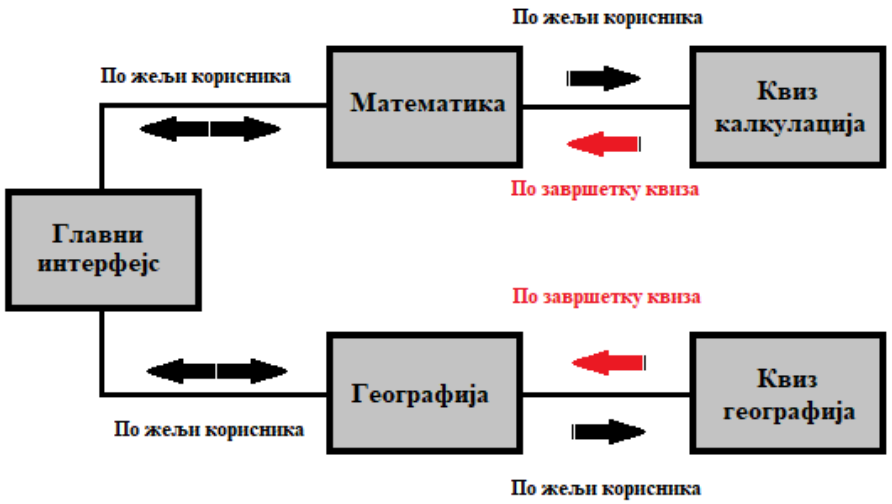
# 4.Mobile application development

The educational game for children Quizuma is intended for the development of children's knowledge in the field of basic operations of mathematics and the geopolitical map of the world. The user's knowledge is tested through a suitable quiz, where the user will learn from his mistakes. The game also provides fun through challenges and competition. The challenge brings a time limit to which the user must give the correct answer. When the user successfully completes the area, he will collect a certain number of points that are entered in the ranking list with other attempts, which encourages the user to compete.

## 4.1 Application user interface

The user interface of the application consists of a main menu, two interfaces for each area and two more interfaces where the quiz is performed. From the main menu, the user can access the math and geography interfaces. From the math interface, the user can return to the main interface or start a quiz in the calculations interface. As for the geography interface, it also works on the same principle as the mathematics interface. It is possible for the user to return from the geography interface to the main interface or to start the quiz in the geography quiz interface. Irrespective of which math operation is selected, the calculation interface will display the corresponding content, this also applies to the field of geography. When the user launches the interface containing the quiz, they will return to the interface area when the quiz is completed successfully or unsuccessfully. You can see a visual representation of the interface connection in the picture (Fig. 2).

In the figure, the arrows show possible access to the interfaces. The black arrows show




*Слика. 2 Везе интерфејса апликације*

where the user can access when he chooses to do so at any time, and the red arrows show the path the user can take only after completing the quiz.

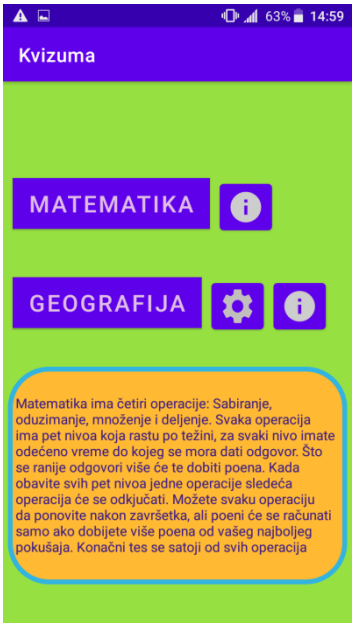
### 4.1.1 Main interface

The main user interface is displayed after opening the application. It is very simple as its primary function is to provide the user with a choice of areas. As for the secondary functions, in the main interface the user can access a short guide that contains the rules of the game individually by area and can set the weight for the geography area. (Fig.3)

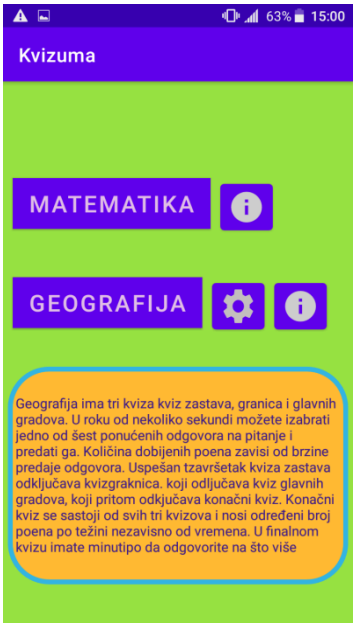
The user can access further interfaces by pressing one next to the button with the text


*Слика. 3 Главни интерфејс*

"MATHEMATICS" or "GEOGRAPHY". The explanation can be accessed by the user by pressing the button with a gray circle and a small Latin letter "i" engraved in the center. Depending on which area button a yellow box with the appropriate text will appear on the lower part of the interface, i.e. whether the information will be related to mathematics (Fig. 4) or geography (Fig. 5).



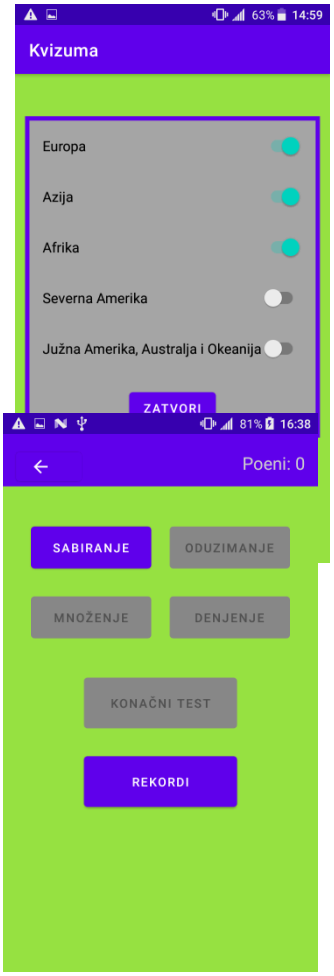

*Слика. 4 Главни интерфејс са објашњењем за математику*




*Слика. 5 Главни интерфејс са објашњењем за географију*

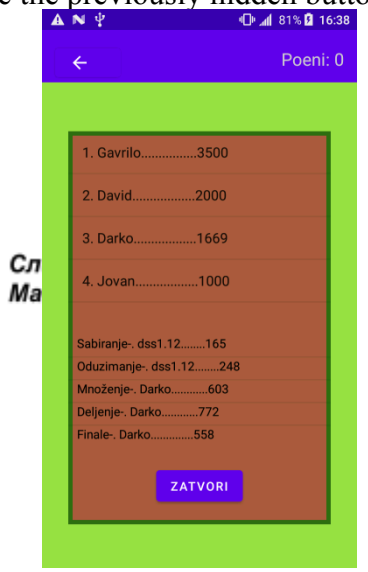
Next to the button to access the geography interface is another button. Pressing this button makes all other buttons disappear and a gray box with switches appears on the screen. Manipulation of these switches allows the user to remove or insert countries from the offered continents. Countries that have been dropped will not appear when the user starts the quiz. However, the number of points the user can get depends on the number of continents included or excluded. Fewer continents earn less points, more continents earn more points. At least one continent must be included for the user to access the geographies interface. The user can close this box with the "CLOSE" button located at the bottom of the box, after which the previously hidden buttons will appear. (Fig. 6)

### 4.1.2 Interface Mathematics




The Math interface contains seven buttons. Five of these buttons ("ADDITION", "SUBTRACTION", "MULTIPLY", "DIVISION", "FINAL TEST") will launch the calculation interface that will start the quiz, the operation in question depends on the button pressed. Depending on whether the operation is unlocked or not, the button changes color. Purple buttons are unlocked operations and gray buttons are locked operations and cannot be accessed by the user until they successfully complete a quiz with one of the unlocked operations. On the upper left corner there is a left arrow, with its help the user can return to the main interface. In the upper right corner is the user's current number of points. This number will change when the user scores points on the math quiz. (Fig. 7)

