UNIVERSITÄT
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Programming 2 - SS22

Project 3 - Wordle

Authors: Tim Bauerschmidt, Niklas Lohmann, Lisa-Marie Rolli

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Saarland University

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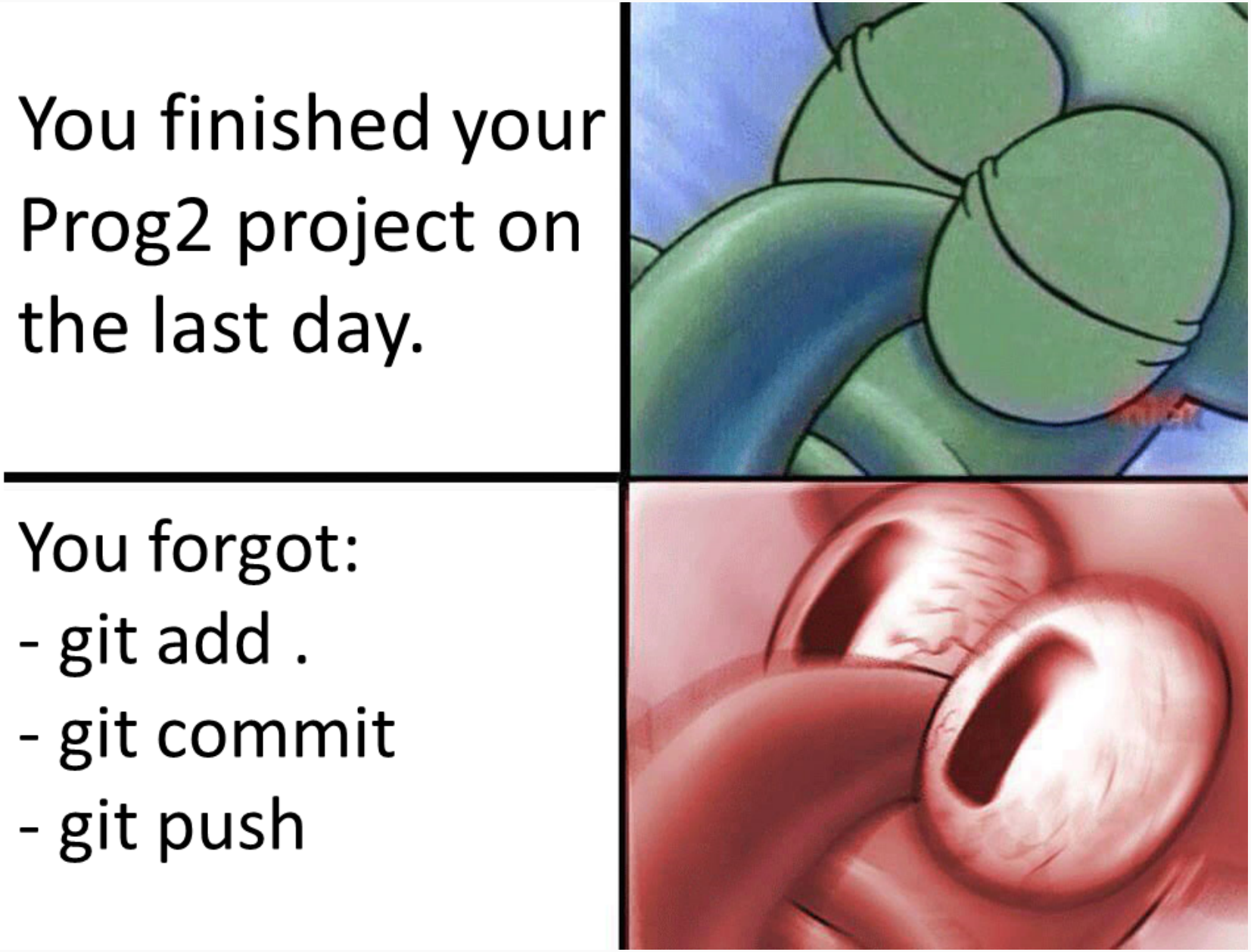
We all love Git



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Guesses

There is a secret word:

M	O	T	O	R

which we will have to guess.

Guesses

M	O	T	O	R

The guess has to be ...

- ... one word: **I was** ✗

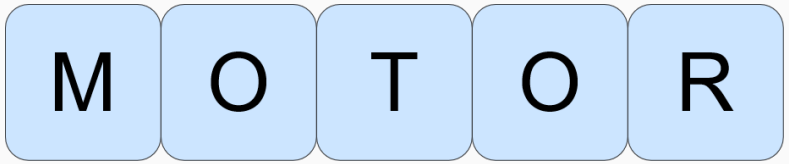
Guesses

M	O	T	O	R

The guess has to be ...

- ... one word: **I was** ✗
- ... of correct length: **rainbow** ✗

Guesses



The guess has to be ...

- ... one word: **I was** ✗
- ... of correct length: **rainbow** ✗
- ... that is in the dictionary: **abcde** ✗

Guesses

M	O	T	O	R

The guess has to be ...

- ... one word: **I was** ✗
- ... of correct length: **rainbow** ✗
- ... that is in the dictionary: **abcde** ✗

Valid guesses for **motor** are: **sugar, mommy, money, ...** ✓

User Feedback

After a user input a valid guess, feedback is provided *character-by-character*. There are 3 possibilities:

1. A character is not in the word (WRONG) ■.
2. A character is in the word but at a different position (WRONGPOS) ■.
3. A character is in the word and at the same position (CORRECT) ■.

User Feedback

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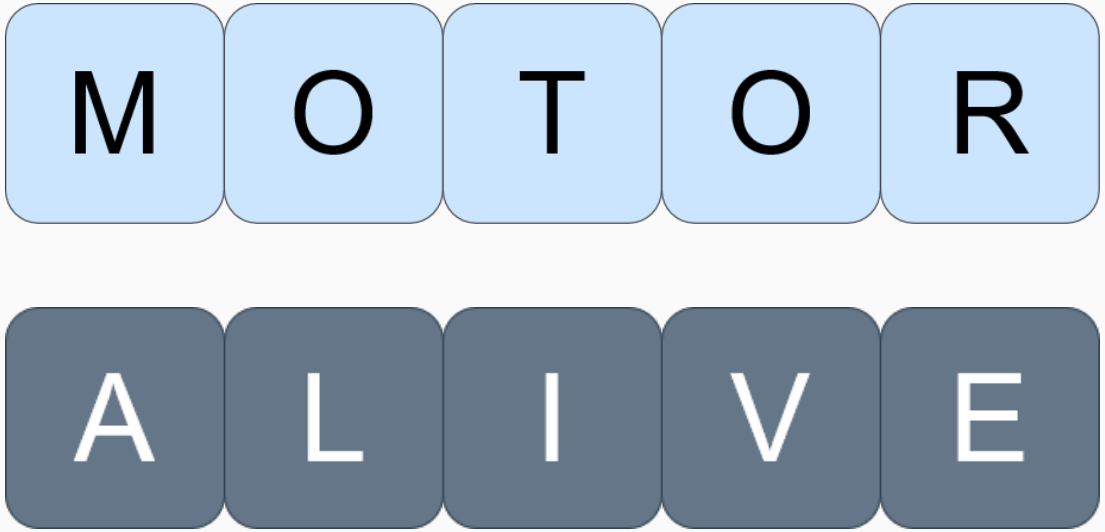
Let's look at a few cases...

