Data Visualization
Brait Ōispuu
Types of Visualization

- Mathematical Visualization
  - $y = x + 1$
  - Mandelbrot

- Scientific Visualization
  - Data acquired via lengthy simulations
  - Missing data must be handled
Types of Visualization (2)

- Information Visualization
  - Abstract, non-coordinate data
  - Trying to provide a concrete form
  - andrew_elliot – 4 months of sleep

- Domain Specific Visualization
  - Medical Scans
  - Business Intelligence
Modes of Visualization

- Interactive Visualization
  - Discovery
  - Single investigator or small groups

- Presentation Visualization
  - Communication
  - Large groups, mass audiences
  - No user input

- Interactive Storytelling
  - Presentations via interactive webpages
The Computer

- RAM
- Cache
  - Camera Video Buffer
  - Microphone Audio Buffer
- CPU
  - Media Processor
- Output Processor
The Human

- **Long-Term Memory**
- **Working Memory**
  - Size: 7 (5-9) chunks
- **Visual Image Store**
  - Size: 17 letters
  - Decay: 200 ms
- **Auditory Image Store**
- **Cognitive Processor**
  - Cycle: 70 ms
- **Perceptual Processor**
  - Cycle: 100 ms
- **Eye**
  - Cycle: 230 ms
- **Motor Processor**

Visual Image Store Size: 17 letters
Decay: 200 ms
Auditory Image Store
Cognitive Processor Cycle: 70 ms
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Eye Cycle: 230 ms

**Working Memory**
Size: 7 (5-9) chunks

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Cycle: 70 ms

**Perceptual Processor**
Cycle: 100 ms

**Eye**
Cycle: 230 ms

**Motor Processor**
Reading

- We read in chunks
- We don’t perceive it

- Aoccdrnig to rscheearch at Cmabrigde Uinervtisy, it deosn't mttarer in waht ordr the Itteers in a wrod are, the olny iprmoetnt tihng is taht the frist and Isat Itteer be at the rght pclae. The rset can be a toatl mses and you can sitll raed it wouthit a porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.
Hand-Eye Coordination

- The brain knows where the limbs are
- Fitt’s Law
  - Larger movements are faster but less accurate than smaller ones
- It does not really matter whether you have large or small selectables.
  - 70 ms to move your hand
  - 100 ms to see the result
  - 70 ms to decide how to correct it
Memory

- Human DRAM
  - 70 ms access time
  - Holds about 7 things
  - Recency effect
  - Chunks and logical units
Forgetting

- Decay
  - Logarithmical – we forget most of the things early-on
  - Jost’s Law – if two equally strong memories at a given time, then the older is more durable

- Interference
  - proactive inhibition – can’t teach an old dog new tricks
  - retroactive interference – mind blown
  - emotion - good old days, forget the mundane
Reasoning

- Deductive Reasoning
  - Drawing a conclusion based on data
- Inductive Reasoning
  - Generalizing
- Abductive Reasoning
  - Modeling
  - Asking why?
- All of the above can be applied correctly and incorrectly
Perception
Perception
Color context
Color context
Mach Bands
Size Context
Size Context
Which is Longer, AB or BC?
Which is Longer, AB or BC?
## Data Types

<table>
<thead>
<tr>
<th>Ordered (values are comparable)</th>
<th>Discrete (no between values)</th>
<th>Continuous (values between)</th>
</tr>
</thead>
</table>
| **Ordinal,**
  e.g. size: S, M, L, XL, ...
  **Quantitative,**
  e.g. counts: 1, 2, 3, ... | **Fields,**
  e.g. altitude, temperature |
| **Nominal,**
  e.g. shape: □ ○ △
  **Categories,**
  e.g. nationality | **Cyclic values,**
  e.g. directions, hues |
# Data as Variables

<table>
<thead>
<tr>
<th>Science</th>
<th>Databases</th>
<th>Data Warehouses</th>
</tr>
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<tbody>
<tr>
<td><strong>Independent Variable</strong></td>
<td>Key</td>
<td>Dimension</td>
</tr>
<tr>
<td><strong>Dependent Variable</strong></td>
<td>Value</td>
<td>Measure</td>
</tr>
</tbody>
</table>
Mapping Quantitative Values

- Position
- Length
- Angle/Scope
- Area
- Volume
- Color/Density
Mapping Ordinal Values

- Position
- Density
- Saturation
- Hue
- Texture
- Connection
- Containment
- Length
- Angle
- Slope
- Area
- Volume
Mapping Nominal Values

- Position
- Hue
- Texture
- Connection
- Containment
- Density
- Saturation
- Shape
- Length
- Angle
- Slope
- Area
- Volume
Using Different Charts

<table>
<thead>
<tr>
<th>Dep.</th>
<th>Quantitative Continuous</th>
<th>Bar</th>
<th>Line</th>
<th>Dep.</th>
<th>Quantitative Continuous</th>
<th>Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Discrete</td>
<td>Bar</td>
<td></td>
<td>Bar</td>
<td>Quantitative Discrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ind.</td>
<td>Quantitative Continuous</td>
<td>Gantt</td>
<td>Scatter</td>
<td>Nominal or Q. Discrete</td>
<td>Table</td>
<td>Gantt</td>
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Parallel Coordinates