Wrapup: Research Papers and Process

Tamara Munzner
Department of Computer Science
University of British Columbia

CPSC 547, Information Visualization
1 December 2021

http://www.cs.ubc.ca/~tmm/courses/547-21

Today

- papers & research: pitfalls & process
  - writing infovis research papers
  - review reading, review writing, conference talks
- course endgame expectations
  - final presentations
  - final report
    - incl. course paper vs research paper differences
- [evaluations]
- open science
  - making research available, reproducible, replicable
- next steps
  - ways to continue on with visualization

Writing InfoVis Papers

Pitfalls

- writing infovis papers: pitfalls to avoid
  - Process and Pitfalls in Writing Information Visualization Research Papers.
    Tamara Munzner. In: Information Visualization: Human-Centered Issues and Perspectives.
    Andreas Kerren, John T. Stasko, Jean-Daniel Fekete, Chris North, eds.
    Springer LNCS Volume 4950, p 134-153, 2008.

Idiom pitfalls

- Unjustified Visual Encoding
  - should justify why visual encoding design choices appropriate for problem
  - prerequisite: clear statement of problem and encoding!
- Hammer In Search of Nail
  - should characterize capabilities of new technique if proposed in paper
- Color Cacophony
  - avoid blatant disregard for basic color perception issues
    - huge areas of highly saturated color
    - categorical color coding for 15+ category levels
    - red/green without luminance differences
    - encoding 3 separate attributes with RGB
- Rainbows Just Like In The Sky
  - avoid hue for ordered attribs, perceptual nonlinearity along rainbow gradient

Later pitfalls: Strategy

- What I Did Over My Summer Vacation
  - don't focus on effort rather than contribution
  - don't be too low level, it's not a manual
- Least Publishable Unit
  - avoid tiny increment beyond (your own) previous work
  - bonus points: new name for old technique
- Dense As Plutonium
  - don't cram in so much content that can't explain why/what/how
    - fails reproducibility test
- Bad Slice and Dice
  - two papers split up wrong
  - neither is standalone, yet both repeat

Later pitfalls: Tactics

- Stealth Contributions
  - don't leave them implicit, it's your job to tell reader explicitly!
  - consider carefully, often different from original project goals

Contributions in research papers

- what are your research contributions?
  - what can we do that wasn't possible before?
  - how can we do something better than before?
  - what do we know that was unknown or unclear before?
- determines everything
  - from high-level message to which details worth including
- often not obvious
  - diverged from original goals, in retrospect
- state them explicitly and clearly in the introduction
  - don't hope reviewer or reader will fill them in for you
  - don't leave unsaid should be obvious after close reading of previous work
  - goal is clarity, not overselling (limitations typically later, in discussion section)

Later pitfalls: Tactics

- Stealth Contributions
  - don't leave them implicit, it's your job to tell reader explicitly!
  - consider carefully, often different from original project goals
- I Am So Unique
  - don't ignore previous work
  - both on similar problems and with similar solutions
- Enumeration Without Justification
  - "X did Y" not enough
  - must say why previous work doesn't solve your problem
  - what limitations of their does your approach fix?
- I Am Utterly Perfect
  - no you're not; discussion of limitations makes paper stronger!

Later pitfalls: Results

- Unfettered By Time
  - choose level of detail for performance numbers
  - detailed graphs for technique papers, high-level for design & eval papers
- Straw Man Comparison
  - compare appropriately against state-of-the-art algorithms
  - head-to-head hardware is best (re-run benchmarks yourself, all on same machine)
- Tiny Toy Datasets
  - compare against state-of-the-art dataset sizes for technique (small ok for eval)
- But My Friends Liked It
  - asking labmates not convincing if target audience is domain experts
- Unjustified Tasks
  - use ecologically valid user study tasks: convincing abstraction of real-world use

Final pitfalls: Style

- Deadly Detail Dump
  - explain *how* only **after** *what* and *why;* provide high-level framing before low-level detail
- Story-Free Captions
  - optimize for flip-through-pictures skimming
- My Picture Speaks For Itself
  - explicitly walk them through images with discussion
- Grammar Is Optional
  - good low-level flow is necessary (but not sufficient), native speaker check good if ESL
- Mistakes Were Made
  - don't use passive voice, leaves ambiguity about actor
    - your research contribution or done by others?

