Code Review

Martin Kellogg

Code Review

Today's agenda:

- **Reading Quiz**
- What is code review (and why we do it)
- How to do a code review (with empirical evidence)
- Good and bad examples of code review comments

Reading quiz: code review

Q1: **TRUE** OR **FALSE**: Code reviews at Google are supposed to be antagonistic: that is, the reviewer should assume that the author is trying to check in bad code.

Q2: **TRUE** OR **FALSE**: Code reviews at Google are supposed to be statistical: there's so much code to review that there isn't time to check every line, so reviewers are encouraged to look at a sample (e.g., one method). If that looks good, they should approve the CL.

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- There is significant **tool support** for “modern” code review
  - We’ll talk about this in more depth later in this lecture

Analogy: writing

Compare the effectivenss of:

- spellchecking your own writing
- reading and editing your own writing
- having your writing be edited by someone else

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Professional writers have editors; professional software engineers have code reviewers

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  - Typically, "code inspection" suggests that a team of reviewers is involved, while "holistic code review" suggests a single reviewer (but these are connotations, not rules)

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History fact: there was a lot of interest (and research) into code inspection in the 80s/90s (at the same time that Waterfall was the dominant methodology)

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- Inductive argument for code quality:
  - if v(n) is good, and the diff between v(n) and v(n+1) is good, then v(n+1) is good

Brief aside/review: proof by induction

(on the whiteboard)

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Modern code review: intuition

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Modern code review: intuition

- “Given enough eyeballs, all bugs are shallow.” – Linus's Law
- Reviewer has:
    - different background, different experience
    - no preconceived idea of correctness
    - no bias because of “what was intended”

Modern code review: intuition

“Breadth of experience in an individual is essential to creativity and hence to good engineering. … Collective diversity, or diversity of the group - the kind of diversity that people usually talk about - is just as essential to good engineering as individual diversity. … Those **differences in experience are the "gene pool" from which creativity springs**.”

– Bill Wulf, National Academy of Engineering President

Modern code review: the most common analysis

- Modern code review is considered a **best practice almost everywhere** in industry

Modern code review: the most common analysis

"All code that gets submitted **needs to be reviewed** by at least one other person, and either the code writer or the reviewer needs to have readability in that language. Most people use Mondrian to do code reviews, and obviously, **we spend a good chunk of our time reviewing code**."

- Amanda Camp, Software Engineer, Google

Modern code review: the most common analysis

“At Yelp we use review-board. An engineer works on a branch and commits the code to their own branch. The reviewer then goes through the diff, adds inline comments on review board and sends them back. The **reviews are meant to be a dialogue**, so typically comment threads result from the feedback. Once the reviewer's questions and concerns are all addressed they'll click "Ship It!" and the author will merge it with the main branch for deployment the same day.”

- Alan Fineberg, Software Engineer, Yelp

Modern code review: the most common analysis

“At Wizards we use Perforce for SCM. I work with stuff that manages rules and content, so we try to commit changes at the granularity of one bug at a time or one card at a time. Our team is small enough that you can designate one other person on team as a code reviewer. Usually you look at code sometime that week, but it depends on priority. **It’s impossible to write sufficient test harnesses** for the bulk of our game code, so **code reviews are absolutely critical**.”

- Jake Englund, Software Engineer, MtGO

Modern code review: the most common analysis

"At Facebook, we have an internally-developed web-based tool to aid the code review process. Once an engineer has prepared a change, she submits it to this tool, which will notify the person or people she has asked to review the change, along with others that may be interested in the change – such as people who have worked on a function that got changed. At this point, the reviewers can make comments, ask questions, request changes, or accept the changes. If changes are requested, the submitter must submit a new version of the change to be reviewed. All versions submitted are retained, so reviewers can compare the change to the original, or just changes from the last version they reviewed. Once a change has been submitted, the engineer can merge her change into the main source tree for deployment to the site during the next weekly push, or earlier if the change warrants quicker release."

Ryan McElroy, Software Engineer, Facebook

Modern code review: the most common analysis

- Modern code review is considered a **best practice almost everywhere** in industry
- While each place has their own way of doing reviews, the broad strokes are common between companies

Modern code review: benefits

- > 1 person has seen every piece of code
  - Insurance against author’s disappearance
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- Inexperienced personnel get experience without hurting quality
  - Pairing them up with experienced developers
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Non-goal: assessing whether the author is good at their job

- managers/HR **shouldn't** be involved in code review

Modern code review: benefits by the numbers

- Average defect detection rates higher than testing
- 11 programs developed by the same group of people
  - First 5 without reviews: average 4.5 errors / 100 LoC
  - Remaining 6 with reviews: average 0.82 errors / 100 LoC
  - Errors reduced by > 80%.
- IBM's Orbit project: 500,000 lines, 11 levels of inspections. Delivered early with 1% of the predicted errors.
- After AT&T introduced reviews, 14% increase in productivity and a 90% decrease in defects.

