Software Process

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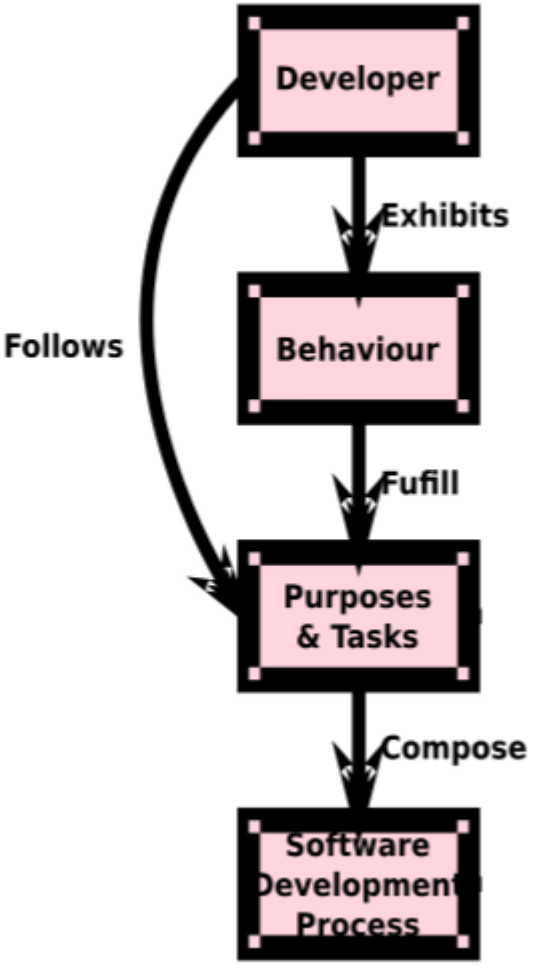
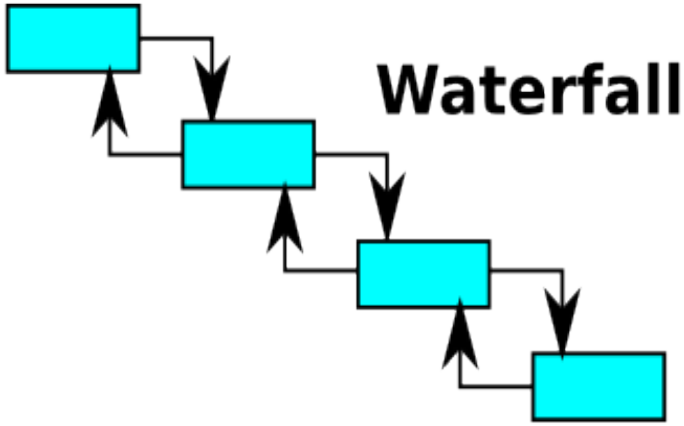
What makes a Process?

