The activities for using TI graphing calculator in Shanghai TTC and Pilot Schools

Yang Changli

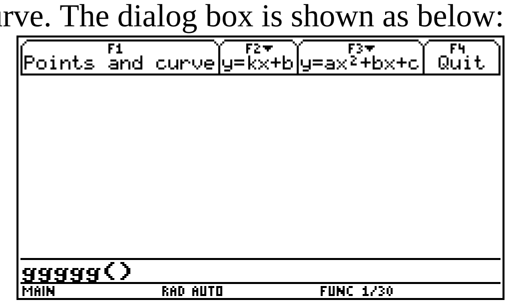
Department of Mathematics
East China Normal University
Shanghai, China

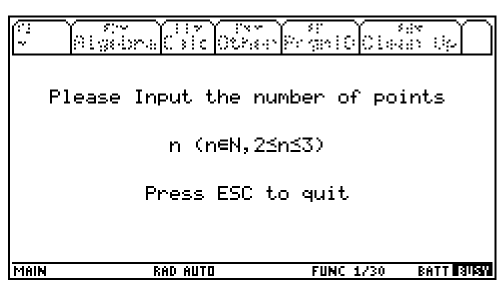
What does the "TTC" mean? That is the abbreviation of "Teaching Technology Centre". Since TTC was established in 1998, we have set up more than 30 pilot schools. With many instructors of high schools, we designed some meaningful subjects, which enrich the technology components of current high school mathematics curricula. There is some examples shown as below.

1. "Guess coefficient" game.

This activity focuses on strengthening student understanding of connections among graphical and algebraic representations of linear functions and quadratic functions.

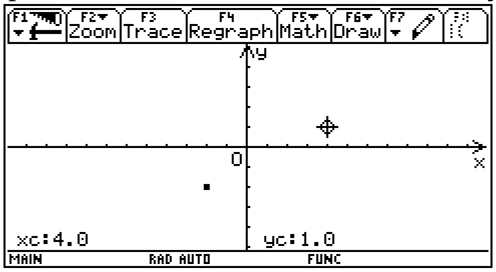
Open the TI-92 Graphing Calculator. Start the program, then select F1: Points and Curve. The dialog box is shown as below:

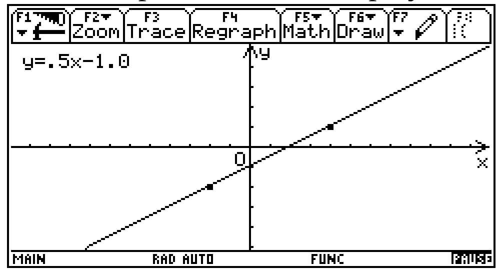




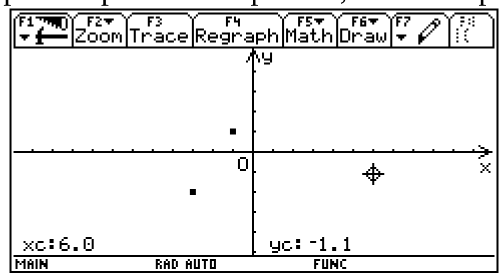
"please input the number of points n (n belongs to positive integer), n is greater than or equal to 2 and less than or equal to 3".

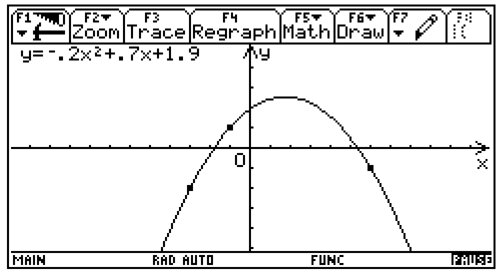
Now we can try to enter a one-digit number within the defined range, just as 2. The blinking cursor is displayed on the rectangular coordinate plane. Then move the cursor to select two points arbitrarily. The calculator can graph the line through the two points which be selected automatically, also the representation is displayed.





If we input a number 3, then move the cursor three times to select 3 points. What's happen? A parabora is plotted, and it's representation is shown.

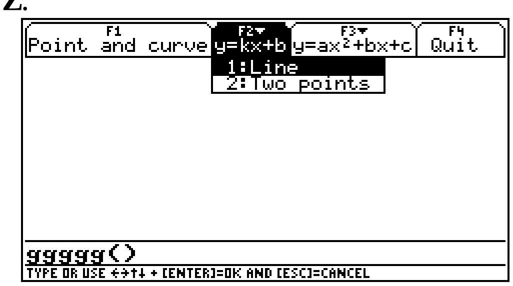


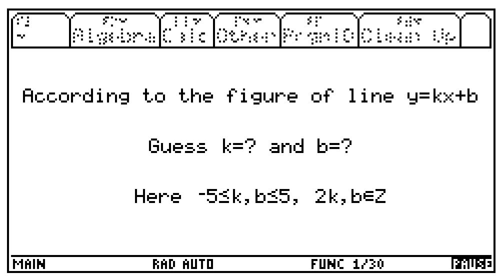


Now let's play "guess coefficient" game.