(From Steve McConnell's Code Complete)

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Author checklist before sending out a CL

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Avoid:

- extraneous whitespace changes
- debugging code
- commented-out code
- style guide violations
- undocumented code
- etc.

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Factors to consider in a reviewer:

- availability (how many reviews are they already working on?)
- code ownership
- code expertise
- readability

How to do a code review: Google’s principles

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- If no other rule applies, then the reviewer may ask the author to be **consistent** with what is in the current codebase
- reviewers should favor approving a CL once it is in a state where it definitely **improves the overall code health** of the system

How to do a code review: Google’s principles

- I’ll add one more:
  - **Don’t be a jerk**

What to look for in a code review

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  - Does each unit of code (class, method, etc.) follow **good code-level design principles**?
  - Is it **over-engineered**?

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Especially relevant for course projects, since Covey.Town is UI-heavy

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  - Is the code doing something **difficult to understand** (such as concurrency)?
    - If so, pay extra attention and **prove to yourself** that it is correct.

How to write code review comments

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> “In general it is the **developer’s responsibility** to fix a CL, not the reviewer’s”

How to write code review comments

- **Be kind**, courteous, and respectful.
- **Explain** your reasoning.
- **Balance** giving explicit directions with just pointing out problems and letting the developer decide.
- **Encourage** developers to simplify code or add code comments instead of just explaining the complexity to you.

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- **Encourage** developers to simplify code or add code comments instead of just explaining the complexity to you.

> “Explanations written only in the code review tool are not helpful to **future code readers**”

How to write code review comments: severity

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Usually authors treat comments without a severity level as **must fix**

How to write code review comments: severity

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  - **Nit**: This is a minor thing. Technically you should do it, but it won't hugely impact things.

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  - **Nit**: This is a minor thing. Technically you should do it, but it won't hugely impact things.
  - **Optional**: I think this may be a good idea, but it's not strictly required.
  - **FYI**: I don't expect you to do this in this CL, but you may find this interesting to think about for the future.

Common mistakes to avoid as a reviewer

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- Being **condescending**, especially if you're wrong.

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If you get **pushback** on a suggestion, take the time to understand why

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- Taking **too long** to complete a review.

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Try to get back to the author within "**one business day**", whatever that means for your team

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Common mistake: "LGTM" everything for the sake of speed

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I've had reviewers ask for one thing, which I do, and then ask for something completely different a week later. **Read your previous review!**

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Doesn't usually happen!

Common mistakes to avoid as an author

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- Respond to **every comment**

Making a code change counts as a response! Don’t write “fixed” or similar on every comment.

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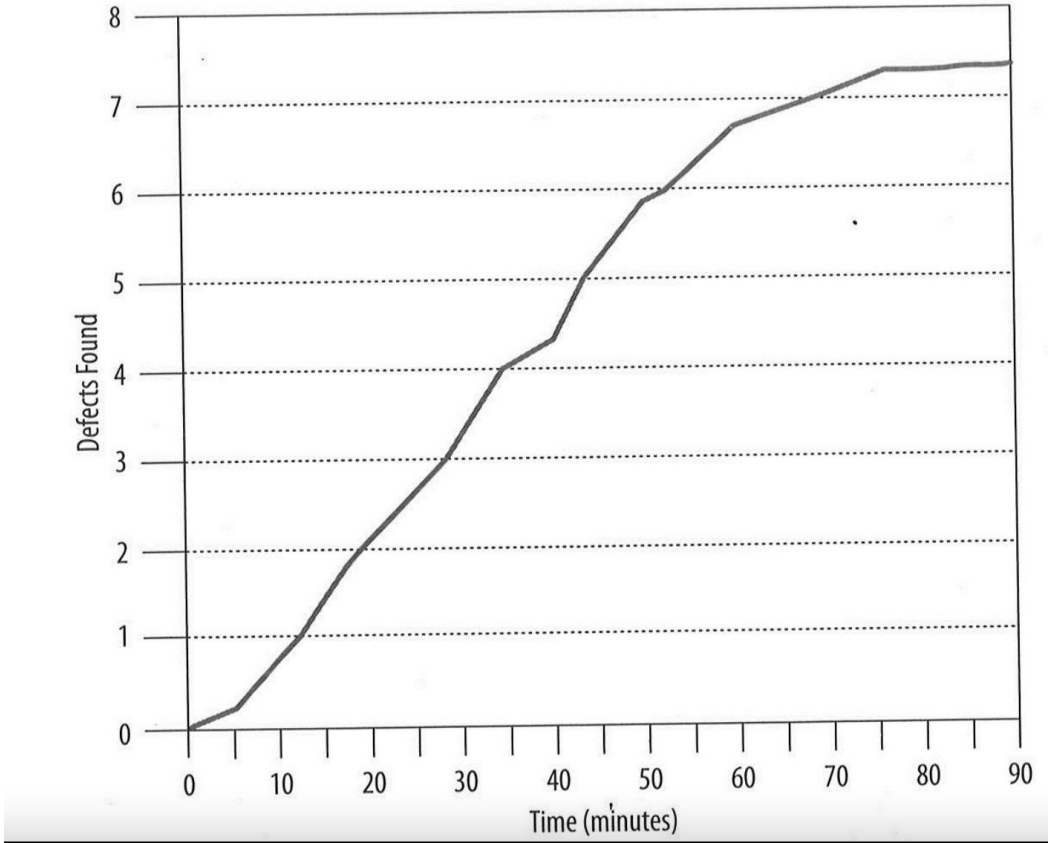
Common mistakes to avoid as an author

