{3}$ button, and then the $\boxed{=}$ button to get the number 9. Then I would press the $\boxed{-}$ button, then the $\boxed{2}$ button, and then the $\boxed{=}$ button to get the number 7. This calculation takes 7 button presses to get the number 7 to appear in the calculator's display.

For each whole number from 1 to 12, show how you can display the number using at most 10 button presses.

NOTE: Your calculations can include 2-digit numbers. For example, if you wish to enter the number 32 you would press the $\boxed{3}$ button and then the $\boxed{2}$ button.

Solution

Answers will vary. Here is a table summarizing possible solutions for each whole number from 1 to 12.

Number	Calculation	Button Presses	Number of Button Presses
1	$3-2$	3 − 2 =	4
2	2	2	1
3	3	3	1
4	2×2	2 × 2 =	4
5	$3\times 3-2-2$	3 × 3 = − 2 = − 2 =	10
6	2×3	2 × 3 =	4
7	$3\times 3-2$	3 × 3 = − 2 =	7
8	$2\times 2\times 2$	2 × 2 = × 2 =	7
9	3×3	3 × 3 =	4
10	$33-23$	3 3 − 2 3 =	6
11	$33-22$	3 3 − 2 2 =	6
12	$3\times 2\times 2$	3 × 2 = × 2 =	7