Research Papers and Process

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http://www.cs.ubc.ca/~tmm/courses/547-22
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
Writing InfoVis Papers
Pitfalls

• writing infovis papers: pitfalls to avoid
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
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 14 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 16 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 14 2-5:15 pm

• 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 reverse alphabetical by first name, from bottom up on project page
  – 2 breaks, between each set of 5-6 presentations
  – CS dept (fac / grads) & infovis group invited, friends/others very welcome!
  – refreshments served
Final presentations, cont

• 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

• slides/video upload
  – upload to Canvas Assignments: Final Slides (mandatory), Final Video (optional)
  – by noon Wed Dec 14

• note: **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

• 2:00-2:10 Yaman Sanobar.
The Use of Data Visualization in E-Commerce: A Review.

• 2:10-2:20 Rosalyn Carr.
Modified VAST Challenge with Applications to Data Breaches.

• 2:20-2:30 Matias I.B. Oddo.
B-Matrix Network Visualization.

• 2:30-2:42 Madonna Huang, Michael Yin.
A Visualization Tool for Global Wastewater Treatment Plants.

• 2:42-2:52 Jianhao Cao.
TableRepoViz: Visualizing Tabular Data Repositories for Facilitating Descriptive Tag Augmentation.

• 2:52-3:05 BREAK

• 3:05-3:17 Ian Hill, Matthew Tang.
GraceFall: Visualizer for Diverse Stress Test Degradation Data Spanning Multiple Time Scales.

• 3:17-3:29 Han Wang, Xin Wang.
AsylumLoupe: EU Asylum Demographics and Movement Information Visualization.

• 3:29-3:41 Haixiang Huang, Jordan Yu, Mingrui Li.
CancerMap: Visualizing Cancer Rate with Economy.

• 3:41-3:53 Chenwei Zhang, Yibo Jiao.
i-ViDa: Visualizing Energy Landscapes and Trajectories of DNA Reactions

• 3:53-4:05 Jingxuan (Carol) Huang, Devyani McLaren, Tommy Nguyen.
Grad student life: Cost of Living @UBC.

• 4:05-4:20 BREAK

A comparison of single cell RNA sequencing visualization tools for multimodal timelapse analysis.

• 4:32-4:44 Armaghan Sarvar, Cecilia Yang.
CMito-AssemblyVis: Mitochondrial Genome Assembly Assessment Visualization.

• 4:44-4:56 Alex Adrian-Hamazaki, Rodrigo S. Conceição, Yerin Kim.
ChIP-Seq Data Visualization Made Simple.

• 4:56-5:08 Ahmed Abu Zuraiq, Helena De Castro Alvarenga, Ryan Smith.
The Dungeon Master’s Dashboard.
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 only if missed or unacceptable)
    • pitch 5%, proposal 10%, update 10%

• 36% Async Discussion
  – 9 weeks, 4% per week (mostly)
    • 75% own comments, 25% responses
    • (most got full credit)

• 14% Sync: In-Class Participation
  – 12 sessions, 1% per session
  – 2% final presentations
  – (most 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

• strongly encourage looking at previous examples
  – https://www.cs.ubc.ca/~tmm/courses/547-22/projectdesc.html#examp
  – Example Past Projects (curated list)
  – direct links to all project pages to browse, 2021-2003
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
  - description of design -- what you did -- is necessary but not sufficient
- 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
  – ideal: formal technical voice, not conversational style

• medium level: order of explanations
  – build up ideas
  – ideal: carefully structured, not stream-of-consciousness infodump

• high through low level: why/what before how
  – paper level
    • motivation: why should I (reader) care
    • overview: what did you (writer) do
    • details: how did you (writer) do it
  – section level
    • overview then details
  – sometimes subsection or paragraph level
Sample outlines: Design study

• [https://www.cs.ubc.ca/~tmm/courses/547-22/projectdesc.html#outlines](https://www.cs.ubc.ca/~tmm/courses/547-22/projectdesc.html#outlines)

• 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 prev
  – cover both academic & relevant non-academic work
  – (you could 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
  – **must have tight connections** between data & 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** as solutions to problem set up w/ data/task abstractions
    • provide rationale, discuss 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
  – totals required