- Respond to **every comment**
- If you fix something in one place, **fix it everywhere**
- Assume **good faith**
- Address comments **by changing the code**, not by explaining in the review tool

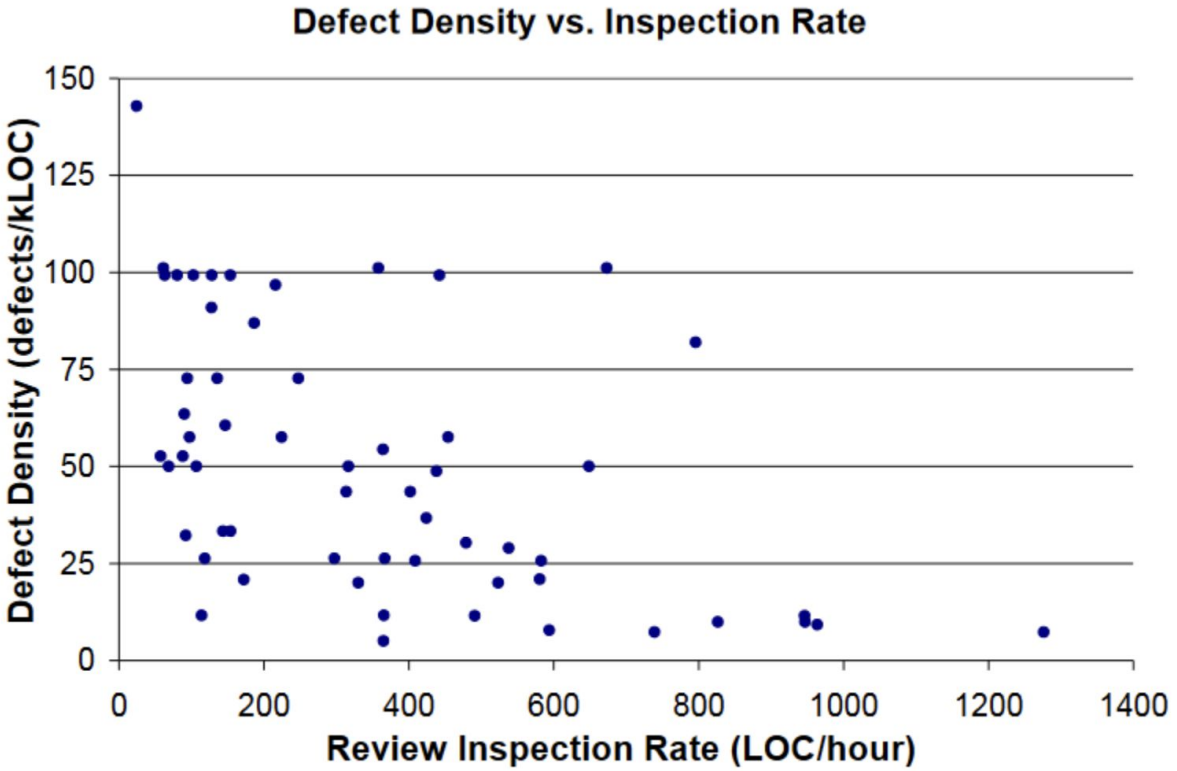
Empirical guidelines for code review

- **Recommendation**: Do not exceed 60 minute session
- **Reason**: focus fatigue



Empirical guidelines for code review

- **Recommendation**: Don’t review more than 400 LoC per hour
- **Reason**: at faster paces, reviews get too shallow