By pressing the "RECORDS" button, a box with records appears, i.e. a table with the name and number of points. This window has two such tables, the top table shows the records of the total points won by the user in all operation quizzes, the rank and the name entered by the user after the end of the quiz. Here the user can register only after completing the final test. This table shows all registered users regardless of rank or number of points, the table can be scrolled if there are too many registered users. The table below contains the records of the highest number of points won in the specified operation. Here, the user can enter only when he wins more points than indicated in the table for the specified operation. At the lower end of the box there is a "CLOSE" button that will hide the record box and restore the previously hidden buttons for selecting operations. (Fig. 8)




***Слика. 8 Рекорди Математика***

A record entry box may also appear on this interface. This box appears when the user completes a final test or breaks a previously set record in operations. In this box the user can enter

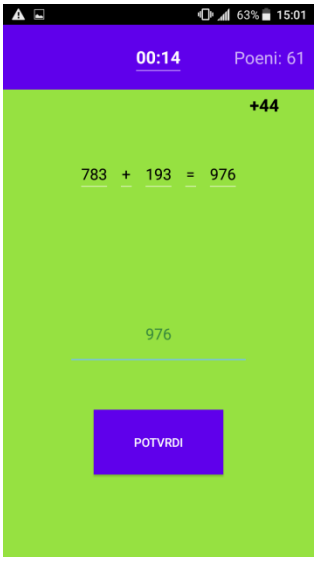

***Слика. 9 Кутија за упис новог рекорда***

his name in the light green rectangle after which he can press the "CONFIRM" button to enter his record and proceed further. In addition, this box displays the text of what the user has achieved

below the congratulatory text and also displays the new number of record points. The entered name and number of points can be found in the records immediately after confirmation. (Fig. 9)

### 4.1.3 Interface Calculation

After the user selects one of the available operations in the Math interface, it will close and the calculation interface will be displayed in its place. In this interface, a quiz is conducted. The quiz starts automatically, immediately after the user has chosen an operation. At the very beginning of the upper part there is a purple rectangle, it shows the time left for the user to give his answer and the number of points the user has earned in the current attempt. Below this element is the equation. The equation consists of two randomly generated numbers. The size of the number depends on what weight the user reached in the attempt. The operation in the middle of two randomly generated numbers changes depending on which operation is selected. The result line is blank until the user enters their answer. When an answer is entered, true or false, the correct answer to the equation will appear here. The user enters his answer on the line above the "CONFIRM" button. Pressing this line will open Android's built-in numeric keypad for the user to enter their answer. By pressing the "Done" button on the bottom right corner of the keyboard, the user can close the keyboard and confirm their answer by pressing the "CONFIRM" button below the answer entry line. Depending on whether the answer is correct or incorrect, the text "TRUE" or "FALSE" will appear in the middle, and in case the time runs out, the text "TIME IS OVER" will be displayed in the same place. Correct answers give points, when the number of points increases, the animation of increasing the number of points is performed. The number of points won appears and decreases while the number of points increases. When the number of points won reaches zero, it is




lost when generating the next equation. (Fig. 10)

When the time expires or when the user confirms an incorrect answer, the interface closes after a few seconds and the Mathematics interface opens again, and the points the user has gained in that attempt until then are deleted. The interface also closes when the user successfully answers five equations, in which case the points the user earned on the previous attempt are added to the current number of points in the Math interface. In the final level, it is possible to answer twenty equations and incorrect answers or running out of time do not delete the earned points but interrupt

the quiz. The user can track the number of answered equations in the upper left corner of the interface in the final level.

### 4.1.4 Interface Geography

The Geography interface is similar to the Math interface. It consists of six buttons and the number of total points. However, this interface also has six indicators attached to the bottom of the purple rectangle. These indicators are used to show the user which countries from the displayed continents will be on the quiz. The indicator is a silhouette in the shape of a continent. When the continent is omitted, the silhouette will not glow and will be black. In case the continent is not omitted, the silhouette on the indicator will light up in green. Which countries of the continents will be in the quiz can be set in the main interface, which the user can return to from the Geography interface at any time by pressing the left arrow button in the upper left corner.

Starting the quiz and switching to the Geography Quiz interface can be done using the buttons labeled "FLAGS", "BORDERS", "MAIN CITIES" or "FINALS". Each of the mentioned buttons leads to a different quiz, more about the types of quizzes will be in the description of the Geography Quiz interface. As in the Math interface, not all quizzes will be unlocked, but the user should unlock them one by one by successfully completing the previous quiz. (Fig. 11)

As for the "" button, it does the same as in the Math interface, only it shows different data.


*Слика. 11 Интерфејс Географија*

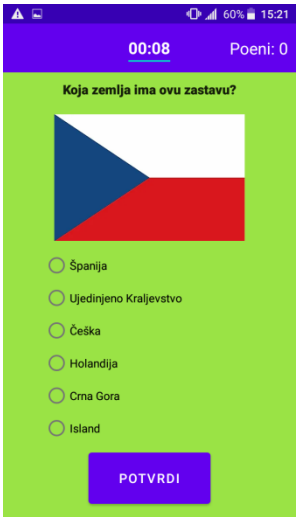
The record box also consists of two tables. The table above shows the total records of users in the discipline Geography. The table below shows users with successful attempts in which they collected the highest number of points from all previous attempts by quiz type. (Fig. 12)


***Слика. 12 Рекорди Географија***

It should also be mentioned that the Geography interface has its own record input box that functions and looks exactly the same as the record input box in the Mathematics interface (Fig. 9). The only difference is that the Geography interface has a different achievement description than the Mathematics interface.

### 4.1.5 Geography Quiz interface

When entering the Geography Quiz interface, the previously selected quiz type from the Geography interface is automatically launched. The interface contains a timer that shows the time for which the user must give an answer, the number of points won on the current attempt, a text with a question, an image relevant to the type of quiz, six radio buttons containing text with possible answers and a button to confirm the answer. (Fig. 13)

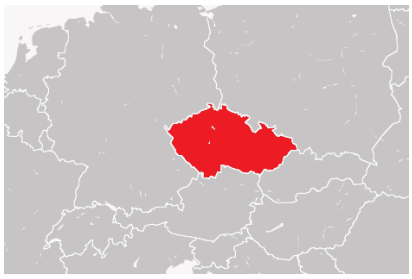



***Слика. 13 Интерфејс Географија Квиз***

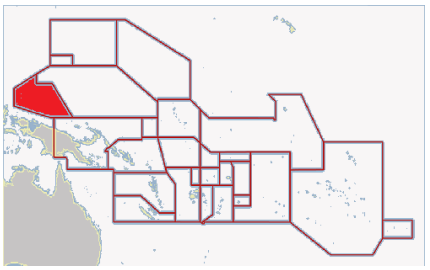
The text with the question in the flag quiz type does not change, this is not the case with the image. The image changes after each response confirmation. The image will show the flag of the country and below the image is a group of six radio buttons. In this group there is one answer that answers the question, namely the name of the country whose flag is shown in the picture. Other names are randomly selected as well as the arrangement of all buttons, this is the case with all other

types of quizzes. After each confirmation, a new country is randomly selected and a new flag is displayed. The same land will not appear twice in the same attempt. The user has successfully passed the quiz when they get twenty correct answers in a row before the time runs out.

In the border quiz type, the same question is asked for all countries. The user should recognize the country whose borders are shown in the image. The picture shows the borders of the country on the map, the country in question is marked in red and the other countries are gray, while the borders are marked with a white line (Fig. 14). This is the case for all countries unless it is a chain of islands, in which case the image shows the area in the ocean where the islands are located, if the islands are too small to be shown on the map. (Fig. 15)



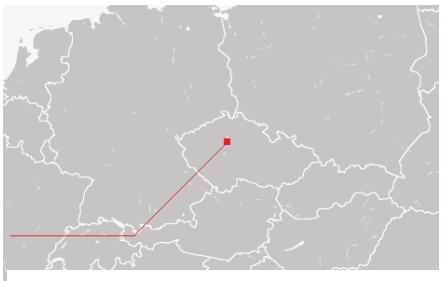
Слика. 14 Приказ границе



Слика. 15 Приказ области

The third type of quiz is the capital city quiz. The question text gives the name of the country and asks the user to provide the name of the capital city for the particular country. The picture shows the same picture as with the borders, except that the country in question is not marked in red, but the location of the country's capital is marked with a red square. Next to the red square there are two lines that are connected to the square. These lines help the user to find the location of the capital faster in case the square is too small. (Fig. 16) A group of radio buttons shows the names of randomly selected state capitals instead of state names in this type of quiz. Also the user must submit ten consecutive correct answers to pass the quiz instead of twenty. In addition, the user is given a little more time and more points for correct answers. The previously mentioned differences were implemented due to the much higher difficulty of this type of quiz compared to the previous two.

