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System Simulation and Modeling

Assignment 2

To model the rise and fall in popularity of a song, let’s assume a standard normal distribution curve. This curve can be simulated with a logistic growth model combined with an inverted logistic model. The logistic curve can be modeled as follows:

The inverse logistic model can be represented as follows:

We can simulate a continuous-time model using the following formula as an approximation of a differential equation. Using the following equation to convert the logistic growth models:

We get this continuous time logistic growth equation to simulate the song’s popularity behavior:

And this continuous time *inverse* logistic growth model:

The continuous time logistic growth equation simulate the rise of the song’s popularity and the inverse logistic growth model simulates the decline in popularity. The point at which decline happens can be determined after the popularity hits its max potential at ‘K’ or with a specific timestep as in the example program below. Look for the yellow-highlighted section. There, the decline in popularity begins halfway through the simulation.

**from** pylab **import** \*  
  
r = 0.2  
K = 1.0  
Dt = 0.01  
  
**def** initialize():  
 **global** x, result, t, timesteps  
 x = 0.1  
 result = [x]  
 t = 0.  
 timesteps = [t]  
   
**def** observe():  
 **global** x, result, t, timesteps  
 result.append(x)  
 timesteps.append(t)  
  
**def** update():  
 **global** x, result, t, timesteps  
 **if** t < 40:  
 x = x + r \* x \* (1 - x / K) \* Dt  
 **else**:  
 x = x - r \* x \* (1 - x / K) \* Dt  
 t = t + Dt  
  
initialize()  
**while** t < 80.:  
 update()  
 observe()  
  
plot(timesteps, result)  
show()