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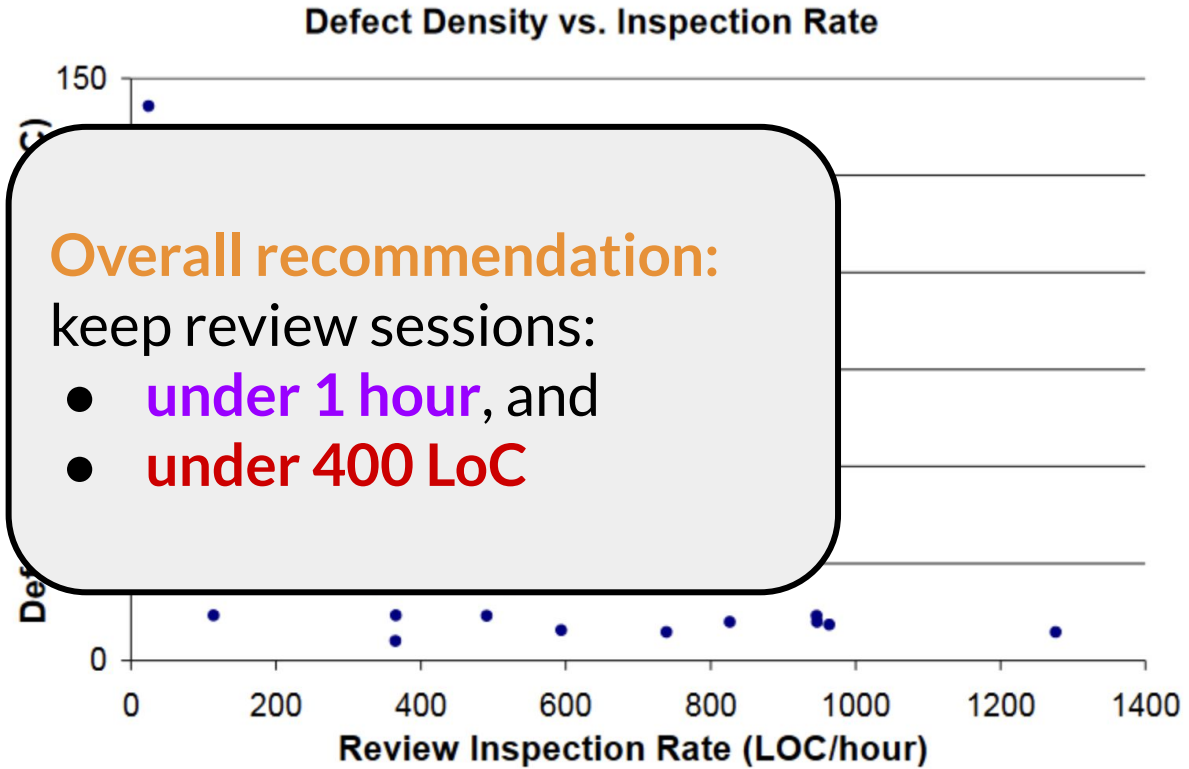

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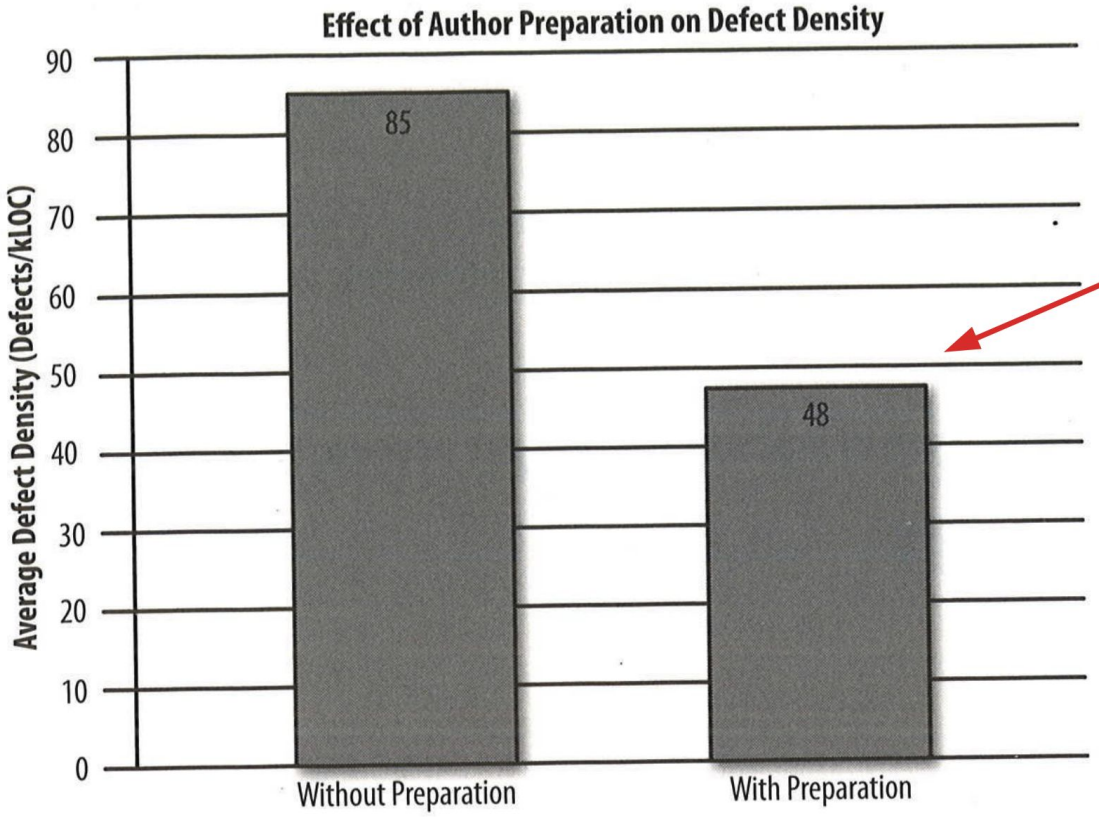