Final pitfalls: Style 2

- Jargon Attack
  - avoid where you can, define on first use
    - all acronyms should be defined
- Nonspecific Use Of Large
  - quantify! hundreds? 10K? 100K? millions? billions?…

Final pitfalls: Submission

- Slimy Simultaneous Submission
  - often detected when same reviewer for both
  - instant dual rejection, often multi-conference blacklist
- Resubmit Unchanged
  - respond to previous reviews: often get reviewer overlap, irritated if ignored

Generality

- encoding: visualization specific
- strategy: all research
- tactics: all research
- results: visualization specific
- style: all research, except
  - Story-Free Captions, My Picture Speaks For Itself

Research Process & Pitfalls

Review reading pitfalls

- Reviewers Were Idiots
  - rare: insufficient background to judge worth
  - if reviewer didn't get your point, many readers won't
  - your job: rewrite so clearly that nobody can misunderstand
- Reviewers Were Threatened By My Brilliance
  - seldom: unduly harsh since intimately familiar with area
- I Just Know Person X Wrote This Review
  - sometimes true, sometimes false
  - don't get fixated, try not to take it personally
- It's The Writing Not The Work
  - sometimes true: bad writing can doom good work (good writing may save borderline)
  - sometimes false: weak work common! reinvent the wheel worse than previous one

Review writing pitfalls

- Uncalibrated Dismay
  - remember you've only read the best of the best!
  - most new reviewers are overly harsh
- It's Been Done, Full Stop
  - you must say who did it in which paper, full citation is best
- You Didn't Cite Me
  - stop and think whether it's appropriate
  - be calm, not petulant
- You Didn't Channel Me
  - don't compare against paper you would have written
    - review the paper they submitted

Conference talk pitfalls

- Results As Dessert
  - don't save until the end as a reward for the stalwart!
  - showcase early to motivate
- A Thousand Words, No Pictures
  - aggressively replace words with illustrations
  - most slides should have a picture
- Full Coverage Or Bust
  - cannot fit all details from paper
  - communicate big picture
  - talk as advertising: convince them it's worth their time to read paper!

Paper writing process suggestions

- pre-paper talk
  - write and give talk first, as if presenting at conference
  - iterate on talk slides to get structure, ordering, arguments right
  - then create paper outline from final draft of slides
    - encourages concise explanations of critical ideas, creation of key diagrams
    - avoids wordsmithing digressions and ratholes
    - easier to cut slides than prose you agonized over
- pre-paper/practice talk feedback session: at least 2-3x talk length
  - global comments, then slide by slide detailed discussion
  - nurture culture of internal critique (build your own critique group if necessary)
- have non-authors read paper before submitting
  - internal review can catch many problems
  - ideally group feedback session as above

Course Endgame

Logistics

- Assignments: Final Presentations on Canvas
  - upload due Wed Dec 15 noon (2 hrs before session)
    - required & posted: slides (Project Final Presentation Slides, PDF)
    - optional & posted: video (Project Final Presentation Video, mp4)
- Assignments: Final Report on Canvas
  - upload due Fri Dec 17 8pm (PST)
    - required & posted: report (Project Final Report, PDF)
    - required & posted: showcase image (Project Teaser Image, png)
    - required but not posted: code incl README (Project Source Code and Other Materials, zip)
    - encouraged & posted: live demo URL (include in code README)
    - encouraged & posted: video (include in code zip *only* if different from final present video)

Final Presentations

Final presentations: Wed Dec 15 2-5pm

- length (14 projects)
  - **presentation** (live **or** prerecorded): 10 min for groups, 8 min for solo
  - **Q&A** live: 2 min per project
- session structure
  - order alphabetical by first name, as on project page
  - 2 breaks, between each set of 5-6 presentations
  - CS dept (fac / grads) & infovis group invited, friends/others very welcome!
- presentation structure
  - content: **motivation/framing**, **project**, **results**, **critique/limitation**
    - standalone: don't assume audience has read proposal or updates (or remembers your pitch)
  - slides (***& slide numbers)*** mandatory for main part
  - demo strongly encouraged, either live or prerecorded
  - format is up to you: live presentation or prerecorded video or a mix

Final presentations, cont

- slides/video upload
  - upload to Canvas Assignments: Final Slides (mandatory), Final Video (optional)
  - by noon Wed Dec 15
- code freeze after presentations!
  - no additional work on project allowed after presentation deadline
  - additional two days to get it all written down coherently for final report