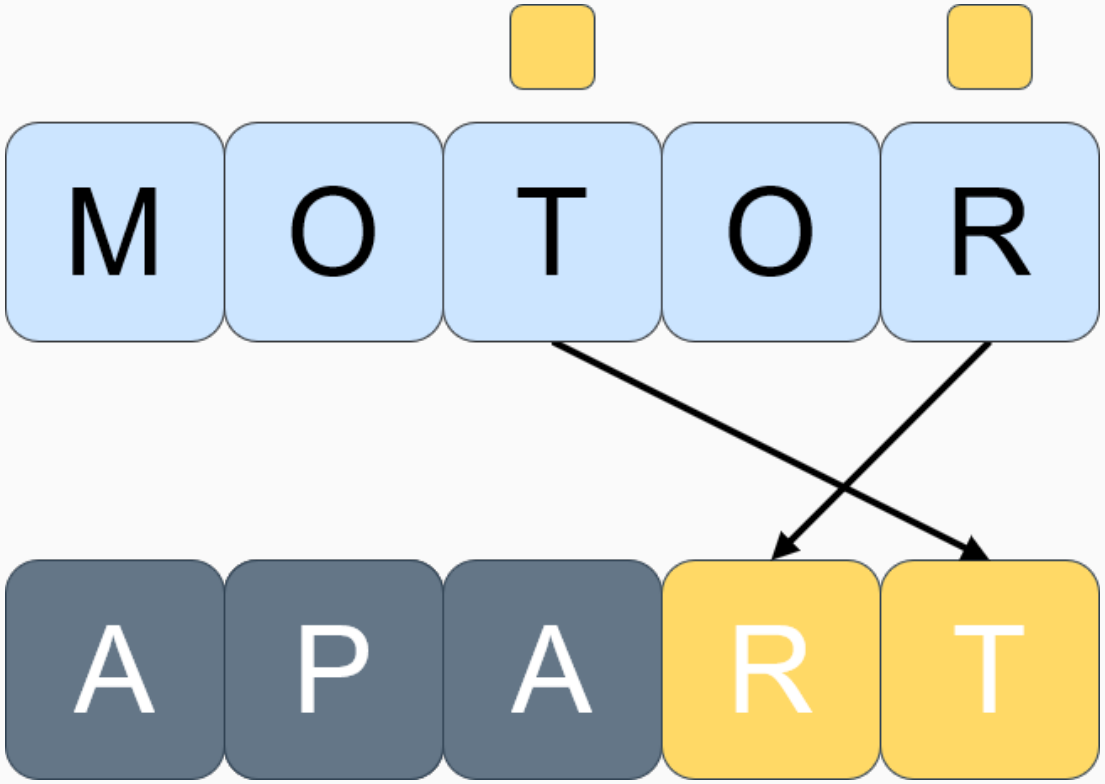
Case 1 (very difficult)

No character is correct:



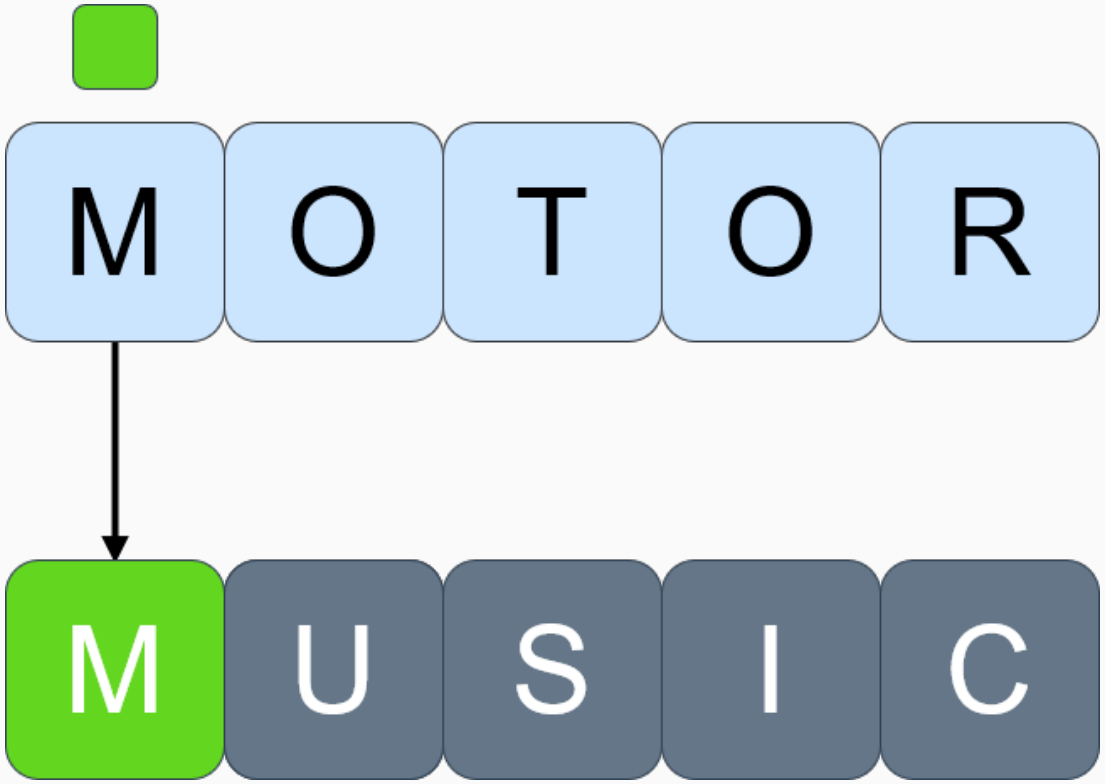
Case 2

Some characters are matched, but they are in the wrong position.