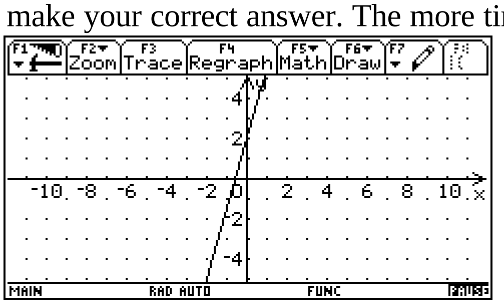
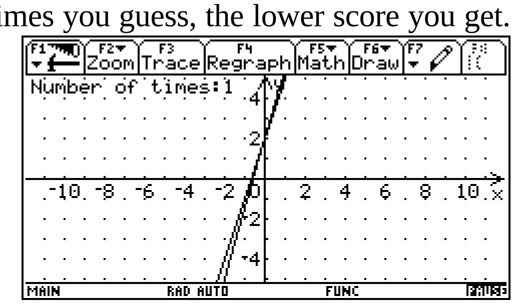
Press F2 "*y*=*kx*+*b*" to select 1: line, the dialog box is shown as below:

"According to the figure of line *y*=*kx*+*b*, guess *k*=? and *b*=? here -5**= *k*, *b*= 5,2*k*,*b* ?** Z."



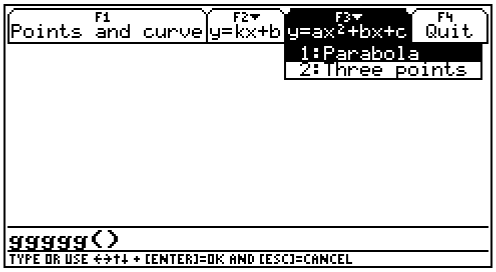


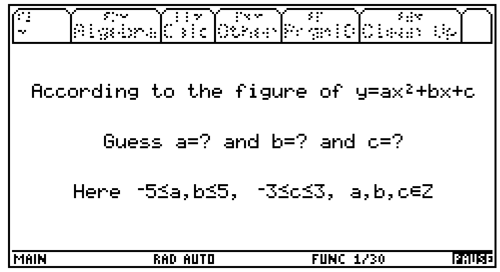
Then the figure of a line will be displayed automatically. You can guess *k* and *b*, enter the values of *k* and *b*. If your guess is wrong , the line using the two coeffcients will be plotted. You will be asked to try again. Then you must adjust the coefficients and make your correct answer. The more times you guess, the lower score you get.

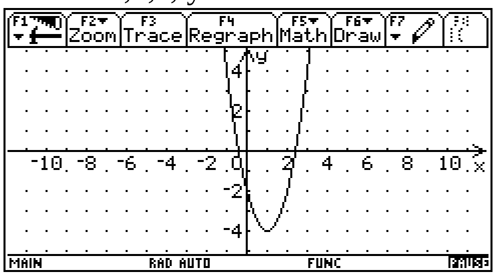
After that, you can press F3 "$y = ax^2 + bx + c$", discuss the relationship between symbolic and graphic representations of quadratic functions. Just as above, it appears the dialog box:

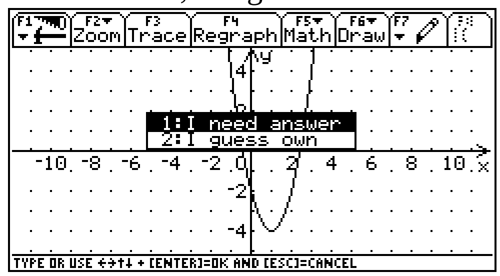
" According to the figure of $y = ax^2 + bx + c$, guess *a*=? and *b*=? and *c*=? here -5**= *a*, *b*= 5, -3= *c*= 3, *a*,*b*,*c*?** Z."



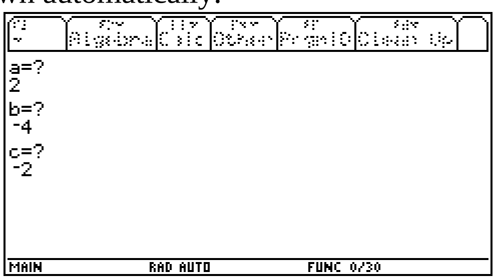


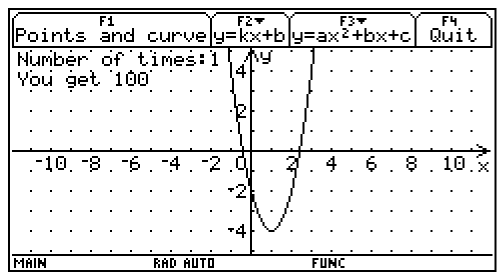
Then the figure of a parabola is displayed randomly. Before you guess the coefficients *a*,*b*,*c*, you have two choices: 1. I need answer; 2. I guess own.



