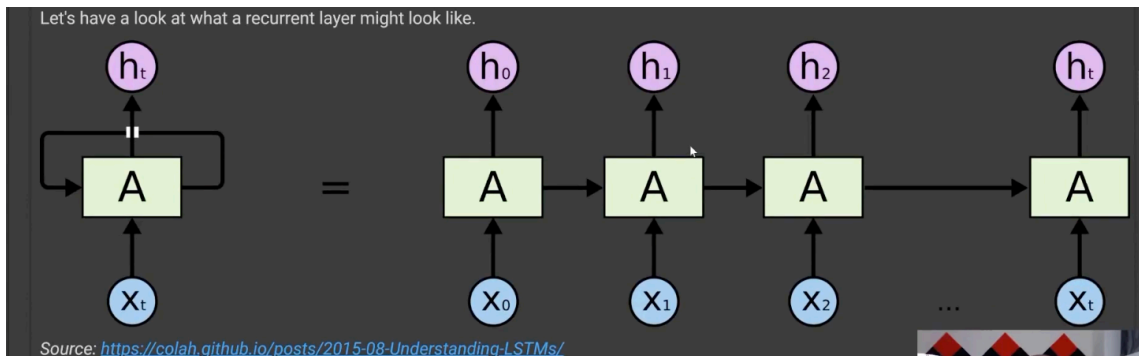- *turning the block of text into numbers*
- *recurrent neural networks <- for processing text*
    - -> vs dense / convolutional neural networks
    - -> in dense networks every node is connected to every other node in the next layer
    - -> in convolutional neural networks filters are applied to images which search for specific features
    - -> recurrent neural networks contain internal loops
    - *-> processing it at different time steps*
        - -> feed forward neural networks -> passing the data from left to right
        - -> it might be passed through different types of layers
        - -> you don't feed the entire data set to the network at the same time, you feed it one word at a time
        - -> like when people read words -> processing everything one word at a time
        - -> you're not feeding the entire paragraph into the network at the same time, you're doing it one word at a time
            - -> because the order of the elements in that model matter
    - *-> unravelling a recurrent layer*
        - -> the output of the entire model changes each time you input a word into it
            - -> the output of the next iteration depends on the output of the last
            - -> the model is trained using an iterative approach

Let's have a look at what a recurrent layer might look like.

Source: https://colah.github.io/posts/2015-08-Understanding-LSTMs/

- -> these are recurrent layers
- *long short term memory*
    - -> this is an example of a recurrent neural network
    - -> all of the things in the circle are one layer
        - we're training one layer by passing the words into it one at a time
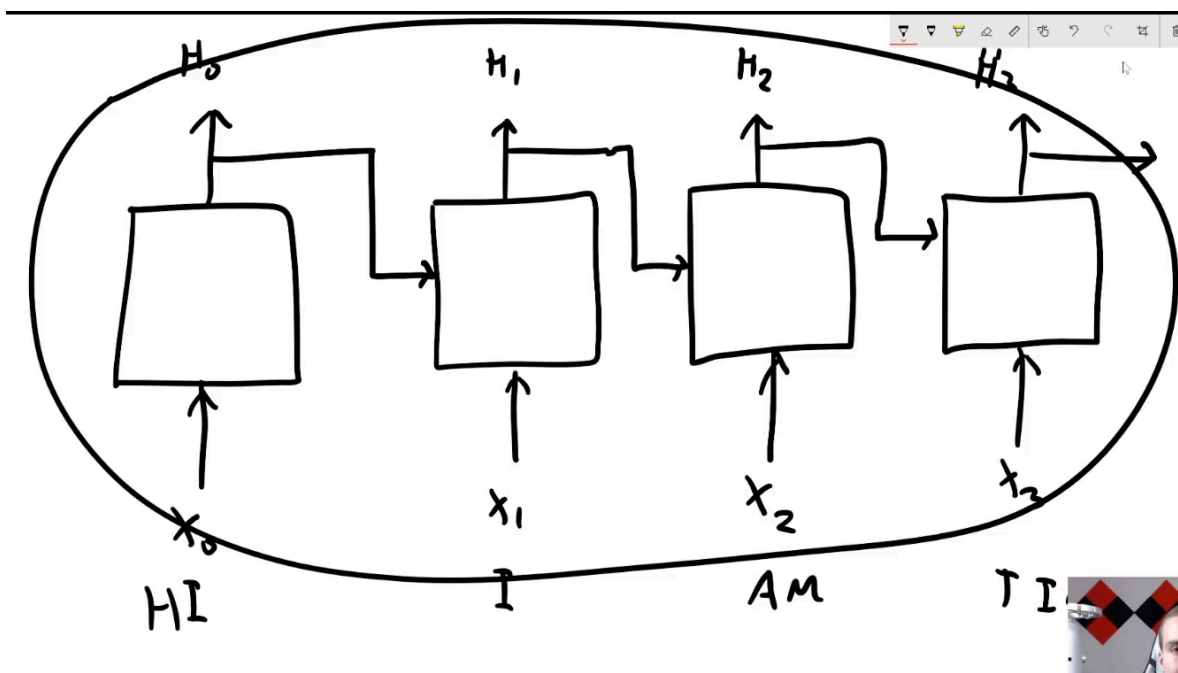
- ○ -> each of the words in the block of text is processed at different points in time
- ○ -> each time we pass a word into the model it does maths
- ○ -> then it moves onto the next word and processes it -> the output of the model from the previous iteration gets passed into the next iteration for the next word
  - ‣ -> this entire thing is all for one layer
  - ‣ -> we process one word then the next based off of the past one and we repeat this until the entire block of text is done <- this is one layer of the recurrent neural network
- ○ **-> this is a simple recurrent neural network layer**
  - ‣ -> building the understanding as you work through the entire sequence
  - ‣ -> the meaning of the sequence gets lost when you train the model
  - ‣ -> if you have a very long passage of text then it becomes a lot less affected by the text at the start
- ○ **long short term memory**
  - ‣ -> this adds another component which keeps track of the internal state
  - ‣ -> not just the previous output
  - ‣ -> so we can access the output of any previous state
  - ‣ -> putting each value at the end of each iteration in the layer into an array
    - • -> i.e we process one word in the text, the model has a value -> then this output is fead into the maths for the next word
    - • -> and this is all part of one layer in the network
    - • -> we store the values of the algorithm during the iteration for each word -> we store those values in an array
    - • -> rather than just the value of the number of the array at the end of the entire thing
  - ‣ -> so we can compare the first and last paragraph of a block of text
    - • -> rather than just keeping the current value of the algorithm -> we have a record of all of the values which it held
  - ‣ -> recurrent neural networks
    - • -> maintain an internal memory/state of the input that was already processed
    - • -> contain a loop and process one piece of input at a time