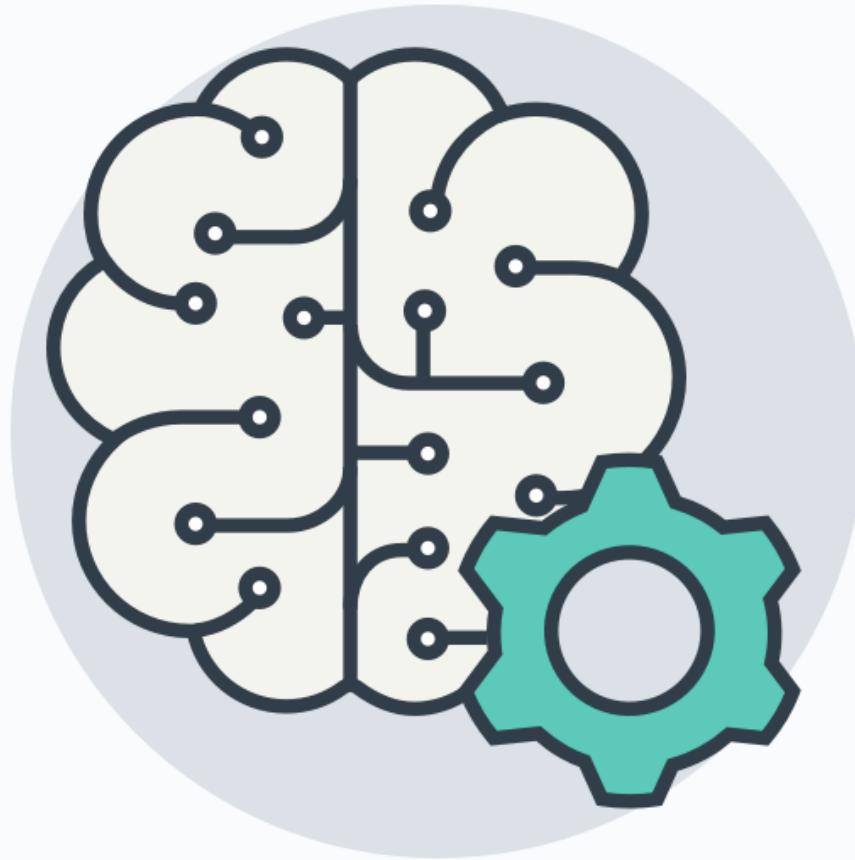
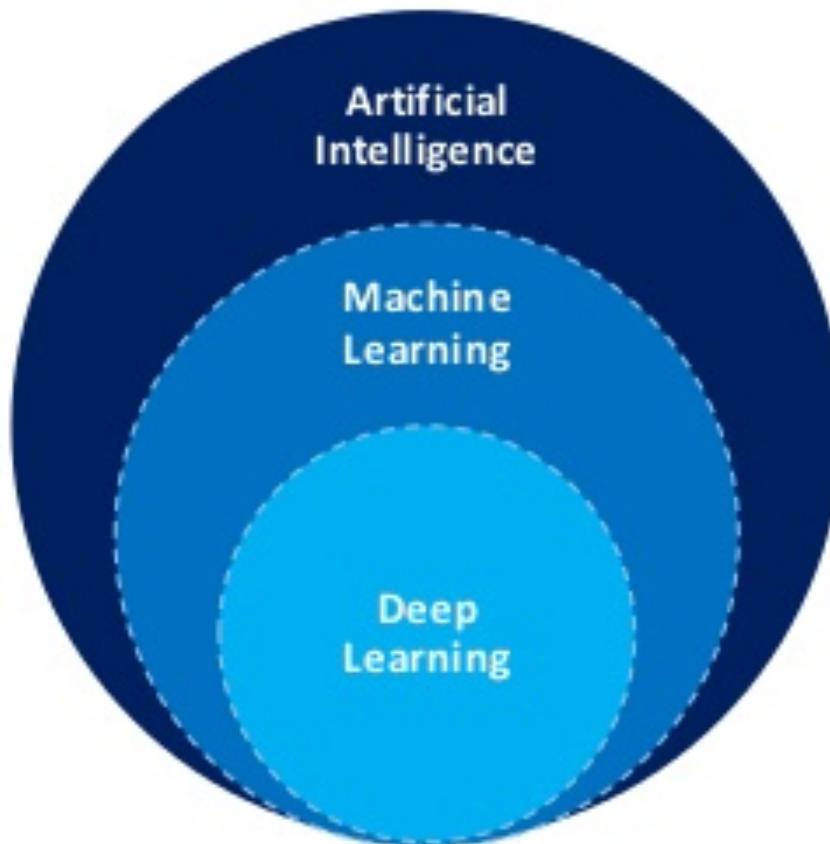


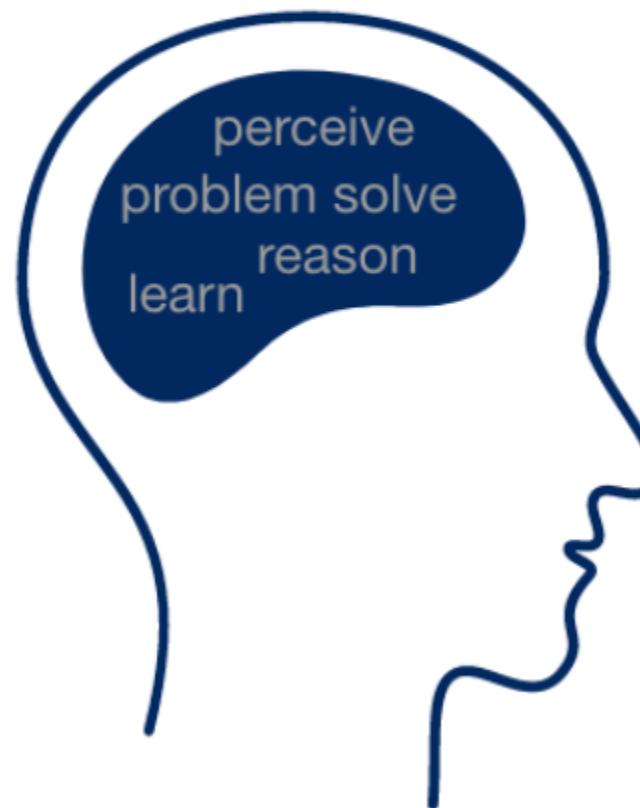
Artificial Intelligence



Machine Learning is a type of AI



Artificial Intelligence



AI is most feasible when:

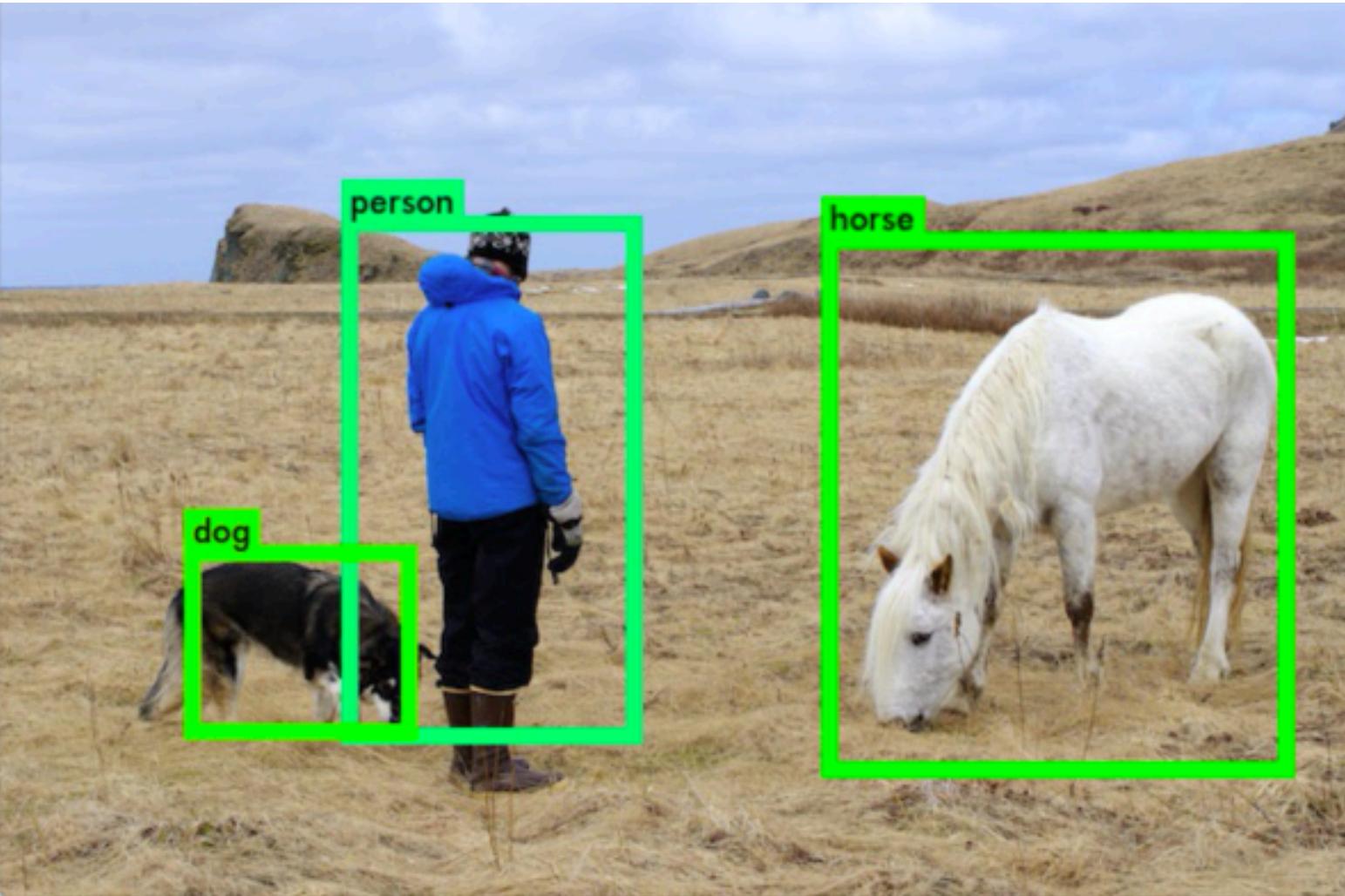
AI is most feasible when:

- The task doesn't require much thinking/reasoning
- Lots of data is available

Anything you can do without much thought,
AI can do.

Input	Output	Application
Audio	Text transcript	Speech Recognition
Music	Like/not like	Music Recommendation
Photo	Image identification	Computer Vision
English	Chinese	Translation
Text	Meaning	Sentiment Analysis

Understanding what's in an Image



Sentiment Recognition

Sentiment Recognition

We enjoyed the food and the service was great.

Sentiment Recognition

We enjoyed the food and the service was great.

Sentiment Recognition

We enjoyed the food and the service was great.

We had to wait for an excessive amount of time
and our order was wrong.

Sentiment Recognition

We enjoyed the food and the service was great.

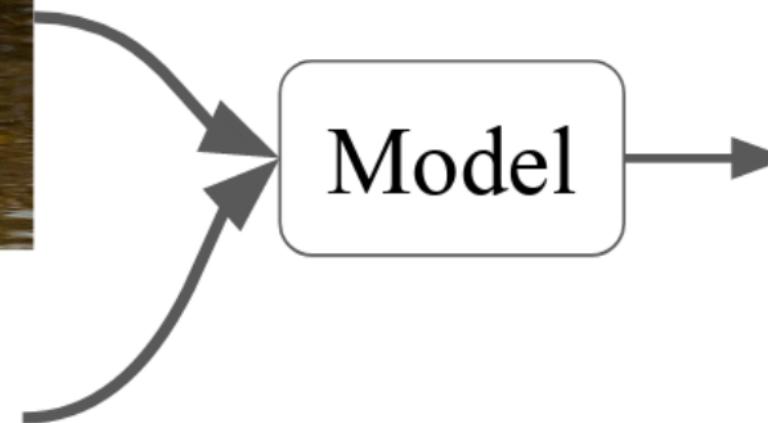
We had to wait for an excessive amount of time
and our order was wrong.

Machine Translation

Machine Translation



A bird flies
over the water



Ein Vogel fliegt
über das Wasser

English

Hello

Chinese

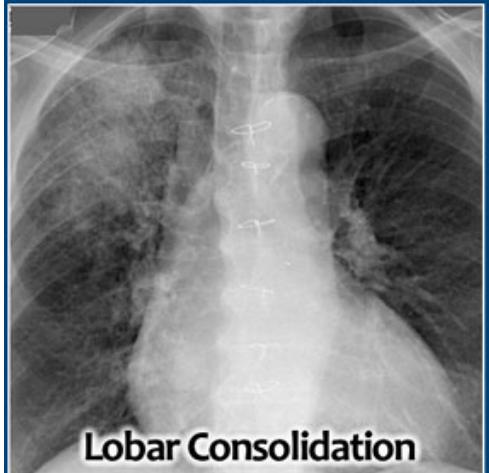
你好

Goodby

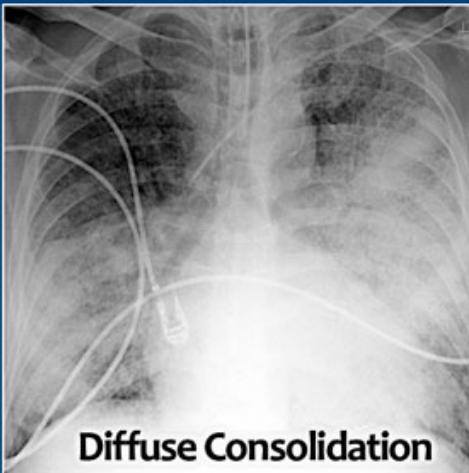
再見

AI performs poorly when:

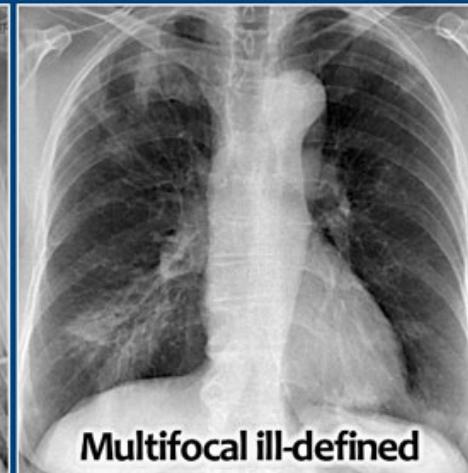
Trying to learn complex concepts from a small amount of data



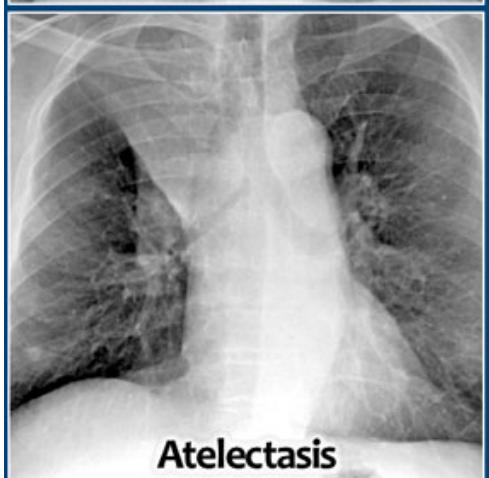
Lobar Consolidation



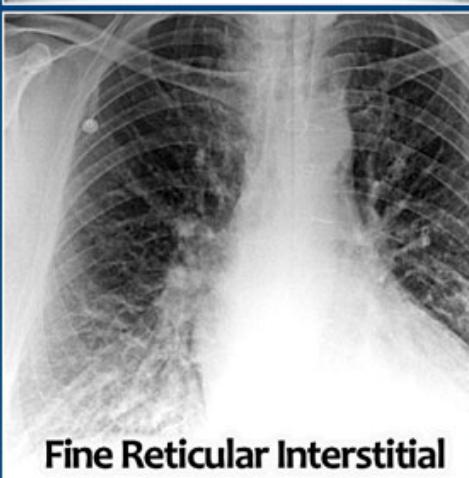
Diffuse Consolidation



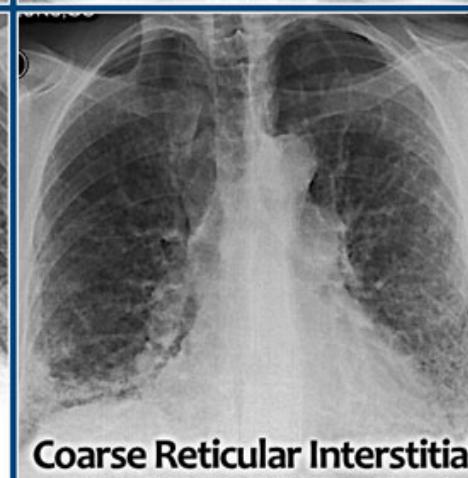
Multifocal ill-defined



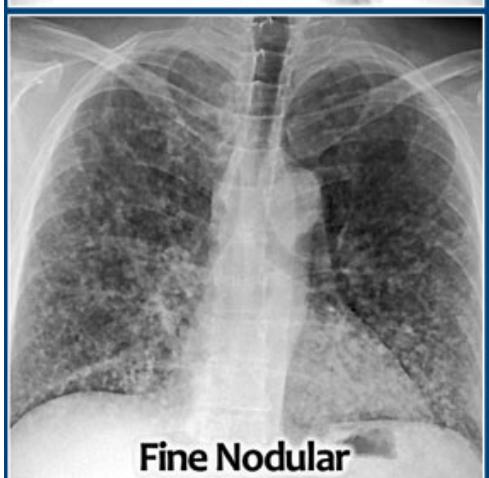
Atelectasis



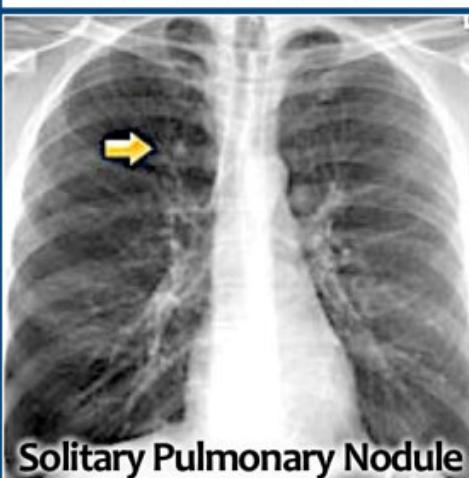
Fine Reticular Interstitial



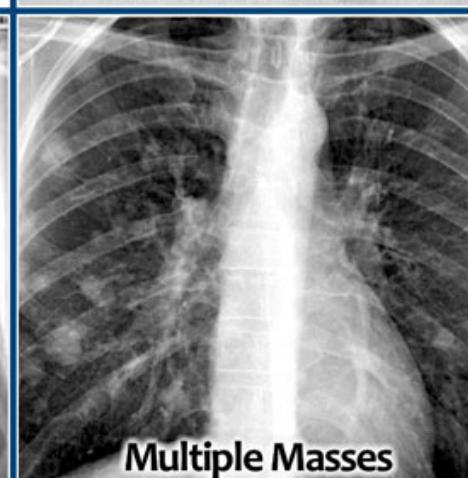
Coarse Reticular Interstitial



Fine Nodular



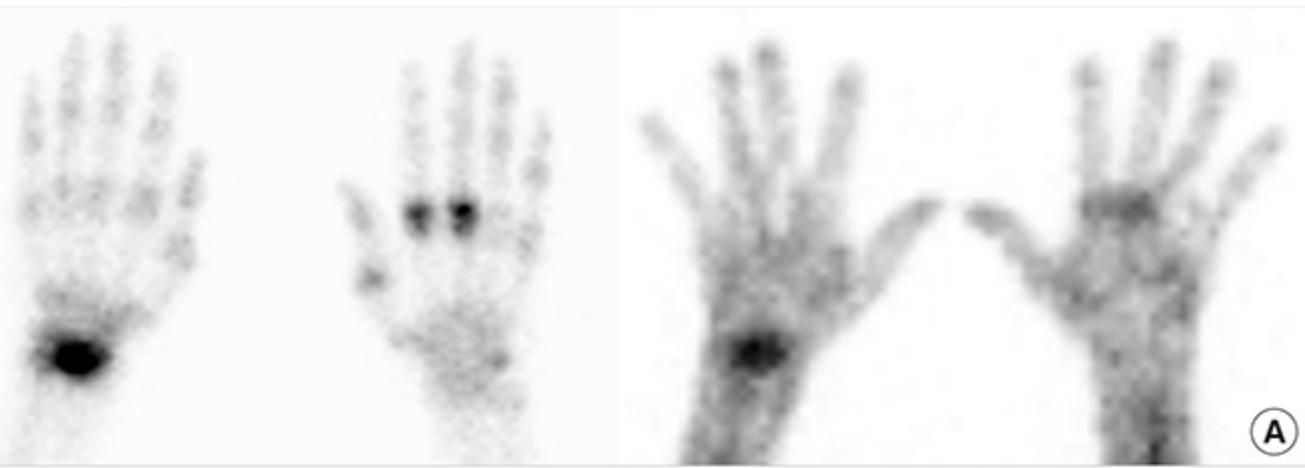
Solitary Pulmonary Nodule



Multiple Masses

AI performs poorly when:

