CIS 635 - Knowledge Discovery & Data Mining

NN Types

Types of NNs

Supervised

- Feed Forward NNs
- Covolutinal NNs
- RNNs
    - LSTMs
- Transformers
- GNN

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Unsupervised

- Auto Encoders
- RBMs

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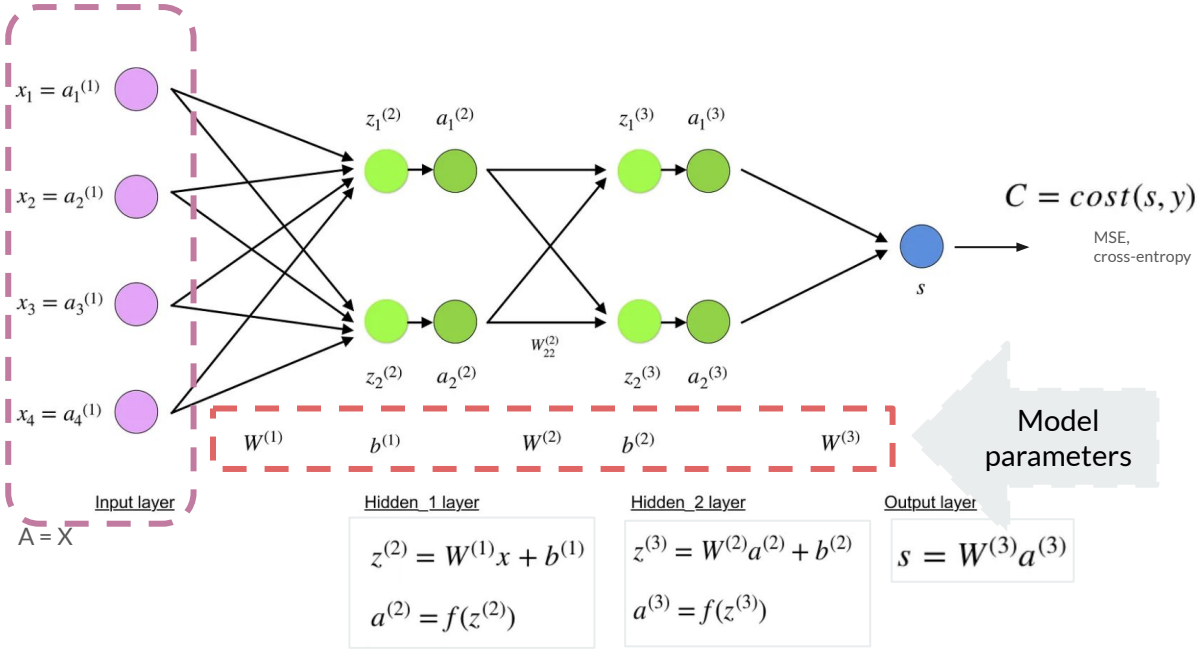
Generative Models

