Neural Networks: Prediction (i.e. the forward pass)

Machine Learning

Based on slides and material from Geoffrey Hinton, Richard Socher, Dan Roth, Yoav Goldberg, Shai Shalev-Shwartz and Shai Ben-David, and others

Neural Networks

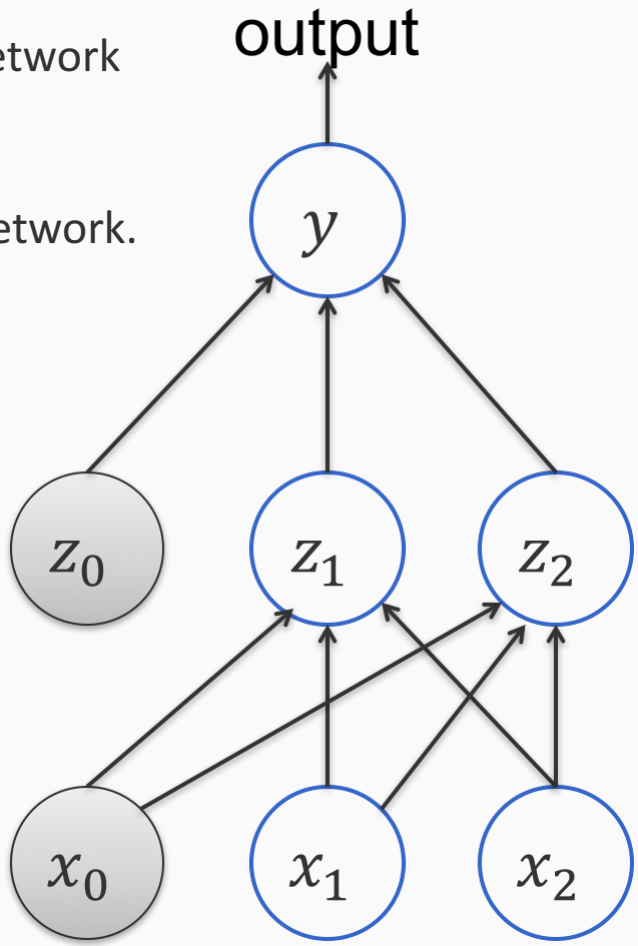
- What is a neural network?
- Predicting with a neural network
- Training neural networks
- Practical concerns

This lecture

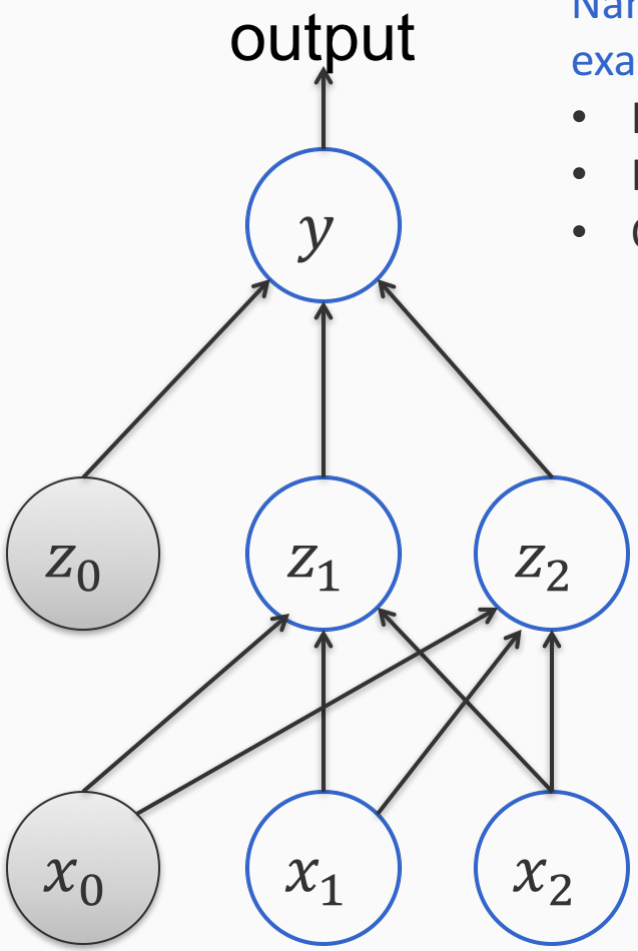
- What is a neural network?
- Predicting with a neural network
- Training neural networks
- Practical concerns

Let us consider an example network

We will use this example network as to introduce the general principle of how to make predictions with a neural network.