Important to review your own code before giving it to others

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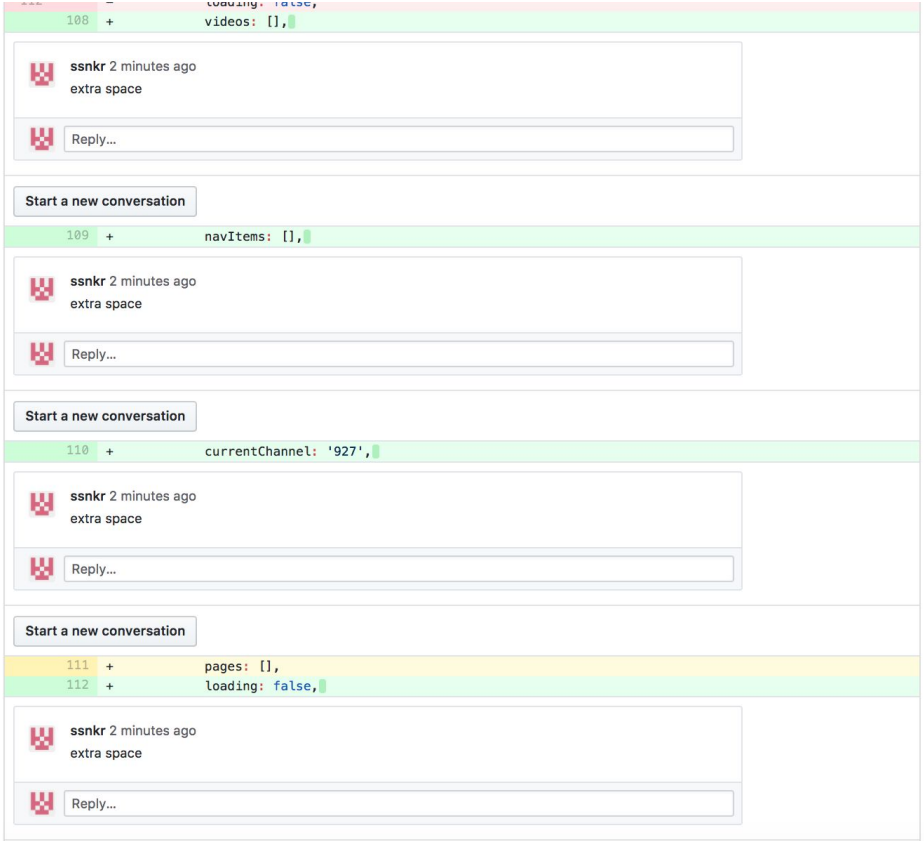
- **Good and bad examples of code review comments**

Example comment: good or bad?

[Many of the examples in the following slides borrowed from Sandya Sankarram's "Unlearning toxic behaviors in a code review culture"]

Example comment: good or bad?