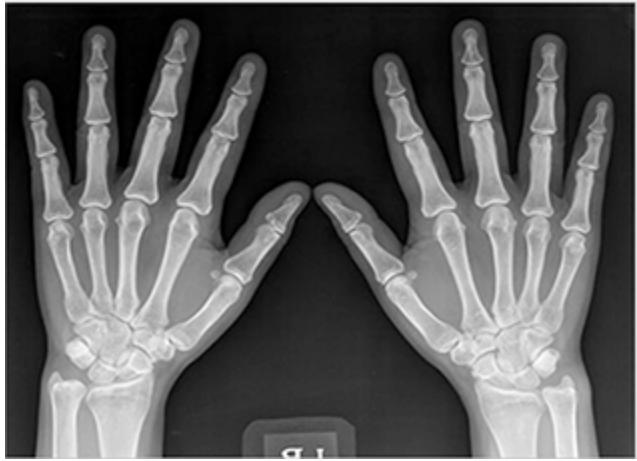
Performing a task on new types of data



A



B

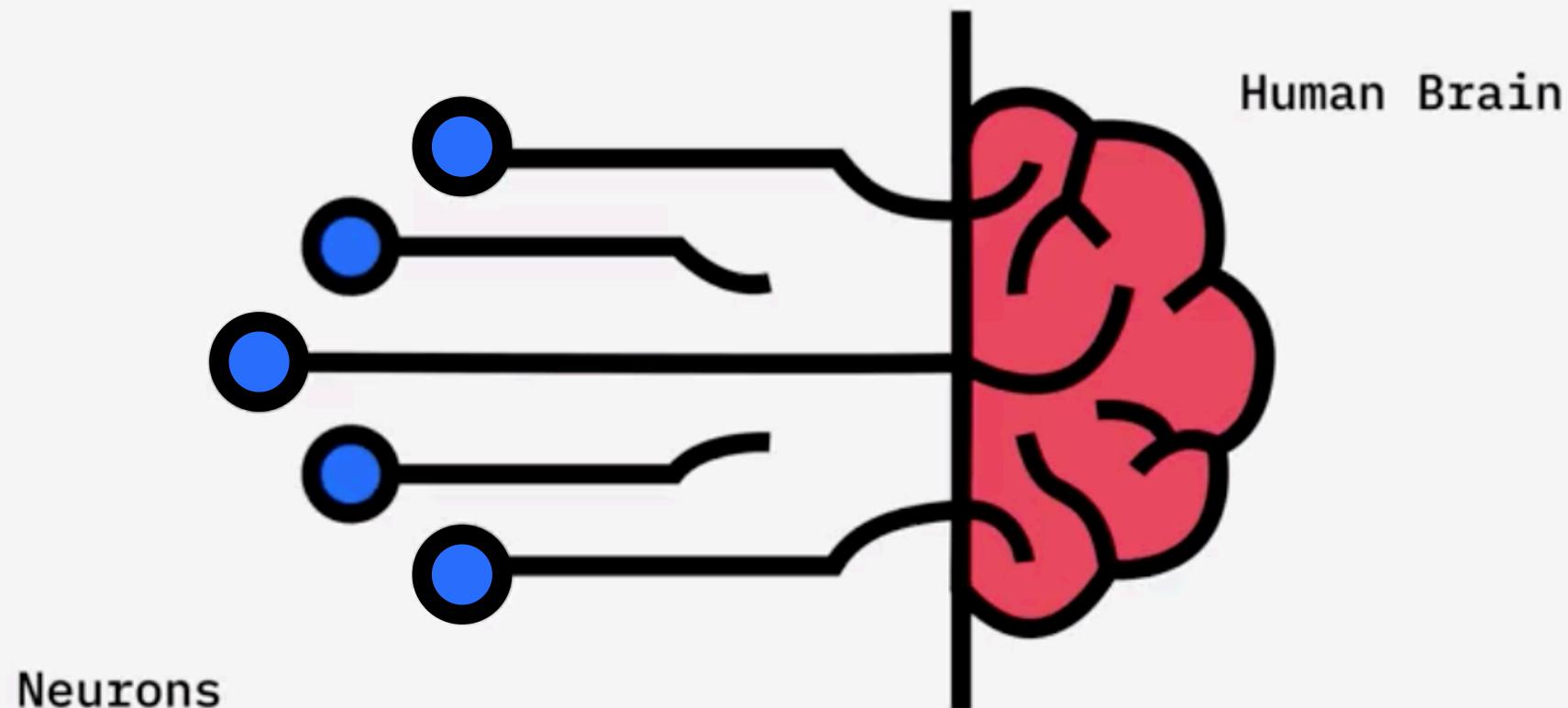


C

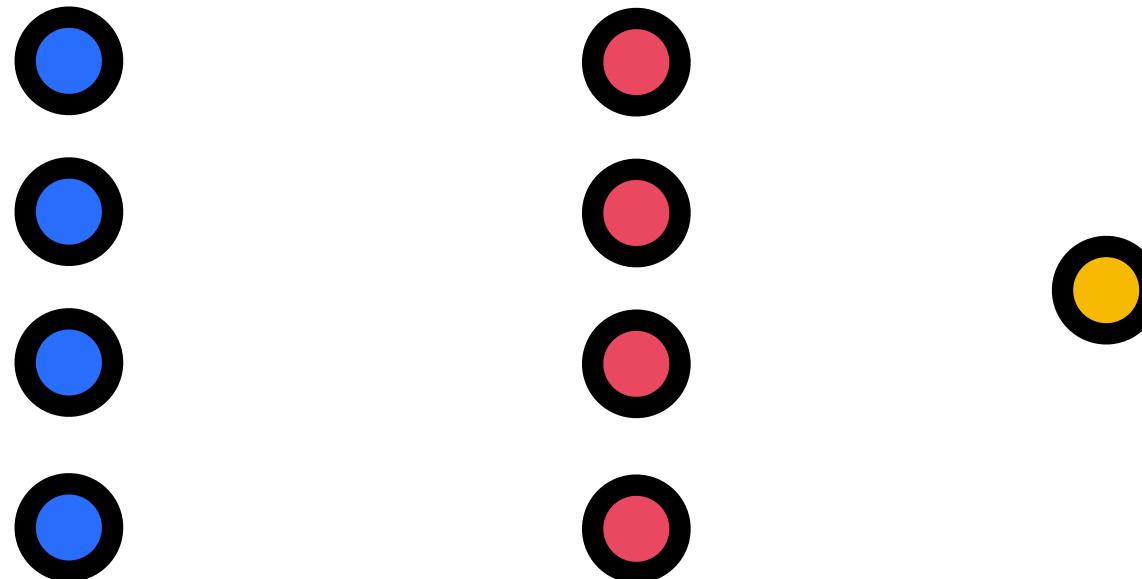


Fig. 2. (a) Initial and (c) follow up hand radiographs and (b) and (d) corresponding four hour bone scan images of a