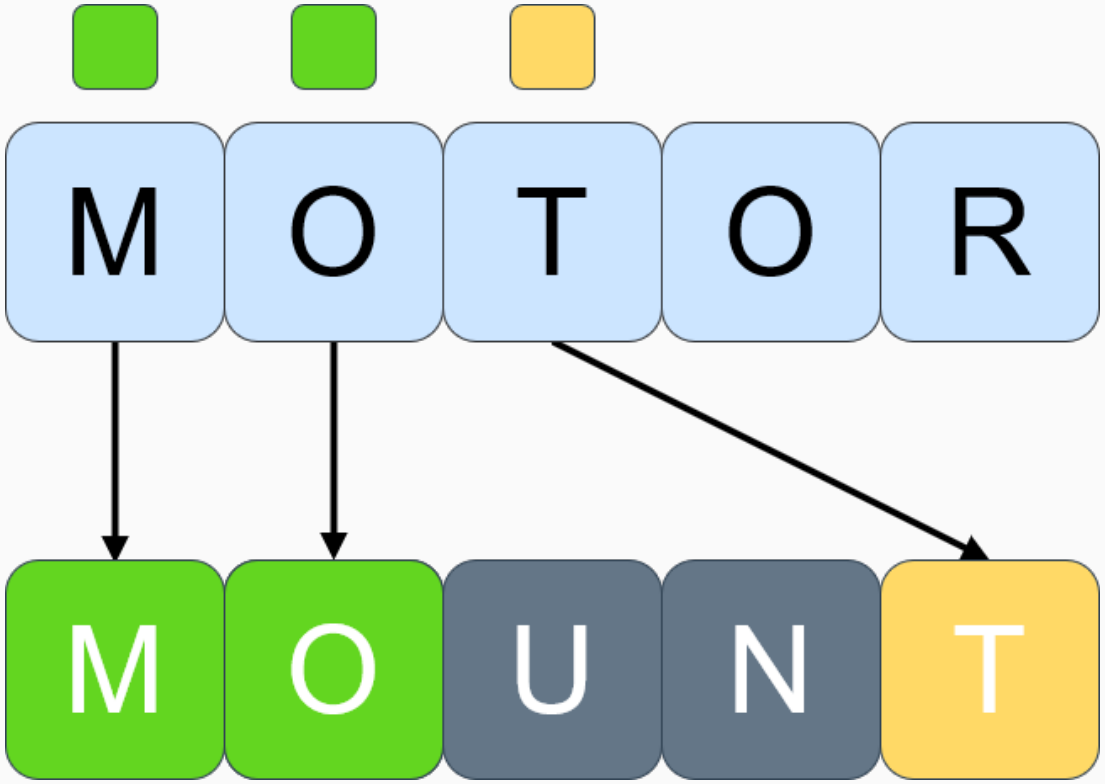
Case 3

Some characters are matched, and they are in the correct position.



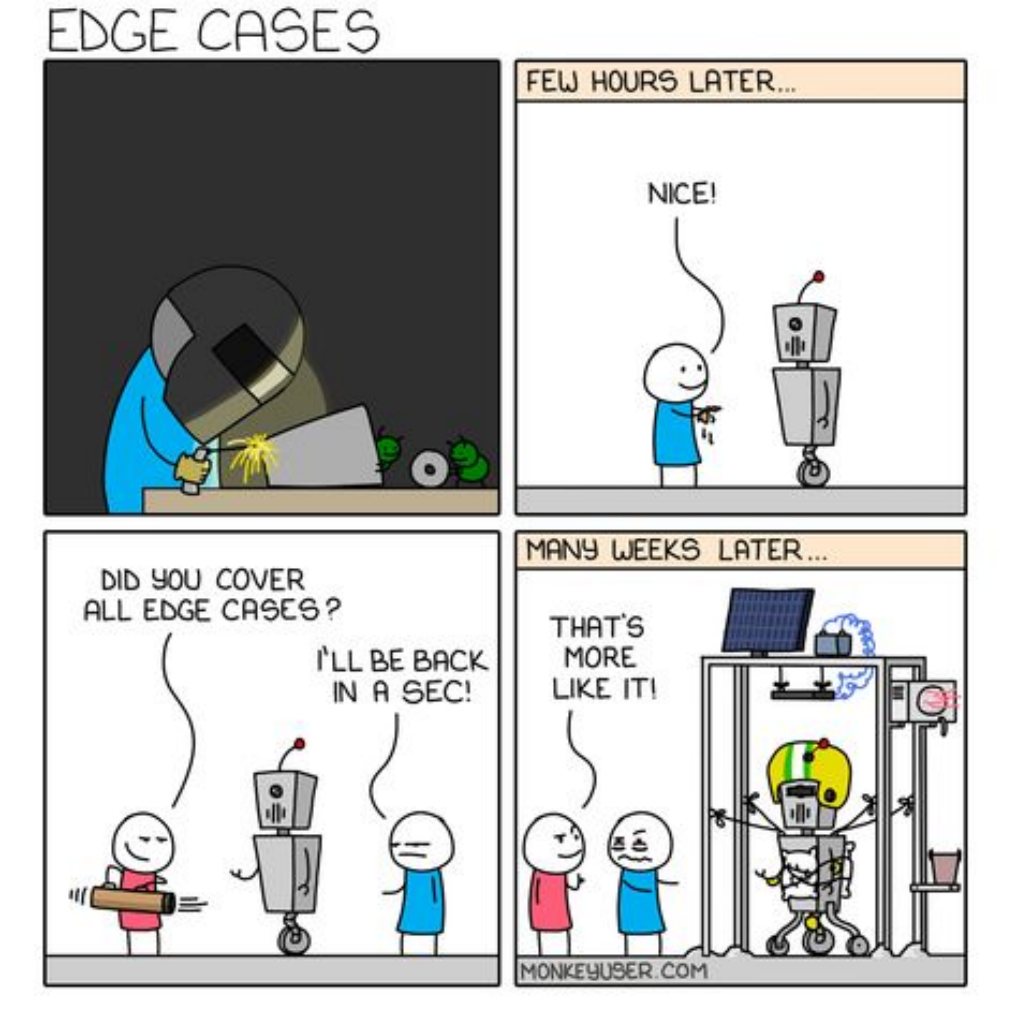
Case 4 (2 & 3)

Combining cases 2 and 3.



User Feedback

Let's get a little bit more edgy.



