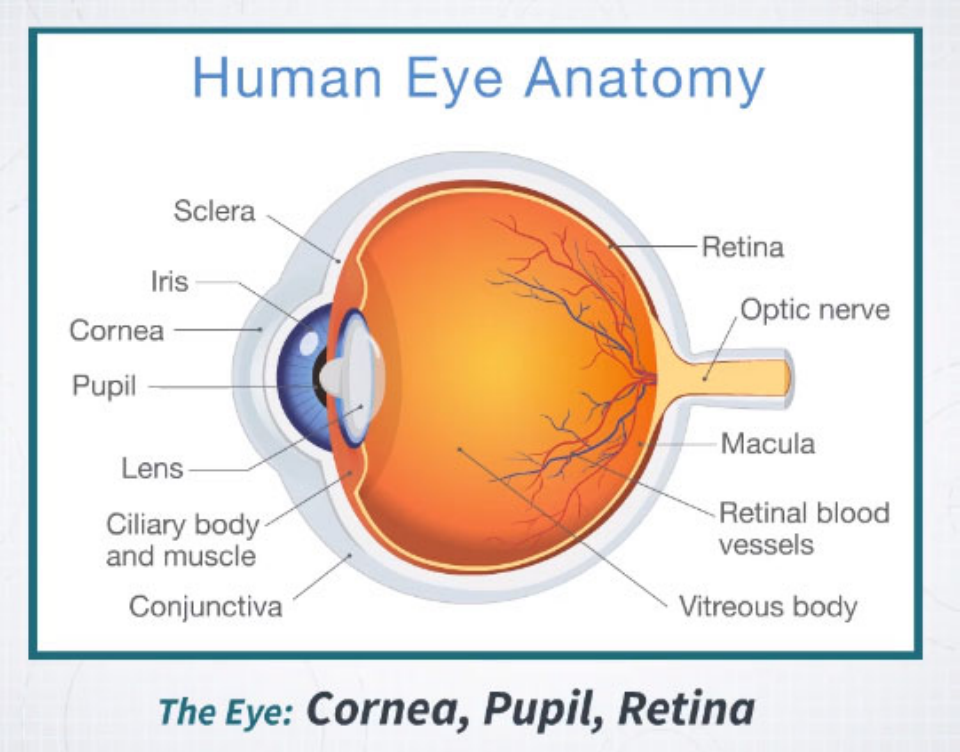
Human Visual Processing System

Sunday, November 4, 2018 22:47



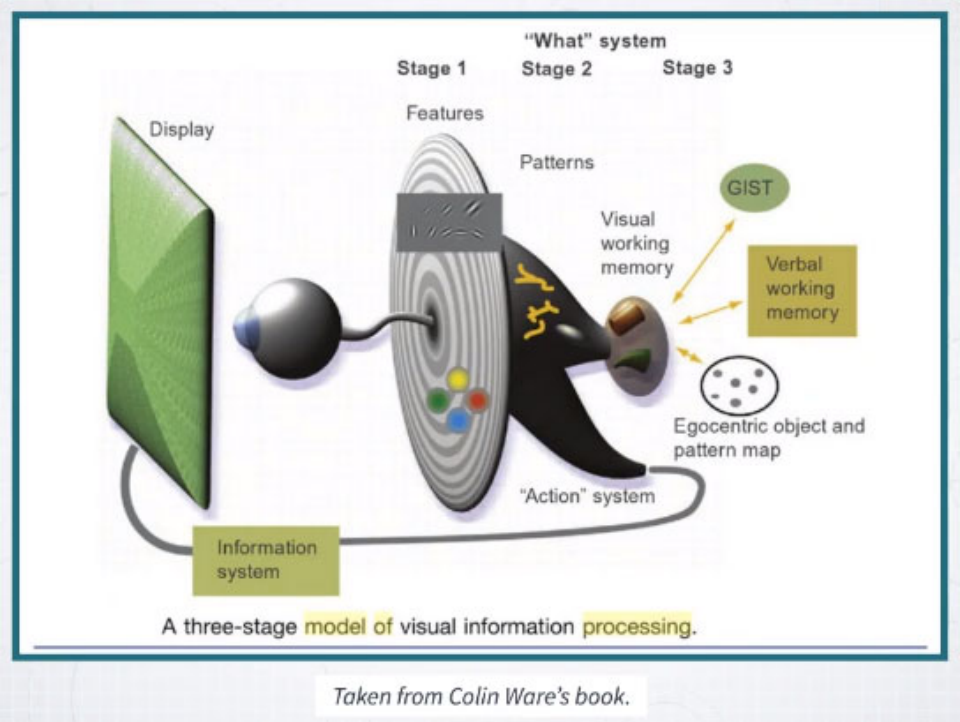
Retina is in contact with the photoreceptors.

