# Code Review

Martin Kellogg

# Code Review

Today's agenda:

- **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

# What is code review?

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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 effectiveness of:

- spell checking 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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**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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> One reason you should care about this lecture: you are **required** to do modern code reviews on **all code** that you write for your group project

# Modern code review: intuition

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- "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

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- Inexperienced personnel get **experience** without hurting quality
  - Pairing them up with experienced developers
  - Can learn by being a reviewer as well

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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

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- 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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**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

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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**?

# Aside: over-engineering

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- over-engineered code is **harder to change**, because it has abstractions that aren't necessary
- defense against over-engineering: do not add an abstraction to deal with a **purely theoretical** problem
  - demand to see evidence that a problem actually exists!

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Large danger of over-engineering in code reviews: designing for changes that you **don't know** whether you will need. Advice: err on the side of not supporting such changes

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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"

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

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- **Balance** giving explicit directions with just pointing out problems and letting the developer decide.
- **Insist** developers 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**"

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

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

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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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- Being **inconsistent**
- Letting complexity through with a promise to **clean up** later

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Doesn't usually happen! If the problem is serious, insist on fixing it now!

# 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.

# Common mistakes to avoid as an author

- Respond to **every comment**
- If you fix something in one place, **fix it everywhere**

As a reviewer, it is very tedious to point out every place that an author has made the same mistake.

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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

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- **Recommendation**: Do not exceed 60 minute session
- **Reason**: focus fatigue
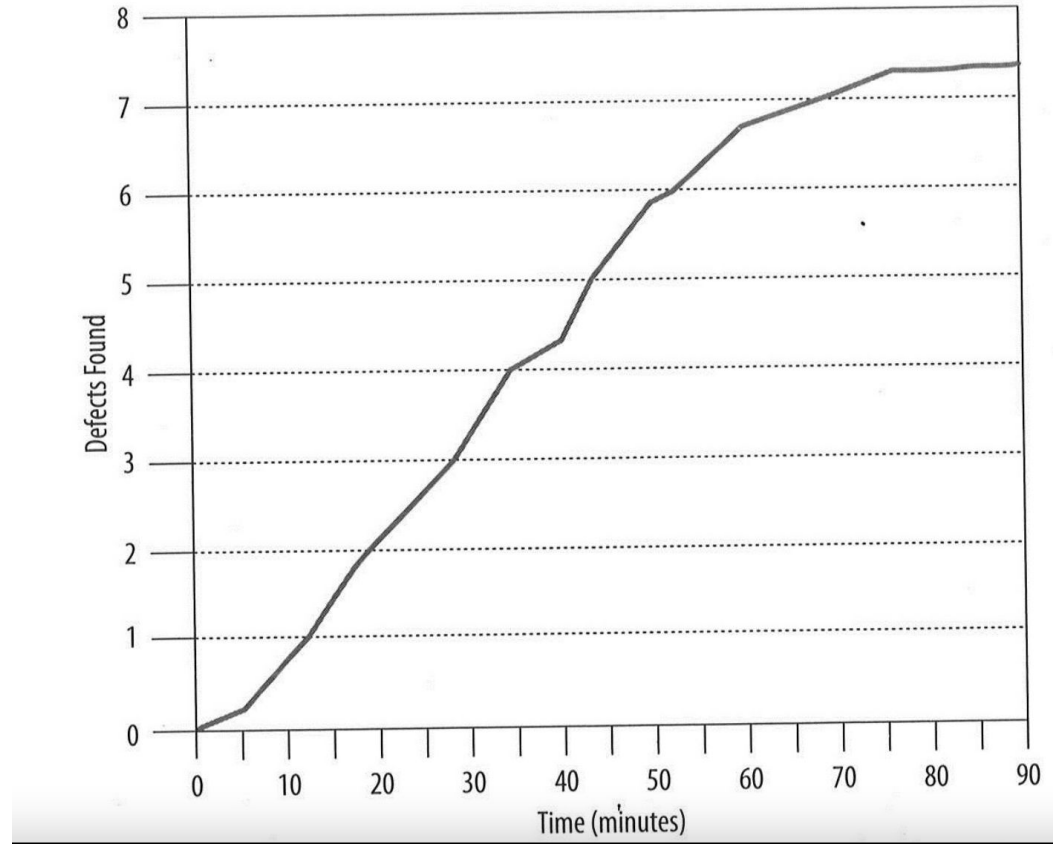
# Empirical guidelines for code review

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



Defect Density vs. Inspection Rate

[ Code Review at Cisco Systems. In J A Cohen et al.'s Best Kept Secrets of Peer Code Review, 2013. ]