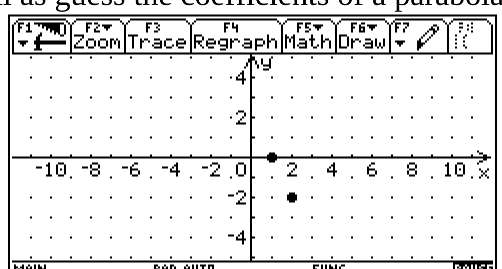


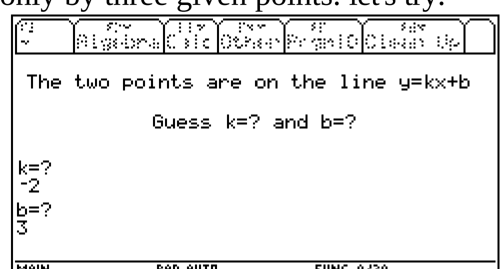
If you select 2, guess and enter the values of *a*,*b*,*c*, the TI-92 will plot the function $y = ax^2 + bx + c$ using the coefficients you guessed. You can guess them continuously till you get the correct answer. Also you can select 1, the correct answer will be shown automatically.

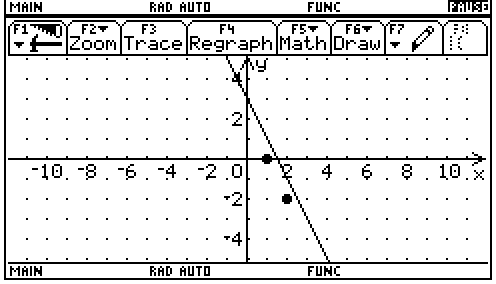


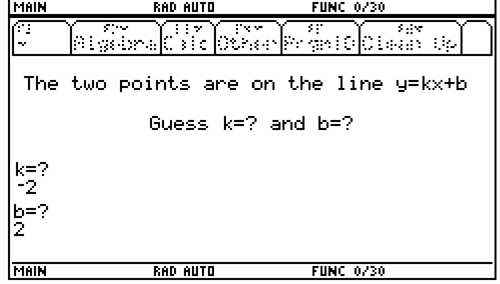


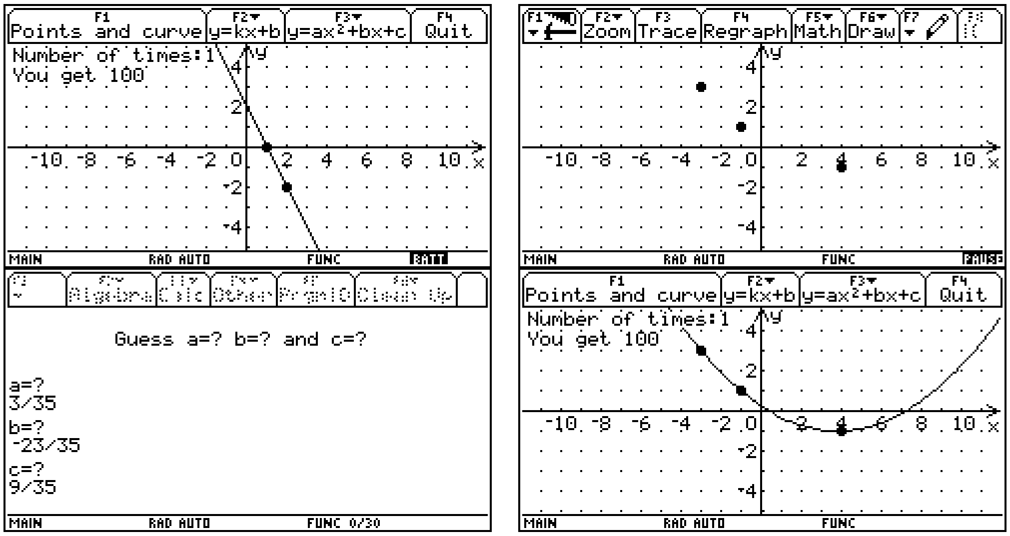
Go a step futher, we can guess the coefficients of a line only by two given points as well as guess the coefficients of a parabola only by three given points. let's try.









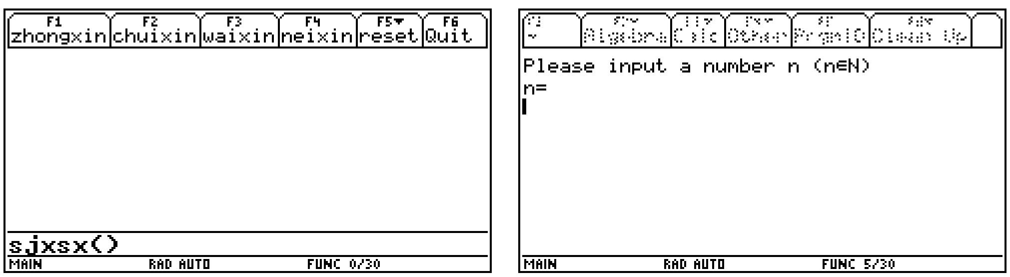


The problem is: Could you get the equation of a line through two points or the equation of a parabola through three points quickly and correctly?

