

## ICVSS 2015 – Examination

**1. Invariance and distinctiveness may be an insufficient characterisation of good representation. What fundamental property of representations is not accounted for by these two concepts?**

- A) speed
- B) compactness
- C) ability to tackle multiple tasks**

**2. Inverting most representations is an ambiguous operation. This is:**

- A) interesting, as we can infer representation properties from the ambiguity.**
- B) problematic, because the representation is discarding information contained in the image.
- C) irrelevant, as most representations are meant for discrimination, not for image generation.

**3. Kernels are:**

- A) Alternative to hand-crafted features
- B) An alternative approach to the construction of representations**
- C) An alternative approach to representations, as they allow using a similarity function instead of a feature vector in classification

**4. What are the relation between wavelets and deep networks ?**

- A) Both are computed with cascades of filtering and subsamplings**
- B) Both are linear operators
- C) Both are non-linear operators

**5. Why can one remove some rectifier non-linearities within a deep network ?**

- A) Because they are usually useless
- B) Because they do not modify the output of a low-pass filter which outputs positive coefficients**
- C) Because rectifiers are similar to absolute values

**6. Why are multiscale transforms useful to analyze complex image scenes?**

- A) Because they can compress data
- B) Because they provide stable representations relatively to deformations**
- C) Because they are sensible to frequencies

**7. The chain rule is used for obtaining the back-propagation algorithm. Which of these is false?**

- A) The chain rule for  $y=f(g(x_1, x_2))$  decomposes as a sum over the terms respectively associated with  $x_1$  and  $x_2$  (consider the case where both  $f$  and  $g$  return a scalar, and  $x_1$  and  $x_2$  are scalar).**

B) The back-propagation algorithm computing time grows as  $O(M)$  if  $M$  is the number of arcs in the computation flow graph (number of connections between neurons), assuming each arc requires  $O(1)$  computation.

C) The chain rule for computing  $dy/dx$  from  $y=f(g(x))$  can be generalized to the case where  $g(\cdot)$  outputs a vector by replacing the dot product between  $f'(g(x))$  and  $g'(x)$  by the matrix product of the corresponding Jacobians.

**8. Consider a convolutional layer with a  $K \times K$  input kernel, an  $N_i \times N_i$  dimensional input with  $F_i$  input maps and  $F_j$  output maps, and no 0-padding. Which of these is false?**

A) The number of free parameters associated with the convolution is  $F_i \times F_j \times K \times K$ .

**B)** The size of the output image is  $M \times M$ , with  $M = N - K$

C) The number of multiply-adds for backprop through the convolution is  $N \times N \times K \times K \times F_i \times F_j$

Hint: try it out in 1-D with a small value of  $K$ .

**9. Which of these statements is probably false?**

**A)** Gradient-based optimization of neural networks tends to get stuck in poor local minima.

B) A distributed representation like in an MLP hidden layer can capture exponentially more distinct regions in input space than a non-distributed one like in clustering or nearest-neighbour algorithms.

C) Deep learning can yield better generalization when the priors or preferences associated with depth and distributed representations fit well with the actual data generating distribution.

**10. Consider a deep neural network A with  $L$  layers and  $N$  parameters and a less deep neural network B with  $L' < L$  layers and  $M$  parameters. Which of these is false?**

**A)** if  $N=M$ , then the set of functions reachable by A is a superset of the set of functions reachable by B.

B) even if  $M$  is 10 times larger than  $N$ , there are functions reachable by A that are not reachable by B

C) with  $N=M$ , there are functions reachable by B that are not reachable by A

**11. Name two pioneers of variational methods:**

A) Galilei and Newton

B) Schrödinger and Heisenberg

**C)** Lagrange and Euler

**12. What dimension does the group of 3D similarity transformations have:**

A) 6

**B)** 7

C) 8

**13. The total variation is**

**A)** convex but non-smooth

- B) convex and smooth
- C) non-convex

**14. What is the formula for computing probabilities to sample from in stochastic pooling?**

- A)  $p_i = \exp(a_i) / \sum_j(\exp(a_j))$
- B)  $p_i = a_i / \sum_j(a_j)$**
- C)  $p_i = a_i / \sqrt{\sum_j(a_j * a_j)}$

