back to modularity

Daniel Jackson · MIT CSAIL · HYTRADBOI · 2025

how good are LLMs at generating code?

single functions

46%

of code is autogenerated
when Copilot enabled
(June 2023)

92%

accuracy of coding
GPT-4 + AgentCoder on MBPP
(Jan 2024)

whole apps

> If you ask GPT-4 to write whole apps for you, it usually can't get there. But if you architect the app in your head, you can ask it to build it out one function at a time pretty effectively.

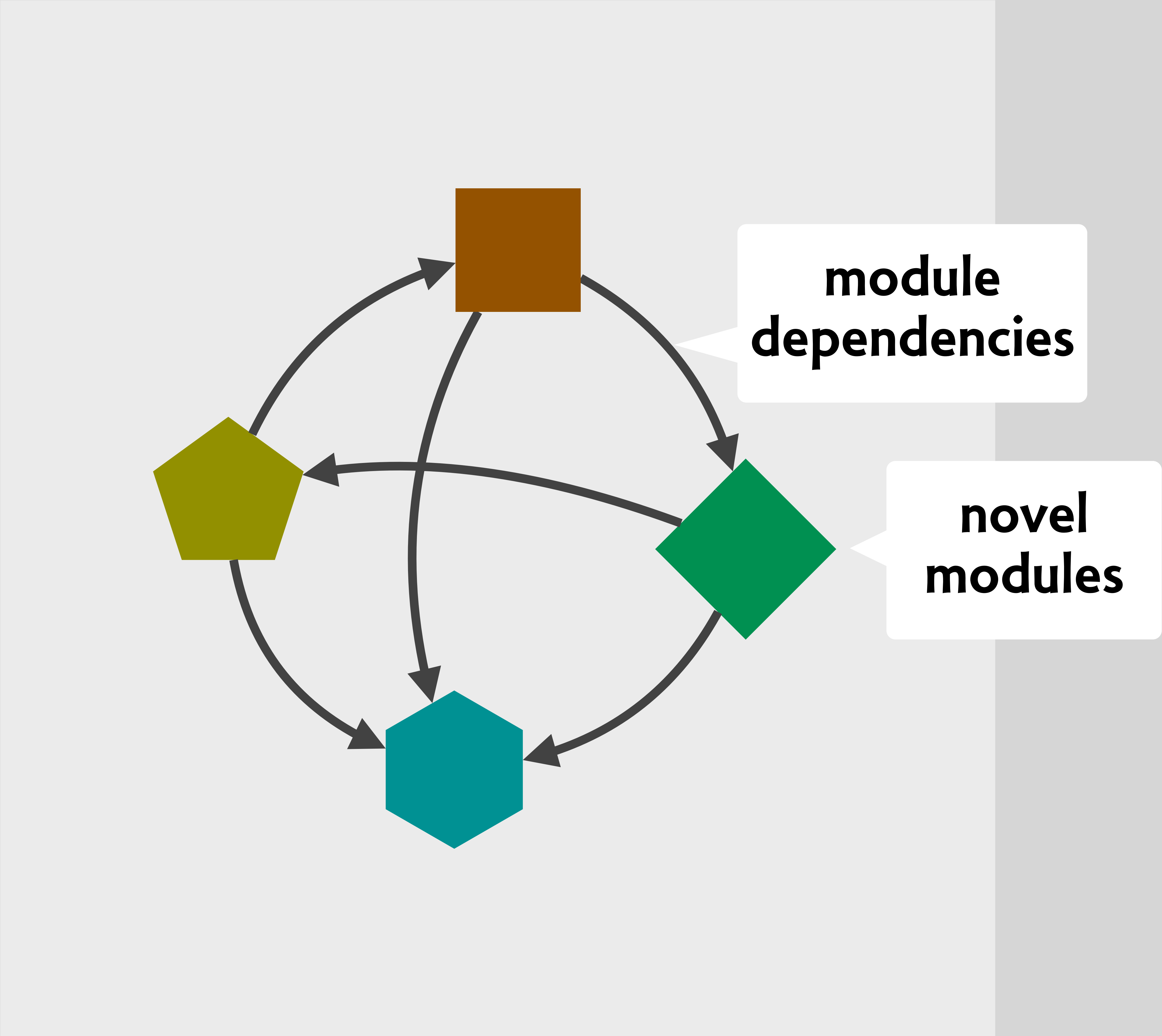
HackerNews, May 2024

> The skills of the developer will be to figure out, "How small do I have to go until I can leverage AI to synthesize that code for me?"

