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SOLUTION STRATEGIES OF NON-ROUTINE PROBLEMS AND CONVERTING SOLUTION WAYS TO GENERALIZED ALGORITHM DIAGRAMS

MODULE 1

Erasmus+

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WHY IT WAS NEEDED?

The primary goal of education is to train individuals who can solved the problems that may face.We believe that the primary goal of education is development of students problem solving skills. We live in an age when information and communication technologies, which social change and development are gaining momentum, affect every moment of human life.New knowledges, opportunities and tools re-shape our mathematical point of view , our expectation from mathematics, the way we use mathematics, and most importantly our mathematics learning and teaching processes.. Together with technological developments, today's world is faced with new problems that previous generations have not encountered. Weare needed more than ever to individuals who valued mathematic, who developed mathematical thinking power, who can use at modelling and problem solve.

In the literature we see that the concept of problem is defined in different ways.Schoenfeld (1992) describes as a problem the situations that are surprising and difficult requiring creative thinking.According to Orton and Wain (1994), the problem is a situation in which attracting the attention of the individual, forces the mind, and needs to research to achieve solution. In order for an encountered situation to be a problem, it is necessary for the individual to have difficulty in making sense of this situation with his current knowledge and to is distorted the cognitive balance (Baki, 2006).On the other hand, problem solving refers to a dynamic process in which cognitive actions are carried out (Mayer, 1985).

According to the four-stage model proposed by Polya (1973), the individuals in this process understand the problem, plan the solution, develop and apply the methods, strategies within this plan, and control the correctness of the solution.Algebraic expressions, algorithms, shapes, diagrams and graphs can be used to re-express the problem.They use their mathematical knowledge as a means to understand, reinterpret, and solve the problems they face and live an effective mathematical process(Freudenthal, 1991).They can move back and forth between stages of the problem-solving process; using different strategies and techniques at each stage, they can operate in a highly flexible and versatile manner (Bayazit and Aksoy, 2008).

Problem solving is the most important cognitive activity that requires mental effort (Jonassen, 2000).In mathematics teaching, it is suggested to use the logic and strategies used in the problem solving process as a basic approach (NCTM, 1989).

NON-ROUTINE PROBLEMS

Mathematical problems are evaluated in two categories as routine and non-routine problems (Arslan and Altun, 2007; Mahlios, 1988).Routine problems are questions that can be solved with known rules, formulas and methods.The main purpose of these questions is to consolidate the knowledge learned in the past.Questions that require the use of different methods and approaches other than the known, which disturb the cognitive balance on the first encounter and force students mentally are considered as non-routine problems (Inoue, 2005).The solution of non-routine problems requires skills such as the ability to identify relationships between data, to analyze and synthesize, to think abstractly and inductive thinking, and to use the knowledge that is possessed in an unusual way (Altun, 2005).Though the right answers are obtained in the solution of such questions, the ideas and approaches displayed in the solution process are most important (Mayer, Sims and Tajika, 1995).In other words, is important how it is obtained the result; the approach and strategies followed in solving, the logical estimates made, the models created, and the originality of the solution produced are much more important.

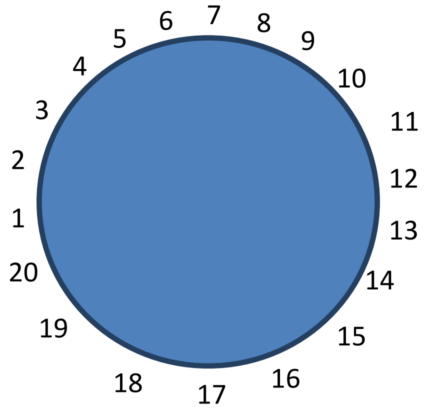
PROBLEM SOLVING STRATEGIES

1. Make a Drawing or a Diagram, Draw a Picture:

The diagram drawing is the most used form of problem solving methods. The person who solves the problem hears the need to draw a diagram to understand what the problem expresses. The diagram shows how we can understand and think about the problem.

Question 1: Students in a class are arranged arround a circle, with regular intervals and numbered. Student number 7 and student number 17 came mutually. How many students are there in the class?[6]

Answer: There are 20 people in this class.



Algorithm:

1- Start

2- Draw a circle

3- Write the numbers 7 and 17 mutually

4- Fill the right sideof the circle with the numbers between 7-17

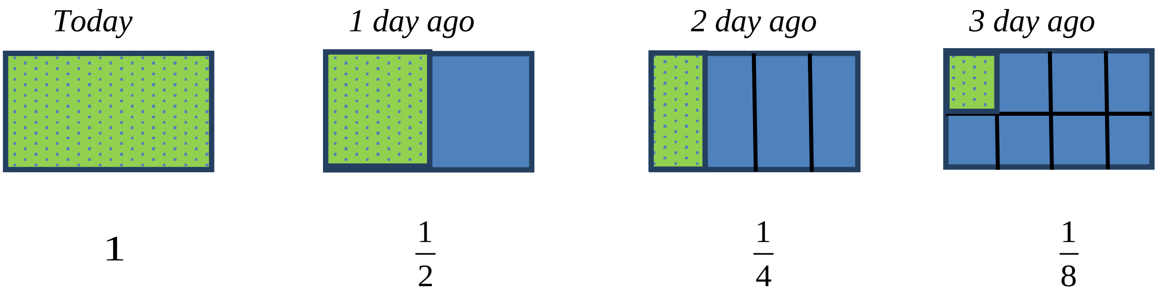
5- Fill the left side of the circle with the same amount.

6- Find the total number of people

7- Finish

Question2: Lotus which is on the surface of a pool expands the leaves area 2 times every day.*When the pool surface is covered by leaves,how many percent of pool surface area are covered by leaves three days ago?[6]*

Answer:



Algorithm:

1. Start

2. On the last day the entire surface of the pool is covered

3. One day ago, the leaves covers the half the surface of pool

4. Two days before, the leaves will cover quarter of the pool

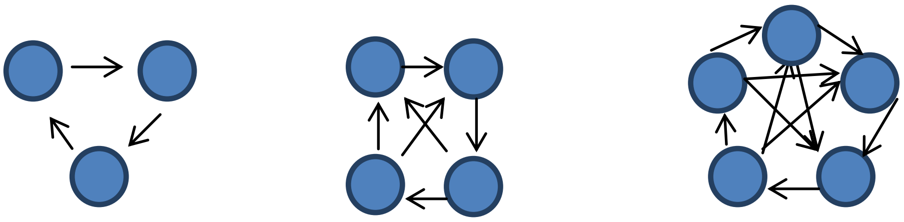
5. if day numberis “n”, $(\frac{1}{2})^{n-1}$ Notice that it progresses in the form of n-1 forces

6. The expected result is found

7. Finish

Question3: A mole prepares a home with 7 different outputs.There is only one tunnel independent of the others that connect each output.According to this, can you find out how many tunnels your mole has digged?

Answer:



Outputsconnecting has shown with arrows . According to this;

Output number	***Tunnel number***	***Generalization***
1	*0*	*0*
2	*1*	*0+1*
3	*3*	*1+2*
4	*6*	*1+2+3*
5	*10*	*1+2+3+4*
6	***15***	*1+2+3+4+5*
7	***21***	*1+2+3+4+5+6*

1- Start

2- No tunnels for one exit

3- There are one for two outlets, three for three outlets, six for four outlets, ten tunnels for five outlets

4- If the number of outputs is n

5 - Number of tunnels result = (n-1) * n / 2

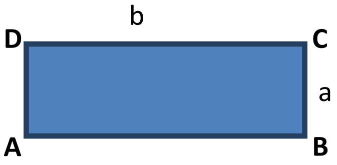
6 - Finish.

2. Make a systematic list:

The systematic list-making strategy we use in everyday life is particularly useful in problems that require finding all possibilities for an event.

Question1:The perimeter of a rectangle is 12 cm. What are the options for these two numbers if the edges are integer? Which option gives the largest area?

Answer:



if   Ç(ABCD) = 2 (a+b) =12 cm

a+b = 6 cm

Short edge (a)	*Long edge (b)*	*Area (a.b)*
1	*5*	*5*
2	*4*	*8*
3	*3*	*9*
4	*2*	*8*
5	*1*	*5*

In the question, the largest area is 8 cm^2 because it is a rectangle.

Algorithm:

1- Start

2- Find the sum of the edges by going out of the given perimeter

3- Find different two positive integer that is sum 6

4- Select the largest of these numbers.

5- Finish

Question2: How many numbers are there in the number obtained by writing the numbers from 1 to 1000 side by side in order?

Answer:

Number interval	*How many are there?*	*How many digit?*	*Number of digits used*
1 - 9	*9*	*1*	*9*
10 – 99	*90*	*2*	*180*
100 – 999	*900*	*3*	*2700*
1000	*1*	*4*	*4*
			Total= *2893*

Algorithm:

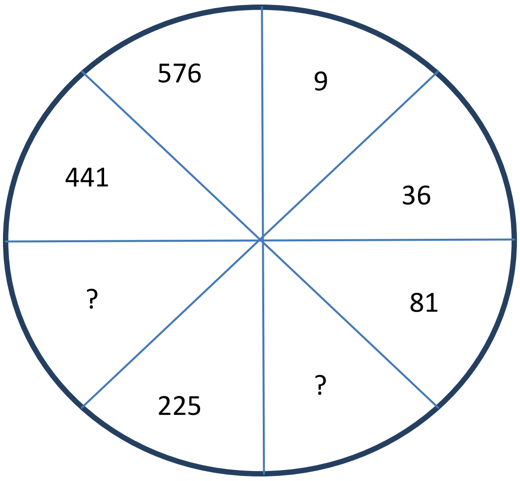
1. Start
2. Number of one,two and three digits are found
3. Number of digits and number of figure are multiplied.
4. Number of figure,which are used, are found
5. Finish

3. Look For a Pattern:

Correlations are everywhere. Children who are encouraged to look for correlations and to express them mathematically begin to understand how mathematics is applied to the world in which they live. Working with different correlation helps in the development of children's knowledge editing and classification skills.[6]

Quastion1: *Which numbers should come in place of question marks?*

Answer:



$3^2 = 9$

$6^2 = 36$

$9^2 = 81$

$12^2 = 144$

$15^2 = 225$

$18^2 = 324$

$21^2 = 441$

$24^2 = 576$

Algorithm:

1-Start

2-Understand the low-valued numbers is square of a number.

3-Understand the numbers which is square of a number, increases by three

4-Control this pattern with the other given numbers.

5- If the patern is true, find the places which is filled with question mark.

6-Finish

Question2:*Find units digit of* 7^{19}

Answer:

$$7^1 = 7$$

$$7^2 = 9$$

$$7^3 = 1$$

When you get powers of 7, You can understand that the units digit of 7^3 is 1.

$$7^{19} = (7^3)^6 . 7^1$$

$$1.7 = 7 .$$

*So,all the 3 power of 7 of units digit happens 1, Units digit of 7^{19} is 1*7=7*

Algorithm:

1-Start

2-Find units digit of all power of 7.

3- Find the power that makes the units digit 1.

4- Write the given number on the question like power that you found.

5- Remainder powers will be given the units digit.

6-Finish

Question3:*A bacteria divides in an environment every 3 hours. The result of division is consist 2 bacteria. The resulting 2 bacteria can be divided again after 3 hours. In this way, will you know how many bacteria ,form in the medium after 24 hours.*

Answer:

Division number	***Number of bacteria***	***Hour***	***Generalization***
First situation	*1*	*0*	2^0
1	*2*	*3*	2^1
2	*4*	*6*	2^2
3	*8*	*9*	2^3
4	*16*	*12*	2^4
5	*32*	*15*	2^5
6	*64*	*18*	2^6
7	*128*	*21*	2^7
8	*256*	*24*	2^8

By generalizing the question, the number of bacteria formed after 3 hours will be 2^n

Algorithm:

1-Start

2- Understand that all the bacterias increase like 2^n during their division.

3-They divide 8 times in 24 hours.

4-Find the number of bacteria with 2^8

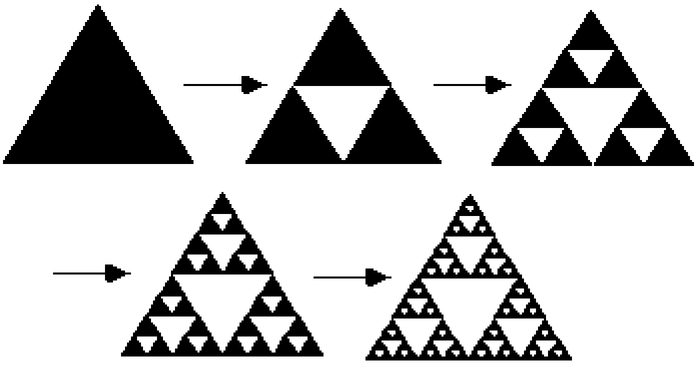
5-Finish

4. Solve a Simpler Problem, Solve an Easier Related Problem:

When encountering a difficult problem that seems due to the complexity or the size of the numbers, it may be useful to look at versions of the same problem with simpler or smaller numbers.