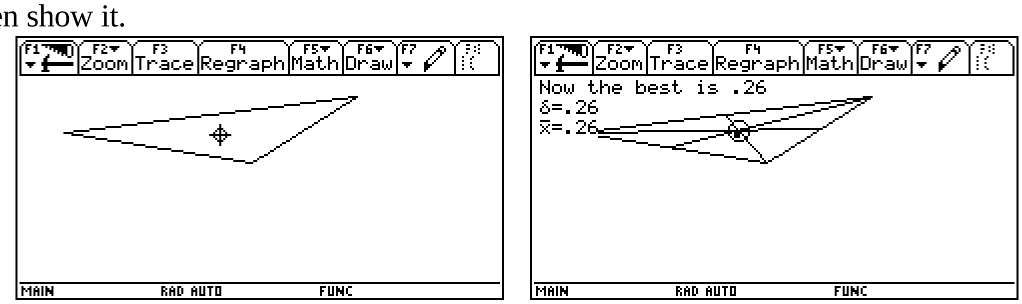
2. Can you hit "the four centers" of a triangle?

Barycenter, circumcenter, orthocenter and incenter are the basic concept of a triangle. This game involves using the calculator to position "the four centers", thereby enhance the comprehension of the concept. The game is exciting just like shooting.

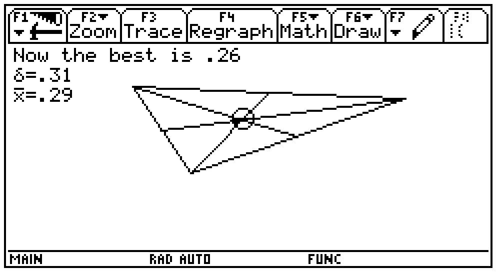
Let's start the program, select the center that we want to explore, for instance barycenter. Then the prompt about the times you attend to try is displayed at the top of the screen.

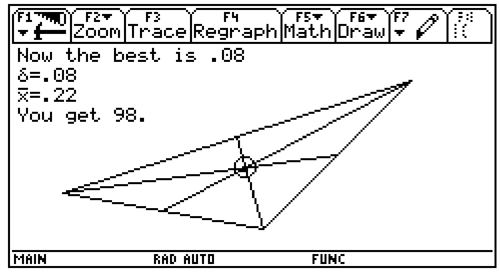


Enter a number such as 3, the calculator produce a triangle randomly. Now you can shooting, move the cursor to the place where you consider the barycenter is and press "enter". The calculator measure the error between the position you guessed and actual, then show it.

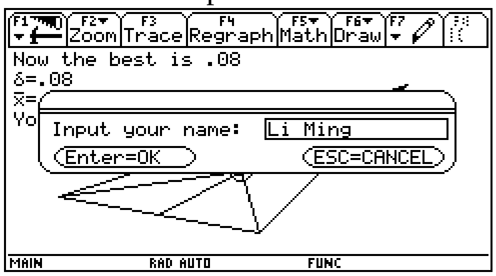


You can repeat it two times. After three times, you can get your average score.

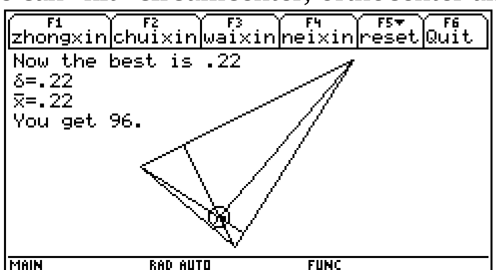


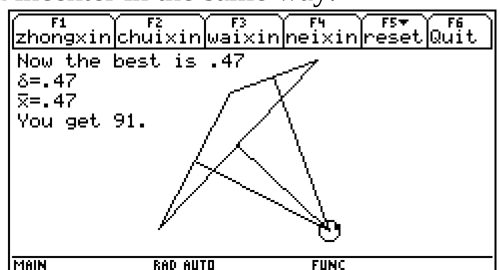


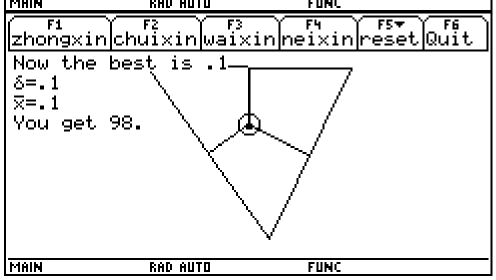
If your score is better than the "best record", you can input your name and keep it in the "best record keeper".