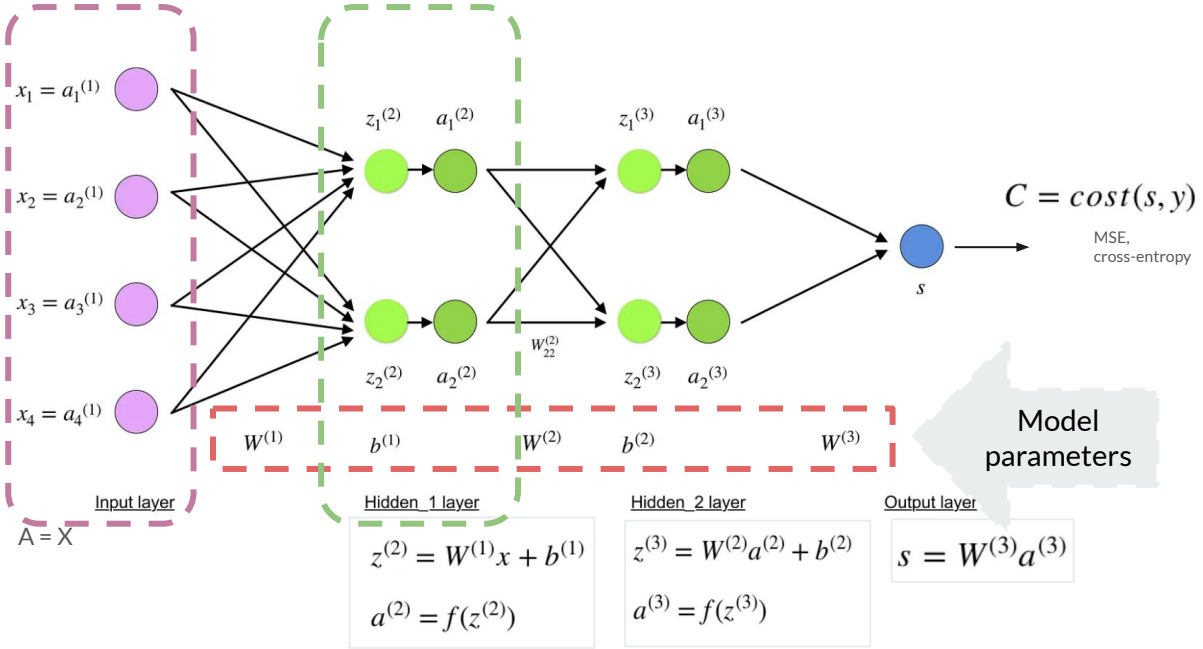
- GANs
- VAEs

Feed forward NNs



mainly adapted from

Feed forward NNs



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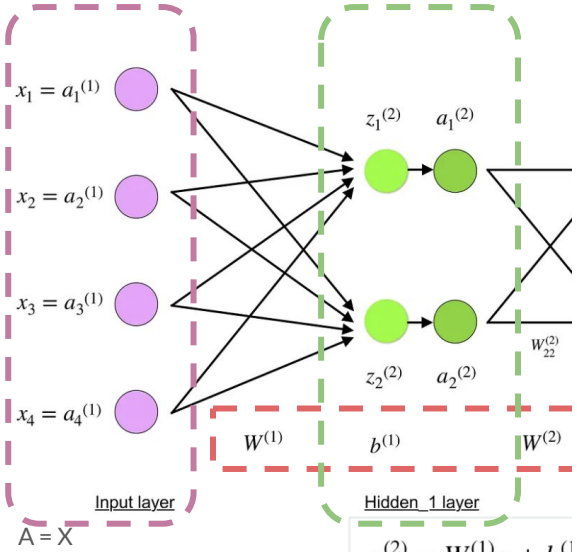
Feed forward NNs