Thomas Dohmke, GitHub CEO, June 2023

it's time to
rethink how software
is structured

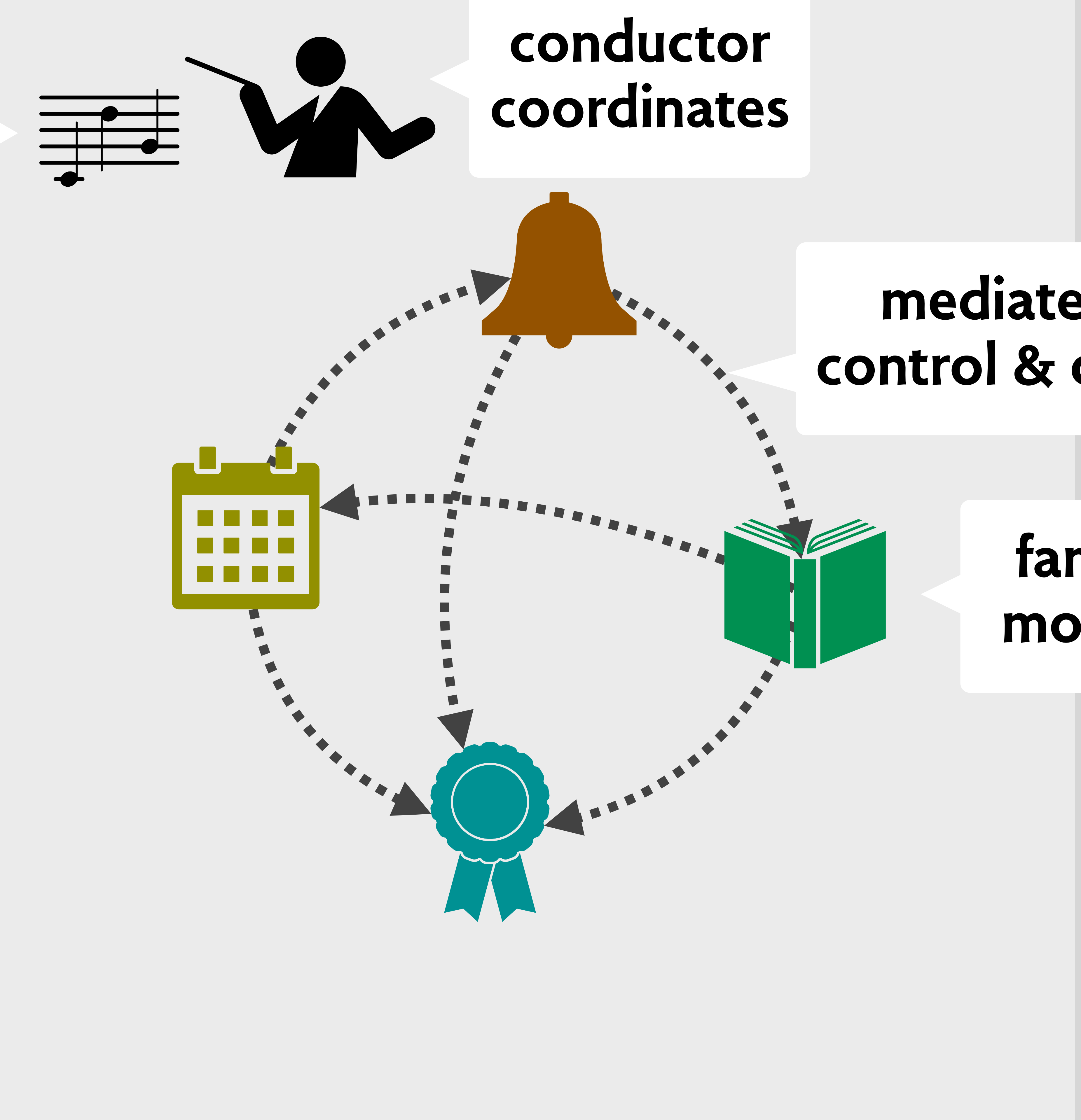
building an app one module at a time



module dependencies

novel modules

a different approach: true modularity



app-specific details

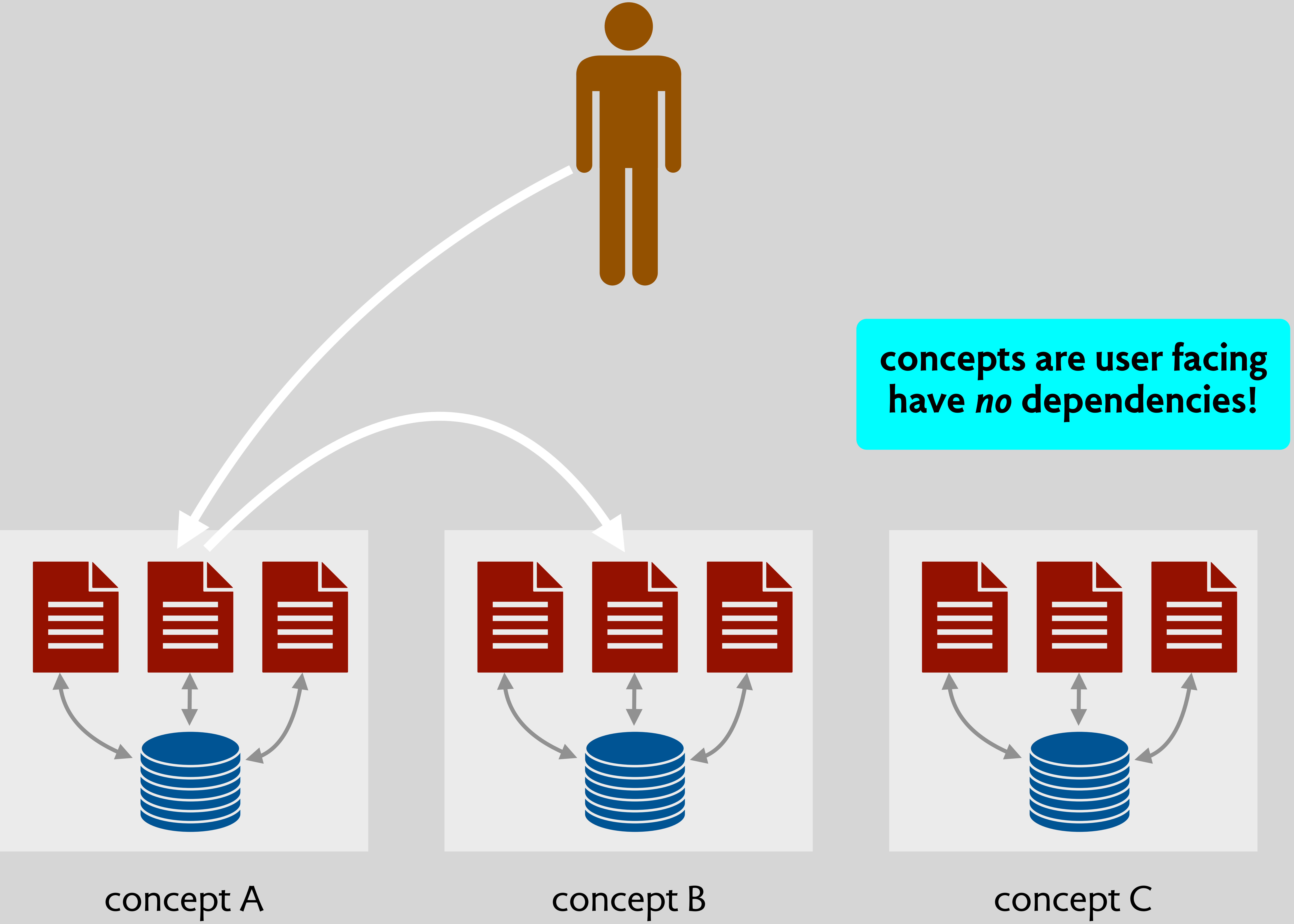
conductor coordinates

mediated control & data

familiar modules

icons by Luis Prado & Zach Bogart, Noun Project

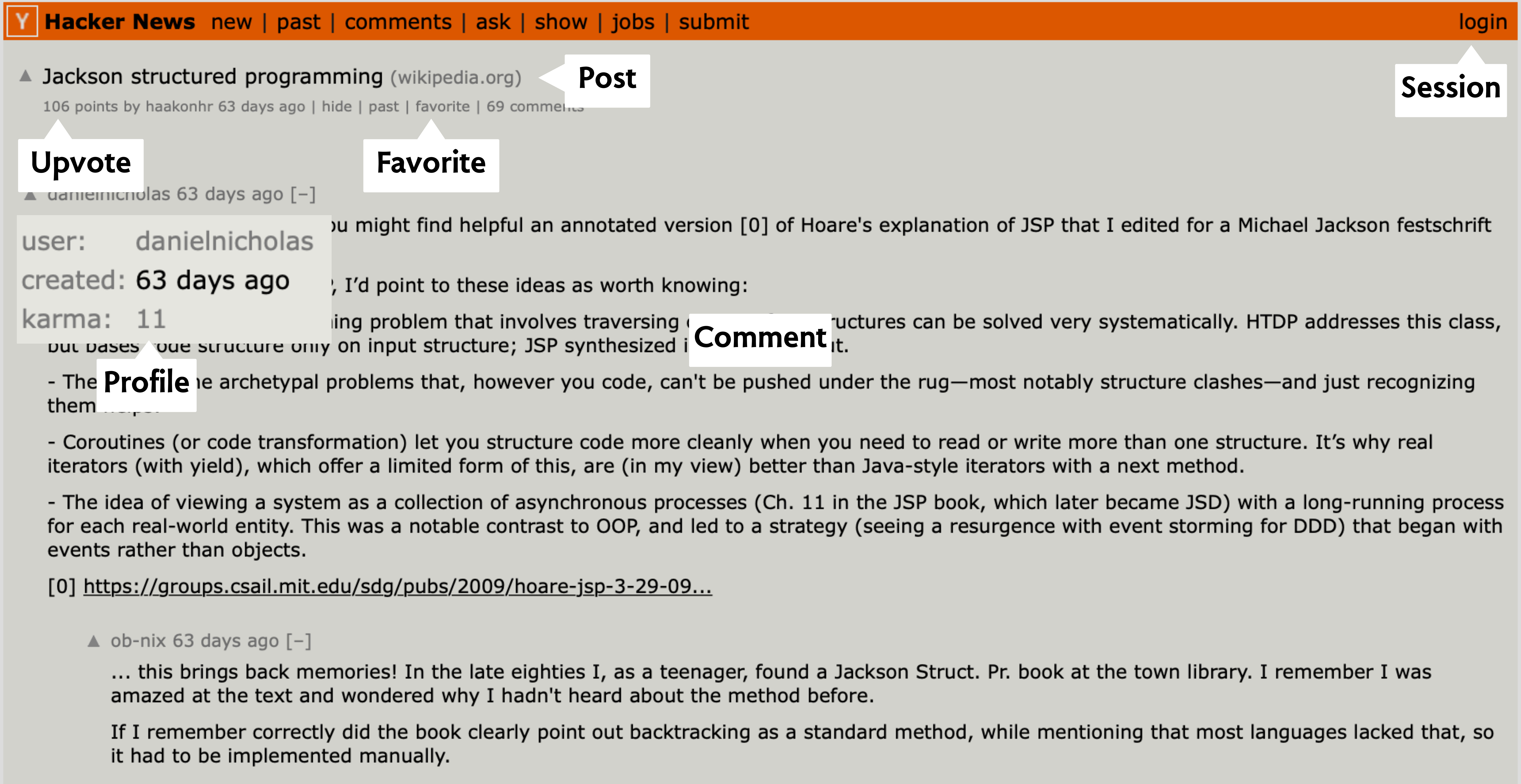
viewing a system in terms of concepts



concepts are user facing
have *no* dependencies!

designing hacker news

most apps are made from familiar functions



▲ Jackson structured programming (wikipedia.org)

106 points by haakonhr 63 days ago | hide | past | favorite | 69 comments

▲ danielnicholas 63 days ago [–]

user:	danielnicholas
created:	63 days ago
karma:	11

u might find helpful an annotated version [0] of Hoare's explanation of JSP that I edited for a Michael Jackson festschrift

, I'd point to these ideas as worth knowing:

ing problem that involves traversing ructures can be solved very systematically. HTDP addresses this class, but bases ode structure only on input structure; JSP synthesized i it.

- The e archetypal problems that, however you code, can't be pushed under the rug—most notably structure clashes—and just recognizing them

- Coroutines (or code transformation) let you structure code more cleanly when you need to read or write more than one structure. It's why real iterators (with yield), which offer a limited form of this, are (in my view) better than Java-style iterators with a next method.

- The idea of viewing a system as a collection of asynchronous processes (Ch. 11 in the JSP book, which later became JSD) with a long-running process for each real-world entity. This was a notable contrast to OOP, and led to a strategy (seeing a resurgence with event storming for DDD) that began with events rather than objects.

[0] https://groups.csail.mit.edu/sdg/pubs/2009/hoare-jsp-3-29-09...

▲ ob-nix 63 days ago [–]

... this brings back memories! In the late eighties I, as a teenager, found a Jackson Struct. Pr. book at the town library. I remember I was amazed at the text and wondered why I hadn't heard about the method before.

If I remember correctly did the book clearly point out backtracking as a standard method, while mentioning that most languages lacked that, so it had to be implemented manually.

… with some creative variation

“combinational creativity” [Boden]