• Results
  – include scenarios of use, extensively illustrated with multiple screenshots of your software
    • walk reader through exactly how your interface succeeds (or falls short) of solving intended problem
    • report on evaluation, if you did any (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 https://www.cs.ubc.ca/~tmw/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: Technique (diffs)

• Abstract, Introduction (same as above)
• Related Work
  – big focus on similar solutions, some discussion of similar problems (same task/data combo)
• Data and Task Abstractions
  – much shorter than the corresponding one for design studies, framing context not core contrib
• Solution
  – describing proposed idiom exactly, not justifying its use for particular domain problem
  – as above, analyze in terms of design choices, justify why appropriate vs alternatives
• Implementation/Milestones (same as above)
• Results
  – less emphasis on scenarios with particular target users
  – more emphasis on characterizing the breadth of possible uses
  – still definitely include screenshots of the system in action
• Discussion / Future Work, Conclusions, Bibliography (same as above)
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
      – but I do not necessarily expect your code compiles on my machine
    • no need to submit data if it's huge

• 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
    • voiceover is very 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
  – required
Course Evaluations (link on Canvas)
Open Science: Available, Reproducible, & Replicable Research
Making your research available & reproducible: why bother?

• 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
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-scrap/

• 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
Archival dissemination: what to provide

• paper
  – post it online at non-paywalled site

• algorithm
  – document well in paper itself
  – document further with code

• code
  – make available as open source (github.com)
  - 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)

• supplemental materials
Supplemental materials: provide as much as possible

• demo videos: show interactive look & feel
• data for computational benchmarks & case studies
  – tricky issue in visualization: data might not be yours to release!
• qualitative work: thematic analysis raw & intermediate materials
• quant experimental stimuli: full set of images, not just a few examples
• quant evaluation: data analysis code/scripts
• evaluation: detailed study results
  – advance planning: ethics approval! if sanitize PII (personally identifiable information)
• technique refinement: previous iterations
• parameters: how exactly to regenerate/produce figures, tables
• additional case studies, screenshots, other exposition
• surveys / design spaces: interactive faceted browser
  – examples: treevis.net, dashboarddesignpatterns.github.io
Dissemination & reproducibility: motivation & howto

• Open Practices in Vis Research, Steve Haroz
  – [https://osf.io/8ag3w/download](https://osf.io/8ag3w/download)

• Cody Dunne VIS22 panel talk (10 min) [https://youtu.be/nPdr7xybUbA?t=260](https://youtu.be/nPdr7xybUbA?t=260)
  – why important to host stuff on site that will stay forever ([arxiv.org](http://arxiv.org), [osf.io](http://osf.io))
    • vs personal and even research group sites that can disappear
    • appropriately enough his slides hosted at [https://osf.io/mfk5z](https://osf.io/mfk5z)

• [osf.io](http://osf.io)
  – great for supplemental materials in addition to paper (vs arxiv focus on paper PDF)
  – can create anonymous view-only link for double-blind review
    • [https://help.osf.io/article/155-create-a-view-only-link-for-a-registration](https://help.osf.io/article/155-create-a-view-only-link-for-a-registration)
  – advice: post when you submit, update with camera-ready
    • don't wait conference presentation, might not happen! (worse yet: promise will do it soon)
  – examples: [osf.io/tr3sb](http://osf.io/tr3sb), [osf.io/uezfk](http://osf.io/uezfk)
Reproducibility: Levels of effort required

• 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

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: questionable research practices (QRPs)
    • p-hacking / p-value fishing / data dredging
    • Hypothesizing After Results are Known (HARKing)
  – in
    • replication
    • pre-registration: avoid "garden of forking paths" & motivated reasoning
  – 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

• psych: 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

• vis:
When and how will this storm hit visualization?

• they’re ahead of us (they = psychology)
  – 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
Upcoming
Next week: Research guests & more

- Steve Kasica (UBC)
  - qualitative research
- Stephen Kobourov (Arizona)
  - techniques & algorithms
- Mara Solen (UBC)
  - survey papers
- me
  - design spaces for visualization
  - visualizing imperfect models
  - next steps
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 next week office hours, or in last few days!