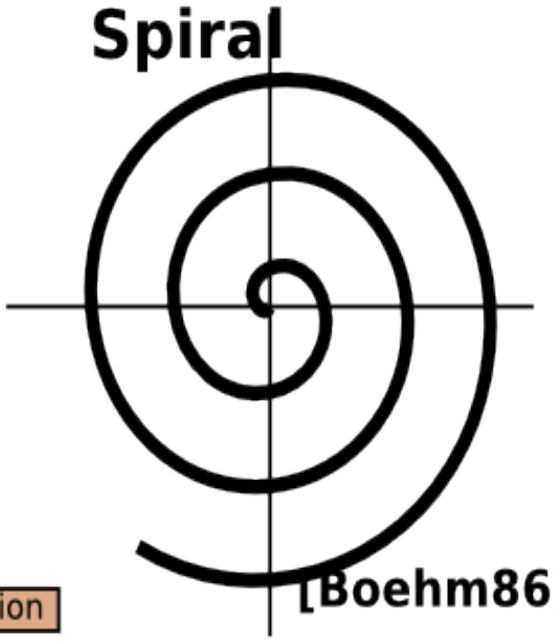


Software Development Processes



Waterfall

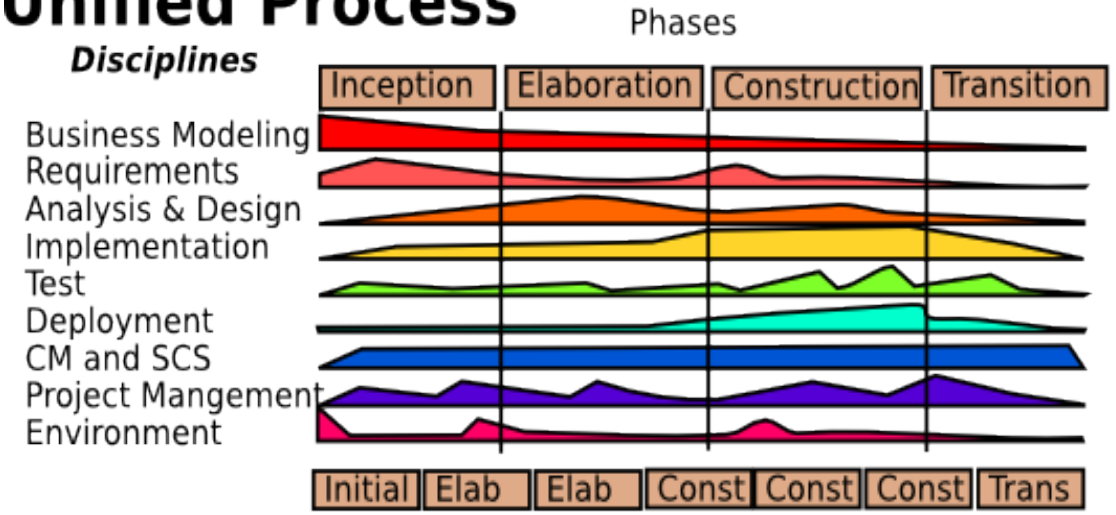
[Royce87]



Spiral

[Boehm86]

Unified Process



[Jacobson99]

Developer Perspective

- Software Engineering:
  - manage complexity, scale, lifetime
  - increase quality
  - reduce defects
  - reduce maintenance and support costs
  - reduce time-to-market
  - reuse successful solutions
  - apply methods and tools
  - iterate and optimize

User Perspective

- Software Usability:
  - meets needs
  - increase productivity
  - easy to learn
  - effective to use
  - reduce errors
  - safe to use

