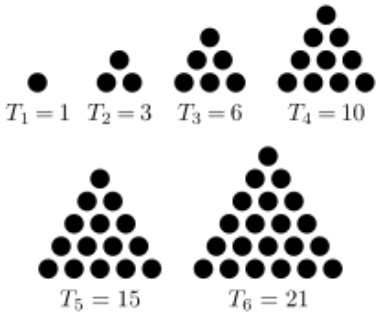
# Grade Recovery assignment

**Due**: 8am, Tuesday, December 19th 2017

You can complete this short assignment to bring up either your hw1 or hw2 grade. This short assignment will test basic knowledge of C (or Fortan), plotting, Unix, and bitbucket: you will write a short program, plot some data, and upload the program, data and figure to bitbucket. This short assignment grade will adjust one of your hw1 or hw2 grades according to the formula

$$\text{new homework grade} = (1/4)(\text{old homework grade}) + (3/4)(\text{short assignment grade})$$

So, as an example, if you have a 50 on homework 1 and a 100 on the short assignment, your new homework 1 grade will be (50)*(1/4) + (100)*(3/4) = 87.5. Your solution (to upload to bitbucket) will be the program, the figure, and the code you used to make this figure.




**Background**: In number theory, a triangle number is an integer defined by the formula

$$T_n = \sum_{k=1}^{n} k = 1 + 2 + 3 + \cdots + n\,. \tag{1}$$

Inspiration for its name can be found in the figure above. The first few triangle numbers are 1, 3, 6, 10, 15, 21, 28, 36, and 45.

In number theory, a square number is a square of an integer. For example, 0, 1, 4 and 9 are square numbers ($0^2 = 0$, $1^2 = 1$, $2^2 = 4$, and $3^2 = 9$).

Every so often a triangular number may also be a square number. An integer that is both triangle and square is called a square triangle number. The first two square triangle numbers are 1 and 36.

**Your job**: Write a program which finds the first 10 square triangle numbers. If we let $N_i$ be the $i^{\text{th}}$ square triangle number, then your code is going to find $N_1$, $N_2$, ..., $N_{10}$ (we already know $N_1 = 1$, $N_2 = 36$).

Finally, let us numerically check the theoretical number theory result that

$$\lim_{i\to\infty} \frac{N_{i+1}}{N_i} = \left(1 + \sqrt{2}\right)^4 . \tag{2}$$

Verify this property by having your program output the ratios $\frac{N_{i+1}}{N_i}$ and comparing to the numerical value of $\left(1 + \sqrt{2}\right)^4$. Plot $\left|\frac{N_{i+1}}{N_i} - \left(1 + \sqrt{2}\right)^4\right|$ vs $i$ on a plot. Please make sure to add labels, legends, and a title to your figure.

For full credit, your program *must* compute the triangular number according to the summation formula Eq. (1) and not some other (simplified) formula you find on the internet (the code must use loops).