Question1:*The Sierpinki triangles are drawn below. How many black triangles are there in the 10th triangle?*

Answer:



Sierpinski triangle	*Number of black triangles*	*Generelazation*
1.	*1*	3^0
2.	*3*	3^1
3.	*9*	3^2
4.	*27*	3^3
.	.	.
.	.	.
.	.	.
10.	***19683***	3^9

Algorithm:

1- Start
2- Notice that the number of triangles increases with powers of 3
3- Find the number of black triangles with the formula 3^{n-1}
4- Finish

5. Work Backward:

In some problems, the situation reached is given as a result of all the actions in the problem and it is *expected* to find out what the initial situation is A backward working strategy is especially useful for such problems. If the result of arithmetic operations is given in the problem, the only thing to do is to reverse the operations. If the result of an array of events is given , it is necessary to start with the last stage, then the previous stage, then the stage from the previous stage and continue until it reaches the initial state.[6]

Question1:*Three girl are playing a game with the candies they have. The game are played three times. The loser gives them own candies number of the other girls have.Every girl lost one time and at the end of the game everyone has 40 candies. Find how many candies at the beginnig of game?* [6]

Answer:

	1. Girl	*2. Girl*	*3. Girl*
Last stage	*40*	*40*	*40*
3.raund	***80***	*20*	*20*
2.raund	*40*	***70***	*10*
1.raund	*20*	*35*	***65***

We can solve the problem backwards. In the last case, the total number of sugars would be equal. ***Bold*** *are lost.*

Question2:*Two people want to play a number game. The game is played by subtracting 1 or 2 in each round from any positive number.If you say zero, you lost game.How do you win this game?*

Answer: *If you say 0, you lost game*

If you say 1, you win game $3.0+1=1$

If you say 2 or 3, you lost game

If you say 4, you win game $3.1+1=4$

If you say 5 or 6, you lost game

If you say 7, you win game $3.2+1=7$

... ...

If you say $3k+1,\ \mathrm{k}\in\mathrm{N}$ *, you win game.*

Algorithm:

1-Start

2-Notice that the player who say $3k+1,\ \mathrm{k}\in\mathrm{N}$

3-Finish

Question3:*Each question is worth 10 points in an information contest where an extra question for every 3 correct answers is earned..At the end of the contest, a competitor who answered all the questions correctly got 400 points, so how many extra questions did the contestant win?*

Answer:

The number of questions the competitor correctly answered;

$$400/10=40$$

Solve the problem backwards

40 = ***1****+39*

the last question to be solved is a bonus

40 = ***1+ 3*** *+ 36*

for win the last question you need to answer correctly 3 questions

40 = ***1 + 3 + 9*** *+ 27*

for win the three question you need to answer correctly 9 questions

and to win 9 bonus questions, you need to give 27 correct answers in the information competition.In that case, the total number of bonus questions won;

$$1+3+9 = 13$$

Question4: One father gives money 5, 10, 15, 20 and 25 TL for 5 children of different ages respectively.The children that to act like their father also decided to play a game. First of all, a child begins to play by share part of the his money in equally to his other siblings. In each raund, a child equally distributing a part of his money to each his siblings.According to this, how many rounds should the game play so that everyone has equal money in their hands? (tübitak,2011)

Answer:

Total of money

$$5+10+15+20+25=75 \text{ Tl}$$

The amount of money everyone should have at the end of the game

$$75/5 = 15 \text{ Tl}$$

	Ç1	**Ç2**	**Ç3**	**Ç4**	**Ç5**
Last stage	**15**	15	15	15	15
5.stage	11	**16**	16	16	16
4. stage	13	8	**18**	18	18
3. stage	16	11	6	**21**	21
2. stage	20	15	10	5	**25**
First stage	25	20	15	10	5

First sibling 1 euro per personsecond sibling 2 euro per person, third sibling 3 euro per person, fourth sibling 4 euro per person, fifth sibling 5 euro per person. The game finish six stage.

6. Guess and Check:

Even if we not aware it, we use the strategy of guess and control in our daily lives. For example, if we are mixing the dyes to make a color that we want, we will continue to try until we reach the expected result.Although this strategy does not look like mathematical, it is a commonly used strategy and is more than a simple test and error process. A student who uses this strategy starts with a logical guess and tests his prediction.If the prediction is not correct, start with another prediction and test it. This process continues until the student reaches the expected result in the problem[6]

Question1:*In the boxes below, place three numbers that sum of 15 so that the sum of all three consecutive boxes is 15* [6]

	6							*4*		

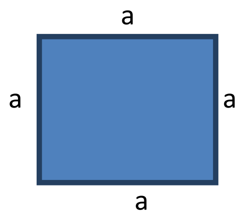
Answer:

$$15 = 4 + 5 + 6$$

5	*6*	*4*	*5*	*6*	*4*	*5*	*6*	*4*	*5*	*6*

Question2:*Ali uses square tiles to tile the floor of his square-shaped room.There are 721 tiles in a box. What are the dimensions of the largest square Ali can make?*

Answer:



Let's assume the area of each tile 1 br^2 *. Square's Area =* a^2

Let's estimate a number

Square's a edge (a)	*Square's Area(* a^2 *)*	*Expected result*
...	...	*721*
25	$25^2 = 625$	*721*
26	$26^2 = 676$	*721*
27	$27^2 = 729$	*721*
...	...	*721*

Expected result 721 is between 676 and 729. An edge of the largest square that Ali can make is the longest 26 br.

Algoritm:

1-Start

2-Square area is power of an edge of square

3-721 is should be between two numbers that are power of two integer that you will find.

4- The small number is edge of the square.

5-Finish

7. Write an Equation or İnequality:

Correlations given in the problem are written as equality or inequality.

Question1:*There was a wounded goose in the ground.It saw the flying geese and said "Hello 100 geese".They said "We are not 100 geese. As much as us plus as much as half of us plus as much as quarter of us and with you we can be 100 geese." How many geese are flying?* [6]

Answer:

Let x be the number of flying geese,

$$x+x+\frac{x}{2}+\frac{x}{4}+1=100$$

$$\frac{11x}{4}=99$$

There are 36 geese flying

$$x=36$$

Question2:*Find the couple of natural numbers that sum of squares smaller than 100 ,multiplications are smaller than 48 .*

Answer:

Two numbers is a and b

$a^2+b^2<100$ ve a.b<48

$$a^2+2.a.b+b^2<196$$

$$(a+b)^2<13^2$$

$a+b<13$ *must be*

First numbers of couple	*Couple of natural numbers*	*Couple number*
0	*(0,0);(0,1);…;(0,12)*	*13*
1	*(1,0);(1,1);…;(1,12)*	*13*
2	*(2,0);(2,1);…;(2,12)*	*13*
3	*(3,0);(3,1);…;(3,12)*	*13*
4	*(4,0);(4,1);…;(4,11)*	*12*
5	*(5,0);(5,1);…;(5,9)*	*10*
6	*(6,0);(6,1);…;(6,7)*	*8*
7	*(7,0);(7,1);…;(7,6)*	*7*
8	*(8,0);(0,1);…;(8,5)*	*6*
9	*(9,0);(9,1);…;(9,5)*	*6*
10	*(10,0);(10,1);…;(10,4)*	*5*
11	*(11,0);(11,1);…;(11,4)*	*5*
12	*(12,0);(0,1);…;(12,3)*	*4*
		Total = 115

8.Make a Table

The main idea of this strategy is to write a table of the data that will reveal correlation.Tables consist of row and columns listing important variables in the problem. This strategy is often used in conjunction with shape drawing, simplification the problem and find a pattern strategies.

Question1:*How many three-digit number that sum of the numbers is 9 do they have?*

Answer:

Hundreds digits is 1		***Hundreds digits is 2***	***Hundreds digits is 3***	***Hundreds digits is 4***
108		*207*	*306*	*405*
117		*216*	*315*	*414*
126		*225*	*324*	*423*
135		*234*	*333*	*432*
144		*243*	*342*	*441*
153		*252*	*351*	*450*
162		*261*	*360*	-
171		*270*	-	-
180		-	-	-
Total	***9***	***8***	***7***	***6***

If you fill the table as much as shown,the numbers sum of figures of equal 9 are

$$9+8+7+6+5+4+3+2+1=45$$

Algorithm:

1-Start

2- Find the numbers, sum of figures are 9 and hundreds digits are 1,2,3,4

3- Understandthe pattern between the number of digits

4- Find the total number of digits.

5-Finish

Question2:*Which weights can be measured with 1kg, 3kg and 5kg weights?*

Answer:

1kg	*3kg*	*5kg*
🟦	🔺	🟢

Left scale	***Right scale***	***Amount of weight***
1 kg	🟦	*1 kg*
2 kg + 🟦	🔺	*2 kg*
3 kg	🔺	*3 kg*
4 kg	🔺+ 🟦	*4 kg*
5 kg	🟢	*5 kg*
6 kg	🟢+ 🟦	*6 kg*
7 kg + 🟦	🟢 + 🔺	*7 kg*
8 kg	🟢 + 🔺	*8 kg*
9 kg	🟢 + 🔺 + 🟦	*9 kg*

9. Logical Reasoning

In fact, although each problem solving process does not require logical reasoning or reasoning, the solution of some problems is based solely on reasoning as a basic strategy.

Question1:*The three men who lose one's way in the desert have 15 water bottles of the same size. Five of the water bottles are empty, five are half , and five are full. Because each of the men wants to travel in a different way, they decide to share the water equally.How can they share equally?* [6]

Answer:

Total amount water : $5x0+5x\frac{1}{2}+5x1=7,5$ water bottle

Per person $\frac{7,5}{3}=2,5$ water bottle

Number of people	***How to share?***	***Total amount water per person***
1.Person	*Full+full+half*	*2,5*
2. Person	*Full+full+half*	*2,5*
3. Person	*Full+half+half+half*	*2,5*

Question2:*Father, mom and two children want to go opposite coast with a bot. Because of the boat is small, either 1 parent or 2 children can go to opposite coast. How many minumum times can the family go accross the other side?*

Answer:

Dad	*Mom*	*C1*	*C2*
🟦	🟪	🟡	🟢

	Their coast	***Situation***	***Opposite coast***
First situation	🟦🟪🟢🟡	*Mother, father and two children are on the left side. Opposite coast is empty.*	
1	🟦🟪	*C1and C2 go to right side*	🟢🟡
2	🟦🟪🟡	*C1 goes to left side with boat again*	🟢
3	🟦🟡	*Mom goes to right*	🟢🟪
4	🟦🟡🟢	*C2 goes to left side*	🟪
5	🟦	*C1 and C2 go to right side*	🟪🟢🟡
6	🟦🟡	*C1 goes to left side*	🟪🟢
7	🟡	*Father goes to right side*	🟦🟪🟢
8	🟡🟢	*C2 goes to left side*	🟦🟪
9		*C1 and C2 go to right side. All family go to opposite coast.*	🟦🟪🟡🟢

Question3:*Inside 8 candy boxes there are diffrent candies for each. If the candies in a random box are shared the other 7 boxes, the number of candies in each boxes happen equal in 7 boxes.Before sharing candies,the box which has maximum number candies how many candies inside the box minimum?*

Answer:

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1	***2***	***3***	***4***	***5***	***6***	***7***	***??***

Because of in the box which has maximum number of candies is asked the minimum candies that is possible,in the other boxes there should be minimum number of candies.Shared box supposes 8th box. When we shared the candies that is inside the boxes,all the number of candies would be equal,lets accept the number of candies as 8. So,

Number of boxes	***Number of shared candies***
1	*7*
2	*6*
3	*5*
4	*4*
5	*3*
6	*2*
7	*1*
	Total = 28

The box which has maximum number candiesminimum 28 candies inside the box.

ALGORITHM

Algorithm is a sequence of operations on a finite number that performs a particular task. In other words; are called all of the sequential logical steps required to solve a problem. This concept has emerged with create general rules for solve of the problems by Musaoğlu Horzumlu Mehmet (Arabicreading Al-Harezmi) at 9 century AC.Algorithm reading latin of Al-Harezm[2]

Algorithm is the method used to solve a job. In daily life we also use algorithms like driving directions or cooking etc.

The characteristics of the algorithm are;

1) It must have beginning

2) It must be simple

3)The solution Implement in the shortest time possible with the least possible steps

4) Should result [3]

FLOW CHARTS

The flow chart is a flow diagram for visualizing the algorithm created for solving the problem. In the flow charts, the steps of the algorithm are written in boxes in the form of symbols and the relationship between the steps and the direction of flow are indicated by arrows.

Benefits

1) They show the logical relationship between the steps involved.

2) It is easy to follow and understand.

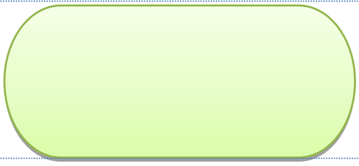
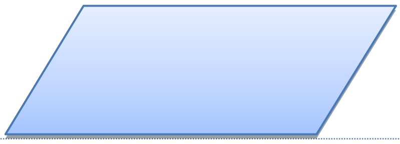
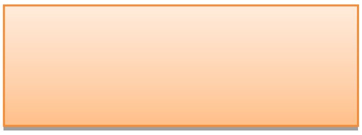
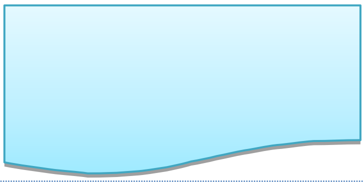
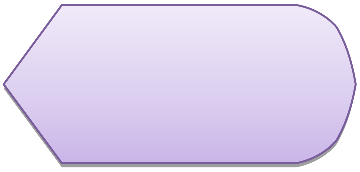
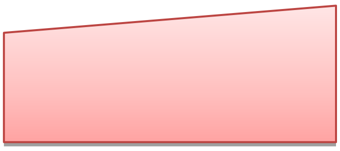
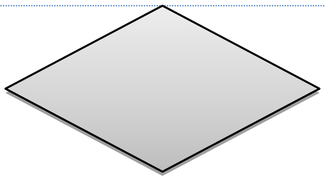
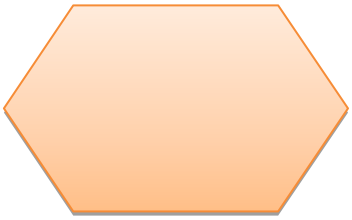
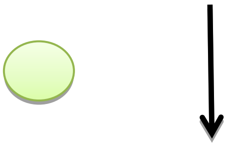
3) It is possible to follow the events that occur depending on the conditions.