Neural Network

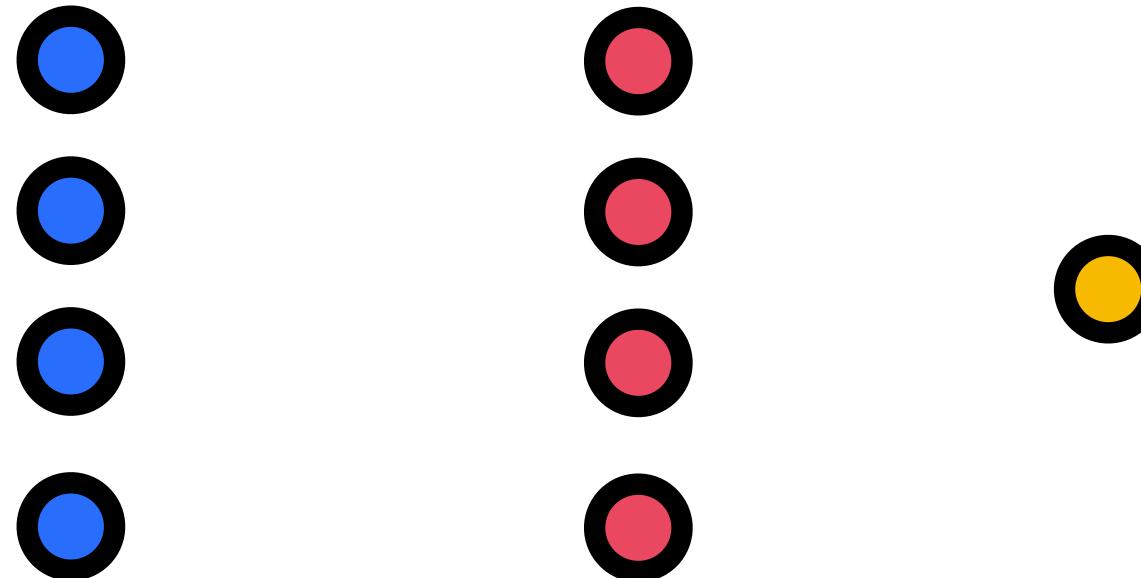


Neural Network

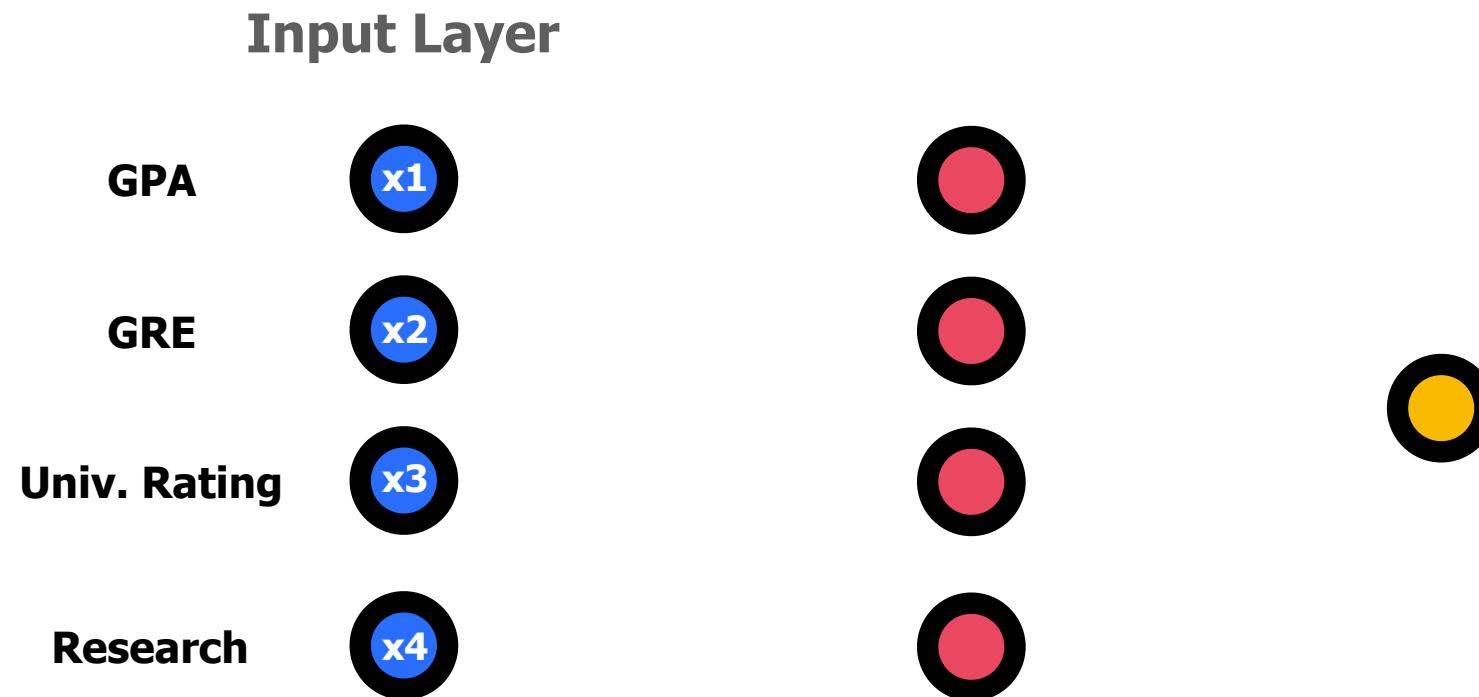


Neural Network

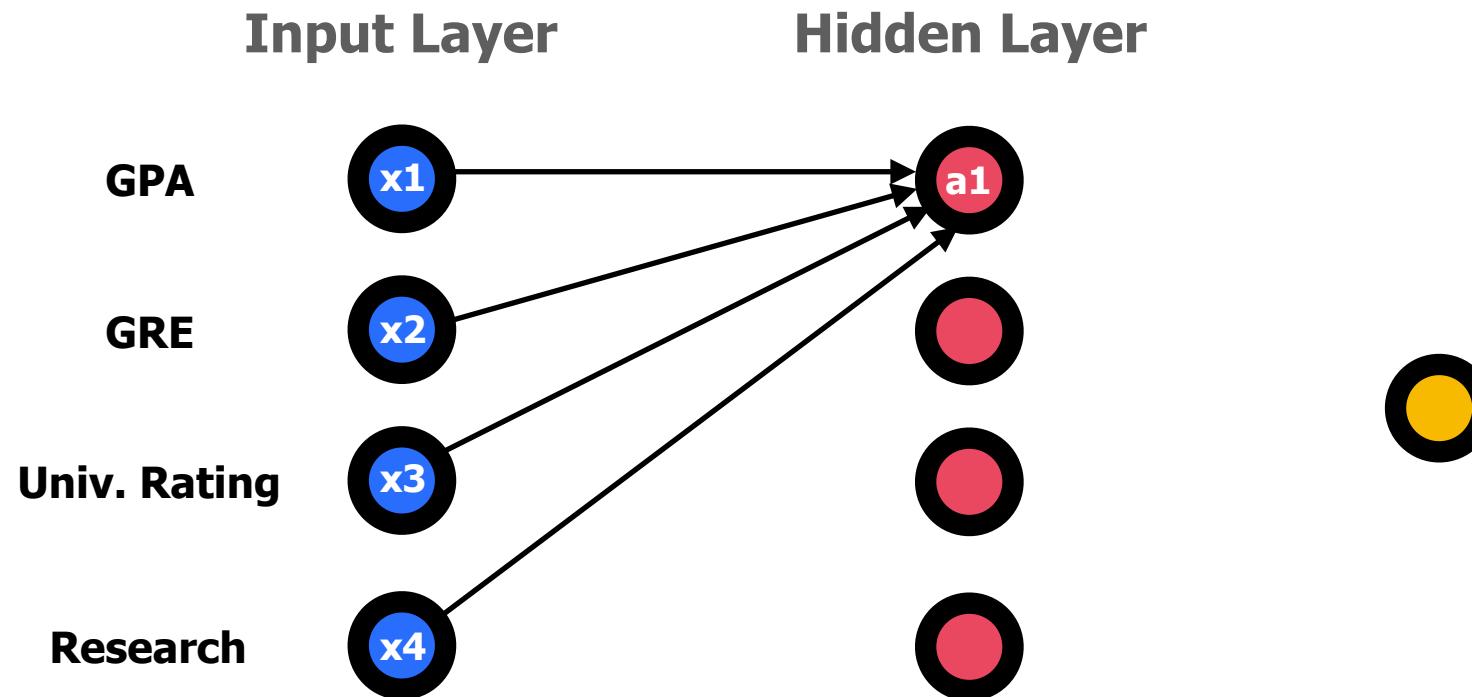
Input Layer



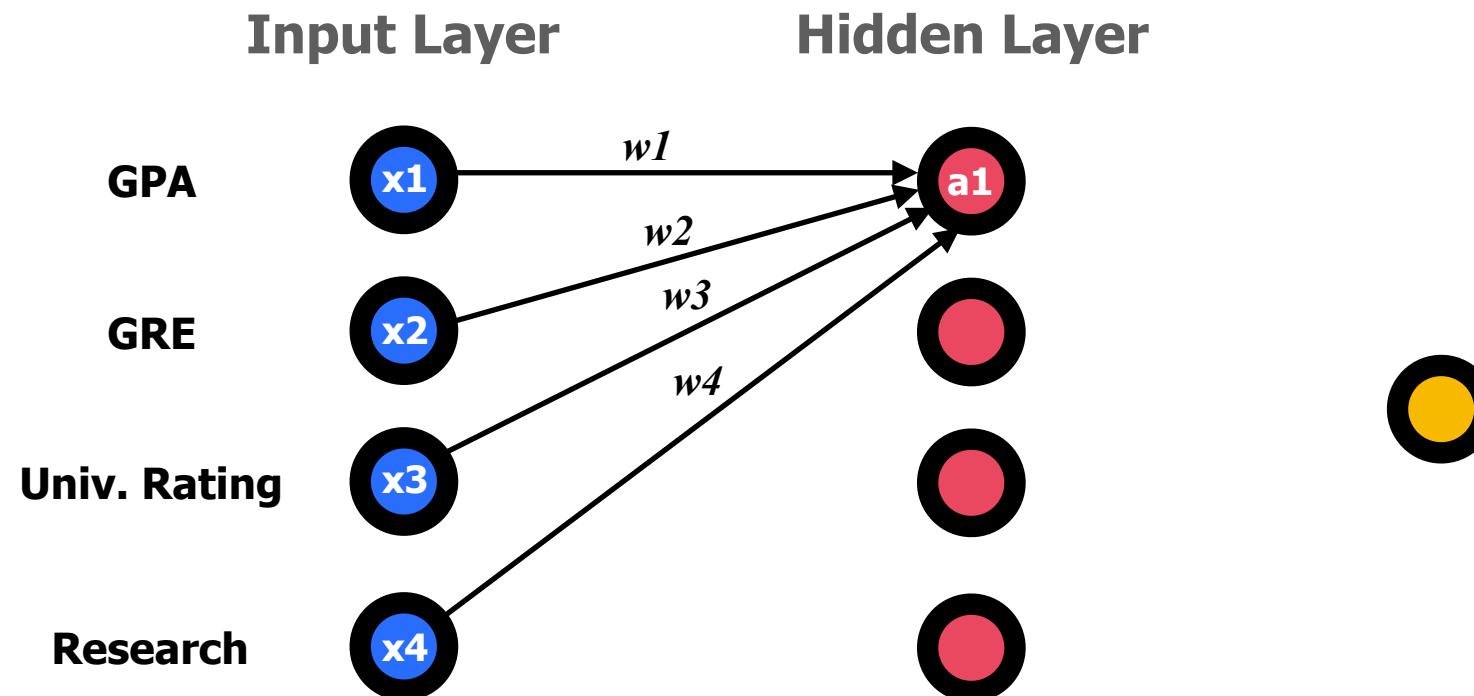
Neural Network



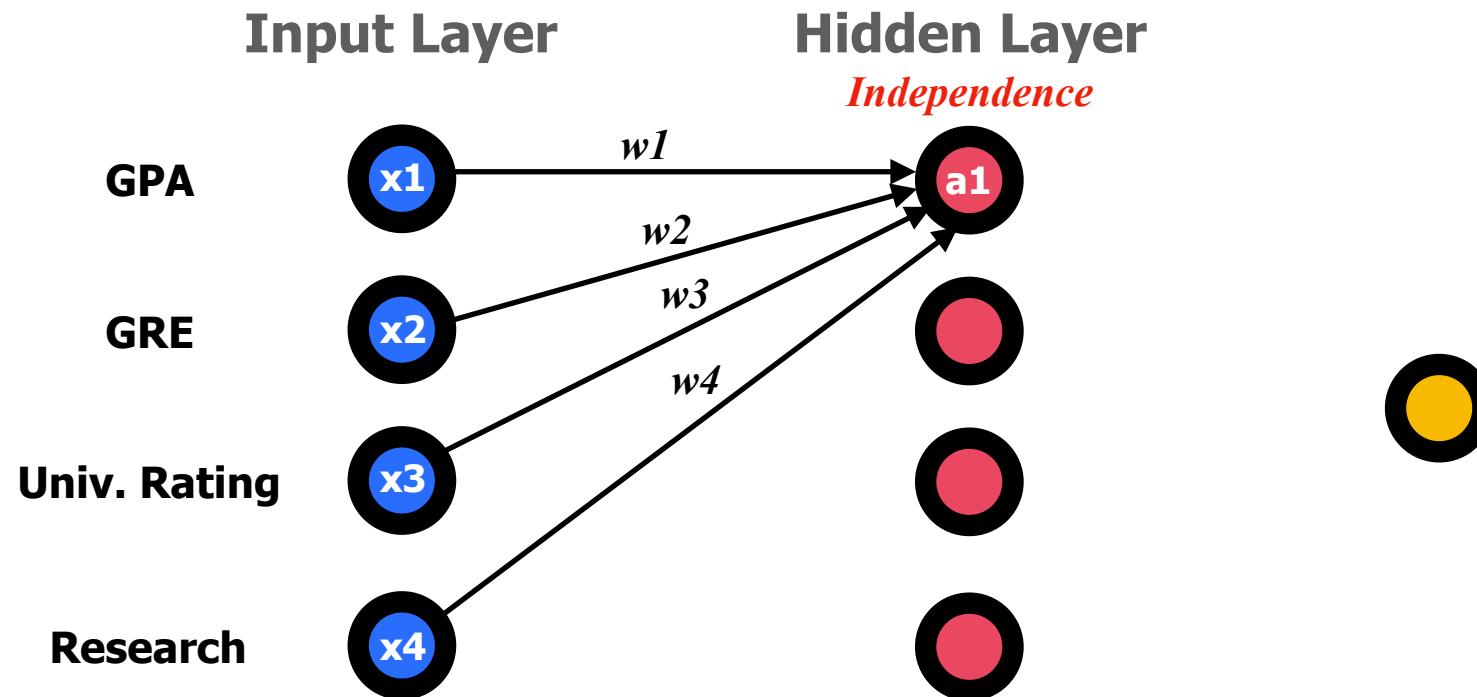
Neural Network



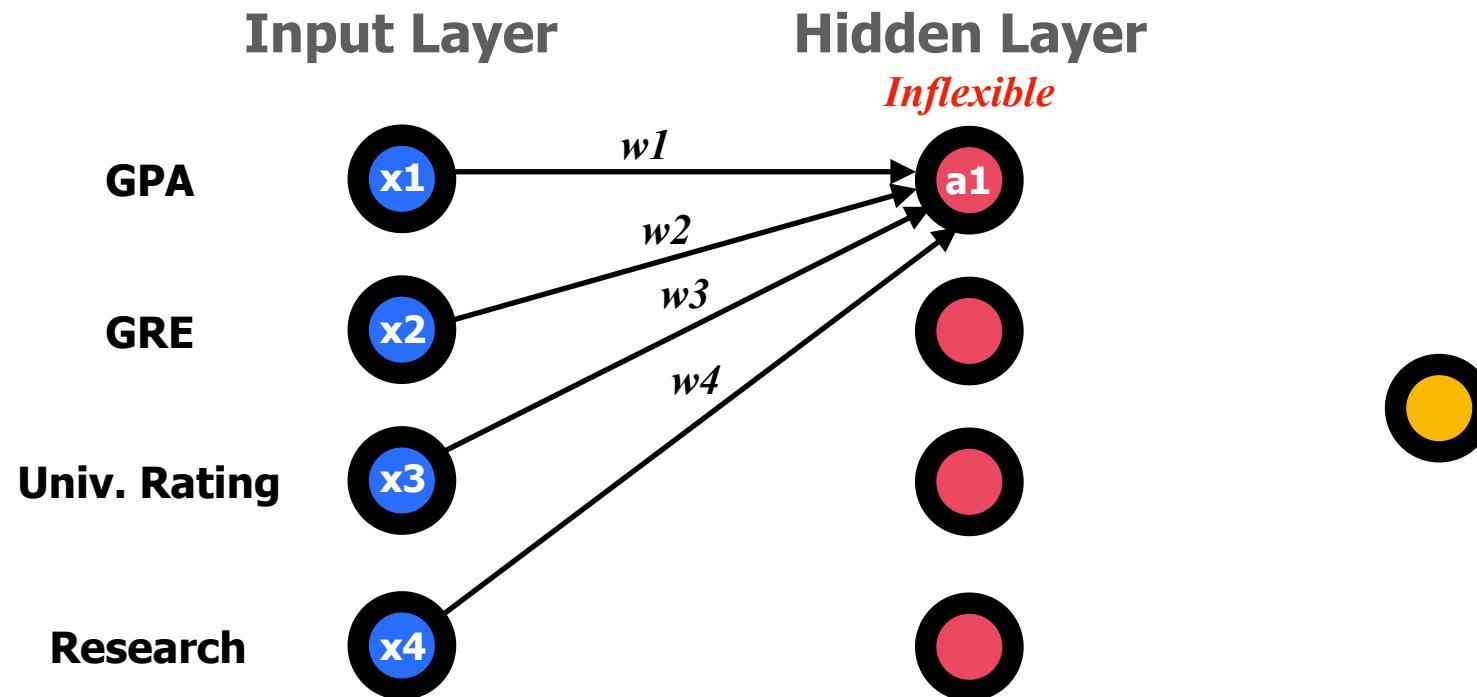
Neural Network



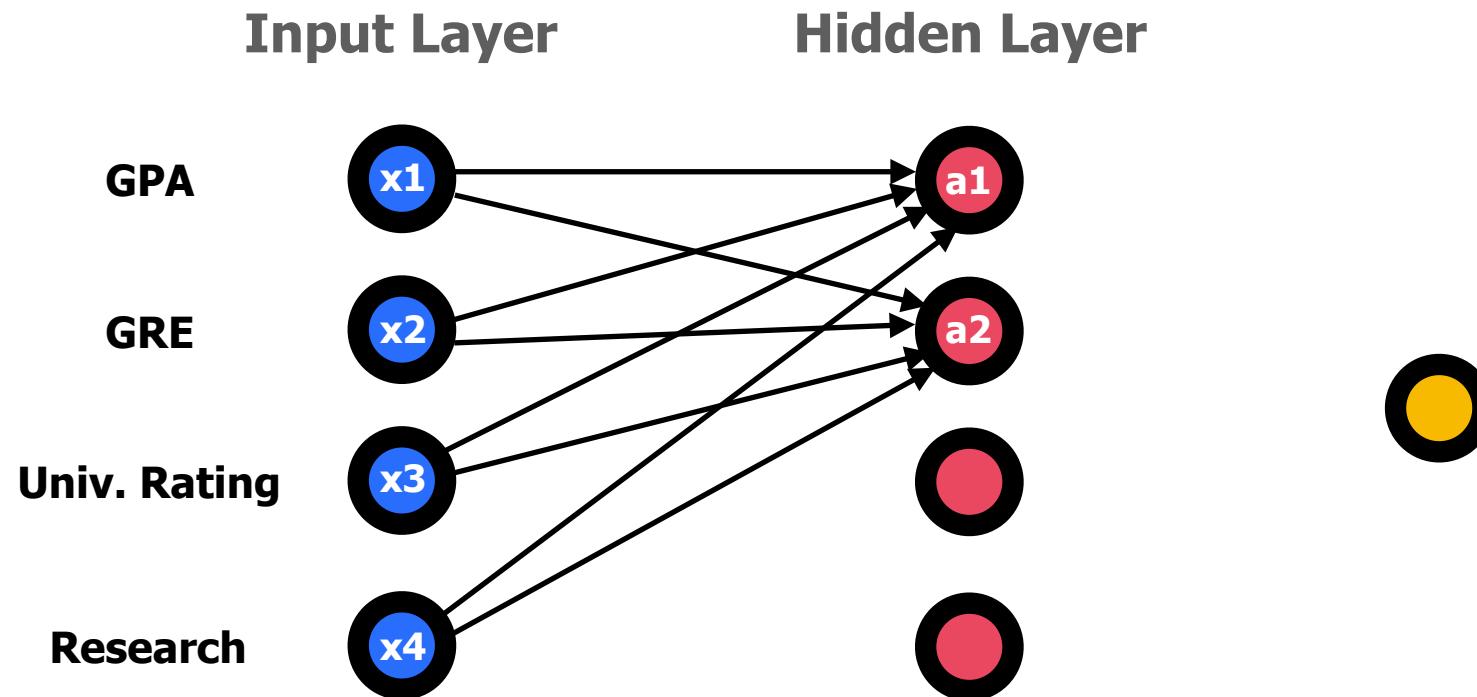
Neural Network



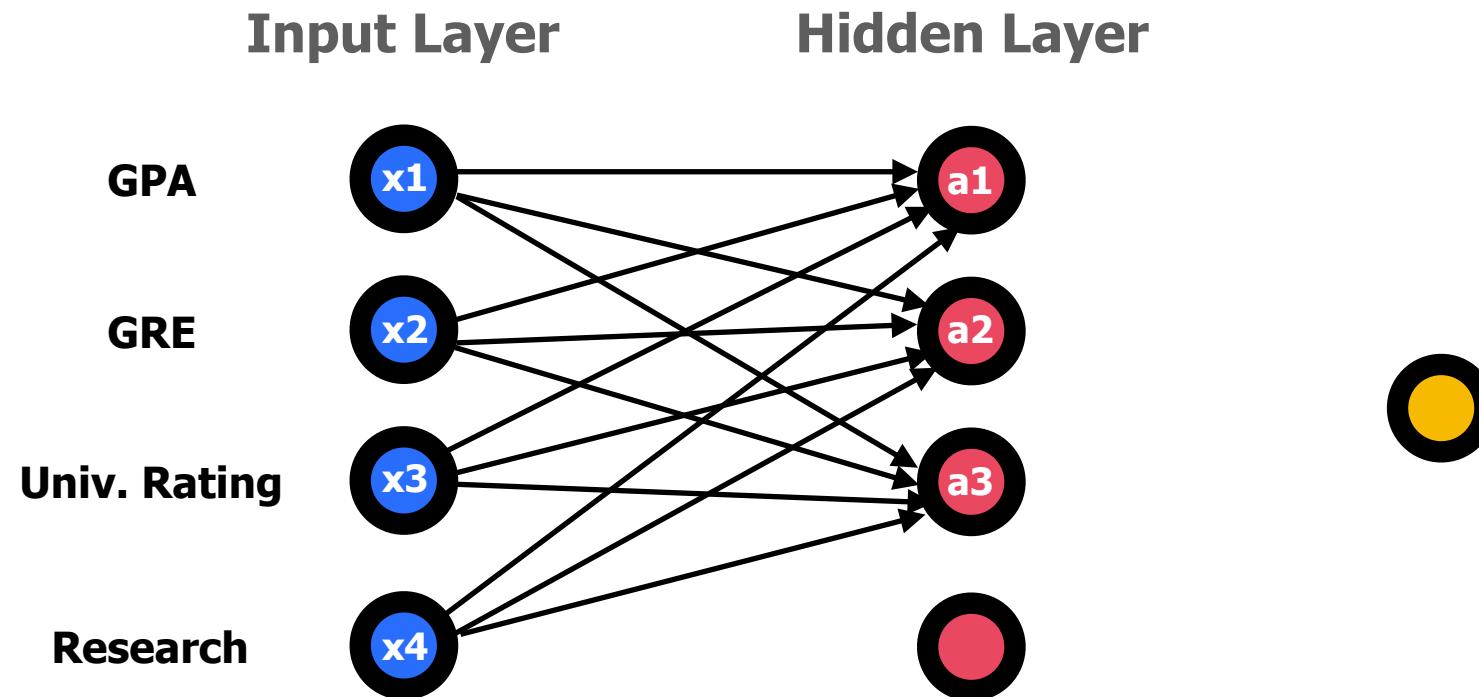
Neural Network



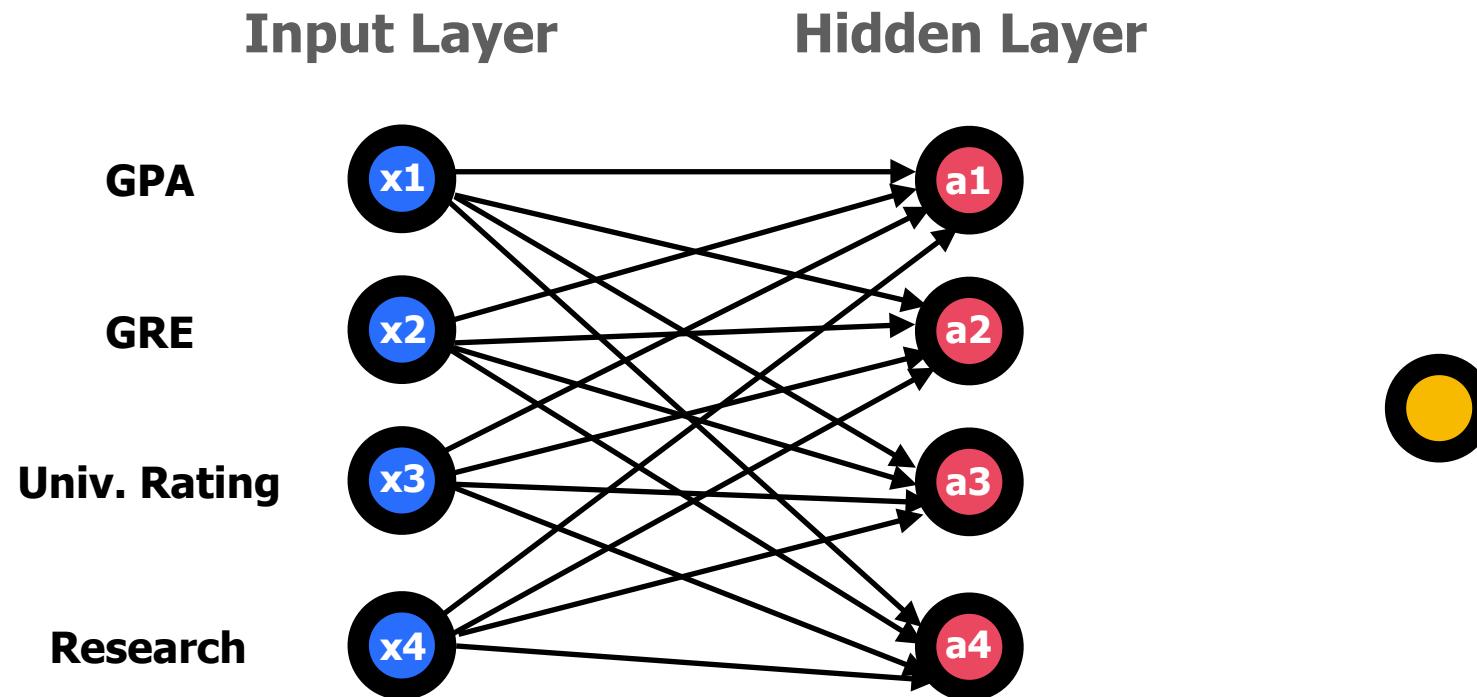
Neural Network



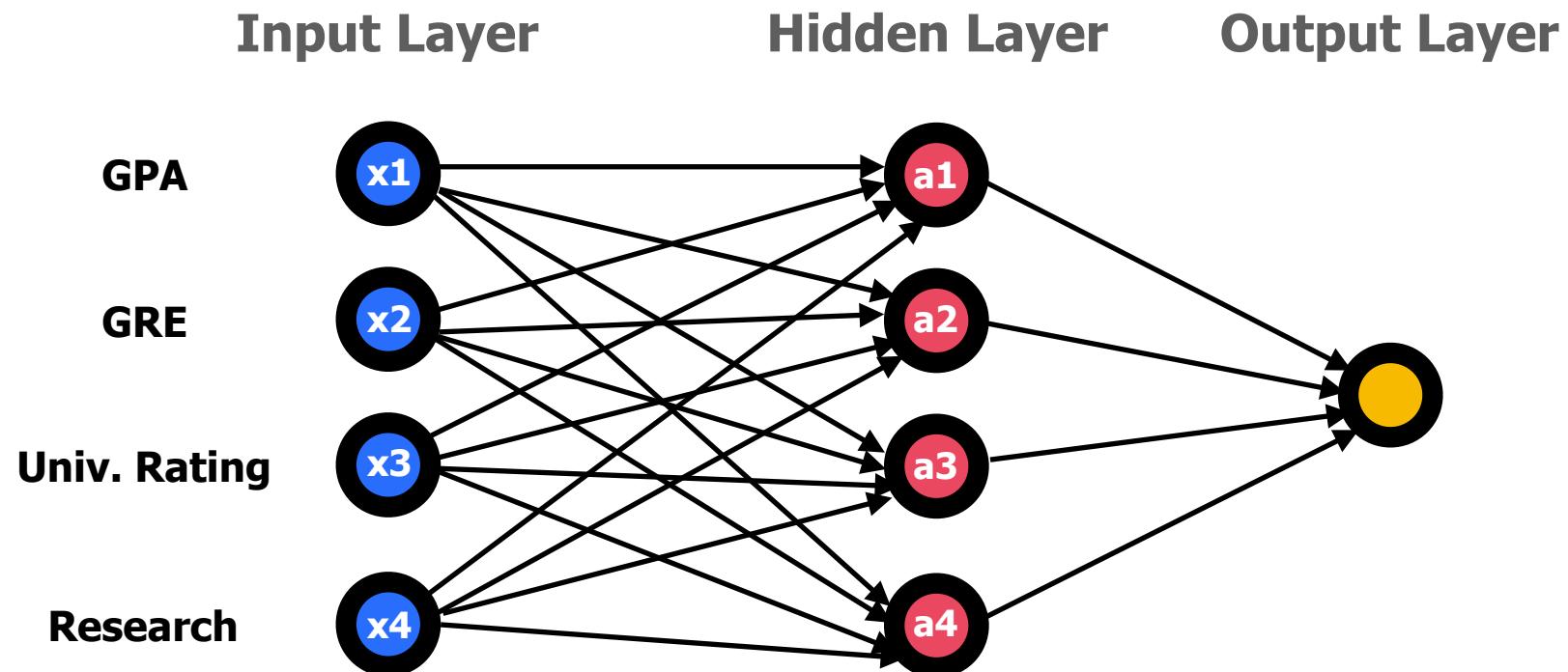
Neural Network



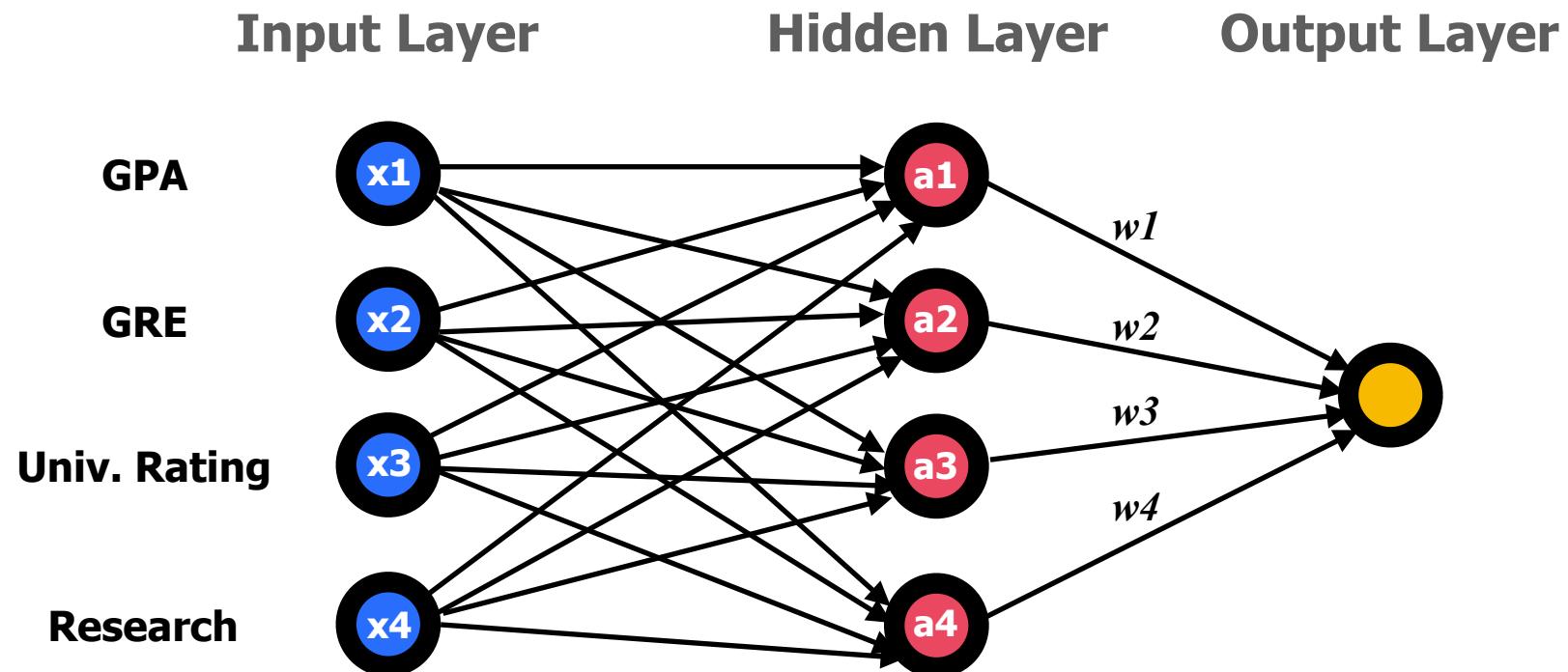
Neural Network



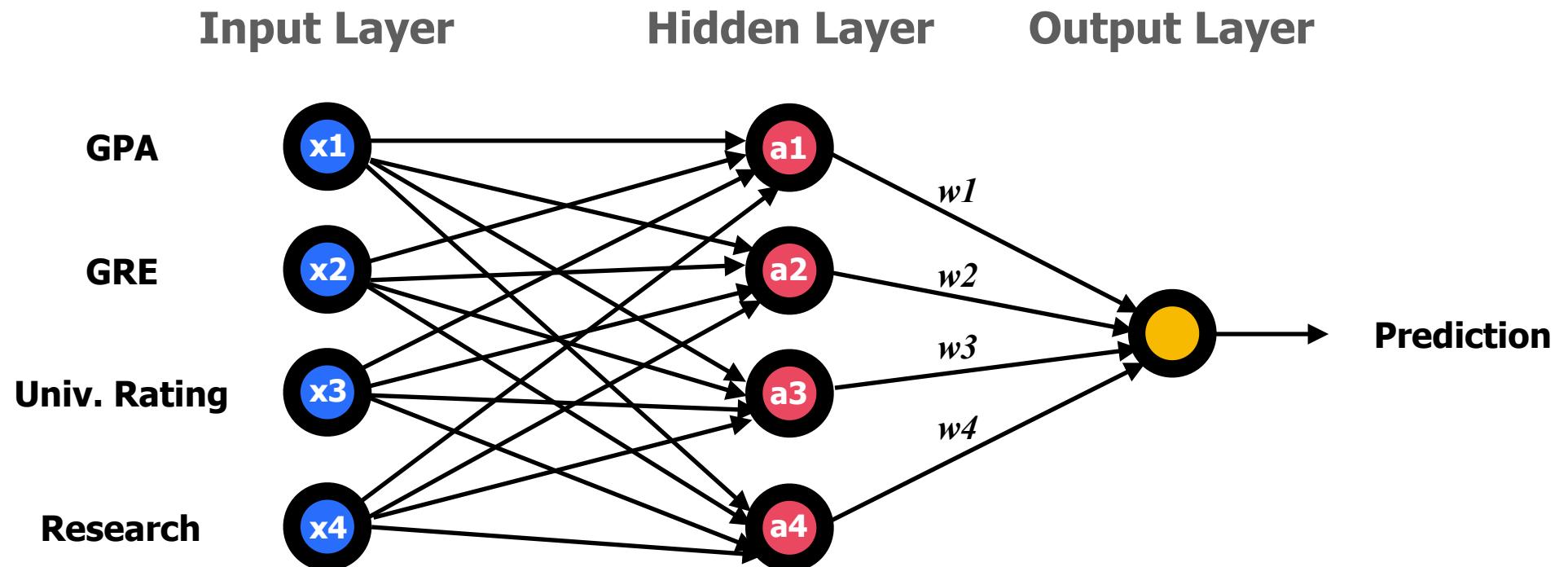
Neural Network



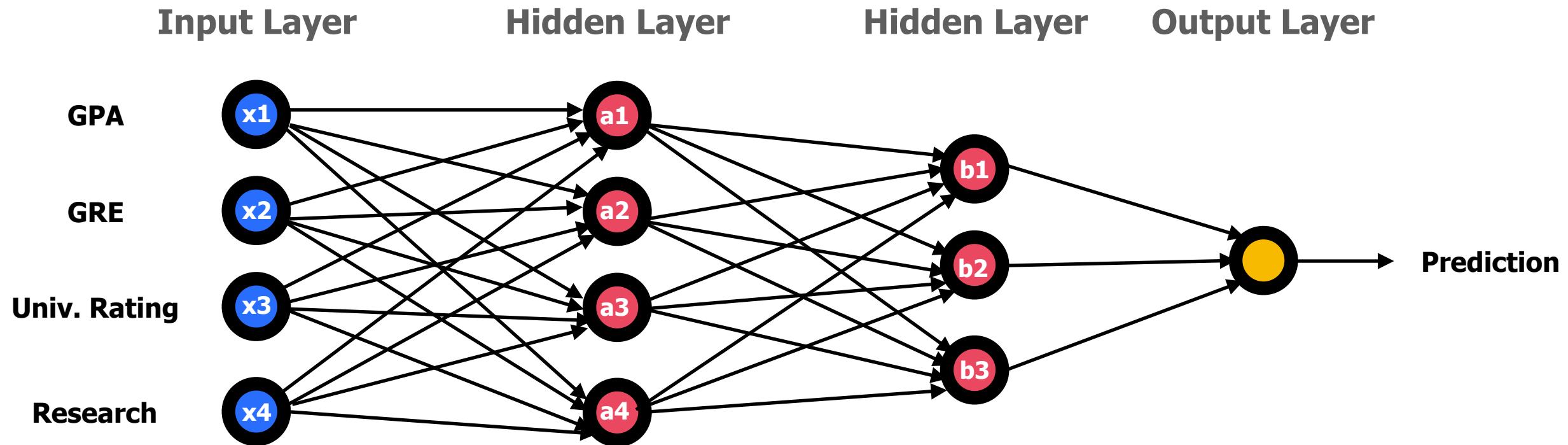
Neural Network



Neural Network



Deep Neural Network



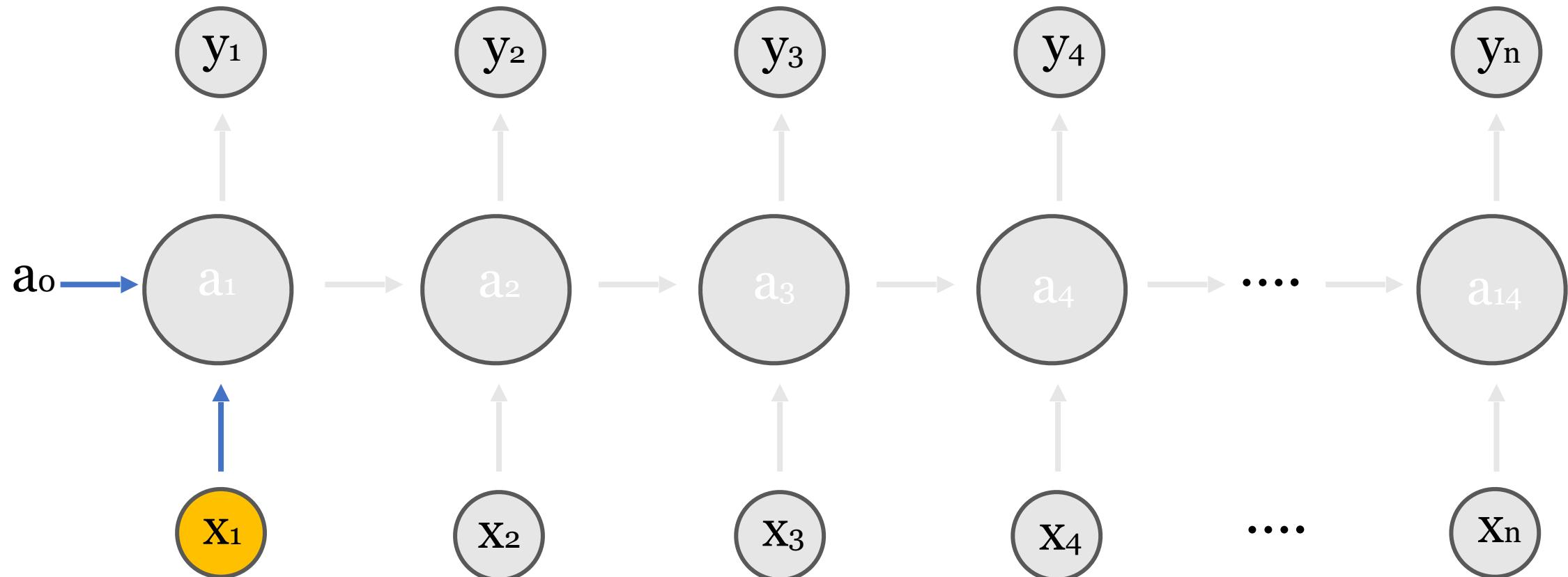
Deep Learning

Natural Language Processing

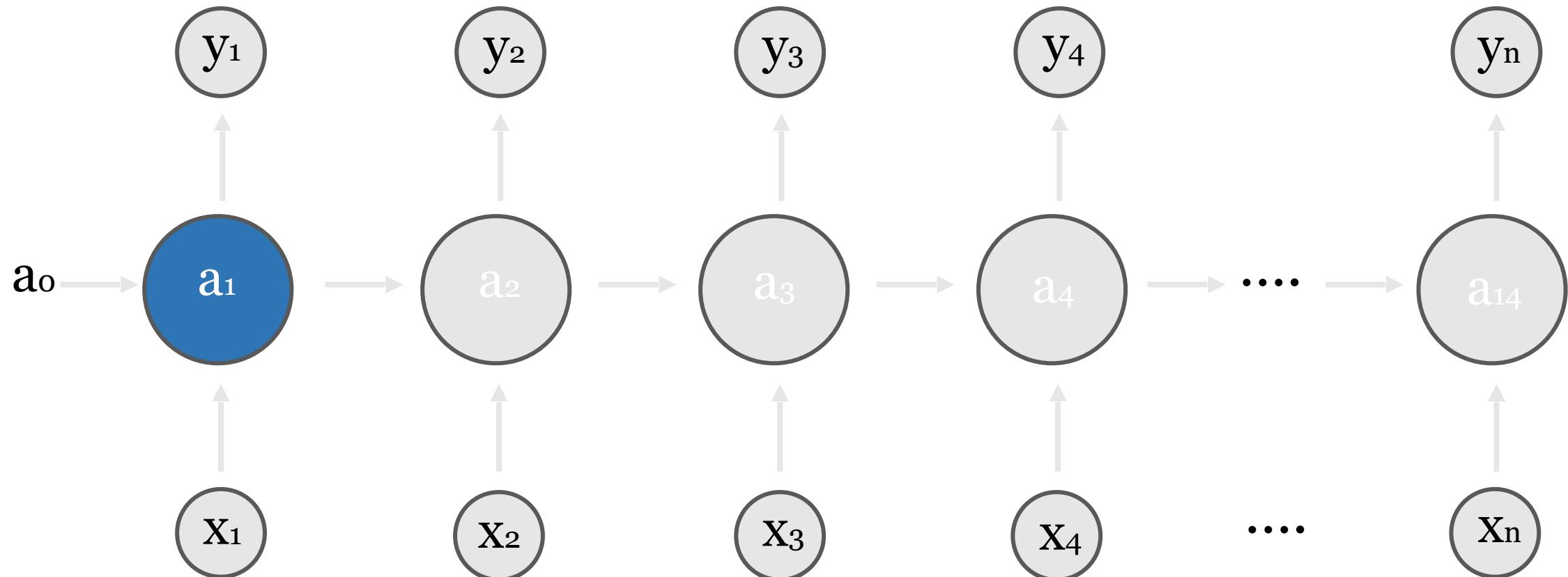


Understanding Language

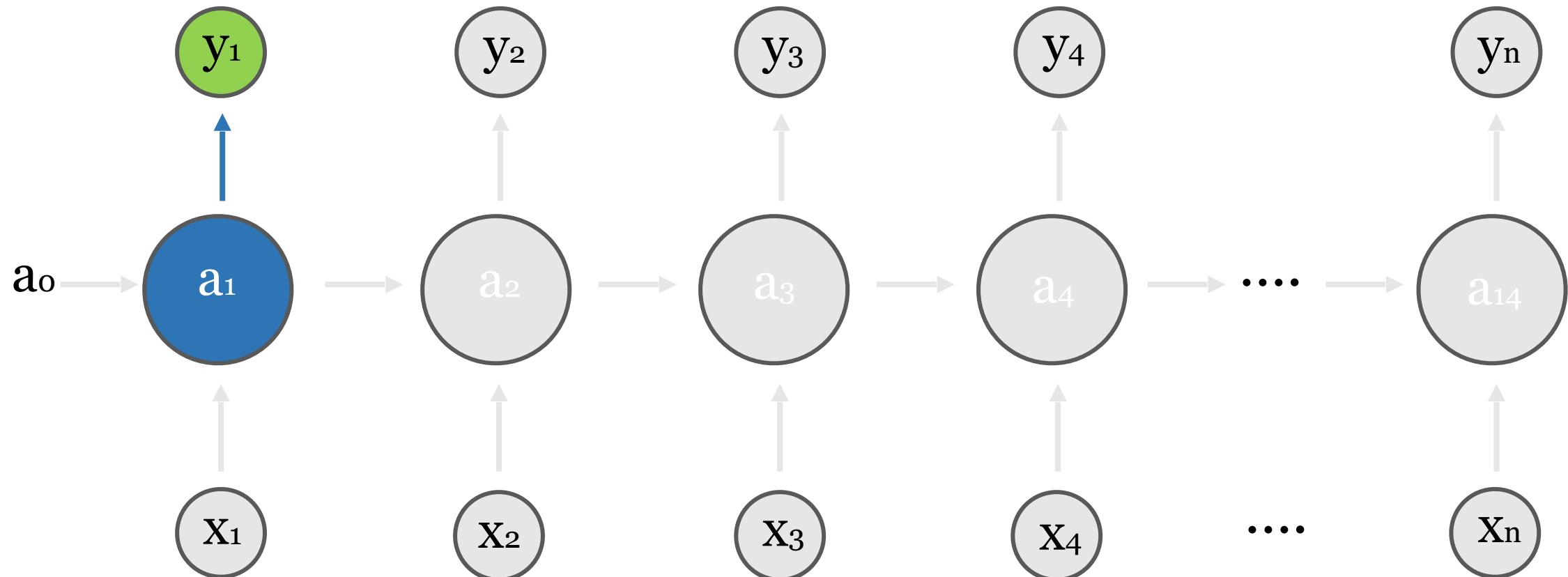
Recurrent Neural Network



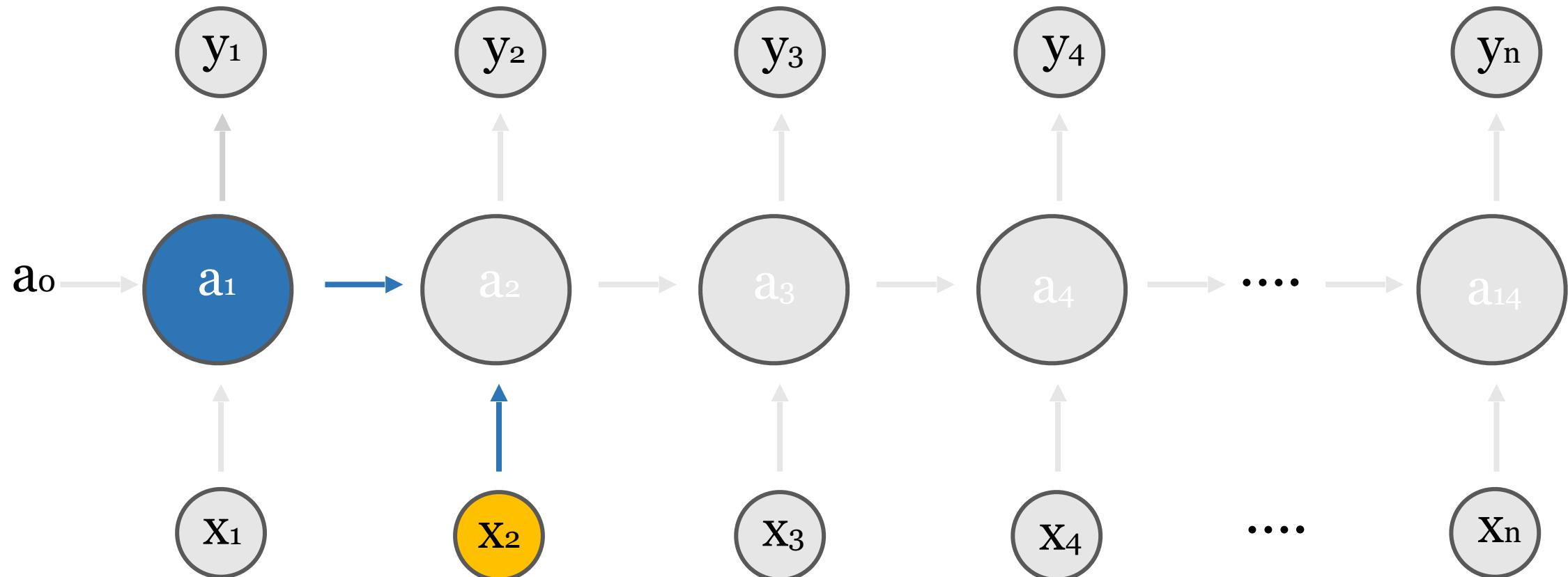
Recurrent Neural Network



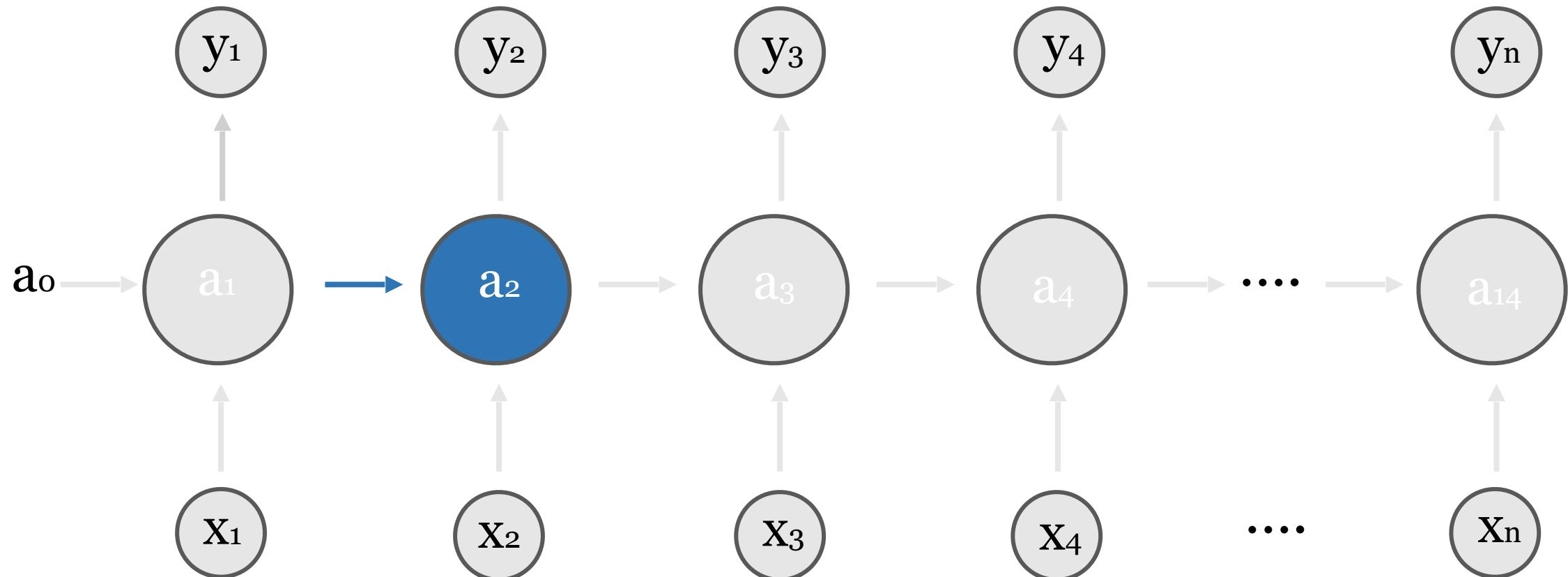
Recurrent Neural Network



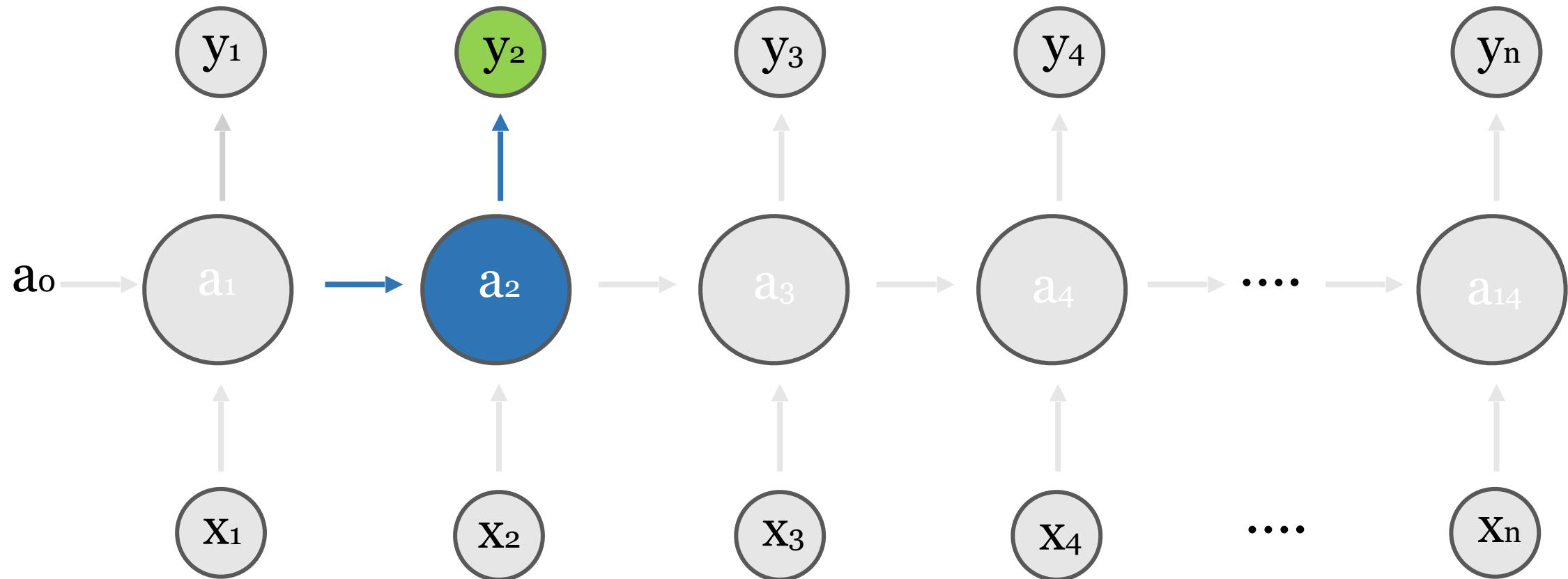
Recurrent Neural Network



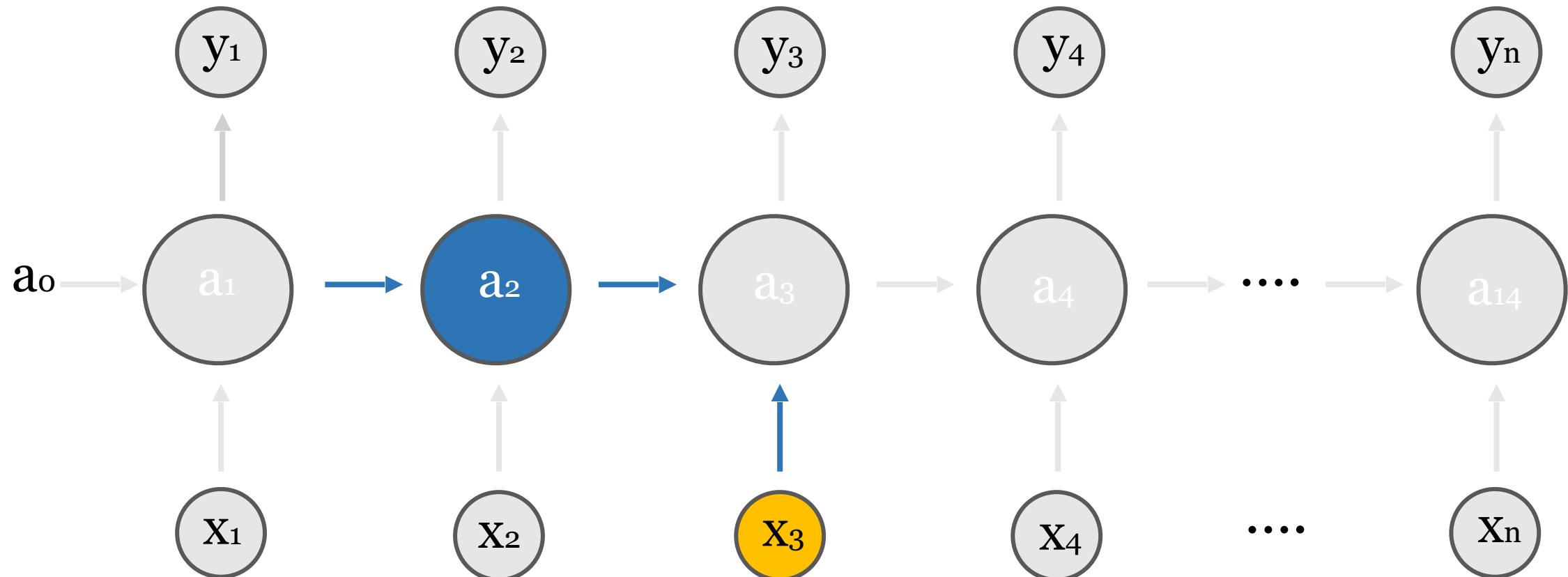
Recurrent Neural Network



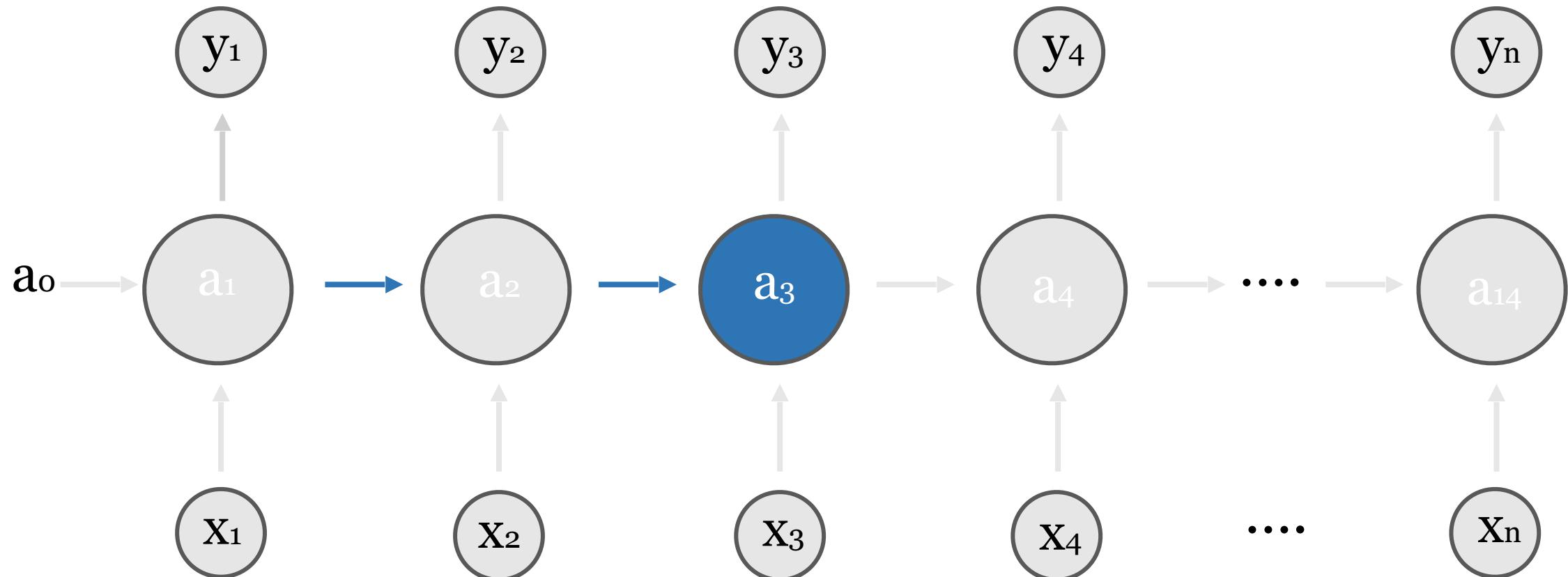
Recurrent Neural Network



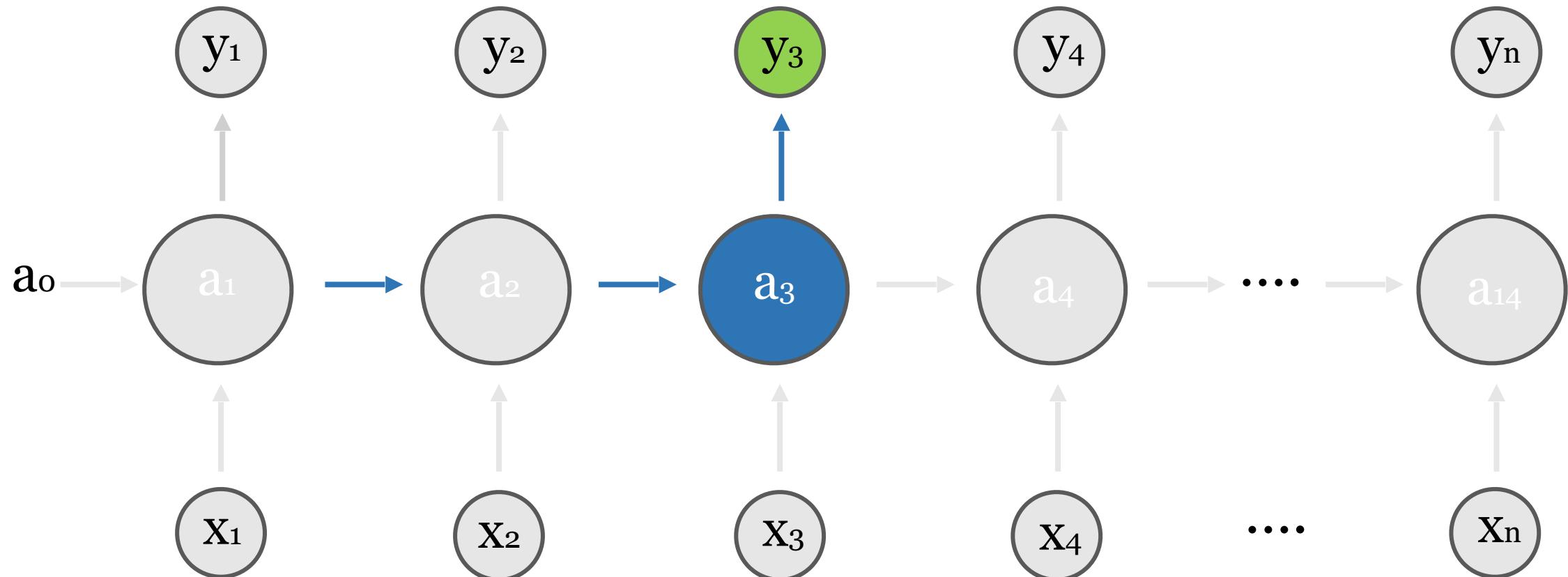
Recurrent Neural Network



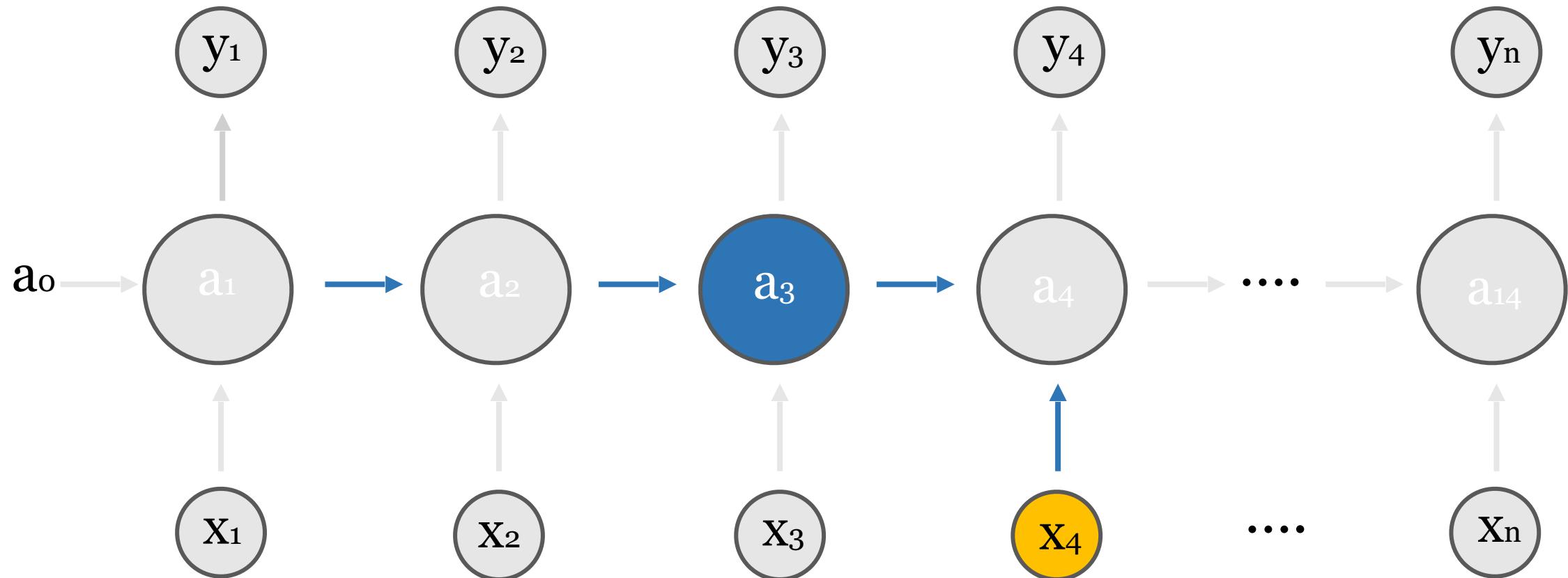
Recurrent Neural Network



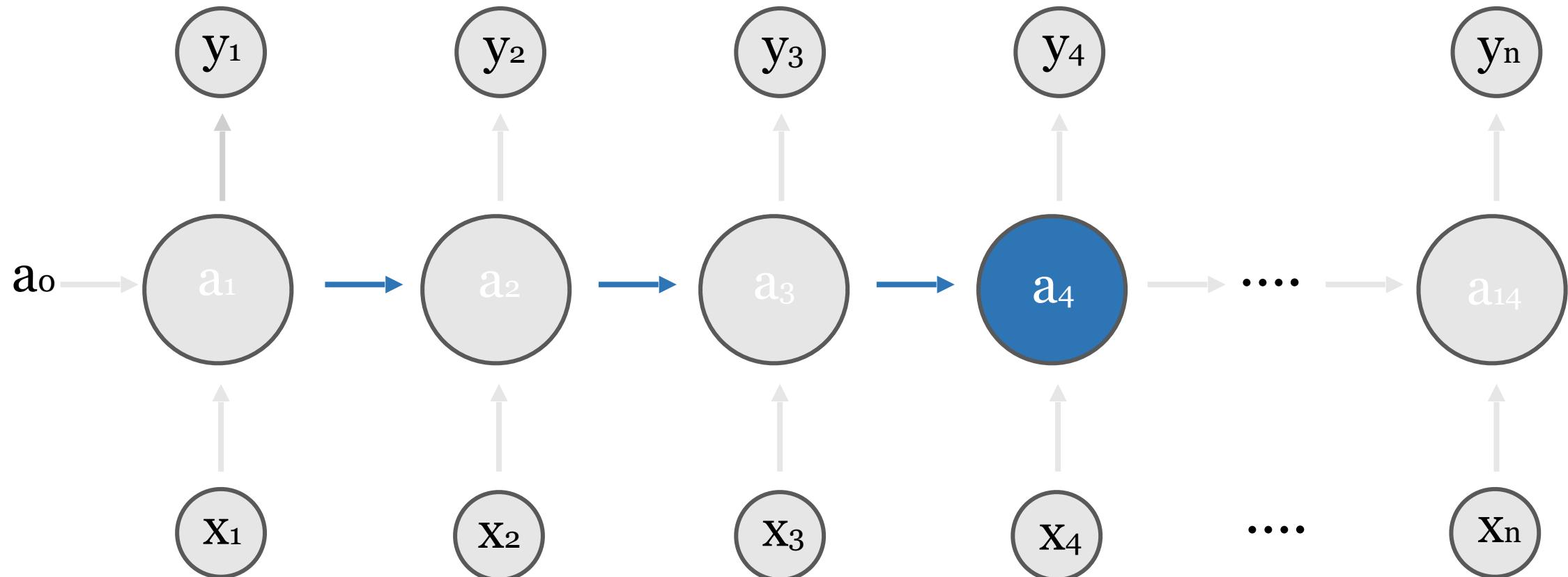
Recurrent Neural Network



