1 INTERACTING WITH DATA AT SCALE

Why Data Visualization:

- Data Analytics and Data Visualization focus on large sample but less qualitative information.
    - Data at scale can be quantitative or qualitative data, e.g. social media messages, sentiment and facial recognition data, documents, sounds …
- Inform users dashboard to take decisions
- Inform designers about cultural trends (determine trends in order to improve the design)
- "data visualization provides tools and techniques for representing, understanding, and exploring data"

Source of Data:

- **Interaction log** 原始互动记录– Collection of data during the interaction with software 在用户使用系统时直接获得想要的数据
    - Click Stream: sequence of clicks (tells the user's goal)
    - GPS data: where the app used
    - Time of logging in: e.g. if most users use the app at night time -> night mode
    - Viewing information: what does the users spend time on
- **Web Scrapping** 爬虫 – Extracting data from website through an automated process implemented using a bot 爬虫技术相当于时一个探测机器, 基本操作就是模拟人的行为去各个网站溜达, 点按钮, 查数据 或者把看到的信息背回来, 例如百度
    - Contact Scraping: get information about your users by build database with extra information (get the information online from other websites instead of ask the users directly)
    - Product Review Scraping: check prices of similar product from other website for comparison
- **Crowdsourcing** 群众外包 – users voluntary undertaking of a task to participative online activity 例如谷歌地图的餐厅评价系统让使用者自己去填写餐厅的评价, 上传照片, 确定餐厅开关时间等
- **Surveillance** 监视 – 软件可以从监视系统中获得数据, 例如公交车到达时间的追踪系统
- **Sentiment Analysis** 情感分析 – process of identifying the subjective information in text and classifying each piece of data as Positive, Negative, or Neutral. Often used for Opinion Mining to provides insights on how customer feel about product or services 可以通过人们的 textual review, 或是面部表情 facial expression 甚至 tweeter 扬声器来分析 – 例如餐厅里的笑脸选择器
- **Social Network Analysis** 社交分析 – Study of social structure of people related to each other through common relations of interests, 可以用人们的 behavior 来分类人群, 确认他们的 community 从而来进行推荐 – 例如推荐你去过的餐厅或者类似的餐厅给你的朋友

Ethics and Data Privacy: 在用户使用 app 之前需要告知用户他们的信息将被如何利用 – agreement

Data Visualization: 将抽象的科学或者商业数据用图像 image plot 表示出来, 以帮助理解数据的意义的过程 reflect the abstract properties of the data. 通常可以在数据分析 data analysis 的过程中大量地使用

- Get the user to understand the data in order to inform their decision 让用户理解一些数据这样他们就可以根据这些数据来做一些决定, 例如在 social network analysis 过后给用户推荐了一些餐厅, 用户看到餐厅的推荐才会做决定去与不去, 若是直接将数据放在用户面前或许会 confuse 用户
- Get insights to inform the design choices 设计者可以从数据中得到一些信息从而进行设计
- 但是和机械学习不一样的是, 机械学习是想让机器学习数据从而做到可以替人类做决定. 而在这里是为了让人们可以根据数据来进行一些设计和 improvement

Defining a Visual Grammar:

- 使用什么数据来 match visual element to data?
    - Items, positions, tables
    - Static or temporal
    - Categorical, ordered, quantitative, sequential
- 为什么?

    - Consume (discover, present, enjoy) and Produce (record and annotate)
    - Search, determine trends, find outliers, discover features, show distributions, show special attributes
- Map the categorical data or order tata with color, size and shape
- Choose to present it in 2D or 3D -> 3D graphs present advantages but final rendering 表现 is done in 2D screen, it might cause distortion 变形或室真, or occlusion 吸收 of information -> one alternative is a Latice of 2D projections

Interactive Plots:

- Dashboard - Interactivity allows to:
    - Explore the data
    - Deal with complexity
    - Change over time
    - Select and navigate (zoom, pan, constrained)
- Split Attention Effect 例如将 pie chart 放在左边, 将各个颜色的解释放在右边就会造成 cognitive overload
- Jitter 晃动 – add noise to make individual points more visible
- Geometrical Distortion 实真 – sometimes necessary when scales are not compatible

2 LINKING THE HEURISTICS TO COGNITIVE LOAD THEORY

Different cognitive load affects:

- Cognitive architecture – Sensory Memory -> Attention -> Working/Short-term Memory (<- Retrieval, -> Elaborate/ Encoding) Long Term Memory
- Worked out examples as an alternative learning strategy to means-end analysis – give novice user worked out examples can help them to learn more quick, instead of just giving the solution like means-end strategy
- The Split Attention Effect – Put relate information in two or more separate pages, or put the explanation of an image far away from the image
- The redundancy effect – remove the unnecessary, redundant and the not essential information
- Reduce Search – too much search can cause cognitive overload
- Diagrams – interact with system is a learning process, diagrams can express the relationship between elements clearly
- The Modality Effect – e.g. giving animation and voice at the same time is better than only animation or only voice
- Expertise Reversal Effect – some design are good for novices but not for expertise for example the worked-out examples
- Different Sources of Cognitive Load (3)
    - Extrinsic/Extraneous cognitive load – 从设计中外来的 cognitive load, 可以通过重新设计来改善
    - Intrinsic cognitive load – 这是本身需要展示的 material/information/original content 里带来的 cognitive load 是不可不免的比如说 excel 里面的普通操作(low)和方程操作(high)
    - Germane Cognitive load (positive) – exists as a result of instructional design, increase the germane load can improve design

