# Homework 4 (sim09_graphics2)

## 1) Magnetic field straight current

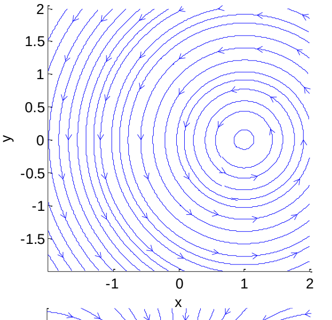
The magnitude of the magnetic field in distance r of a long straight wire with current I is $H = \frac{I}{2\pi r}$

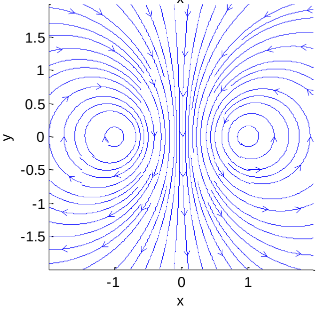
The field direction can be described with a vector

$$\begin{pmatrix} H_x \\ H_y \end{pmatrix} = \frac{I}{2\pi r^2} \begin{pmatrix} -y \\ x \end{pmatrix}$$

a) Use streamslice() to plot the field lines in the xy-plane, if the current intersects the xy-plane at the point P (x=1, y=0).

b) Superimpose the magnetic fields of two conductors at points P1 (x1=1, y1=0) and P2 (x2=-1, y2=0) whose currents are antiparallel.



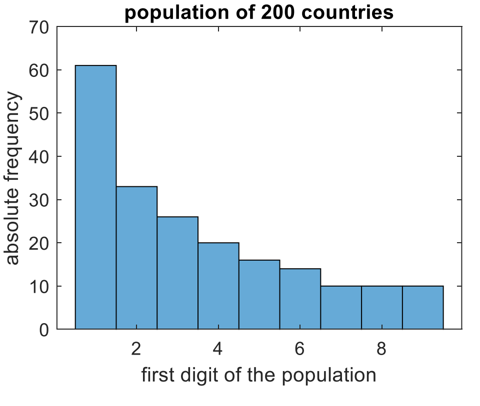




## Aufgabe 2: Benford‘s law

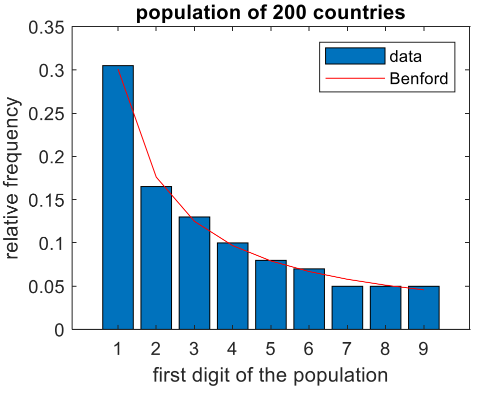
https://de.wikipedia.org/wiki/Benfordsches_Gesetz

a) Read in the data set *hw04_population.xlsx*. Column 3 contains the population of the 200 largest countries in the world. Create a histogram of the first digit of the population data.

b) Compare the relative frequency of the digits with Benford's analytical formula
p(d) = log10(1+1/x)




Application (in German)