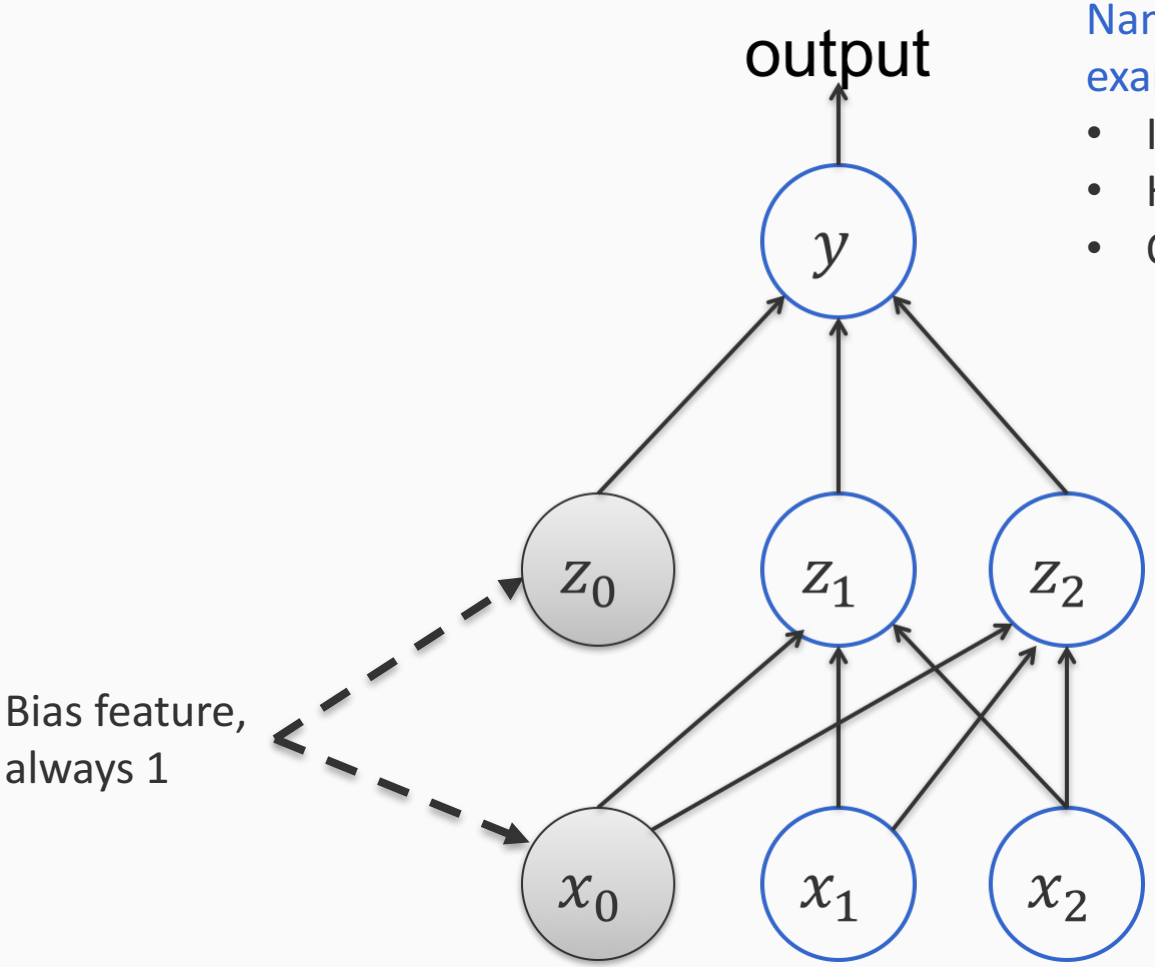
Let us consider an example network



Naming conventions for this example

- Inputs: x
- Hidden: z