Finale works differently than other types. The user is given one minute and thirty seconds to



Слика. 16 Приказ главног града земље

answer as many questions as possible. The questions are chosen randomly from the three previous types ie countries, borders and capitals. Incorrect answers do not return the user to the previous interface, but the quiz continues until the time expires and points are deducted, unlike the final test in the Mathematics section.

When the user gives the correct answer, a new text appears in the place of the question, in green color that reads "TRUE!", the text is present until the next question is asked. In addition, the

text of the radio button of the correct answer will light up in yellow and the animation of adding points will be played, just like in the Calculation interface. Incorrect answers will display the question text in red and read "INCORRECT!". Also, the text of the correct answer radio button will light up in yellow, while the incorrect answer chosen by the user will be red. After an incorrect answer or timeout, the user is automatically returned to the Geography interface and his points won in an unsuccessful attempt are not included in the total number of points. This is not the case only in the final type of quiz.

## 4.2 Functioning of the application

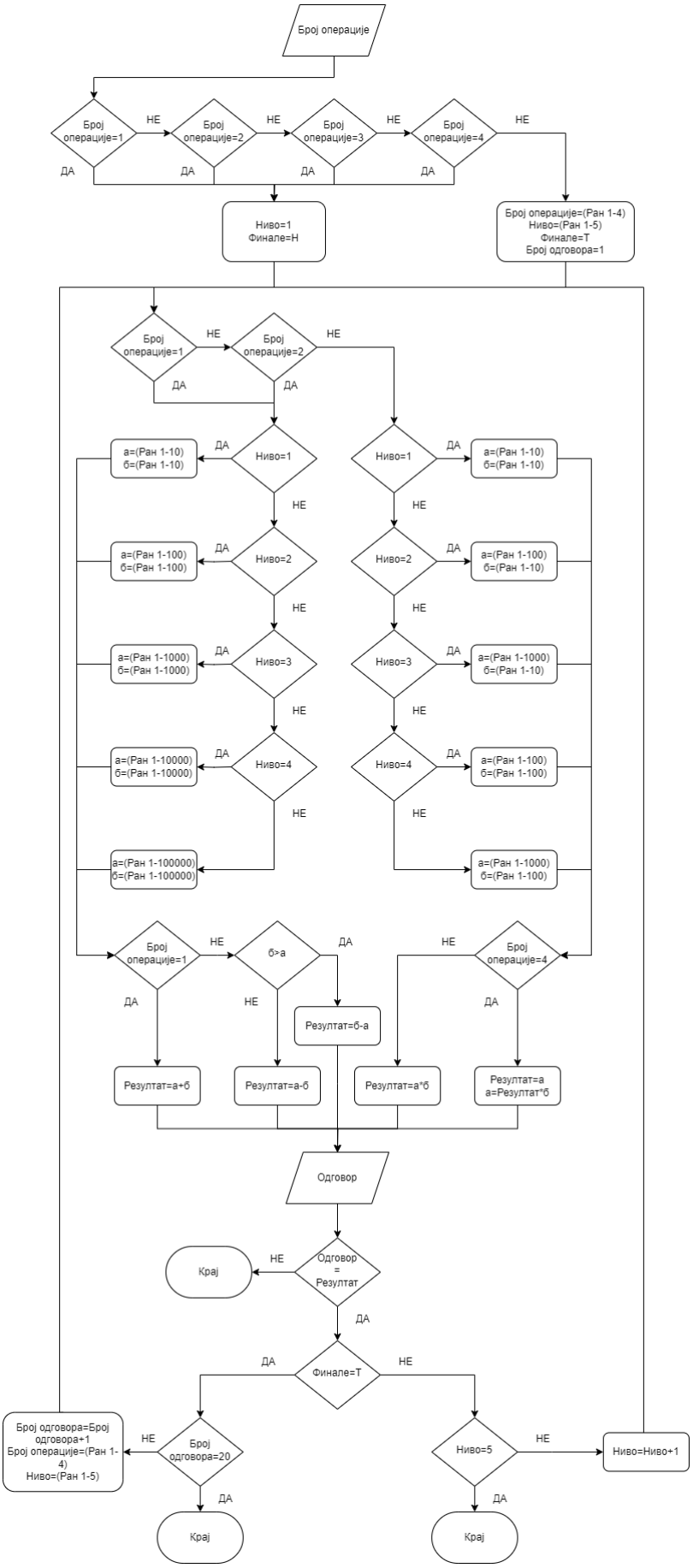
In this chapter, some of the more complicated functionalities that appear in applications are described. Some of the functions that have been described relate to the generation of equations in the field of mathematics, the allocation of points in the field of mathematics and geography, the selection of questions in the geography quiz and others. For each of the mentioned functions, a flow algorithm will be drawn, which will be described in detail. The aim of this is to give the reader insight into how the application achieves the desired results. If a function has some process that affects only the interface, that part will be omitted from the algorithm.

### 4.2.1 Generation of equations

In the field of mathematics, at the beginning of the quiz, it is necessary to generate an equation. The user selected one of five "Operations", which were represented by a number from one to five (1-Addition, 2-Subtraction, 3-Multiplication, 4-Division and 5-Final test). This number is called "Operation number" in the diagram (Fig. 17). If any operation other than the final test is selected, the Level parameter is assigned a value of one.

In the second case if the "Operation Number" is five, it is changed to a random(in the diagram "Ran" in parentheses means a random number between and including the two specified numbers) a number from one to four, this is also the case with the parameter "Level" only which is border number five instead of four. Also, with the help of the "Finale" parameter, it is marked whether the final test is selected with the letter "T", for other cases it is marked with the letter "N". Since the "Operation Number" parameter changes, it is necessary to memorize what the user has chosen. The "operation number" changes because the final level consists of all operations. The last parameter "Number of answers" measures the number of correct answers that the user gave during the final test.

The next step is to choose the two numbers that make up the equation. It is necessary to check which operation is in the state. Addition and division generate a random number between the same limits, if these operations are not involved, a random number is generated between other choices of limits shared by the multiplication and division operations. This difference is implemented to balance the weight of the generated equations. Before generating equation numbers, it is necessary to check the "Level" parameter. The higher the level, the harder the equation should be, this is achieved by adding digits to the number of the equation. The first equation number is stored in the "a" parameter, and the second in the "b" parameter.




**Слика. 17 Алкоритам тока генерисања једначине**

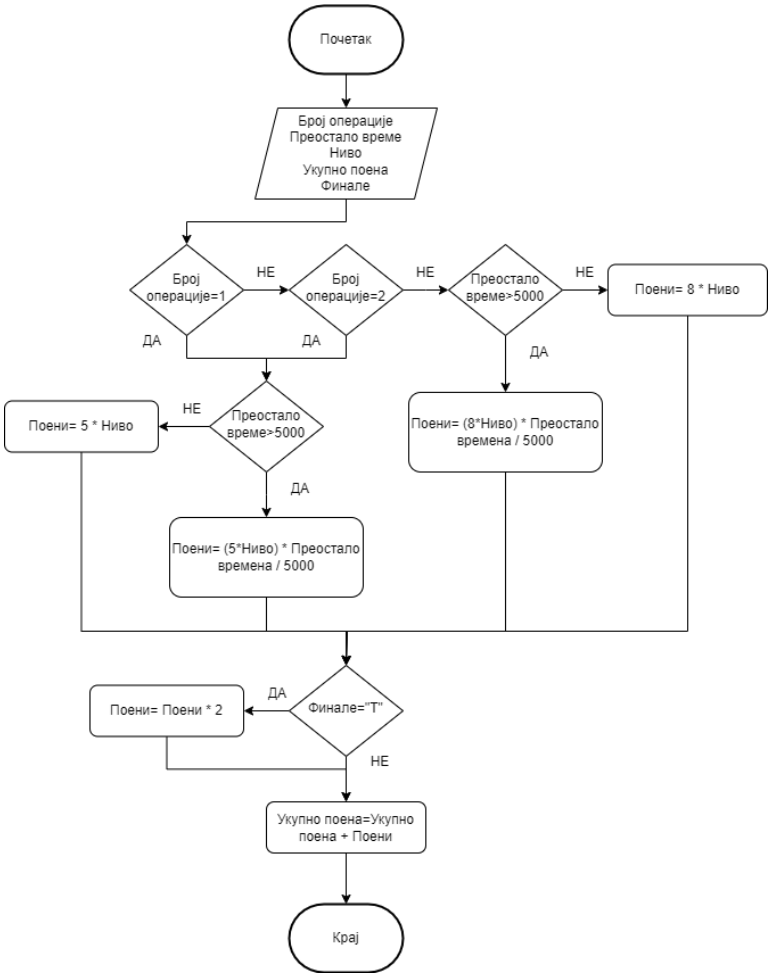
It is necessary to check the "Operation Number" again in order to calculate the correct result of the equation. After checking, a value is added to a new parameter called "Result", the value is sum, difference or product. In case the operation is subtraction, it is necessary to check which number is larger and calculate the result depending on it, so as not to get a result with a negative number. As for division, the "Result" parameter is given the value of the generated number "a", while the product of the generated number "b" and the "Result" which took the original value of the generated number "a" is assigned in its place. This way the user will not have to deal with decimal values in the quotient of the equation.

