

THIS IS

CPSC110H

BASICBUTTON CODE

HACKER EDITION – 3 STATES

BASIC NEURAL NETWORKS

NO STATE

An example from the hip 90s

An example from the hip 90s

The movie was a bomb.

The movie was the bomb.

An example from the hip 90s

Laputa: castle in the sky is the bomb. The message is as strong as his newer works and more pure, fantastic and flying pirates how could it be any better!.

This movie blends comedy, action and great special effects. It even has a person in it that does a lot of voices on The Simpsons. William H. Macy is the bomb.

An example from the hip 90s

This movie was terrible! I rented it not knowing what to expect. I watched the 1st 5 minutes and the movie and knew it was a bomb.

The first movie that was a remake of the Disney cartoon classic starring Glenn Close as Cruella De Vil, it seemed like a sure hit, but it was just a bomb.

THE SOLUTION FOR OVER 20 YEARS

NGRAM MODELS

THE PROCESS

Laputa: castle in the sky is the bomb.

Tokenization

```
['laputa', ':', 'castle', 'in', 'the',  
 'sky', 'is', 'the', 'bomb', '.']
```

THE PROCESS

Laputa: castle in the sky is the bomb.

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unigrams

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THE PROCESS

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Tokenization

```
['laputa', ':', 'castle', 'in', 'the',  
 'sky', 'is', 'the', 'bomb', '.']
```

unigrams

```
['laputa', ':', 'castle', 'in', 'the',  
 'sky', 'is', 'the', 'bomb', '.']
```

bigrams

```
[['$', 'laputa'], ['laputa', ':'], [':', 'castle'],  
 ['castle', 'in'], ['in', 'the'], ['the', 'sky'],  
 ['sky', 'is'], ['is', 'the'], ['the', 'bomb'],  
 ['bomb', '.'], [',', '$']]
```

TEXT

GOOGLE NGRAM CORPUS

Laputa: castle in the sky is the bomb.

Ngram viewer

**WITH NGRAMS WE CAN FAKE
SEQUENCES.**

Just add integers for ngrams.