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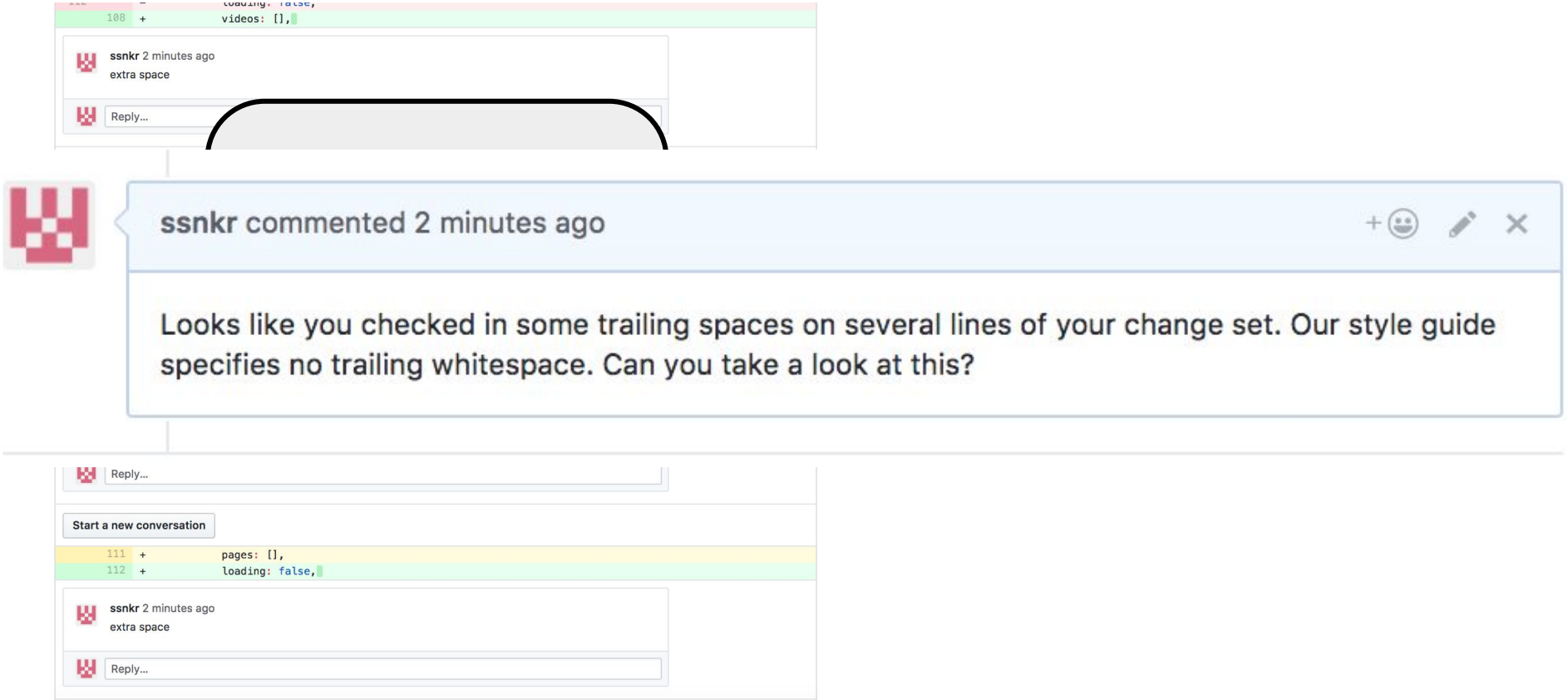

