SEIR model dynamical equations:

\[
\begin{align*}
\frac{dS}{dt} &= \nu - \beta SI - \mu S \\
\frac{dE}{dt} &= \beta SI - \sigma E - \mu E \\
\frac{dI}{dt} &= \sigma E - \gamma I - \mu I \\
\frac{dR}{dt} &= \gamma I - \mu R
\end{align*}
\]

- \( S(t) \) = number of individuals not yet infected with the disease at time \( t \), or those susceptible to the disease.
- \( E(t) \) = number of individuals who have the disease but not yet show any symptom.
- \( I(t) \) = number of individuals who have been infected with the disease and are capable of spreading the disease to those in the susceptible category.
- \( R(t) \) = the number of individuals who have been infected and then removed from the disease, either due to immunization or due to death.

**S+E+I+R=N** (whole population)

- \( \nu \) = Birthrate
- \( \mu \) = Death rate
- \( \sigma^{-1} \) = mean latent periods
- \( \gamma^{-1} \) = mean infectious periods
- \( \beta \) = mean transmission rate

The classic model for micro parasite dynamics is the flow of hosts between Susceptible, Exposed (but not infectious), Infectious and Recovered compartments. This leads to the following standard formulation of the SEIR model.

In this model, the population consists of four groups: \( S \) is the fraction of susceptible individuals (those able to contract the disease); \( E \) is the fraction of exposed individuals (those who have been infected but are not yet infectious); \( I \) is the fraction of infective individuals (those capable of transmitting the disease); \( R \) is the fraction of recovered individuals (those who have become immune).

The most important driving force in repeated measles outbreaks over many years is the seasonal forcing in the contact rate \( \beta \). During the school year, the contact rate is high, during the holidays it is low. The epidemic oscillator results from interplay of seasonal forcing, which triggers a single outbreak, and the birth process, which slowly increases the number of susceptibles between two outbreaks.

Measles is a highly infectious childhood disease, caused by respiratory infection by a morbillivirus, measles virus (MV). The disease exhibits clearly non-stationary patterns in time series of cases.

When modeling measles dynamics, or those of any other micro parasitic disease, the number or density of individuals in each stage of the disease is the important quantity to keep track of whereas the viral load per person is relatively unimportant.

Simulation with SEIR model
Simple Object Orientated Programming Example

```python
classdef mydate
    % write a description of the class here.

    % define the properties of the class here, (like fields of a struct)
    % minute = 0;
    % hour;
    % day;
    % month;
    % year;
end

% methods, including the constructor are defined in this block

function obj = mydate(minute,hour,day,month,year)
    % class constructor
    if(min > 0)
        obj.minute = minute;
        obj.hour = hour;
        obj.day = day;
        obj.month = month;
        obj.year = year;
    end
end

function obj = rollDay(obj,numdays)
    try
        obj.day = obj.day + numdays;
    catch
        printf('ERROR: Adding days failed');
    end
end
end
```

**Properties:** Defines the variables of the object. May be accessed externally and, if `obj` is passed, by the functions of the object.

**Constructor:** When a new instance of the object is created, this method initialises the properties variables.

**Public Method:** Method that simply adds days to the object.

### Error handling examples

#### Usage example of the mydate object

```plaintext
>> a = mydate(2,1,34,2,1990)  # usage example of the mydate object
a =

    mydate with properties:
        minute: 2
        hour: 1
        day: 34
        month: 2
        year: 1990

>> a = a.rollDay(3)  # usage example of the mydate object
a =

    mydate with properties:
        minute: 2
        hour: 1
        day: 37
        month: 2
        year: 1990
```

All files can be found at https://www.dropbox.com/sh/uq33pxipwcw4uii/SWjonuSWG4