4) It is understandable that they are prepared according to a certain standard and more than one person can work on the same scheme.

Preparation Rules

- Start and end points must be defined.
- Standard symbols should be used.
- Interconnecting flow lines should not be used.
- Simple decisions must be made.
- The scheme should be prepared in a certain way. [7]

Shapes Used While Creating Flow Diagrams

	Start / Stop: This symbol is used to start or stop the algorithm.
	It is used for data input or output.
	It is the type used for processing. It has single inlet and single outlet. [1]
	Used to specify to print.
	The algorithm shows the position where an information will be written on the screen. The expression or variable to be written on the screen is written in this figure. [1]
	It is the type that indicates the position to enter information from the keyboard to the computer. You can type in the box to indicate which variable is to be entered. [1]
	It is used in decision making processes.
	It is used to indicate loops.
	Link-connection line

Variable Concept

Variables are statements holding data in the program.

If we were to see a different kind of jar, we could think of it as the honey in the jar that we threw into it.

In the case of NUMBER1 expressing nothing in the programming language alone, if we assign any data into it, the expression is held in our variable, and now we have the data we assigned to NUMBER1.

Example

Print an algorithm that prints 5 on the screen.

```
1- START
2- DEFINE VARIABLE;NUMBER1
3- NUMBER1 = 5;
4-DISPLAY; NUMBER1
5-STOP
```

In this example we started to think about the algorithm steps in detail and defined the variable NUMBER1. In step 3 we assigned the number 5 into the variable. When we print the number 5 on the screen, we have seen that the algorithm step that should be written is not the 5th step, but the variable itself is NUMBER1.

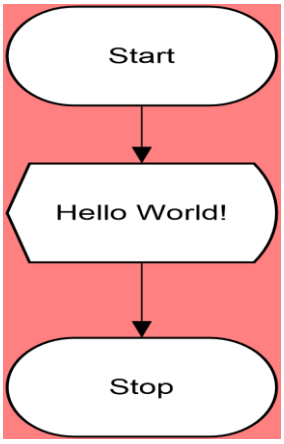
Only Processed Situations

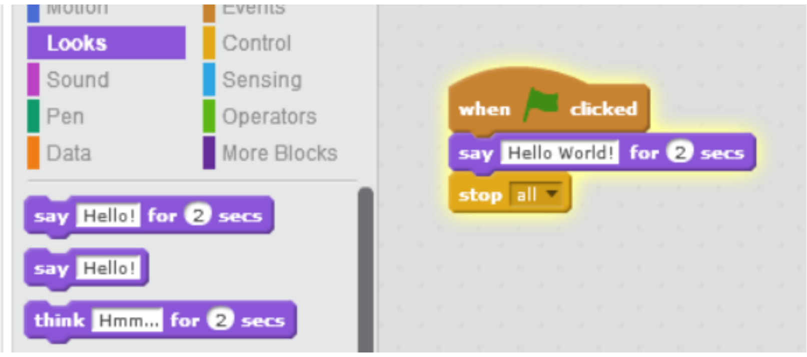
They are unconditionally without loop situations involving writing to the screen, reading values, assigning values.

***1)** Print " Hello World" on the screen.*

1- START
2-WRITE "Hello World"
3-STOP

This example shows the start, end, and screen print states. The flow diagram of this algorithm is as shown next. With Stratch we can implement this algorithm.





```
when [flag] clicked
say Hello World! for 2 secs
stop all
```

***2)** The algorithm that gives the sum of two numbers.*

1-START
2-DEFINE THREE VARIABLES; NUMBER1 AND NUMBER2, TOTAL
3- NUMBER1 = 6, NUMBER2 = 8;
4-TOTAL = NUMBER1 + NUMBER2;
5-WRITE THE TOTAL ON SCREEN
6-STOP

In the second stage, the variables NUMBER 1 and NUMBER2 are defined and TOTAL variables are defined for use in the 4th stage. The reason why the TOTAL variable is used is that another variable is passed in order to print the sum of the values held in NUMBER1 and NUMBER2 on the screen. The flow

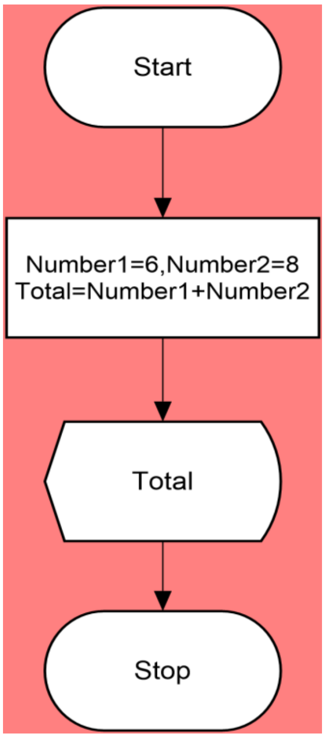
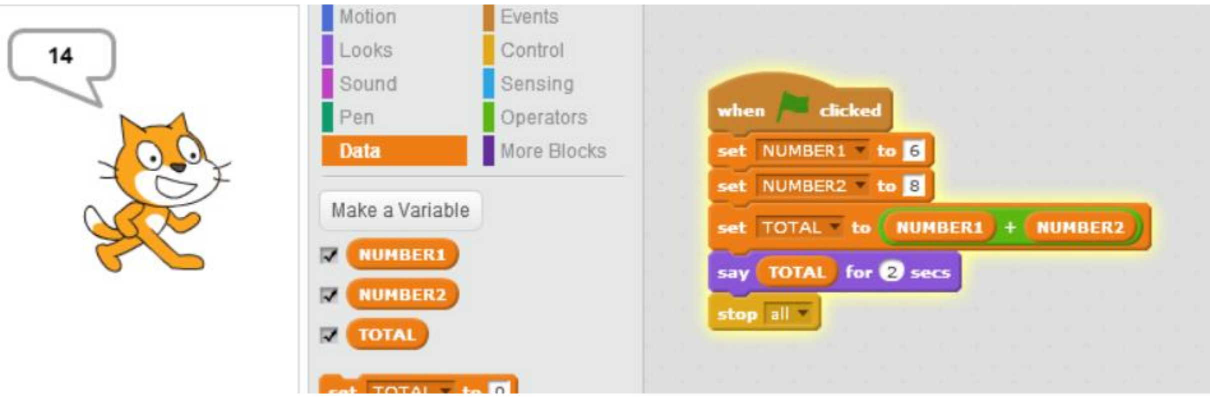


diagram of this algorithm is as shown next.



```
when 🏁 clicked
set NUMBER1 to 6
set NUMBER2 to 8
set TOTAL to (NUMBER1 + NUMBER2)
say TOTAL for 2 secs
stop all
```

Reading Value

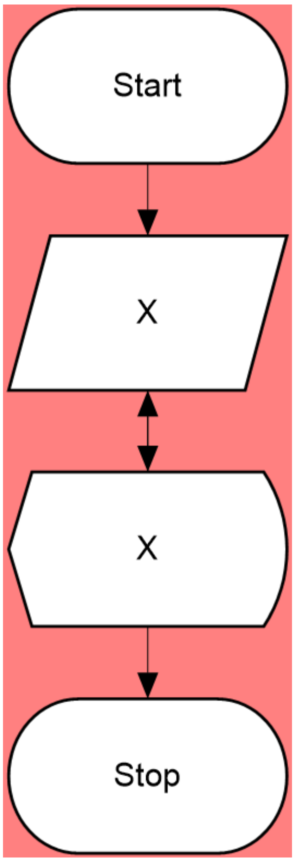
When generating the algorithm of the program, not only the data is entered in the program but also the value can be transferred from the outside. This is called reading.

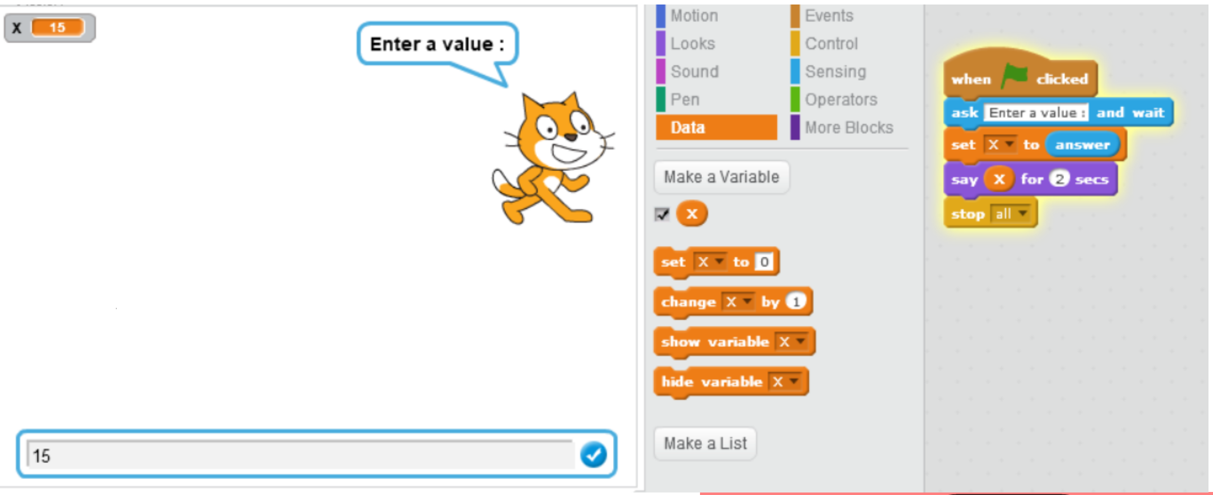
Example

Printing on the reading screen

1-START
2-VARIABLE DEFINITION; X
3- READ X
4-WRITE X SCREEN
5- STOP

We have also seen that in Step 2 of the algorithm, an external variable X can be passed into the variable. With Stratch, we can implement this algorithm. The flow diagram of this algorithm is as shown next.

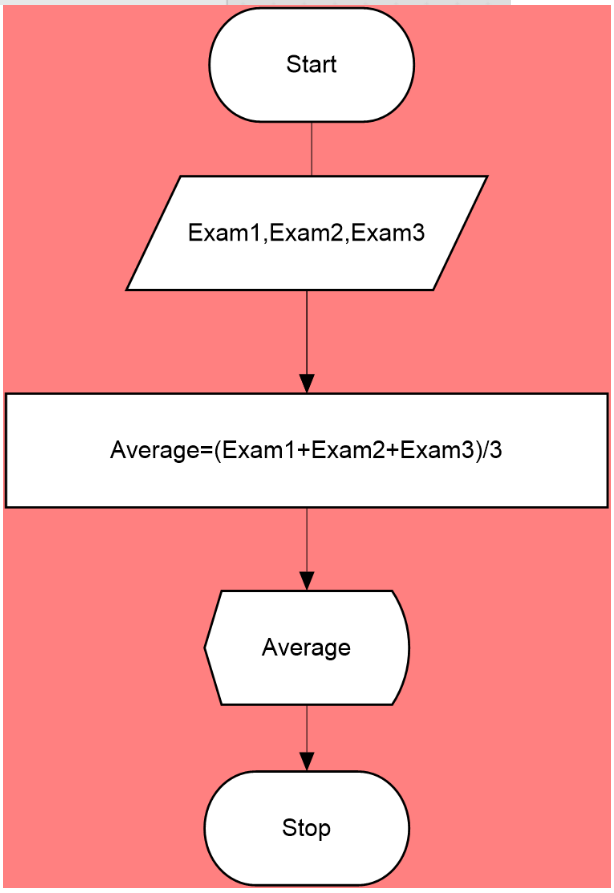




```
when clicked
ask Enter a value : and wait
set X to answer
say X for 2 secs
stop all
```

Examples

1)*Prepare the algorithm that takes the average of the three letters entered from outside and prints the average on the screen.*



1-START

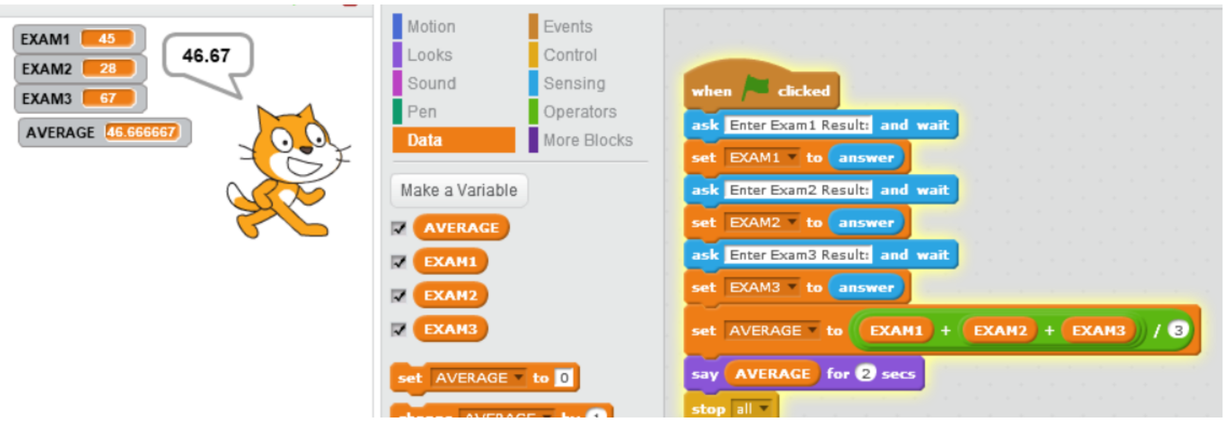
2-DEFINE VARIABLES; EXAM1, EXAM2, EXAM3,AVERAGE

3-READ; EXAM1, EXAM2, EXAM3

4-AVERAGE = (EXAM1 + EXAM2 + EXAM3) / 3

5-WRITE AVERAGE ON THE SCREEN

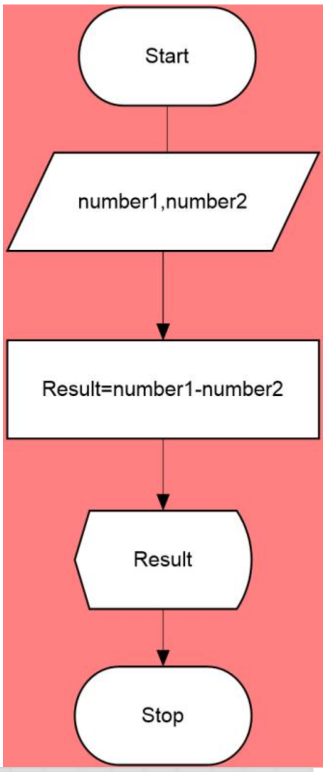
6-END

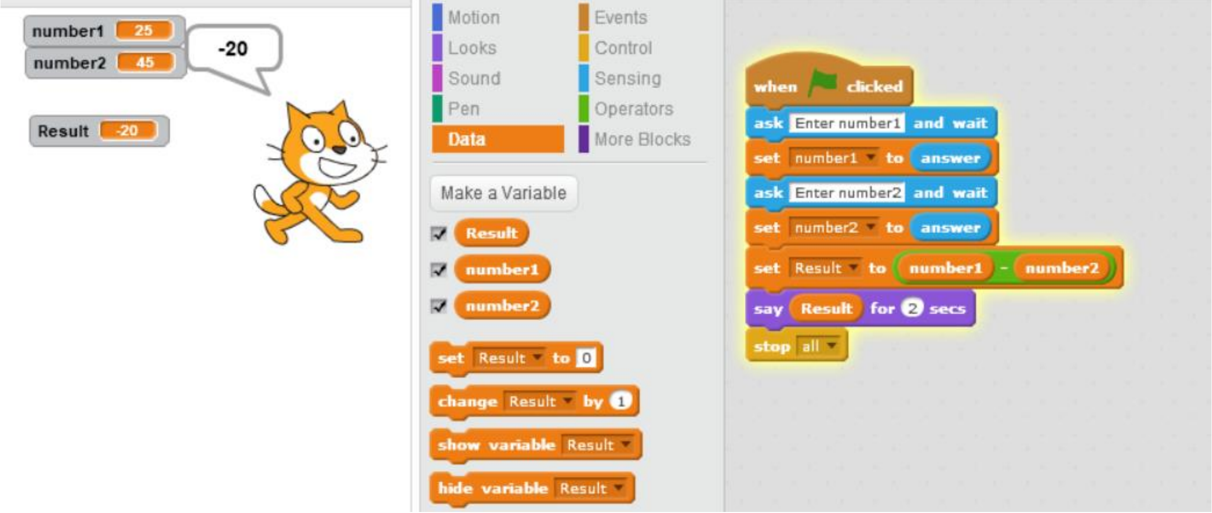


```
when clicked
ask Enter Exam1 Result: and wait
set EXAM1 to answer
ask Enter Exam2 Result: and wait
set EXAM2 to answer
ask Enter Exam3 Result: and wait
set EXAM3 to answer
set AVERAGE to EXAM1 + EXAM2 + EXAM3 / 3
say AVERAGE for 2 secs
stop all
```

2) *Prepare the algorithm that finds the difference of the number entered from the outside and prints it on the final screen.*

1-START
2-DEFINE VARIABLES; number1, number2, RESULT
3-READ; number1, number2
4-ACCOUNT; Result = number1-number2
5-WRITE Result ON THE SCREEN
6-END

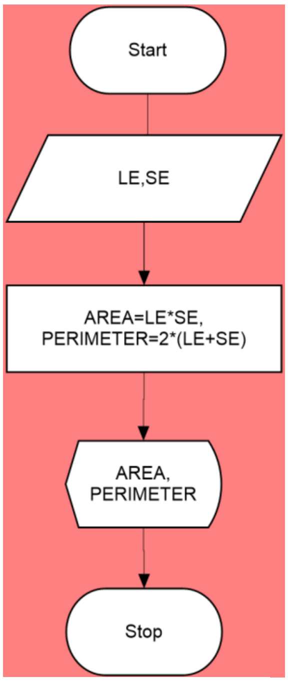


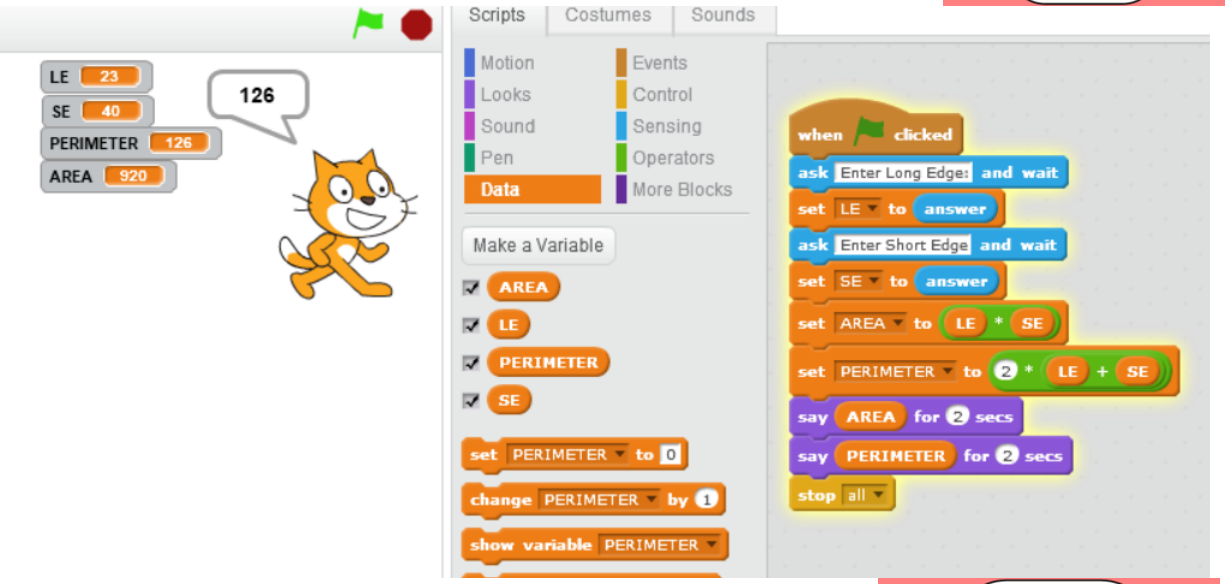

number1 25
number2 45
-20
Result -20

```
when clicked
ask Enter number1 and wait
set number1 to answer
ask Enter number2 and wait
set number2 to answer
set Result to (number1 - number2)
say Result for 2 secs
stop all
```

<b>3)</b> We write the algorithm that we enter length measurements of the rectangle from the outside, calculate area and perimeter, and print it on the screen.

1-START
2-DEFINITION DEFINITION; LE, SE, AREA, PERIMETER
3-READ; UK, KK
4-CALCULATE, AREA = LE * SE, PERIMETER = 2 * (LE + SE)
5-WRITE ON THE SCREEN; AREA, PERIMETER
6-END

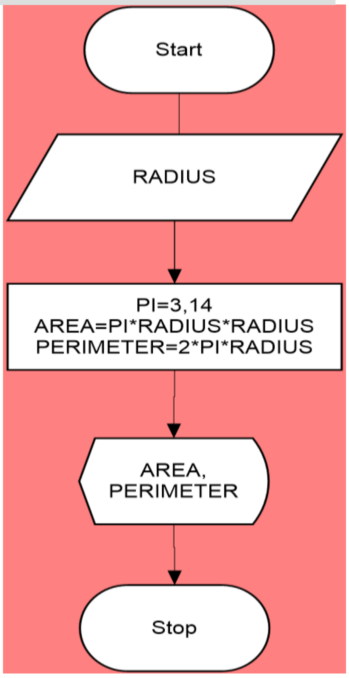


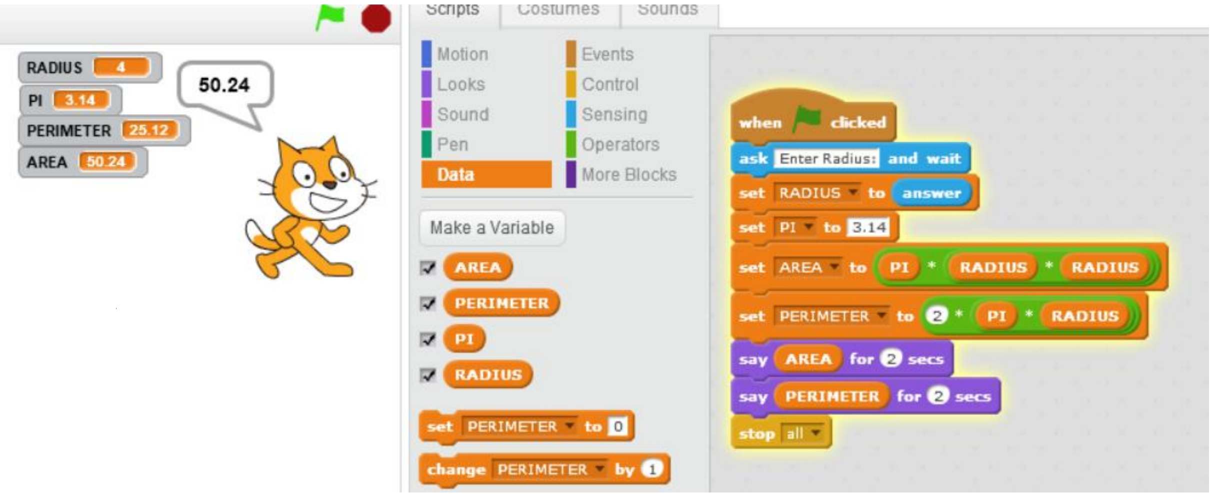


```
when [flag] clicked
ask Enter Long Edge: and wait
set LE to answer
ask Enter Short Edge and wait
set SE to answer
set AREA to LE * SE
set PERIMETER to 2 * LE + SE
say AREA for 2 secs
say PERIMETER for 2 secs
stop all
```

***4)** We write the algorithm that calculates the area and circumference of the circle and prints it on the screen by entering the radius from the outside.*

1-START
2-DEFINE VARIABLE, RADIUS, AREA, PERIMETER, PI
3-READ; RADIUS
4-ACCOUNT; AREA = PI * RADIUS * RADIUS , ENVIRONMENT = 2 * PI * RADIUS
5-SUMMER ON THE SCREEN; AREA, PERIMETER
6-END





```
when clicked
ask Enter Radius: and wait
set RADIUS to answer
set PI to 3.14
set AREA to PI * RADIUS * RADIUS
set PERIMETER to 2 * PI * RADIUS
say AREA for 2 secs
say PERIMETER for 2 secs
stop all
```

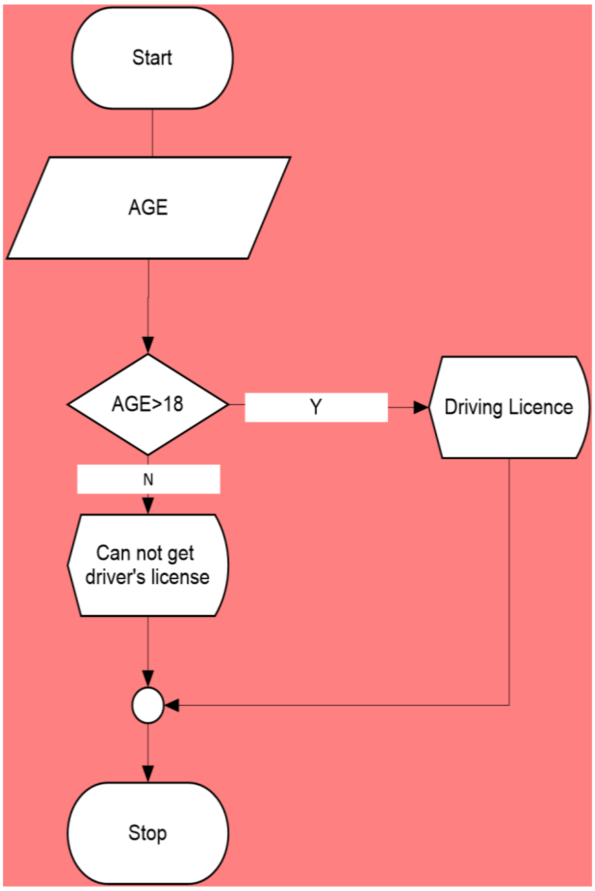
CONDITIONAL EXPRESSIONS

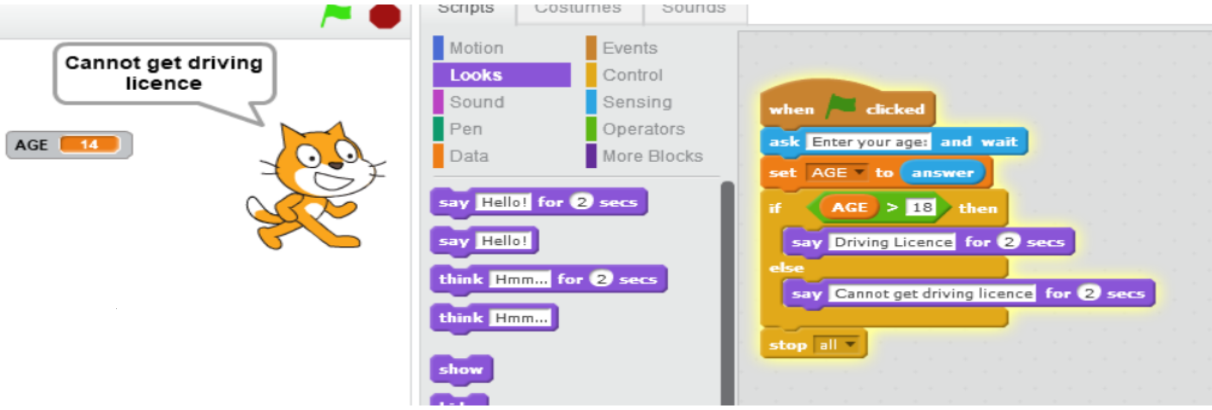
The control statements are used to determine the solution to the problem, one or more than one, depending on the work or process steps to be performed. [4]
We will use control expressions with the expression IF.