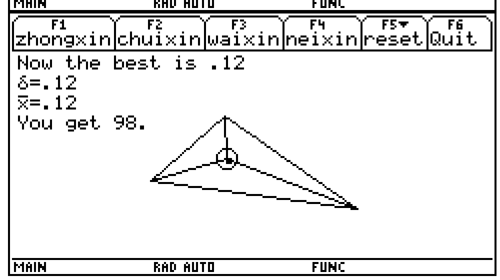


We can "hit" circumcenter, orthocenter and incenter in the same way.



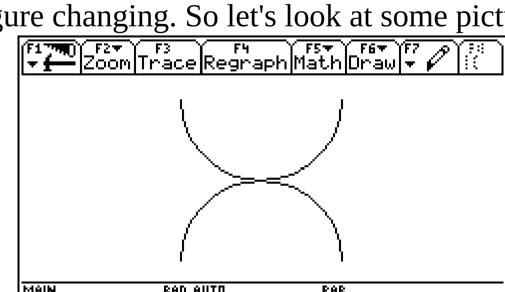
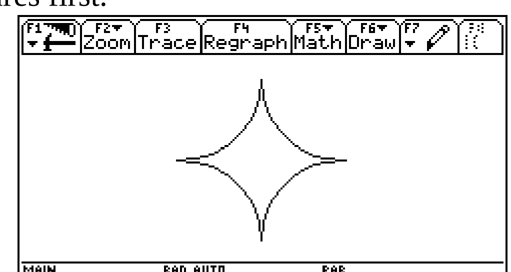
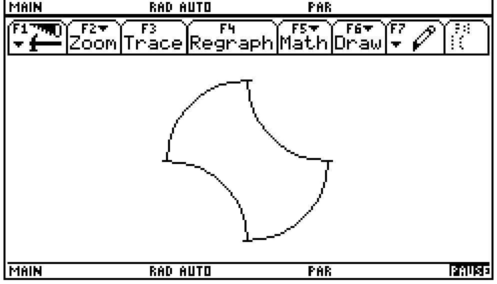
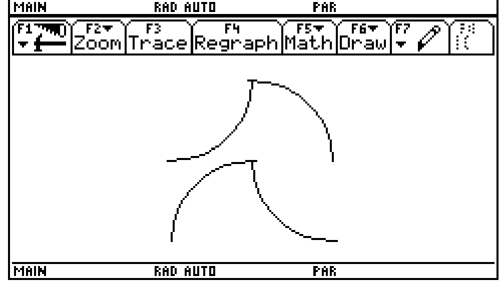




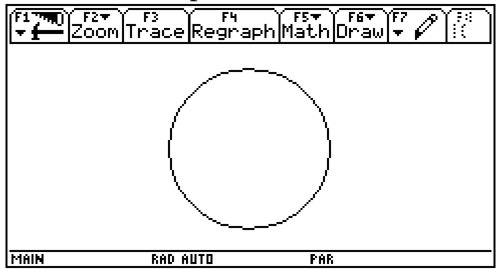


3. Compose a circle.

The goal of this game is find the relationship between coordinate changing and figure changing. So let's look at some pictures first.

We realized that the figures all be constituted by four arcs, but may be they are on the wrong positions. How can we compose it as a circle?

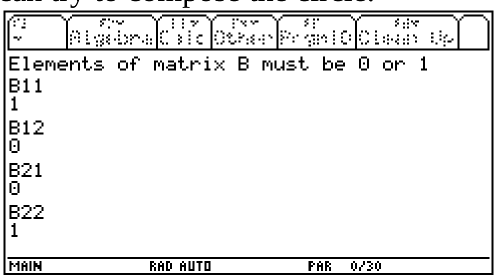


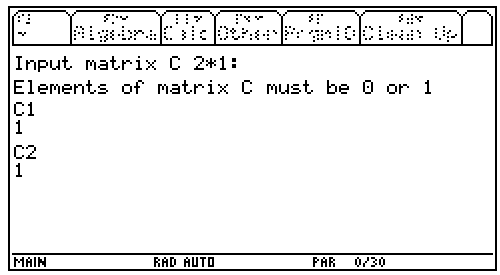
Our task is exploring a formula of coordinate changing, just like

$$\begin{cases} u = b_{11}x + b_{12}y + c_1, \\ v = b_{21}x + b_{22}y + c_2, \end{cases}$$

here (u, v) indicates new coordinate, (x, y) indicates old coordinate.

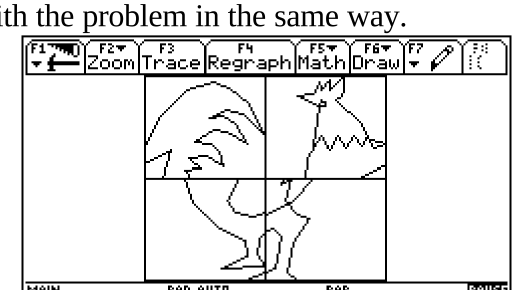
Suppose the values of $b_{11}, b_{12}, b_{21}, b_{22}, c_1, c_2$ only can be 0 or 1, also set 1+1=0. Now we can try to compose the circle.