Retina is packed with sensors:

- Rods: active in low light conditions (bastoncillos)
- Cones: active in normal conditions (conos)

The resolution that human has in the retina varies according the position:

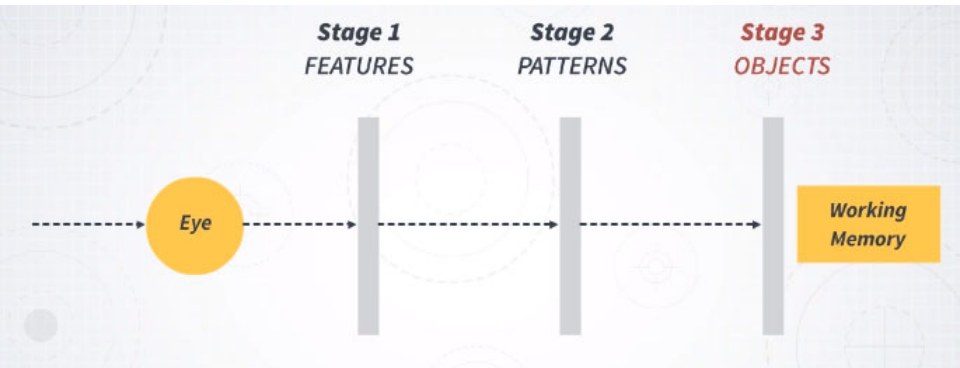
- The fovea: very high resolution, 1/10 of a pixel (fóvea)



Taken from Colin Ware's book.

Processing steps

We perceive a huge amount of information that is processed through several stages and reduced and simplified enormously -> very limited information stored.



Stage 1: Feature perception

- Extraction of low level features
- Very fast
- Parallel processing: it doesn't depend on where the features are, they're perceived all at once
- Stored in Iconic memory: transitory stored (unconscious)

Stage 2: Patterns

- Perception is sequential
- Slow
- Influenced by attention

Stage 3: Objects

- Patterns that have been detected are transformed into objects

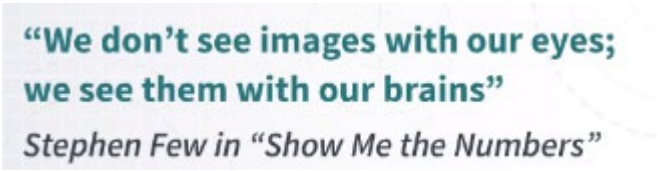
- Retained into working memory (memory we need in order to reason about certain thoughts)
- Conscious
- Limited storage (about 7 chunks/objects)

Saccadic Eye Movement / Role of Attention

We see only a very small portion of the world and yet perceive we have **full awareness** of it.

Why? :O
Two important reasons:

1. We move our eyes extremely fast to sample the area around the focus of attention so we can get more info at high-res around it -> Saccadic Eye Movement
    - We sample the world continuously through eye movement: Quick twitching around the area of interest
    - Image suppressed while the ye is moving
    - The brain joins the pieces together: image is reconstructed in the brain

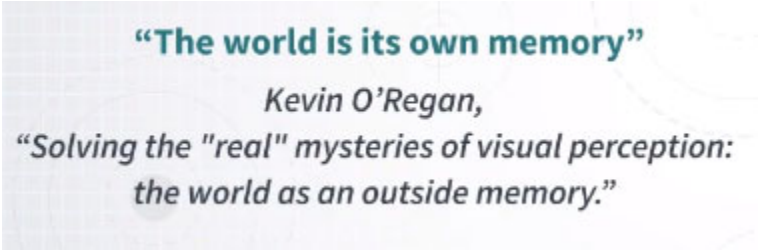


2. Visual perception is highly driven by human attention:
    - At any given time, the information that we're gathering from the world is actually the information that we need in order to carry out the tasks that we are carrying out.
    - Because of that, we perceive that we do have the information that is needed when it is needed.
    - But that's the only information we retain: The only information we retain is the information that is needed to carry out the tasks that we are performing.

    We see a small portion but also retain a very little information.
    What we attend to and retain is highly dependent on the task we're performing.

Inattentional Blindness

It's very easy to be blind to very big changes if we don't attend to the visual information that changes.



> *"It is more accurate to say that we are conscious of the field of information to which we have rapid access rather than we are immediately conscious of the world."*

When we design a visual representation, we have to guide attention in a way that is useful to achieving the goal we want people to be able to achieve.

Visual Queries

Acts of attention **driving our eye-movements** to find the information we need to accomplish a task.

1. It's **very important** to be mindful of what **tasks** and **visual queries** your design is supposed to support
2. Translating this task in a number of **visual queries** that the users are going to probably execute on top of your graphic
    - The more you know about these tasks, the easier is going to ideate designs that support the task your users are supposed to accomplish

Example:

Subway map of London

How do I go from A to B?