# Empirical guidelines for code review

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

**Defect Density vs. Inspection Rate**

**Overall recommendation:** keep review sessions:
- **under 1 hour**, and
- **under 400 LoC**

Review Inspection Rate (LOC/hour)

[ Code Review at Cisco Systems. In J A Cohen et al.'s Best Kept Secrets of Peer Code Review, 2013. ]

# Empirical guidelines for code review



**Effect of Author Preparation on Defect Density**
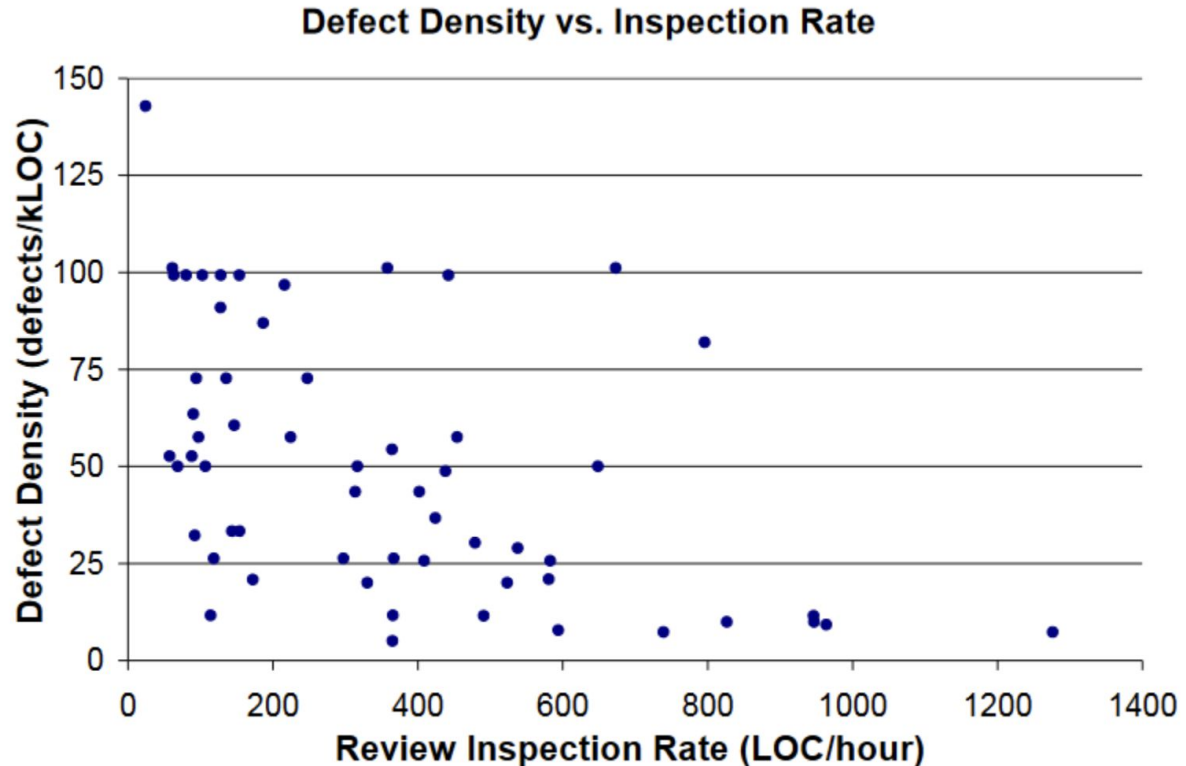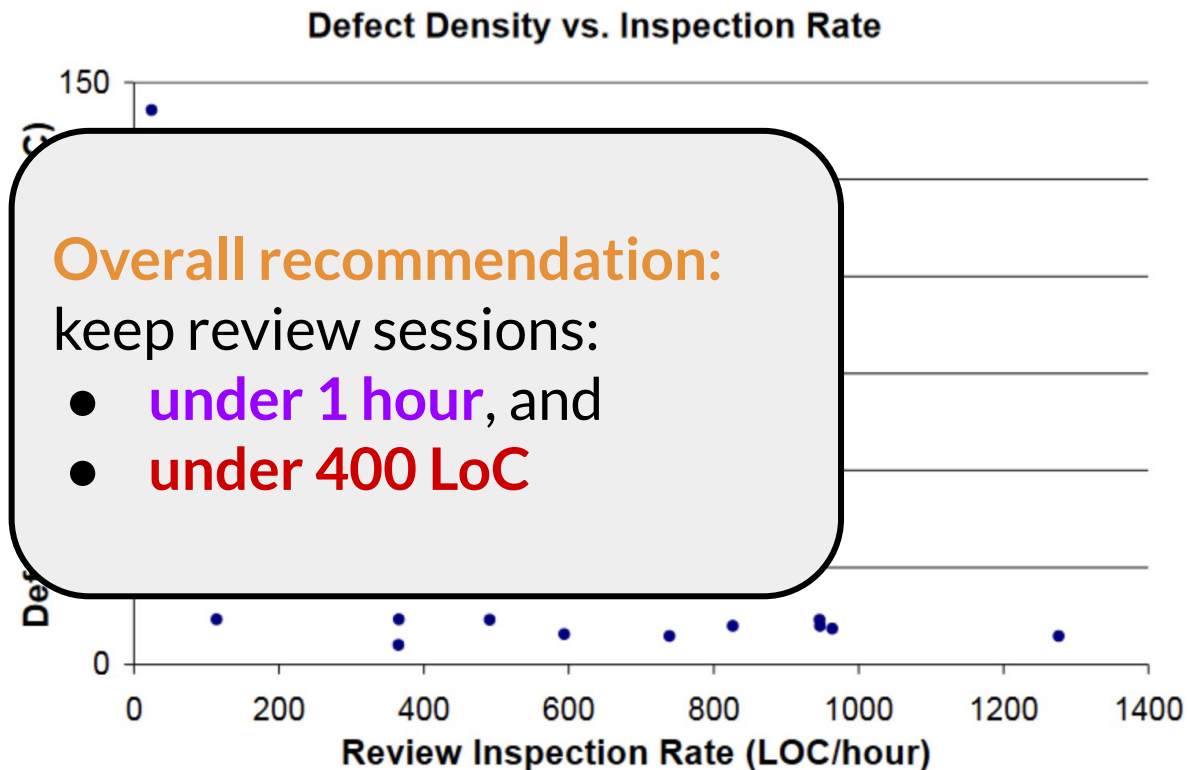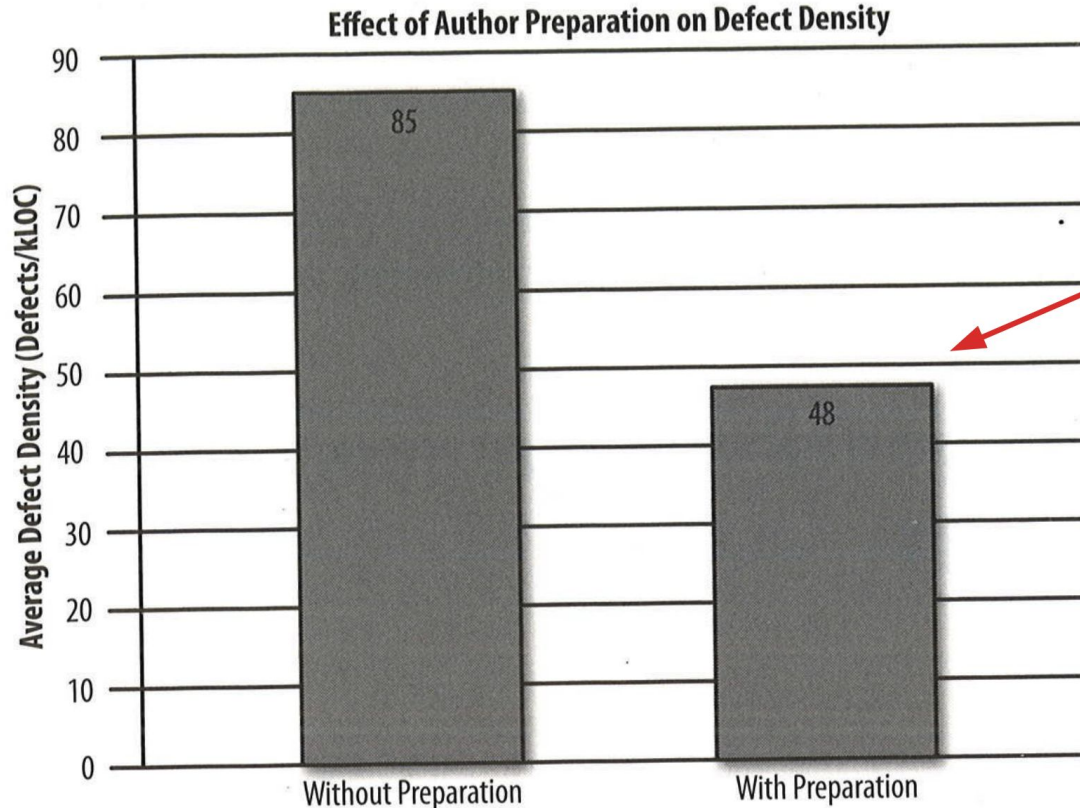
Important to review your own code before giving it to others

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- 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

# 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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108 + videos: [],

ssnkr 2 minutes ago
extra space

Reply...