Final Presentations Schedule

- 2:00-2:12 Abi Kuganesan, Ivan Song, Lufei Liu.
  Hood Hunter: A House Hunter's Guide to Narrowing Neighbourhoods.
- 2:12-2:24 Arash Kamyabi, Negar Sadrzadeh.
  Drinking Behavior Patterns in Dairy Cattle.
- 2:24-2:36 Armita Safa, Janet Li, Neera Patadia.
  Multiscale Visualization of Pathogenic Structural Variants.
- 2:36-2:48 David Chen, Hongyang Yang, Madison Lore, Niels Semb.
  A New City Map.
- 2:48-3:00 Deepansha Chhabra, Lucie Polakova, Niloofar Zarif.
  What Can We Learn from User-Movie Ratings?
- *3:00-3:10 BREAK*
- 3:10-3:22 Elizabeth Reid, Mifta Sintaha, Nichole Boufford.
  SoundMap: A Visualization Tool to Explore Multi-Attribute Sound Data.
- 3:22-3:34 Felipe Gonzalez-Pizarro, Soheil Alavi.
  MultiModalTopicExplorer: Topic modeling for exploring multi-modal data from asynchronous online conversations.
- 3:34-3:44 Hadi Sinaee.
  PartViz: Visualizing Graph Partitioners.
- 3:44-3:56 Inna Ivanova, Jonatan Engstad.
  Explorify: A Personalized Interactive Visualization Tool for Spotify Listening History.
- 3:56-4:08 Jocelyn Minns, Mary Abikoye, Minglong Li.
  Necklace Maps for COVID-19 Visualization.
- *4:08-4:18 BREAK*
- 4:18-4:28 Mara Solen.
  Visualization Literacy in the Age of Big Data: Vital Skills for Modern Media Consumption.
- 4:28-4:40 Marie Salomon, Noa Heyl, Shizuko Akamoto, To To Tokaeo.
  Course Friction Explorer: Visualizing and Validating Indicators of Student Struggle.
- 4:40-4:50 Michael Tegegn.
  Visualizing Android Features Through Time.
- 4:50-5:00 Zainab Saeed Wattoo.
  Visualizing the Run Time Execution of Command Patterns.

Final presentations marking

- template (may change)
  - Intro/Framing: 20%
  - Main: 30%
  - Limitations/Critique/Lessons: 10%
  - Slides: 10%
  - Presentation/Video Style: 10%
  - Demo: 10% (or N/A)
  - Question Handling: 10%
- marking by buckets
  - great 100%
  - good 89%
  - ok 78%
  - poor 67%
  - zero 0%

Marking: Course overall

- 50% Project, summative assessment at end
  - 15% Final Presentation
  - 25% Final Report
  - 60% Content
  - *(Milestones pass/fail, penalty up to 25% if missed)*
    - *pitch 5%, proposal 10%, update 10%*
- 36% Async Discussion
  - 9 weeks, 4% per week
    - 75% own comments, 25% responses
    - *(almost all got full credit)*
- 14% Sync: In-Class Participation
  - 12 sessions, 1% per session
  - 2% final presentations
  - *(almost all got full credit)*

Final Reports

Final reports

- PDF, use InfoVis templates http://junctionpublishing.org/vgtc/Tasks/camera_tvcg.html
  - your choice to use Latex/Word/whatever
- no length cap: illustrate freely with screenshots!
  - design study / technique: aim for at least 6-8 pages
  - analysis / survey: aim for at least 15-20 pages
- strongly encouraged to re-use text from proposal & update writeups
- encourage looking at my writing correctness and style guidelines
  - http://www.cs.ubc.ca/~tmm/writing.html
- strongly encourage looking at previous examples
  - www.cs.ubc.ca/~tmm/courses/547-21/projectdesc.html#examp
  - Example Past Projects (curated list)
  - direct links to all project pages to browse 2020-2003

Course requirements vs research paper standards

- research novelty **not** required
- mid-level discussion of implementation **is** required
  - part of my judgement is about how much work you did
  - high level: what toolkits etc did you use
  - medium level: what pre-existing features did you use/adapt
  - low level **not** required: manual of how to use, data structure details
- design justification **is** required
  - (unless analysis/survey project)
  - different in flavour between design study projects and technique projects
  - technique explanation alone is not enough
- publication-level validation **not** required
  - user studies, extensive computational benchmarks, utility to target audience

Report structure: General

- low level: necessary but not sufficient
  - correct grammar/spelling
  - sentence flow
- medium level: order of explanations
  - build up ideas
- high through low level: why/what before how
  - paper level
    - motivation: why should I care
    - overview: what did you do
    - details: how did you do it
  - section level
    - overview then details
  - sometimes subsection or paragraph level