Example
The algorithm that prints on the screen whether or not the driver's license is valid when we enter the age of the person.

1-START
2-DEFINE VARIABLE; AGE
3-READ;AGE
4- If you are younger than 18, go to the 5th STEP, otherwise go to the 6th STEP.
5-DISPLAY "Can not get driver's license". GO TO STEP
6-DISPLAY "Driving License"
7-END

In the above example, we defined the AGE variable in step 2. In step 3, we made it possible to enter data into the OUTLINE variable. In the 4th step, we checked whether the value held in the AGE variant was small. If the value held in the AGE variant is less than 18, we go to step 5 and print "No license" to the screen, and we end the algorithm. If not, the 6th step will guide the algorithm and display the "Driver's license"



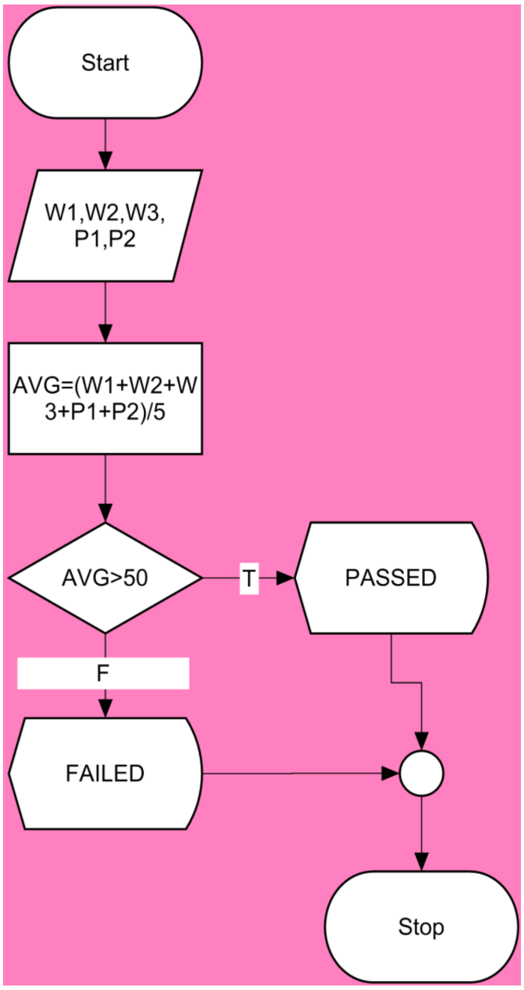


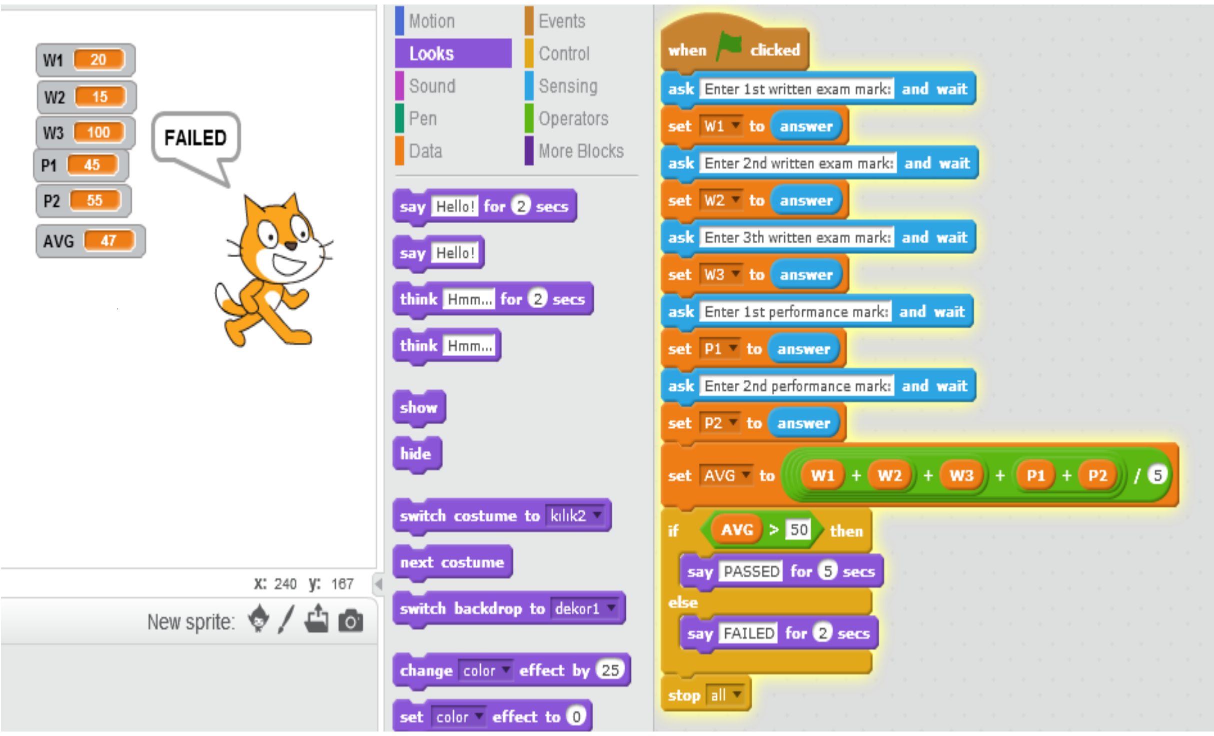
```
when [flag] clicked
ask Enter your age: and wait
set AGE to answer
if AGE > 18 then
    say Driving Licence for 2 secs
else
    say Cannot get driving licence for 2 secs
stop all
```

Examples

1)*The student has to enter three written and two performance marks and the necessary algorithm (above 50) to learn the passing situation.*

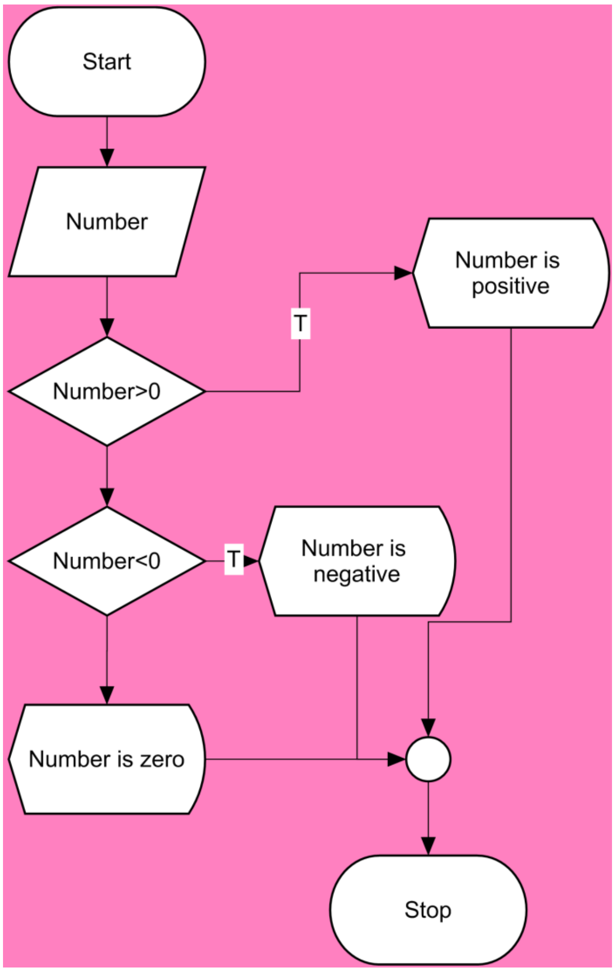
1-START
2-VARIABLE DEFINITION: W1, W2, W3, P1, P2, AVG
3-READ; W1, W2, W3, P1, P2
4-CALCULATE; AVG = (W1 + W2 + W3 + P1 + P2) / 5
5-IF IT IS LARGER FROM ORT 50, IF NOT STEP 6 GO 7 STEP
6-DISPLAY "PASSED" AND STEP 8 GO
7-DISPLAY "FAILED"
8-STOP



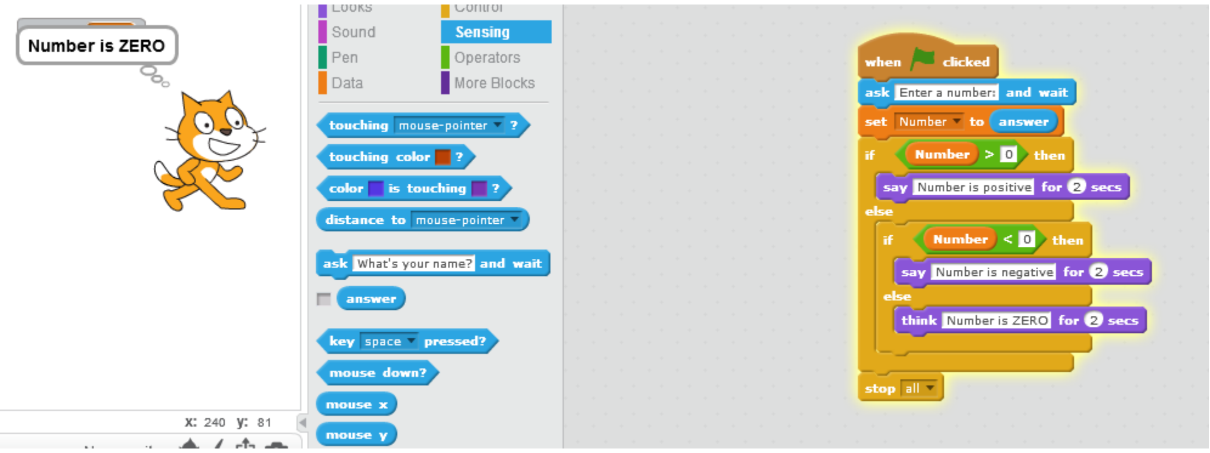


```
when clicked
ask Enter 1st written exam mark: and wait
set W1 to answer
ask Enter 2nd written exam mark: and wait
set W2 to answer
ask Enter 3th written exam mark: and wait
set W3 to answer
ask Enter 1st performance mark: and wait
set P1 to answer
ask Enter 2nd performance mark: and wait
set P2 to answer
set AVG to W1 + W2 + W3 + P1 + P2 / 5
if AVG > 50 then
    say PASSED for 5 secs
else
    say FAILED for 2 secs
stop all
```

***2)** Design an algorithm that finds whether the given integer is zero, positive, or negative.*



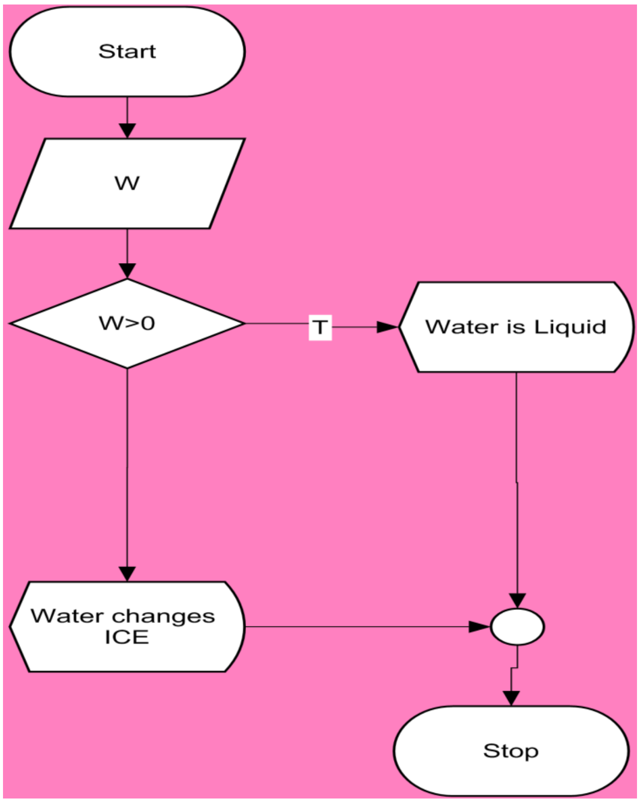
1-START
2-READ; Number
3-IF Number> 0 IS DISPLAY "This number is positive"
4-IF Number<0 DISPLAY "This number is negative" YAZ
5-ELSE Number = 0 DISPLAY "This number is zero"
6-END