familiar elements combined in new ways

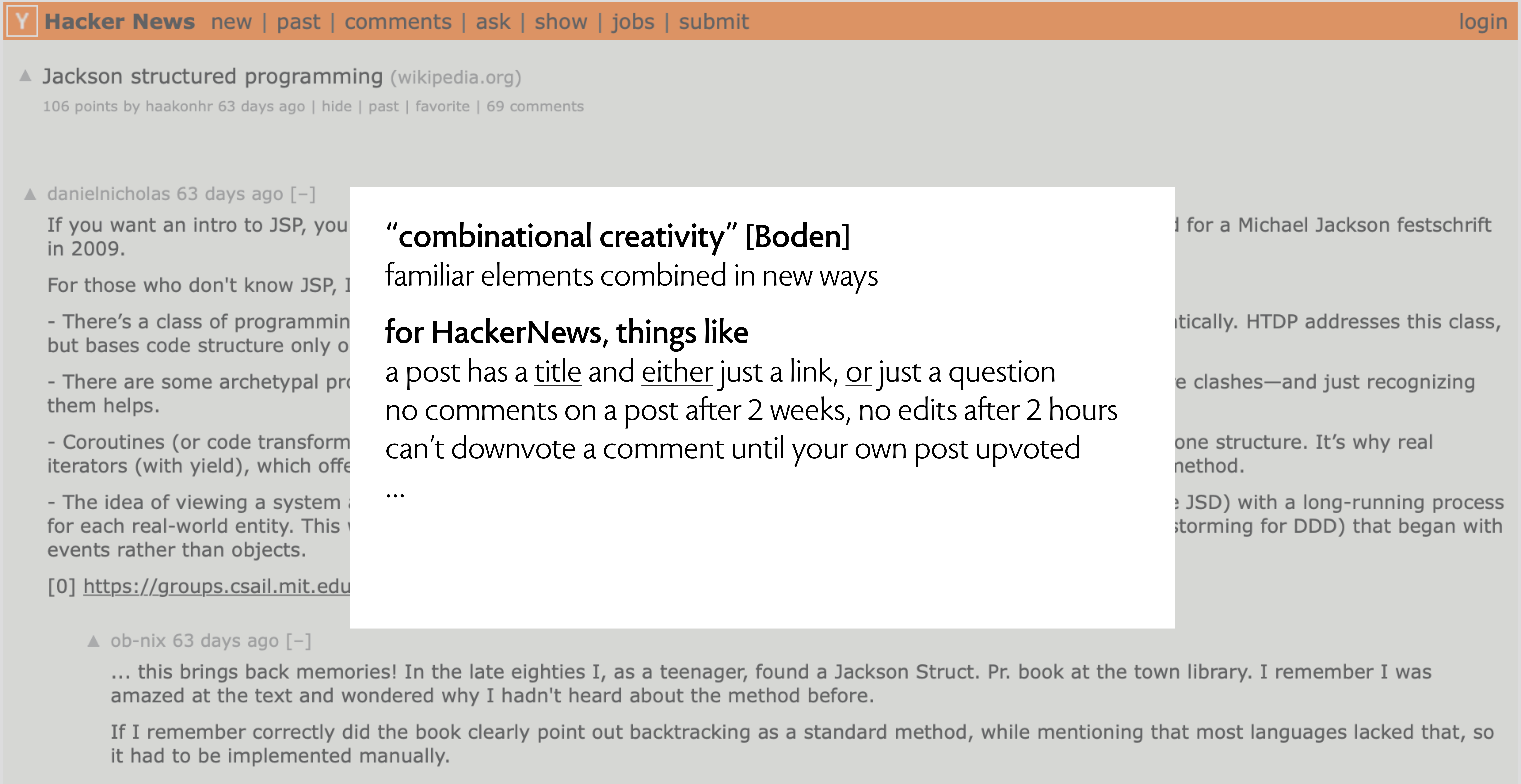
for HackerNews, things like

a post has a title and either just a link, or just a question

no comments on a post after 2 weeks, no edits after 2 hours

can’t downvote a comment until your own post upvoted

…



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If you want an intro to JSP, you … d for a Michael Jackson festschrift in 2009.

For those who don't know JSP, I

- There’s a class of programmin … tically. HTDP addresses this class, but bases code structure only o

- There are some archetypal pr … e clashes—and just recognizing them helps.

- Coroutines (or code transform … one structure. It’s why real iterators (with yield), which offe … nethod.

- The idea of viewing a system … JSD) with a long-running process for each real-world entity. This … storming for DDD) that began with events rather than objects.

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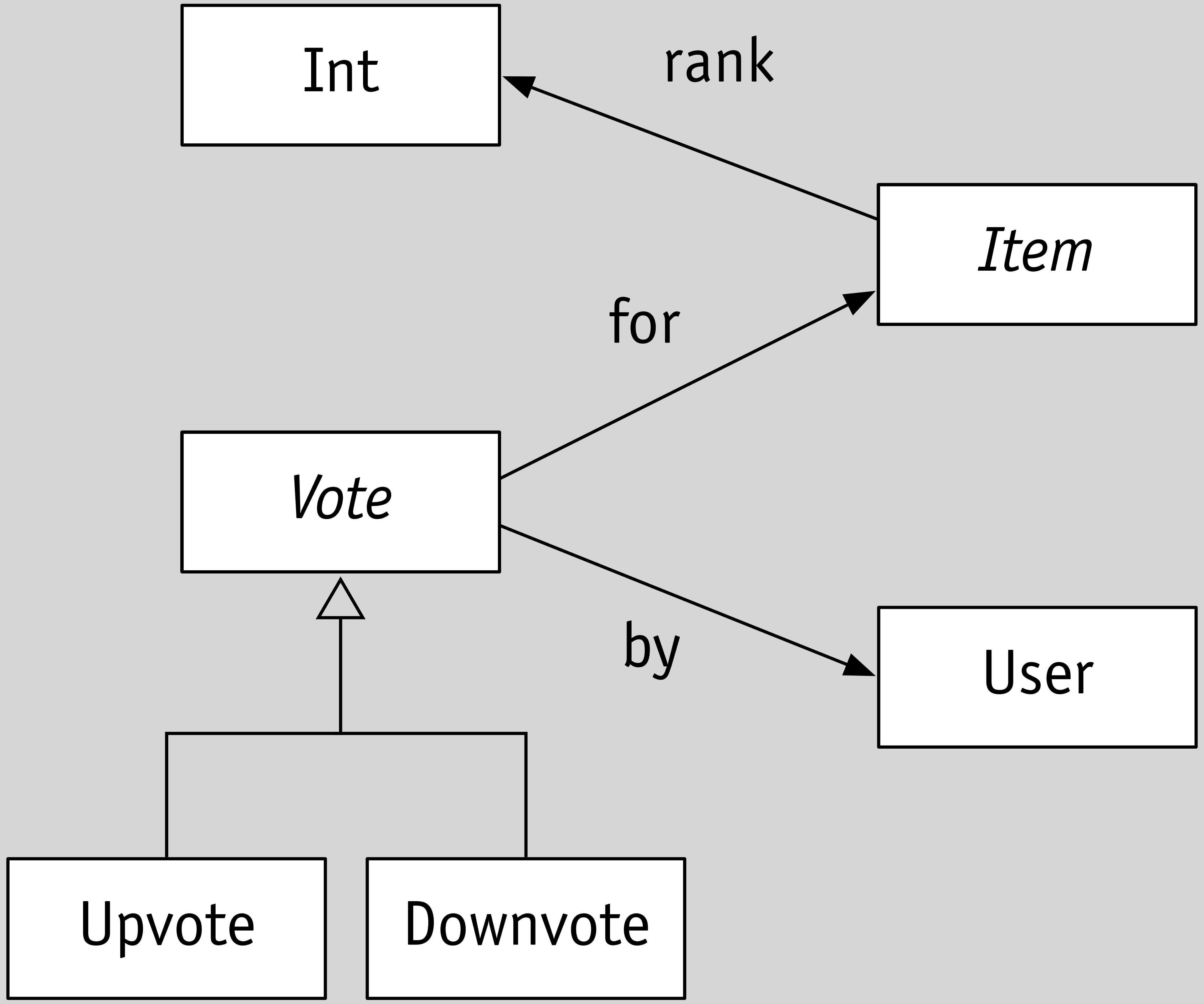
a sample concept: upvote

concept Upvote

purpose rank items by popularity

state
by: Vote -> **one** User
for: Vote -> **one** Item
Upvote, Downvote: **set** Vote
rank: Item -> **one** Int

actions
upvote (u: User, i: Item)
downvote (u: User, i: Item)
unvote (u: User, i: Item)



how to add app-specific functionality?

concept Upvote

purpose rank items by popularity

actions
upvote (u: User, i: Item)
downvote (u: User, i: Item)
unvote (u: User, i: Item)

suppose I want this behavior:
you can't downvote an item
until you've received
an upvote on your own post

define a new concept!
a hint: not just used by Upvote

concept Karma

purpose privilege good users

state
karma: User -> one Int

actions
reward (u: User, r: Int)
permit (u: User, r: Int)

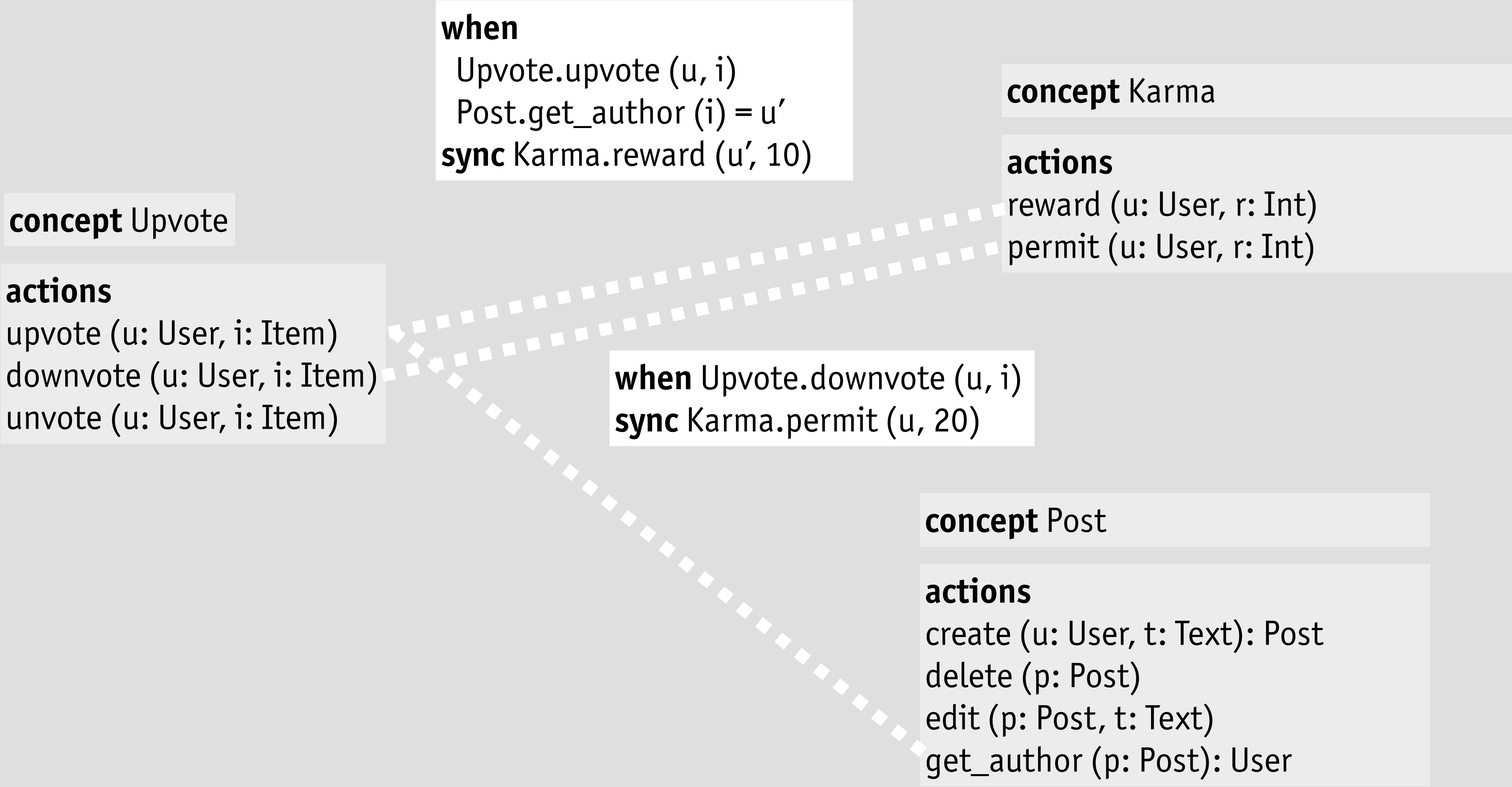
concept Post

purpose share content

state
author: Post -> one User
body: Post -> one Text

actions
create (u: User, t: Text): Post
delete (p: Post)
edit (p: Post, t: Text)
get_author (p: Post): User