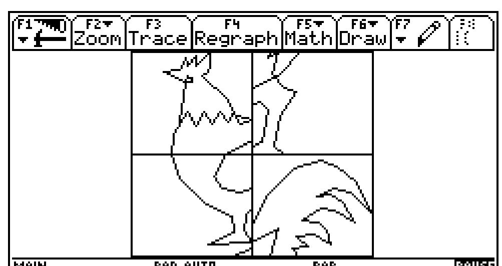


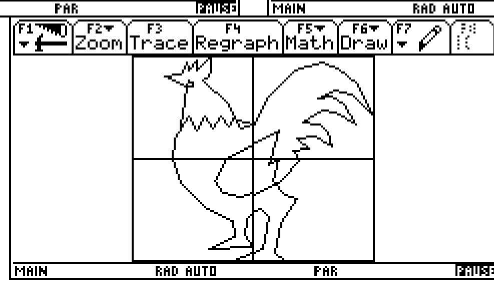


After enter the numbers, the screen displays the figure changed by values you input. If it is just a circle, that demonstrates the coordinate changing you selected is correct. If it's not a circle, you must go on the exploration until it is right.

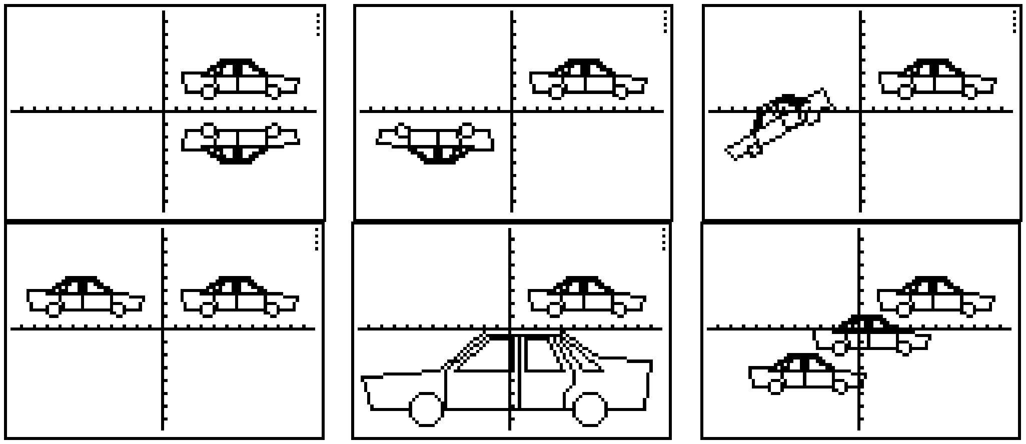
As to make the activity interesting, we also designed the picture as cock or other funny pattern. The fundamental principles is the same as mentioned above. We deal with the problem in the same way.







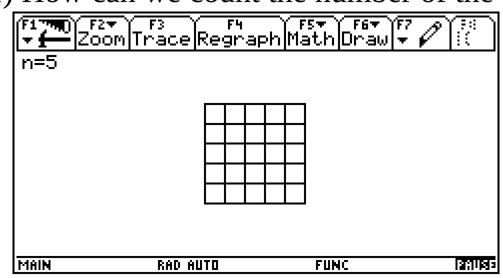
Also we can make another changing through matrix.

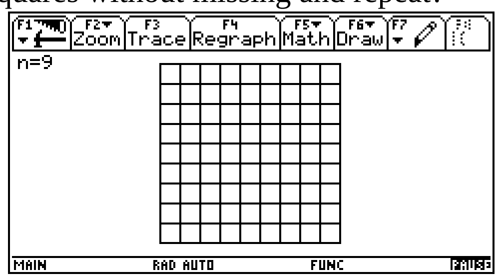


4. "Destroy" the squares.

This activity focuses on researching the relationship between $1^2+2^2+3^2+\cdots+n^2$ and n through observing the number of squares. Then "destroy" the squares using least points.

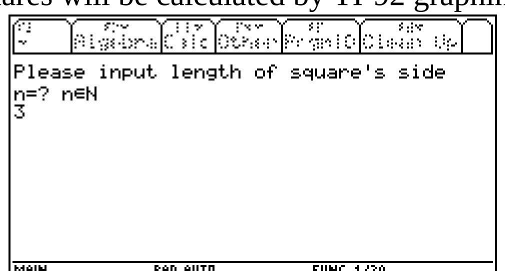
(1) How can we count the number of the squares without missing and repeat?