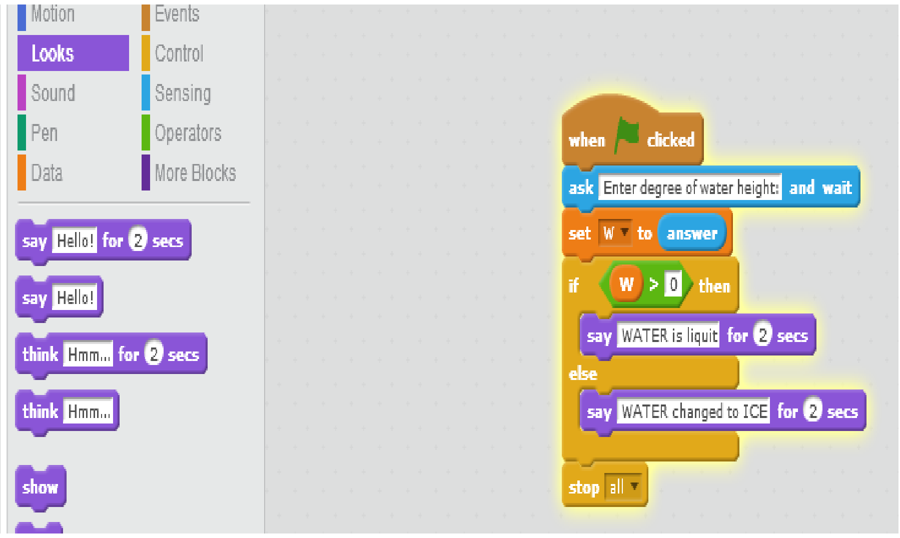


```
when clicked
ask Enter a number: and wait
set Number to answer
if Number > 0 then
    say Number is positive for 2 secs
else
    if Number < 0 then
        say Number is negative for 2 secs
    else
        think Number is ZERO for 2 secs
stop all
```

***3)** Algorithm that finds solid liquid state according to temperature of water and writes to screen [5].*

1-START
2-DEFINITION DEFINITION; W
3-PRINT THE DISPLAY "EXCEPT LIQUID" AT MORE THAN W 0 0C.
4-ELSE DISPLAY "SOLID" THE OTHER SCREEN.
5-END.

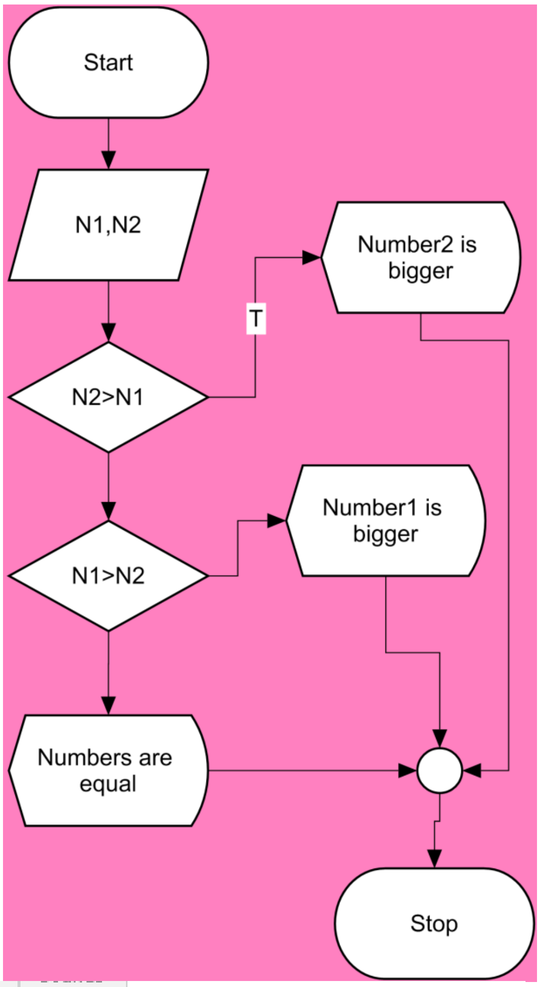


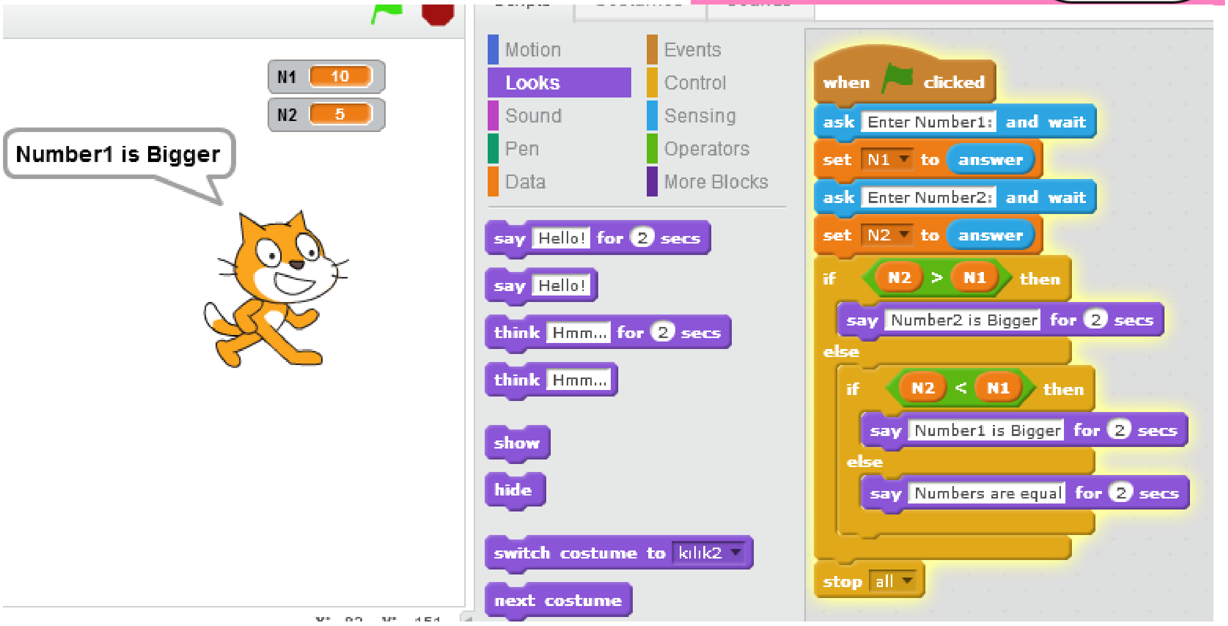


```
when ⚑ clicked
ask Enter degree of water height: and wait
set W ▾ to answer
if W > 0 then
    say WATER is liquit for 2 secs
else
    say WATER changed to ICE for 2 secs
stop all ▾
```

***4)** The algorithm that finds the size of the input 2 digits.*

1-START
2-DEFINE VARIABLES: N1, N2
3-READ; N1, N2
4-IF N1 <N2 DISPLAY ON SCREEN "Second Number is Bigger"
5-IF N1> N2 DISPLAY ON SCREEN "First Number is Bigger"
6-ELSE DISPLAY ON SCREEN "Numbers are EQUAL"
7-STOP

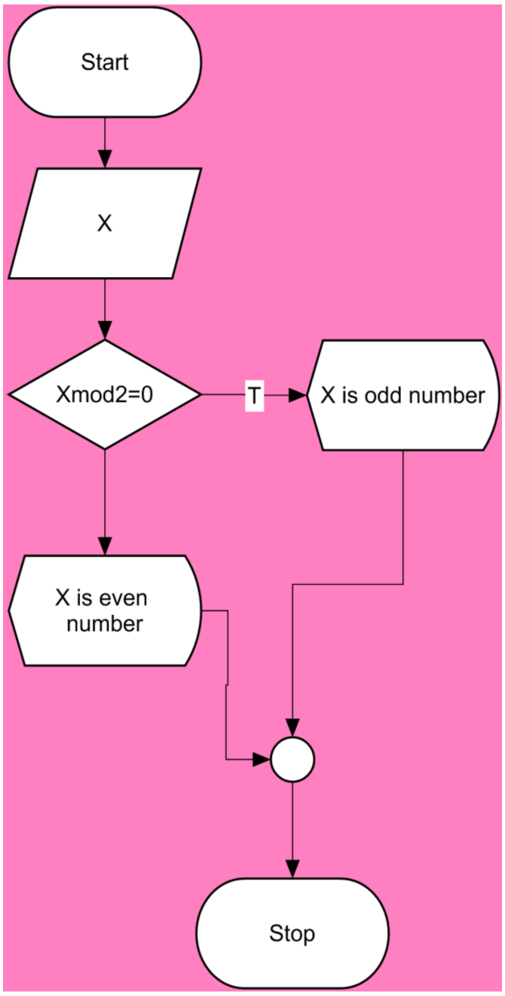


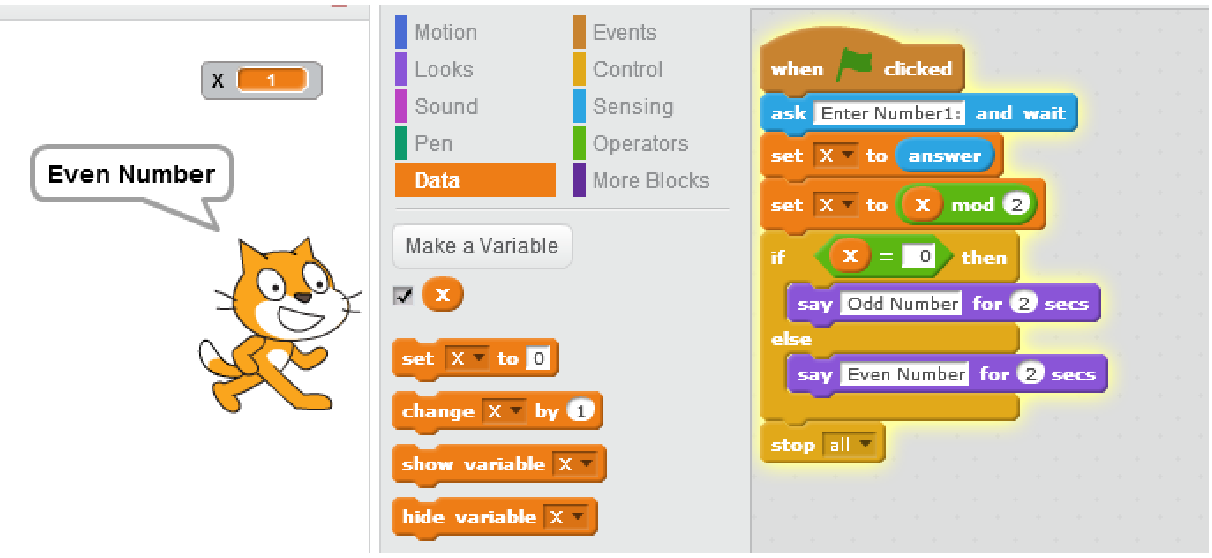


```
when [flag] clicked
ask Enter Number1: and wait
set N1 to answer
ask Enter Number2: and wait
set N2 to answer
if N2 > N1 then
    say Number2 is Bigger for 2 secs
else
    if N2 < N1 then
        say Number1 is Bigger for 2 secs
    else
        say Numbers are equal for 2 secs
stop all
```

***5)** An algorithm that finds whether the entered number is odd or even.*

1-START
2-DEFINE VARIABLE; X
3-IF X Remains in 2-Up Cover age 0 (X mode 2 = 0) DISPLAY ON SCREEN "Odd number"
4-ELSE DISPLAY ON SCREEN "Even number"
5-END





```
when ⚑ clicked
ask Enter Number1: and wait
set X to answer
set X to X mod 2
if X = 0 then
    say Odd Number for 2 secs
else
    say Even Number for 2 secs
stop all
```

LOOP

For the solution of the problem, any step or step that takes place in the solution is used more than once. The actions that are requested in the program are placed in a loop and these actions are repeated until the end of the loop.
There are 3 main elements that form a loop:

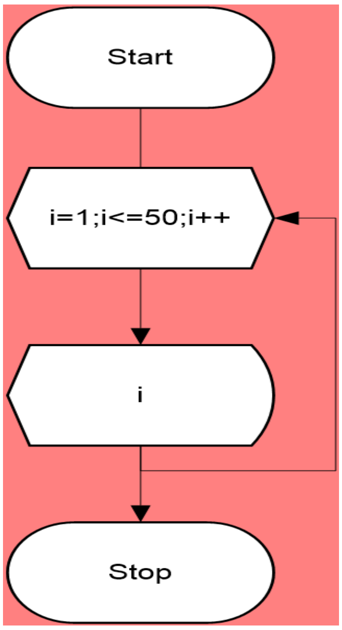
- *initialization (initialvalue)*
- *condition (endvalue)*
- *step (movementvalue)[5]*

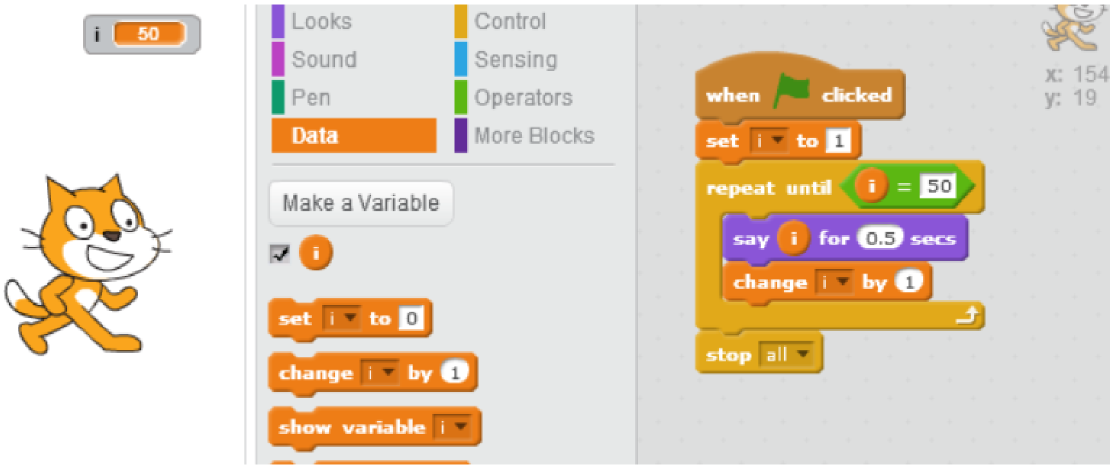
Assignment

TOTAL = TOTAL + 1 In mathematics, we can see in the programming that the student does not encounter. Theprocess ‘=’operation assign a value to be used in cycles. It is not a equalitation process.

