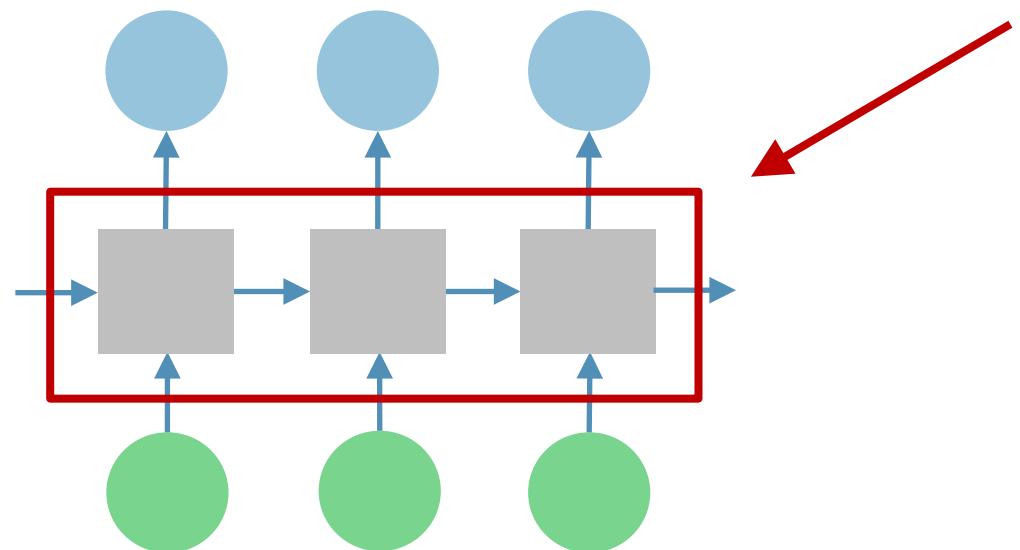


Practical use cases

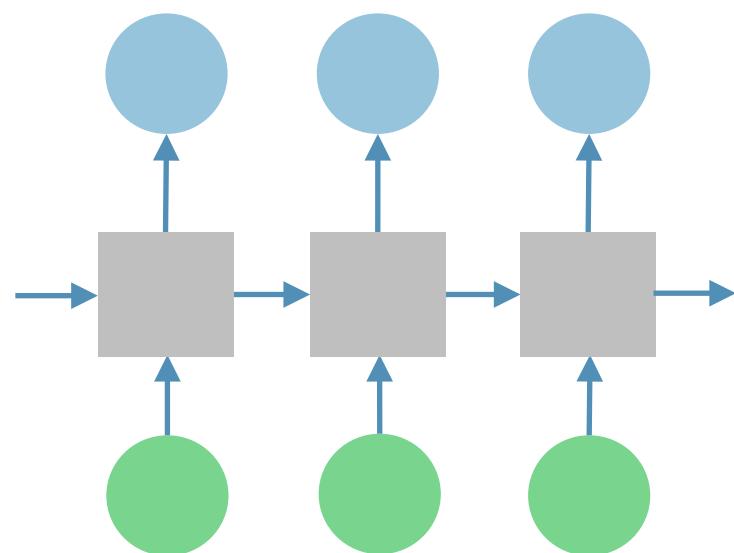
Previously on this week: Recurrent architecture



One or more layers:

- Simple RNN
- LSTM
- GRU
- ...