Heuristics:

- These rules or thumb can improve the design because they try to *reduce the load on user's limited cognitive working memory* -> make things easier to process and make sense of.
- *Visibility of System Status* – always keep the users informed about what is going on by giving appropriate feedback with reasonable time, useful/effective feedback can increase the chances that users learn from their mistakes, and easily to integrate the new knowledge to the existing schemas.
    - It can reduce the need for user to search for information -> save the cognitive resource for searching, and use it in learning and understanding
- *Match between system and the real world* – speak user's language, use the words/phrases/concepts familiar to the users
    - Designing terminology and concept that users are familiar with can allow people to apply their prior knowledge and schemas to the task -> system will be easier to use
- *User Control and Freedom* – provide ways to allow users to easily escape from the unexpected places, such as logout
    - When users are in control, they can use the cognitive resource to focus on what they're interested in achieving. But too many exists ways can lead redundancy.

- *Consistency and Standards* – use the same word, situations, actions when meaning the same thing
    - It is easier for user to use the system once they become familiar with the layout, colors, actions. Consistency makes it easier for user to acquire schemas of where to find things or how to do things
- *Help users Recognize, Diagnose, and Recover from Errors* - use plain language to describe the nature of the problem, and the suggestion of how to solve it.
    - Effective/useful feedback can increase the chances that user will learn from their mistakes, easily integrate it into the existing schemas, and the familiar/simple language increase the chance of user will understand the information.
- *Error Prevention* – Prevent error occurring in the first place e.g. avoid confusing and redundant links
    - When error occurs, cognitive resource would devoted 献身 to fixing/understand the issue rather than focus on the task. Cognitive resource can be used to focus on the task to lead fast learning if the errors are avoided.
- *Recognition rather than recall* – Make objects, actions, options visible
    - It would reduce the burden on users' limited working memory is there is less information to remember. And will reduce the chance of error occurs, would make the system easier to use as well.
- *Flexibility and Efficiency of use* – provide accelerators that are invisible for novices, but allow experienced user to carry out tasks more efficiently.
    - Accelerators would require more processing capacity for novices, so make it invisible is good
    - Accelerators would allow experts to finish work more efficiently and effectively.
- *Aesthetic and Minimalist Design* – avoid using information that is irrelevant or barely used
    - It would help to reduce search to find relevant things is information is well laid out for easily read. Searching uses up working memory capacity, it will help to save up more resource for understanding and learning.
    - It also helps to eliminate the redundant information, as processing the information uses up cognitive resources.
- *Help and Documentation* – provide information that can be easily searched and provide help in a set of concrete steps that can easily be followed.
    - When help and documentation is easy to use and understand, it can help users to learn how to use the system easier, helps save cognitive resource.
    - Make sure help system provide meaningful headings and cues to locate relevant information – reduce search to reduce limited working memory.

3 WEB DESIGN & APP DESIGN

Single Use Tools:

- Analog tools – lathes 机床, paint brushes, whisks 打蛋器
- Analog observation tools – mercury thermometers, wristwatches, dipsticks 量油尺
- Digital creation tools – 3D printers, coffee machine
- Digital manipulation tools – presentation clicker

Multivariate tool: Swiss army knife set, laptop, smart phones

Flexibility-Usability tradeoff ⇔ when flexibility increases, usability decreases

Principles:

- Screen Size & Real estate
    - Screen size is increasing with desktops and fluctuating 波动 with mobiles
    - More screen space != more content ⇔ Less is More
    - Use the real estate effectively, and be ruthless 无情地 to chop out the unnecessary/rarely used information
- Font / Layout
    - Consistency in font and layout is important otherwise it would make it harder to read
    - Try to use web-safe font, use one set of styles (heading, subheading, body text)
    - Make sure the layout is consistency – keep things in the same place on every page
- Colors and Navigation
    - Maximum of 4 colors
        - Primary color for links/highlights; secondary color for alternative things; having background color

    - Navigation – be careful with the levels
        - App
            - Slide bars 像苹果调照片颜色拖动地 bar 一样
            - Codrops 像方框下面有三角形表示已经点了这个选项
            - Flex nav 像邮箱左边的选项栏
        - Mobiles
            - Gestures
            - Swipe up/down/back/forward
            - Tiny buttons / screen density issues
            - Use touch to replace right click
    - Mobile struggle with levels/dropdown and facilitation of schemes
    - “Order by” should be used, do not order alphabetically
- Mobile and Responsive Design
    - mobile
        - Bandwidth
        - Image vs. Text
        - Accessibility
        - Scroll
        - Size of the screen
    - Responsive Design – CSS and Bootstrap can help with it

Concepts:

- Cascading Style Sheets
    - Can use Skeuomorphism 看起来比较例题的设计比如说老的苹果界面 icon
    - Font awesome/material icons 是两组比较常用的简洁 icons
- Design Patterns – UI patterns exist for virtually everything
    - Navigation
    - Data Collection and input
    - Feedback
    - Social
- Designing for IOS
    - Apple has its own HCI guidelines for their platform, same as Windows
        - Layout/navigation/modal windows
        - Interactivity/feedback
        - Branding/animation
        - Typography/color/fonts/wording
    - BlackBerry has same principles but different approach for example it focuses on fluid environment, communication, content and cinematic experience
- Case Studies