The application asks the user to enter their answer to the equation, the answer value of that answer is stored in the "Answer" parameter. The given user response is compared to the value of the "Result" parameter, if they are not equal this function ends. When the user gives the correct answer, the program checks whether this is the final test. If it is not a final test, i.e. the value of the "Finale" parameter is "N", the program performs the following: checks whether the user has just given the correct answer at the last level, (that is, whether the value of the "Level" parameter is equal to the number five), if if it is the last level, the function ends, if it is not the last level, the user moves to the next level and the generation of equations is repeated from the second check of the operation number. In case the test is final (the "Finale" parameter has the value "T"), it is checked whether the user has successfully answered twenty equations, if this is the case the function ends, otherwise the "Number of answers" counter is increased by one and re-generate random numbers for "Operation Number" and "Level", repeating the generation of equations from the second operation number check.

### 4.2.2 Allocation of points in mathematics

The scoring function is triggered when the user enters the correct answer to the equation. At the very beginning of the algorithm (Fig. 18) you can see the values that the function uses. Most of these values are defined in the equation generation function (Fig. 17). The "Total Points" parameter is used to store the number of points the user has won during the quiz attempt, and the "Time Remaining" parameter has the value of the time left before the timeout in milliseconds.

At the start of the function, the "Operation number" defined at the beginning of the quiz is checked. The addition and subtraction operations are separated from the multiplication and division operations because they have a different formula for calculating points. There are two formulas for each of the listed operation groups, a formula that does not use the remaining time and a formula that uses the remaining time. Which formula will be used depends on whether the user has more than five seconds left when he gave the answer, that is, if the "Time Remaining" parameter is greater than five thousand. The timeless formula is the product of the level with the number five or the number eight if it is a multiplication or division operation. The formula with time multiplies the product of the level with the number five or the number eight by the quotient of the value of the "Time Remaining" parameter by five thousand, which is rounded up. The only difference between the formulas from the two groups of operations is the replacement of the number five with the number eight, as mentioned previously. This difference serves to reward the user more for more difficult operations.



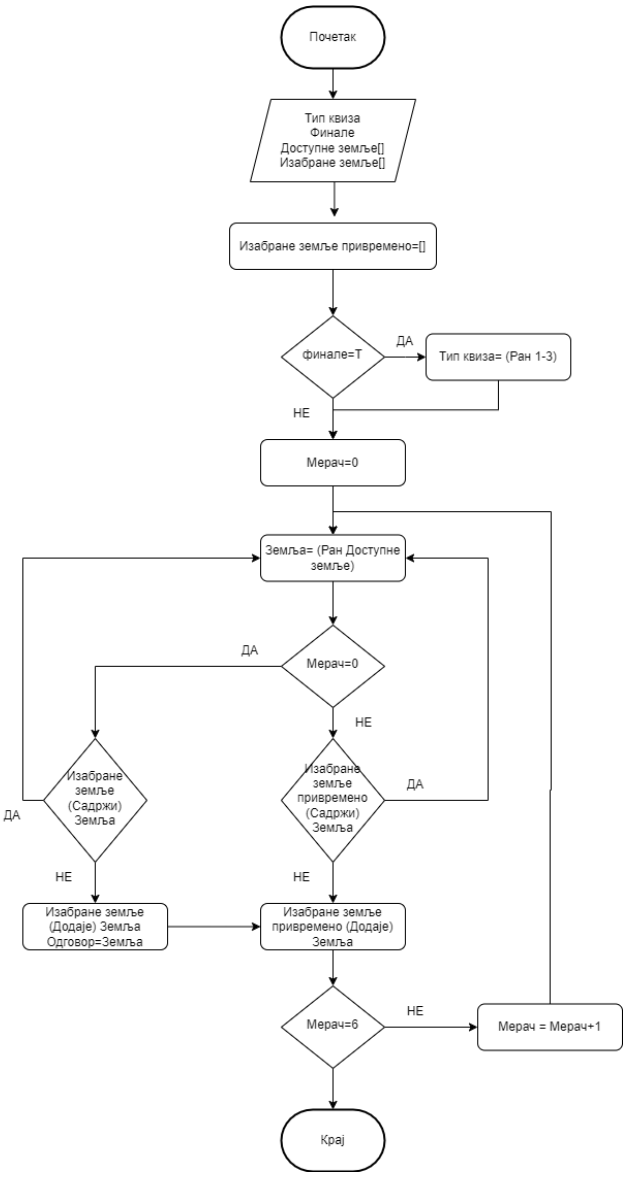

***Слика. 18 Алгоритам тока додељивања поена у математици***

After the number of awarded points is calculated and stored in the "Points" parameter, it is checked whether the user has selected the final test with the help of the "Finals" parameter. If it is the final test, the number of points won is doubled. In both cases, at the end, the value of the "Total Points" parameter is increased by the value of the "Points" parameter, after which the function ends and/or a new equation is generated.

### 4.2.3 Selection of countries in geography

This algorithm (Fig. 19) covers only the country selection function and does not show how the answers are distributed by radio buttons or which country attributes are selected for display, because even if this function determines the parameters that affect the mentioned characteristics, they affect, mainly, to interface changes not covered in this chapter. Regardless of this, it will be briefly explained how it affects the rest of the program.

The "Available countries" parameter is a list of countries that have a set of their attributes (country name, identification number, border image, flag image, capital image, and capital name). This list includes only those countries that are in the selected continents. "Quiz Type" is a number from one to four used to identify the selected quiz type by the user (1-Flags, 2-Borders, 3-Capitals, 4-Finals).




***Слика. 19 Алгоритам тока за избор земаља у географији***

The "Selected Countries" parameter is a list that will store the countries selected as a question. This list serves to avoid asking questions for countries that have previously appeared in the attempt. While the parameter "Selected countries temporarily" stores only those countries that are selected for the question and serves to prevent the user from being offered more than one answer to the question.

The function further checks if the user has selected the final quiz in order to assign a random value to the quiz type and thereby randomize the question type after each answer confirmation. After that, the "Meter" parameter is assigned a value of zero. Since the user is offered six possible answers, the "Meter" serves as a recorder of the number of selected countries.