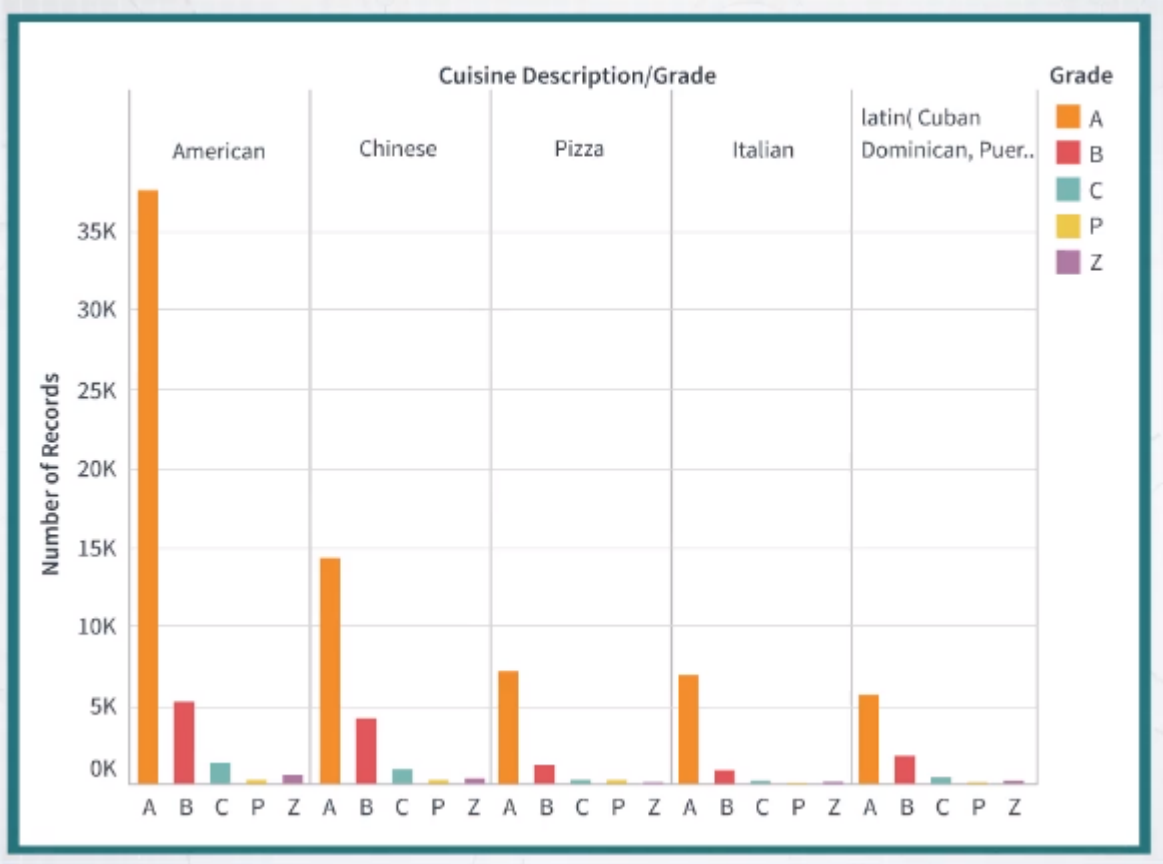
*Goal: Finding the best way to go from **origin** to **destination***

- Which train connects the two points?
- What is the fastest route?
- Which route requires the fewer changes?
- Which one minimize the walking time?