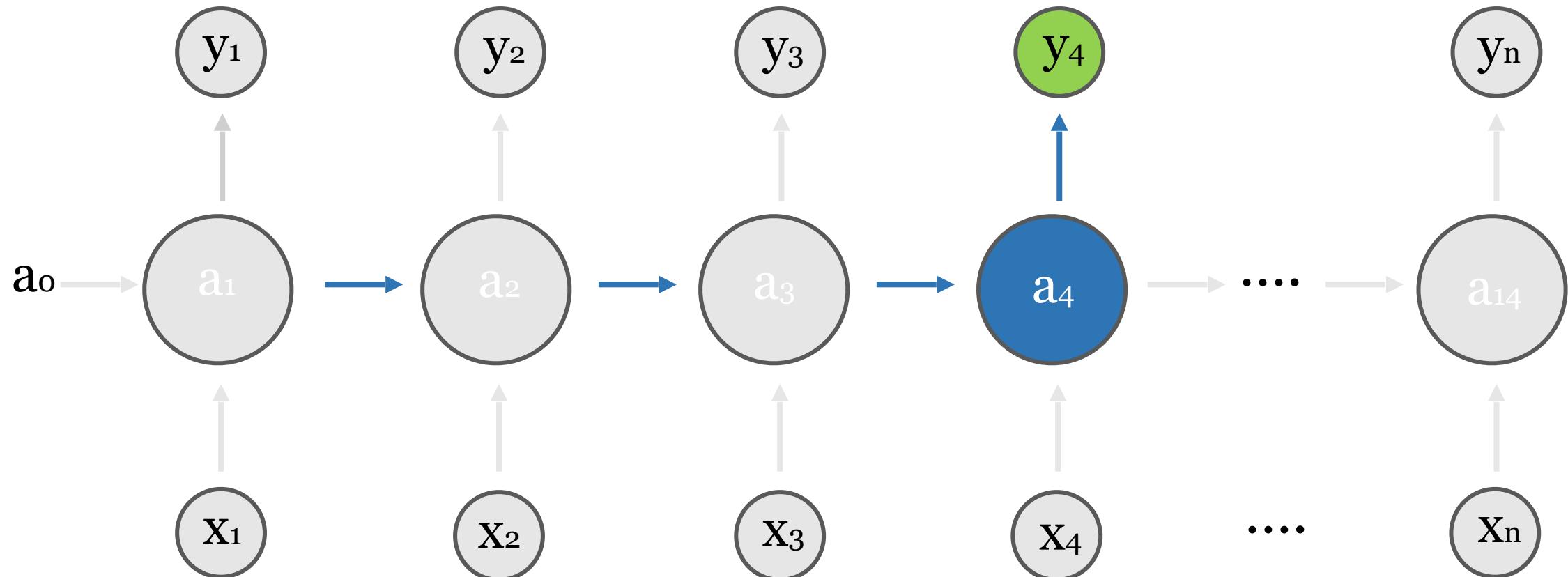
Recurrent Neural Network



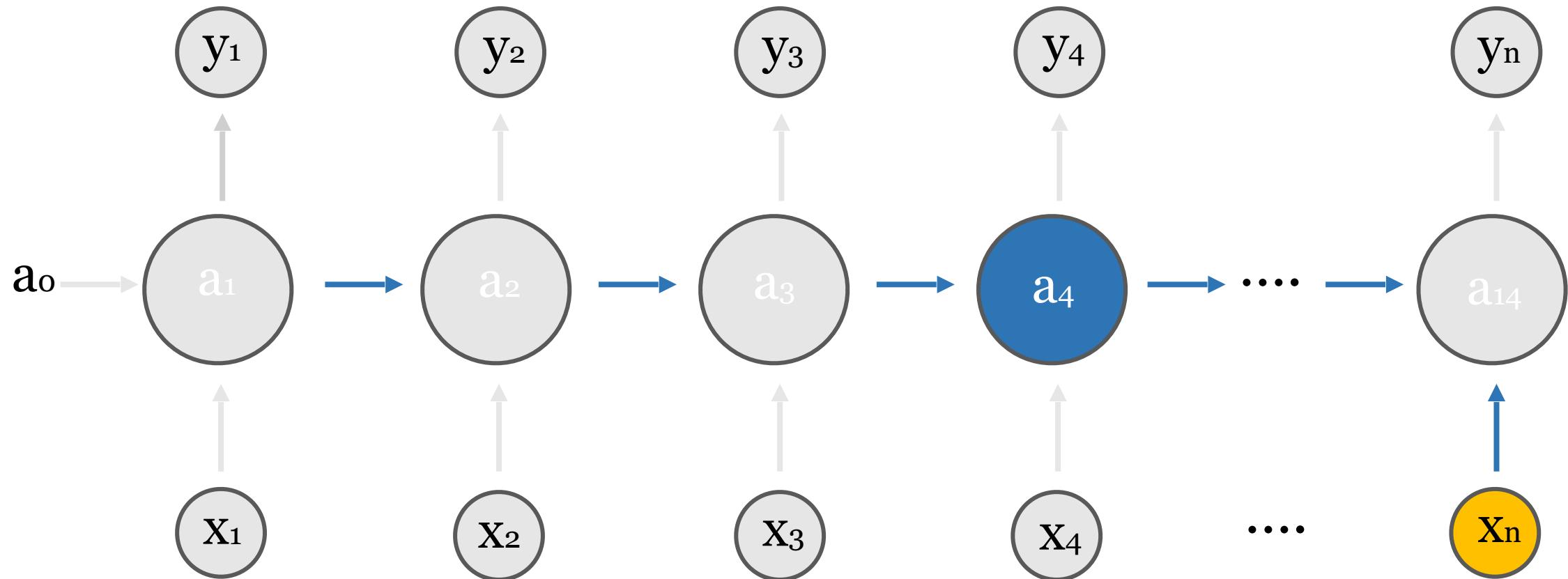
Recurrent Neural Network



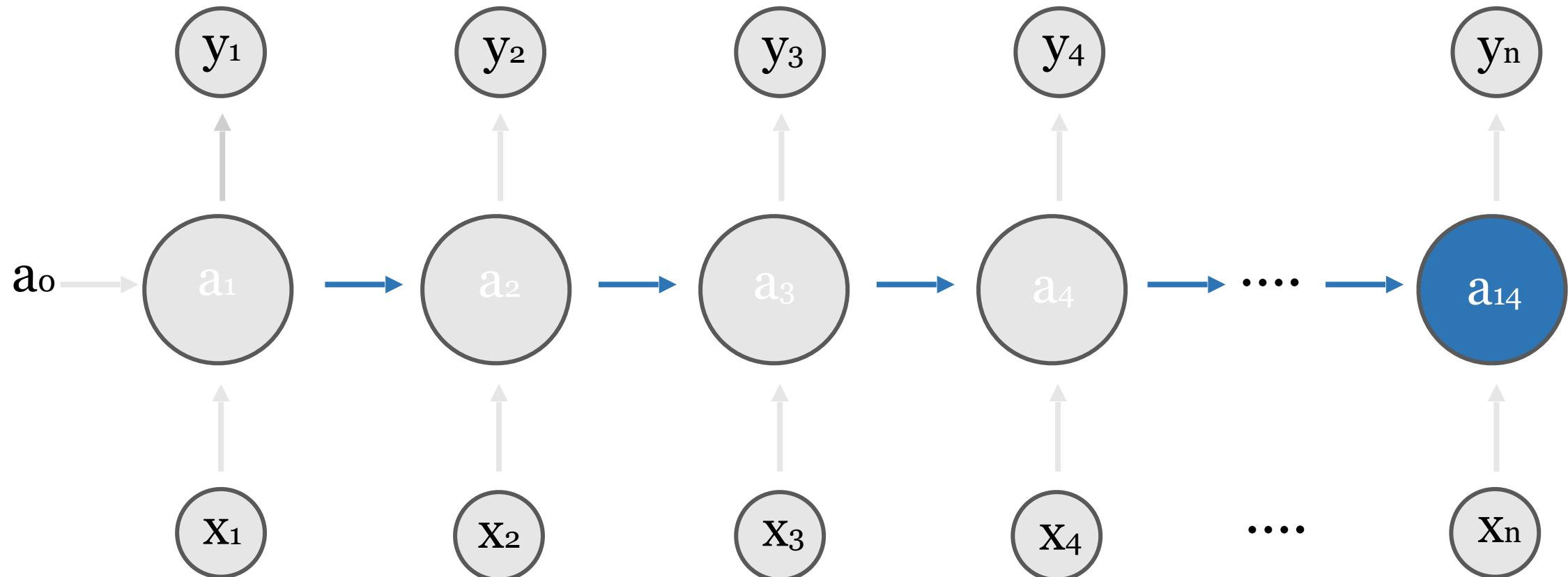
Recurrent Neural Network



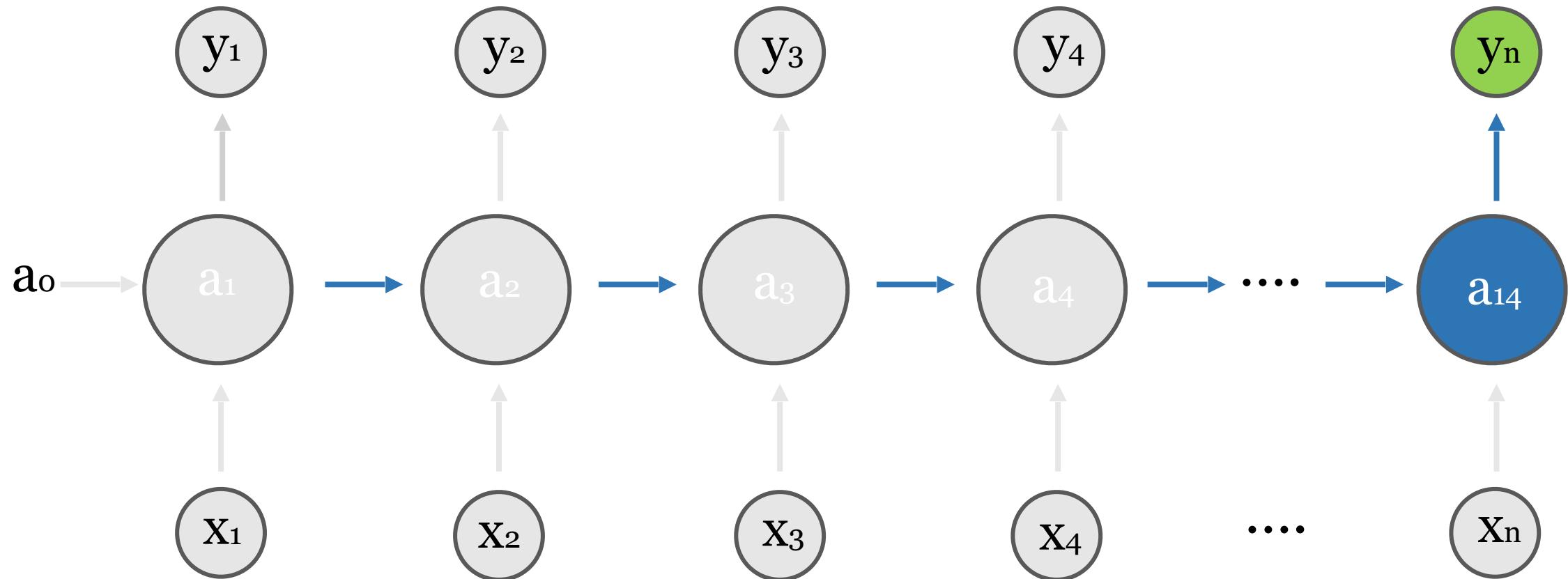
Recurrent Neural Network



Recurrent Neural Network



Recurrent Neural Network

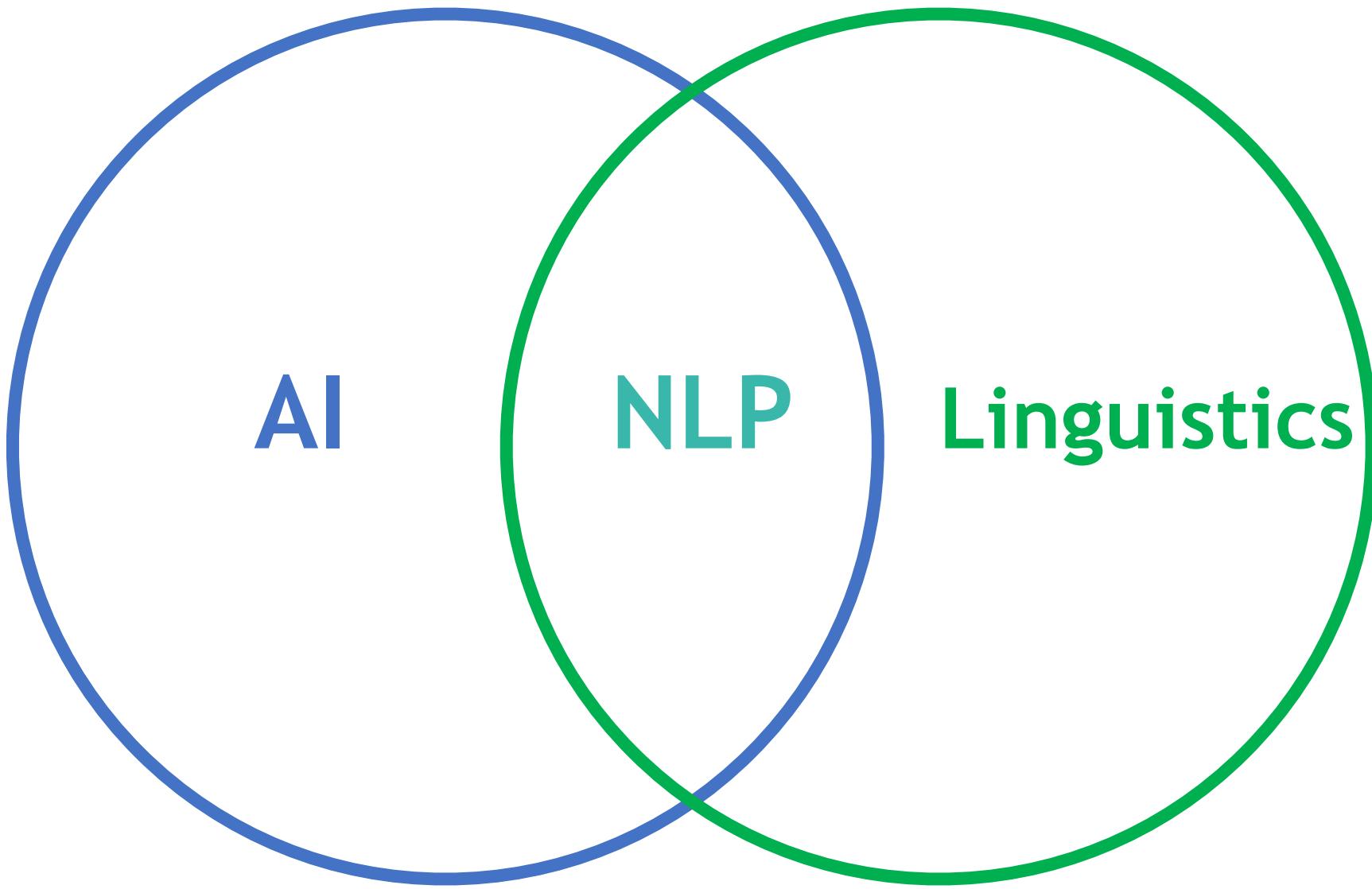


Natural Language Processing

Natural Language Processing

Natural Language Processing

NLP



Challenges doing NLP

Ambiguity in Language

That is your computer.

That is your computer.
That isn't your computer.

That is your computer.

That isn't your computer.

That is your computer.

That isn't your computer.

Is that your computer?

That is your computer.

That isn't your computer.

Is that your computer?

Isn't that your computer?

That is your computer.

That isn't your computer.

Is that your computer?

Isn't that your computer?

Misheard Speech

“Recognize speech” or “Wreck a nice beach”

Ambiguous Pronunciation

project (noun) vs. project (verb)

Syntactic Ambiguity

We were out and I saw you last weekend with my wife.

Syntactic Ambiguity

My wife and I were out last weekend and we saw you.

Context

May I have your _____?

May I have your attention?

May I have your number?

May I have your keys?

How do we encode words?

Sentiment Classification

“A touching movie full of emotions with wonderful acting.
Worth seeing a second time!”

Preprocess

A touching movie full of emotions with wonderful acting
Worth seeing a second time

Lowercase

a touching movie full of emotions with wonderful acting
worth seeing a second time