Sample outlines: Design study

- www.cs.ubc.ca/~tmm/courses/547-21/projectdesc.html#examp
- Abstract
  - concise summary of your project
  - do not include citations
- Introduction
  - give big picture, establish scope, some background material might be appropriate
- Related work
  - include both work aimed at similar problems & similar solutions
  - no requirement for research novelty, but still frame how your work relates to it
  - cover both academic & relevant non-academic work
  - you might reorder to have this section later

Sample outlines: Design study II

- Data and Task Abstractions
  - analyze your domain problem according to book framework (what/why)
  - include both domain-language descriptions and abstract versions
  - could split into data vs task, then domain vs abstract - or vice versa!
  - typically data first then task, so that can refer to data abstr within task abstr
- Solution
  - describe your solution idiom (visual encoding and interaction)
  - analyze it according to book framework (how)
    - only for custom encodings, no need to repeat book material for standard chart types
  - justify your design choices with respect to alternatives
  - if significant algorithm work, discuss algorithm and data structures

Sample outlines: Design study III

- Implementation
  - medium-level implementation description
    - specifics of what you wrote vs what existing libraries/toolkits/components do
- Milestones
  - breakdown of who did what work
  - **remember to update milestones:** add actual hours/date to estimated hours/date
- Results
  - include scenarios of use illustrated with multiple screenshots of your software
    - walk reader through how your interface succeeds (or falls short) of solving intended problem
    - report on evaluation you did (eg deployment to target users, computational benchmarks)
    - screenshots should be png (lossless compression) not jpg (lossy compression)!
- Discussion / Future Work
  - reflect on your approach: strengths, weaknesses, limitations
  - lessons learned: what do you know now that you didn't when you started?
  - future work: what would you do if you had more time?

Sample outlines: Design study IV

- Conclusions
  - summarize what you've done
  - different than abstract since reader has seen all the details
- Bibliography
  - note format is numerical & alphabetical
    - use citation manager / bibtex!
  - make sure to use real references for work that's been published academically
    - not just URL
    - **check arxiv papers**, some have link to final publication venue, also search on titles!
  - **check carefully to ensure consistency & nothing mangled or missing**
  - most online sources require cleanup
    - see guidance at http://www.cs.ubc.ca/~tmm/writing.html#refs

Marking

- **design study** & technique & explainer
  - 12.5% each for
    - intro
    - related work
    - abstractions
    - solution
    - implementation/milestones
    - results
    - discussion
  - 10% style, 2.5% bibliography

Sample outlines: Survey (diffs)

- *Abstract (same as above)*
- Introduction
  - discuss the scope of what you're covering, why it's interesting/reasonable partition compared to visualization as a whole
- Related Work
  - **only** previous surveys
    - focus on how your work is similar to or different from them, especially wrt coverage
- Main
  - break up into sections based on your own synthesis of themes of work covered
  - you might want a Background section at the start if domain-focused survey
    - where there's important vocabulary/ideas to establish before diving into main discussion
  - analyze visualizations proposed in these papers in terms of what/why/how framework (if applicable)
    - include images from papers
- *Milestones, Discussion / Future Work, Conclusions, Bibliography (same as above)*
- *marking: intro (10%), relwork (10%), main (60%), milestones/discussion (10%), style (10%)*

Sample outlines: Implementation (diffs)

- *Abstract, Introduction (same as above)*
- Related Work
  - paper you're reimplementing, maybe other closely related work for framing context
  - much shorter than other project types
- Scope
  - big picture of what you did, esp. only a subset of original paper or covering multiple papers
  - nice to have somewhat comprehensible & standalone document but no need to explain in full
    - ok to discuss similarities and differences assuming familiarity with goals of original work
- Implementation
  - detailed implementation discussion: much more than other project types
  - as above, include specifics of what you build on vs what you coded yourself
  - issues that arose: choices unclear in original, subtleties and nuances you discovered along the way, challenges in adapting toolkit capabilities

Sample outlines: Implementation (diffs)

- Results
  - as above, should include screenshots of your software that illustrate scenarios of how to use it
    - but less emphasis particular target users in scenarios
  - definitely include computational benchmarks to evaluate your work
- *Milestones, Discussion / Future Work, Conclusions, Bibliography (same as above)*
- *marking: intro (10%), relwork (10%), main (60%), milestones/discussion (10%), style (10%)*