- Output: y

Let us consider an example network



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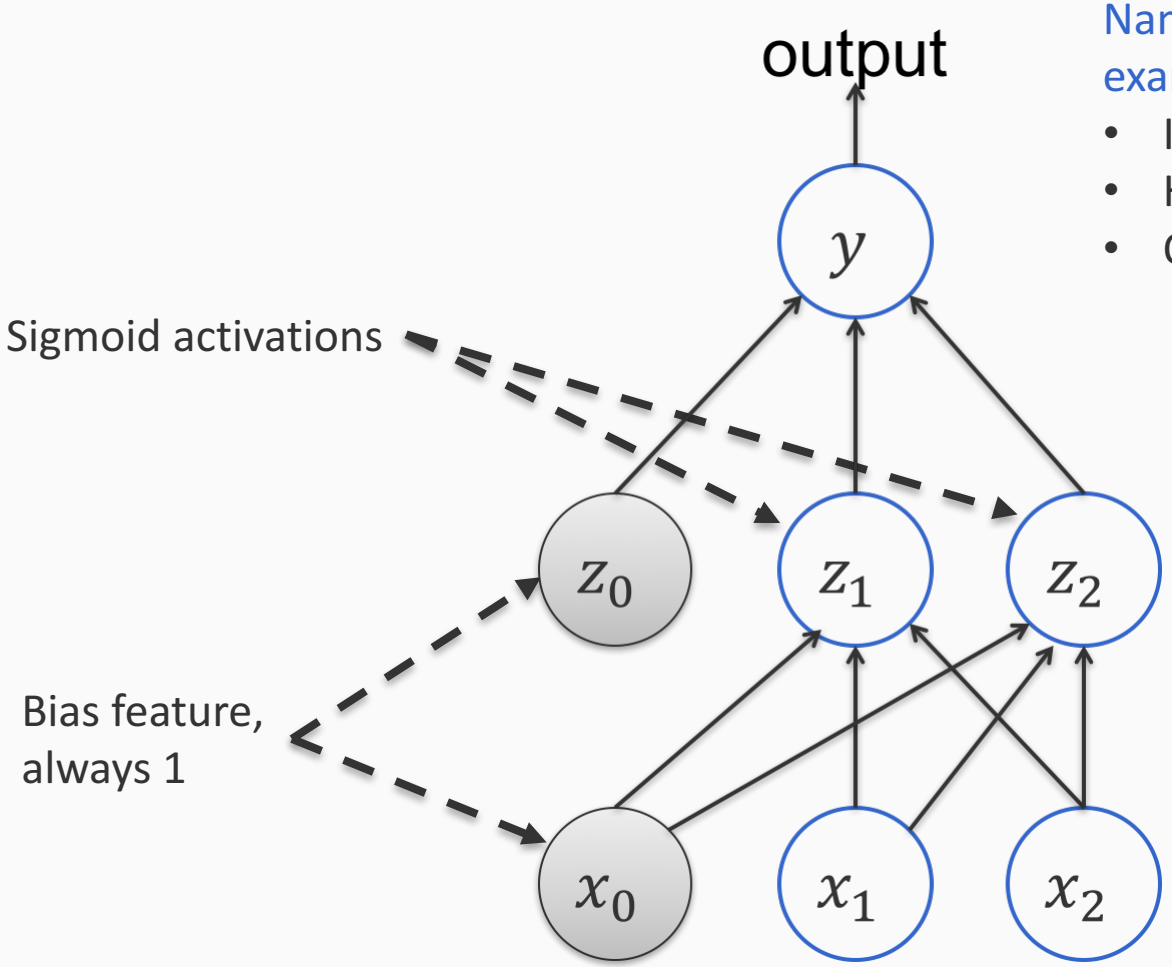