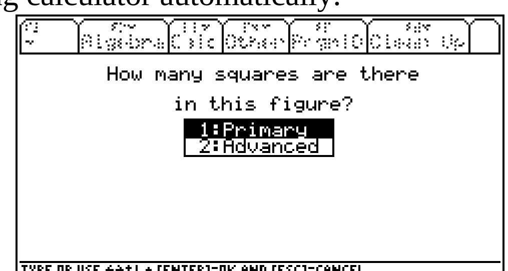


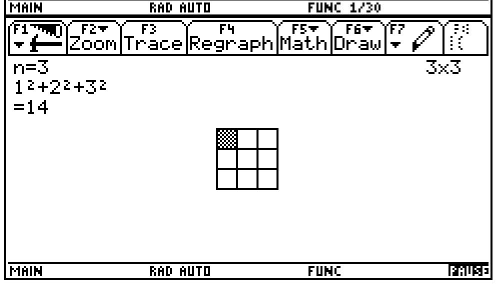


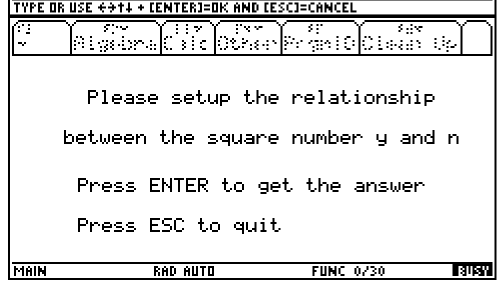
Can you setup the relationship between the total number of the squares and the length of the largest square's side?

Let's try. Start the program, input length of square's side, the total number of the squares will be calculated by TI-92 graphing calculator automatically.

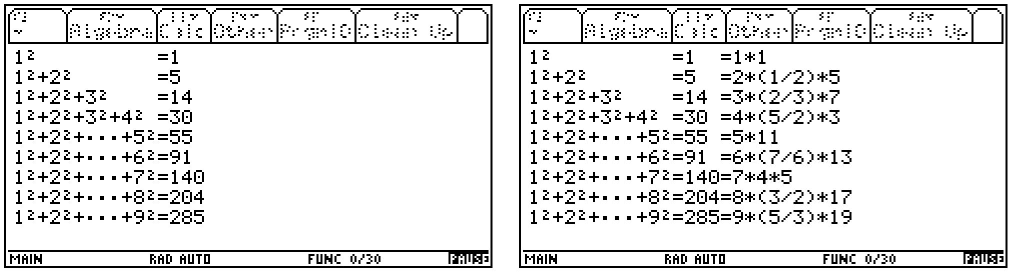




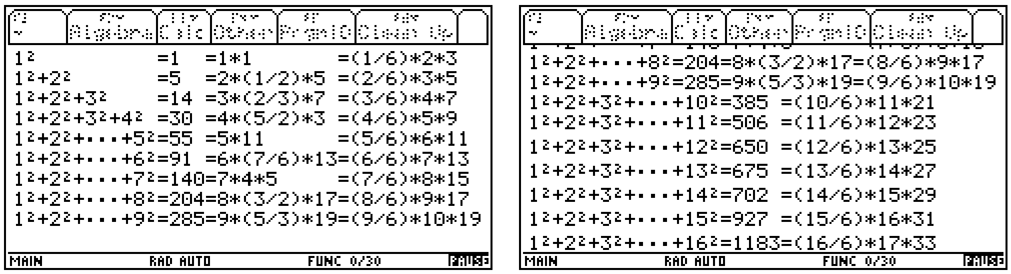




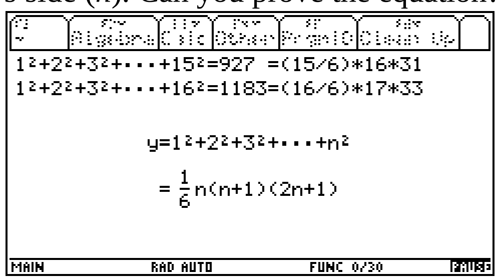
It can be concluded: when n=4, the number of the squares is $1^2+2^2+3^2+4^2$; when n=5, the number of the squares is $1^2+2^2+3^2+4^2+5^2$; ; Can we find the relationship between $1^2+2^2+3^2+\cdots+n^2$ and n?



We futher our exploration and change all the equations to multiplicative form. One of the factor is *n*. We realize that the denominator of fraction is 2, 3, 6, thereby we extract the factor 1/6.

