Human-Computer
Interaction Group

Leibniz
Universität
Hannover

Mobile Interaction
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Assignment 4

All exercises that are not explicitly declared as group tasks must be done individually and handed in individually. Identical submissions are treated as plagiarism. Plagiarism may lead to loss of exam bonus points.

You can submit the solution to this task in English or German until Wednesday, May 1, at 23:59 via https://assignments.hci.uni-hannover.de. Create a pdf file that contains the text and images of your solution, name it "Assignment-04-<Firstname>-<Lastname>.pdf", and save it together with the exported project (Android Studio: File → Export → Export to Zip File) in a single zip file. Your submission must consist of a single zip file containing all necessary files. The name of the .zip file, as well as the names of the contained files, **must not contain any umlauts.** Therefore, please resolve umlauts in file names.

Android Phones: Please let us know if you need an Android phone for the assignments. We can lend a limited number of simple Android phones for the duration of the semester. These must only be used for the assignments.

Exercise 1: ATOMIK-Keyboard Test-App (12 points)

This task is about mobile text input with the ATOMIK keyboard. Download the template MI-assignment-04-AtomikKeyboard.zip from Stud.IP and import it into Android Studio.

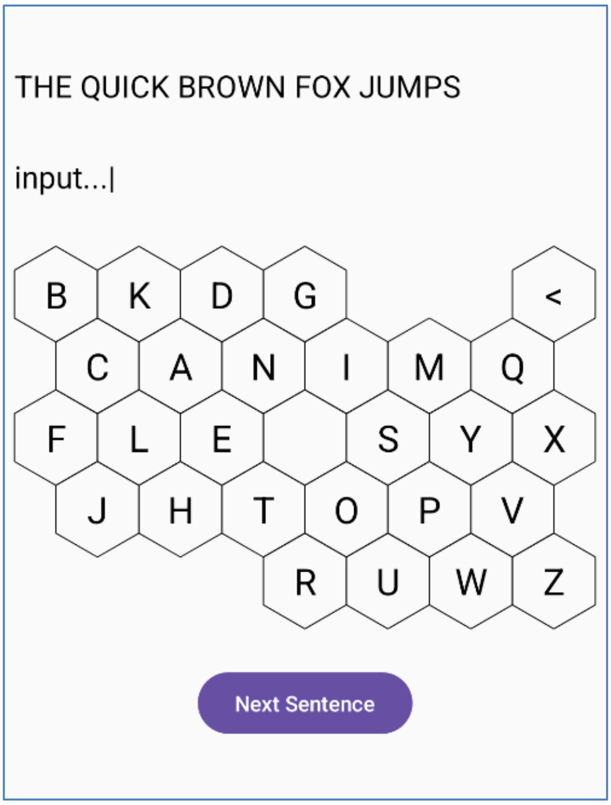
The app shows in a single column (from top to bottom): a target sentence to be copied, the input so far, the ATOMIK keyboard (with an additional backspace key on the upper right), and a button to advance to the next sentence. The task of the user is to copy the target sentence as quickly as possible.

The app logs each key press and "next" button press in a log file. Each input event generates a new line of semicolon-separated ASCII data. When the phone is connected via USB, the log file can be located using Android Studio via: Device Manager → (Your Device) → Open in Device Explorer → /data/data/de.luh.hci.mi.atomikkeyboard/files → double click: log<timestamp>.txt. The log data format for a key press is: KEY;sentenceIndex;keyPresses;character;input;timestamp

- sentenceIndex the index of the current target sentence
- keyPresses the number of key presses made for the current sentence so far
- character the symbol on the key that was pressed
- input the complete input so far for the current sentence
- timestamp timestamp (as returned by System.currentTimeMillis)

The log data format when pressing the "next sentence" button is:
END;sentenceIndex;sentence;keyPresses;input;editDistance;timestamp

sentenceIndex	the index of the target sentence that has been ended
sentence	the target sentence itself
keyPresses	the number of key presses made for the target sentence
input	the complete input for the target sentence
editDistance	the edit distance (Levenshtein distance [1])
timestamp	timestamp (as returned by System.currentTimeMillis)