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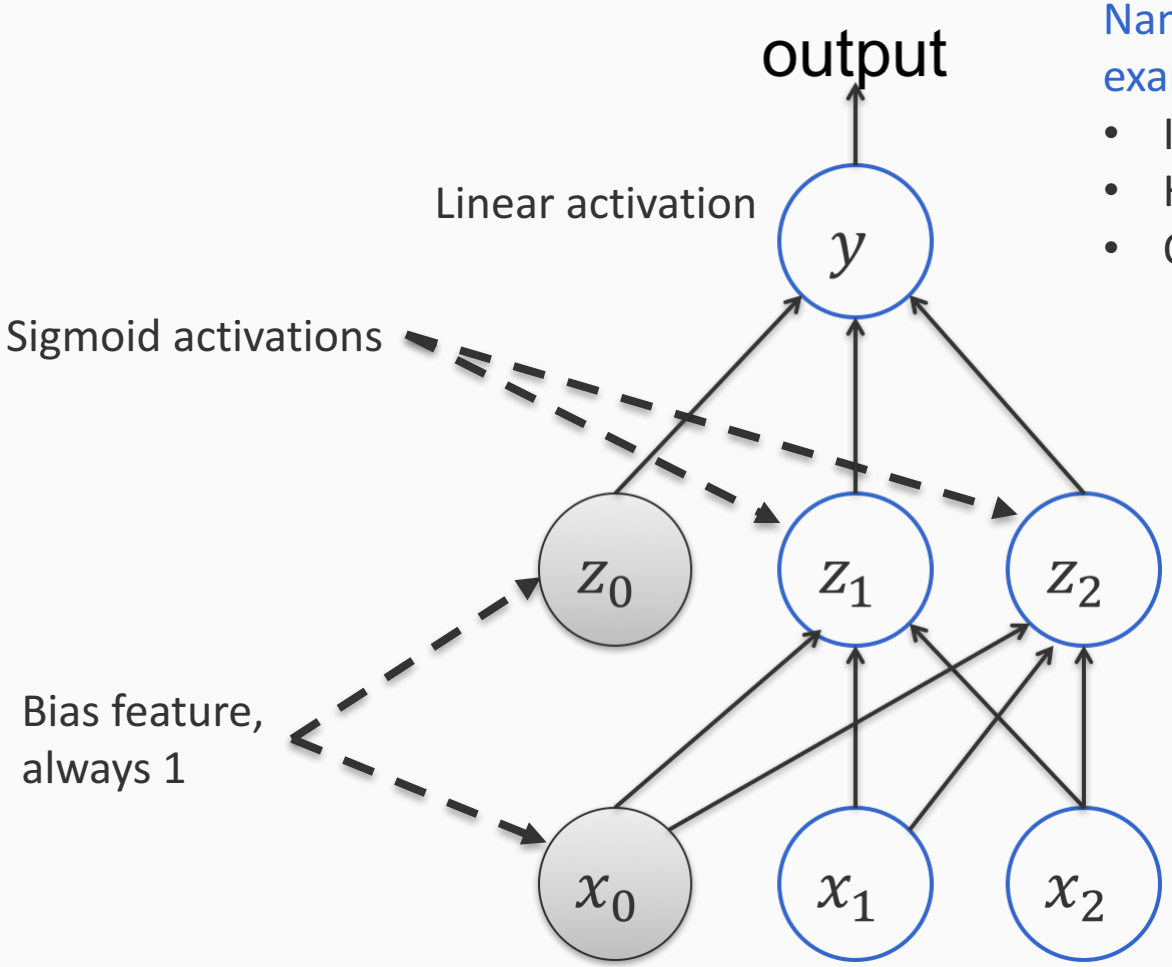

