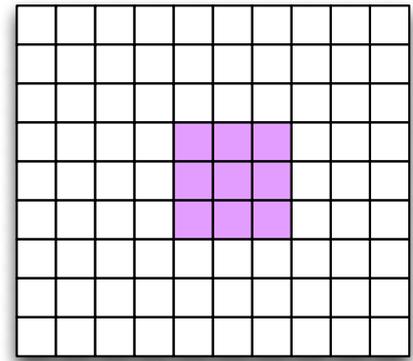


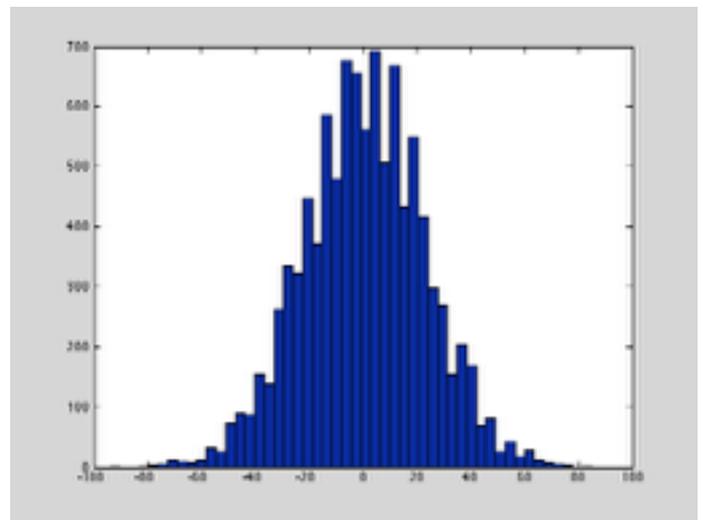
Now its your turn.

1.) Write a function that takes three integers A,B and C. The function should return the 9 cells centred at the position B,C from the magic square with width and height A. Make sure your code can cope with the conditions of B or C =1 and B or C = A.
I.e The edges of the magic square.



2.) Write a script to calculate all the prime numbers between 1 and 100. It might be useful to know that the command **mod(X,Y)** returns the remainder of the division of X by Y.

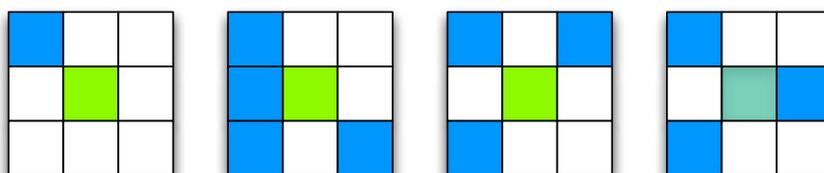
3.) A particle can move either up, down, left or right once each time step. Calculate the average distance a particle moves in 1000 step.
The command `random('bino',1,.5);` will return the numbers 1 or 0 with an equal probability of either.
The command `X=random('unid',n)` will produce either a discrete distribution up to n. The distance the particle moves after 1000 steps is $=\sqrt{X^2+Y^2}$. Where X is the left right distance and Y is the up down distance. Note that you will have to perform this calculation for many different particles to get a decent distribution.



4.) Design a life simulation. Use a Matlab square matrix to build your own world. Build a 100 x 100 cell matrix and populate a small number of the cells with living organisms, by setting the value of those cells to **1**, every other cell should be set to zero. Once you have build your world, you can use the following rules to watch life on your world play out.

- For a populated cell:
 - (a) Each little organisms with one or no neighbour little organisms dies from loneliness.
 - (b) Each little organisms with four or more neighbours perishes due to overspill population.
 - (c) Each little organisms with two or three neighbours survives because of the balance of the social structure.
- (d) For an unpopulated cell: A new little organisms arises from procreation on a cell with exactly three neighbours. (It is insignificant which of the three neighbour little animals are involved in the procreation and what their sex is.

The matrices below show the various situations outlined above.



(a)

(b)

(c)

(d)

Hint: In order to display and update your 'World' matrix you can use the following commands.

```
hook=imshow(World); % This builds a figure with the world matrix in it and calls it hook.
```

```
set(hook, 'CData', World); %This updates the  
drawnow;
```

5.) Newton's method: The Newton method is used to find the roots of a function. The idea is as follows: one starts with an initial guess which is reasonably close to the true root, then the function is approximated by its tangent line, and one computes the x-intercept of this tangent line. This x-intercept will typically be a better approximation to the function's root than the original guess, and the method can be iterated.

The tangent line is calculated using the derivative of the function. For $f(x)$, the expression for a linear function representing the tangent line at the point x_n is given by

$$y(x) = x f'(x_n) + f(x_n) - x_n f'(x_n)$$

here $f'(x)$ is the derivative of $f(x)$.

Thus the intercept of this function (i.e. the next iteration) is calculated from

$$y(x) = 0 \quad \text{as}$$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

When the difference between the intercept and the value of $f(x)$ becomes small enough you have found the root of the function. Try to obtain the roots of $f(x)=x^2-3x-2$, for an accuracy of better than 10^{-12}

6.) A casino uses a very specific card shuffling system, which is outlined below. A card machine selects a random number of cards from the front of the pack and a random number of cards from the back of the pack, leaving a small number of cards in the middle. The cards from the back are moved to the front and the cards from the front are moved to the back leaving the cards in the middle untouched.

Badly shuffled card packs make counting cards easier, the casino is worried that the 10 shuffles the machines currently perform are not enough. Write a Matlab script to simulate the problem and find the optimal number of shuffles needed to completely shuffle the cards. To be completely shuffled the casino requires that there are five or less region of the pack where original cards are next to the card they started with.

What happens if the machine keeps on shuffling?