Elements-wise classification



Input
Output

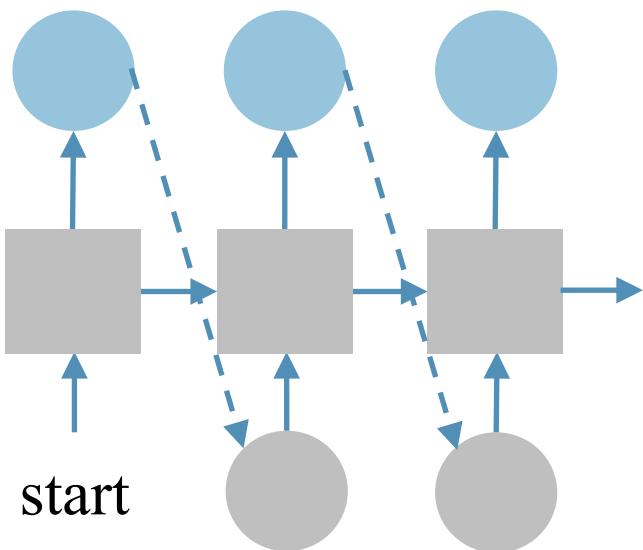
sequence
sequence

Input and output are synchronized

Tasks

- POS tagging
- Video frames classification

Sequence generation



Input
Output

sequence

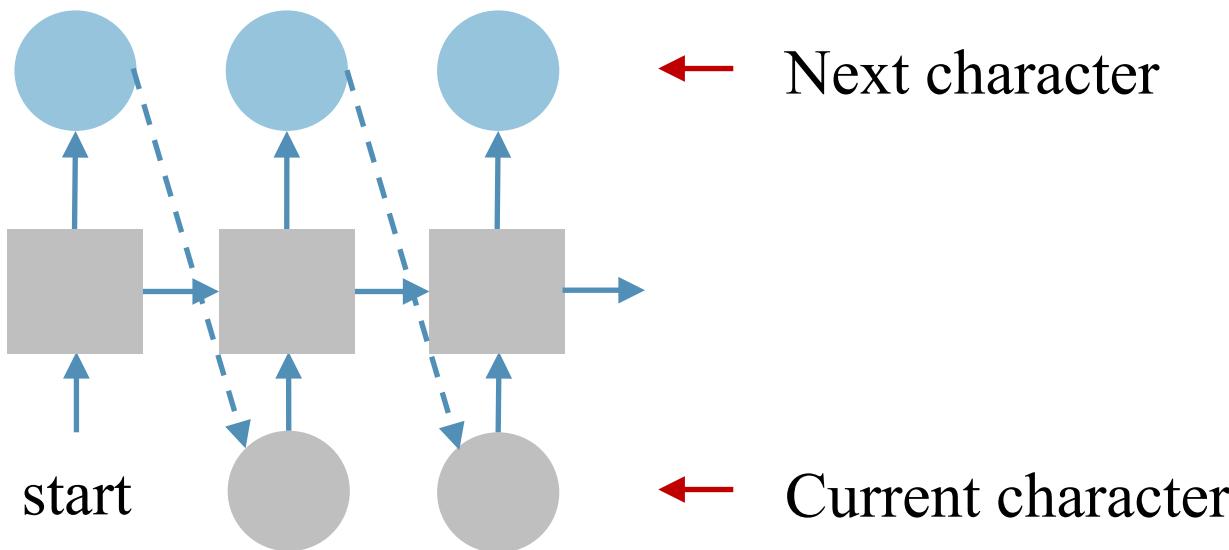
Tasks

- Character-based language model
- Word-based language model
- Music generation
- Speech generation
- Handwriting generation
- ...

Char-based language model: Shakespeare

Model
Training data

3 layer LSTM of 512 units
all the works of Shakespeare



Char-based language model: Shakespeare

Second Senator:

They are away this miseries, produced upon my soul,
Breaking and strongly should be buried, when I perish
The earth and thoughts of many states.

DUKE VINCENTIO:

Well, your wit is in the care of side and that.

Second Lord:

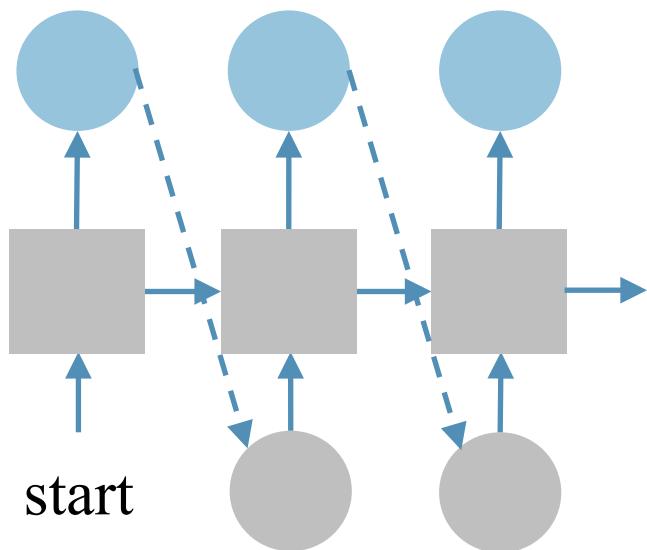
They would be ruled after this chamber, and
my fair nues begun out of the fact, to be conveyed,
Whose noble souls I'll have the heart of the wars.

Clown:

Come, sir, I will make did behold your worship.