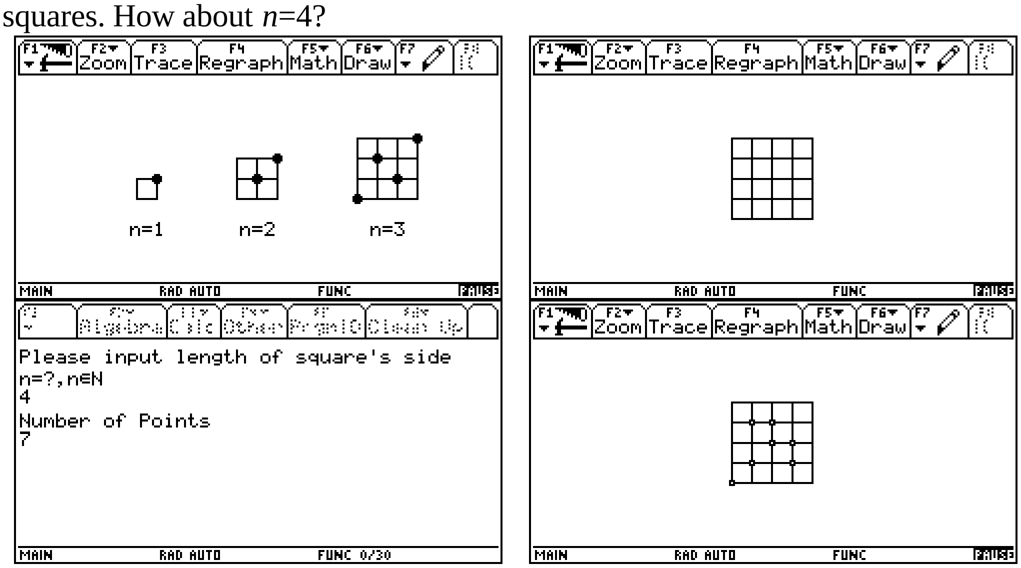


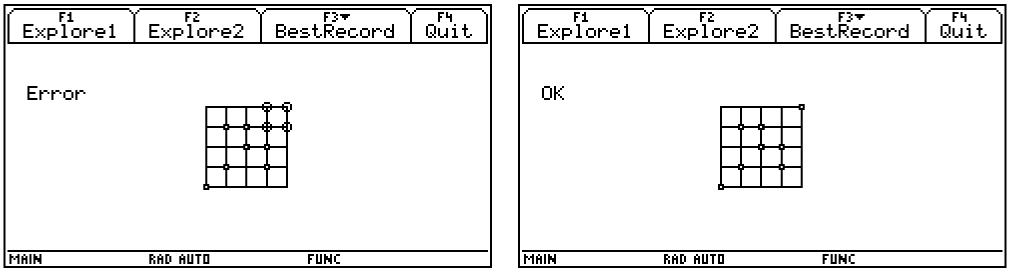
Now we can guess the relationship between the total number of the squares (*y*) and the length of the square's side (*n*). Can you prove the equation?



(2) "Destroy" the squares .

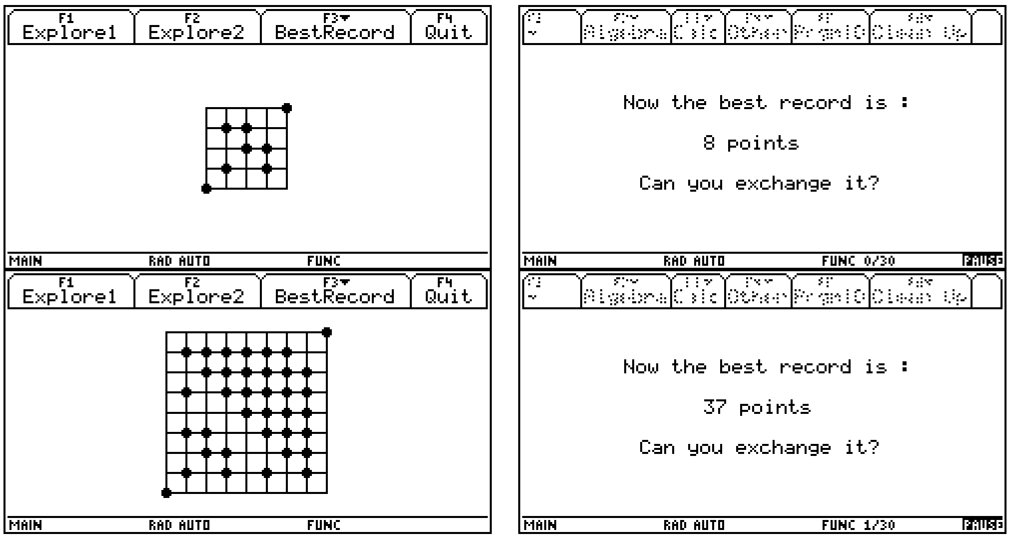
If one of the four vertices of the square is selected, it is thought the square is "destroyed". When *n*=1, one point can destroy one square; When *n*=2, it needs two points at least to destroy 5 squares; When *n*=3, it needs four points at least to destroy 14 squares. How about *n*=4?





Now we find the number of points which can destroy all the squares is 8 at least. Could you find the number of points less than 8?

Also we can choose the "Best Record" to find the answer.



The "Best Record" is only conjecture by author. You can change it as well as prove it.