The "Country" parameter temporarily stores the attributes of one of the offered countries from the "Available Countries" list. On the algorithm in parentheses is "Ran", as a random value from the list. With the help of a meter, it is checked whether this is the first iteration, in order to determine the first selected country as a question (that is, that the question is related to that country). In order not to repeat the same country in the same attempt, it is checked whether a

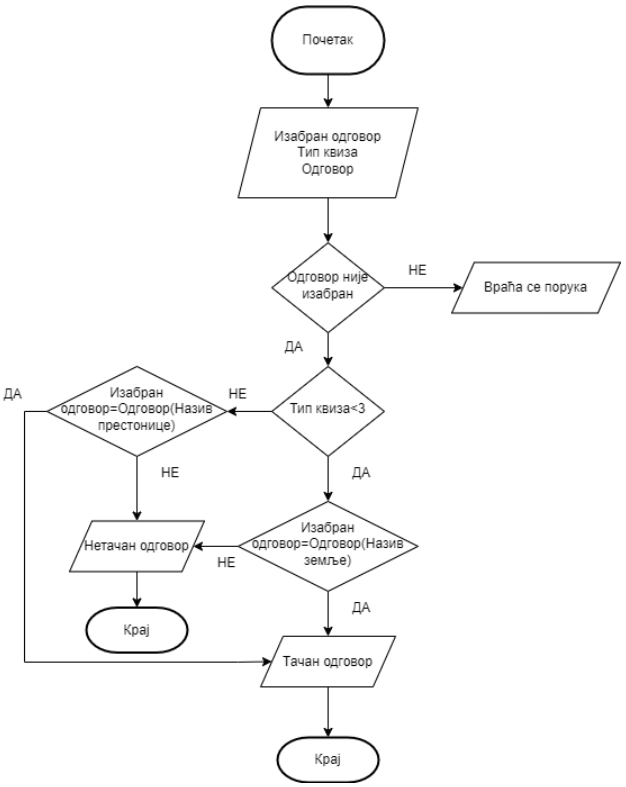
randomly chosen country is in the list, if so, a new country is chosen and checked again until a new country appears. When a new country appears, it is added to the "Selected countries" list. This country is also remembered in the "Answer" parameter, because already in the next iteration the "Country" parameter will be replaced. From the "Answer" parameter, the attributes of the country from which the question is asked and the answer checked are extracted. After that, the country is added to the second "Temporarily selected countries" list, so that the same country is not repeated in the remaining iterations.

The iteration is measured with the help of the "Meter" parameter, if it has not reached the number six, the previous process is repeated and the meter is increased by one. The process is repeated from the selection of the country from the list of offered countries ("Available countries"). If it is not the first iteration, it is checked whether the selected country exists in the "Temporarily selected countries" list, if it is repeated, a new one is generated, if not, it is inserted into the same list.

In each iteration, the corresponding attributes are drawn for the selected country and randomly arranged radio buttons in the offer interface as responses. When the process is repeated six times, ie when six countries are selected, the function ends.

### 4.2.4 Checking answers in geography

To check the answers, the function needs the values of the "Answer selected" and "Quiz type" parameters. The "Selected Answer" parameter carries the value of the country attribute for the corresponding question, as the answer, and that value is taken from the text of the radio button selected by the user before pressing the confirm button. If the user did not choose any of the offered answers, a text message is returned, as shown in the algorithm (Fig. 20).




***Слика. 20 Алгоритам тока провере одговора у географији***

Next is the quiz type check. For the first (Flag Quiz) and the second (Border Quiz) type of quiz, the name of the selected country is requested as an answer, and for the third (Capital Cities Quiz), the name of the capital is requested. So it is necessary to separate them and define which attribute of the selected country the program should compare with the selected answer. The attribute of the selected country is extracted from the "Answer" parameter of the previous algorithm (Fig. 19)

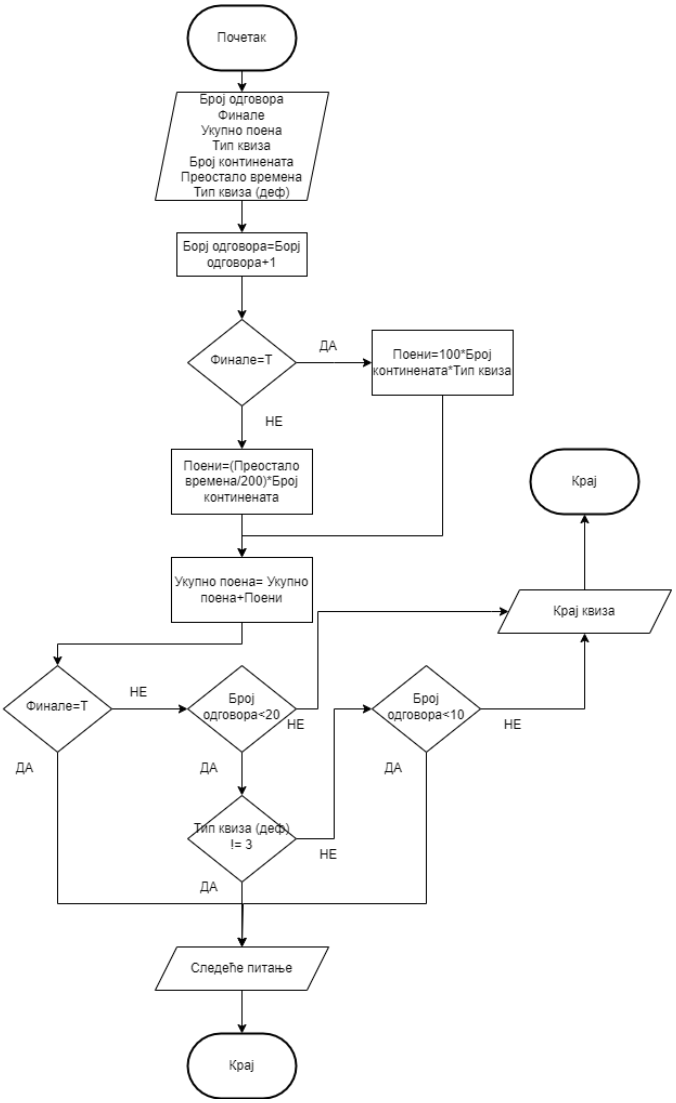
For the first two types of quizzes, country names are compared, while for the third one, capitals are compared. If the "Selected answer" and the corresponding attribute of the selected country in the "Answer" parameter are different, the function for the incorrect answer is fired, otherwise the function for the correct answer is fired, and in both cases this function terminates.

### 4.2.5 Correct answer for geography

Whenever the user gives a correct answer to a question, this function is triggered, and ends with the end of the quiz or the generation of a new question. On the algorithm (Fig. 21) it can be seen that this function uses many parameters determined by other functions. Most of these parameters you've already seen in past algorithms, except for the "Number of Continents" and "Quiz Type (def)" parameters. The "Count of continents" parameter contains the number of all continents selected by the user. In more detail, if two continents are included in the quiz, the value of that footmeter will be two, and the same for continent numbers up to five. As for the "Quiz Type (def)" parameter, the quiz type identification number is the same as the "Quiz Type" parameter, which has been mentioned several times in past function explanations so far. What differentiates them is that the "Quiz Type (def)" parameter does not change during the entire attempt, and the "Quiz Type" parameter changes in the final quiz as you can see in the flow algorithm for selecting countries in geography (Fig. 19) . In parameter "(def)" is short for definitely.

The "Number of Answers" parameter is incremented by one, because a correct answer has just been given. After that, the number of points the user will receive is recalculated. In the case of the final quiz, the user will receive one hundred points multiplied by the number of continents and the identification number of the quiz type. Otherwise, the formula for awarding points is the product of the number of continents and the quotient of the number of two hundred times the remaining time. The more continents in the quiz, the more difficult the quiz will be for the user, because he should know more countries and therefore should get more points. As for the quiz type ID, it is in the formula because the quiz types are progressively more difficult, so the user will get more points in the final quiz if they fail a harder question type. The formula for the final quiz is not time-dependent, because the user's goal is to answer as many questions as possible, correctly, in one minute and thirty seconds. The time in the final quiz is not reset after each answer, as in other types of quizzes. After the amount of points is calculated, it is added to the "Total Points" parameter, which measures how many points the user earned during the attempt.

In the final type of quiz, the quiz should continue until the time runs out so that answering the questions will not affect the completion of the quiz. With other types of quizzes, the attempt ends when the user repeatedly gives the correct answer to a certain number of questions. For the "Flag" and "Border" quizzes, the user needs to give twenty correct answers, and for the "Capitals" quiz only ten, because it is more difficult than the others.