compose concepts by **action synchronization**



when
Upvote.upvote (u, i)
Post.get_author (i) = u′
sync Karma.reward (u′, 10)

concept Karma

actions
reward (u: User, r: Int)
permit (u: User, r: Int)

concept Upvote

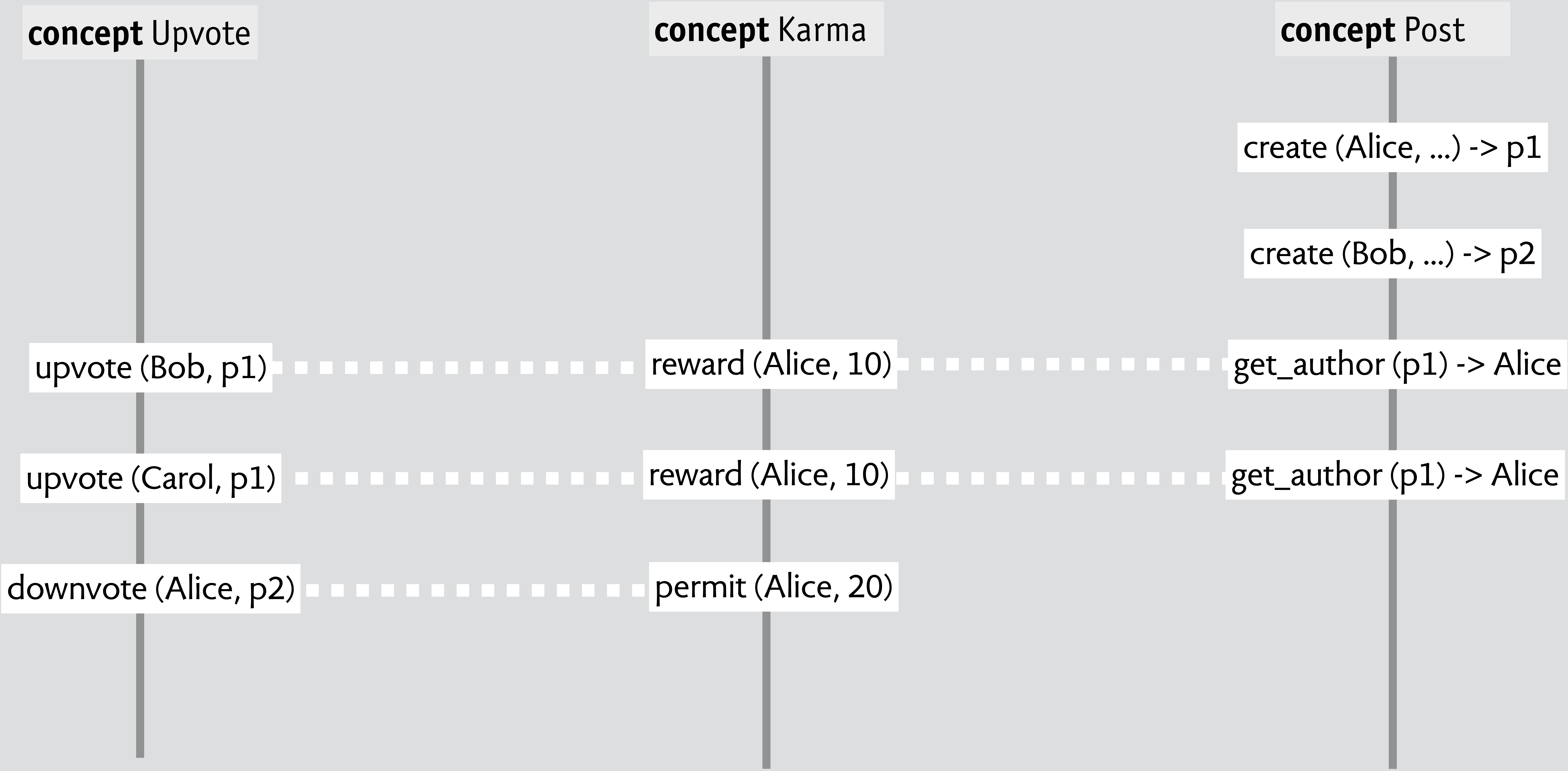
actions
upvote (u: User, i: Item)
downvote (u: User, i: Item)
unvote (u: User, i: Item)

when Upvote.downvote (u, i)
sync Karma.permit (u, 20)

concept Post

actions
create (u: User, t: Text): Post
delete (p: Post)
edit (p: Post, t: Text)
get_author (p: Post): User

synchronizing concepts



concept Upvote

concept Karma

concept Post

create (Alice, ...) -> p1

create (Bob, ...) -> p2

upvote (Bob, p1)

reward (Alice, 10)

get_author (p1) -> Alice

upvote (Carol, p1)

reward (Alice, 10)

get_author (p1) -> Alice

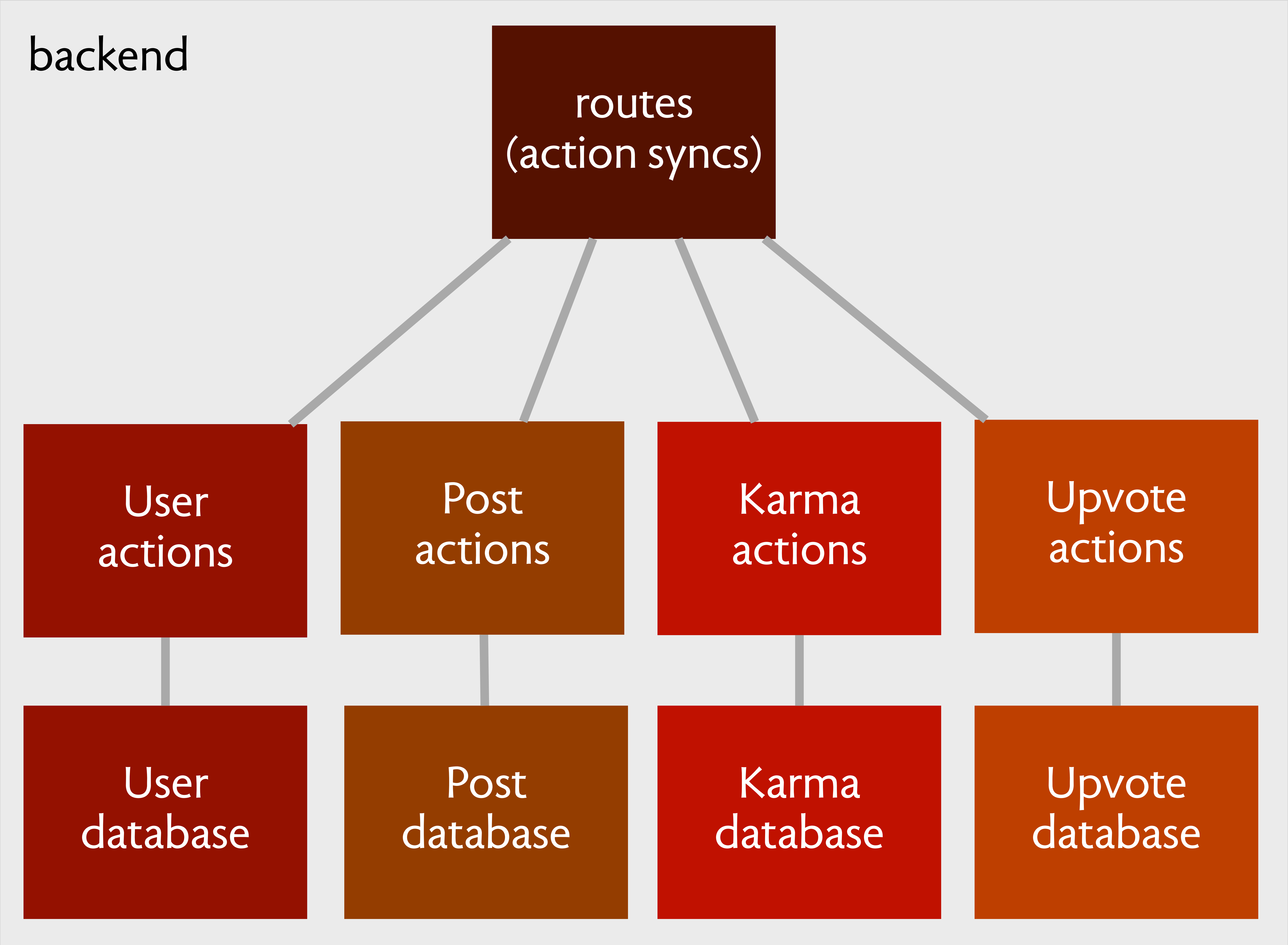
downvote (Alice, p2)