NGRAMS

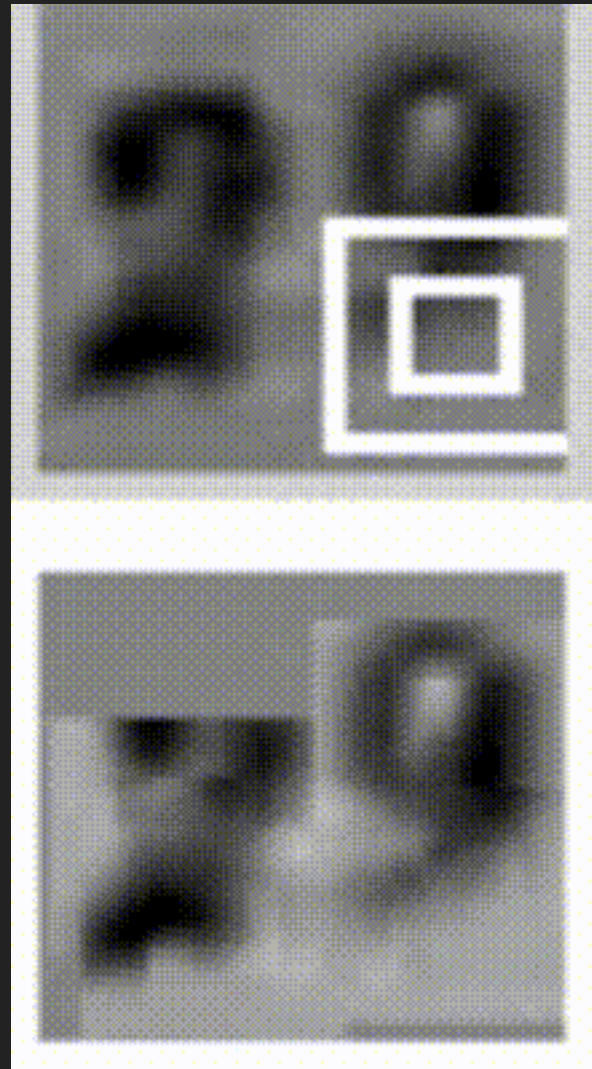
Was a great solution

NGRAMS

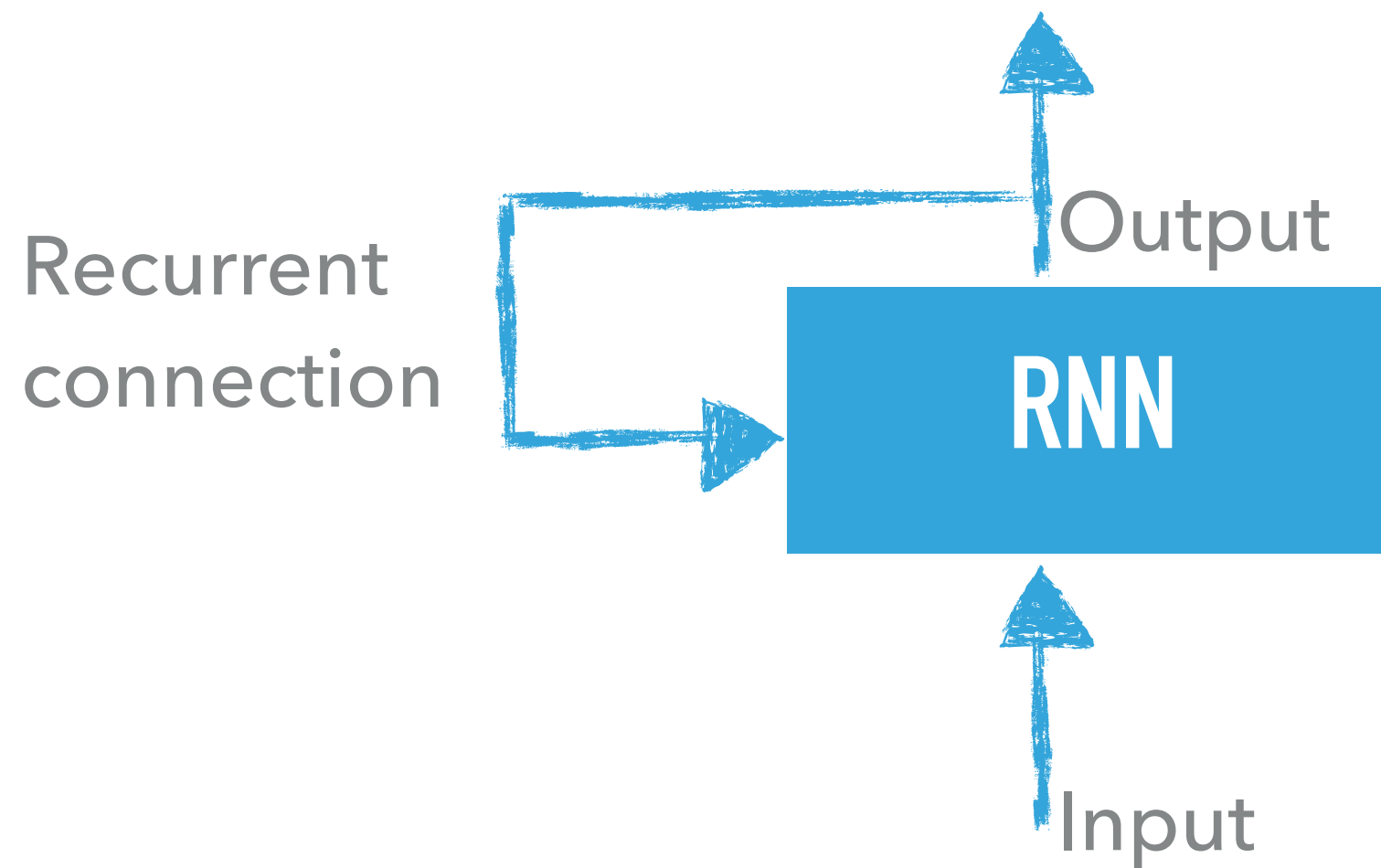
Not a good solution

PROBLEM RESTATED

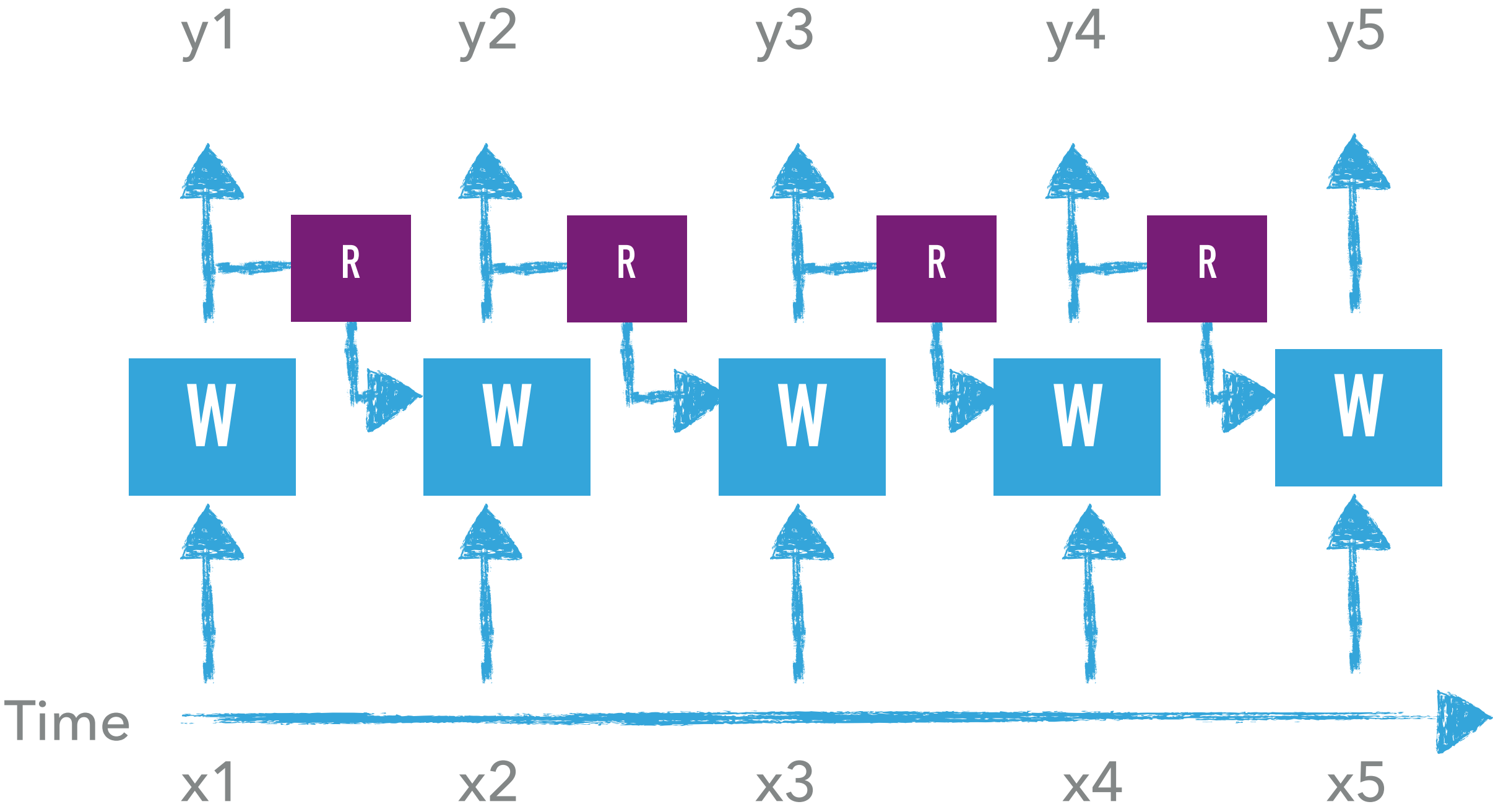
- ▶ Neural Networks stateless
- ▶ Can fake it by using ngrams
- ▶ But that feels unsatisfactory
- ▶ We need state
- ▶ Not just for language but for other problems



RNN – recurrent neural network



Loop. State



PLAIN OLD NN

`activation(dot(W, input_t) + b)`

PLAIN OLD NN VS RNN

`activation(dot(W, input_t) +
dot(U, state_t) + b)`

PLAIN OLD NN

`activation(dot(W, input_t) + b)`

PLAIN OLD NN VS RNN

`activation(dot(W, input_t) +
dot(U, state_t) + b)`

```
state_t = np.zeros((output_features,))  
for input_t in inputs:  
    output_t = np.tanh(np.dot(W, input_t) +  
                        np.dot(U, state_t) + b)  
    successive_outputs.append(output_t)  
    state_t = output_t
```

A high-angle, black and white photograph of a massive concrete dam. The dam's surface is composed of large, rectangular concrete blocks, creating a textured, grid-like pattern. A single person stands on the top edge of the dam, providing a sense of scale to the enormous structure. The sky is a uniform, dark grey, and the overall lighting is dramatic, highlighting the textures of the concrete.