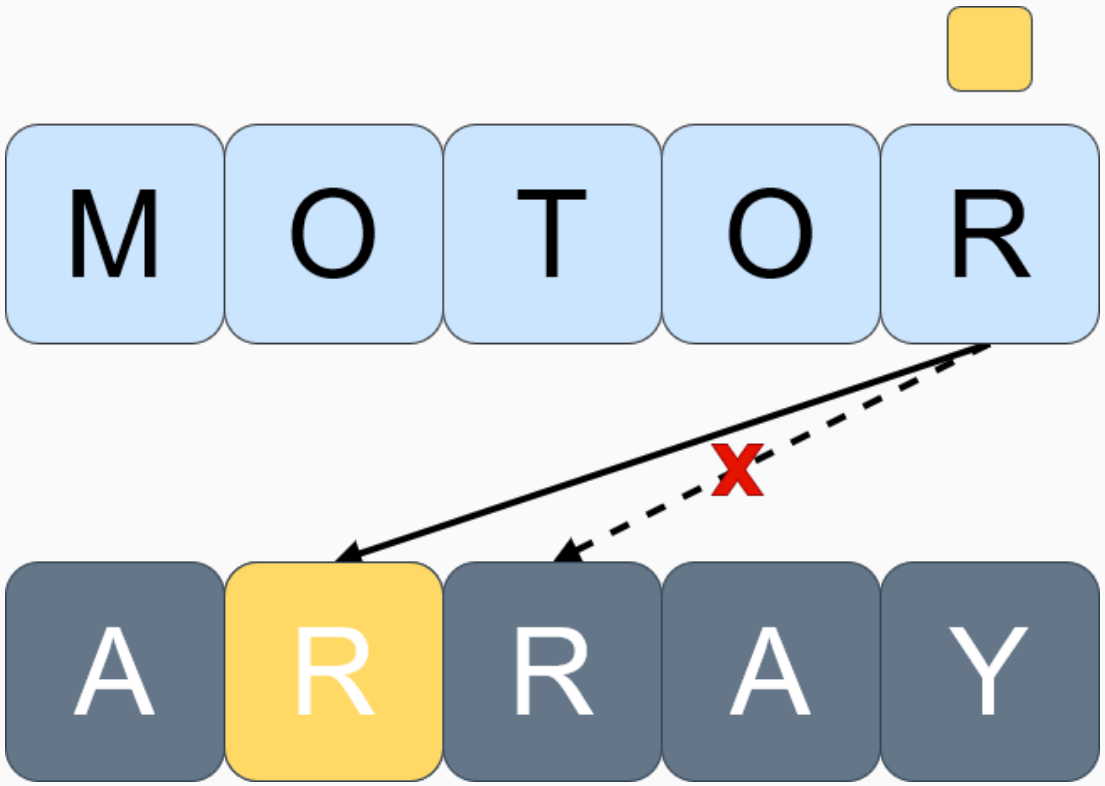
Case 5

- The guess contains the same character $n \in \mathbb{N}$ times.
- The character does only occur $k \in \mathbb{N}, k < n$ times.
- All n instances of the character are in the wrong position.

$\Rightarrow$ We only mark the first k occurences with (WRONGPOS) ■.

Case 5

Here: $n = 2,\ k = 1$



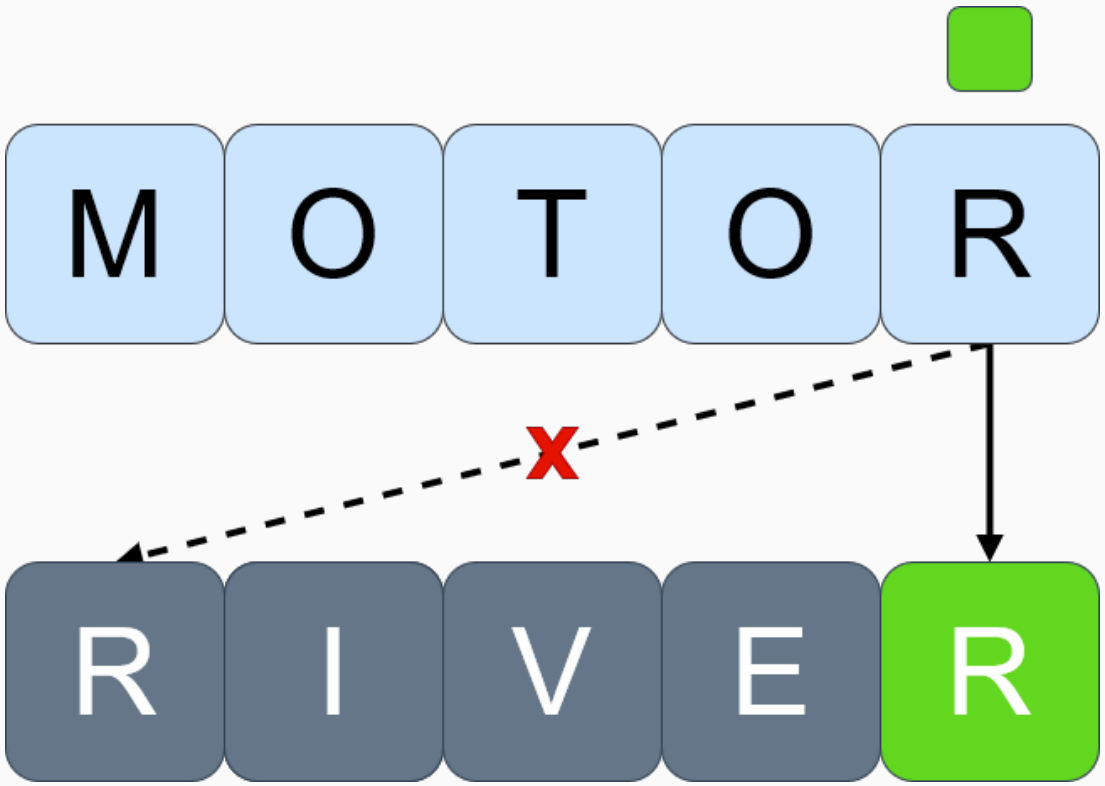
Case 6

- The guess contains the same character $n \in \mathbb{N}$ times.
- The character does only occur $k \in \mathbb{N}, k < n$ times.
- k of the n instances of the character are in the correct position.
- Consequently, $n - k$ instances of the character are in the wrong position.

$\Rightarrow$ We only mark the k correct occurence with (CORRECT) ■.
This means we ignore the order of the characters in the guess.

