Lecture 8.
Early Vision: Review
ECEN 5283 Computer Vision

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Goals

- To study the basic concept of "early vision" in both biological visual processing and computer vision.

- To have a big picture of "early vision" that includes a few major technical issues.

Parallel Pathways in Visual Processing

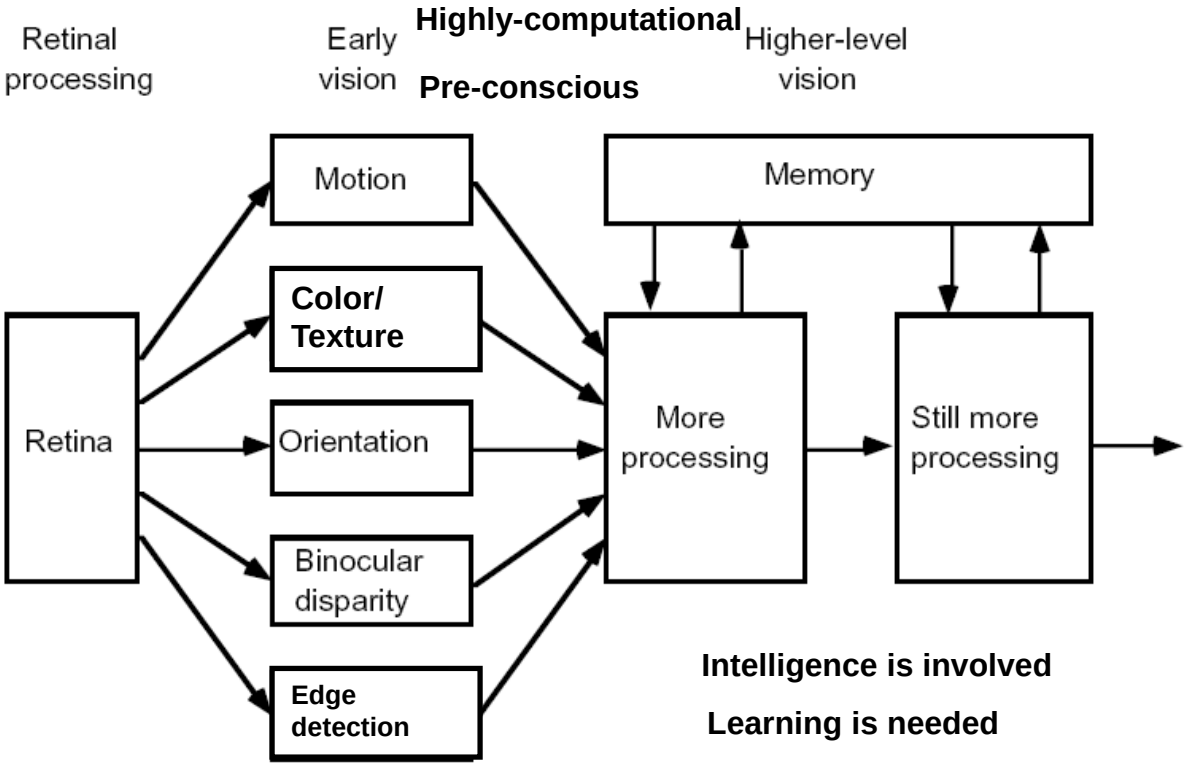


Fig. 1.1
A generic diagram for visual processing. In this approach, early vision consists of a set of parallel pathways, each analyzing some particular aspect of the visual stimulus.