Report marking

- required: at least material I've listed
  - you may include more material
  - you may choose alternate orderings
- reminder: project content is 60% of entire project mark
  - report is 25%, presentation is 15%
- you'll get detailed written feedback
  - combined: final presentation, final report, project content
  - in some cases, next steps

Code / Video

- required: submit your code
  - so I can see what you've done, but I will not post
  - include README.txt file at root with brief roadmap/overview of organization
    - which parts are your code vs libraries
    - how to compile and run
    - I do not necessarily expect your code compiles on my machine
- encouraged but not required
  - submit live demo URL (provide in README.txt file)
  - open-source your code (if so, fine to just send me that URL)
  - submit supporting video (if different from final presentation)
    - with or without voiceover
    - very nice to have later, software bitrot makes demos not last forever!

Showcase image

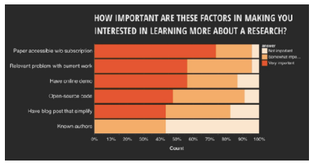
- showcase image for projects page
  - 300x300 image
  - call it showcase.png

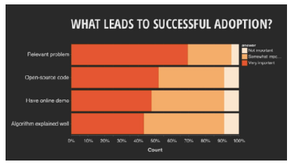
Evaluations

Open Science: Available, Reproducible, & Replicable Research

Making the world care about your research!

- Increasing the Impact of Visualization Research panel, VIS 2017
  - Krist Wongsuphasawat, Data Visualization Scientist, Twitter





https://www.slideshare.net/kristw/increasing-the-impact-of-visualization-research

Disseminating research

- paper page for each paper
  - everything! PDF, supplemental materials, videos, software/demos, talk slides, figures, ...
  - examples:
    - Table Scraps, http://www.cs.ubc.ca/group/infovis/pubs/2020/table-scraps/
    - TimeLineCurator, http://www.cs.ubc.ca/labs/imager/tr/2015/TimeLineCurator/
- write blog post to accompany each paper
  - very high-impact bang for the time buck
    - Multiple Views: Visualization Research Explained umbrella blog https://medium.com/multiple-views-visualization-research-explained
    - UW IDL individual lab blog
      - Surprise Maps: Showing the Unexpected https://medium.com/@uwdata/surprise-maps-showing-the-unexpected-e92b67398865
      - Bayesian Surprise Maps http://idl.cs.washington.edu/papers/surprise-maps/

Making your research reproducible

- why bother with reproducibility?
  - moral high ground
    - for Science!
  - enlightened self-interest
    - make your own life easier
    - you'll be cited more often by academics
    - your work more likely to be used by industry
- reproducibility levels
  - 5: 15 minutes with free tools
  - 4: 15 minutes with proprietary tools
  - 3: considerable effort
  - 2: extreme effort
  - 1: cannot seem to be reproduced
  - 0: cannot be reproduced

[Vandewalle, Kovacevic and Vetterli. Reproducible Research in Signal Processing - What, why, and how. IEEE Signal Processing Magazine, 26(3):37-47, May 2009.]

Reproducibility: Levels to consider

- paper
  - post it online
  - make sure it stays accessible when you move on to new place
  - external archives are better yet (arxiv.org)
- algorithm
  - well documented in paper itself
  - document further with supplemental materials
- code
  - make available as open source
  - pick right spot on continuum of effort involved, from minimal to massive
    - just put it up warts and all, minimal documentation
    - well documented and tested
    - (build a whole community - not the common case)

Reproducibility: Levels to consider, cont.

- data
  - make available
    - technique/algorithm: data used by system
      - tricky issue in visualization: data might not be yours to release!
    - evaluation: user study results
      - ethics approval possible if PII (personally identifiable information) sanitized, needs advance planning
- parameters
  - how exactly to regenerate/produce figures, tables
  - example: http://www.cs.utah.edu/~gk/papers/vis03/

Replication: crisis in psychology, medicine, etc

- early rumblings left me with (ignorable) qualms
  - papers: Is most published research false?, Storks Deliver Babies (p= 0.008), The Earth is spherical (p < 0.05), False-Positive Psychology
- groundswell of change for what methods are considered legitimate
  - out: QRPs (questionable research practices)
    - p-hacking / p-value fishing / data dredging
    - Hypothesizing After Results are Known (HARKing)
  - in
    - replication
    - pre-registration
  - brouhaha with bimodal responses
    - some people doubling down and defending previous work
    - many willing to repudiate (their own) earlier styles of working