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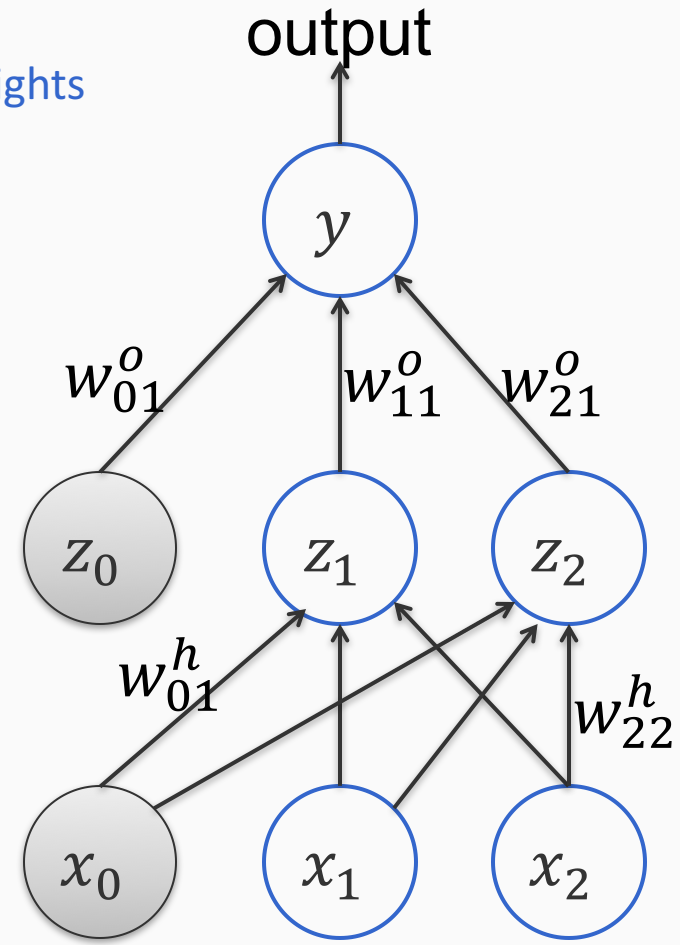
Let us consider an example network