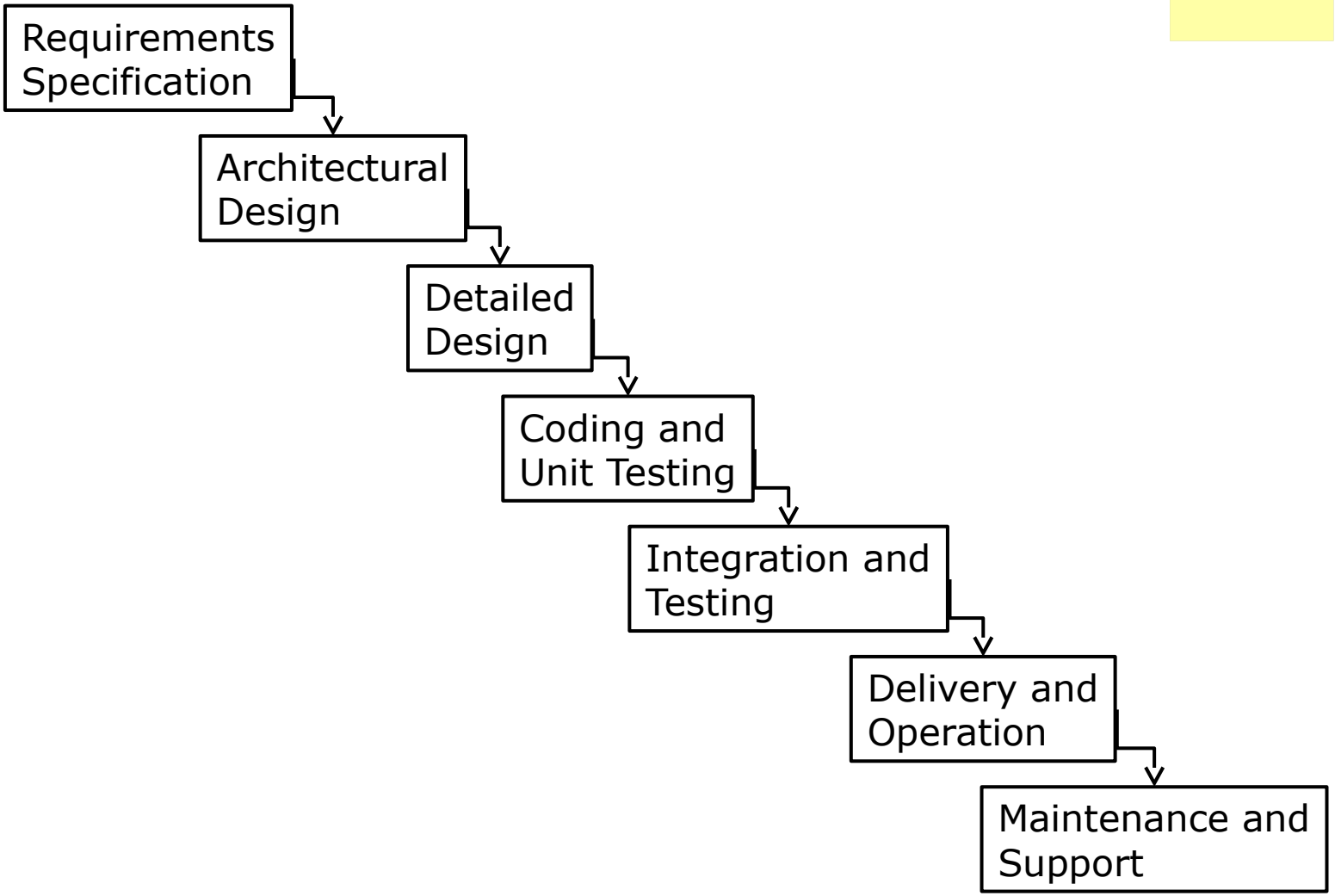
User Perspective

- User Experience (UX):
  - Satisfying
  - Motivating
  - Looks nice (aesthetically pleasing)
  - Enjoyable
  - Fun

Meeting Needs

- Verification
  - making sure you develop the system right
    - according to the requirements

Waterfall Lifecycle Model



Waterfall

- Pros:
  - Easily understood
  - Enforces Discipline
  - Verification at every phase
  - Well documented product

Waterfall

- Cons
  - uses a manufacturing view of software
    - most software is not made as a "final" product
  - customer must be patient
    - but time-to-market is critical
  - customer sees the system only at the end
    - may not satisfy their real needs
      - No early feedback!

Waterfall

- Cons
  - Requirements need to be right (accurate) at the start
    - This is almost never the case
    - Could end up building the wrong system
    - Hard to predict all necessary requirements
    - Hard to react to changing requirements
- Waterfall doesn't work
  - We need to be able to iterate!

Prototyping

- It's hard to get the requirements right at the start…
- But we need validation…
  - making sure we develop the right system
  - Making sure we build what the customer really needs
- One solution: Prototyping!

Prototyping

- Iterative design
  - Cycling through several designs
  - Improve the product with each pass

Prototyping

- Types of prototyping:
  - Throwaway Prototyping
  - Incremental Prototyping
  - Evolutionary Prototyping
- These can be combined!