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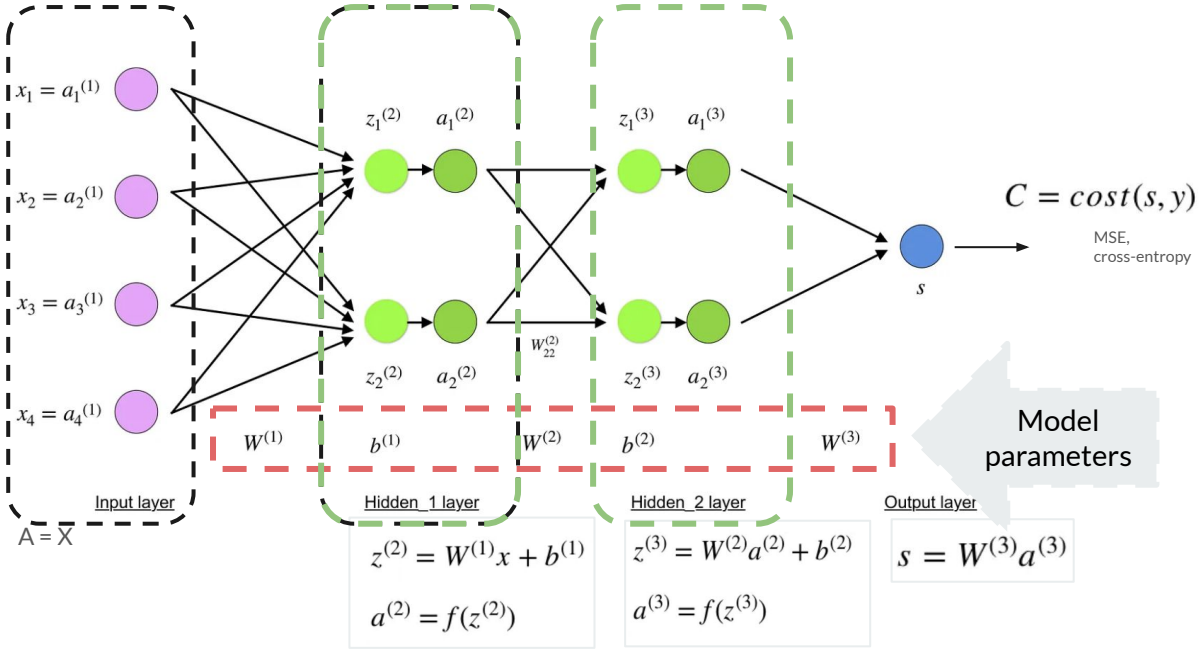
Activation functions

Name	Plot	Function, $g(x)$
Identity		x
Binary step		$\begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } x \geq 0 \end{cases}$
Logistic, sigmoid, or soft step		$\sigma(x) \doteq \frac{1}{1+e^{-x}}$
Hyperbolic tangent (tanh)		$\tanh(x) \doteq \frac{e^{x}-e^{-x}}{e^{x}+e^{-x}}$
Soboleva modified hyperbolic tangent (smht)		$\operatorname{smht}(x) \doteq \frac{e^{ax}-e^{-bx}}{e^{cx}+e^{-dx}}$
Rectified linear unit (ReLU)[8]		$(x)^+ \doteq \begin{cases} 0 & \text{if } x \leq 0 \\ x & \text{if } x > 0 \end{cases}$ $= \max(0,x) = x\mathbf{1}_{x>0}$
Gaussian Error Linear Unit (GELU)[2]		$\frac{1}{2}x\left(1+\operatorname{erf}\left(\frac{x}{\sqrt{2}}\right)\right)$ $= x\Phi(x)$
Softplus[9]		$\ln(1+e^{x})$
Exponential linear unit (ELU)[10]		$\begin{cases} \alpha\left(e^{x}-1\right) & \text{if } x \leq 0 \\ x & \text{if } x > 0 \end{cases}$ with parameter α

Feed forward NNs



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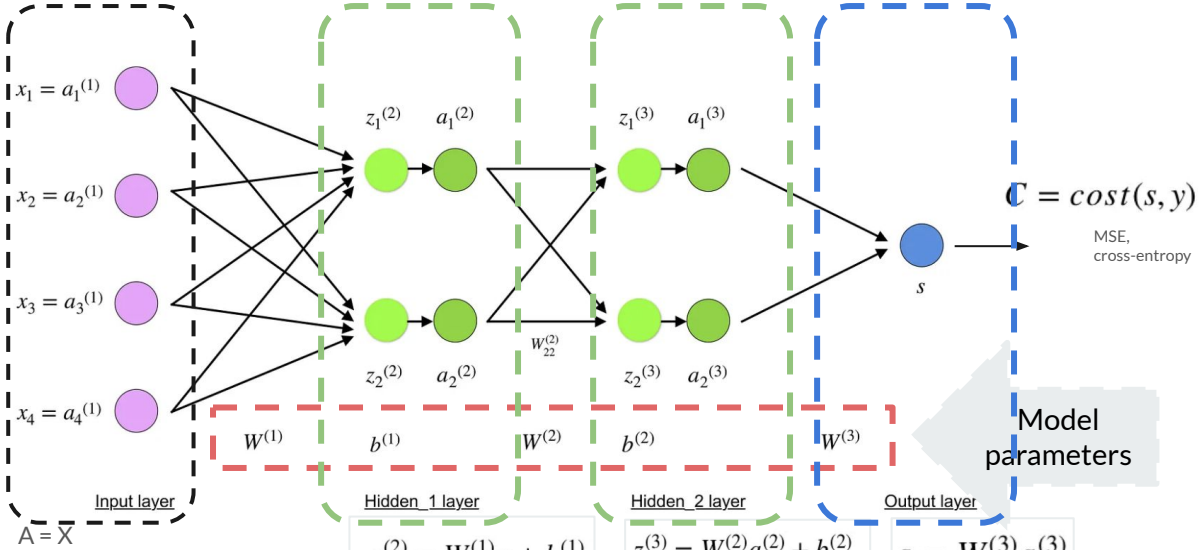
Feed forward NNs