THE QUICK BROWN FOX JUMPS

input...|

Example: If the target sentence is "THE" and it has been correctly entered, the corresponding lines in the log file will be:

```
KEY;0;1;T;T;1713936621978
KEY;0;2;H;TH;1713936623146
KEY;0;3;E;THE;1713936624974
END;0;THE;3;THE;0;1713936628503
```

In Exercise 2 (below) an experiment with different target sentences is to be carried out. They are displayed one after the other:

1) THE QUICK BROWN FOX JUMPS
2) MY LAZY DOG SLEEPS WELL
3) EAST WEST NORTH SOUTH
4) UP DOWN LEFT RIGHT

The procedure should be as follows: Sentence 1 is displayed. The user enters sentence 1. Corrections can be made using the backspace ('<') key. The user presses the "Next Sentence" button. Sentence 2 is displayed. The user enters sentence 2, and so on. Each sentence should be entered several times to get more robust statistics (mean or median). The input should be provided with the index finger of the dominant hand, while the other hand holds the device.

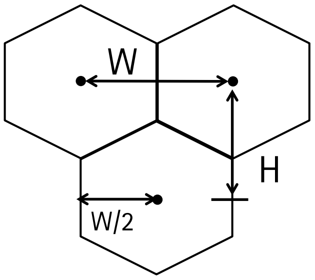
Answer the following questions.

a) What is the meaning of the line containing the word "portrait" in the Android Manifest and why is it justified for this app? **(2 points)**

b) In the view model class, why is "keyPresses" not defined as "mutableStateOf" as the other properties? Why are the other ones defined as "mutableStateOf". **(2 points)**

c) Explain the effect of the keys.map operation in MainActivity.kt. **(3 points)**

d) Each Row of the keyboard fills the available width. Explain how Modifier.weight settings are used to horizontally distribute the space and why this approach works for screens of different widths. Also consider the Key composable function in your explanation. **(3 points)**



e) Explain how the height of each Row is specified. **(1 point)**

f) Why is the Key composable an extension function of RowScope? What happens if "RowScope." is removed? **(2 points)**

[1] Levenshtein distance: https://en.wikipedia.org/wiki/Levenshtein_distance

Exercise 2: Experimenting with the ATOMIK-Keyboard (10 points)

Your task now is to evaluate mobile text input with the ATOMIK keyboard. This should be done in a self-experiment for repeated input of sentences. You should analyze the input speed, error rate, and learning rate. During the test, hold the mobile phone in one hand and type with the index finger of the other hand. Use the test app from Exercise 1 and carry out the following steps:

Block 1 – Enter sentences for 4 minutes.

2 minutes pause.

Block 2 – Enter sentences for 4 minutes.

Pause between 1 and 24 hours (this is important!)

Block 3 – Enter sentences for 4 minutes.

2 minutes pause.

Block 4 – Enter sentences for 4 minutes.

a) Calculate the input speed for each block (in wpm, assuming 5.7 characters per word). Use a spreadsheet program of your choice. Create a bar chart showing the average input speed for each block. Name the axes and bars so that the bar chart is easy to understand. **(4 points)**

b) Calculate the error rate for each block using the Levenshtein distance (edit distance). There is a function to compute the Levenshtein distance in the template. Create a bar chart showing the average error rates for each block. Name the axes and bars so that the bar chart is easy to understand. **(4 points)**

c) Is there a learning effect between the blocks? Justify your statement. **(2 points)**

Exercise 3: Material Design Research (8 points)

Research the Material Design Guidelines. At https://m3.material.io you will find the material design elements developed by Google with corresponding objectives and justifications.

a) What is typically meant by "navigation" in terms of material design? What types of navigation are there and what are their distinguishing features? For each navigation type, name a design component that can implement the navigation type. Refer to the references linked from the “Navigation” section in https://m3.material.io/components (except “Navigation Rail”, which is designed for larger devices), **(5 points)**

b) What is the purpose of the top app bar? Refer to https://m3.material.io/components/top-app-bar/overview. **(3 points)**