Example: *Prepare the algorithm that prints numbers from 1 to 50 on the screen.*

```
1-START
2-DEFINE VARIABLE: C
3-LOOP C = 1 to 50
4-DISPLAY C
5-END OF THE LOOP
6-STOP
```



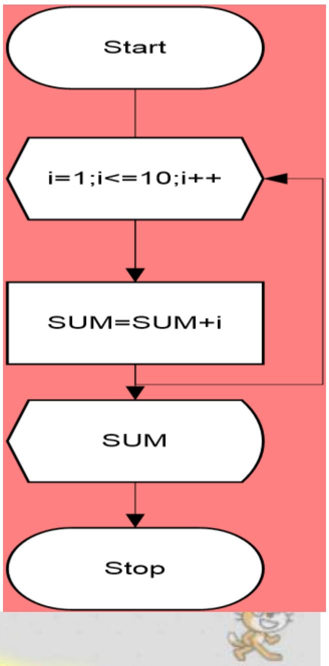


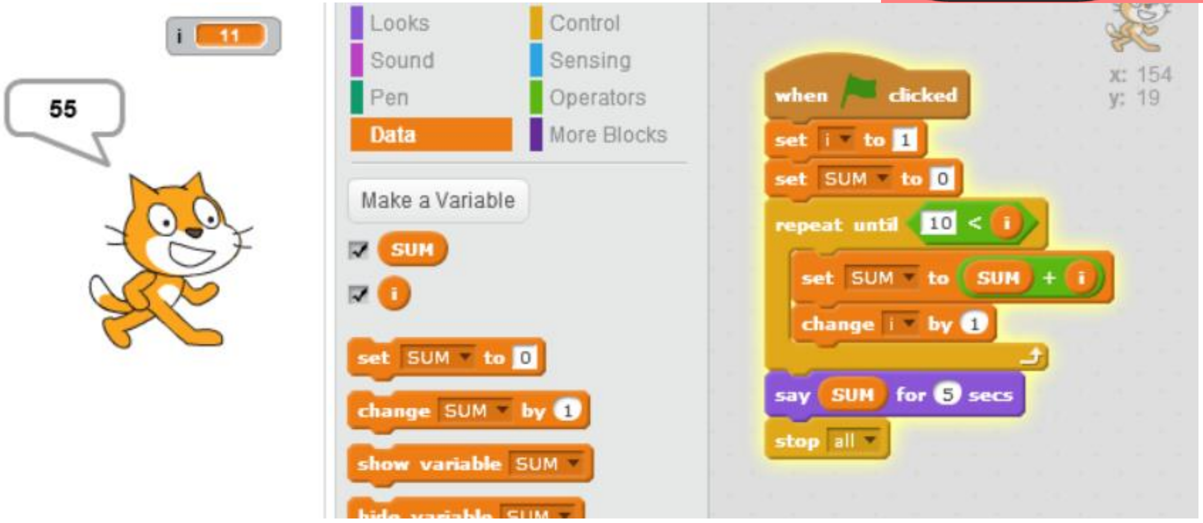
```
when [flag] clicked
set i to 1
repeat until i = 50
    say i for 0.5 secs
    change i by 1
stop all
```

Examples

***1)** The algorithm which gives the sum of numbers from 1 to 10.*

1-START
2-DEFINE VARIABLES; i, SUM
3-LOOP; i = 1, i = <10, i ++;
4-SUM = SUM + i
5-END OF LOOP
6-DISPLAY SUM
7-END.

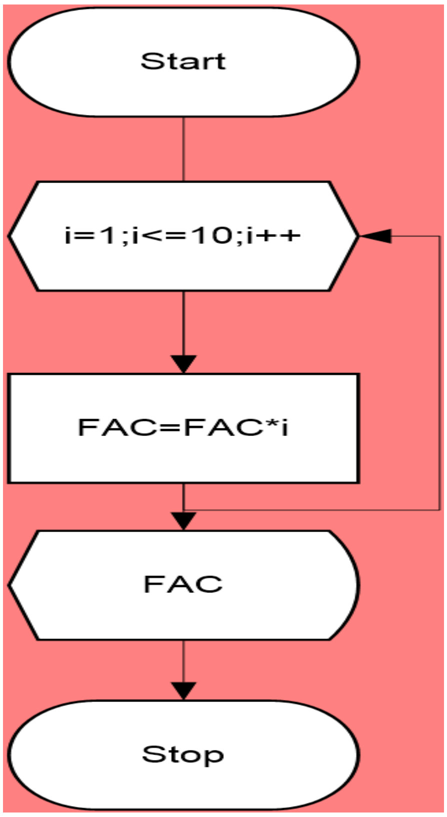


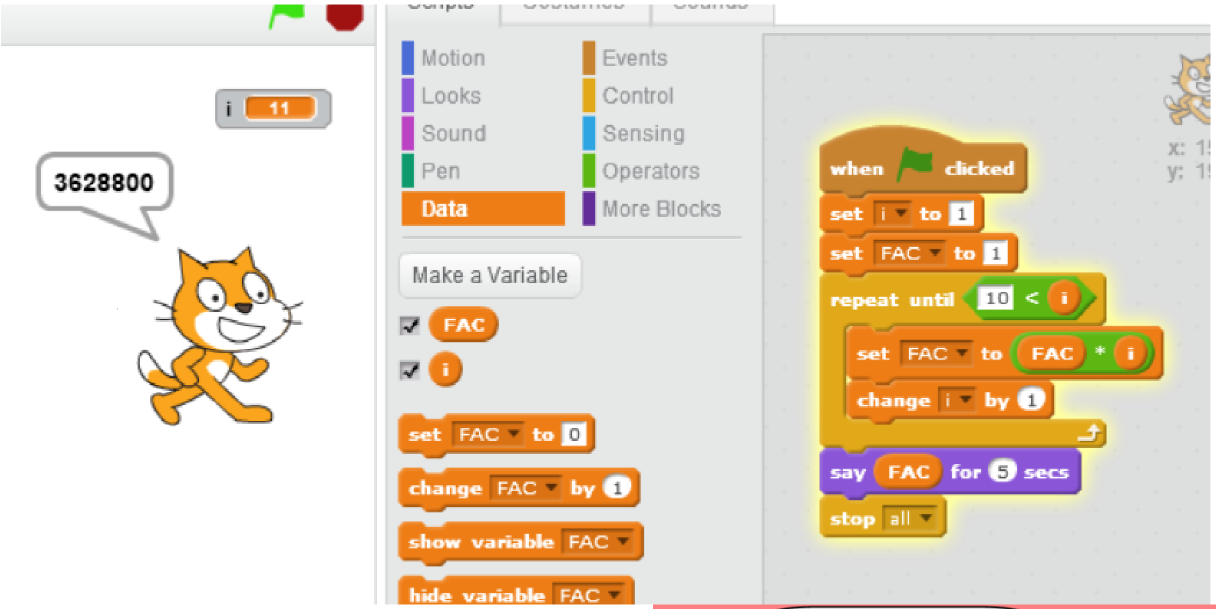


```
when [flag] clicked
set i to 1
set SUM to 0
repeat until 10 < i
    set SUM to SUM + i
    change i by 1
say SUM for 5 secs
stop all
```

***2)** 10! algorithm that finds and prints on screen.*

1-START
2-DEFINE VARIABLE; i, FAC
3-LOOP; i = 1, i = <10, i ++;
4-FAC=FAC*i
5-END OF LOOP
6-DISPLAY FAC
7-STOP

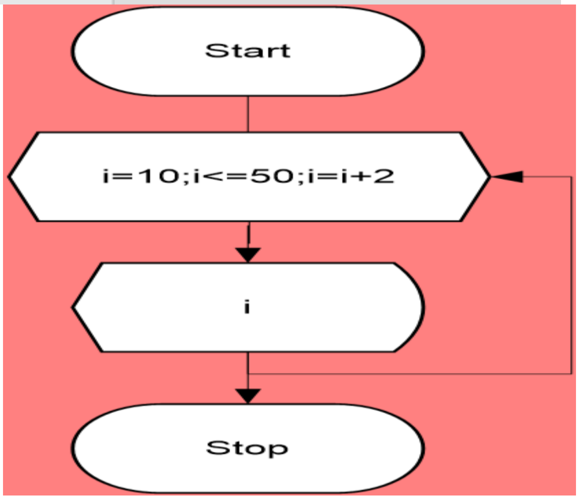


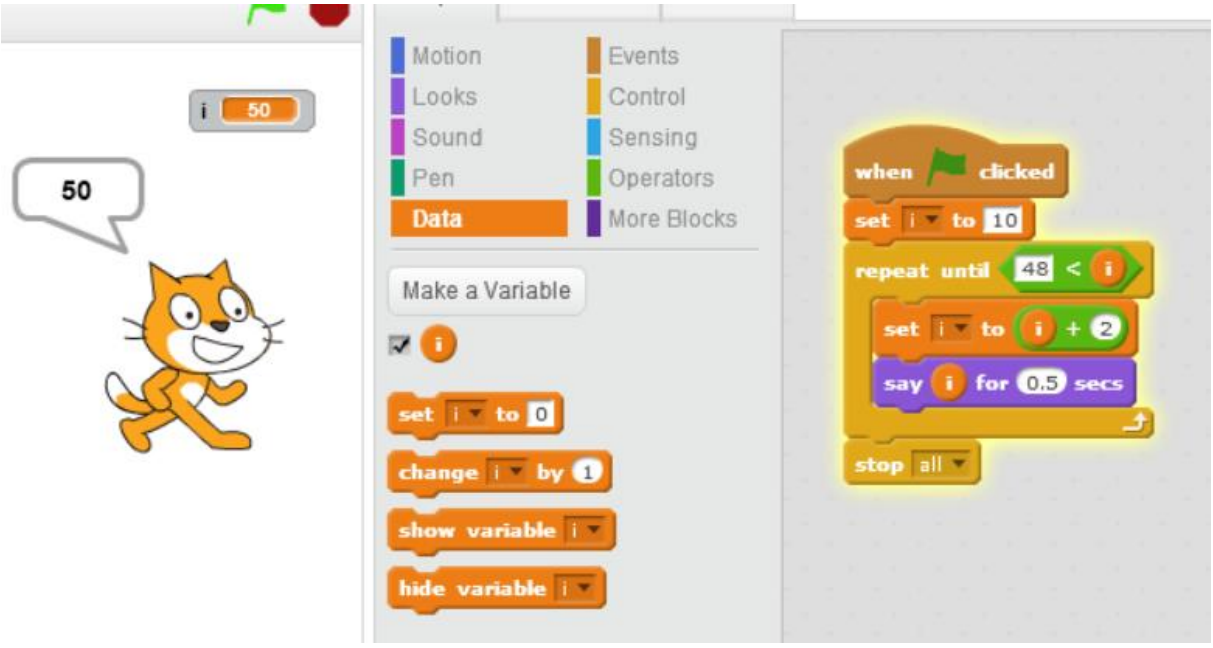


```
when [flag] clicked
set i to 1
set FAC to 1
repeat until 10 < i
    set FAC to FAC * i
    change i by 1
say FAC for 5 secs
stop all
```

3) Algorithm that displays from 10 to 50 even numbers.

```
1-START
2-DEFINE VARIABLE; i,
3-LOOP; i = 10, i = <50, i = i + 2;
4-DISPLAY i
5-END OF LOOP
6-END
```