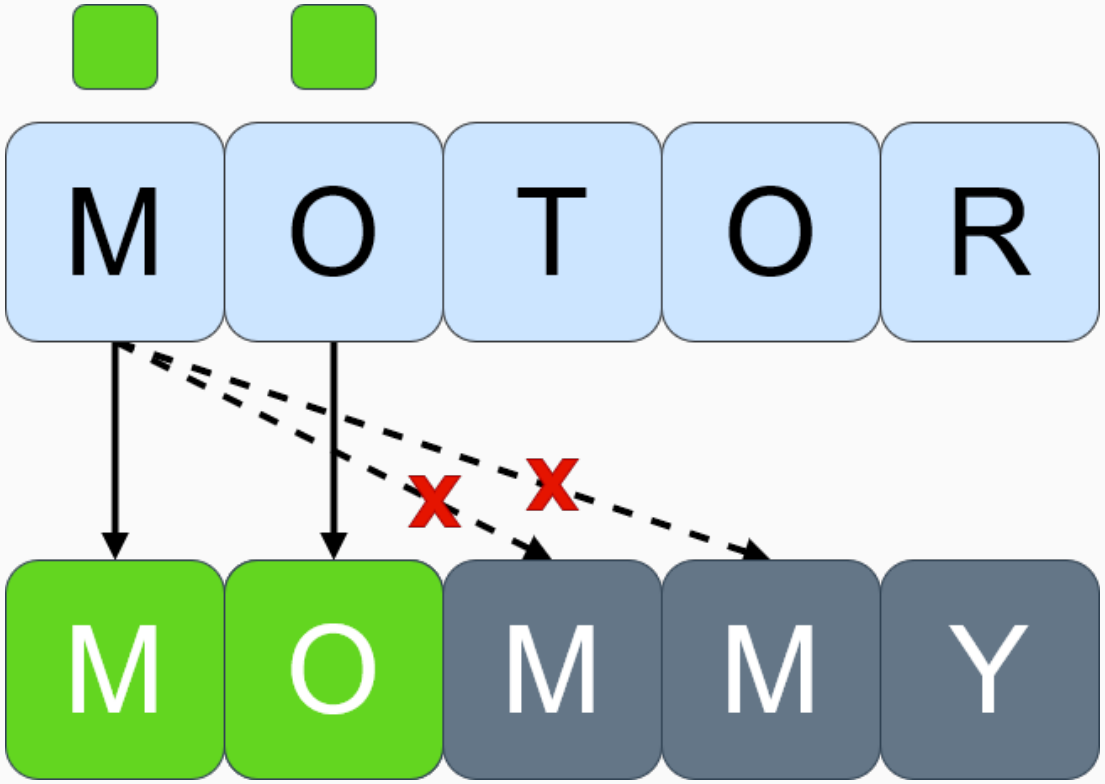
Case 6

Here: $n = 2,\ k = 1$



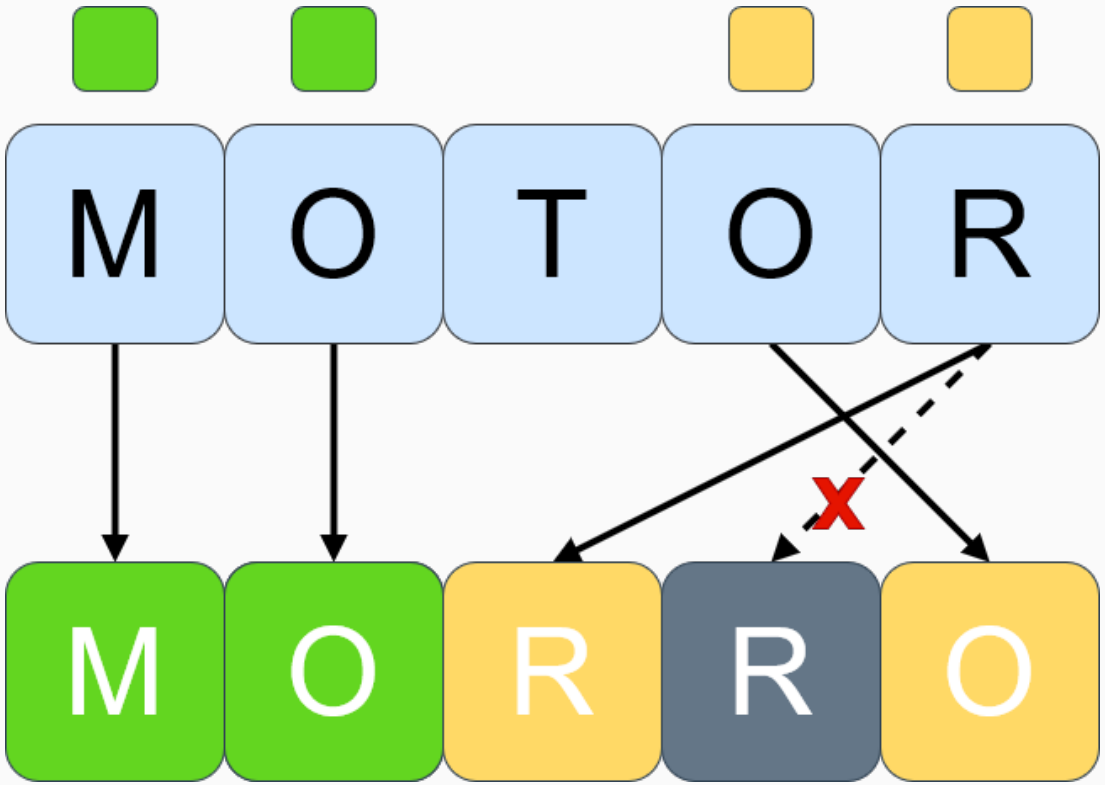
Case 7 (3 & 6)

Of course, we can again combine cases.



Case 8 (Idk, probably 1 & 2 & 3 & 4 & 5 & 6 & 7)

(I swear the word **morro** (span.) exists and is not just made up for demonstrative purposes!!!)



Case 8

Let's unpack this. In general:

- Correct characters have the highest priority, and always get marked as CORRECT first, before we mark WRONGPOS .
- For WRONGPOS , we always mark the first occurences.
- We only mark occurences of a character until the number of marks for that character is equal to the occurences in the word we have to guess.

Let's do it

(1) M O R R O We mark the correct characters.

(2.1) M O R R O We mark the characters at the wrong position, going from left to right.

(2.2) M O R R O We do not mark **R**, because it is already marked 1 time. ✗

(2.3) M O R R O

Case 9 (finally)

Every character is correct.

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Differences to Wordle

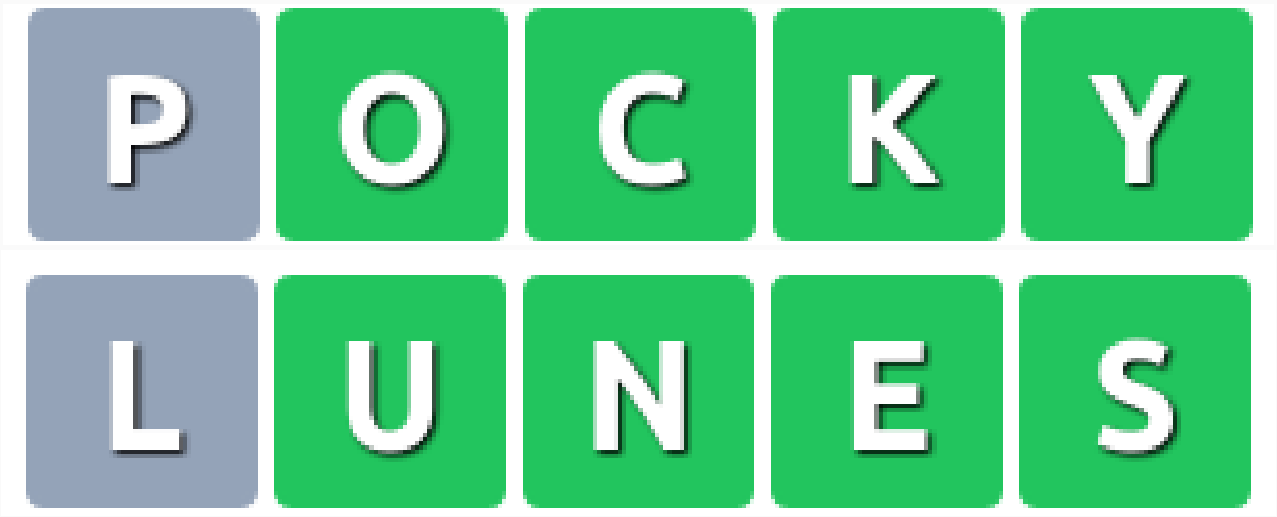
- 2 secret words instead of one
- The 2 secret words do not share letters.