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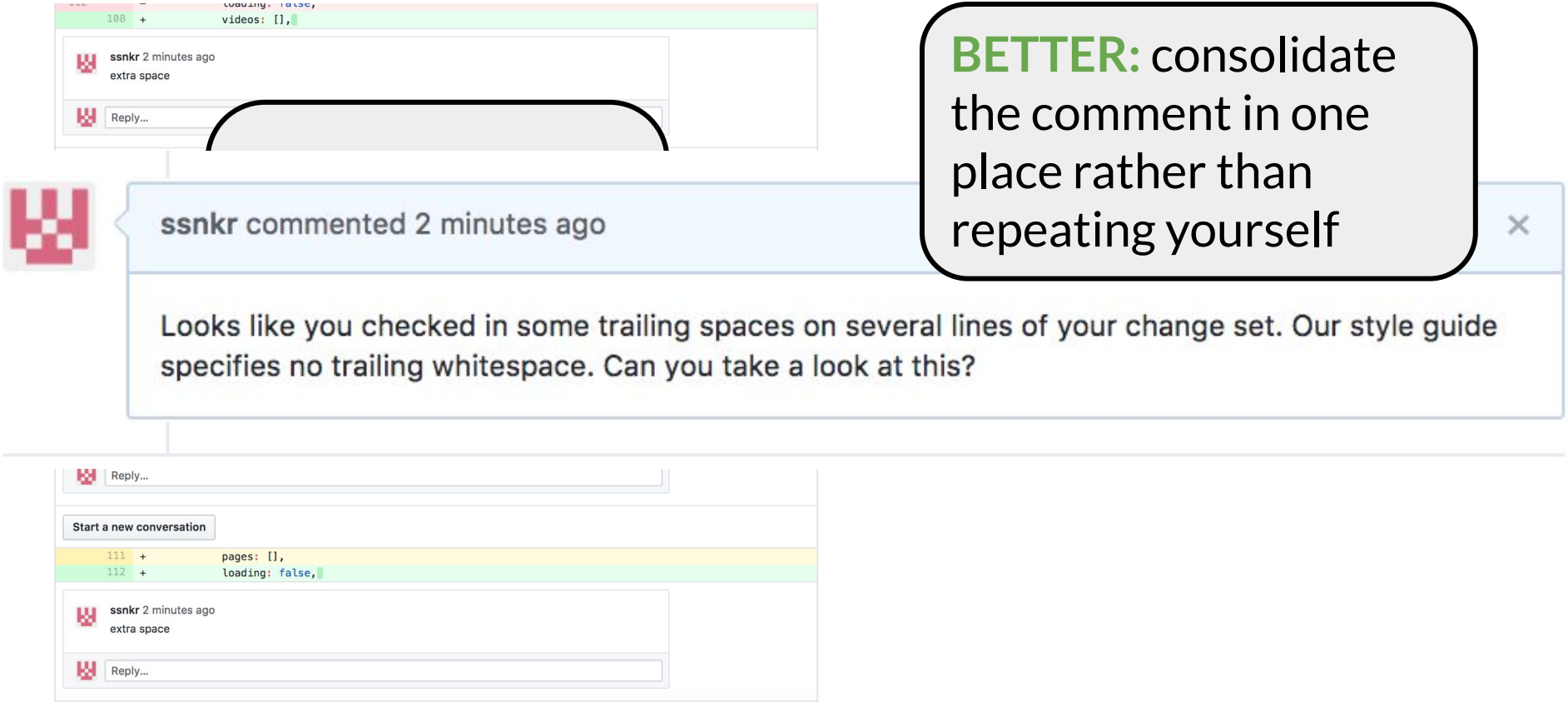
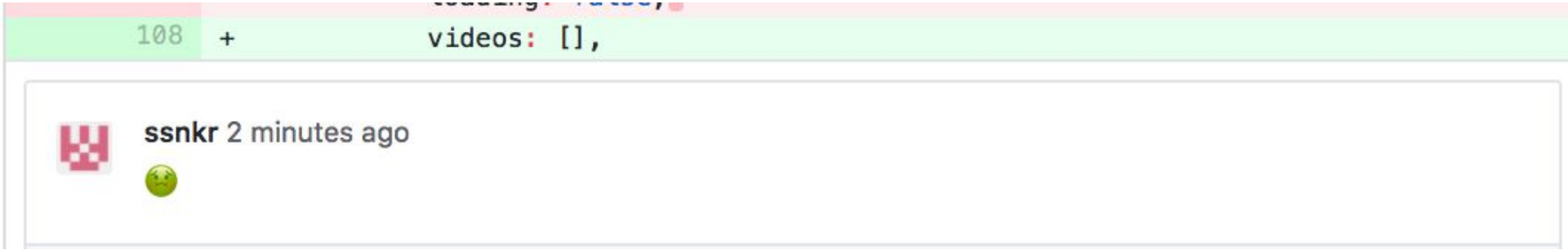


BETTER: consolidate the comment in one place rather than repeating yourself

Example comment: good or bad?



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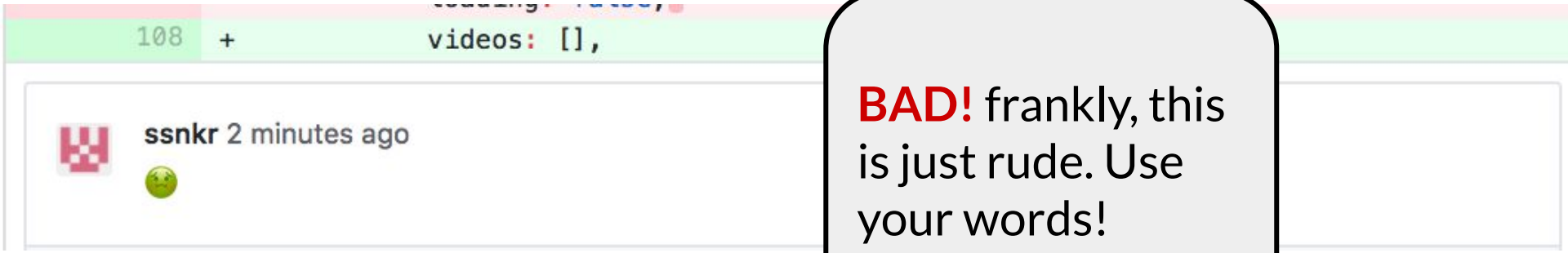


BAD! frankly, this is just rude. Use your words!