Throwaway Prototyping

- Process
  - Build and test prototype
  - Learn about:
    - What's needed for the real product
    - What works
    - What does not work
  - Throw away the prototype
  - Then develop the real product

Throwaway Prototyping

- Pros
  - more communication between users and developers
  - functionality is introduced earlier, which is good for morale

Throwaway Prototyping

- Cons
  - The throwaway prototype must be built very quickly
  - some qualities may be sacrificed,like security, reliability, etc.
  - temptation to use the throwaway prototype in the final product

Incremental Prototyping

- Process
  - Triage system into separate "increments"
    - Example: "must do", "should do", "could do"
  - Develop and add one increment at a time
- Example: Accounting System
  - Prototype 1: general ledger
  - Prototype 2: accounts receivable/payable
  - Prototype 3: payroll

Evolutionary Prototyping

- Process
  - Each feature is refined or “evolved” over time
- Example: Text Editor
  - Prototype #1: Keyboard Cut and Paste
  - Prototype #2: Touchscreen Cut and Paste
  - Prototype #3: Cut and Paste works with Undo

Other Kinds of Prototypes

- User Interface Sketches
  - Hand Drawn
  - or using a drawing Tool
    - Figma, Balsamiq, etc.
- Storyboards
  - Graphical depiction of the user interface
  - Like a comic strip, but only draw the UI

Other Kinds of Prototypes

- Physical Mockups

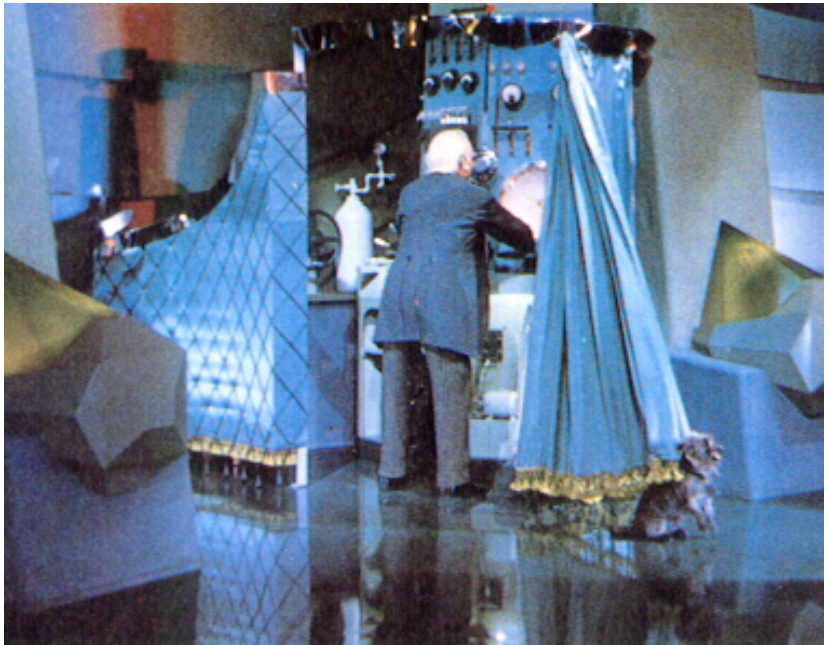
Balsa wood mock-up

Partial clay mock-up

Precision mock-up

Other Kinds of Prototypes

- Wizard of Oz
  - "Pay no attention to that man behind the curtain!"
  - feature is actually "implemented" through human intervention "behind the scenes"



Agile Practices

- Created with the release of the
- “Agile Manifesto”
  - http://agilemanifesto.org/

4 Agile Values

- “Individuals and Interactions”
- “Working Software”
- “Customer Collaboration”
- “Responding to Change”

4 Agile Values

- "Individuals and Interactions"
  - trust motivated individuals
  - face-to-face conversation
  - best work emerges from self-organizing teams
  - team reflects on and adjusts their behavior
  - promote constant, sustainable pace

4 Agile Values

- “Working software”:
  - the main measure of progress
  - continuous, frequent delivery of value

4 Agile Values

- “Customer collaboration”:
  - customers and developers work together
  - satisfy customer early