The Plenoptic Function and the Elements of Early Vision
web.mit.edu/persci/people/adelson/pub_pdfs/elements91.pdf

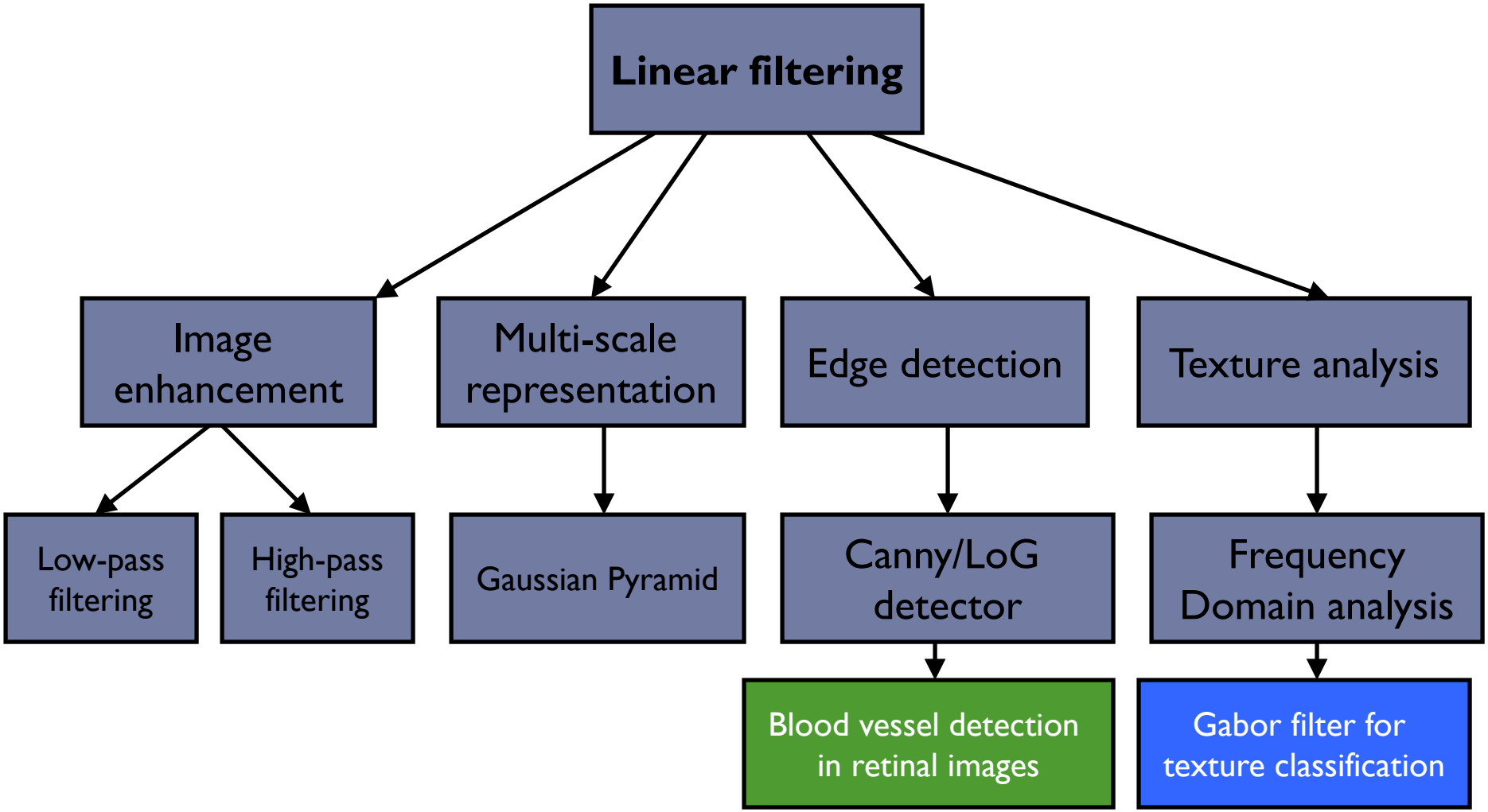
Early Vision for Biological Visual Processing

- Early vision refers to the *first stages of visual perception* of an experienced observer.
- Early vision is known biologically to have the *simple cells to extract simple edges*.
- Early vision is *a set of low level visual tasks* that do not require intelligence, such as motion estimation.
- Early vision is mostly a data-driven *bottom-up* process.