Handwriting generation

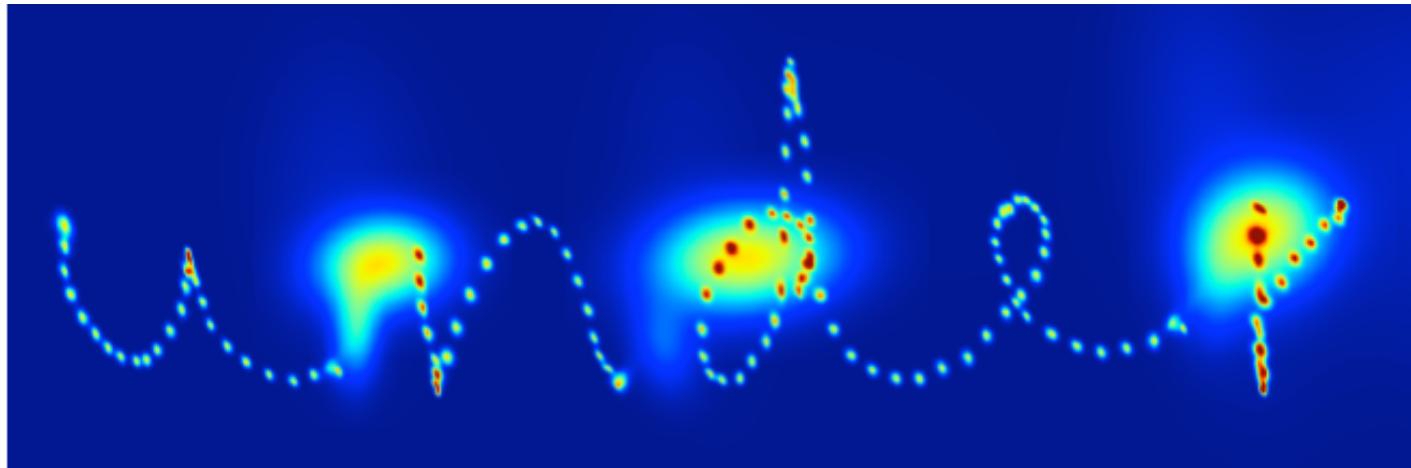
We predict handwriting point by point



- ← Next pen position:
 x, y – mixture of Gaussians
 z – Bernoulli distribution
- ← Current pen position:
 x, y – pen offset
 z – do we end a stroke here?

Handwriting generation

We predict handwriting point by point



Alex Graves, <https://arxiv.org/pdf/1308.0850.pdf>

Handwriting generation

urn my under your eye here. will

- (eg) red anche. ' besetness th' th'

Maine Cenkle of hye Woditro'

see Boung a. The accent was fa

purely mistaken bvr lured

bopes & cold minnes wine ames

heist. Y Ceesh the gather me

. - style satet Domg In soing Te a

Handwriting generation

when my under your eye here will

- (eg) red anche. ' besetness the ' the

Maine Cenek le of his Wadits'