States in Qwordle

- Letter occurences are checked for both words.
- If there are occurances from both words, we use quantum states.
- (Words are ROCKY AND DUNES)

Words are ROCKY and DUNES

- If there are only hits from one of the words, we use normal states.



Winning Qwordle

- We win the game if we guess **one** of the 2 secret words.

Summary Qwordle

Types of feedback in Qwordle:

1. A character is not present in both words (WRONG) ■.
2. There are only letter occurences from one of the words:
   - A character is in the wrong position (WRONGPOS) ■.
   - A character is in the word and at the same position (CORRECT) ■.
3. There are letter occurences from both words:
   - A character is in the wrong position (QUANTUMWRONGPOS) ●.
   - A character is in the correct position (QUANTUMCORRECT) ●.

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Trie

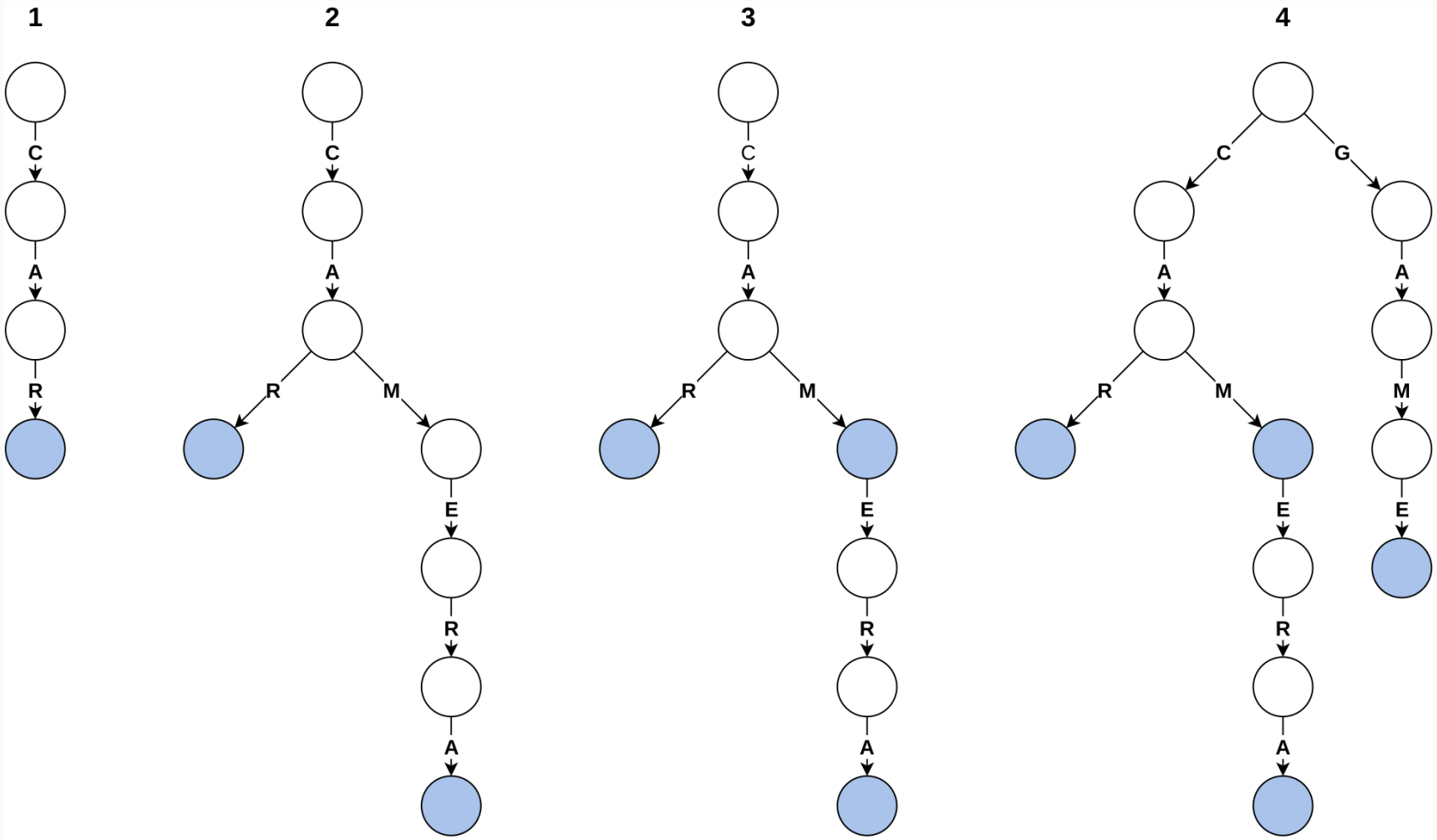


Figure 1: An example construction for a trie. The inserted words are CAR, CAMERA, CAM, and GAME. Find more explanation in the project description or the book

Give Feedback! - Use Enums!

What is an enum?

- special kind of data type defined by the programmer
- consists of integral constants

Why do we use enums?

→ useful to store constant values (e.g. weekdays, directions, wordle-feedback)

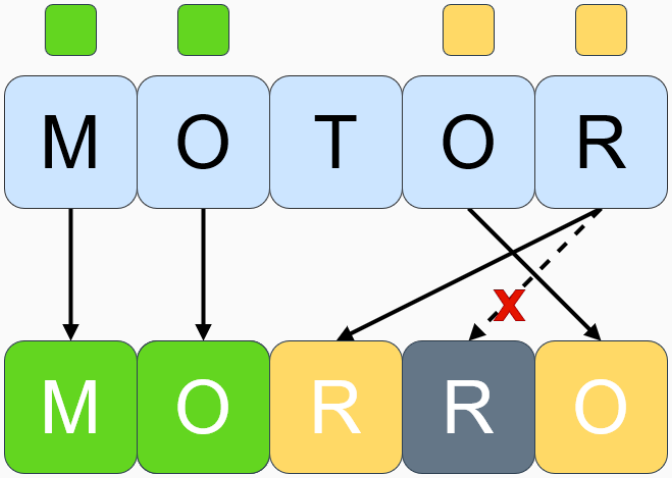
Enums

```c
#include "dict.h"

typedef enum {
    CORRECT,
    WRONGPOS,
    WRONG,
    QUANTUMCORRECT,
    QUANTUMWRONGPOS,
} feedback_result;
```

Figure 2: Code snippet found in wordle.h. It defines a new type which is called *feedback_result*. A variable of this type can only have 5 values: CORRECT, WRONGPOS, WRONG, QUANTUMCORRECT and QUANTUMWRONGPOS.