Early Vision for Computer Vision

- In biological vision systems like our own, this means "pre-conscious" vision before any thinking takes place.
  - *Raw, high-information, intrinsic* data are extracted from the light patterns incident on the retina.
  - These processes tend to be *highly computational*, involving filtering, coding, feature detection, etc., as opposed to *symbolic* or *cognitive operation*.
- For computer vision systems, similar "low-level" tasks have been defined, e.g., as edge detection, texture analysis, denoising.
- In practice, an early vision process may attempt to emulate biological vision, or involve other specific tasks.

Overview of Early Vision



Linear Filtering

- Transform the image intensities via linear convolution to
  - Enhance certain desirable image features
  - Suppress undesirable image attributes, such as noise

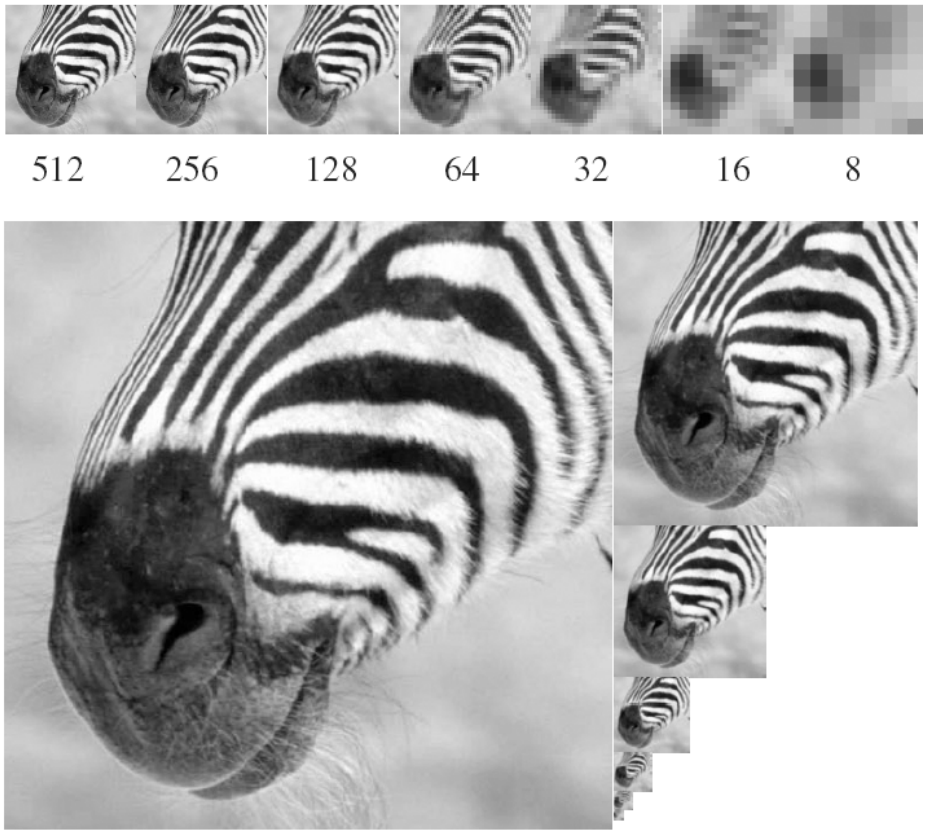
Original Image

Blurred Image

Sharpened Image

Pyramid Representation

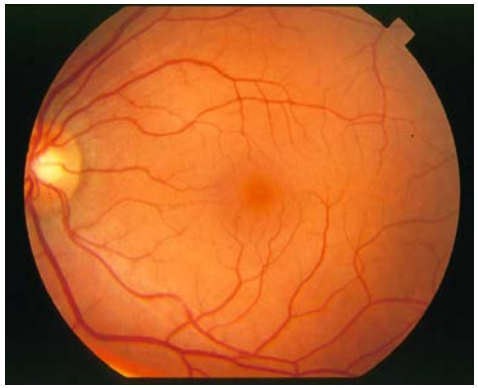
- A pyramid is a collection of representation of an image at different scales or resolutions