see Boung a. The accent was fa

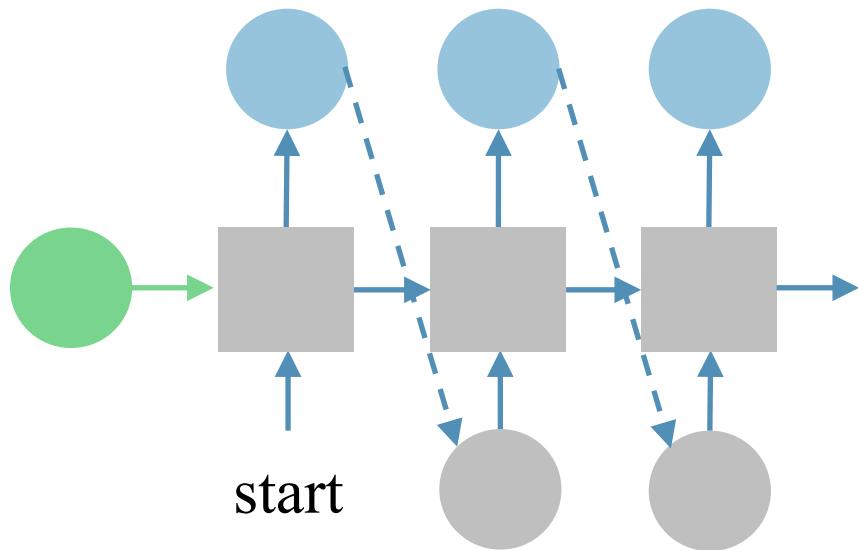
purple mist Jaen bcr lined

bopes & cold minefs wine wine curas

heist. Y Ceesh the gather me

- style satet Domg In soing Te a

Conditional sequence generation



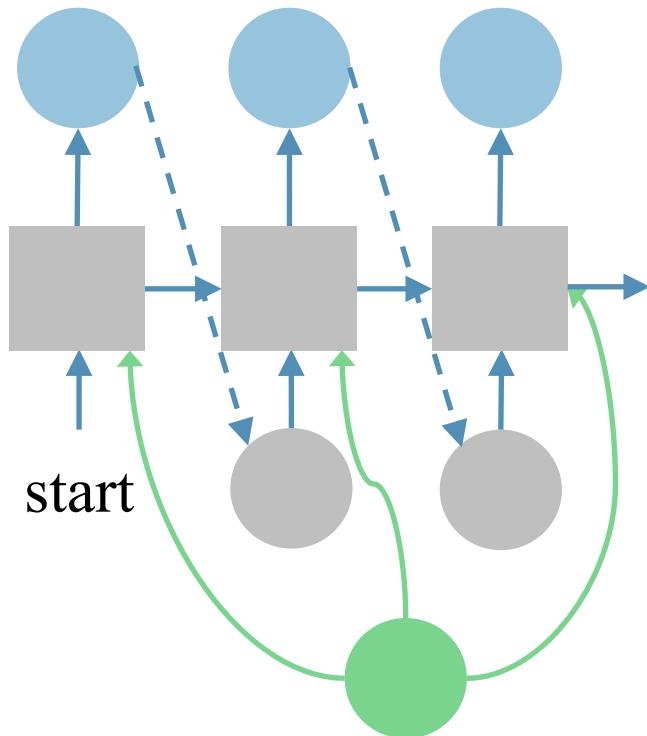
Input
Output

some object
sequence

Tasks

- Speech generation
- Handwriting generation
- Image captioning
- ...