Tokenization

a touching movie full of emotions with wonderful acting
worth seeing a second time

[‘a’, ‘touching’, ‘movie’, ‘full’, ‘of’, ‘emotions’, ‘with’,
‘wonderful’, ‘acting’, ‘worth’, ‘seeing’, ‘a’, ‘second’, ‘time’]

Stop words removal

a touching movie full of emotions with wonderful acting
worth seeing a second time

[‘touching’, ‘movie’, ‘full’, ‘emotions’, ‘wonderful’, ‘acting’,
‘worth’, ‘seeing’, ‘second’, ‘time’]

Lemmatization

a touching movie full of emotions with wonderful acting
worth seeing a second time

[‘touch’, ‘movie’, ‘full’, ‘emotion’, ‘wonder’, ‘act’, ‘worth’,
‘see’, ‘second’, ‘time’]

Word Embeddings

	Gender	Age	Audible	Edible	Color	...
Woman						
Man						
Music						
Voice						
Apple						
Orange						

	Gender	Age	Audible	Edible	Color	...
Woman	-1					
Man	1					
Music	.02					
Voice	.73					
Apple	.04					
Orange	.03					

	Gender	Age	Audible	Edible	Color	...
Woman	-1	.37				
Man	1	.38				
Music	.02	0.14				
Voice	.73	0.33				
Apple	.04	-.01				
Orange	.03	.00				

	Gender	Age	Audible	Edible	Color	...
Woman	-1	.37	.05			
Man	1	.38	.07			
Music	.02	0.14	.99			
Voice	.73	0.33	.98			
Apple	.04	-.01	.06			
Orange	.03	.00	.03			

	Gender	Age	Audible	Edible	Color	...
Woman	-1	.37	.05	.01		
Man	1	.38	.07	.03		
Music	.02	0.14	.99	.00		
Voice	.73	0.33	.98	-.01		
Apple	.04	-.01	.06	.97		
Orange	.03	.00	.03	.94		

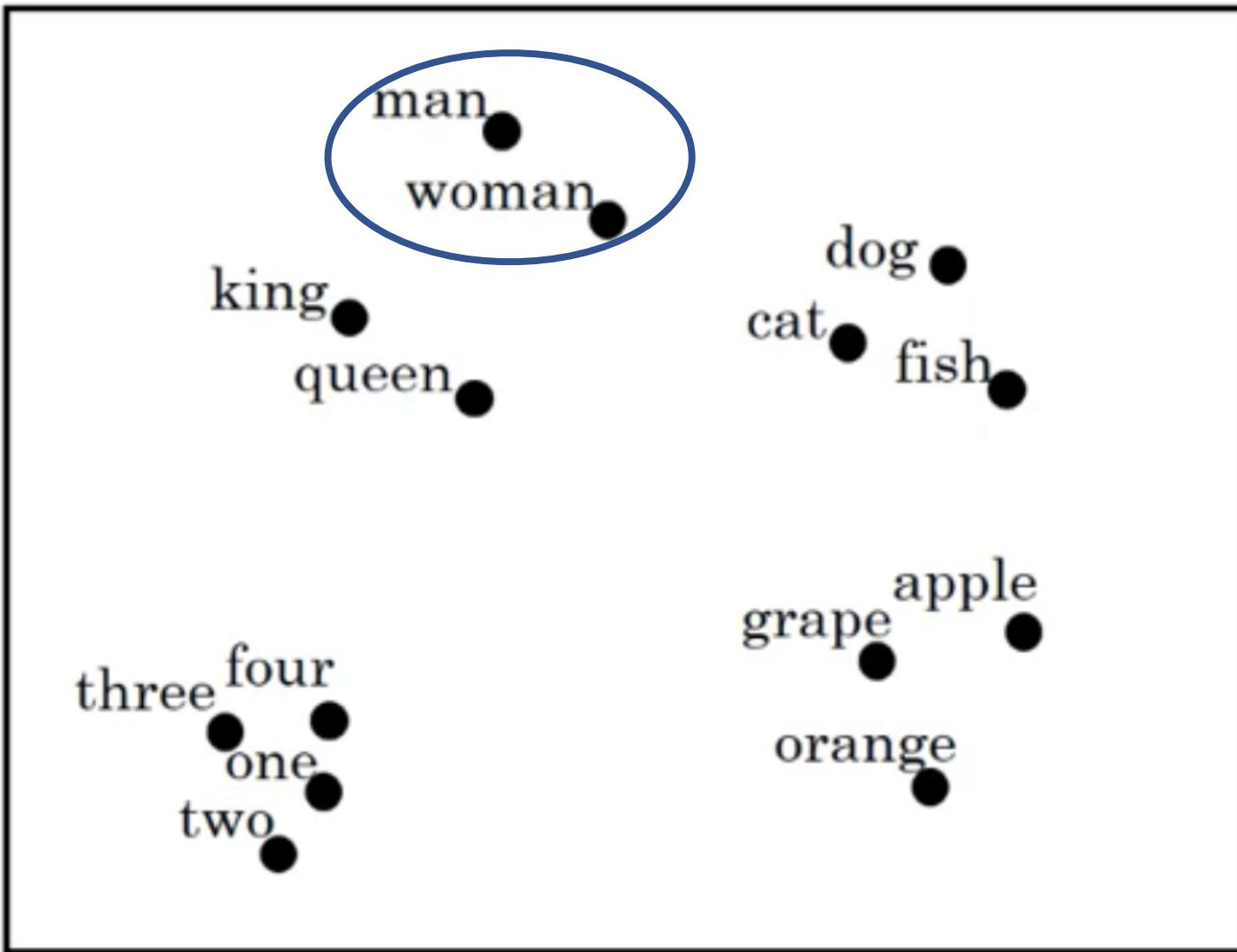
	Gender	Age	Audible	Edible	Color	...
Woman	-1	.37	.05	.01	.73	
Man	1	.38	.07	.03	.71	
Music	.02	.04	.99	.00	.03	
Voice	.73	.03	.98	-.01	.02	
Apple	.04	-.01	.06	.97	.88	
Orange	.03	.00	.03	.94	.92	