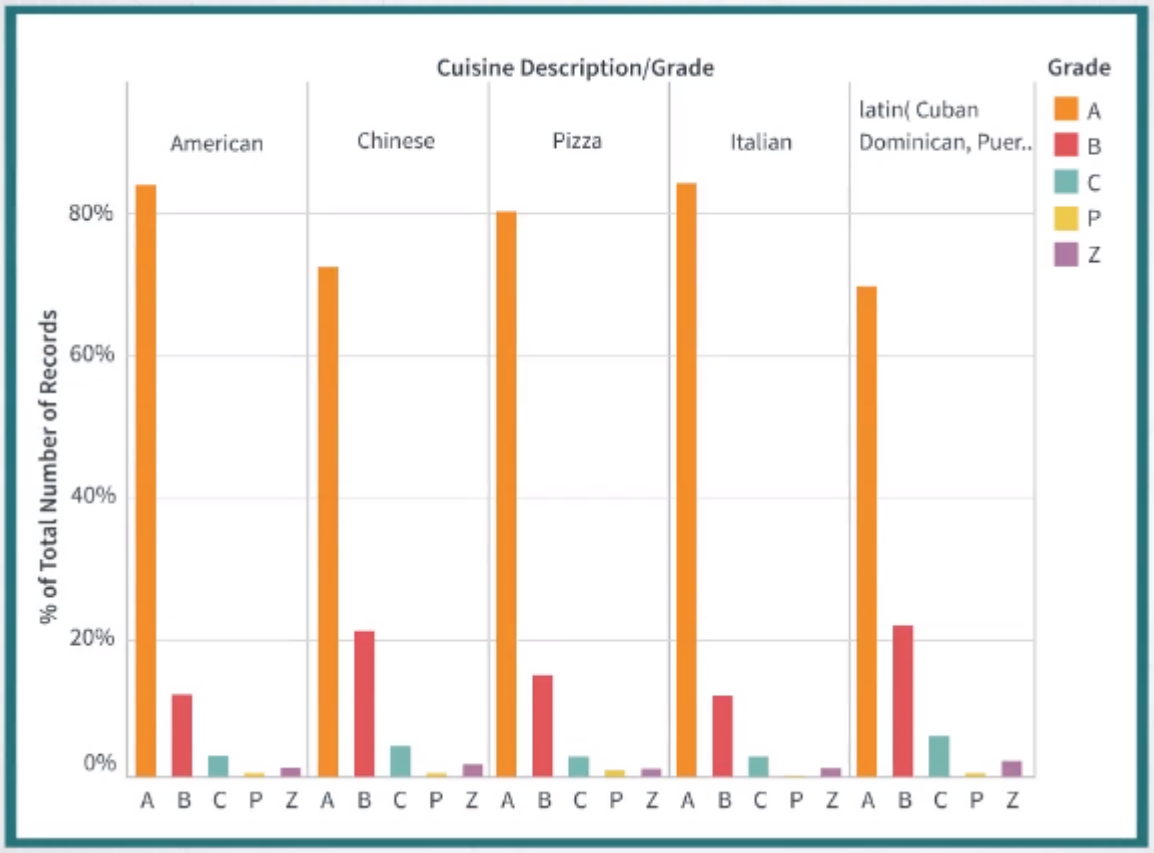
Design: Translate the goal into a number of visual queries

Example:
Visual task: compare the heights of the bars.

Graph 1: Y-axis -> Number of records



Graph 1 (modified): Y-axis -> Proportion
Comparison is now easier



What we can easily see?

The way human visual system is organized, makes some visual features much easier to detect than others.

After information goes through our eye, it passes two regions in the brain, populated with neurons tuned to respond to specific kind of properties, such as:

- Form
- Color
- Orientation
- Motion
- Depth
- Sound

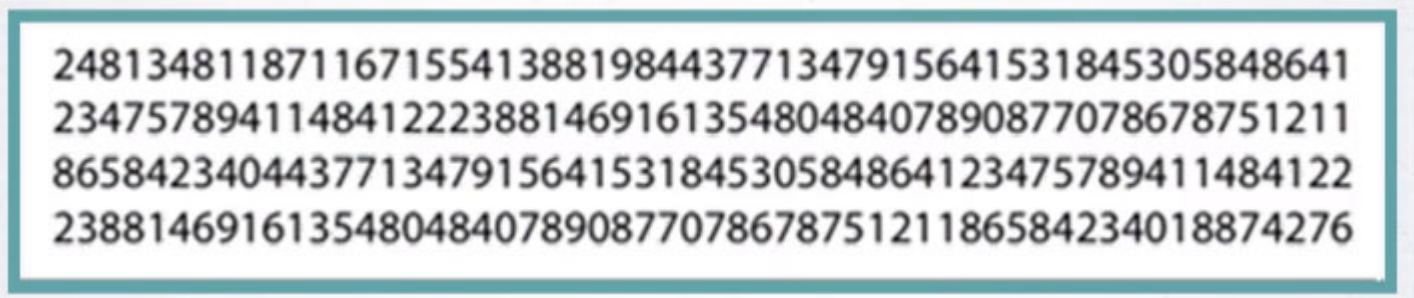
- V1 region:
- V2 region: identifies complex types of patterns

Those neurons are capable of processing the information in a parallel fashion -> it makes this processing extremely efficient.

What visual representations make it easy to answer visual queries?

- Some features can be described as **"*tunable*"** *(so called ~~preattentive~~ features)*
- That means we can tune our search towards detecting features of interest.

Example: Detect how many 3's



Key concepts: guidelines

- *"Eyes beat memory"*
  - Moving your eyes is much faster than moving between views
  - It is good to visualize the max number of visual information in one view/picture, because when we introduce *user interactivity* (scrolling, zooming, panning, etc.) we introduce body movement, which is far slower than eye movement

- Making tasks and visual queries explicit when evaluating designs is a very good idea.
  - What questions does the viewer have?
  - What visual queries are needed to answer this question?

- Leverage pre-attentive ("*tunable*") features