Approaches to Human Cognition: Experimental Cognitive Psychology and Cognitive Neuroscience

Exercises

Find and download the following paper and its supplementary material:

Kay, K. N., Naselaris, T., Prenger, R. J. and Gallant, J. L. (2008). Identifying natural images from human brain activity. *Nature*, 452:7185, 352 – 355.

(Hint: Go to aub.aau.dk and use e-Journal Finder!)

Read the paper and answer the following questions. (The questions are in the order in which the answers appear in the text, so you can answer the questions as you read the text.)

1. What limitations do the authors identify with previous related studies?
2. What do the authors mean by a "quantitative receptive field model"?
3. What is a *voxel*?
4. What ethical issues are raised by the possibility of what the authors call a "general brain-reading device" or "general visual decoder"?
5. Can the authors' system be used to reconstruct any visual scene viewed by the participant? Explain your answer.
6. The authors say that the receptive field in Figure 2 has "broadband orientation tuning and high-pass spatial frequency tuning". What does this mean?
7. Why is identifying natural images harder than identifying simple artificially produced images such as gratings or pre-segmented scenes?
8. Briefly explain what is meant by a "Gabor wavelet pyramid".
9. Were the 120 test images among the 1750 training images used to construct the receptive field model?
10. Why were the voxel activity patterns of the participants averaged across 13 repeated trials?
11. Explain how the authors' results suggest the feasibility of real-time decoding of perceptual experiences?
12. What does it mean to say that "early visual areas are organized retinotopically"?
13. What is "spatial frequency"?
14. What evidence do the authors provide for the claim that "identification improves substantially when orientation and spatial frequency tuning are included in the model"?
15. What evidence do the authors provide that the way that V1 encodes an image remains largely stable over time?
16. What extra final step is required before we have a general visual decoder?