4 Agile Values

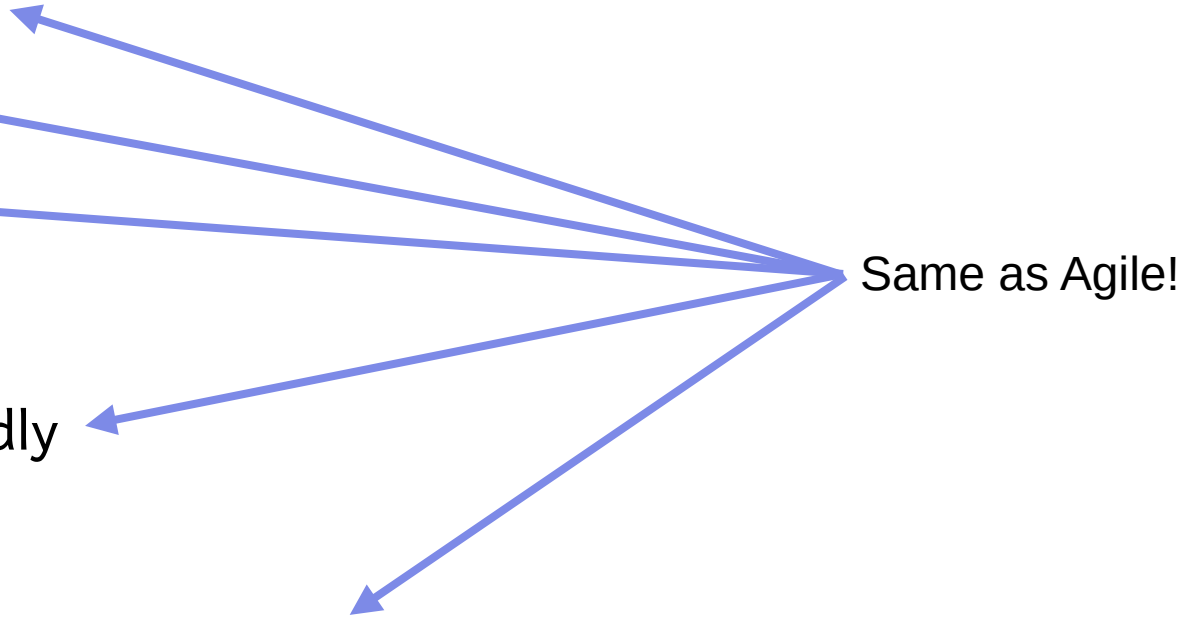
- "Responding to change":
  - welcome changing requirements, even late
  - technical excellence and good design
  - simplicity—art of maximizing work not done

eXtreme Programming (XP)

- http://www.extremeprogramming.org/
- Predecessor to Agile

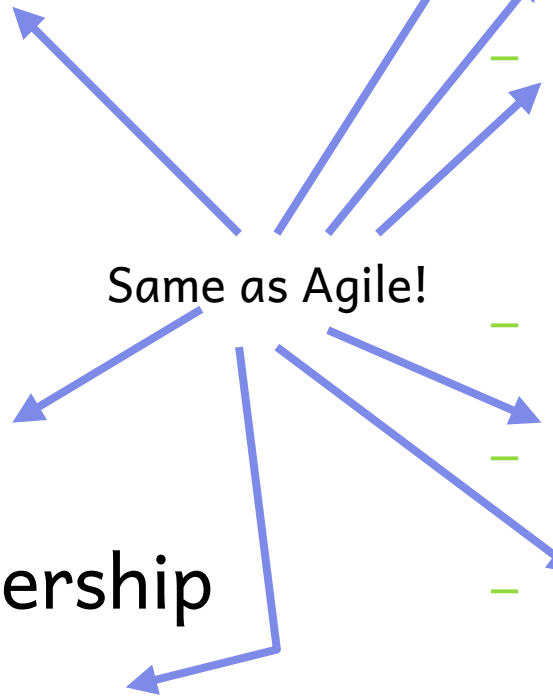
XP

- Philosophy:
  - communication
  - feedback
  - simplicity
  - programmer friendly
  - code-centric
  - for small teams (up to about 20)
  - requires courage