Example Feedback



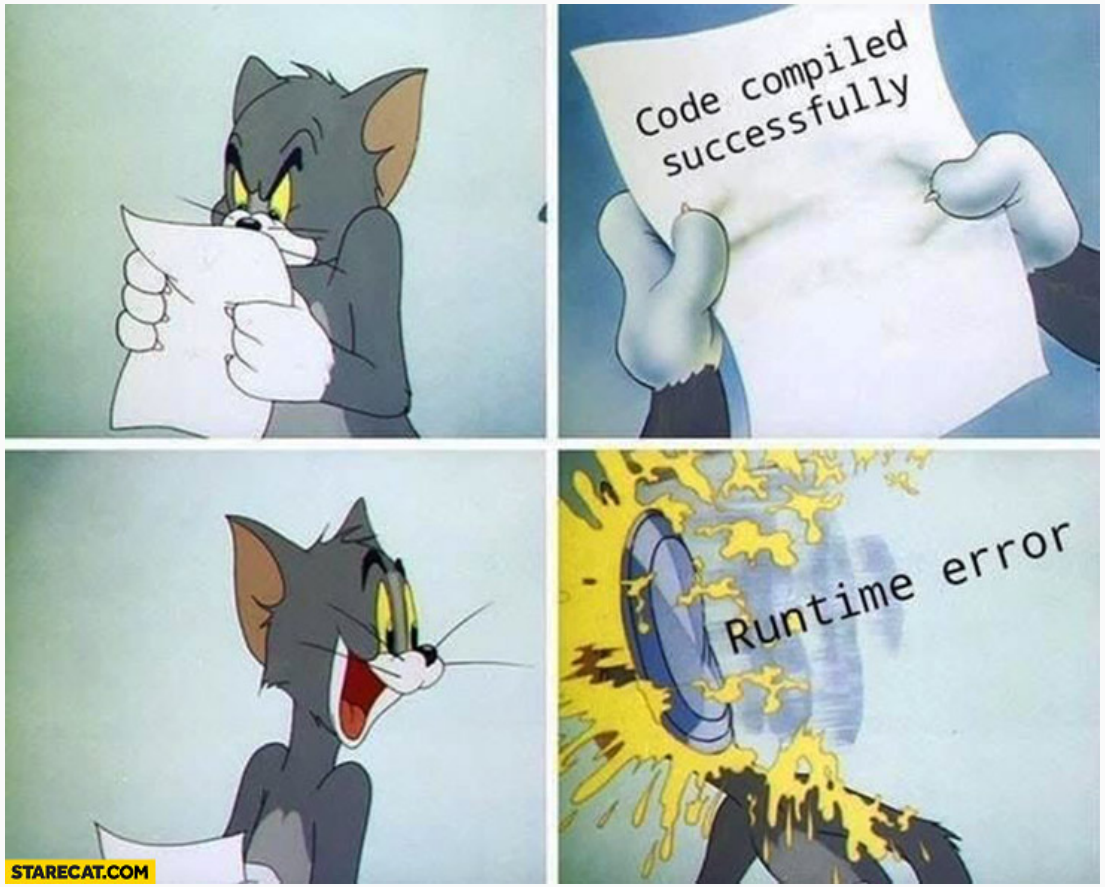

```
feedback_result* giveFeedback() {
    feedback_result* result;
    result = malloc(5*sizeof(feedback_result));
    result[0] = CORRECT;    // M
    result[1] = CORRECT;    // O
    result[2] = WRONGPOS;   // R
    result[3] = WRONG;      // R
    result[4] = WRONGPOS;   // O
    return result;
}
```

We can have an array of *feedback_results* and fill it with the values defined in the enum.

Linear Runtime

Your algorithm should run in time $\mathcal{O}(k)$[*] for a word of length k.

Linear Runtime



Linear Runtime

- The runtime is given as a function of the length of the input.
- Simple statements (e.g. logical or, arithmetic operations and assignments) need constant time: $\mathcal{O}(1)$.
- Repeating some program a **constant** number of times does **not** change the asymptotic runtime.

Linear Runtime

```
for (int i = 0; i < 10; i++) {
  //some statements which run in O(1)
}
```

10 is a **constant** $\rightarrow$ the program needs still constant time $\mathcal{O}(1)$ for this for-loop.

✓

Linear Runtime

```
for (int i = 0; i < k; i++) {
  // some statements which run in O(1)
}
```

k is a **variable** $\Rightarrow$ the program needs $k \cdot \mathcal{O}(1) = \mathcal{O}(k)$ time for this for-loop.

✓

Linear Runtime

```
for (int i = 0; i < k; i++) {
  for (int j = 0; j < k; j++) {
    // some statements which run in O(1)
  }
}
```

k is a **variable** $\Rightarrow$ the program needs $k \cdot k \cdot \mathcal{O}(1) = \mathcal{O}(k^2)$ time for this for-loop.

✗

Programmer's Rule:

We prefer a slow working code to a fast, buggy one.

Dummy Functions

The project will not compile, if you don't implement all functions which are declared in the .h files. You can handle this problem by writing "dummy functions".

```
int someFunctionInHeader(int arg1, char * arg2) {
    UNUSED(arg1);
    UNUSED(arg2);
    // the return type must match of course
    // some example defaults:
    // bool -> false
    // some pointer -> NULL
    // int -> 0
    return 0;
}
```

Tests and GUI

To run the tests, run:

```
$ make check
```

To start the GUI, run:

```
$ make
```

```
$ ./gui.sh
```

in the root directory of your git repository.