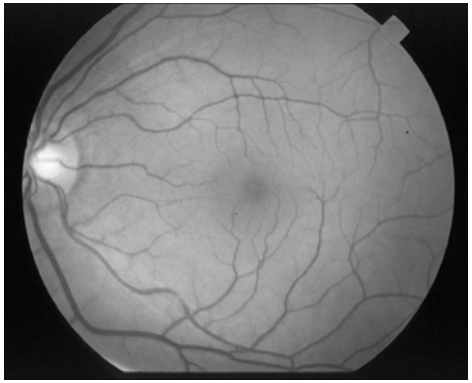
Edge Detection

- Edge Detection is a fundamental early stage in most computer vision tasks.

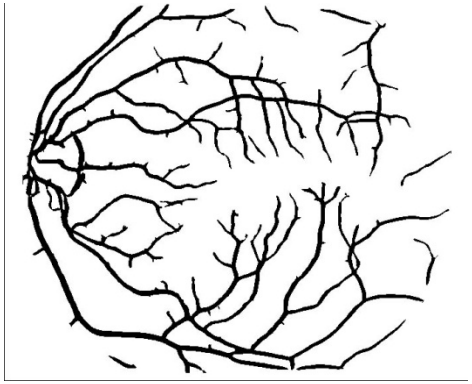
Special edge detection applications



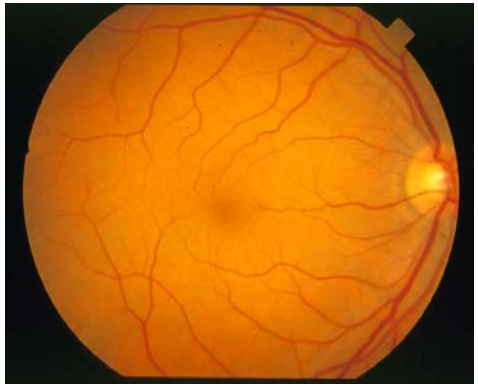
Retina Image A (color)



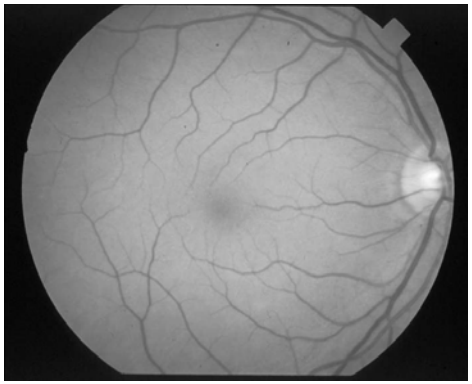
Retina Image A (grayscale)



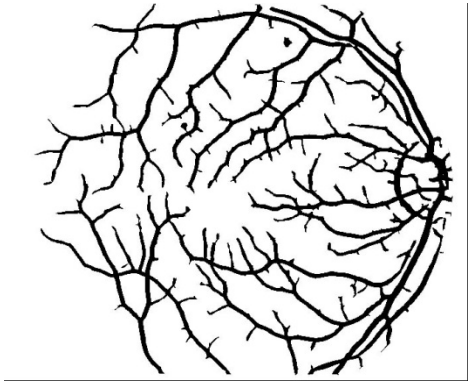
Blood vessel detection of A



Retina Image B (color)