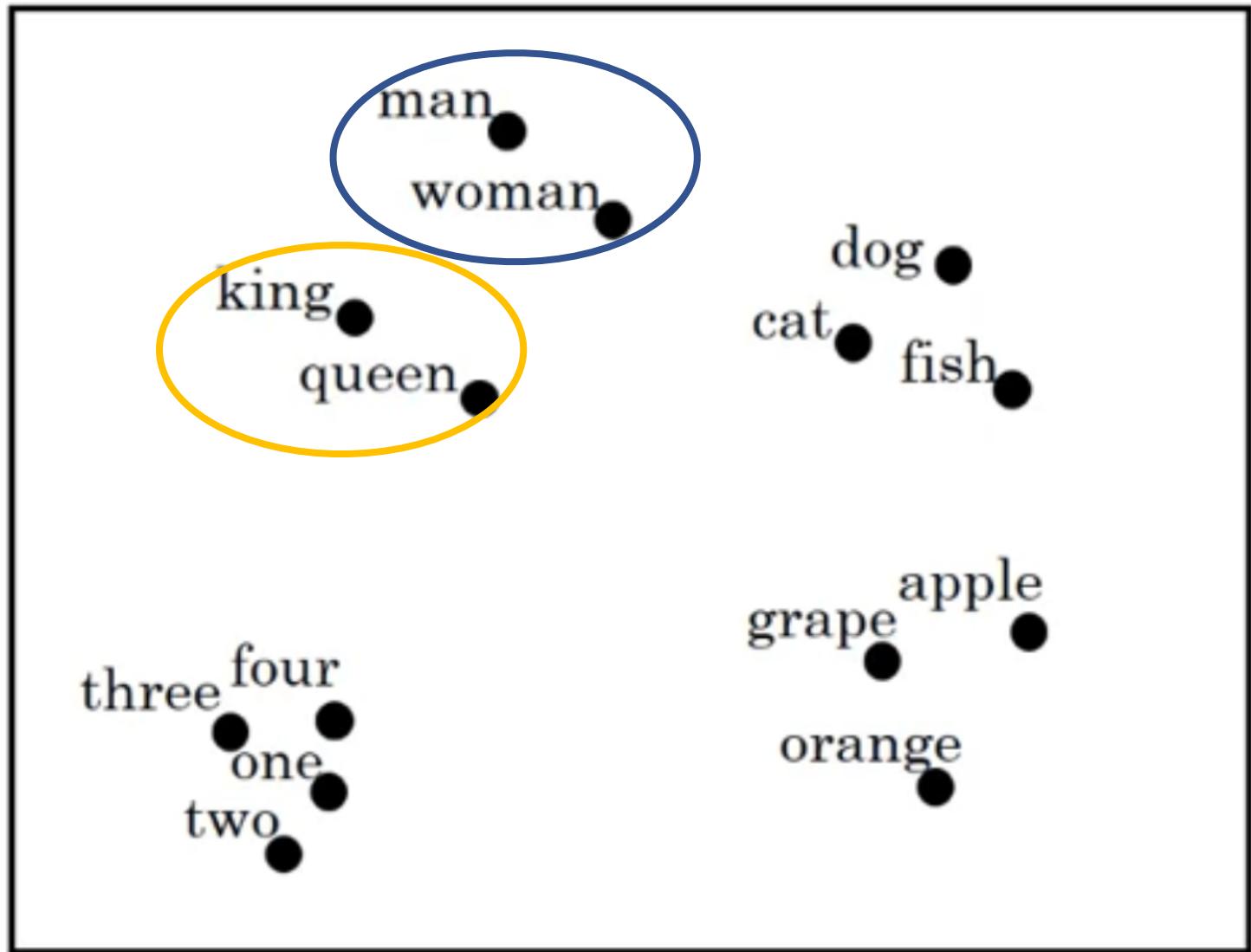
A scatter plot enclosed in a black rectangular frame, illustrating the spatial distribution of ten different nouns. Each noun is represented by a black dot, with its name printed in black text directly above it. The nouns and their approximate coordinates are:

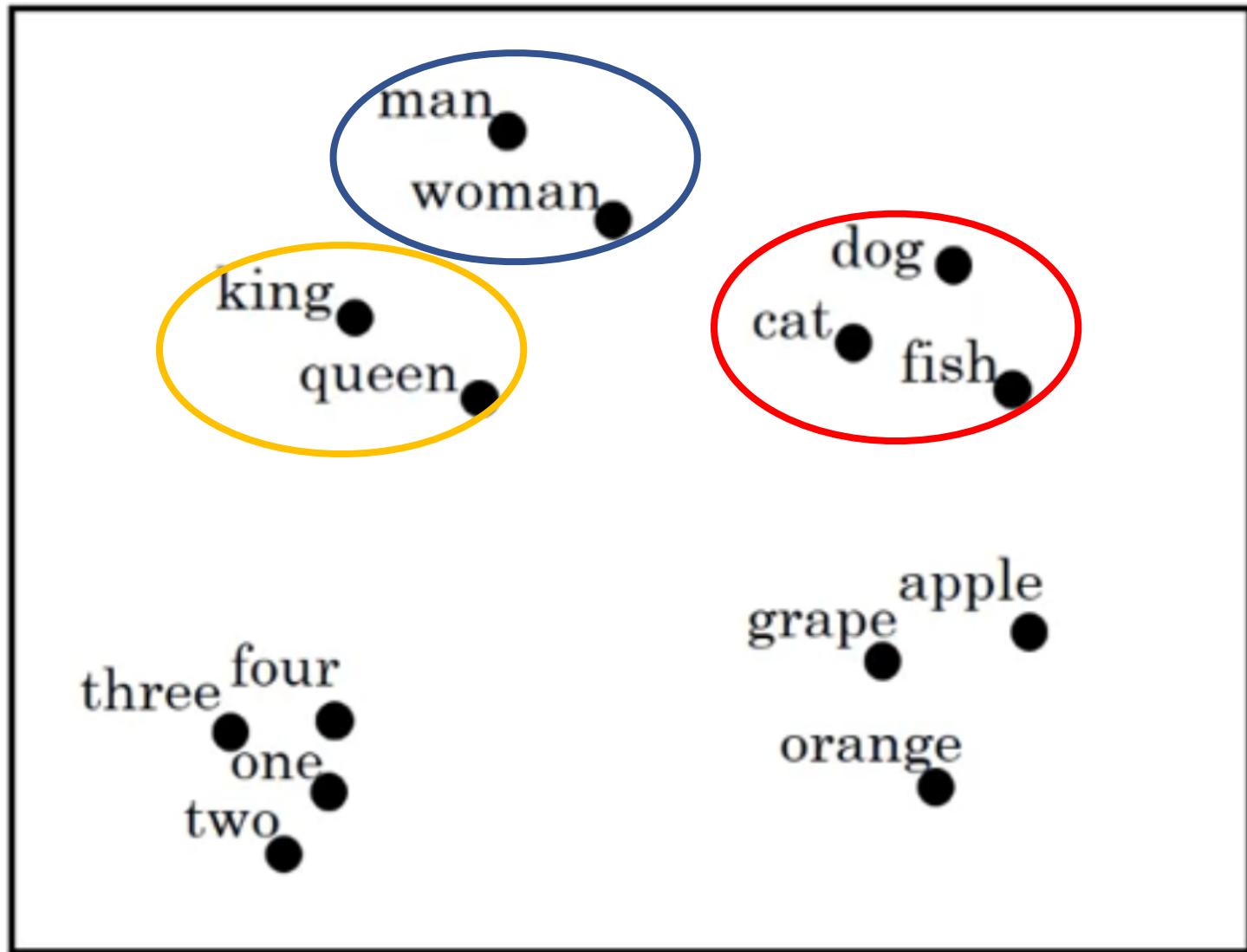
- man (top center)
- woman (center)
- king (left center)
- queen (center)
- dog (right center)
- cat (center)
- fish (right center)
- apple (right bottom)
- grape (center)
- orange (bottom right)

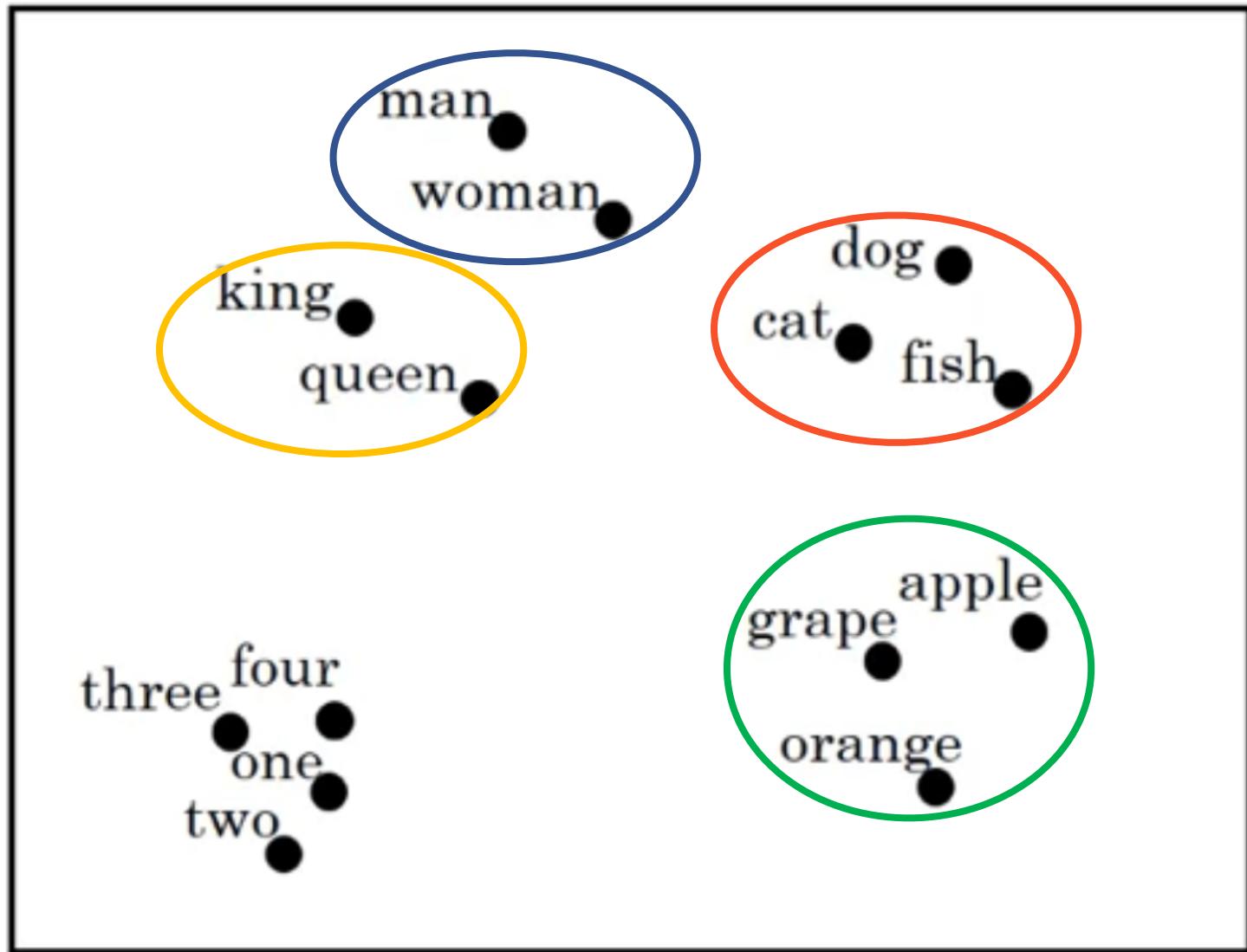
The nouns are distributed across the frame, with some clustering in the center and others more towards the periphery.

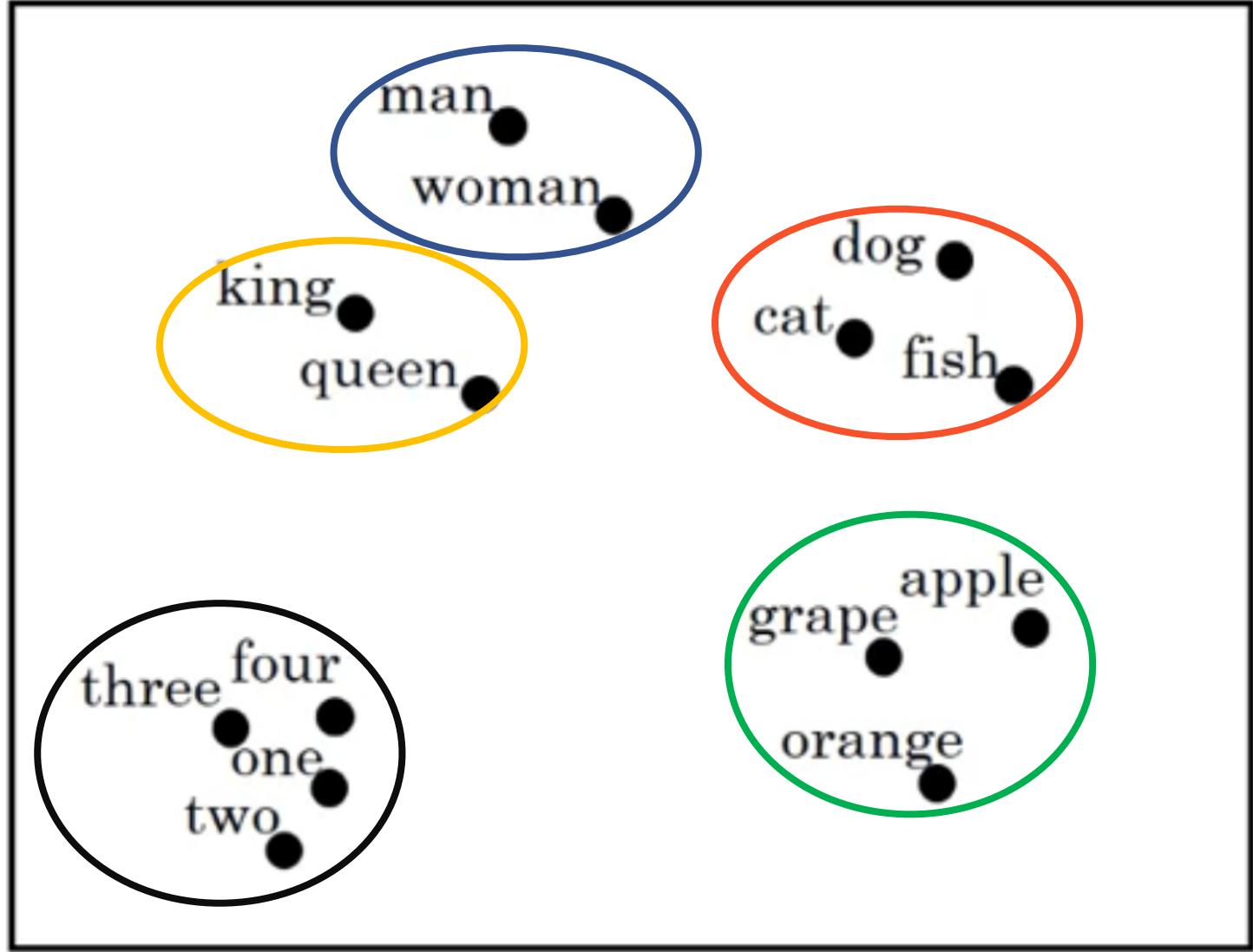
man
woman
king
queen
dog
cat
fish
apple
grape
orange
three
four
one
two

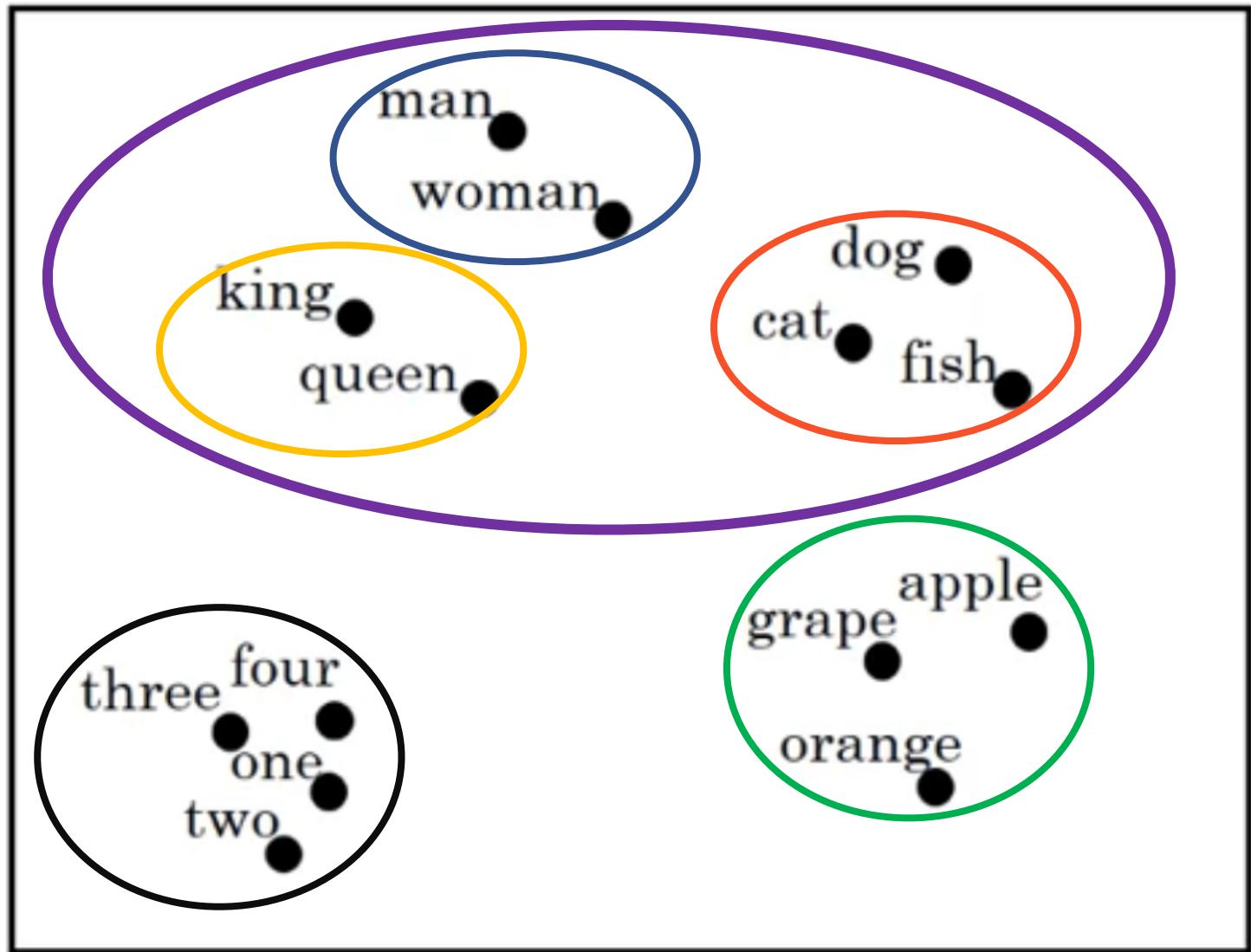










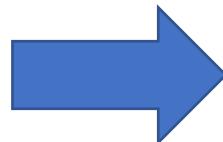


Speech

Speech Synthesis

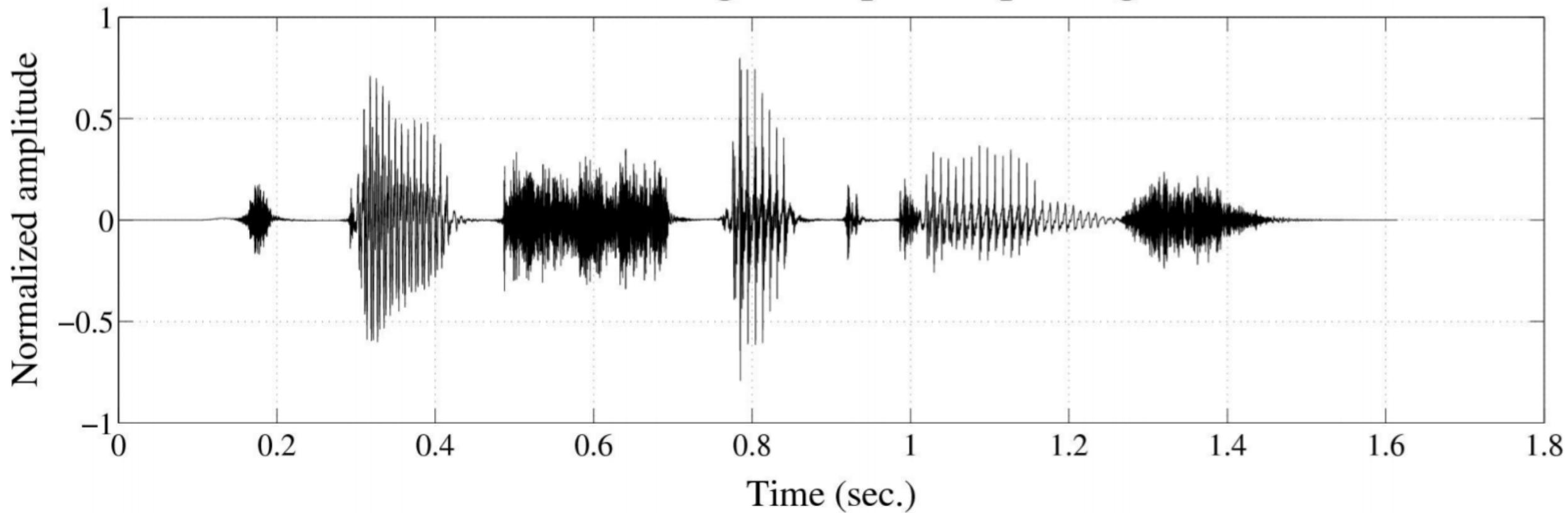
(text-to-speech)

Becoming
human.



Speech Recognition (speech-to-text)

Audio recording for "Speech spectrogram"



Voice Commands Assistants





1. Activated by wake word

1. Activated by wake word

“Hey Siri, ...”

1. Activated by wake word

“Hey Siri, ...” → 0/1

2. Speech recognition

2. Speech recognition

“What is the weather tomorrow?”

2. Speech recognition

“What is the weather tomorrow?”
“Give me the sports scores.”

2. Speech recognition

“What is the weather tomorrow?”

“Give me the sports scores.”

“Call Mom.”

2. Speech recognition

Speech-to-text

3. Intent recognition

3. Intent recognition

Tell the time

3. Intent recognition

Tell the time

Play music

3. Intent recognition

Tell the time

Play music

Change the channel

3. Intent recognition

Tell the time

Play music

Change the channel

Make a call

3. Intent recognition

3. Intent recognition

Input
“What time is it?” → Intent
time

3. Intent recognition

Input

“What time is it?”

“Tell me the time.”

→

→

Intent

time

time

3. Intent recognition

Input

“What time is it?”

→

Intent

time

“Tell me the time.”

→

time

“How late is it?”