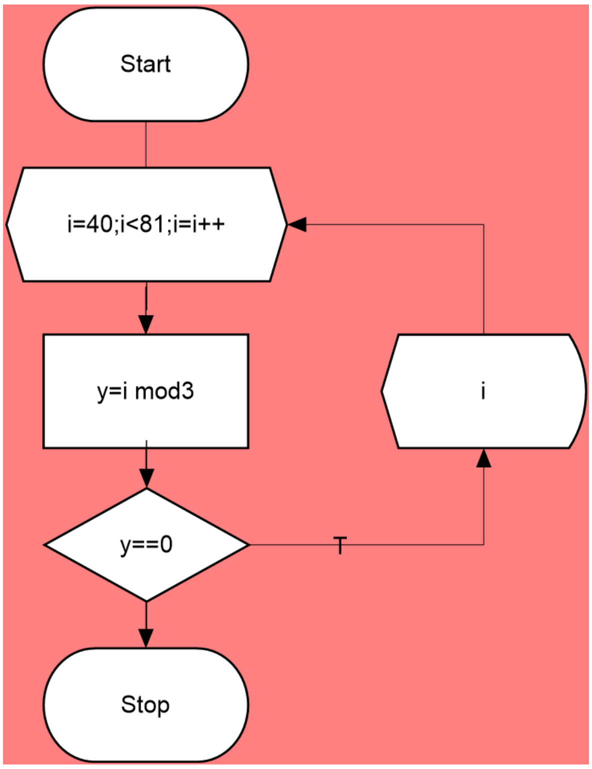


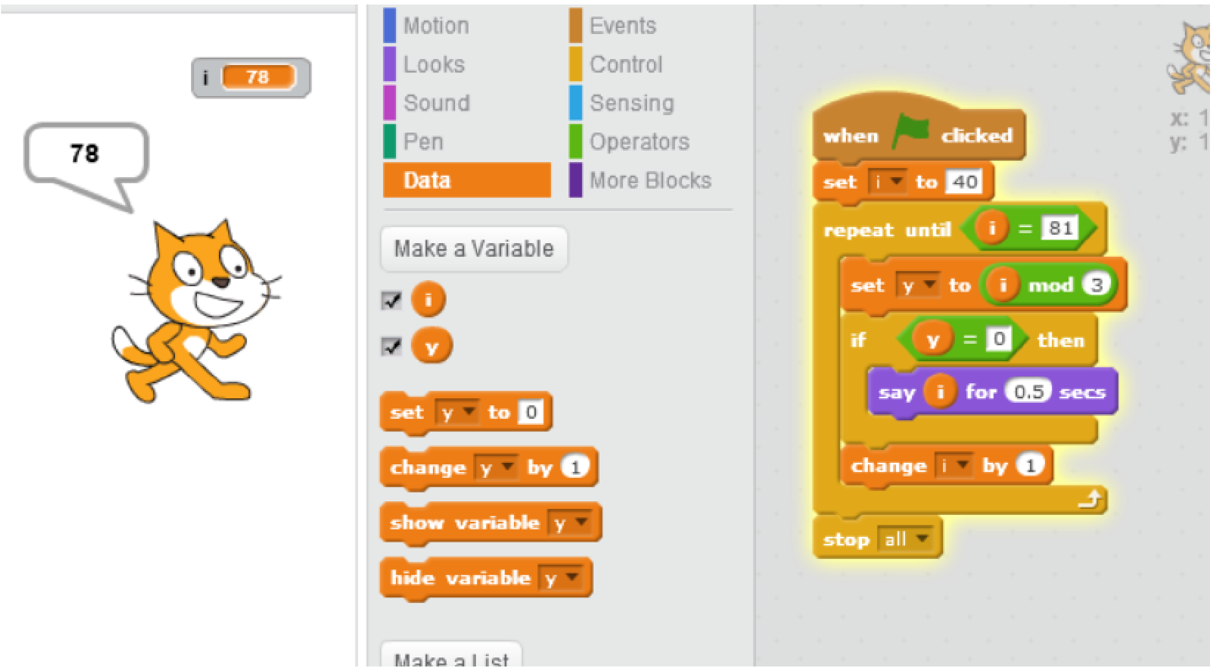


```
when [flag] clicked
set i to 10
repeat until 48 < i
    set i to i + 2
    say i for 0.5 secs
stop all
```

***4)** Algorithm that displays the numbers divisible by 3 from 40 to 81.*

```
1-START
2-DEFINE VARIABLE; i, y
3-LOOP; i = 40, i = <81, i = i ++;
4-IF i mode 3 = 0 RESULT GET INSIDE y
DISPLAY y;
5-END OF LOOP
6-END
```

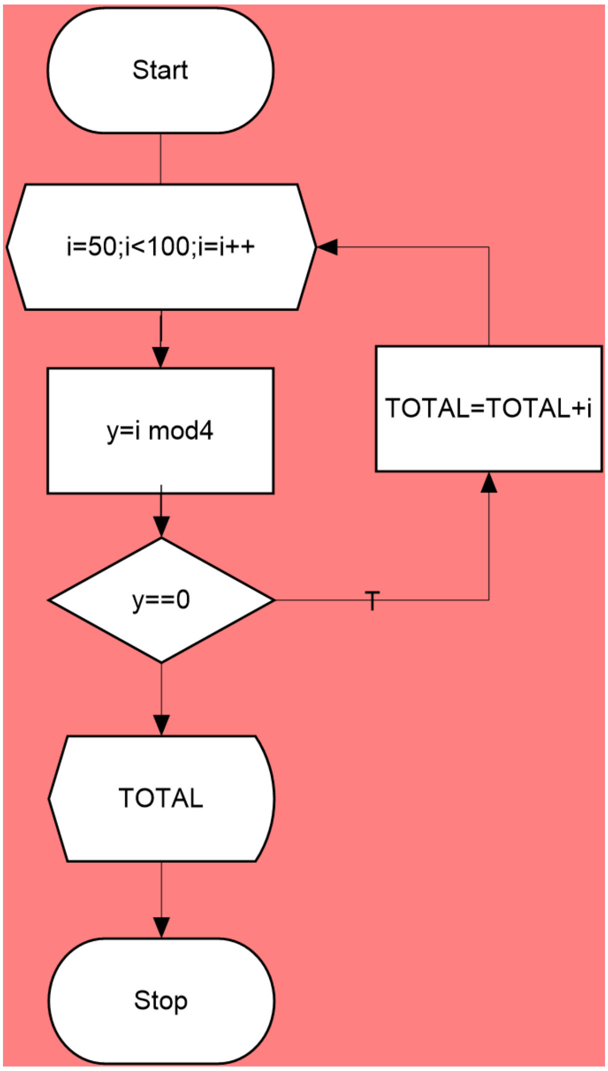


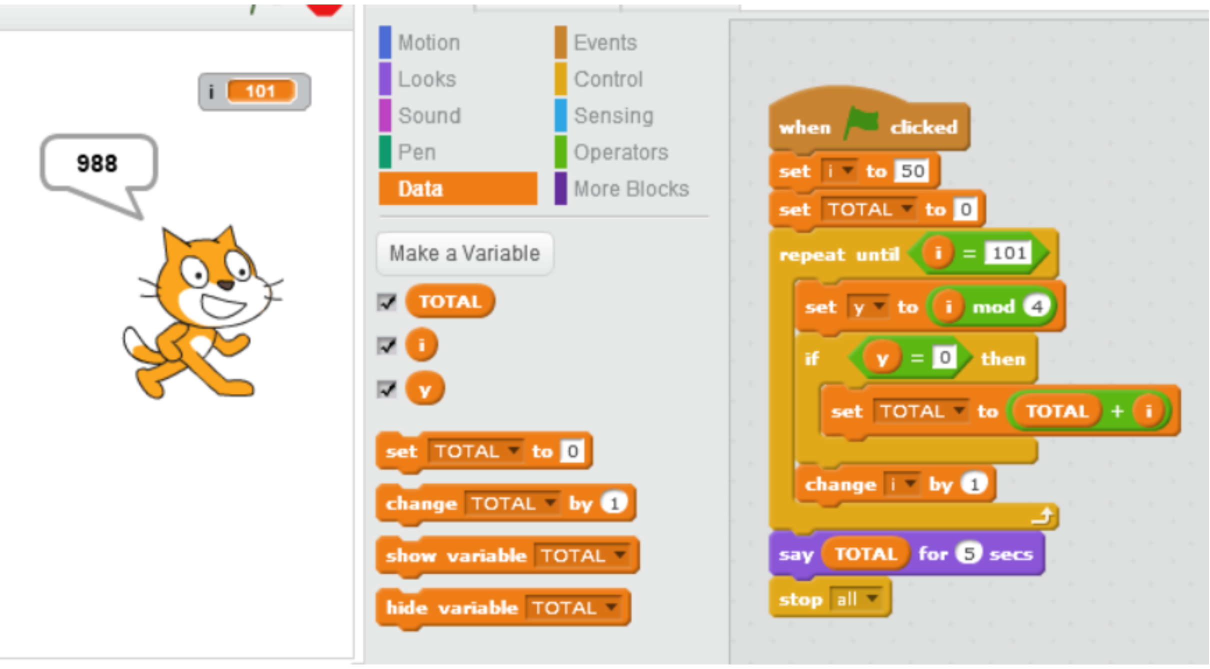


```
when ⚑ clicked
set i to 40
repeat until i = 81
    set y to i mod 3
    if y = 0 then
        say i for 0.5 secs
    change i by 1
stop all
```

5) *An algorithm that gives the sum of the numbers of divisible numbers to 4 from 50 to 100.*

```
1-START
2-DEFINE VARIABLE; i, TOTAL, y
3-LOOP; i = 50, i <= 100, i = i ++;
4-IF i mode 4 = 0 GET RESULT INSIDE y
TOTAL = TOTAL + i
5-END OF LOOP
6-DISPLAY TOTAL
7-STOP
```

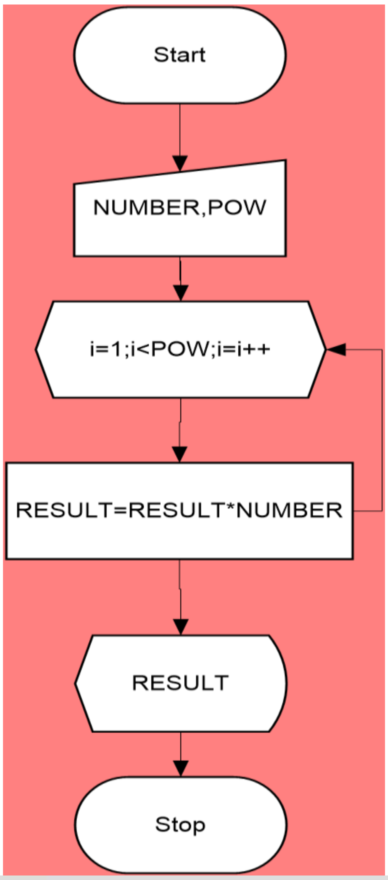


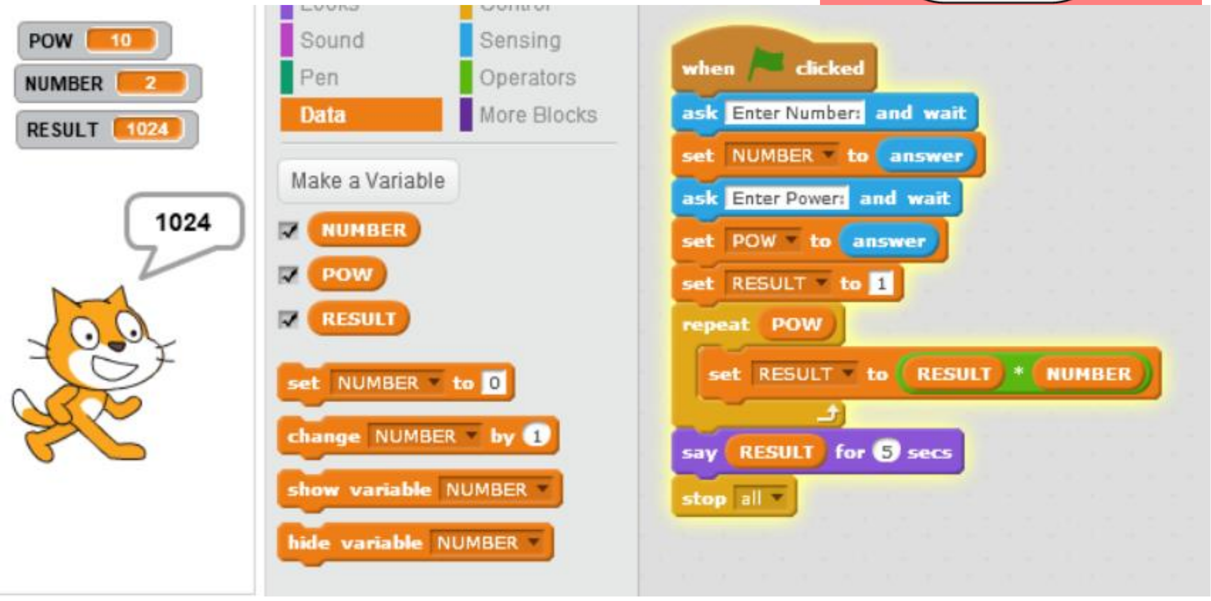


```
when clicked
set i to 50
set TOTAL to 0
repeat until i = 101
    set y to i mod 4
    if y = 0 then
        set TOTAL to TOTAL + i
    change i by 1
say TOTAL for 5 secs
stop all
```

6) *Algorithm that calculates the strength of the input number.*

```
1-START
2-DEFINE VARIABLE; NUMBER, POW, i, RESULT;
3-READ; NUMBER OF POW
4-LOOP; i = 1, i = <POW i ++;
5-RESULT = RESULT * NUMBER;
6-END OF LOOP
7-DISPLAY RESULT
8-END
```





```
when clicked
ask Enter Number: and wait
set NUMBER to answer
ask Enter Power: and wait
set POW to answer
set RESULT to 1
repeat POW
    set RESULT to RESULT * NUMBER
say RESULT for 5 secs
stop all
```

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