Conditional sequence generation



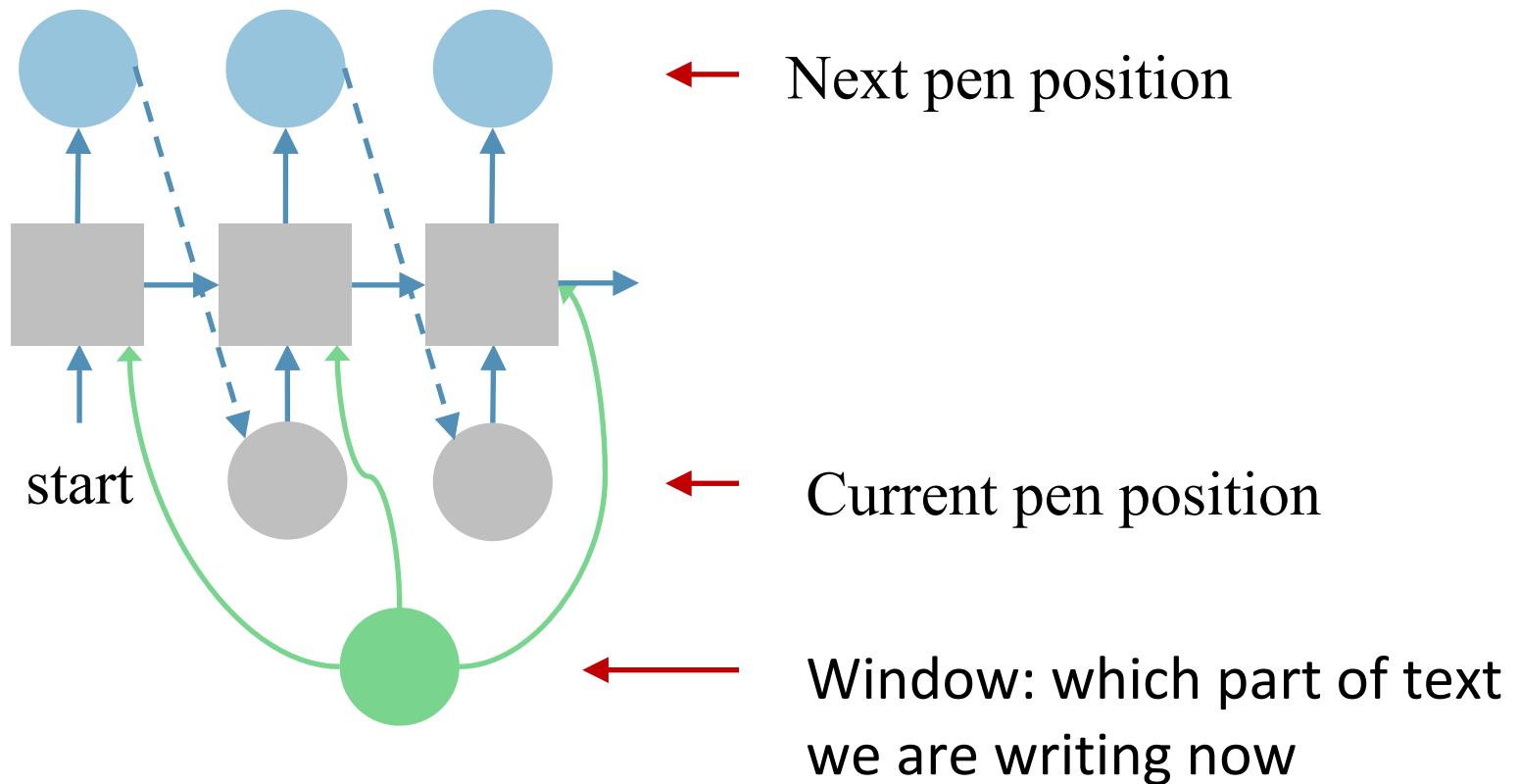
Input
Output

some object
sequence

Tasks

- Speech generation
- Handwriting generation
- Image captioning
- ...

Conditional handwriting generation



Conditional handwriting generation

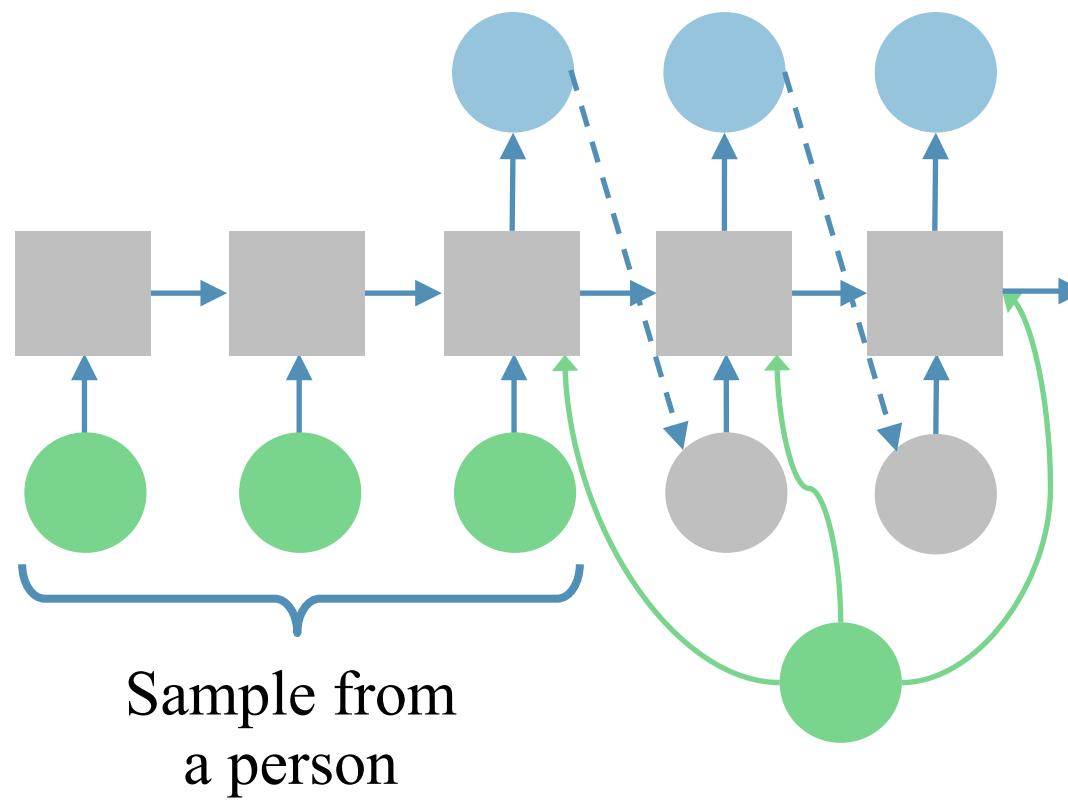
stack more layers



stack more layers

Conditional handwriting generation

Primed sampling



Conditional handwriting generation

Primed sampling

init
samples {

Take the breath away when they are
when the network is primed
with a real sequence