Naming Convention for Weights

$$w_{from,to}^{target\_layer}$$



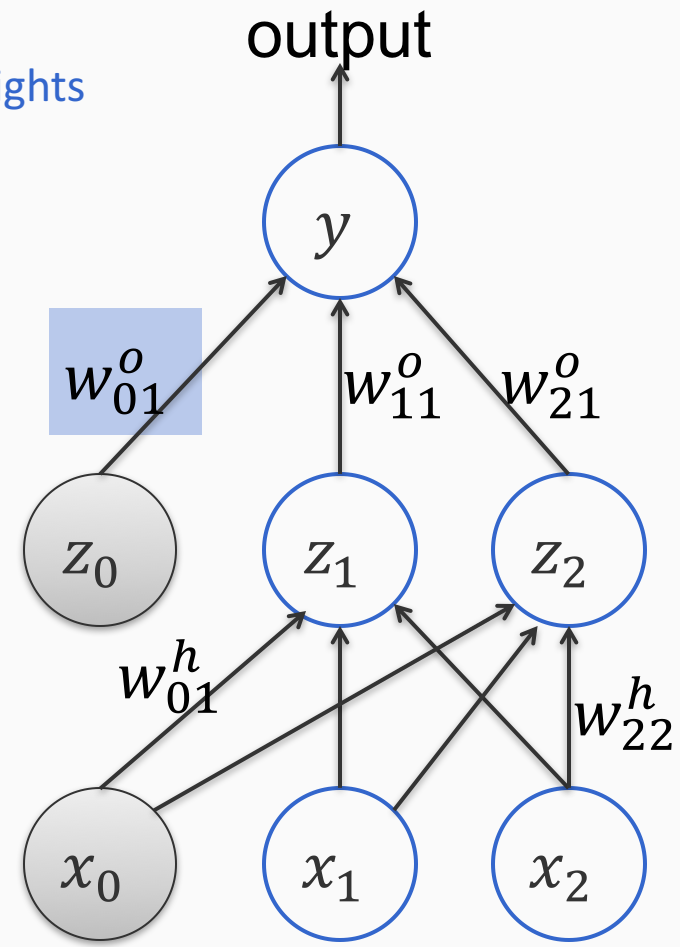
Let us consider an example network

Naming Convention for Weights

$$w_{from,to}^{target\_layer}$$

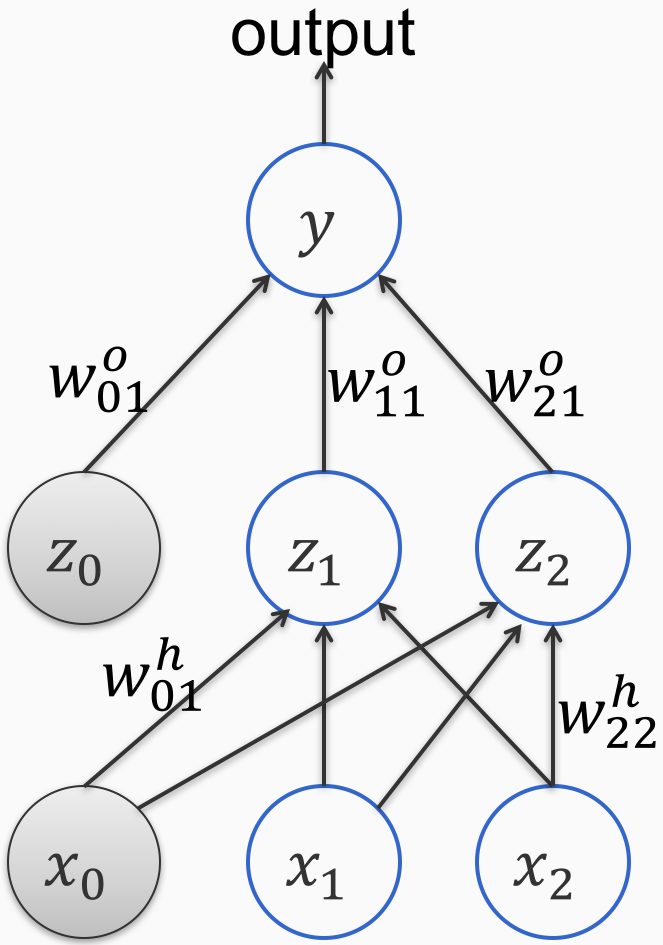
$$w_{01}^{o}$$

From neuron #0 to neuron #1 in output layer

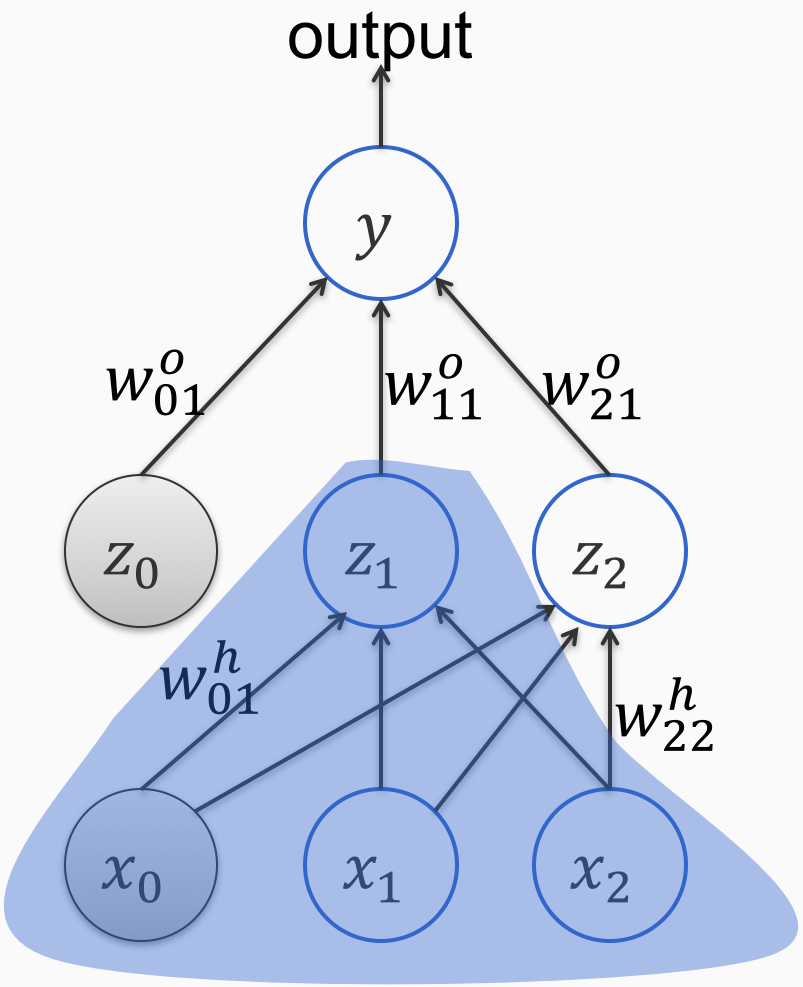


How to predict with a neural network: The forward pass

