Technical debt, refactoring, and maintenance (2/2)

Martin Kellogg

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Today's agenda:

- Reading Quiz
- Technical debt: the costs of bad design
- How to pay off technical debt: refactoring

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Reading quiz: tech debt 2

Q1: The author describes Netscape making “the single worst strategic mistake that any software company can make”. In **one phrase** (<= 5 words), what mistake did Netscape make?

Q2: The author claims that most programmers, when asked about the system they’re working on, “think the old code is a mess”. He posits this is due to a “fundamental law of programming”. Which one?

A. reading code is harder than writing code
B. the halting problem
C. given enough eyeballs, all bugs are shallow

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- a system with technical debt is **harder** to change and reuse

Technical debt: benefits and costs

Examples of debt:

- code smells
- missing tests
- missing documentation
- dependency on old versions of third-party systems
- inefficient and/or non-scalable algorithms

Examples of costs:

- “smelly” code is less flexible
- tests don’t catch breaking change, causing outages
- need to spend time to figure out how to system works
- may need to take over maintenance of old system
- lose potential customers

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Whether to take on technical debt is often one of the **most consequential** choices you get to make as an engineer. **Take it seriously!**

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- Best practice (especially for relatively risky debts): **write everything down**!
    - that way, you know what you need to fix before releasing

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  - **immediate benefit**: saves hard disk space (expensive in 1980)
  - **long-term cost**: if the program is still being used in 2000, need to fix it!
    - "I just never imagined anyone would be using these systems 10 years later, let alone 20."

[Philippe Kruchten, Robert Nord, Ipek Ozkaya: "Managing Technical Debt: Reducing Friction in Software Development"]

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    - the amount of technical debt you have is higher than if your bus factor was very high
- Other examples include having **high staff turnover** (which systematically lowers bus factor) or few senior engineers

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  - You **do not gain** the benefit: the benefit was immediate, but you're reaching the code too late to see it

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  - If the code's structure does not also evolve, it will "rot"

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Other similar choices include:

- middleware frameworks
- deployment pipeline
- major dependencies

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    - "Hack enables us to dynamically convert our code one file at a time" - Facebook Technical Lead, HipHop VM (HHVM)

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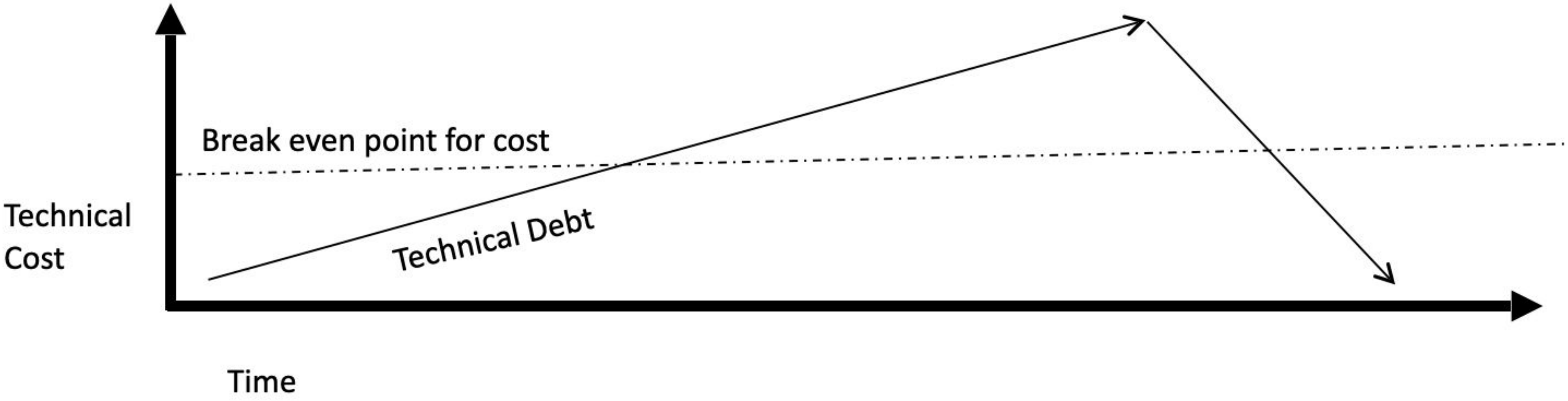
  - more common: **refactoring** the code
- ***refactoring*** is the process of applying behaviour-preserving transformations (called ***refactorings***) to a program, with the goal of improving its non-functional properties (e.g., design, performance)