***Слика. 21 Алгоритам тока тачног одговора за географију***

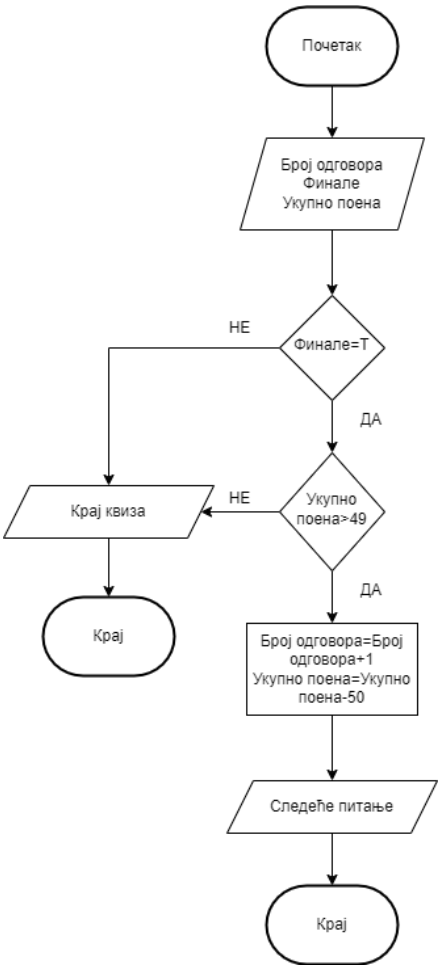
Before the end of this function, a new country selection function is started, if none of the quiz completion criteria are met. In this function, at the end of the quiz, collected information about the user's attempt about the number of points collected is sent to the part of the program that manages the Geography interface.

### 4.2.6 Incorrect answer for geography

This functionality, in addition to the process shown in the algorithm (Fig. 22), affects the interface more. All the parameters it uses are already known, "Number of answers", "Finals" and "Total points". It is activated every time the user gives an incorrect answer during a quiz, regardless of the type of quiz.

An incorrect answer will terminate the quiz for all quiz types except the final quiz. In the final type of quiz, fifty points are deducted from the user. In the event that the user does not have more than forty-nine points, the user is not deducted points, in order not to accumulate a negative value of points. So the "Total Points" parameter should be greater than the number forty-nine. Also, in the final quiz type, the "Number of answers" parameter is increased by one, so that other functions work correctly in the final quiz type.

Finally, a new country selection feature is released in the final level. This is because the final type of quiz, as previously mentioned, only ends when the user's predetermined time runs out, regardless of the answers.




***Слика. 22 Алгоритам тока нетачног одговора за географију***

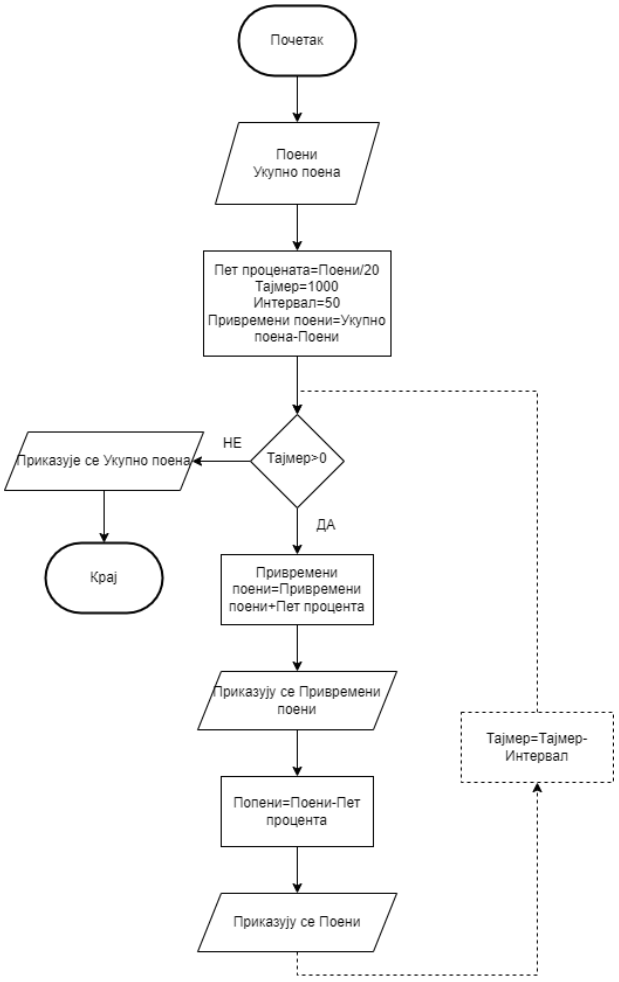
### 4.2.7 Point change animation

By now you should be familiar with the parameters used in the previous flow algorithms. So I can cover the function, which is the part of all functions where the total points are changed. The purpose of this functionality is mainly related to changes in the interface, but it is more complicated than others, such as changing the color of the text.

The "Points" and "Total Points" parameters are required for this function to work correctly. These parameters occur in past flow algorithms so their possible values are already known. A new parameter "Five percent" is created, which is the quotient of the parameter "Points" and the number twenty, which is five percent of the collected points. Furthermore, the values of the "Timer" and "Interval" parameters represent milliseconds, and what they are for will be explained later in the course. A new "Temporary Points" parameter is also created, the purpose of which is to carry the value of the "Total Points" parameter. The animation needs a number to contain the change in total

points to display, but it's safer to leave the Total Points parameter unchanged to avoid adding points with decimal numbers.

Until the timer expires, the following process is performed. Five percent of the accumulated points are added to the temporary points, after which it is displayed on the interface. In the same way, at the same time, five percent is deducted from the collected points and displayed on the interface. This process is repeated two hundred times in one second every fifty milliseconds, which is shown in the algorithm (Fig. 23) as a dashed line and the difference between the "Timer" and "Interval" parameters.




***Слика. 23 Алгоритам тока анимације промене поена***

When the timer expires, the value of the "Total Points" parameter is displayed on the interface, instead of the "Temporary Points" parameter, after which this function ends. The reason for this is the already mentioned risk of changing points in decimals. Because the only reason for this function is aesthetic, it is not necessary to display the exact value during the animation, but an approximate one. In order not to display wrong information to the user, it is best to display the correct, predefined value on the interface at the end of the animation. The "Total Points" parameter is added to the value of the "Points" parameter before starting this function, as you can see in the past algorithms.

### 4.2.8 Impact of functions on the interface

Because the impact on the function interface is mostly omitted in the algorithms, this section briefly states what the aforementioned functionalities change in the interface.

**Generating the equation:**

- Sets the solved equations counter in the final test and increments it
- Changes operators and values in an equation
- Terminates the current interface and opens a new one
- Starts a timer
- Displays the message "You have not entered an answer", if the user has not entered an answer

**Allocation of points in mathematics:**

- Animation adding points
- Change the color of the text with the suggested solution for the problem to green or red
- Stops the timer
- Shows and hides the correct answer to the equation
- Empty the line for the proposed solution for the components, for the new equation

**Selection of countries in geography:**

- Change text in radio buttons
- Changing the image
- Changing the question text with a new question
- Starts a timer

**Answer check in geography:**

- Displays the message "You did not enter an answer", if the user did not select an answer

**Correct Answer for Geography:**

- Change the question text to "TRUE!" with green color
- Changes the text color in the radio button with the selected answer to green
- Stops the timer if it is not the final quiz
- Animation adding points
- Returns all colored text to black
- Terminates the current interface and opens a new one

**Incorrect answer for geography:**

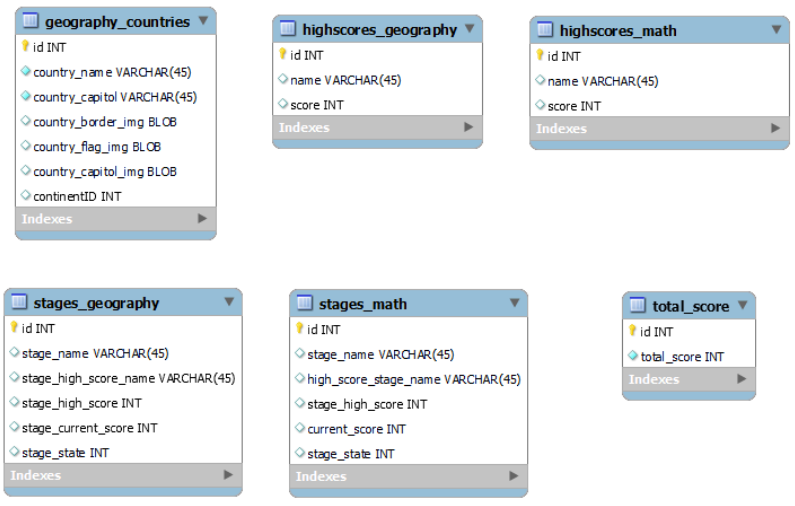
- Change the question text to "FALSE!" with red color
- Changes the text color in the radio button with the selected answer to red
- Changes the text color in the correct answer radio button to green
- Stops the timer if it is not the final quiz
- Point subtraction animation
- Returns all colored text to black
- Terminates the current interface and opens a new one

## 4.3 Application database

The application uses a "SQLite" database. This database comes with the android operating system, so it is easy to use for developing android mobile applications. This database contains data on the states used in the geography quiz, availability of geography or math operation quiz types, score records for all users, and data on the user's progress through the quizzes.

