Vision is not straightforward

- The complexity of the problem was completely overlooked because
  - The problem is so difficult
  - The human visual system is so efficient

Vision and pictures

- Explain
- Inspire
- Malfunction & art
- Technical simplification
  - Cinema, Color, JPG
- Pictures can challenge or simplify perception
- Emphasize or eliminate cues or channels
  - Time, color

Beware of the El-Greco Fallacy

- El-Greco, elongated characters
- Were supposed due to astigmatism
- However, pictures and real people would have been stretched equally
- Almost as fallacious as assuming painting should be inverted because our eyes invert what we see

However...

- Monet had a cataract operation
- Cataract makes vision blurry and yellowish

Textbooks
**Plan**

- Eye
- Low-level processing
- Different pathways

- Organization
- High-level
- Focus, attention
- Color

**Eye: optics**

- Image is inverted (mainly by cornea)
- Lens makes the focus

**Eye: visual angle**

- Corresponds to size of the projection on retina
- Depends on real size and distance

**Retina**

- Layer of photoreceptors
- Light->neural signal
- Optic nerve

**Photoreceptors**

- Rod: night vision
- Cone: bright, color vision

- 100M rods
- 5M cones
- Variable density
- Fovea: most acuity, cone only
Field of view

- Fovea=2-5 degrees

Summary

- Light is transformed into 100M neural signals
- But… optic nerve has only 1M nerve fibers

Overview of pathway

- Input from both eyes is dispatched
- Left brain: right part of visual field

Visual processing

- First step in the retina itself

Contrast processing

- We are sensitive to contrast, not to absolute luminance
- Useful because contrast is more invariant (it depends less on illumination)
Contrast processing

- Receptors are wired to other neurons
- Center-surround organization

Hermann Grid

Florida Election Recount

Count and total black dots for Al Gore and white dots for George Bush. Recount to confirm.
Vasarely, Supernovae

Mach Bands
- Contrast is enhanced at region boundaries

Relation with photo and painting
- Low contrast is not that much a problem
- A photo can be brighter/lighter than the original

Visual processing
- First step in the retina itself
- ...Next step: visual cortex area V1

Edge detection
- Similar to center-surround
- Measured using micro-electrodes

Edge detection: Multi-resolution
- Edge of different sizes
Edge detection: not so simple

• Edges are only a special case
• Patterns

Retinotopic

• Close optical stimulus map to close parts of V1
• A monkey is shown A
• Radioactive tracer
• His V1 area is shown in B

Retinotopic

• Close optical stimulus map to close parts of V1
• But not complete correspondence

Relation with line drawing

• The information is ~ the same
• Drawing simplifies edge detection
• Some neurologist believe that line drawing nicely excites areas of the brain

Optical art

• Op’ Art directly exploits low-level vision

Higher-level visual processing

• More complex
• Less understood or “measured”
• Different pathways
**Dorsal vs. Ventral pathways**

- Ventral pathway: What?
  - Object recognition
- Dorsal Pathway: Where?
  - Location
- Study on monkeys with damaged brain

**Different visual channels**

- Quite complex interactions
- Not sequential
- Not one-way
- Not strictly separate

**Relation to visual arts**

- Same elements:
  - Color
  - Form
  - Layout
  - Texture
- Selective treatment
  - Focus in brain
- Orchestra metaphor
Form and color

Lines

Absence of color, contrast

Shape

Duet: shape and texture

Symphony
**Plan of the few next sessions**

- Stepping back
- Organization, Gestalt
- Perceiving shape and objects
- Focus, attention
- Color vision

**Assignments**

- Feedback
- Image
- Reading
- Piranesi

**Reading**

- Do not forget Gombrich…

**Assignment**

- Piranesi tutorial
  - Demo version on the class web page
  - Non-photorealistic rendering
  - Tutorial 1 to 3
  - Skip 2.4

**Talk**

- Decision next week
- Either come with a subject
- Or look on the class web page for suggestions