mainly adapted from

Convolutional NNs

Examples:

- Alexnet
- VGG
- ResNet
- GoogLeNet
- ..

$$(f * g)(t) := \int_{-\infty}^{\infty} f(\tau) g(t - \tau)\, d\tau.$$

ref

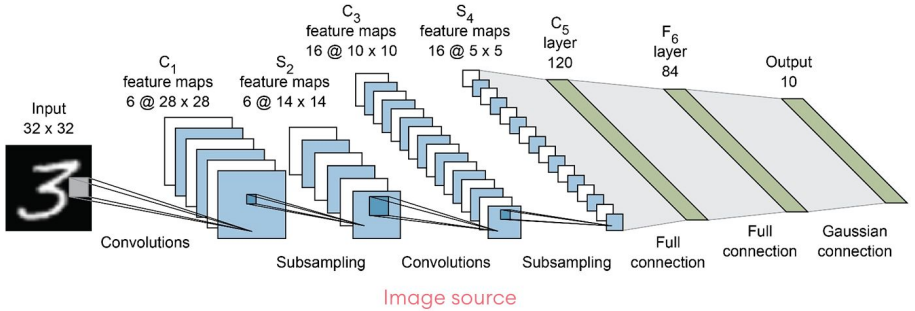
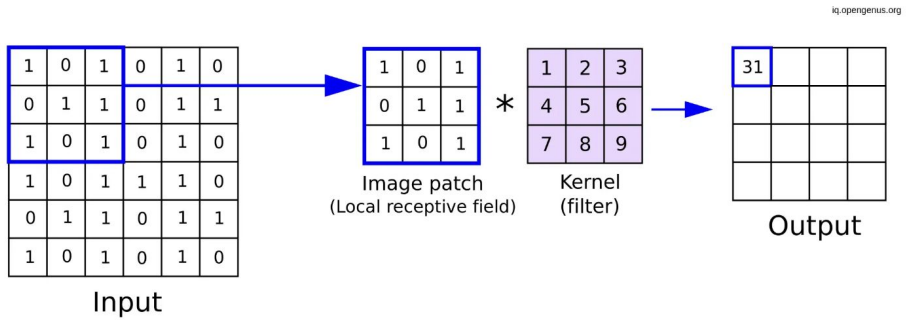


Image source

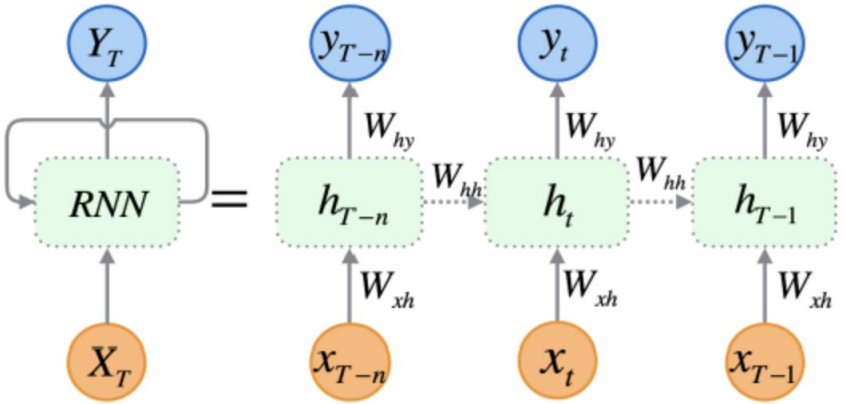
The convolutional layer



Recurrent Neural Networks

Examples:

- LSTMs
- GRU



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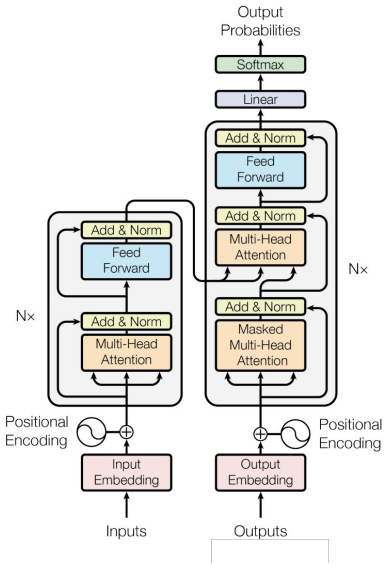
Transformers

Examples:

- Encoder decoder pair
- GPT
- BERT

BERT

Encoder



GPT

Decoder

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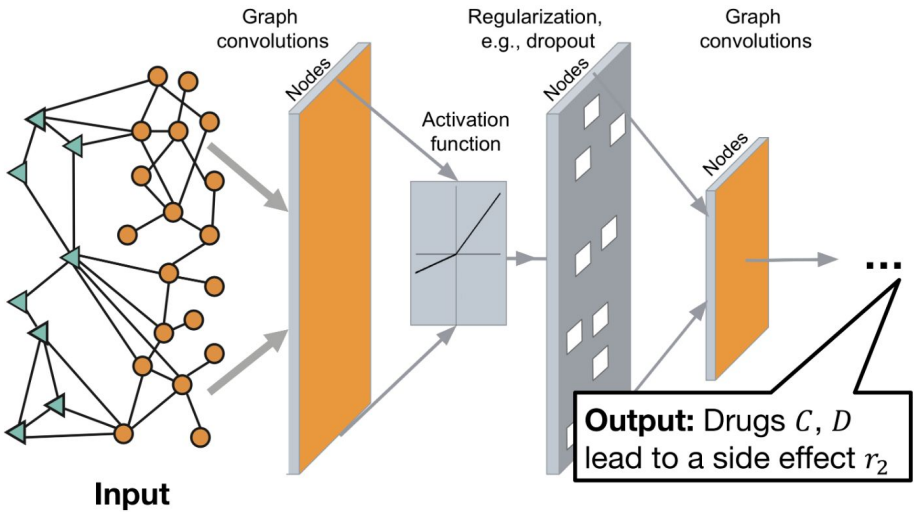
Graph Neural Network

Examples:

- Graph Convolutional NN



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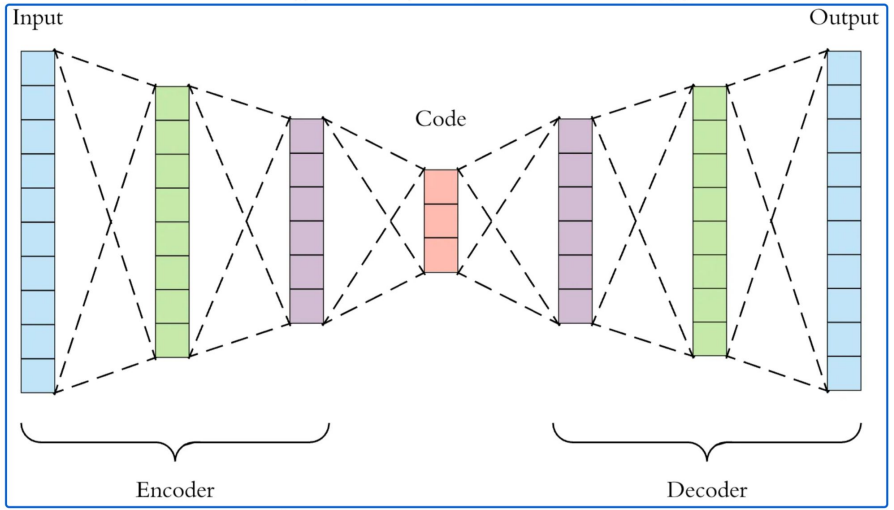
Unsupervised learning (nonlinear)