Conditional handwriting generation

Primed sampling

init

samples {

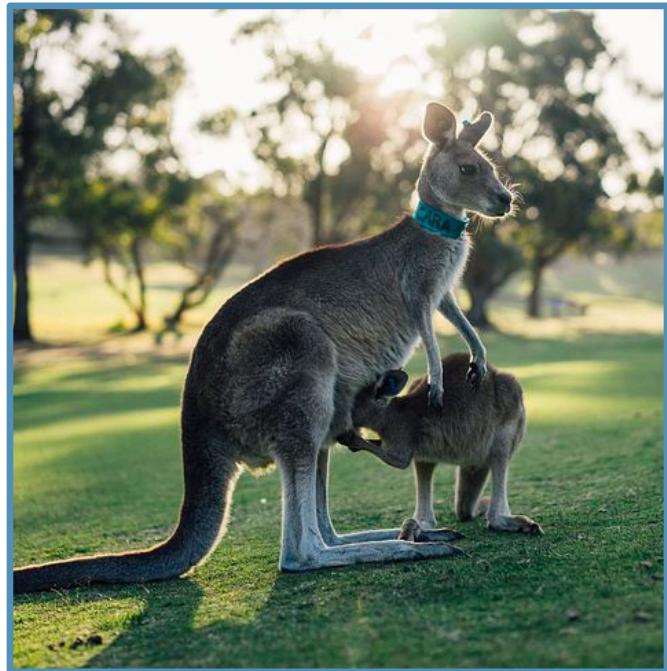
Take the breath away when they are
when the network is primed
with a real sequence

init

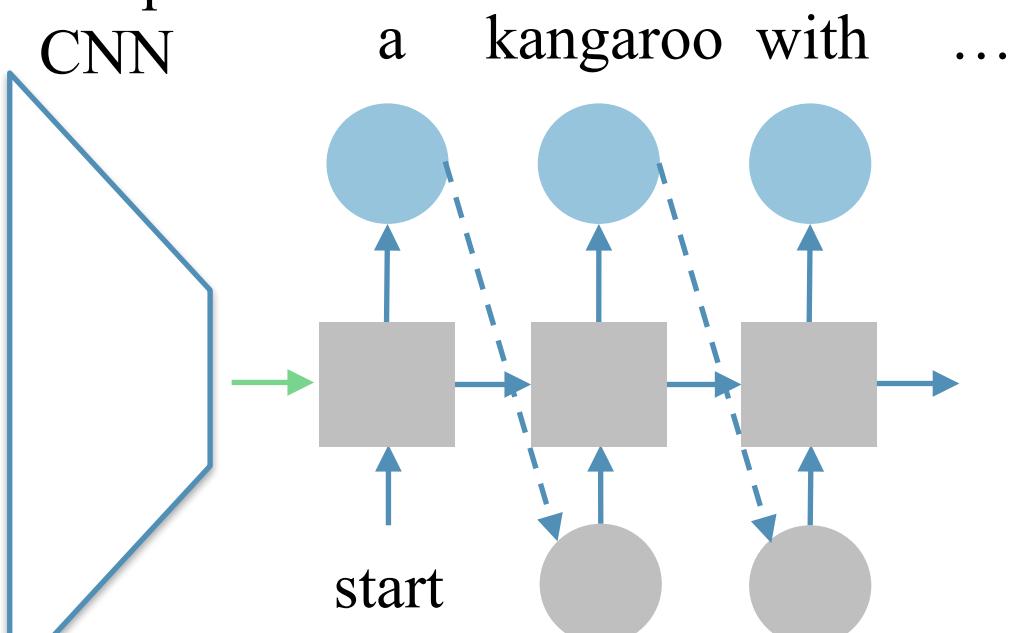
samples {

He dismissed the idea
when the network is primed
with a real sequence

Image Captioning



Deep
CNN



a kangaroo with ...

Image Captioning: good examples



a man riding a wave on a surfboard

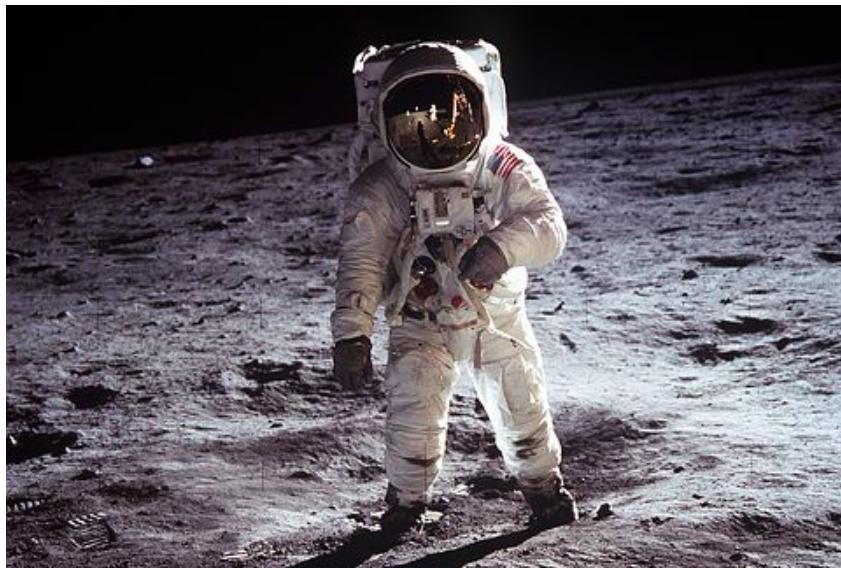


a large brown bear walking across a river

Image Captioning: bad examples



a man riding on the
back of a boat



a man riding a snowboard

Image Captioning: bad examples



?



