We have seen some general behavior of the virus in aggregated data, for the country where the coronavirus was originated and for four other interesting countries. There's a lot of information to be extracted from this data; for example, we haven't analyzed the effects of long/lat of countries. However, since our main purpose is to develop a predictive model in order to understand the key factors that impact the COVID-19 transmission, I'll move on to one of the most famous epidemiologic models: SIR.

SIR is a simple model that considers a population that belongs to one of the following states:

1. **Susceptible (S)**. The individual hasn't contracted the disease, but she can be infected due to transmisison from infected people
2. **Infected (I)**. This person has contracted the disease
3. **Recovered/Deceased (R)**. The disease may lead to one of two destinies: either the person survives, hence developing inmunity to the disease, or the person is deceased.

There are many versions of this model, considering birth and death (SIRD with demography), with intermediate states, etc. However, since we are in the early stages of the COVID-19 expansion and our interest is focused in the short term, we will consider that people develops immunity (in the long term, immunity may be lost and the COVID-19 may come back within a certain seasonality like the common flu) and there is no transition from recovered to the remaining two states. With this, the differential equations that govern the system are:

dSdt=−βSINdSdt=−βSIN

dIdt=βSIN−γIdIdt=βSIN−γI

dRdt=γIdRdt=γI

Where ββ is the contagion rate of the pathogen and γγ is the recovery rate.

2.1. Implementing the SIR model

SIR model can be implemented in many ways: from the differential equations governing the system, within a mean field approximation or running the dynamics in a social network (graph). For the sake of simplicity, I'vem chosen the first option, and we will simply run a numerical method (Runge-Kutta) to solve the differential equations system.

The functions governing the dif.eqs. are: