What goes wrong in APIs and how to fix it:
API Design anti-patterns:

http://www.aleax.it/europ11_adap.pdf

Google

When you do software...

- ...what do you focus on?
  - functionality: "does a lot of useful stuff"
  - correctness: "few if any serious bugs"
  - performance: "what it does, it does fast"
  - user interface: "looks & feels nice"
  - security: "no easy target for hackers"
  - elegance: "easy and smooth to maintain"
- ...what's missing from the above...?
- BTW: all issues best achieved with agile, incremental development (except security)

This talk

- I'll tell you what I'm going to tell you
- then, I tell you
- finally, I tell you what I just told you

- now THIS is a classic Pattern, no auntie!-)

- concrete examples: scarce, as I don't want to make (too many) more enemies
  - except errors I made myself
  - and stuff nobody could defend (Windows)

What's an API

- "Application" (?) "Program Interface"
  - a collection of functions, data types, protocols, events, &c, whereby any software system X can interact with a given software system Y
  - Y can be: a library, framework, application, operating system, web site...
  - Y's developers are typically responsible for designing and implementing the API

What's an Anti-pattern

- a category of counterproductive behaviors that are often, systematically repeated
  - can be in: business processes, project management, design, programming, ...
  - an anti-pattern write-up should include:
    - root causes (why did it seem a good idea at the time?)
    - effects (why it's actually a bad idea)
    - interactions (how it helps or hurts other patterns [or anti-patterns])
    - remedies (suggestions for fixes)

API Design Antipatterns

- the very worst APIDA: not having any API
  - the worst API's the one that's not there
  - most frequent 1: "just didn't think of it"!
- the second worst: not having any design
  - the API that "just happened"
  - worse than most other "non-designs"
- Too many APIs spoil the broth
- "fear of commitment": to design→to choose
- inconsistency in APIs
- ...but wait, there's more...!

More kinds of APIDAs

- Won't do these justice, either, but...:
- "extremes": no balance between concerns
  - what language(s) to support?
    - excessive language dependence
    - excessive language INdependence
  - what about standard protocols/formats?
    - ignoring them blithely
    - rigidly, lavishly letting them "drive"
- debugging, error messages, documentation
- performance-related APIDAs

The very worst APIDA

- the worst API is -- no API at all
  - people just don't think about APIs...!
- e.g. check stackoverflow: most common Qs
  - spidering and scraping websites
  - simulating keystroke & mouse gestures
- some of those Qs are about system testing
- most of them are about "missing APIs"
  - the APIs may not actually be there
  - ~ equivalent, they may be undocumented

Why "no API" is bad

- people DO need an API
  - whether you supply it or not
- they're gonna "scrape" your UI
  - or alleged-UI;-)
  - or, monkeypatch you (if no "hooks")
- useless extra load on your system
  - rendering things that then get ignored
- makes their lives miserable
  - every cosmetic change breaks their SW
  - gives your "competitors" a nice entry!

What to do instead

- Offer an API! "Pick an API, any API"...
- Should be easy -- you ARE "in their shoes"
- Even a simple, weak one's better than none
- Document it! or, at least...:
  - to reduce workload, consider _examples_
  - may be easier than text to programmers
- Keep docs updated!
  - wrong docs can be worse than none
  - examples can be tested & should be

If you're an unwilling APIer

- Make life easy on yourself AND the users:
- Follow the yellow-brick road of the "path of least resistance": de facto standards
  - for web apps, REST & JSON
  - for Windows apps, COM
  - for Mac apps, "Applescript"
  - ...wish there was ONE similarly broad answer for Linux apps too... ah well!-)
- doctest, for the my-only-docs-r-examples crowd (or as useful supplement to any doc)

The accidental API

- an "interface" that was never actually designed as such (also a "didn't think"...).
- designing an interface for proper program access is hard (though interesting) work
  - (think of what you'd like to USE!)
- "but wait, we already have one!"...
  - often what the UI uses to the backend
  - sometimes the database schema
- "let's use that one -- look, ma, no work"!-)

Why "no design" is bad API

- if you haven't designed what API you're exposing, specifically in order to expose it...
- ...then what you're exposingm is not an API, but "internal implementation issues"!
- what happens when you want to change the implementation's details?
    - either you don't (→forego improvements)
    - or you break your clients,
    - or you shoulder forever the burden of dual implementations (real one and API)...