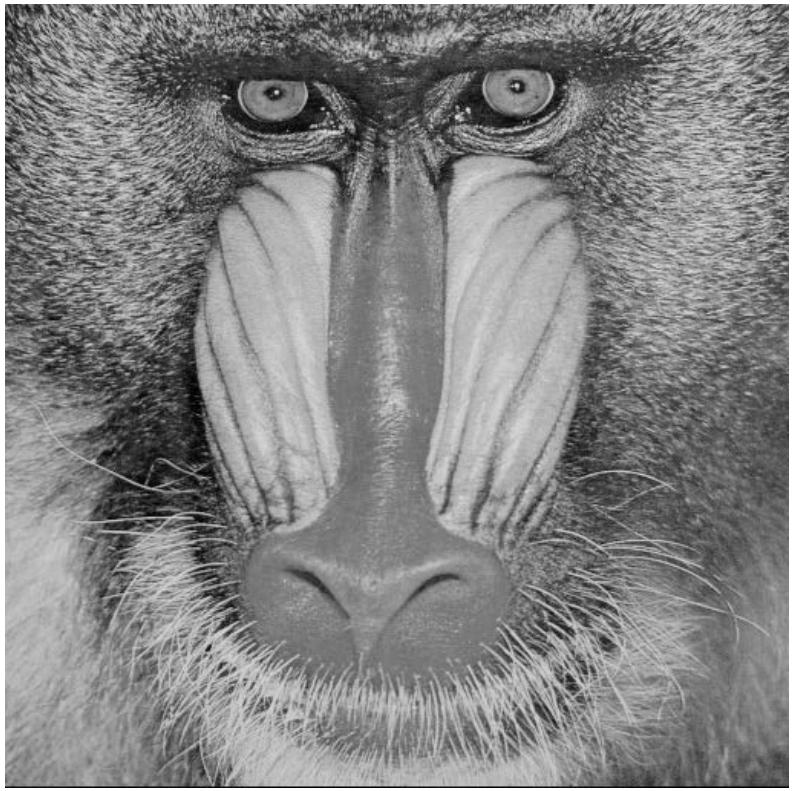
Retina Image B (grayscale)

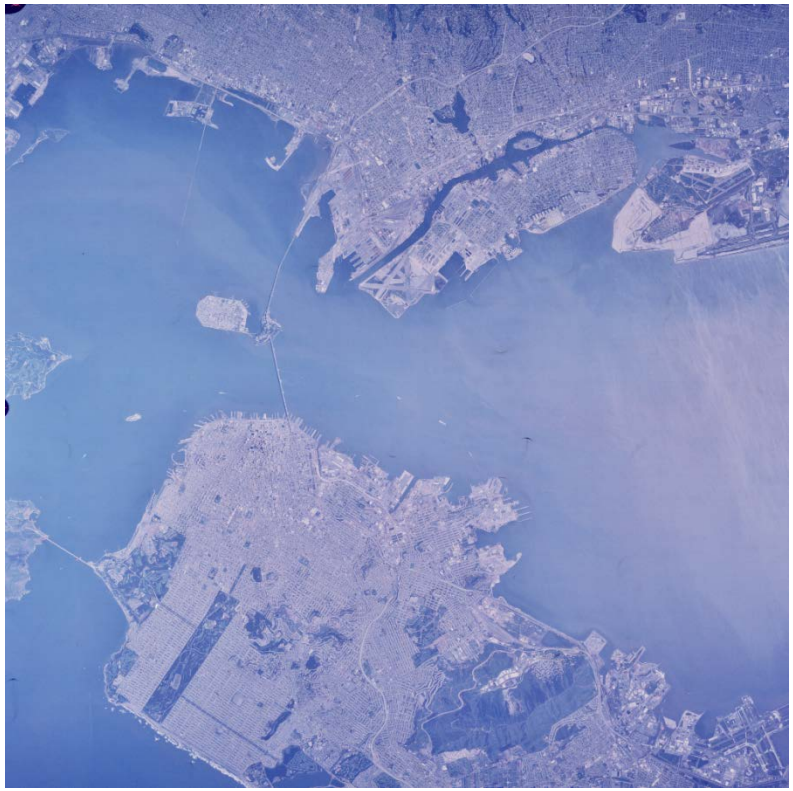


Blood vessel detection of B

Texture analysis

- Texture is a phenomenon that is widespread, easy to recognize and hard to define.





Frequency-domain Texture Analysis