Problems?

- Object comparisons are fastest if the main axis of an object is the same as the object it is being judged against
- BUT…there is not strong data supporting the “psychological reality” of the Marr & Nishihara model (although it might be a very good way to get computers to identify objects).
Geons (Biederman)

• According to geon theory, complex objects are made up of arrangements of basic, component parts (‘geons’).
• Some evidence for the psychological reality of geons comes from experiments that show that recognition is impaired when we hide the intersections of geons.
• However, occluding these intersections also changes the picture in many other ways.
Evidence in Support of Geons
View-dependent recognition?

- An alternative theory of recognition is simply that you store a set of characteristic views (mental images) of each object. You recognize each object by finding the closest match.
- Note that this type of model does not require you to infer/recover 3D shape in order to identify objects.

- Although view-dependent recognition may seem “too simple,” there is a lot of experimental evidence in support
  - For example, Bulthoff & Edelman trained people to learn the shapes of weird objects that they made up. They tested them on identification of the objects shown from (1) the same views as during training; and (2) different views. Performance was much better for the training (familiar) views.
Overview:
Theories regarding object “construction”

- Focus is on how the “elementary” features of objects are “assembled” into recognizable objects
  - Hubel and Wiesel – Neural feature detectors
  - David Marr – Computational approach
  - Biederman – Recognition by components
  - Triesman – Feature Integration

Feature integration (FIT) ……

- Focus on an analysis of the “stages” that the features of a stimulus are processed
  - From very basic through to identification
  - Stages include:

  Object > preattentive stage > focused attention > perception
Pop-out in visual search…

(a)  (b)

Lack of pop-out when target shares features with distracters….

(a)  (b)
FIT: The Details (cont)

- Need some way of:
  - Locating features
  - Binding appropriate features together
- Focal attention does this

The Role of Attention in FIT

- Attention moves within the location map
- Selects whatever features are linked to that location
- Features of other objects are excluded
- Attended features are then entered into the current temporary object representation
Evidence for FIT

- Visual Search Tasks
- Illusory Conjunctions

Feature Search

- Is there a red T in the display?
- Target defined by a single feature
- According to FIT this should not demand attention
- Target should “pop out”
Conjunction Search

- Is there a red T in the display?
- Target is now defined by its shape and colour
- This involves binding features and so should demand attention
- Need to attend to each item until target is found

Treisman & Schmidt (1982): Illusory Conjunctions

- Features occasionally "migrate" from one object to another.
- Provides evidence that there is a stage in perceptual processing where features are represented independently from "binding" to objects.
Treisman & Schmidt

- Next you will see 2 numbers and 4 objects. The numbers are to the left and right of the objects.

YOUR TASK
- Make sure that you notice and remember the numbers.
- Then try to notice and remember as much as you can about the objects.
- As soon as the display is gone, write down the numbers, and write down as much as you can remember about the objects.
Huge influence of context on shape and pattern perception

– The “context” that a shape or pattern appears in has tremendous influence of the subsequent perception
– A prime example of the influence of top-down on bottom-up processing

(Top)
Knowledge

(Bottom)
Physical stimulus

Perception

Vision is inferential: Light
(http://www-bcs.mit.edu/people/adelson/checkershadow_illusion.html)

Checker-shadow illusion:
The squares marked A and B are the same shade of gray.

Edward H. Adelson
Perceptual Organization

• The basic motto of the Gestaltists-- the first real "school" of perceptual organization theory-- was that the whole is greater than the sum of its parts.
• Examples: a melody made a various notes; or see an example from the pointillist painter Paul Signac.
Figure & Ground

• The first step in organizing the perceptual world is to divide figure and ground; ambiguous figures demonstrate this...

Ambiguous Figures

• Notice that you can perceive either the white or dark portion of the picture as figure or ground, but that it's very difficult to perceive both as figure or both as ground simultaneously.
Gestalt Laws of Organization:
Principles of how our visual systems group together elements

- **Proximity.**
  - Elements that are close are often grouped together.

- **Similarity.**
  - Similar elements tend to be grouped together.

- **Common fate.**
  - Things that move together tend to group.

- **Good continuation.**
  - Perceptual mechanisms tend to preserve smooth continuity in favor of abrupt edges.

- **Closure.**
  - Of several possible perceptual organizations, ones yielding “closed” figures are more likely than those yielding “open” ones.

- **Orientation & symmetry.**
  - Objects oriented with horizontal and vertical axes, or ones that are symmetric, are more often perceived as figures.

Grouping by proximity and by similarity.

Figure/ground changes with orientation, closure.
Illusions.

- Sometimes, your visual system must group/segment an object, not based on edges in the retinal image, but by inferring parts of the missing boundaries.

**Illusory contour.** Note that there is no physical contour for most of the perceived "edge".

Impossible figures.

- Certain figures can be drawn so that there is no consistent interpretation, due to the fact that there is no obvious real-world physical object that could correspond to the image.
• However, "impossible objects" can be built so that they look like an impossible figure from a certain vantage point.
Failures of grouping.

- Some figures do not yield a consistent grouping, and so the visual system struggles to arrive at a solution, and ends up switching back and forth between several possible groupings, as seen here.
Illusory contours....
Face Recognition

- A special problem for theories of pattern recognition:
  Different set of rules? (Example: object vs. facial recognition)
- Yin (1970), and Rock (1974) demonstrated that facial recognition is more easily impaired by inversion than is object recognition.