What to do instead

- THINK
  - ...about your API
    - would you like to USE it...?
- FORGET
  - ...your implementation
    - definitely at least its details

Wtdi: Think

- THINK about your API!
  - "if I was an outside programmer, what would I want to be doing? And, how?"
    - "and why?" can't hurt, by the way;-)
  - don't just think; "walk a mile in their shoes" (e.g., your auxiliary scripts)

- I dislike big-design-up-front, BUT...
  - ...APIs are THE exception to this!
 - (well OK, security/privacy too;-)

Wtdi: Forget

- FORGET about your current implementation
  - as an implementation, inevitably it's chock full of specific details, of course
  - or, think about at least 2-3 alternative ones you might want to try in the future
  - what's common to ALL?
  - what changes w/every implementation is "an accident", irrelevant to your API
  - what stays the same is "the substance", what really must be in the API
    - the CONCEPTS your SW is about!

Wtdi: why?

- isn't this API design stuff a lot of work...?
- yes, some -- BUT...
  - the ROI on API design efforts is amazing!
    - not only does it enhance your API,
    - the insight it gives on your overall SW's design is hard to obtain otherwise
  - +: a strong API helps you properly divvy up the system (as little as feasible "in the core", as much as can be, "outside"!)
  - so you get better architecture too

A worst-case bad API...
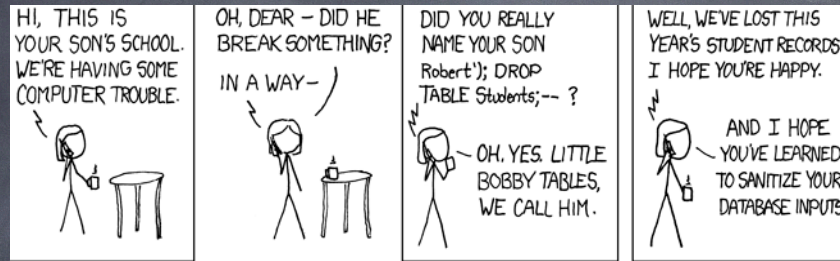
- "no API" / "expose the DB" worst case:
  - accept SQL directly via URL or forms...
  - (note the security/privacy connection...)

Too many ~~cooks~~ APIs

- zero APIs is too few, three is too many
- four is right out
- somewhere in-between, probably one (maybe two) is the sweet spot
- root cause #1: transition
  - esp. from a "not-really-designed" API
  - or, between technologies/platforms
- root cause #2: unwillingness to decide
  - cfr the "commitment issues" APIDAs
- root cause #3: org/project structure

Why "many APIs" is bad

- extra work to maintain all of them
  - w/o real benefit to the user,
  - w/o real benefit for refactoring either
- can often be confusing to the user (must learn them all and choose/pick one?)
  - sometimes you can perform task A in one API, task B in another, but in neither can you do both needed tasks A and B
- of course, API transitioning/versioning is a very hard problem (no silver bullets...)

What to do instead

- "LAYERING" APIs is OK
  - ONE lowest-level API -- exposing all the nuts and bolts of the system's logical architecture (NOT implementation!-)
  - it's OK if it's user-unfriendly, hard to use, a little bit underdocumented, &c
    - as long as it's full-power, high-performance, transparently debuggable
  - because all OTHER APIs (one or more) are built entirely ON TOP OF the lowest-level one (no system internals involved)

API Transition: must plan!

- to err is human: you have a so-so API (or worse;-), have designed a better one, and want to transition all your users over to it
- "big-bang" transition (breaking all existing users) is right out: must take it in steps
  - 1+ releases where using the old API still works -- but with clear, copious warnings
  - tutorials & docs to help transitioning
  - no new functionality in old API (motivate!)
  - design to help transition? sometimes...

Fear of commitment

🔵 AKA, the "let's do both!" syndrome

The "Let's do both!" APIDA

- why is it bad?
  - to DESIGN is to DECIDE, i.e., to CHOOSE
  - oh boy, that's scary
    - am I going to be ACCOUNTABLE for it?
  - I am not worthy (to decide) -- do both
- management-structure / employee empowerment problems (often, in firms)
- wishy-washy programmers (rare)