a man is holding a
kite in the air

Image Captioning: bad examples

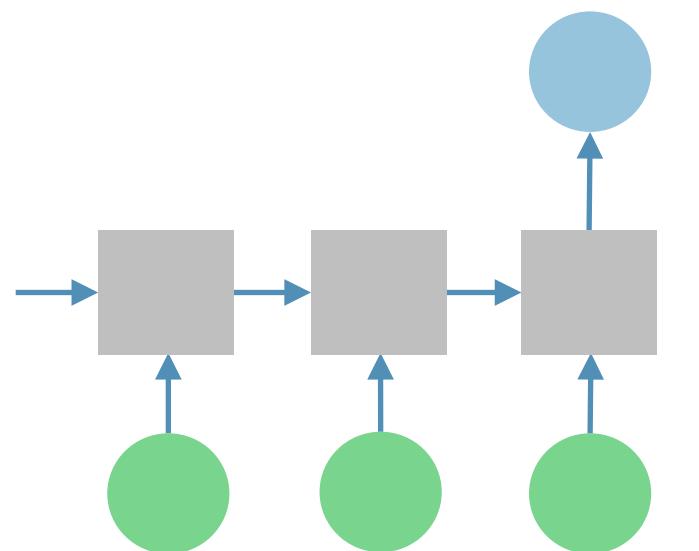


a man is holding a tennis racket on a tennis court



a man is holding a kite in the air

Sequence classification



Input
Output

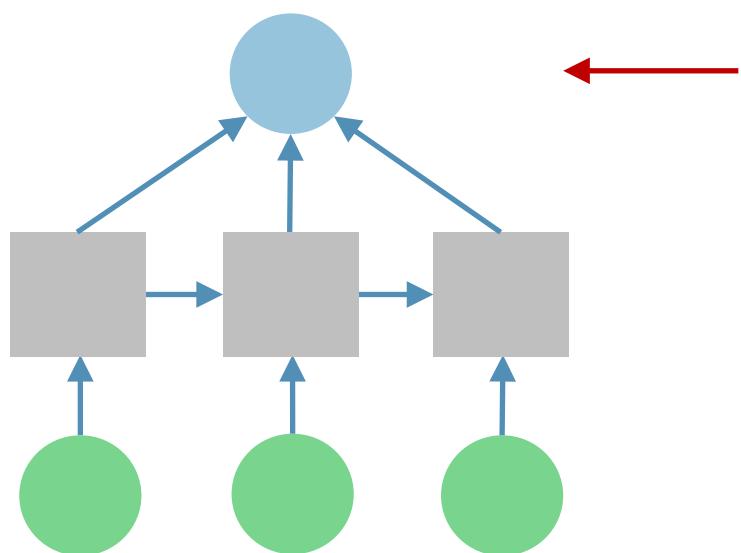
sequence
one label

← One output at the end

Tasks

- Sentiment analysis
- ...

Sequence classification



Input
Output

sequence
one label

Dynamic mean or max pooling
+ Attention mechanism

Tasks

- Sentiment analysis
- ...

Sequence translation

Input	sequence	Tasks
Output	sequence	<ul style="list-style-type: none">• Handwriting to text / text to handwriting• Speech to text / text to speech• Machine translation

Sequence translation

Input	sequence	Tasks
Output	sequence	
		<ul style="list-style-type: none">• Handwriting to text / text to handwriting• Speech to text / text to speech• Machine translation

Input and output ...

- are **NOT** synchronized
- may have different length
- may have different order