permit (Alice, 20)

coding hacker news

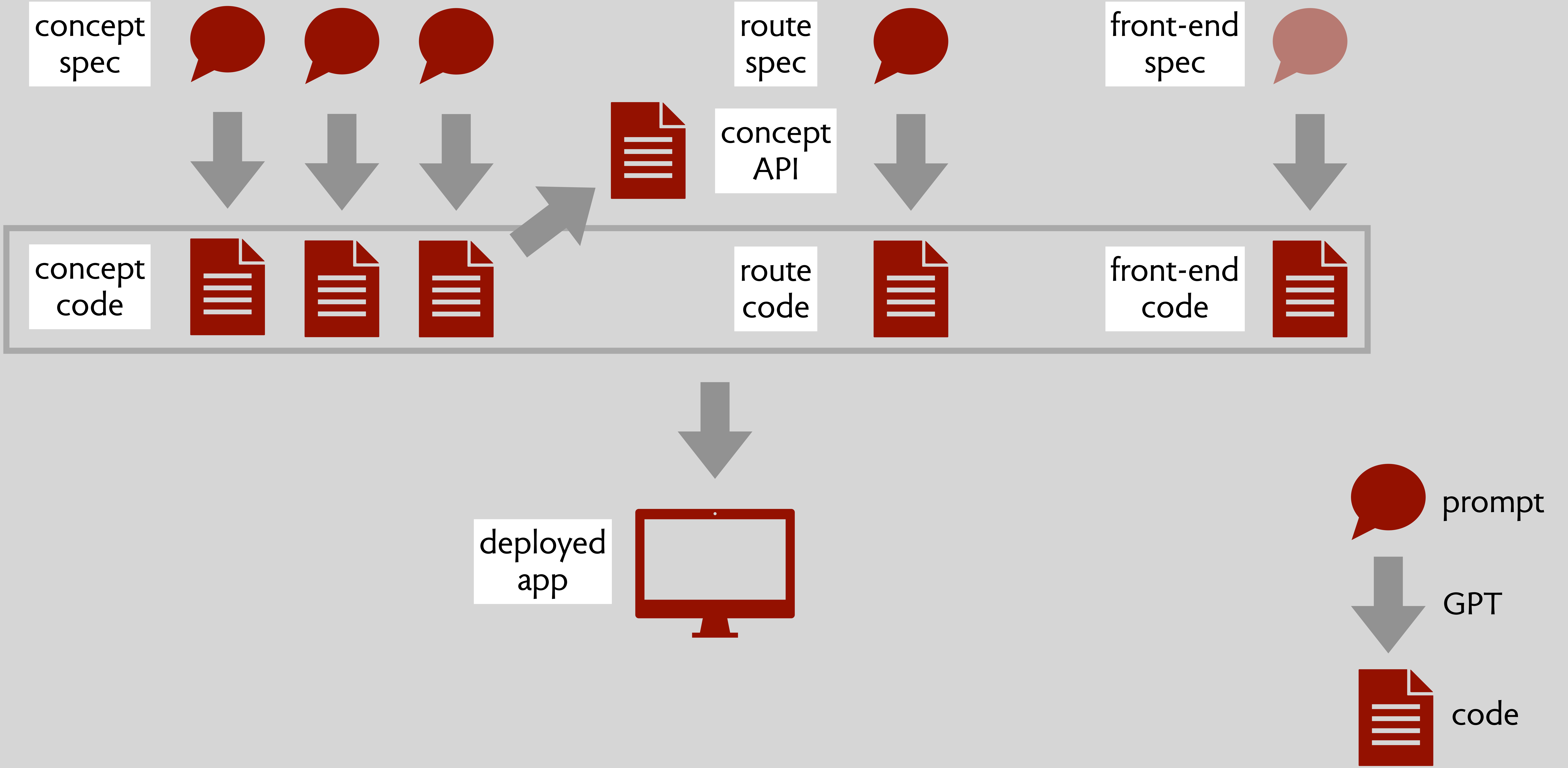
joint work with Abutalib Namazov

a new way to structure a web app

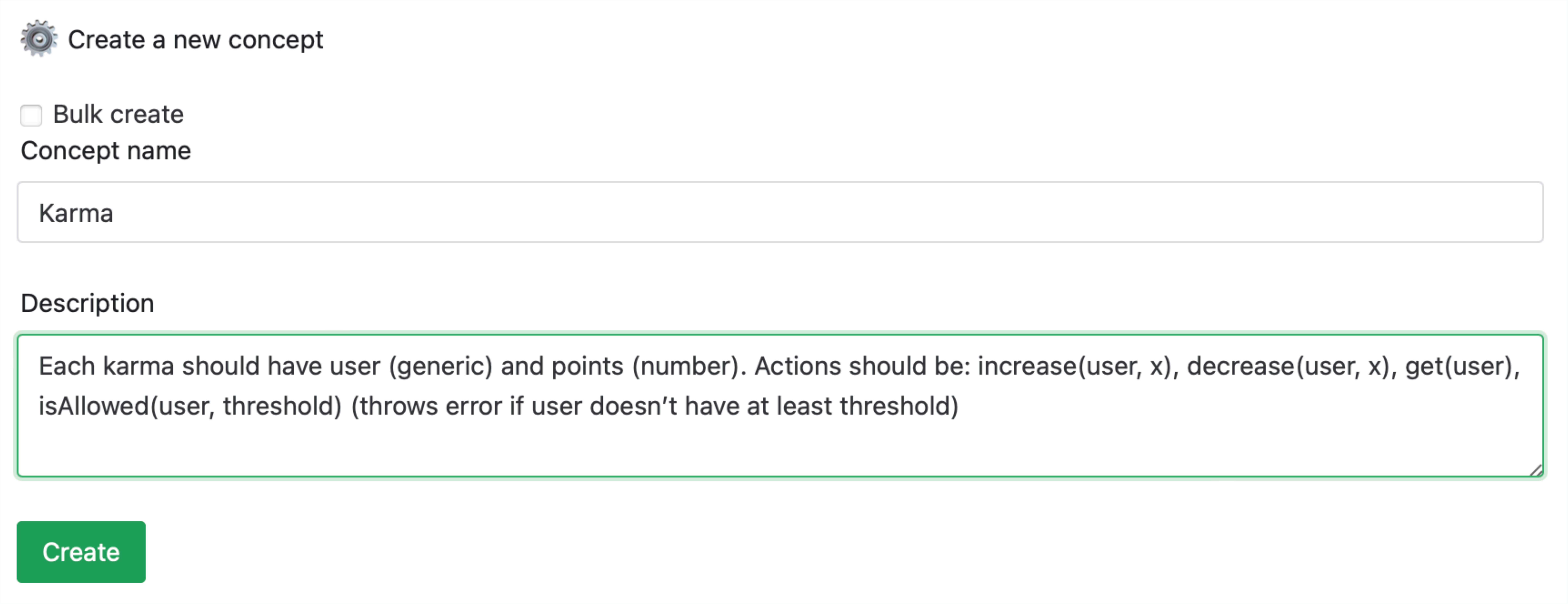


no dependencies between concepts!

now we can generate code!



creating a concept



Create a new concept

□ Bulk create

Concept name

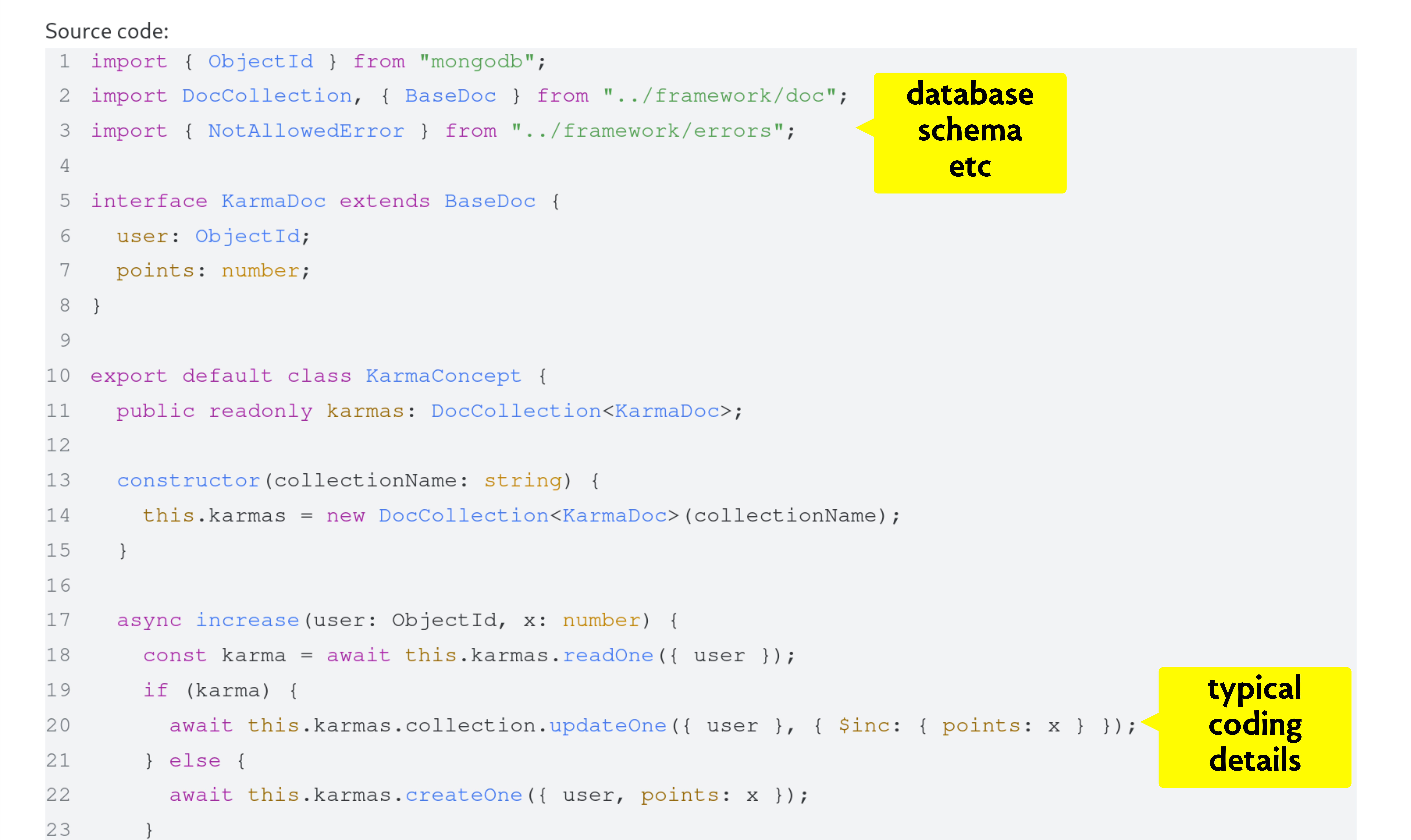
Karma

Description

Each karma should have user (generic) and points (number). Actions should be: increase(user, x), decrease(user, x), get(user), isAllowed(user, threshold) (throws error if user doesn't have at least threshold)