**15. What components is the cost function of a deconvolutional network composed of?**

- A) L1 sparsity and reconstruction of feature maps by convolving feature maps with learned filters.**
- B) L0 sparsity and reconstruction of feature maps by convolving image with learned filters.
- C) L1 sparsity and reconstruction of image by convolving feature maps with learned filters.

**16. What improvements to the first layer convolutions were made to Alexnet (Alex Krizhevsky's CNN model from Imagenet 2012) due to deconvolution network visualizations?**

- A) smaller stride and larger convolution kernels.
- B) larger stride and larger convolution kernels.
- C) smaller stride and smaller convolution kernels.**

**17. Subspace clustering refers to the problem of (choose the best answer):**

- A) Clustering data according to their membership to multiple groups
- B) Clustering data according to their membership to multiple subspaces**
- C) Clustering data according to their membership to multiple manifolds

**18. Sparse subspace clustering is based on the principle of (choose the best answer):**

- A) Expressing each data point as a linear combination of all data points
- B) Expressing each data point as a sparse linear combination of all data points
- C) Expressing each data point as a sparse linear combination of all other data points**

**19. In sparse subspace clustering, the number of nonzero coefficients in the representation of a data point corresponds to:**

- A) The dimension of the subspace containing that point**
- B) The number of subspaces
- C) The diameter of the subspace containing that point

**20. What is one major difference between cells in areas V1,V2,V3,and V4 and cells in inferotemporal (IT) cortex?**

- A) Cells in the IT cortex have a retinotopic map, whereas V1-V4 have very large receptive fields.
- B) Cells in V1-V4 are mostly sensitive to oriented edges, while cells in IT together form a retinotopic map.
- C) Cells in V1-V4 have localized receptive fields, together forming a retinotopic map of space, while cells in IT cortex have very large receptive fields.**

**21. What is one major transformation occurring along the face patch system?**

- A) Building a representation of faces that is invariant to view, illumination, and identity.
- B) Achieving illumination invariance by oriented edge detection.
- C) Construction of a view-invariant representation of individual identity.**

**22. According to one computer vision algorithm, pooling light-invariant local contrast features provide a powerful way to detect faces. Describe how neural data from the macaque brain supports this idea.**

- A) Cells showing similar responses as Haar wavelets indicate that the brain architecture is similar to a Viola-Jones detector.
- B) Cell recordings show that HOG type features are extracted, leading to a lighting-invariant encoding of face geometry.
- C) Cells are completely consistent in their contrast preferences to each other, and to predictions from computational experiments revealing which features are lighting-invariant.**

**23. The main advantage of features (versus direct methods) for structure from motion is that they enable to match:**

- A) more efficiently
- B) more accurately
- C) over a wider baseline**

**24. A Wulff shape allows to implement**

- A) an arbitrary anisotropic surface penalizations
- B) a convex shape prior**
- C) convex surface penalizations, yielding a nonconvex shape prior

**25. A high-order ray potential for a pixel-ray containing N voxels and considering a total of C semantic classes (including free space) has how many different groups of states that need to be handled separately?**

- A)  $C^N$
- B)  $N*(C-1)+1$**
- C)  $N*C$

**26. How does one have to customize a DLP projector to be used in a system to avoid illuminating raindrops?**

- A) Increase power
- B) Decrease latency**
- C) Increase brightness

**27. How did the structured light system work that tolerates bright illumination?**

- A) Synchronizing light projection and detection**
- B) Increasing light output and using a high-framerate camera
- C) Filtering outdoor light by active polarization filters