Remarkable introspection on methods

- thoughtful willingness to change standards of field
  - Andrew Gelman's commentary on the Susan Fiske article
    - http://andrewgelman.com/2016/09/21/what-has-happened-down-here-is-the-winds-have-changed/
  - Simine Vazire's entire Sometimes I'm Wrong blog
    - http://sometimesimwrong.typepad.com/
    - especially posts on topic Scientific Integrity
  - Joe Simmons Data Colada blog post What I Want Our Field to Prioritize
    - http://datacolada.org/53/
  - Dana Carvey's brave statement on her previous power pose work
    - http://faculty.haas.berkeley.edu/dana_carney/pdf_My%20position%20on%20power%20poses.pdf

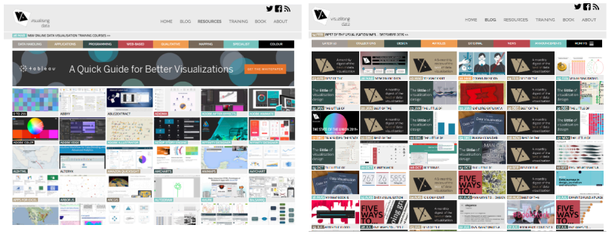
When and how will this storm hit visualization?

- they're ahead of us
  - they have some paper retractions
    - we don't (yet) have any retractions for methodological considerations
  - they agonize about difficulty of getting failure-to-replicate papers accepted
    - we hardly ever even try to do such work
  - they are a much older field
    - we're younger: might our power hierarchies thus be less entrenched??…
  - they are higher profile
    - we don't have vis research results appear regularly in major newspapers/magazines
  - they have rich fabric of blogs as major drivers of discussion
    - crosscutting traditional power hierarchies
    - we have far fewer active bloggers
- replication crisis was focus of BELIV 2018 workshop at IEEE VIS
  - evaluation and BEyond - methodoLogIcal approaches for Visualization
  - http://beliv.cs.univie.ac.at/

Next Steps

Tools & ideas: Andy Kirk's Visualizing Data

http://www.visualisingdata.com/resources/ https://www.visualisingdata.com/blog/

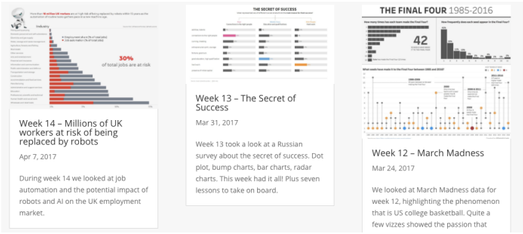


Videos

- many great conferences with free videos online
  - broadly accessible: OpenVisConf, Eyeo, InformationPlus
  - cutting-edge technical research: IEEE VIS

Redesign En Masse: **Makeover Mondays**

- easy entry point (Tableau focus)



http://www.makeovermonday.co.uk/blog/

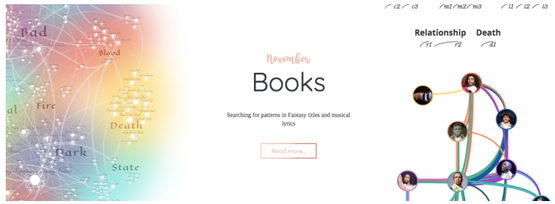
Visual Design Process In Depth: **Dear Data**

- inspiring celebration of data humanism

http://www.dear-data.com/by-week/ Giorgia Lupi and Stefanie Posavec

Visual Design Process In Depth: **Data Sketches**

- detailed process notes, from sketching through coding



http://www.datasketch.es/ Shirley Wu and Nadieh Brehmer

Pathways for more participation

- join Viz@UBC
  - https://dfp.ubc.ca/initiatives/viz-ubc
  - get on visatubc-announce email list (send mail to vizatubc-info@cs.ubc.ca)
  - talk series
- join Vancouver Visualization meetup
  - https://www.meetup.com/Vancouver-Data-Visualization/
  - 4K members
- join Data Visualization Society
  - https://www.datavisualizationsociety.com/
  - less than three years old, 18K+ members around the world
  - resources, jobs board, super-active Slack incl local groups, challenges, …
  - articles on highly active blog/journal: Nightingale

Next Week

Come talk!

- encourage meeting with me to get advice/feedback before final present
  - chance to get feedback while you can still act on it
  - optional, not mandatory
  - wise to schedule in advance by email
    - can't meet with all 14 teams in last few days or in Tue office hours!