brief & application independent

first kodless generates the concept code



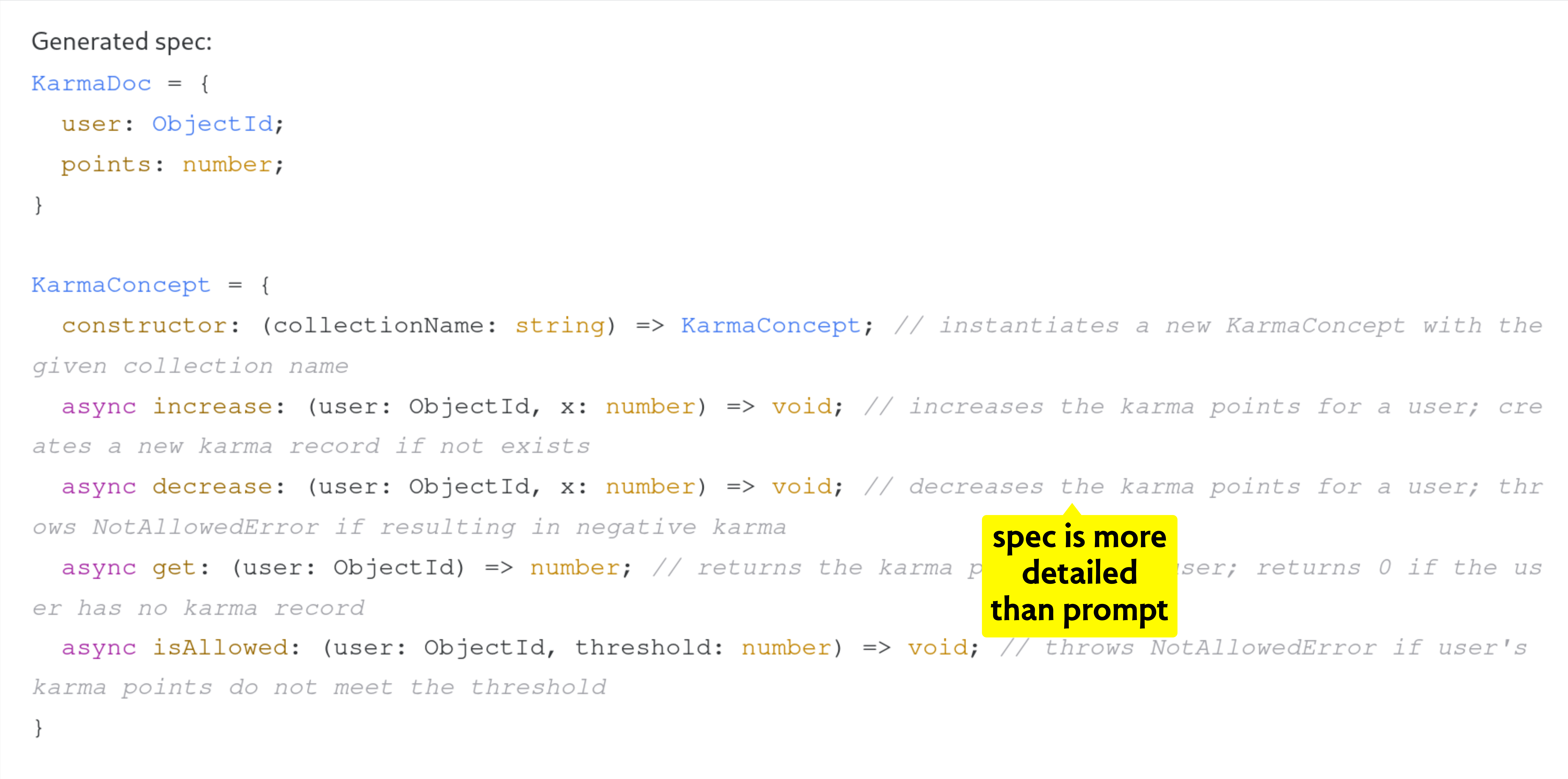
Source code:

```
import { ObjectId } from "mongodb";
import DocCollection, { BaseDoc } from "../framework/doc";
import { NotAllowedError } from "../framework/errors";

interface KarmaDoc extends BaseDoc {
  user: ObjectId;
  points: number;
}

export default class KarmaConcept {
  public readonly karmas: DocCollection<KarmaDoc>;

  constructor(collectionName: string) {
    this.karmas = new DocCollection<KarmaDoc>(collectionName);
  }

  async increase(user: ObjectId, x: number) {
    const karma = await this.karmas.readOne({ user });
    if (karma) {
      await this.karmas.collection.updateOne({ user }, { $inc: { points: x } });
    } else {
      await this.karmas.createOne({ user, points: x });
    }
```

database schema etc

typical coding details

then it generates an API spec from the code

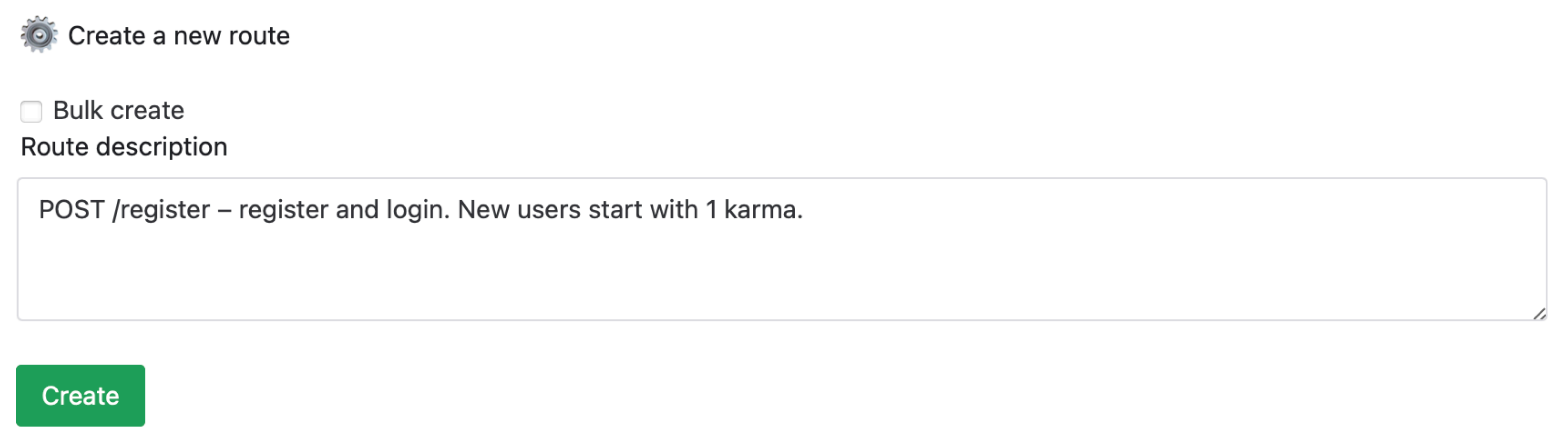


Generated spec:

```
KarmaDoc = {
  user: ObjectId;
  points: number;
}

KarmaConcept = {
  constructor: (collectionName: string) => KarmaConcept; // instantiates a new KarmaConcept with the
given collection name
  async increase: (user: ObjectId, x: number) => void; // increases the karma points for a user; cre
ates a new karma record if not exists
  async decrease: (user: ObjectId, x: number) => void; // decreases the karma points for a user; thr
ows NotAllowedError if resulting in negative karma
  async get: (user: ObjectId) => number; // returns the karma p              ser; returns 0 if the us
er has no karma record
  async isAllowed: (user: ObjectId, threshold: number) => void; // throws NotAllowedError if user's
karma points do not meet the threshold
}
```