XP

- 12 practices:
  - 40 hour week
  - metaphor
  - simple design
  - collective ownership
  - coding standards
  - small releases
  - continuous integration
  - refactoring
  - planning game
  - testing
  - on-site customer
  - pair programming



XP

- For programmer welfare:
  - “40 hour week”
  - work no more than 40 h a week
  - never work overtime a second week in a row

XP

- For shared understanding:
  - "metaphor"
    - guide development with a shared story of how the system works
  - "simple design"
    - design the system as simply as possible; remove extra complexity when discovered

XP

- For continuity:
  - “small releases”
    - put simple system into production quickly, then release new versions on a very short cycle
  - “continuous integration”
    - integrate and build the system many times a day
  - “refactoring”
    - restructure the system to improve its design, simplicity, or flexibility

XP

- For feedback:
  - “planning game”
    - determine scope of the next iteration and overall release together with customer
  - “testing”
    - write automated unit tests first before the code; customer writes tests in requirements
  - “on-site customer”
    - include real, live user on the team, available full-time to answer questions quickly

XP

- For synergy:
  - “pair programming”
    - have all production code written with two programmers actively at one machine
    - Prevents Individual Code Ownership!

XP: So why is it called “extreme?”

- if short iterations are good,
  - make them really short
- if simplicity is good,
  - make the simplest thing that works
- if design is good,
  - do it all the time (refactoring)
- if testing is good,
  - write tests first, and do it all the time (test-driven development)
- if code reviews are good,
  - do it all the time (pair programming)

Pair Programming

- Synergies:
  - more ideas
    - complementary skills
    - better consideration of alternative solutions
  - learning
    - expert/student apprenticeship
    - continuous critique to learn new things

Pair Programming

- Synergies:
  - pressure
    - they do not want to let each other down, or waste each other's time
  - courage
    - they give each other confidence to do things they might avoid if alone

Pair Programming

- Synergies:
  - reviews
    - better able to reveal defects with more eyes looking at the code
  - debugging
    - bugs reveal themselves when one explains the misbehaving code to the other

Scrum

- One **part** of an agile development process
  - based on
    - Feedback
    - Roles
    - Meetings
    - Prioritization
    - planning
  - like classic engineering management, and is often used onsite in civil engineering

Scrum

- Roles:
  - Scrum master
    - knows the process (agile, xp...)
    - protects the team and helps the team follow Scrum
  - product owner
    - represents the customer
  - team members
    - write the code

Scrum

- Meetings:
  - daily scrum (1 per **day**)
  - planning meeting (1 per iteration)
  - review meeting (1 per iteration)
  - retrospective meeting (1 per iteration)

Scrum

- Daily scrum also known as standup
  - time limited
  - everyone is standing, so they are more uncomfortable and want to finish soon
  - each team member answers 3 questions
    - what did you do?
    - what are you going to do?
    - what is blocking you?

Scrum

- Planning meeting:
  - first meeting of the iteration (only on first day)
  - input: requirements and user stories
  - output: choose stories to work on next
    - estimate their cost in time
    - prioritize them
    - fit them into the time left for the iteration

Scrum

- Review Meeting
  - review work completed
  - review work not completed
  - demonstrate current system

Scrum

- Retrospective Meeting
  - review issues faced with quality and personnel
  - try to improve the process
  - what went well?
  - what could be improved?
  - stay calm

More Information

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- D. L. Parnas and P. C. Clements
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- M. Cusumano, A. MacCormack,
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- Comm. ACM, 4(6), 1997

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- Microsoft Press, 1998

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More Information

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- Addison-Wesley, 2004

Pair Programming Illuminated

- L. Williams and R. Kessler
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