Start a new conversation

109 +

ssnkr 2 minutes ago
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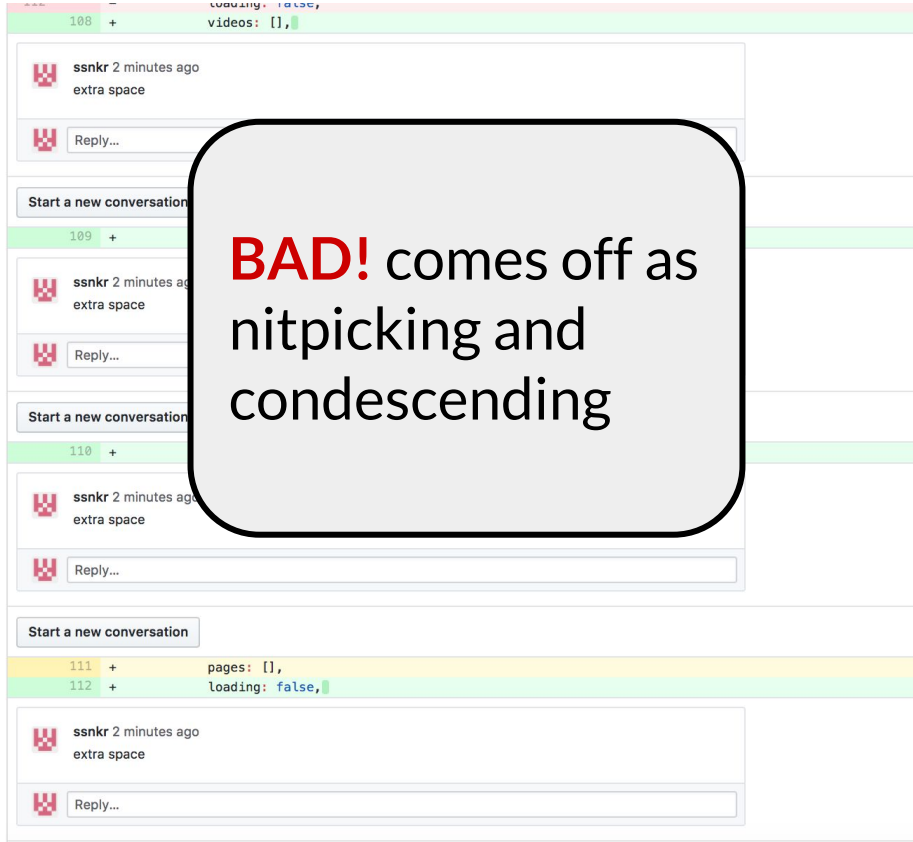
Reply...

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111 + pages: [],
112 + loading: false,

ssnkr 2 minutes ago
extra space

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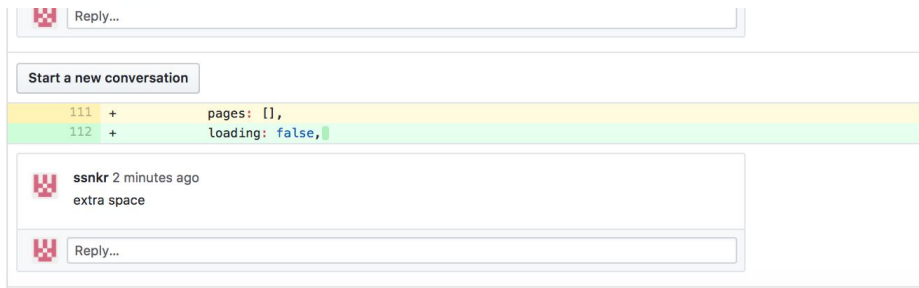
**BAD!** comes off as nitpicking and condescending

# Example comment: good or bad?



ssnkr commented 2 minutes ago

Looks like you checked in some trailing spaces on several lines of your change set. Our style guide specifies no trailing whitespace. Can you take a look at this?

# Example comment: good or bad?



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

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108  +              videos: [],
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ssnkr 2 minutes ago

🤢

# Example comment: good or bad?



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

# Example comment: good or bad?



ssnkr commented 2 minutes ago

LGTM 💯 🎉

# Example comment: good or bad?



ssnkr commented 2 minutes ago

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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?

anon-reviewer

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**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?

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

# Reading quiz: code review

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Q1: **TRUE** or **FALSE**: tests should be added in a follow-up CL to the CL containing the production code

Q2: today's reading was an engineering practices guide associated with which of the following companies:
**A.** Microsoft
**B.** Amazon
**C.** Netflix
**D.** none of the above

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B. Amazon
C. Netflix
D. none of the above    Google!

# Takeaways

- Code review is one of the best ways to prevent defects
  - You must do it during the course project (I will check!)
- 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)