spec is more detailed than prompt

creating a route



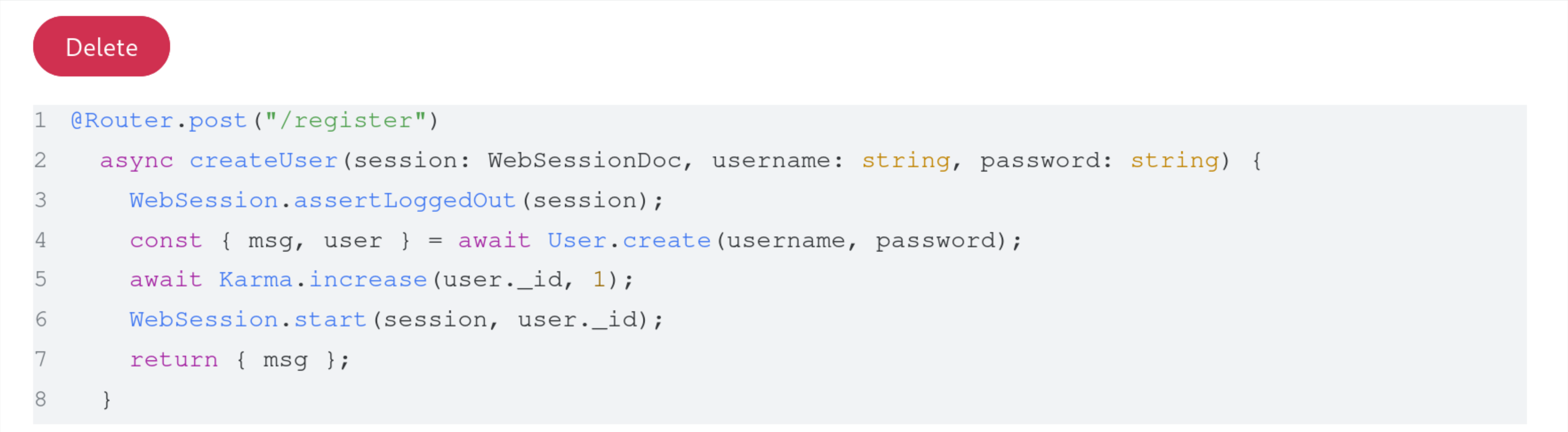
□ Bulk create

Route description

POST /register – register and login. New users start with 1 karma.

no explicit mention of concepts or their actions

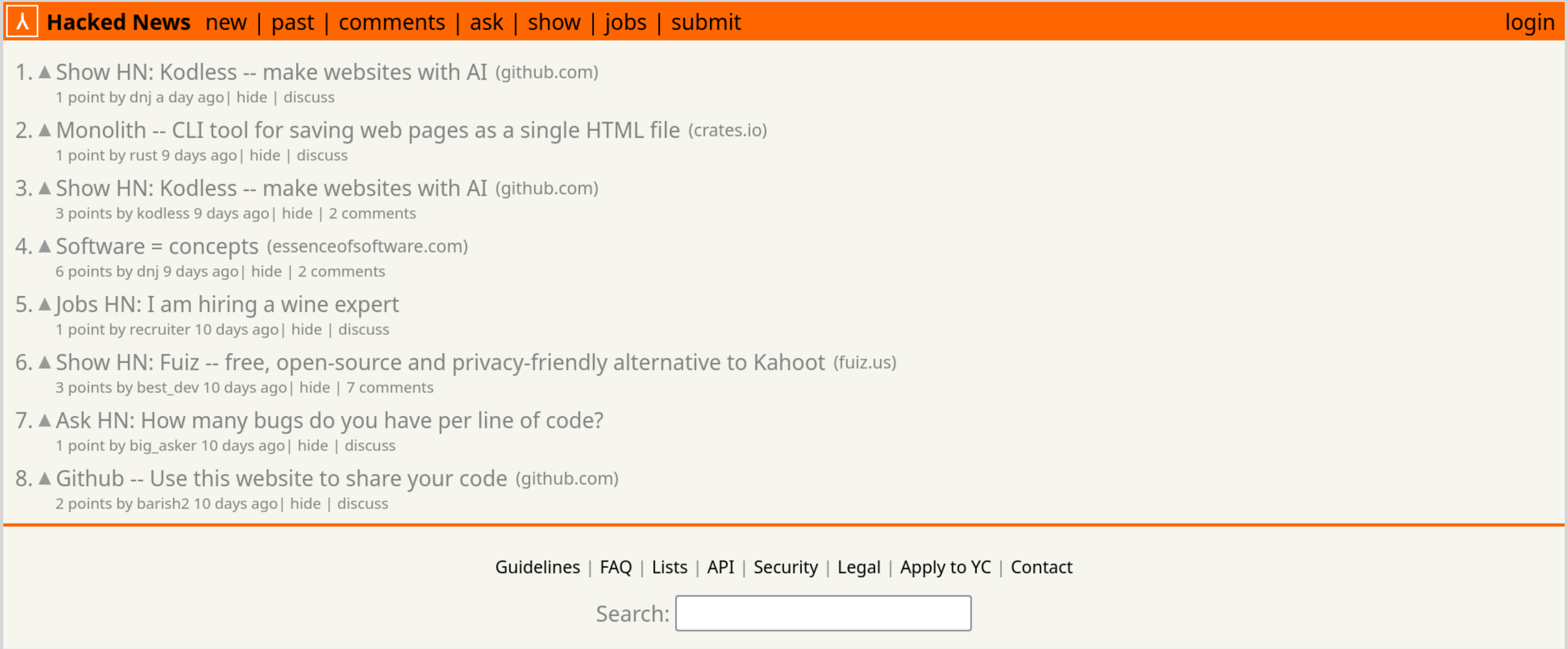
kodless generates the route code



```
@Router.post("/register")
  async createUser(session: WebSessionDoc, username: string, password: string) {
    WebSession.assertLoggedOut(session);
    const { msg, user } = await User.create(username, password);
    await Karma.increase(user._id, 1);
    WebSession.start(session, user._id);
    return { msg };
  }
```

Kodless uses concept APIs to select actions

hacked news: home page



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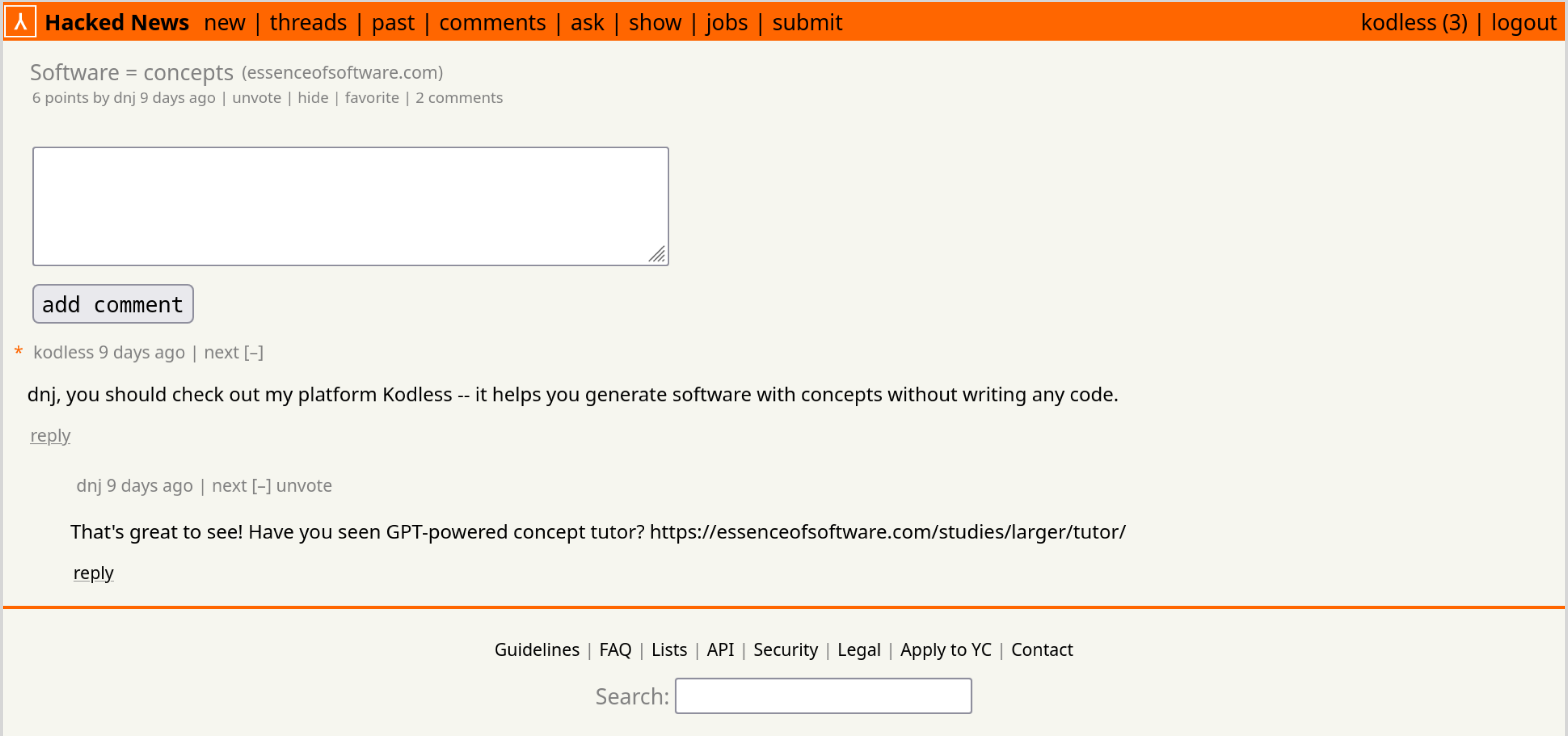
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* kodless 9 days ago | next [–]

dnj, you should check out my platform Kodless -- it helps you generate software with concepts without writing any code.