### 4.3.1 Structure and content of the database

The structure of the database is very simple. There was no need to connect the tables as you can see in the picture (Fig. 24). The entry of new data is done automatically, and the existing data is used mainly for display and all can be simply transferred to the application.




*Слика. 24 Структура базе података*

The "geography_countries" table contains the most data. It stores data on one hundred and ninety-three countries in the world. This data is used in a geography quiz, where the name of the country name ("country_name") and the name of the capital ("country_capitol") are offered as

answers. The flag image ("country_flag_img") appears in the flag quiz and was taken from the "WorldAtlas" site[6]. An image with borders ("country_border_img") appears in the borders quiz, and an image with capitals ("country_capitol_img") in the capital cities quiz. Images of capitals and borders are edited from a map clip on the website "Snazzy Maps"[7]. All these images are in "BLOB" format, because that is the only format that "SQLite" has that can be read by an android application. Each country contains its unique identification number ("id") with the help of which the application selects the country for the quiz. Each continent has its own identification number ("continentID"), with the exception of Australia and South America due to the already mentioned reason of the insufficient number of countries in the mentioned continents. With the help of the identification number of the continent, the user can choose a group of countries that will appear during the quiz.

The next two tables, "highscores_geography" and "highscores_math", carry data about user records. The data is used to display the discipline records of geography and mathematics. The record has its identification number ("id"), a column for storing the user's name ("name") and a column for storing the total number of points ("score") that the user has won. The user enters new data into these two tables when he completes the final quiz or final test.

The tables "stages_geography" and "stages_math" also share the same purpose. They contain data on a specific type of quiz in geography and data on operations in mathematics. This refers to the data with which the program remembers whether an operation or quiz type is unlocked ("stage_state") and remembers the user's best attempt in all operations ("current_score") and quiz types ("stage_current_score") to know whether and how much points to add in case of retry. The mentioned tables also have the data displayed on the records, namely the name of the user who set the record ("high_score_stage_name" - for mathematics, "stage_high_score_name" for geography) and the number of points of the best attempt ever ("high_score_stage" - for mathematics, "stage_high_score" for geography). Both tables have data where the name of the operation or quiz type is specified for easier identification ("stage_name"). The user does not add anything to the data in this table, but only changes the existing data. The availability data of the quiz type or operation is changed when the user successfully completes the quiz type or operation. The value of this data is in numerical format, it can be one or zero, in the program these numbers are translated into exactly as one and false as zero. Best attempt points are not shown to the user, they change when the user scores more points than are in the table for the corresponding quiz type or operation and when the user completes the final quiz or final test, then that value resets to zero. As for the data displayed in the records, the user changes it when he wins more points than in the table for the specified quiz type or operation and when he enters a new name.

Finally, there is the table "". With its help, the user's total number of points for each discipline is saved. Identification number (""), can have values of one or two. The unit lets the application know that it is looking for data for mathematics, and as for the two, for geography. The number of points saved changes when the user successfully completes the quiz and adds new points and when the final quiz or final test is completed.

### 4.3.2 Implementation of the database in the application

In order for the application to be able to provide useful data from the database, it is necessary to install the database together with the application. Android studio can create its own database if we define appropriate SQL commands for it. However, if we want to use the existing

database, it is necessary to copy it to the appropriate directory. In the fun children's game Quizum, this is achieved with the help of Java's "input/output stream" which copies the file data to a given location. Copying is done when the application requests access to the database, the first time after installation.

In the application program, there is a whole, separate class, which is used for the communication of the database with the rest of the application and the already mentioned copying of the database to the device. Communication is done by calling class methods as needed. Each method contains a corresponding SQL command, which will take some data from the database, change some data or add new data. Here I will list those methods, where they are used, what data they manipulate and when they are used.

- **Set a new record**: This method uses a custom recordset class with record information, such as name, rank, and number of points. The number of points earned by the user and the name of the user are inserted into the database as a new record. It is used when the user completes a final quiz or final test, and enters a name and presses the confirm button on the interface. This method, like all other methods, has two different SQL commands for mathematics and geography, determined by a separate parameter.
- **Download all records**: Gets all the data from the record table for the selected discipline. The name of the record and the number of points are stored as the previously mentioned set of records, and the method assigns them a rank based on the number of points. All record sets are stored in a list and from that list are displayed on the record table (as in Figures 8 and 12). The method is invoked whenever the user presses the view record button.
- **Compare the points**: Compares the points the user earned in a successful attempt of a quiz or operation type and returns true if so. It is used when the user successfully completes a quiz, so that based on the results, he can open a part of the interface to enter a new record for the corresponding quiz type or operation. It does not change the data in the database, but only takes the number of points set as a record for the corresponding type of quiz or operation.
- **Set new records**: Sets a new record for quiz or operation types, by changing the number of points of the previous record and the name of the user who set the record. The method is used when the user presses the name confirmation button, on the new record entry window, before which the user must enter his name. Existing data is modified using this method.
- **Change the current number of points**: This method will take the user's current number of points for the quiz type or operation and compare it to the number of points the user received when completing the corresponding quiz type or operation. Based on the results of comparing the methods in the database, change the current number of points. If the number of points obtained is not greater than the number of current points in the database, nothing happens, if it is, the current number of points in the database is changed to that number obtained. It is used every time a user successfully completes a quiz. The method also returns the difference between the

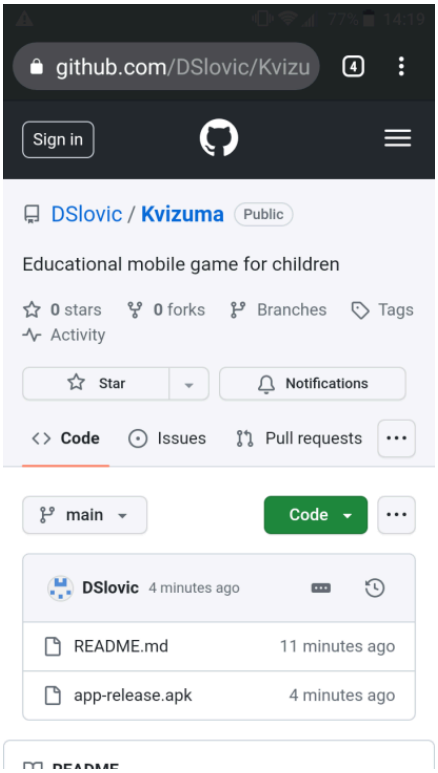
current number of points from the database and the points received by the user. The difference is used when adding points to the total number of points. This quiz feature exists so that the user can attempt to set a new quiz record even if they have previously completed it and unlock the next quiz, while rewarding them for each better attempt.

