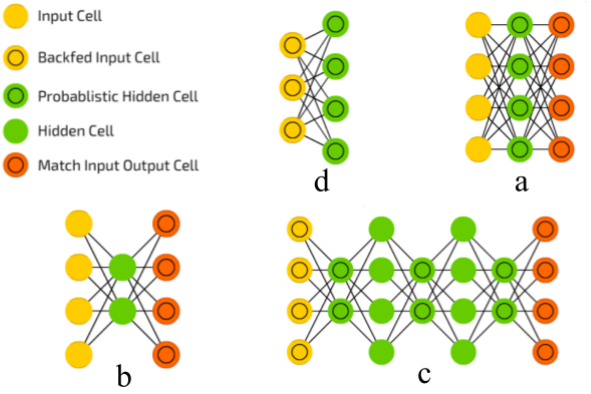
Deep Learning for Artificial Intelligence (DLAI)
MET - ETSETB **Final (solved) 8/1/2018**
120 min **Name:**

Question 1: Unsupervised Learning

Match each of the four unsupervised learning architectures with its corresponding scheme, by writing its letter (a,b,c or d) below the corresponding figure.

Figures by F. Van Veen: "The Neural Network Zoo" (2016)

a) Variational Autoencoder
b) Autoencoder
c) Deep Belief Network
d) Restricted Boltzmann Machine

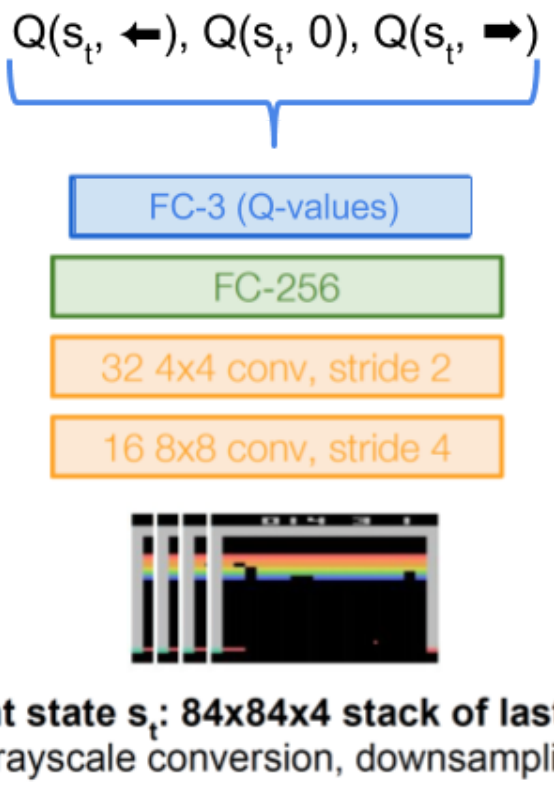


Question 2 Reinforcement Learning

Draw the architecture of a Deep Neural Network capable of playing the Atari Breakout game (see screenshot) just by looking at the pixels on screen, and obtaining as reward the game score.

Provide details about the input and output data, as well as the type of layers you propose.

Tip: Search for “Atari breakout” on Google after the exam.



Current state s_t: 84x84x4 stack of last 4 frames
(after RGB->grayscale conversion, downsampling, and cropping)

Name:

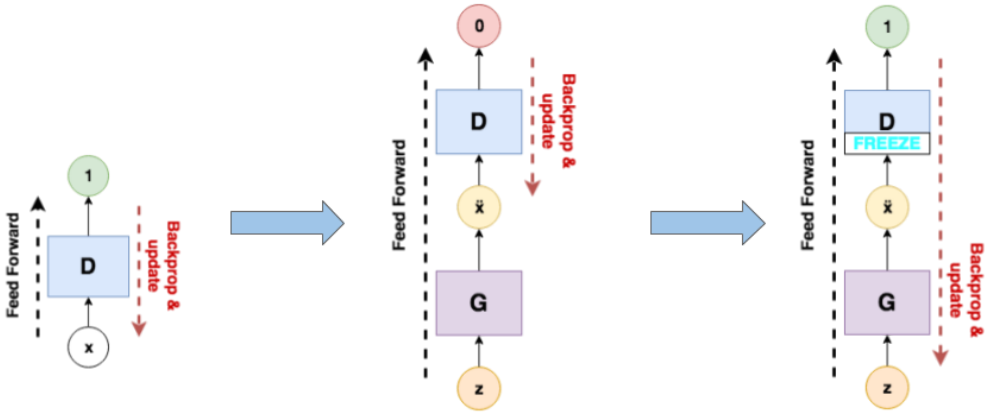
Question 3: Variational Autoencoders

A Variational AutoEncoder (VAE) is a generative model of our dataset with samples X = [x1, x2, ..., xN], thus capturing P(X), and composed of two modules: the encoder Q(Z|X) and the decoder P(X|Z). The encoder projects data points x into a latent representation z that follows a certain prior distribution Z, and the decoder projects points from that space back into the original one, thus trying to recover or generate plausible samples x^. Reason the following questions:

1. Vanilla AutoEncoders project points x over deterministic codes c instead of the latent random prior Z. Why vanilla AutoEncoders are not considered to be generative models?
2. What is the reparameterization trick and what is its purpose?

Question 4: Generative Adversarial Networks

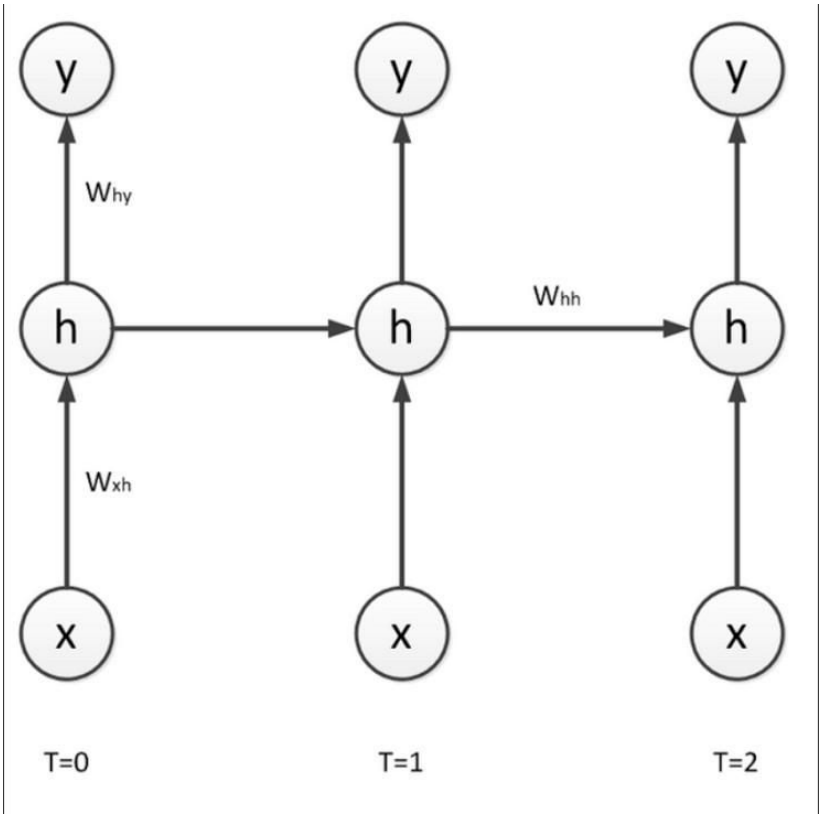
The Figure below presents the three steps of a batch update in an adversarial training. Describe with your own words each of the three steps, using 30 words in each of them. Capacity of synthesis will be valued.



Name:

Question 5: Recurrent Neural Networks

Recurrent Neural Networks (RNNs) allow to model sequences because they introduce recurrence. The figure below shows a RNN with one input unit x, one logistic hidden unit h, and one linear output unit y. The network parameters are W_{xh} = -0.1,WW_{hh} = 0.5 and W_{hy} = 0.25, h_{bias} = 0.4 and y_{bias} = 0.0. The input takes the values 18, 9, -8 at time steps 0,1 and 2.



Compute the hidden unit value h_0, h_1, h_2 and the output unit y_1

HINT: Remember RNN equations are: $h_t = f(Wx_t + Uh_{t-1} + b)$; $y_t = Vh_t$;
$f(k) = \frac{1}{1+\exp exp(-k)}$

Question 6: Attention Models

Given the query vector q=[0.3,0.2,0.1], the key vector 1 k1=[0.1,0.3,0.1] and the key vector 2 k2=[0.6,0.4,0.2].

1. What are the attention weights 1&2 computing the dot product?
2. What are the attention weights 1&2 when computing the scaled dot product?
3. To what key vector are we giving more attention?
4. What is the advantage of computing the scaled dot product?