Given an input **x**, how is the output predicted



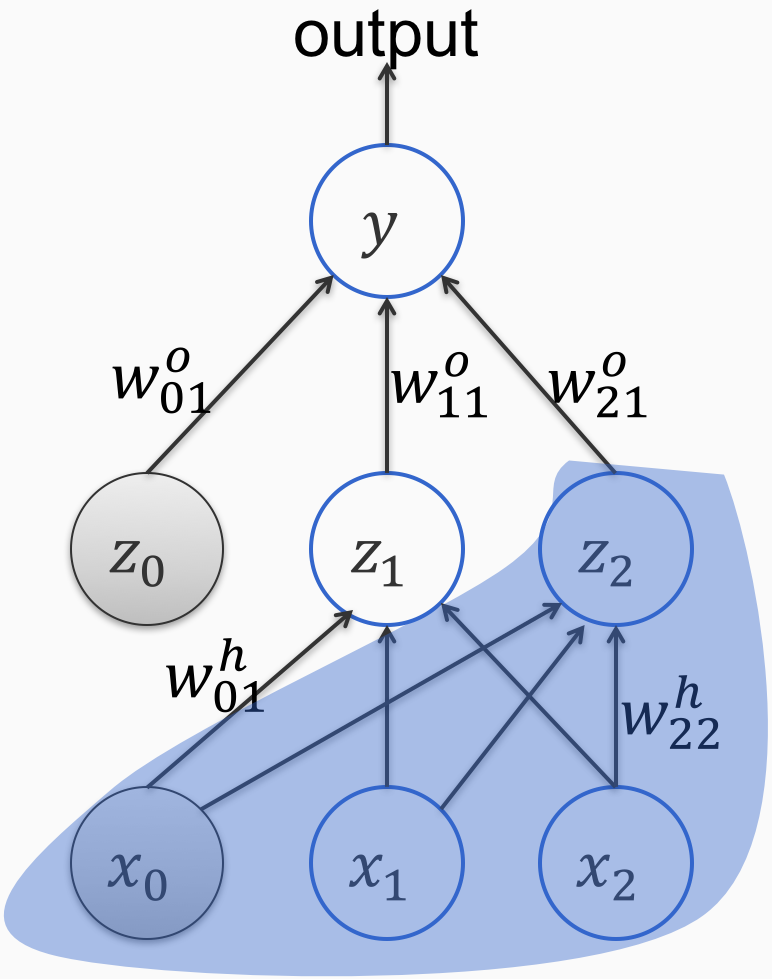
The forward pass



Given an input **x**, how is the output predicted

$$z_1 = \sigma(w_{01}^{h} + w_{11}^{h} x_1 + w_{21}^{h} x_2)$$

The forward pass

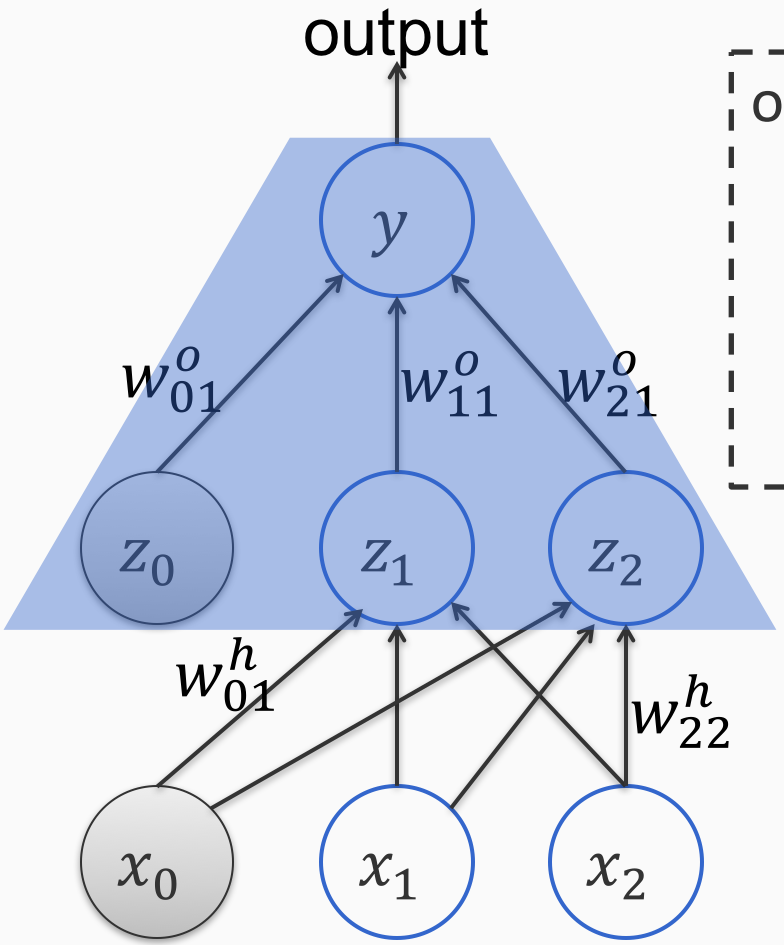


Given an input **x**, how is the output predicted

$$z_2 = \sigma(w_{02}^h + w_{12}^h x_1 + w_{22}^h x_2)$$