Paying down technical debt



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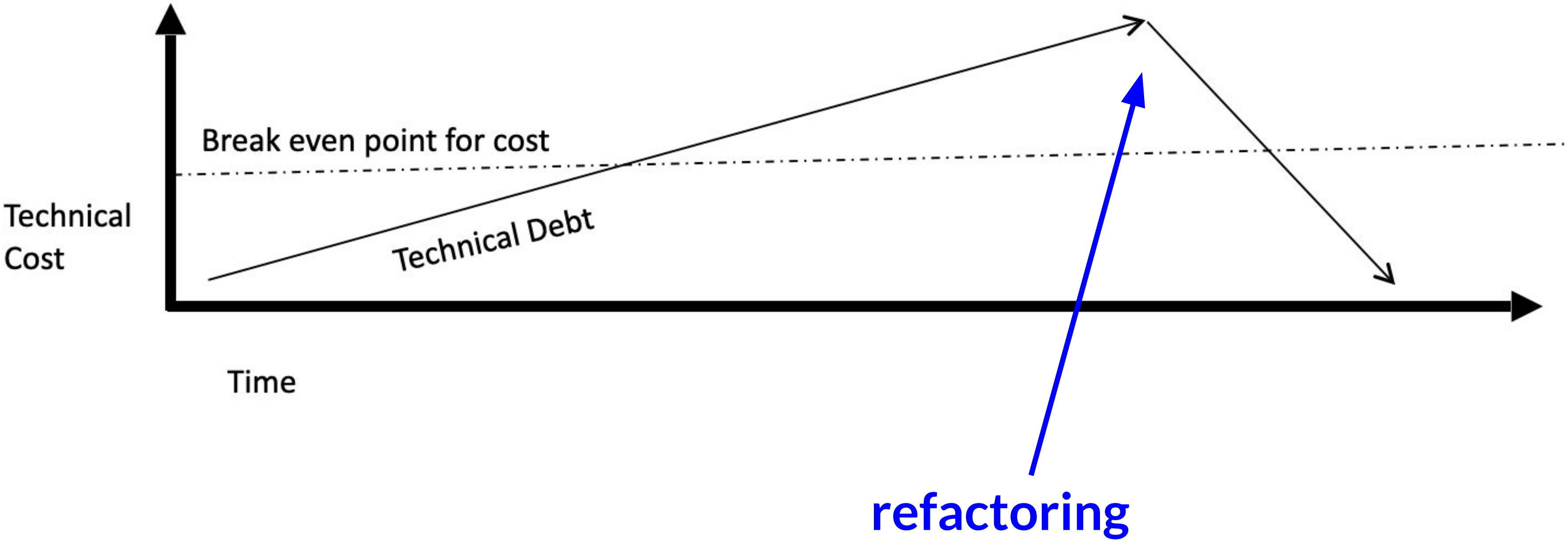

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- Have a plan: **don’t put off dealing with technical debt indefinitely**
  - When a crisis hits, it’s too late
  - Hasty fixes to unmaintainable code likely to multiply problems!
  - Eventually, mounting technical debt can bury a team

Tech debt, refactoring, and maintenance (1/2)

Today's agenda:

- Finish design pattern slides
- Reading Quiz
- Technical debt: the costs of bad design
- **How to pay off technical debt: refactoring**

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What refactoring is **not**:

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What refactoring is **not**:

- rewriting code
- adding features
- debugging code

Aside: rewriting code

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Advice:

- even if rewriting is necessary, don't totally abandon the old system
- keep old tests/CI jobs, and don't release the new system until they pass

Refactoring: motivation

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  - to communicate well to developers who read it.
- If the code does not do one or more of these, it ***is*** broken.
- Refactoring should improve the software's design:
  - more extensible, flexible, understandable, performant, …
  - every design improvement has costs (and risks)

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- a good refactoring often fixes more than one code smell
  - sometimes many more than one

Refactoring: when to refactor

Examples of **common code smells**:

Refactoring: when to refactor

Examples of **common code smells**:

- Duplicated code
- Poor abstraction (change one place → must change others)
- Large loop, method, class, parameter list; deeply nested loop
- Module has too little cohesion
- Modules have too much coupling
- Module has poor encapsulation
- Dead code
- Design is unnecessarily general
- Design is too specific

Refactoring: “low-level” refactoring

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Refactoring: “low-level” refactoring

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  - Renaming (methods, variables)
  - Naming (extracting) “magic” constants
  - Extracting common functionality (including duplicate code) into a module/method/etc.
  - Changing method signatures
  - Splitting one method into two or more to improve cohesion and readability (by reducing its size)

also see https://refactoring.com/catalog/

Refactoring: “low-level” refactoring

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  - ***IDE*** = “***integrated development environment***”
    - e.g., Eclipse, VSCode, IntelliJ, etc.
- they automate:
  - renaming of variables, methods, classes
  - extraction of methods and constants
  - extraction of repetitive code snippets
  - changing method signatures
  - warnings about inconsistent code
  - …

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- Compared to low-level refactoring, high-level is:
    - Not as well-supported by tools
    - But much **more important**!

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These are a good set of criteria for deciding to refactor code

- especially “needs new features”, because if you don’t refactor you’ll be **paying interest** on the tech debt!

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  - As always, keep changes small, do code reviews, etc.

Tech debt & refactoring: takeaways

- most real systems have some amount of technical debt
- taking on technical debt can be an effective way to meet goals, but it also comes with significant costs. Consider the choice to take on tech debt carefully.
- refactoring is the best method to “pay down” tech debt
- when refactoring, be sure to maintain the current behaviors of the system: refactorings should be functionally-identical
- avoid rewriting a whole system unless you absolutely have to
    - prefer to gradually refactor a “bad” system over time
- set aside time in your schedule to pay down tech debt