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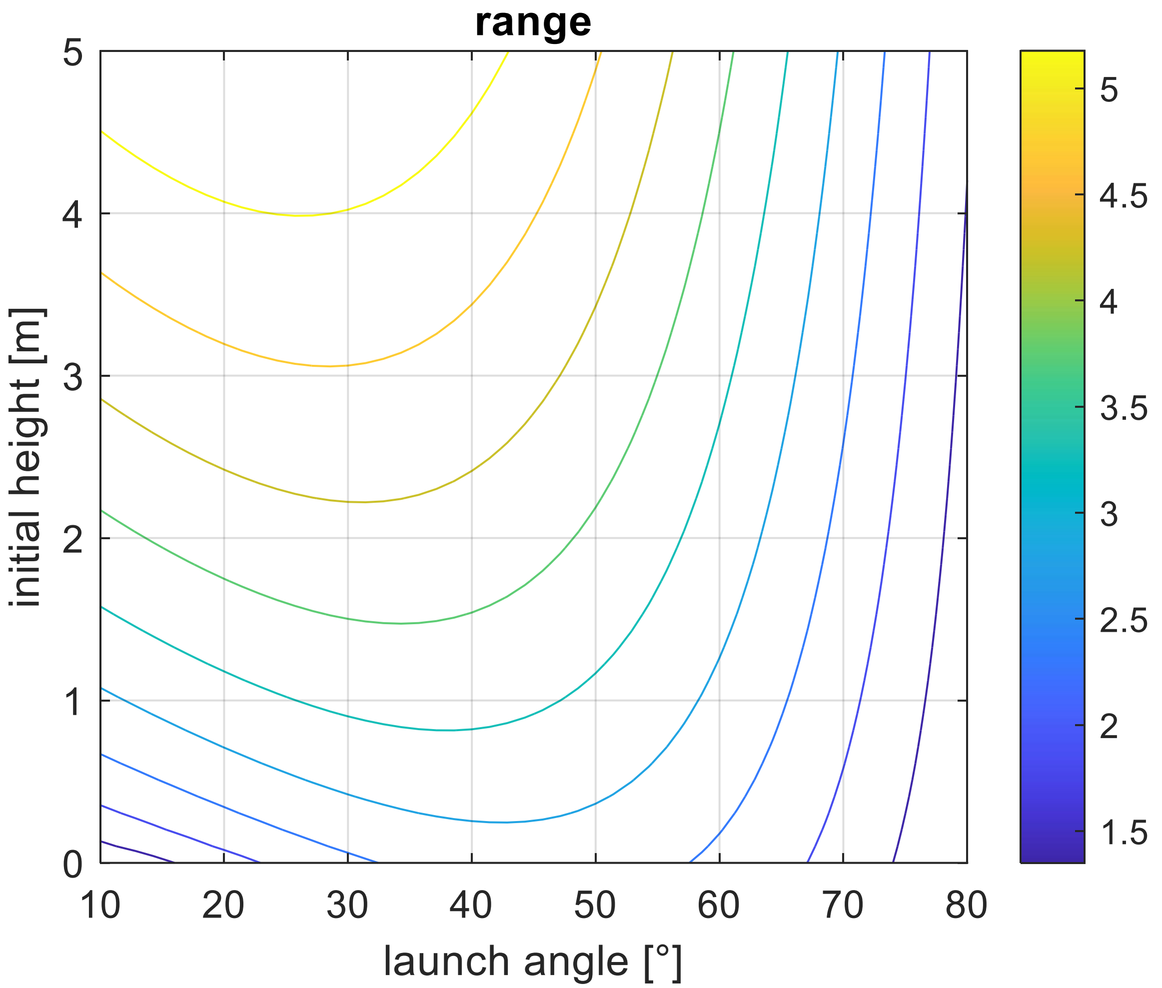
### 3) Furthest throw

The range R for a throw without friction as a function of the initial height h0 and the launch angle can be found e.g. on Wikipedia https://de.wikipedia.org/wiki/Wurfparabel.

$$R = \frac{{v_0}^2}{2g}\sin(2\beta)\left[1+\left(1+\frac{2gh_0}{{v_0}^2\sin^2\beta}\right)^{1/2}\right] = \frac{v_0\cos\beta}{g}\left(v_0\sin\beta+\sqrt{(v_0\sin\beta)^2+2gh_0}\right)$$

Define the function range(launch angle,initial height).
Generate a contourplot of the range as a function of the launch angle (10°-80°) and the initial height (0-5m) for the launch velocity v0=5m/s.




**without** Matlab: Do you understand the plot? Read from the plot the optimal launch angle from an initial height of 2.5m to achieve maximum range.