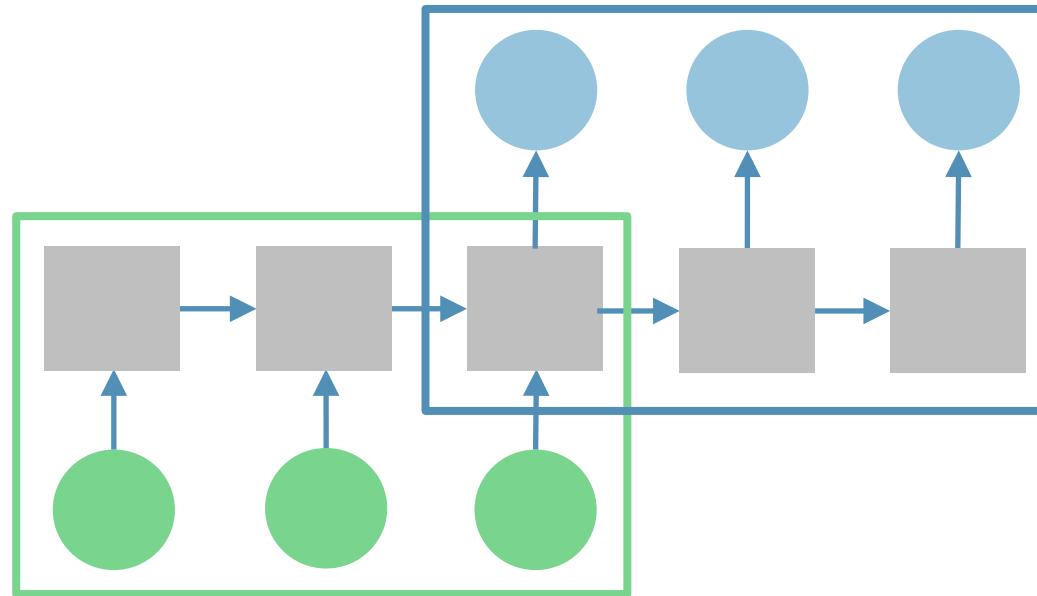
Sequence translation

Input
Output

sequence
sequence

Tasks
• Machine translation

Input and output have different order



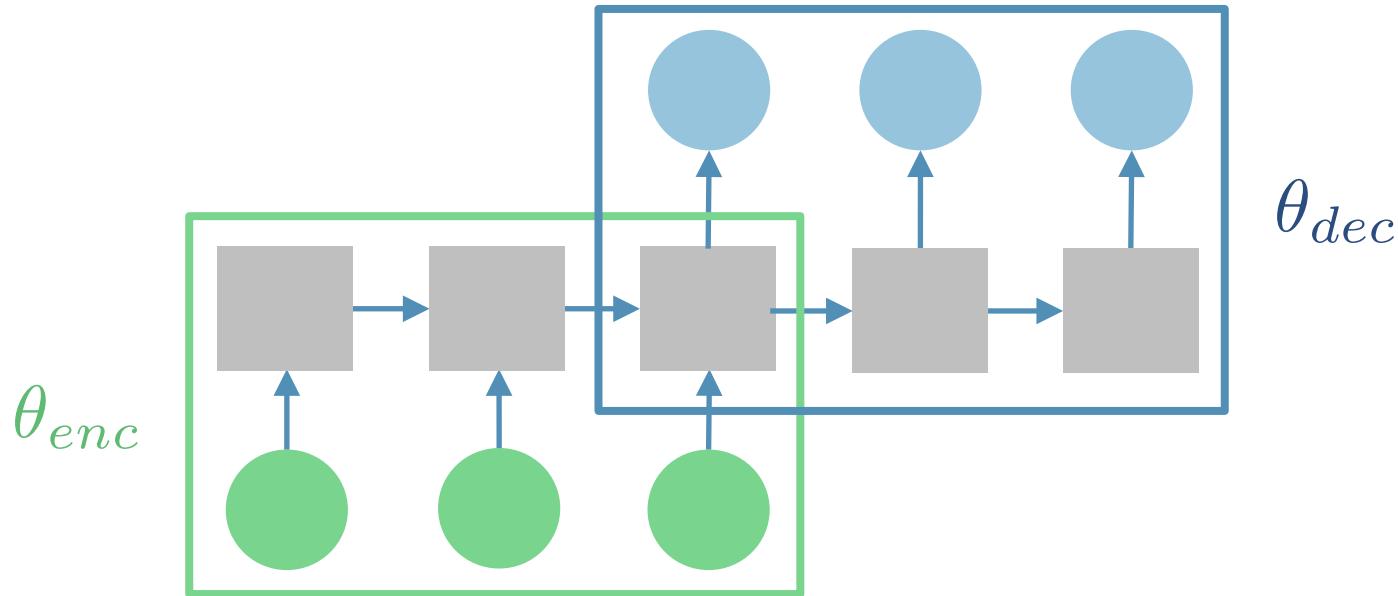
Sequence translation

Input
Output

sequence
sequence

Tasks
• Machine translation

Input and output have different order



Summary

We have learned how to use recurrent networks for:

- Element-wise sequence classification
- Sequence generation: unconditional and conditional
- Sequence classification
- Sequence translation

Good luck with the final project!