- **Refresh the current number of points**: Changes the current number of points to zero. Used when the user completes a final quiz or final test. This will allow the user to be correctly scored on the next round of quizzes (a new round of quizzes starts after each final quiz or final test).
- **Download all quiz records**: Gets all point numbers and record names of operations or quiz types from the database and stores them as a set of records in a list. The name of the quiz is set instead of the rank. The contents of the record set list are displayed in the records table. The method is used when the user presses the button to display the record.
- **Download the total number of points**: Retrieves from the database the total number of points the user has earned, for the respective discipline. The downloaded value is displayed on the math (Fig. 7) or geography (Fig. 11) interface. It is used every time the mentioned interfaces are accessed. With the help of this method, the user's total number of points will be remembered even if he leaves the application.
- **Change the total number of points**: Changes the total number of points in the database to a new value, for the corresponding discipline. It is used on every successful completion of a quiz, where the user has won more points than the current number of points in the database and when the user completes the final quiz or final test and enters his record, this value changes to zero.
- **Download accessibility quiz**: Gets the accessibility value of the requested quiz, from the database. The retrieved value can be one or zero, which in the same method translates to true if it is one or false if it is zero and returns that value. It is used for each quiz individually, except for the first quiz which is always available, when accessing the mathematics (Figure 7) or geography (Figure 11) interface. If the method returned true, the quiz access button will be enabled, otherwise it will be disabled and the user will not be able to start that quiz.
- **Change quiz accessibility**: Changes the accessibility value of the quiz in the database to zero or one. It is used on the first completion of quizzes in a round, except for the final quiz or final test where the user must first enter their record before the method is used. This allows the user to unlock the quiz upon successful completion of the quiz and reset upon completion of the quiz round.
- **Take over the lands**: Retrieves all country attributes from the database based on the provided identification number. The retrieved data is stored as a state set, which is a special class consisting of a set of all attributes that can be found in the database. It is used every time a country is selected during the quiz, i.e. every time a question is asked.

- **Download available countries**: Returns the list of identification numbers of countries from the database, which have the identification number of the continents, selected by the user. It retrieves only country identification numbers from the database. The numbers in this list will be randomly selected as the identification number of the country, whose attributes are downloaded in the database. Only used when entering any geography quiz.

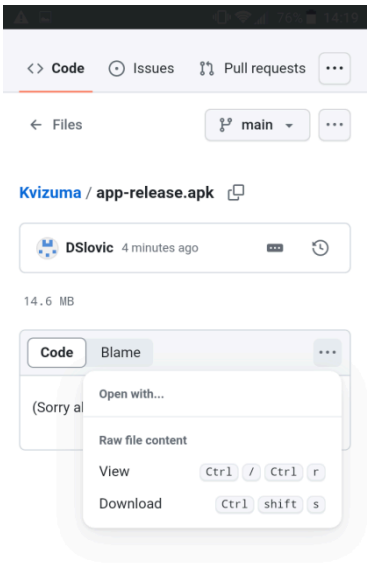
# 5. Download and development of the mobile application

The installation process is simple. First, you need to download the "APK" of the application. The "APK" can be downloaded from my "GitHub" page (Fig. 25) at this link (https://www.github/DSlovic/Kvizuma.com). On the page you need to select the file "app-release.apk", which leads to the page where you can download the "APK" file.



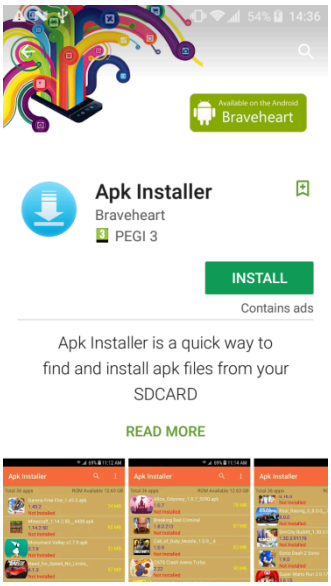

*Слика. 25 "GitHub" страна апликације*

Next, on the new page, click on the button with three dots in the box that should contain the contents of the file ("GitHub" cannot read this format, so an error message is displayed) and select the option "Download" as shown in the image ( Figure 26). To download this file, you need about fifteen megabytes of free space on your device. If your device opens a message before downloading or during installation about the security or insecurity of the files, you just need to confirm in the message that you want to continue. The installation of the educational game for kids Quizuma does not contain any malware or any form of program that can harm your device, so it is safe to download. Additionally, in case you get an insecurity message that requires you to change something in the options, temporarily turn off those security options until you finish installing the app. After installation, don't forget to turn these security options back on.




***Слика. 26 страна са фајлом за преузимање***

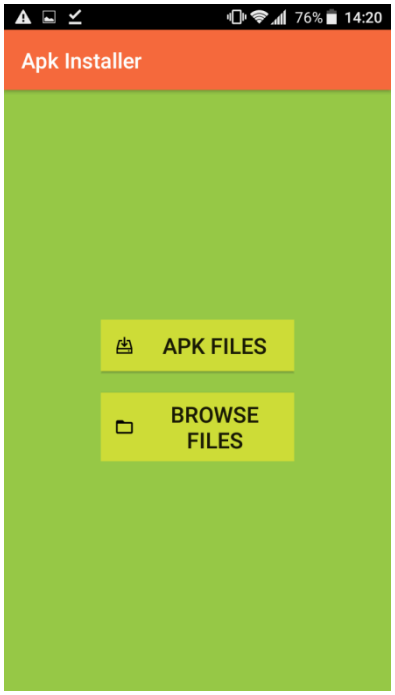
After you have downloaded the file, an installer is needed to extract the contents. There are multiple "APK" installers for android on google play store, any of them should work. If you do not have an "APK" installer, it is recommended to install the "APK Installer" from the company "Braveheart" on the Google Play Store (Fig. 27).



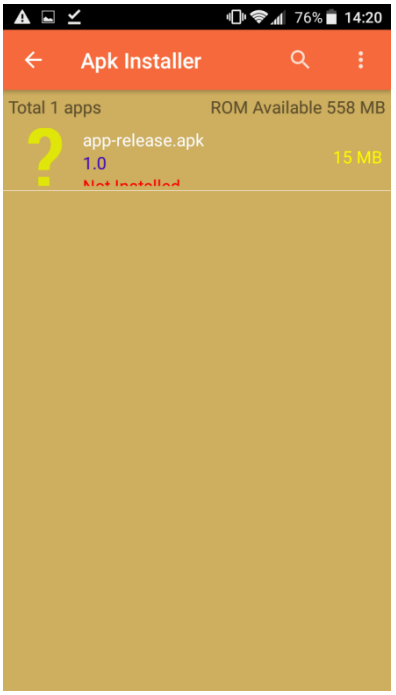

***Слика. 28 "APK" инсталер на гуглової плеј продавници***

After downloading the application to install the "APK" files, everything is ready to install. The next step is to open the application for installing "APK" files and select the "" option (Fig. 29). The installer will automatically scan your device for "APK" files and display the files it finds. In this case, if you have successfully downloaded the "APK" file from the "GitHub" side, the installer will list the downloaded file. Select the file with the yellow question mark as in the picture (Fig.

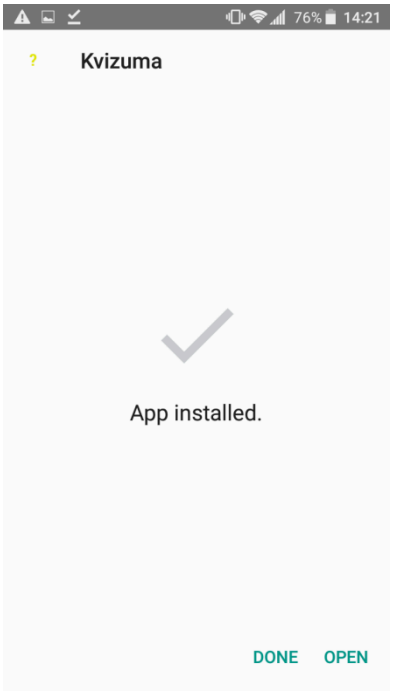
30). If the program has been successfully installed on your device, a message will appear as shown in the picture (Figure 31), after which you can start the application. Also, an icon with a yellow question mark should appear on the device wall.




*Слика. 29 Опције инсталера*




*Слика. 30 Доступни фајлови*




*Слика. 31 Успешна инсталација*

**Disclaimer**: This document is translated by google translate from serbian so the grammar is bad. It took weeks to make it in the first place. I am not going to spend weeks going over every word and remaking every image so that in the end no one sees it. I hope someone sees it, that is the reason I am posting it and writing this… message… I guess. Hoewer, from my experience so far, no one is looking. Therefore my lack of effort is justified.

[6] https://www.worldatlas.com/countries

[7] https://snazzymaps.com/style/56225/grey-style-without-country-names