RECURRENT NEURAL NETWORKS

RNN – KERAS

KERAS

```
from keras.layers import SimpleRNN
```

KERAS

```
from keras.layers import SimpleRNN
```

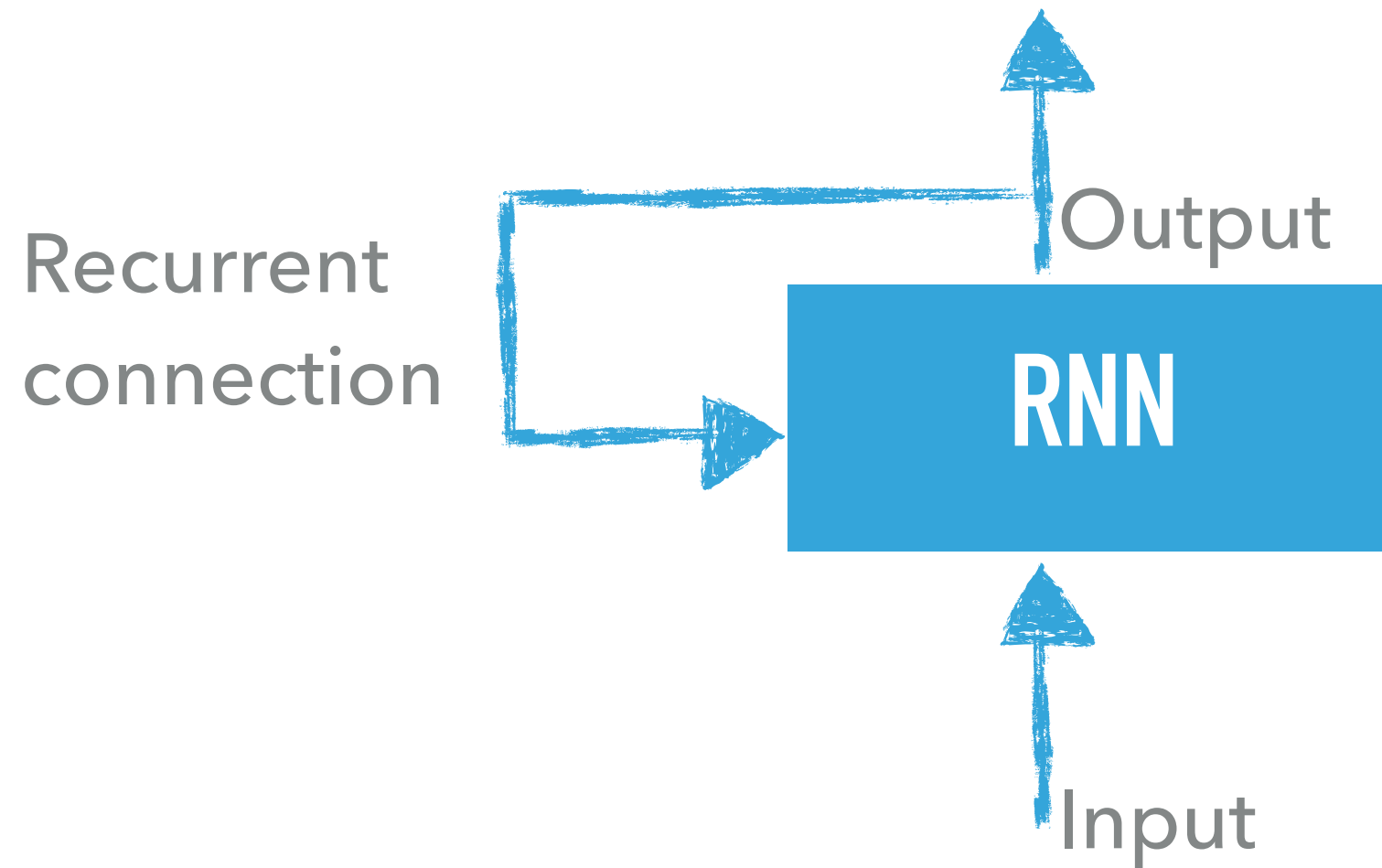
```
>>> model.add(Embedding(10000, 32))
```

```
>>> model.add(SimpleRNN(32))
```