→

time

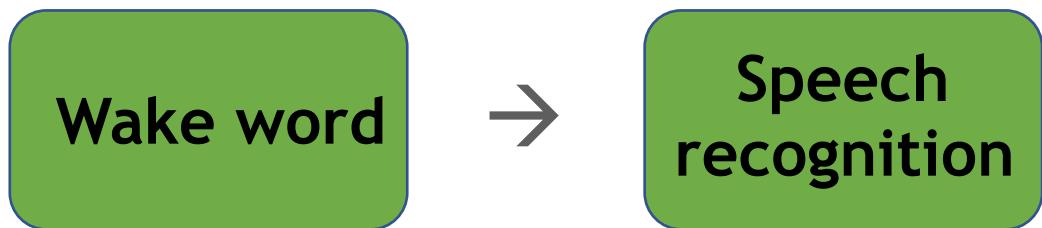
4. Intent execution

AI Pipeline

AI Pipeline

Wake word

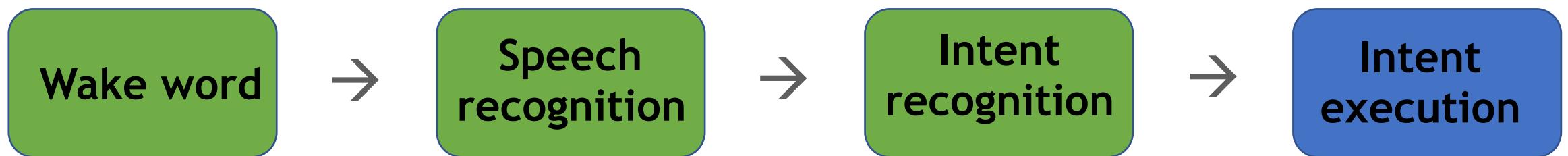
AI Pipeline



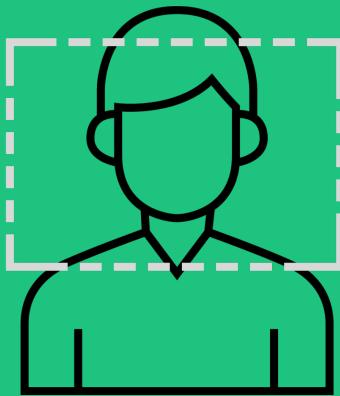
AI Pipeline



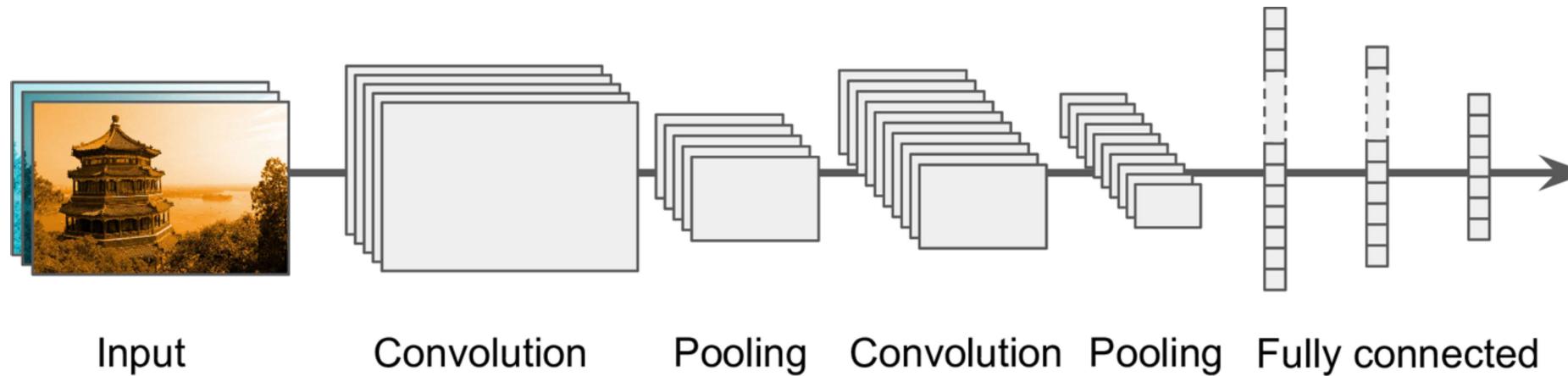
AI Pipeline



Facial Recognition



Convolutional Neural Network





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Kernel

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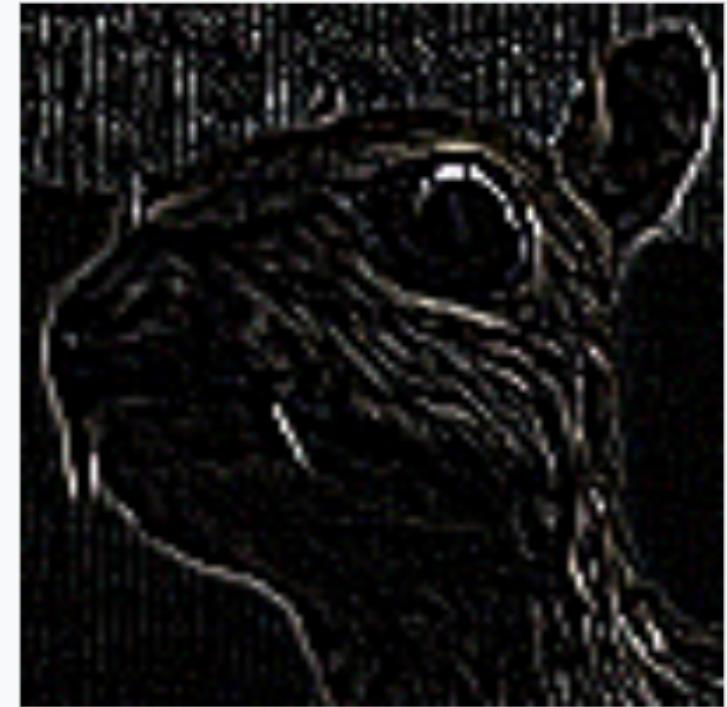
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Kernel

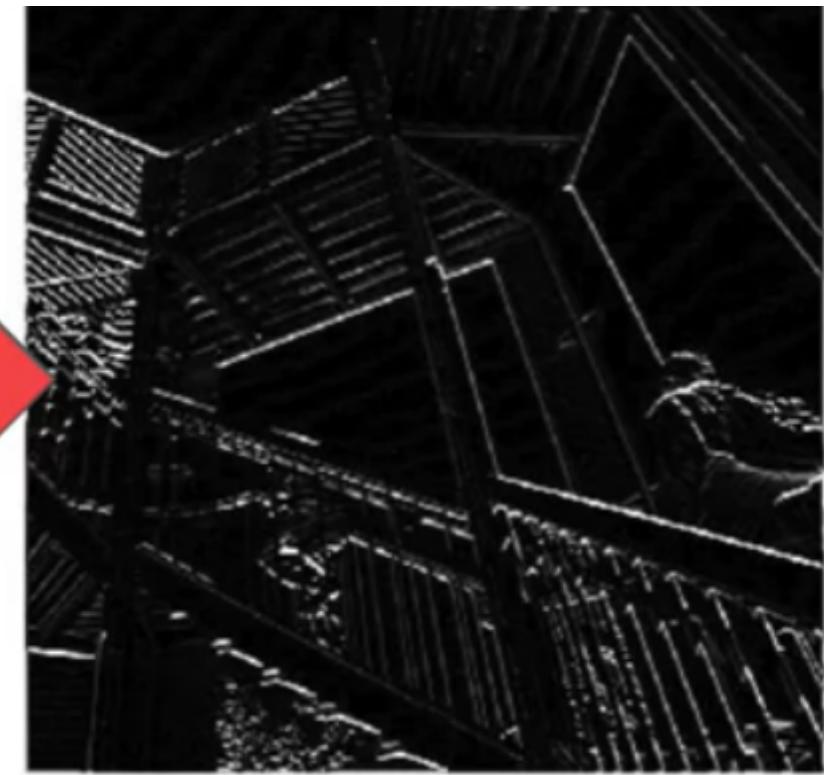
Edge
Detection

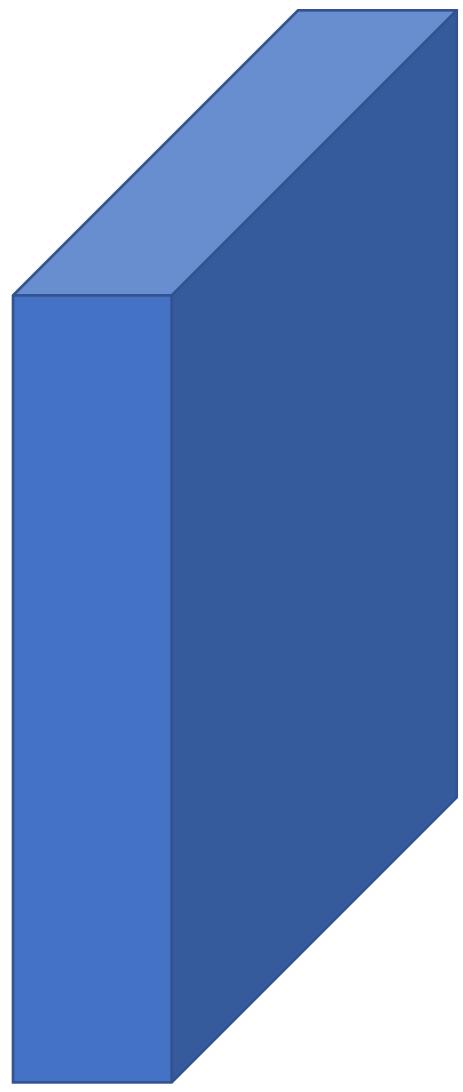
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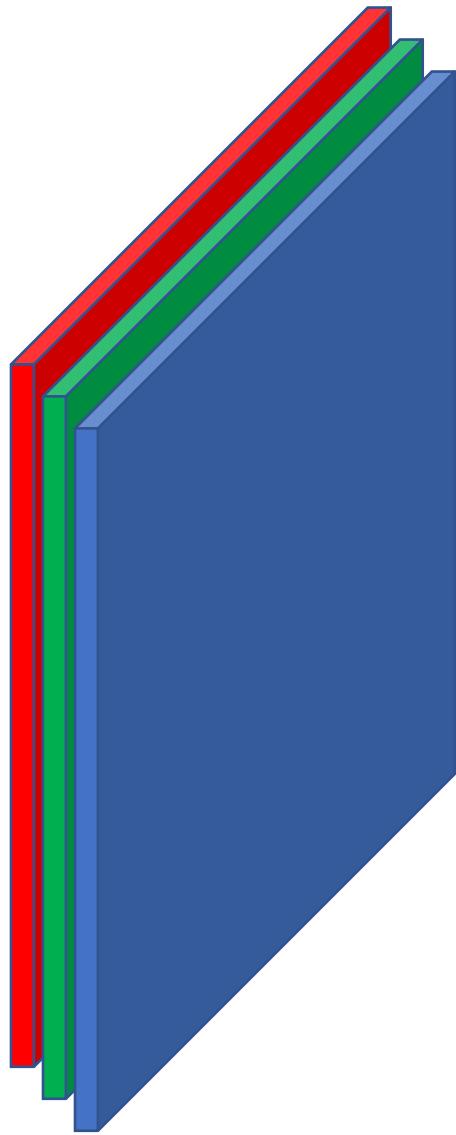


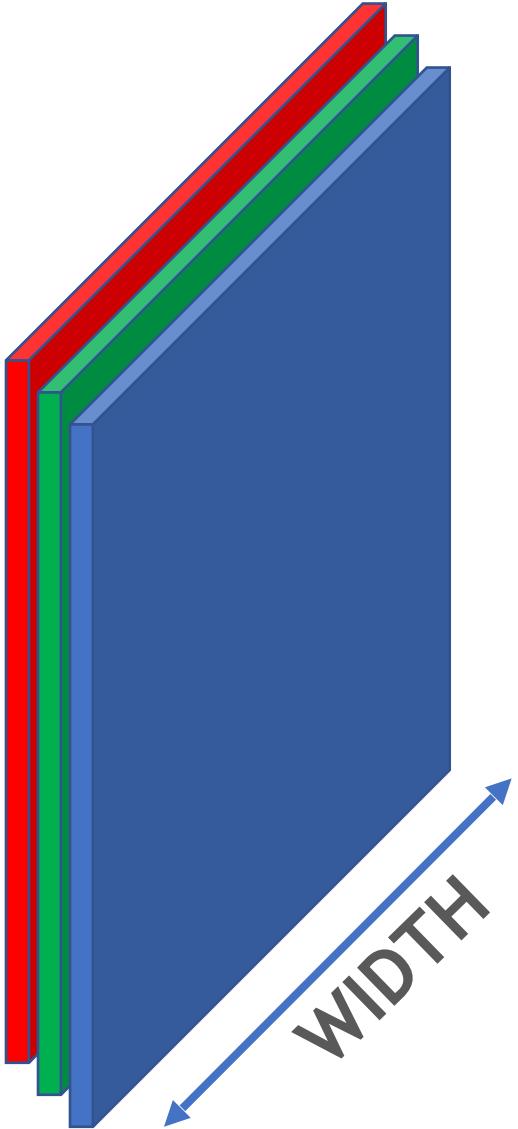


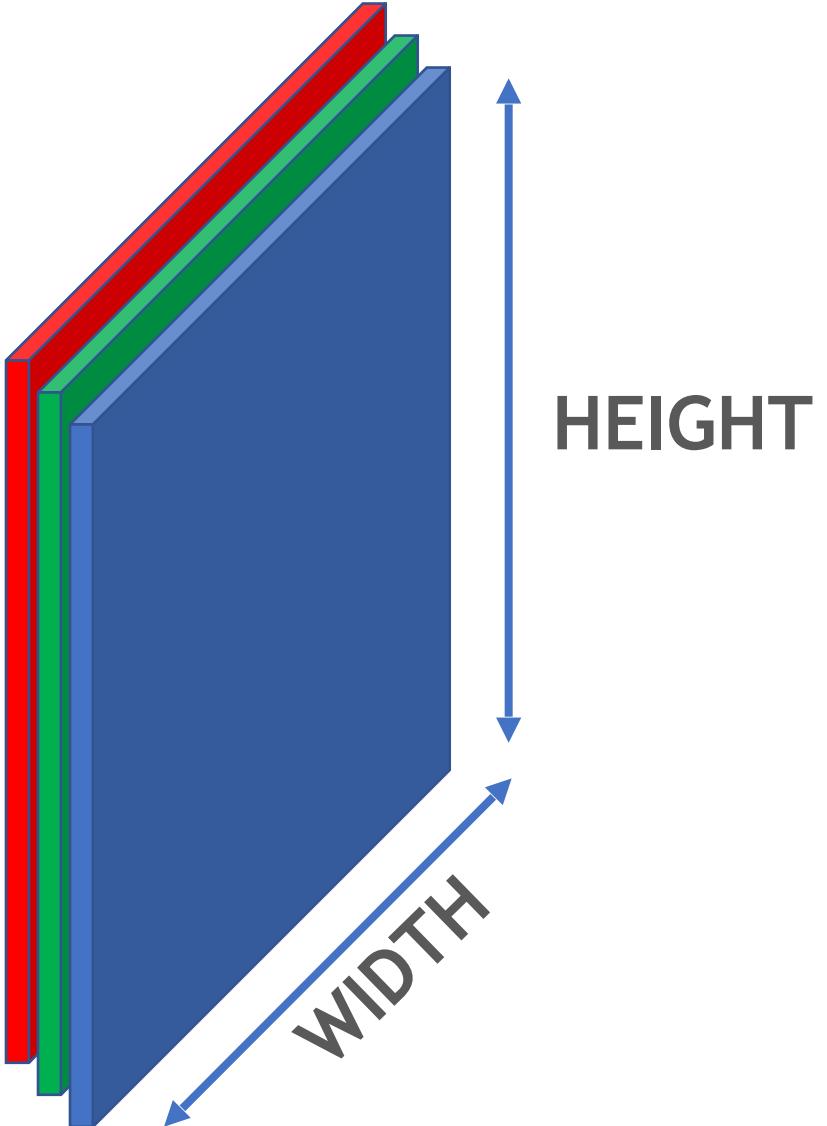
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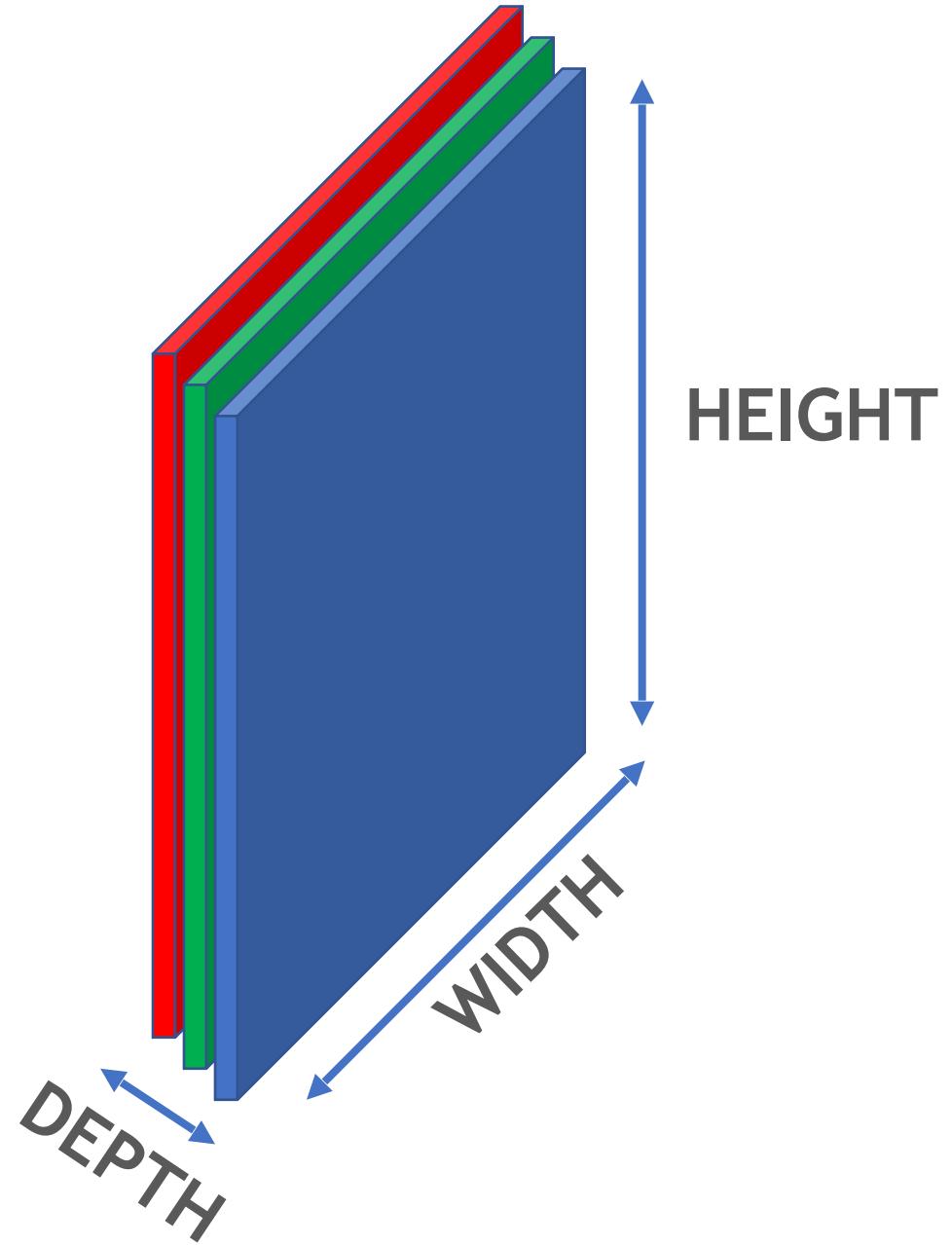


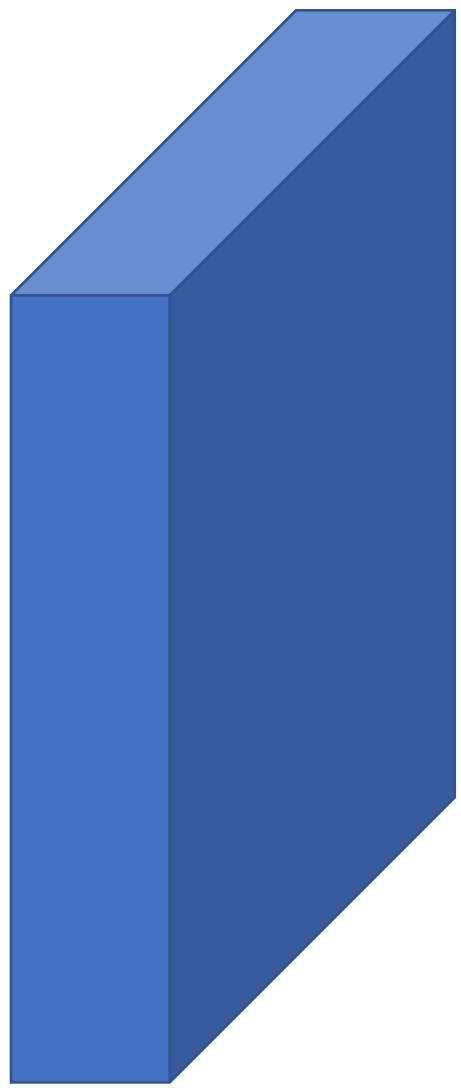


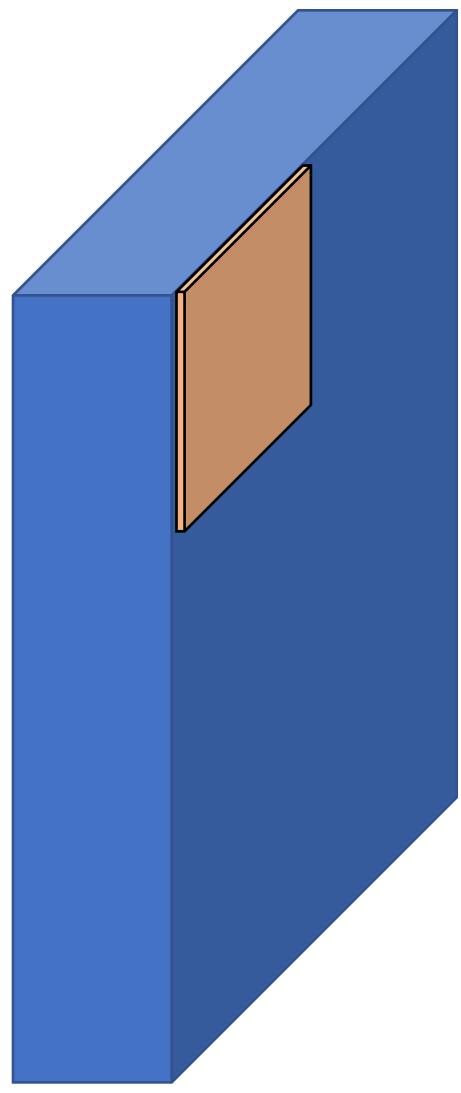


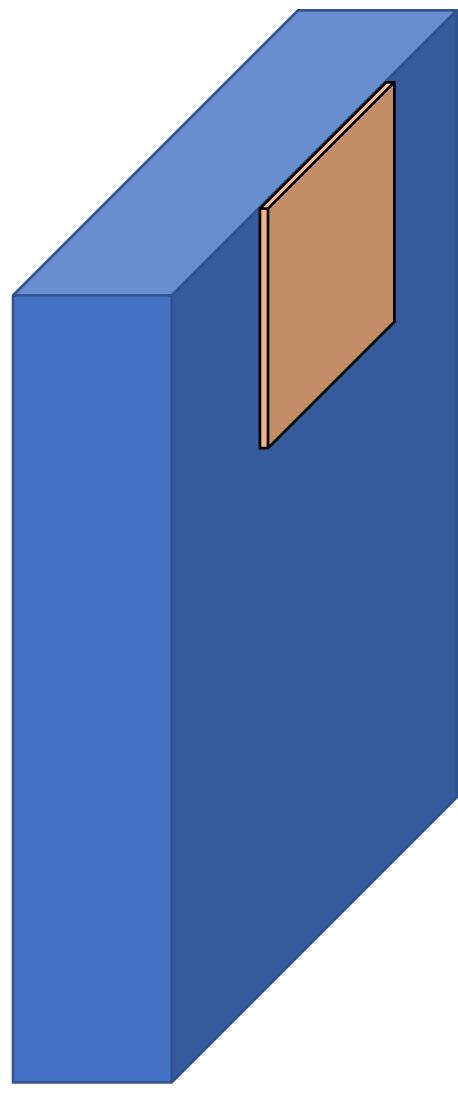
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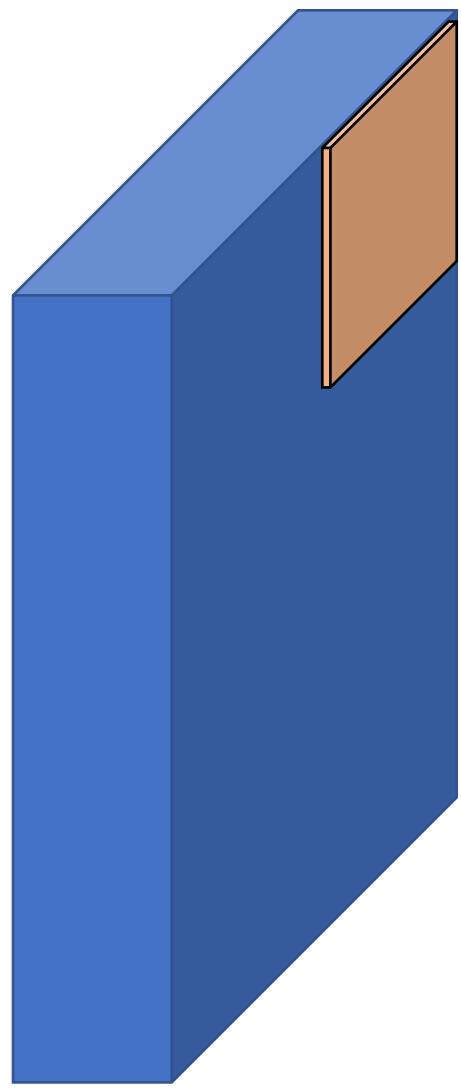
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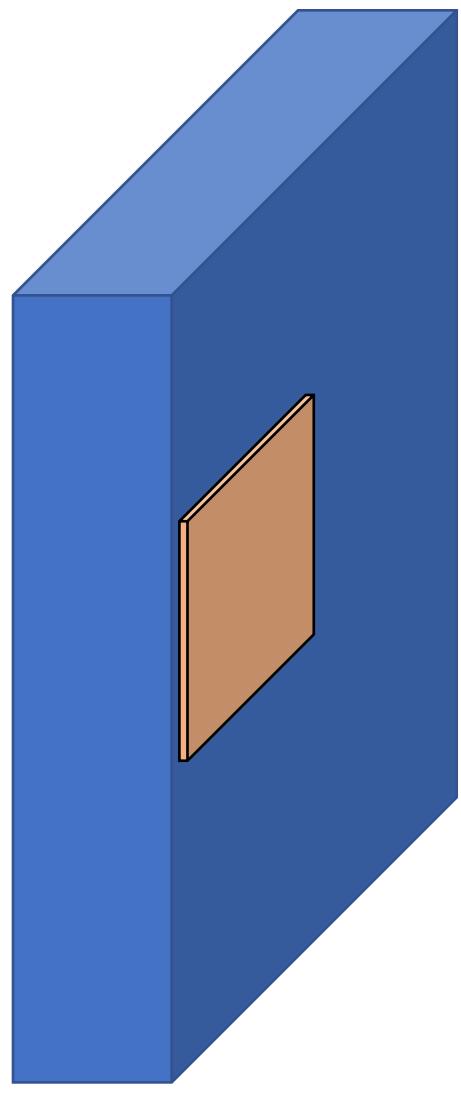


