**Exercise 1**

1.1 Your friend's mood dependent on the past few days as well as in the current day's weather. You've collected data for the past 365 days on the weather, which you represent as a sequence as x<1>,...,x<365>. You've also collected data on your friends's mood, which you represent as y<1>,...,y<365>. You'd like to build a model to map from x→y. Should you use a Unidirectional RNN or Bidirectional RNN for this problem?

1.2 Explain why vanishing gradients affects heavily on RNN's than in deep FNN's

**Solution:**

1.1 You need a unidirectional RNN because your friend's mood does only depend on the current and past days' weather. Having the information from the future weather's would not help you.

1.2 Vanishing gradients affect much more RNN's because the weight matrices (in time steps) are shared whereas in FNN the weight matrices are different at each step.
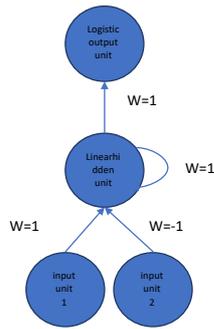
**Exercise 2**

In this exercise we are showing several "rolled" computational graphs of RNN. For each one, you are asked to (1) draw the "unrolled" computational graphs for the input that we ask, make sure to write the values of inputs, hidden, outputs units and also weights for each time step; (2) you have to write the RNN equations and (3) you have to explain what the RNN is learning

2.1 For the following RNN, we have the following input sequence: x(t=0)=2, x(t=1)=-0.5; x(t=2)=1
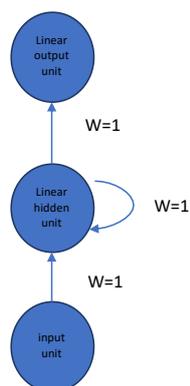


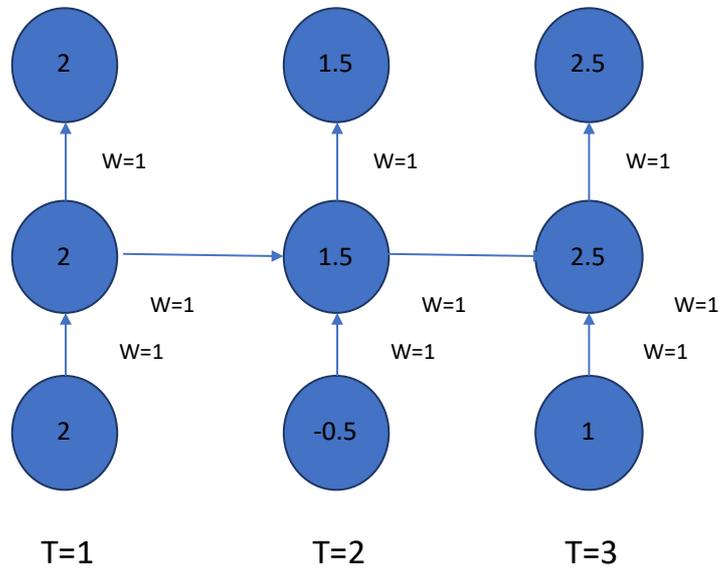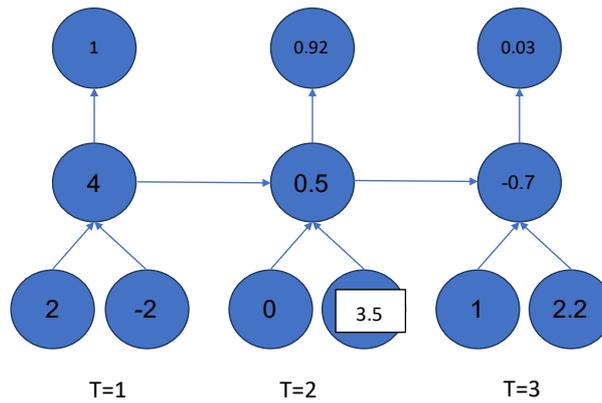2.2 For the following RNN, we have the following input sequence x(t=0)=(2,-2); x(t=1)=(0,3.5); x(t=2)=(1,2.2)

SOLUTION

2.1 Equations: h(t)=Wx(t)+Wh(t-1); y(t)=Wh(t); The network is summing the inputs.



| 2 | 1.5 | 2.5 |
|---|-----|-----|
| W=1 | W=1 | W=1 |
| 2 | 1.5 | 2.5 |
| W=1 | W=1 | W=1 |
| W=1 | W=1 | W=1 |
| 2 | -0.5 | 1 |
| T=1 | T=2 | T=3 |

2.2 Equations h(t)=Wx(t)+Uh(t-1); y(t)=f(Wh(t)), with $f(z) = \frac{1}{1+e^{-z}}$

This one compares the total values of the first or second input

## Exercise 3.

The figure shows a RNN with one input unit x, one logistic hidden unit h, and one linear output unit y. The Network parameters are Wxh=-0,1, Whh=0.5 and Why=0.25, hbias=0.4 and ybias=0.0. The input takes the values 18, 9, -8 at time steps 0,1 and 2.
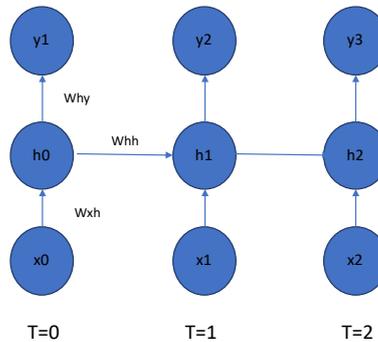


3.1-Compute the hidden value h0
3.2-Compute the output value y1
3.3-Compute the output value y2

SOLUTION:

3.1

$$f(z) = \frac{1}{1 + e^{-z}}$$

$h_0 = f(x_0 W_{xh} + h_{-1} W_{hh} + b);$
$h_0 = f(18 * -0.1 + 0 + 0.4);$

$h_0 = \frac{1}{1 + e^{1.4}} = 0,2;$

3.2

$y_1 = W_{hy} h_0 = 0,25*0,2=0,05$

3.3

$$h_1 = f(x_1 W_{xh} + h_0 W_{hh} + b)$$

$$y_2 = W_{hy} h_1 = 0{,}25 * h_1$$