reply

dnj 9 days ago | next [–] unvote

That's great to see! Have you seen GPT-powered concept tutor? https://essenceofsoftware.com/studies/larger/tutor/

reply

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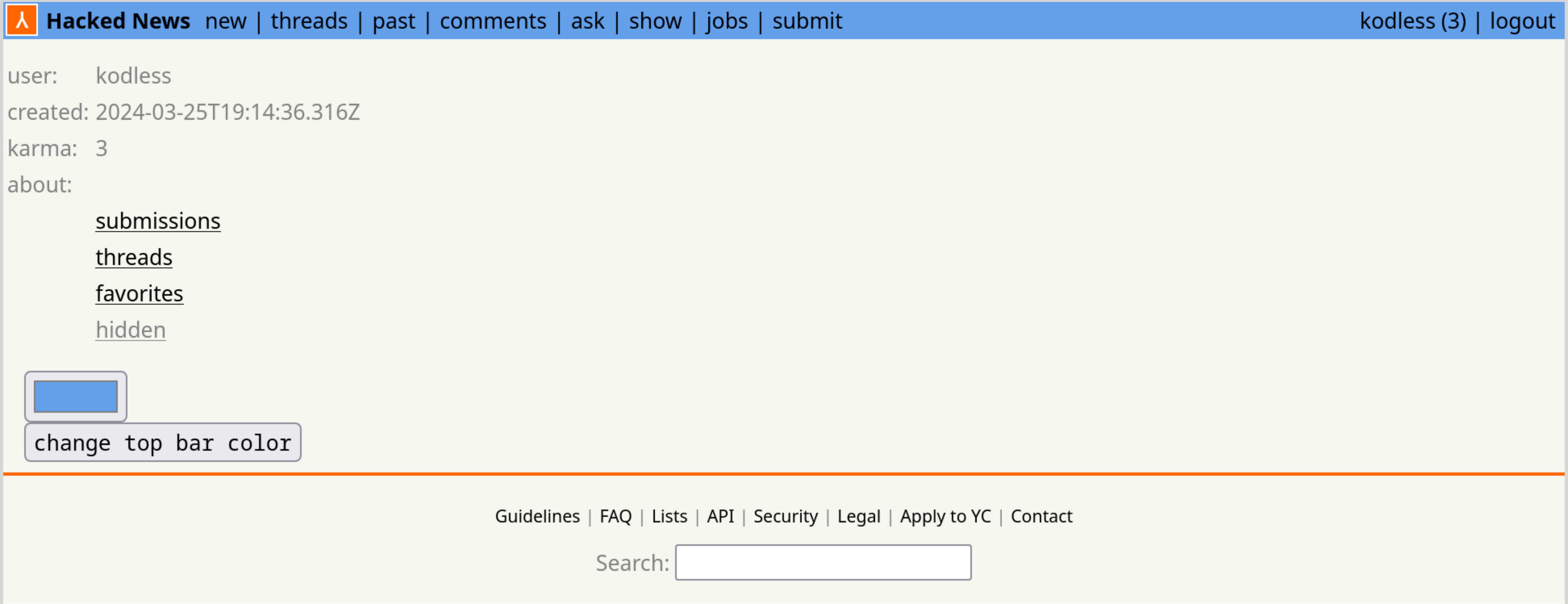

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user: kodless

created: 2024-03-25T19:14:36.316Z

karma: 3

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submissions
threads
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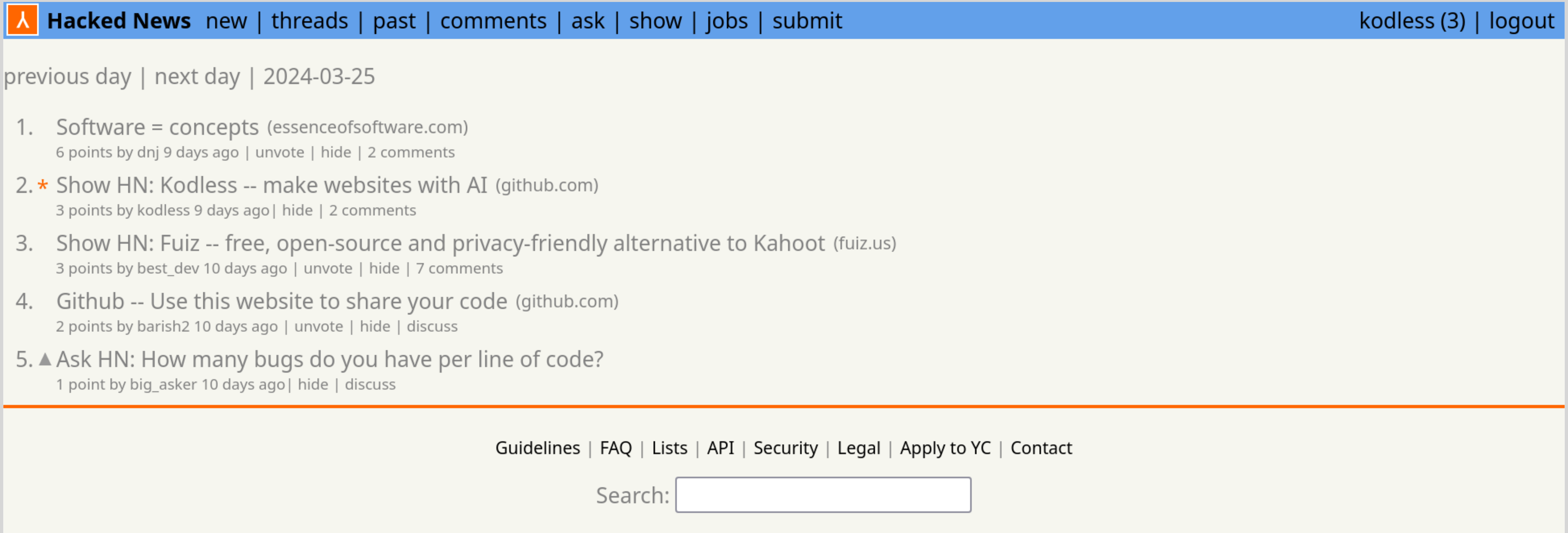

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successes & challenges

coverage of all major functionality

flagging, hiding, karma, etc

nested comments, complicated ranking rules

many application-specific details (eg, karma)

minimal prompting required

< 1,000 words in total in prompts

no code editing needed

some prompt revisions to tweak behavior

frontend code not yet fully automated

but have designed HTMx like DSL

need actions to query concept state

eg, Post.getByIds to simplify route code

implementation details in a few route specs

eg, prompt for GET/session says "return currently logged in user with karma in same object"

conclusions

where we are

a DSL for syncs (Eagon Meng)

removes all the magic in our current framework

clean separation of core logic from presentation

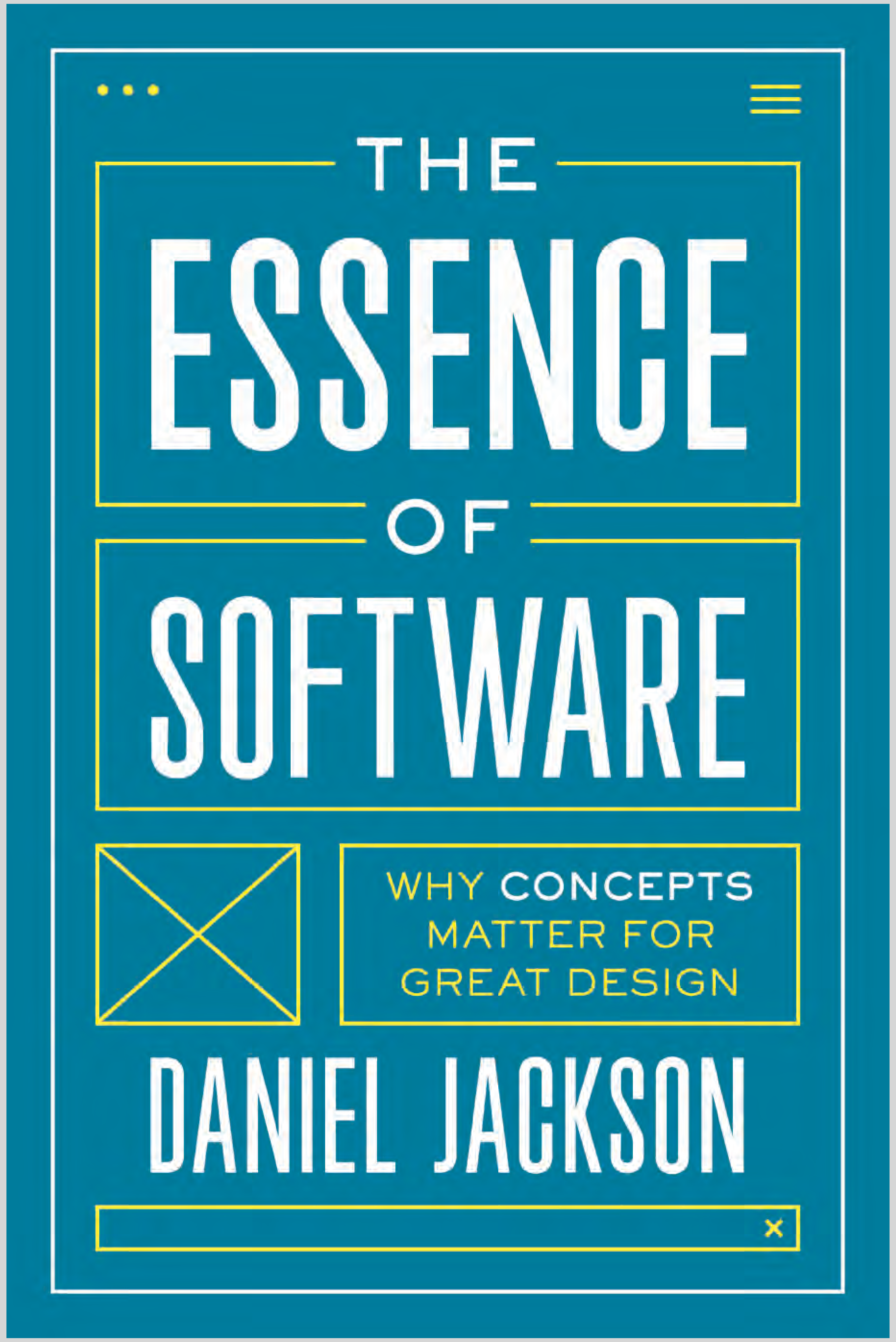
factor our persistence layer, write concepts over plain JS

database challenges

concepts are polymorphic, but can't express in schemas

syncing doesn't allow joins across concept schemas

for more about concept design



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