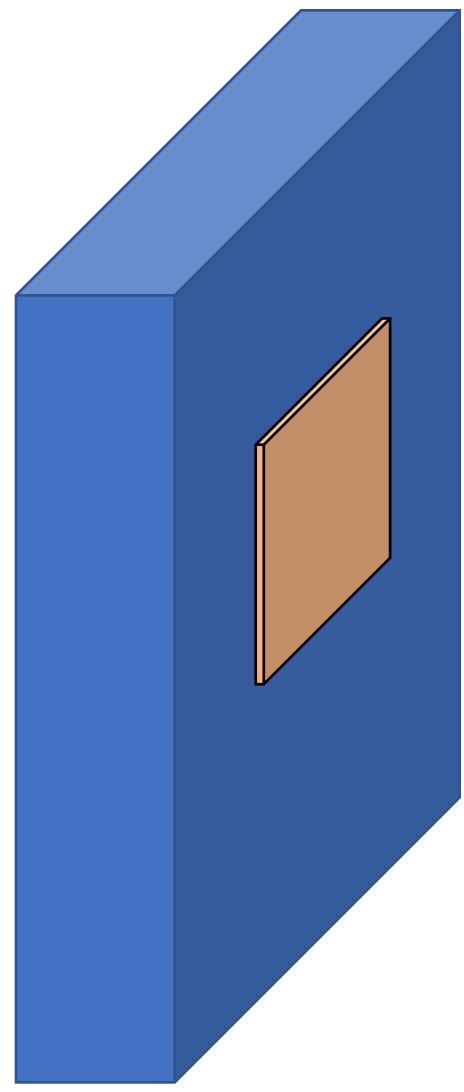


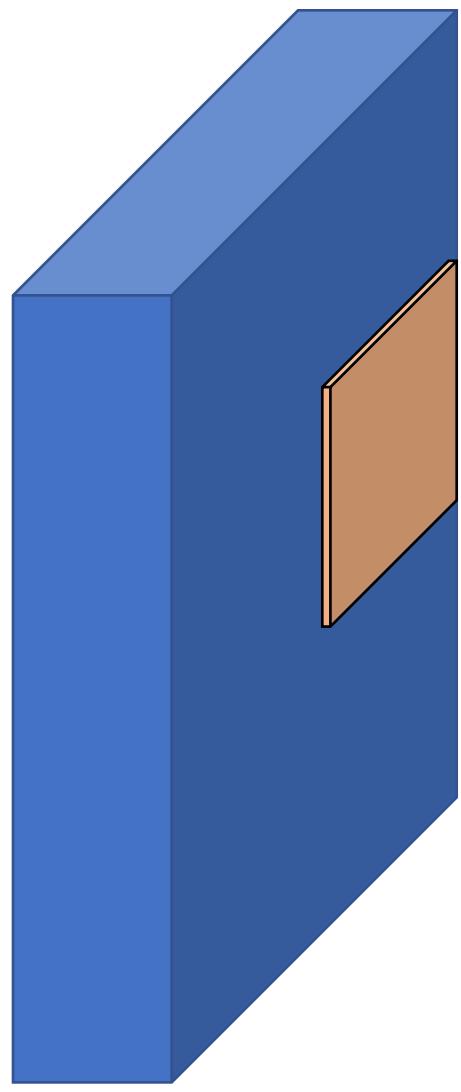


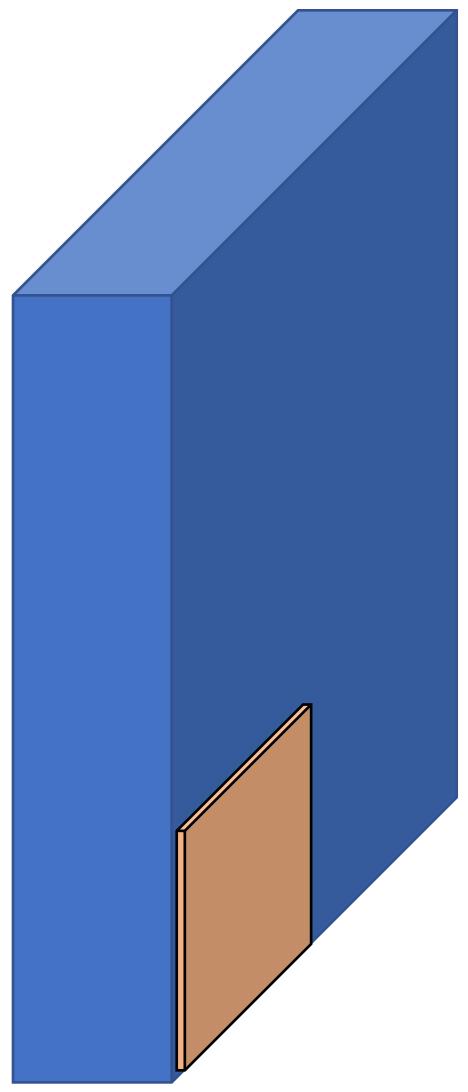


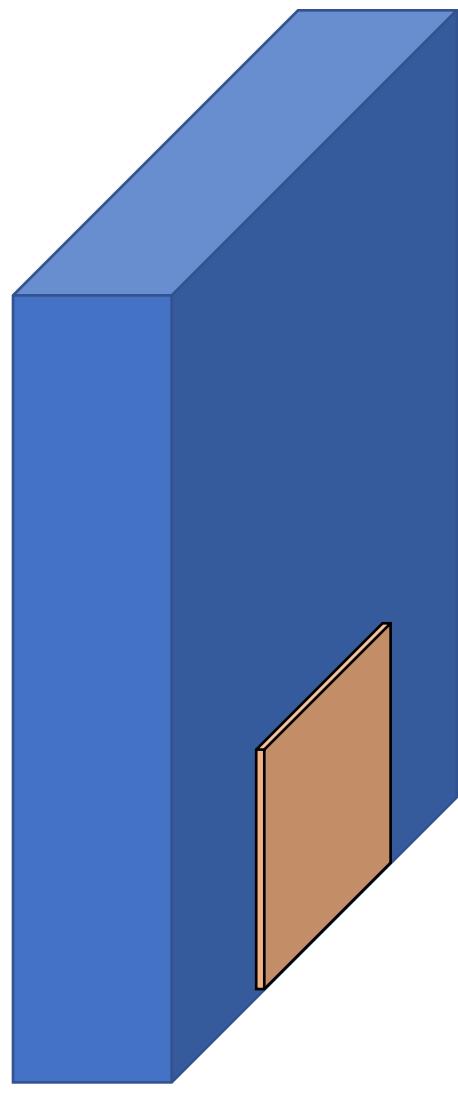


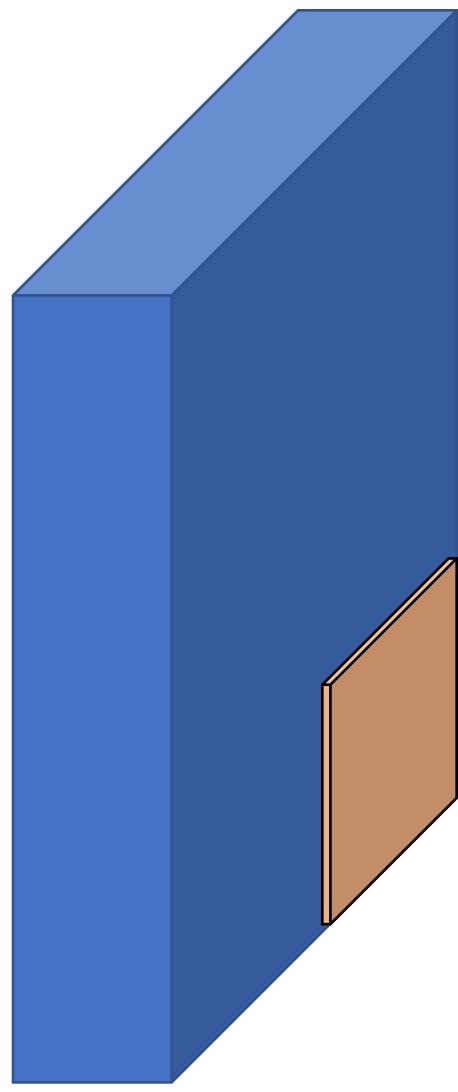


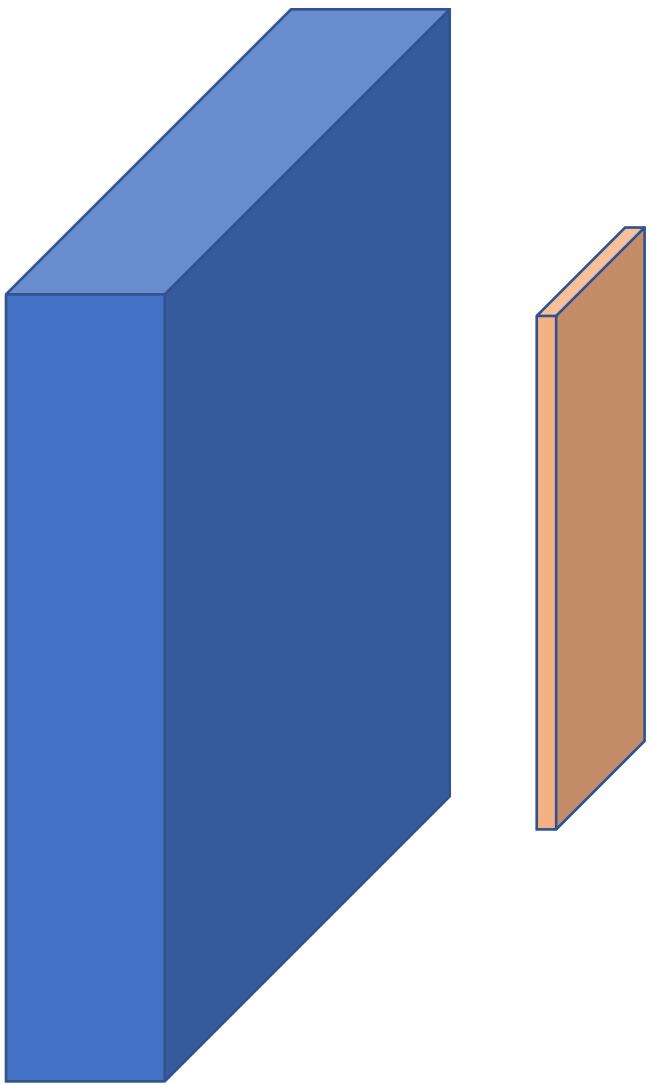




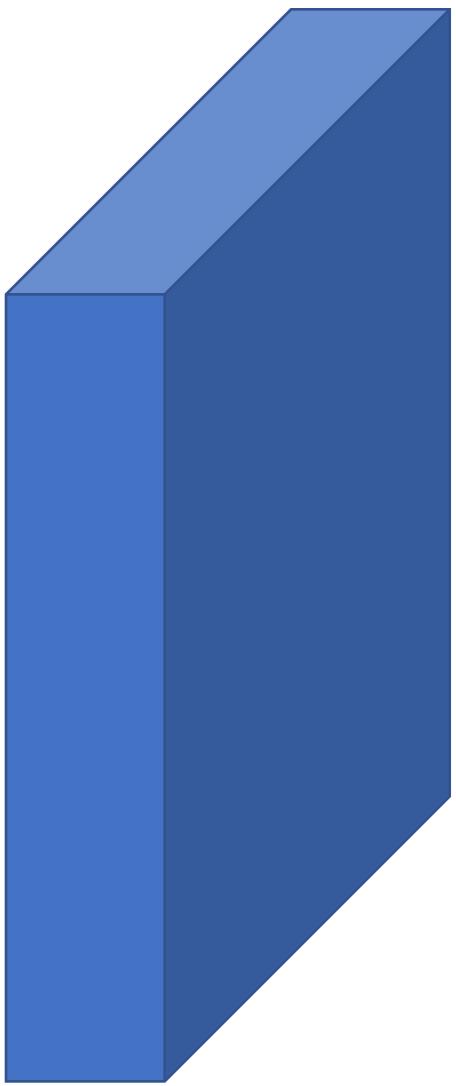




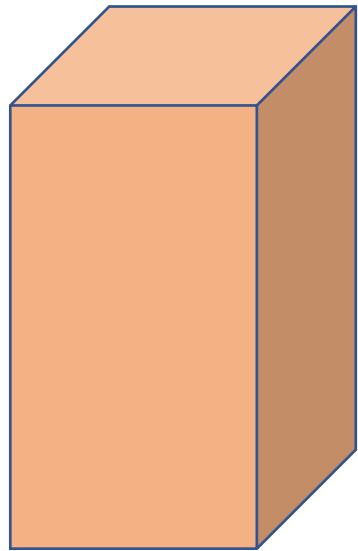


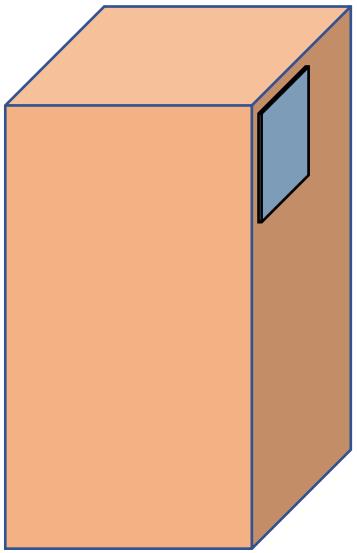
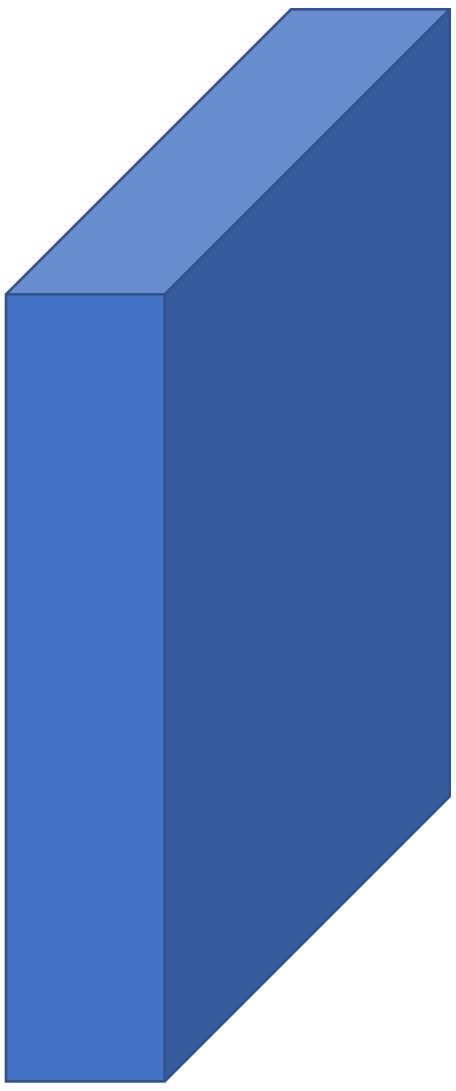


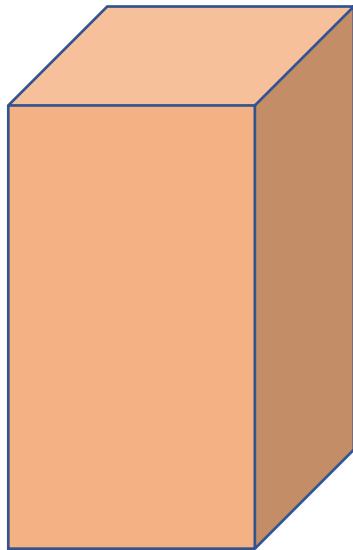
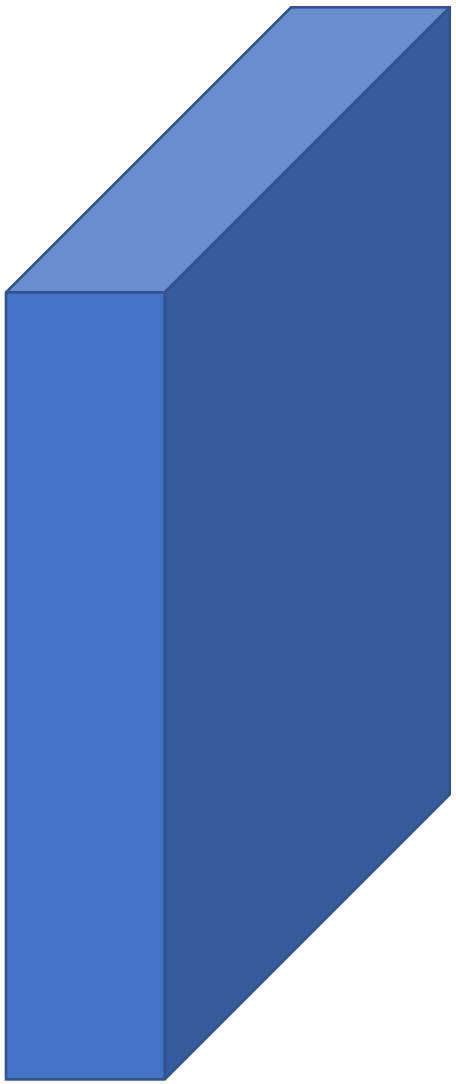
**Feature
Map**



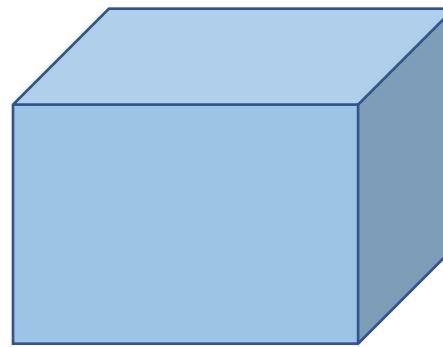
Convolution & Pooling

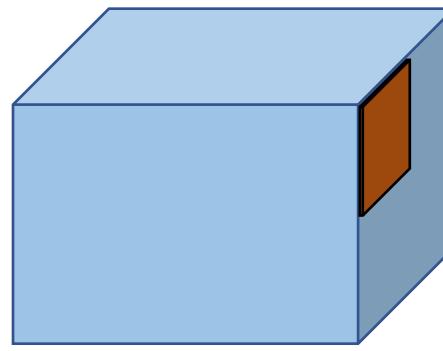
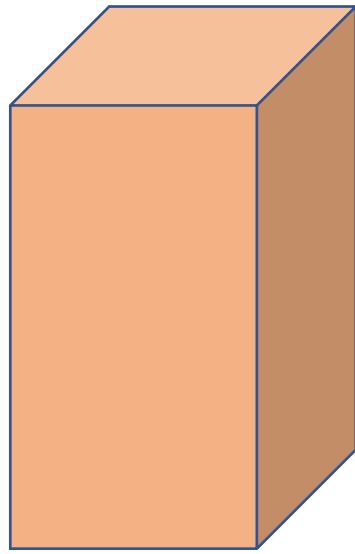
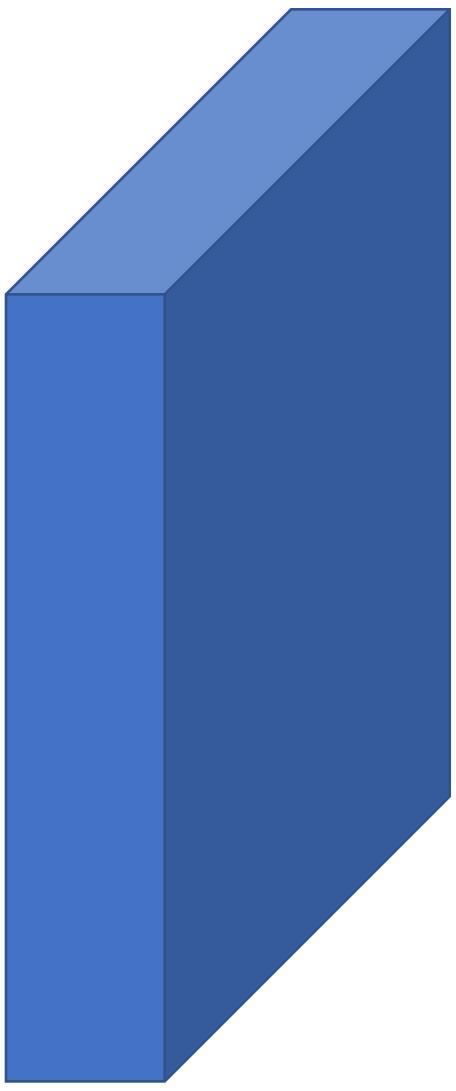


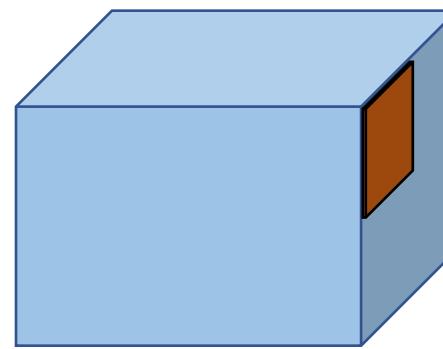
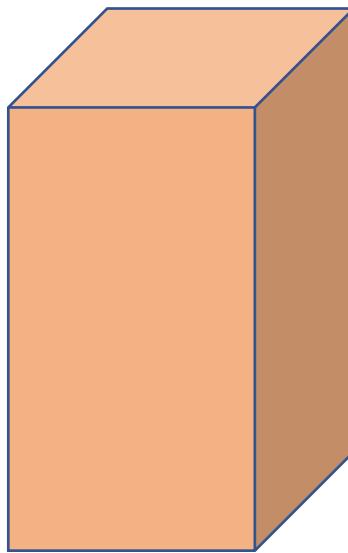
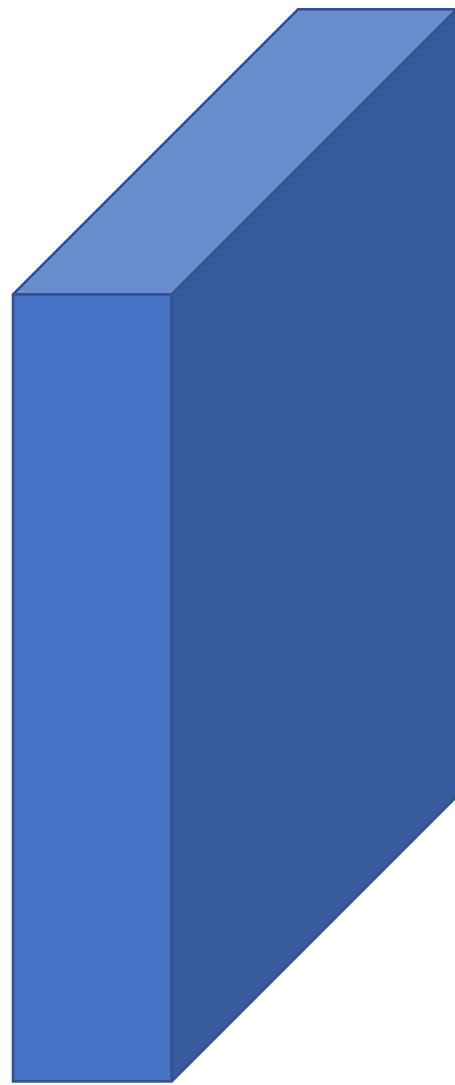




Convolution & Pooling







Convolution & Pooling