"fear to decide" example

```
HANDLE WINAPI CreateFile(
__in        LPCTSTR lpFileName,
__in        DWORD dwDesiredAccess,
__in        DWORD dwShareMode,
__in_opt    LPSECURITY_ATTRIBUTES
                    lpSecurityAttributes,
__in        DWORD dwCreationDisposition,
__in        DWORD dwFlagsAndAttributes,
__in_opt    HANDLE hTemplateFile
);
          vs

int open(const char *pathname,
        int flags, mode_t mode);
```

gmpy as a bad example

```
import gmpy

x = gmpy.mpz(23)
y = x.whatever(45)
```

...or, equivalently...:

```
y = gmpy.whatever(23, 45)
```

- we did fix in gmpy2 (not backwards comp;-)

To decide is human

- Q to Ken Thompson:
  - "if you were to design Unix all over again from scratch, what would you change"?
- Ken's A:
  - "I'd spell "creat" with a trailing E"
  - (better A: open is enough→no creat;-)

- Perfection is not of this world
  - not an OK excuse for "not even trying"

What to do instead

- have the courage to choose
- choose to work in environments where failure (and honest acknowledgment of it, w/fixes) is not punished, but *encouraged*
  - "fail -- but, fail fast!"
  - AKA -- empowering environments
- you're human -- deal. You WON'T "get it right the first time". Be humble.
  - Launch fast, and iterate
  - "Rough consensus, and running code"!-)

Inconsistency APIDAs

- argument ordering
  - foo(widget, value) vs bar(value, widget)
- lexical issues (under_score, MixedCase)
  - this_one(foo) vs TheOther(bar)
- nomina sunt consequentia rerum (verbs too)
  - RemoveThis/DeleteThat/EraseYonder/...
  - plural vs singular: CommitTransaction vs RollbackTransactions (both w/1+ targets)
  - SomeVeryDetailedSpecificName(x)/blah(y)
  - acronyms: HttpConnect/HTTPSendQuery

Why inconsistency?

- too much Ralph Waldo Emerson?-)
  - but that's against a _foolish_ consistency
- people, ideas change over time
  - so do APIs
  - maybe CommitTransaction used to take only one target, then grew to take 1+
- different people on the same project conceptualize (thus name) the same thing in slightly different (inconsistent) ways

What to do instead

- establish a "data dictionary" (not just "data": "verbs", too!), 1-1 mapping of words ↔ concepts in the SW system

- when a new concept arises, add it & the appropriate word in the DD _first_
  - before you name any API entry!
- cost: a little bit more work to coordinate
- advantages: not just to "external users" of the API -- like all coding conventions, once established, it _saves_ decision overhead!

In medio stat virtus

- navigate very cautiously between pairs of "extreme" positions, esp. in underlying technology choices. For example...:
  - what prog. language(s) to support and how closely to adhere to their "style"s?
  - what protocols (esp. platform-standard or cross-platform standard ones) &c?
- extremism is simpler, sharper, attractive...
  - but never works as well as balance, good taste, and moderation!-)

Prog.language support

- "sure we have an API... it's in BrainFork!"
  - whatever language(s) you've chosen to implement your SW system,
  - there's no good reason to foist it on everybody else who wants to use your system's API!
  - avoid language-specific data interchange formats in your API (for example, expose no Python "pickles"!!!)
- "you can program Fortran in any lang."
  - ...but you shouldn't HAVE to!-)

Standard-protocol support

- don't invent Yet Another Data Format
  - ain't JSON (or YAML) gud enuf 4 ya'?
  - or CSV, FITS, HDF, netCDF, SAIF... (&c)?
    - and Protocol Buffers, XML, ...
  - you'd better have a darn good xcuse!-)
- if on the web, why not ReST? If not (yet) on the web, why not ReST _anyway_?
- on Windows, COM; on Mac, Applescript
- need more generality? RPC standards -- CORBA, XMLRPC, ... -- why not those?

Debugging, errors, docs

- you make an API → somebody will (you hope!-) be _developing_ with/on it
  - they'll make mistakes; so will you
  - good debugging support is a must
  - open-source helps, does NOT suffice
- error msg "an error was encountered" (!)...
- docs are hard to write, but precious
  - at least, provide COPIOUS examples!
  - and TEST them routinely (doctest)!

Performance issues

- a performance-incorrect API can kill performance in many, many ways, e.g.:
  - excessive "make-work" in building / dismantling objects unnecessarily
  - excessive "round trips" through lack of "batching" facilities
  - improper support for threading/distrib.
  - no or inferior support for async use
    - e.g.: mandatory vs optional callbacks
  - too-picky error-diag timing guarantees

Q & A

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