$$z_1 = \sigma(w_{01}^h + w_{11}^h x_1 + w_{21}^h x_2)$$

The forward pass



Given an input **x**, how is the output predicted

output $y = w_{01}^{o} + w_{11}^{o} z_1 + w_{21}^{o} z_2$

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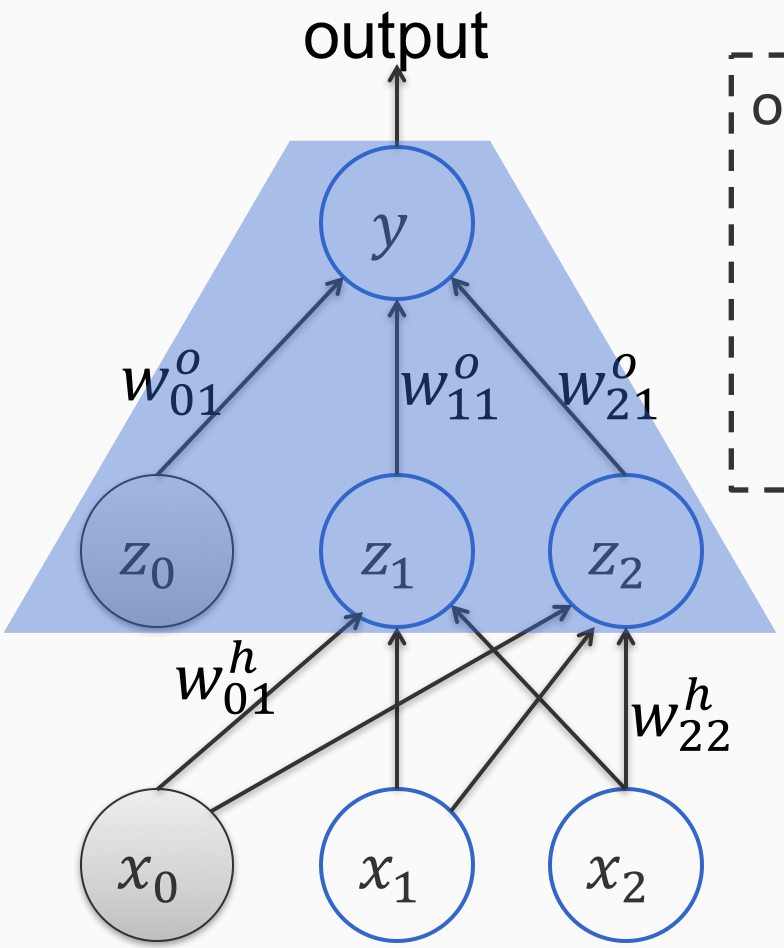
$$z_1 = \sigma(w_{01}^{h} + w_{11}^{h} x_1 + w_{21}^{h} x_2)$$

The forward pass



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Questions?