Dimensionality of
output space

RNN – recurrent neural network



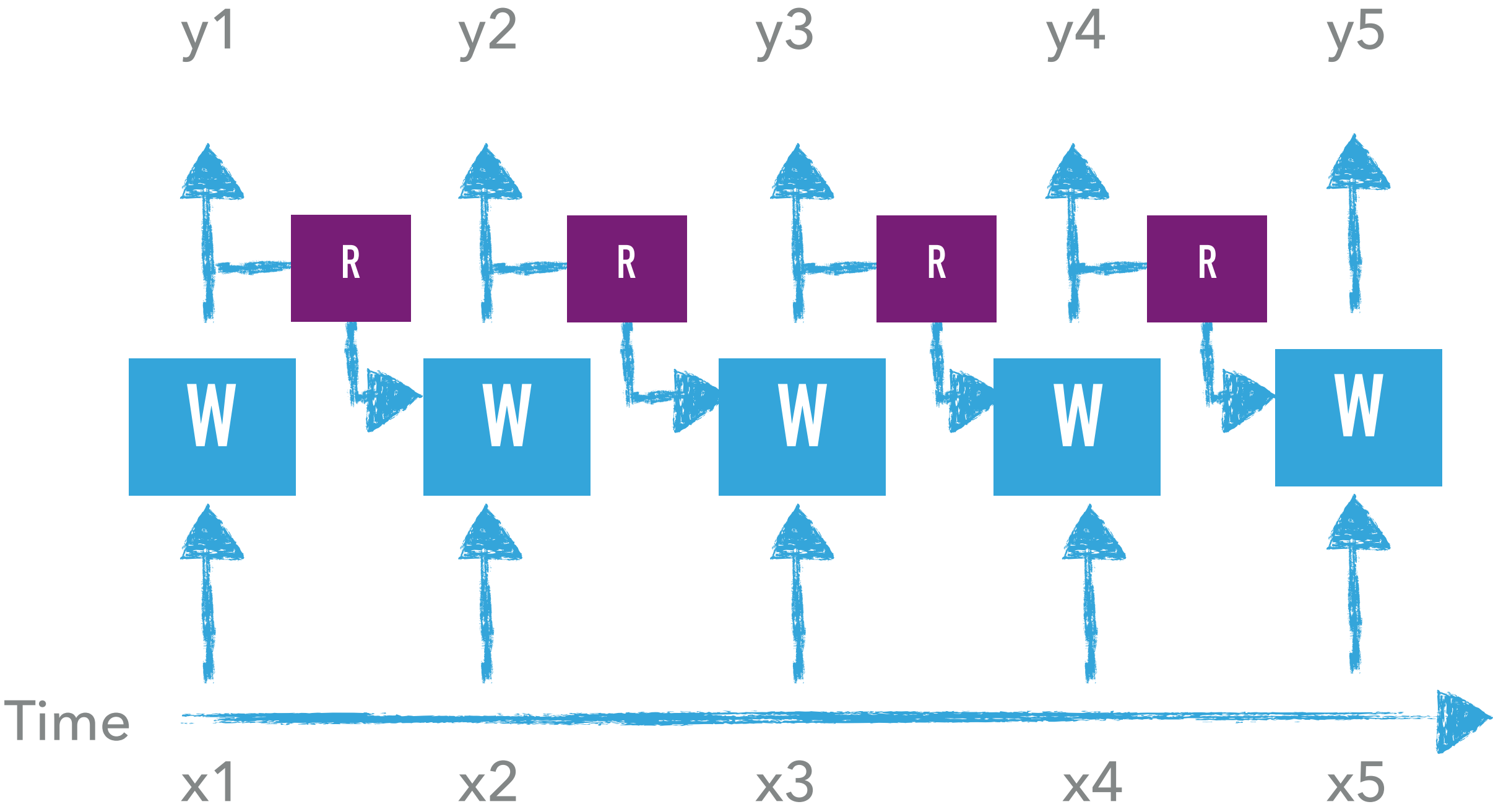
Loop. State

SOMETIMES WE WANT THE LAST OUTPUT

```
from keras.layers import SimpleRNN
```

```
>>> model.add(Embedding(10000, 32))
```

```
>>> model.add(SimpleRNN(32))
```



SOMETIMES WE WANT THE ENTIRE OUTPUT

```
from keras.layers import SimpleRNN
```

```
>>> model.add(Embedding(10000, 32))
```

```
>>> model.add(SimpleRNN(32, return_sequences=True))
```



NEXT TIME

RNN LAB 1

RNN – recurrent neural networks – in Keras