Code Style

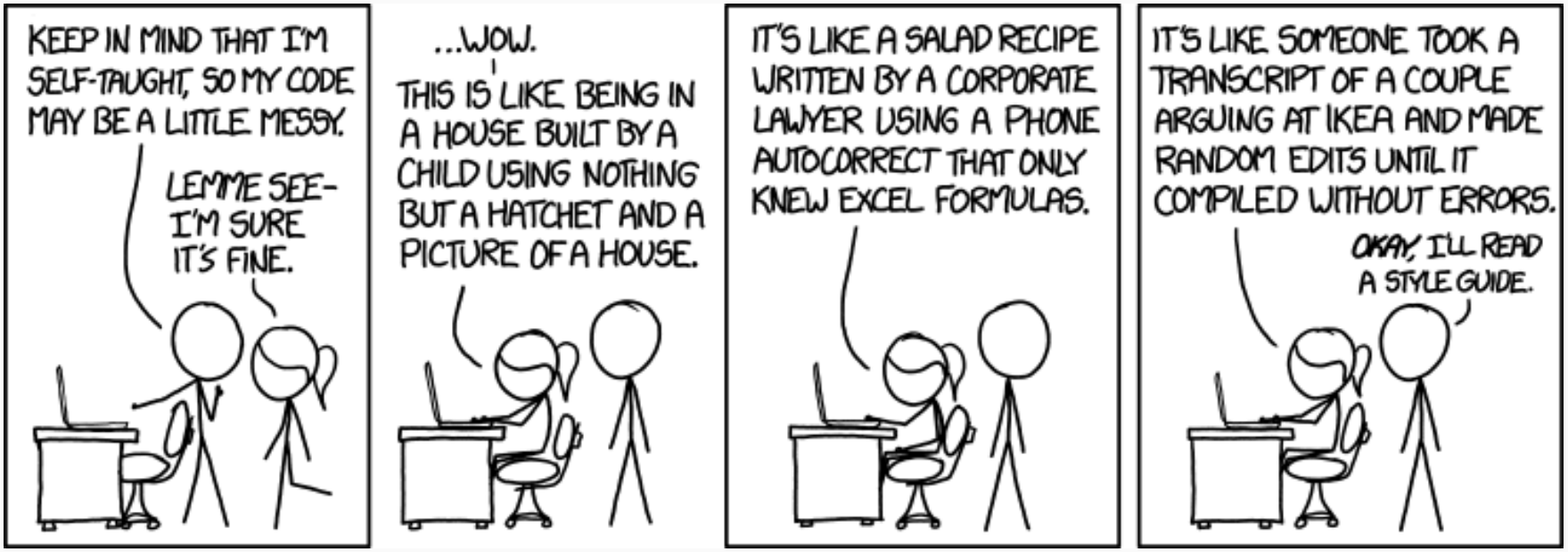


Figure 3: We want you to write sane, readable Code. Therefore, there is 1 point for following the style guide that we will provide you in the repository.

Useful VS Code Shortcuts

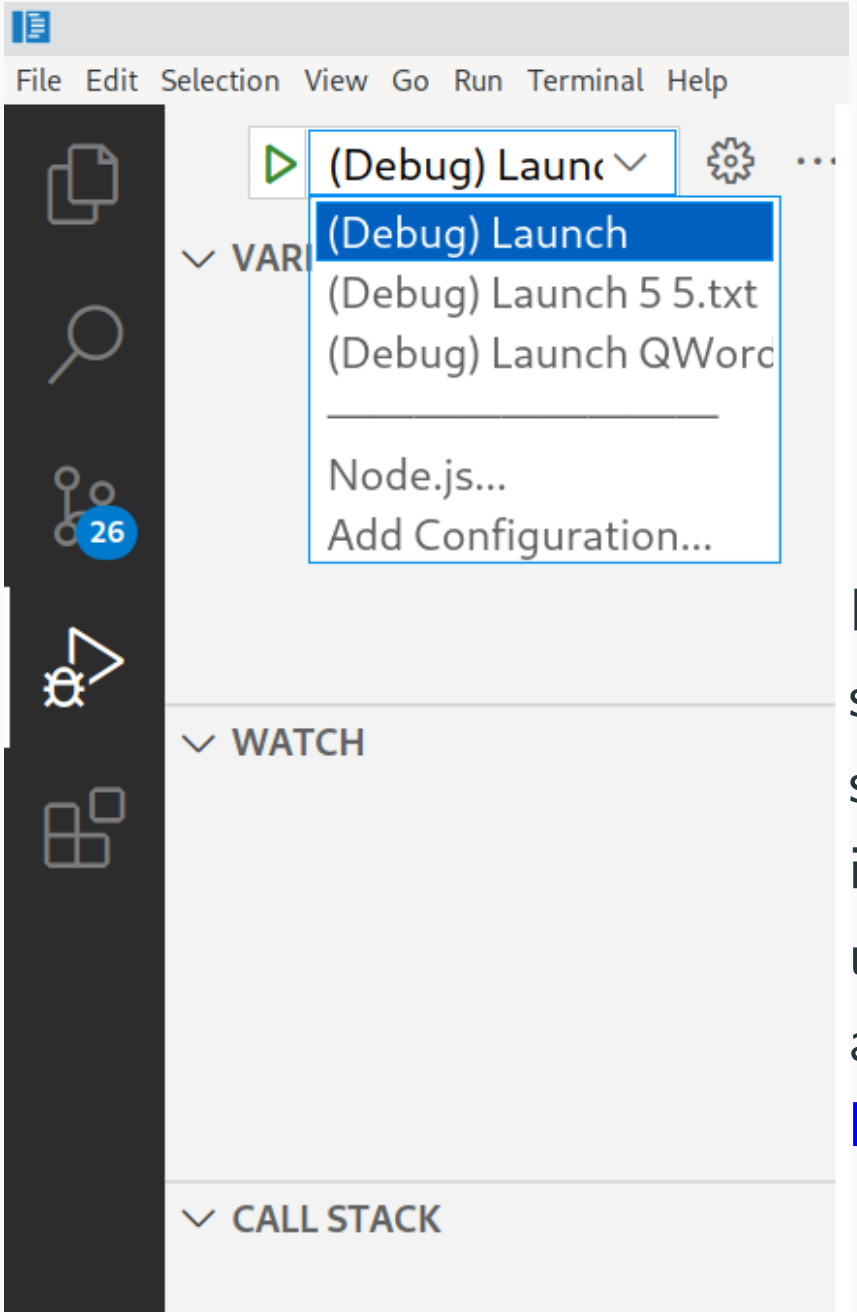
• Ctrl + K Ctrl + S	Keyboard Shortcuts
• Ctrl + Shift ⇑ + I	Autoformat
• Ctrl + Shift ⇑ + D	Run and Debug
• F5	Start/Continue
• Shift ⇑ + F5	Stop
• Ctrl + F	Find
• Ctrl + H	Replace

Debugging in VS Code

```
20        printf(
21            "
22            "de
23        exit(EX
24    }
25
26    // initiali
27    srand48(tim
28    int k = ato
```

Figure 4: By clicking on the bar next to the line numbers you can toggle breakpoints. During debugging the execution will stop here.

Debugging in VS Code



By using the run-and-debug-shortcut or clicking on the debug-symbol on the left side of the editor, you can choose your configuration and start debugging. For a more detailed explanation click here.

Questions?

If you have any problems, use the forum or come to the office hours!

Thank You All!