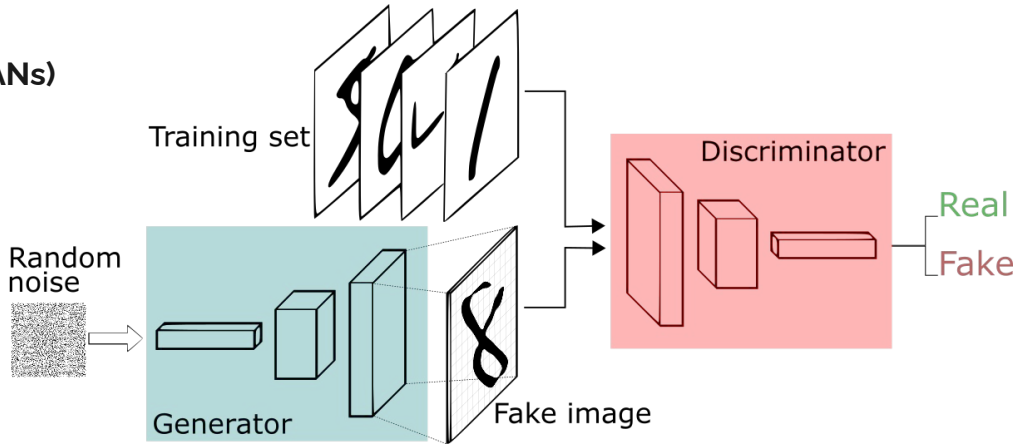
- Auto Encoders
- Restricted Boltzmann Machines (RBMs)



Generative AI

Examples:

- **Generative Adversarial Networks (GANs)**
- Variational Autoencoders (VAEs)



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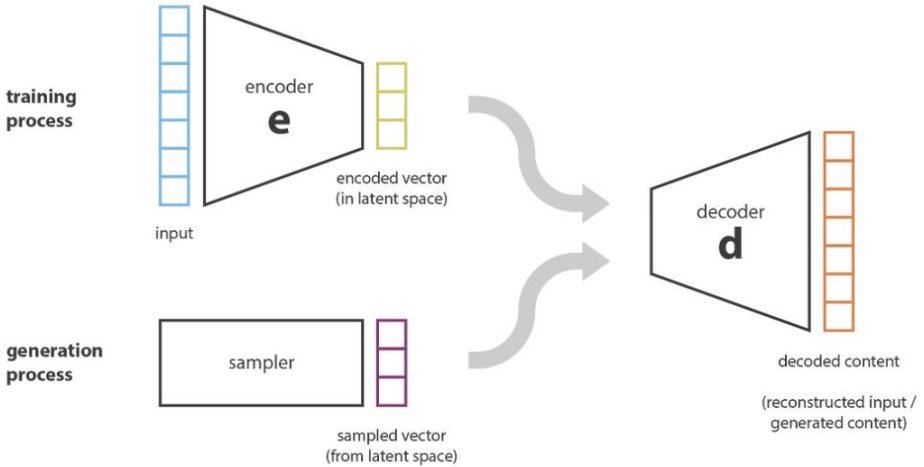
Generative AI

Examples:

- Generative Adversarial Networks (G
- **Variational Autoencoders (VAEs)**



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