Example comment: good or bad?

Example comment: good or bad?

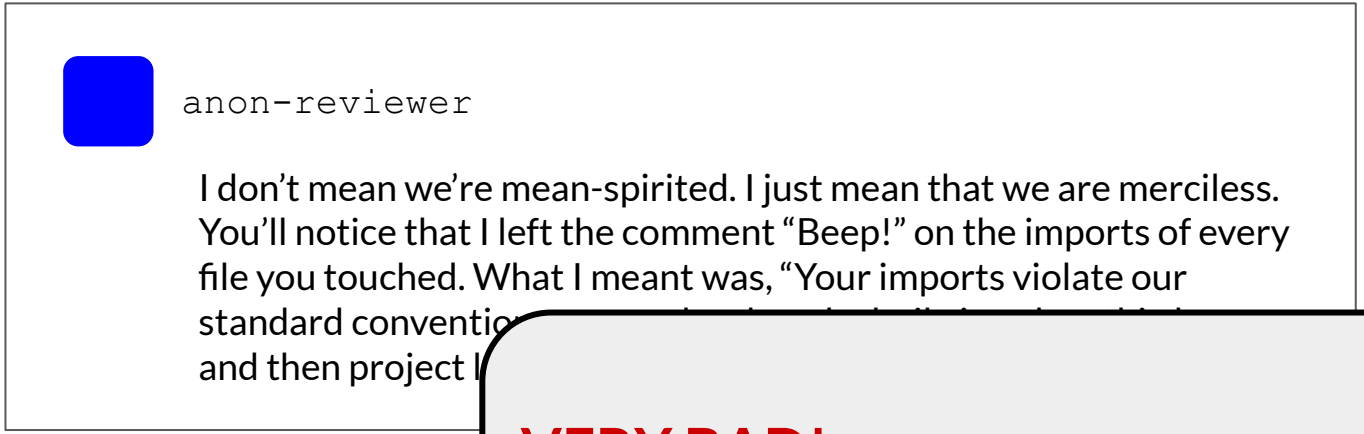
OK: emojis and similar “casual” language should only be used to praise, never to criticize

Example comment: good or bad?

anon-reviewer

I don’t mean we’re mean-spirited. I just mean that we are merciless. You’ll notice that I left the comment “Beep!” on the imports of every file you touched. What I meant was, “Your imports violate our standard convention — we order them by built-ins, then third party, and then project level,” but that was too much to type on every file.

Example comment: good or bad?



VERY BAD!

rude, condescending, and sarcastic.

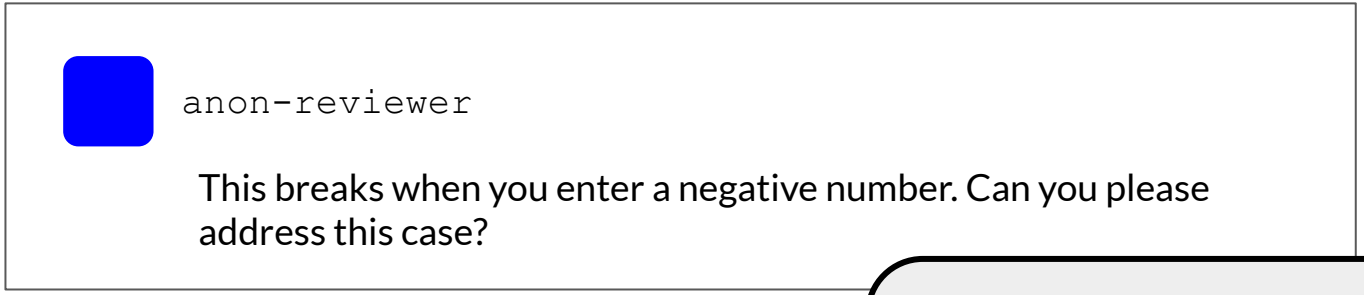
Be helpful, not antagonistic

Example comment: good or bad?

`anon-reviewer`

This breaks when you enter a negative number. Can you please address this case?

Example comment: good or bad?



GOOD: straight to the point, politely points out a technical problem

Takeaways

- Code review is one of the best ways to prevent defects
  - Do it!
- Be nice as both an author and a reviewer
  - Respect each other and each other's time
- One thing I'll look for when assessing your group project is the quality of your code reviews
  - If you're unsure, you can ask the course staff to review your reviews (in office hours)