COnputAtional State Transfer (COAST)
A New Architectural Style For Decentralized, Adaptive, and Secure Applications

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I hope I don’t frighten you...

With thanks to Antoine de Saint-Exupéry and *Le Petit Prince*
An architectural style is a named collection of architectural design decisions that
(1) are applicable in a given development context,
(2) constrain architectural design decisions that are specific to a particular system within that context, and
(3) elicit beneficial qualities in each resulting system.

The COAST style:

- For decentralized applications (the context)
- Based on mobile computations, communication constraints, POLA (the constraints)
- Yields dynamic adaptability, pervasive security, ... (some of the beneficial qualities as architectural consequences)
Ex. 1: Search for a Name

```
let my_results_address = make_curl()
let target = "Taylor, Richard"

define find_name():
  let person = find_person(target)
  send(my_results_address, person)

spawn("example.com:5000", find_name)

let person = receive_using(my_results_address)
```
Ex. 2: Names that are palindromes (“Bob”, “Anna”)

```
define find_palindromes():
    let names = get_names()
    if empty?(names) send(my_results_address, [])
    else
        let palindromes = filter(names, (λs. palindrome?(s, 0, length(s)-1)))
        send(my_results_address, palindromes)
    spawn("example.com:5000", find_palindromes)
```
Ex. 3: Multiple Database Sites

1. Spawn(first(sites),..., find_palindromes)
   (carries move_to & palindrome?)

2. Spawn
   Database Site 1
   - Execution Site
     find_palindromes()
     palindrome?(...)
     move_to(...)
     get_name

3. Spawn
   Database Site 2
   - Execution Site
     find_palindromes(r1)
     palindrome?(...)
     move_to(...)
     get_name

4. send(....,palindromes)
   Database Site 3
   - Execution Site
     find_palindromes(r2)
     palindrome?(...)
     move_to(...)
     get_name
Design Intuitions #1

- Computations are mobile
- Move computations to where the (big) data is
  - Remember: networks have real latency!
- Doesn’t have to be a hub-and-spoke architecture
Ex. 4: Buy Gold

1. Spawn(first(sites),..., get_best_price) (carries move_to & start_buy)
2. Spawn
3. Spawn
4. Spawn(...., start_buy(...))
5. send(...., contract) (carries CURL)
6. send(make_payment)

London
get_best_price(...) start_buy(...) move_to(...) get_current_offer

New York
get_best_price(...) start_buy(...) move_to(...) get_current_offer start_buy(...) propose_purchase

Hong Kong
get_best_price(...) start_buy(...) move_to(...) get_current_offer

Me

Commodities Database

Spawn(first(sites),...) get_best_price
(carries move_to & start_buy)

send(...., contract)
carries CURL

send(make_payment)
Ex. 5: Rapid Gold Market

1. Spawn(site, subscribe_to_options) (carries CURL for me)
2. send(…,contract) (carries CURL w/ option limits)
3. send(make_payment) (uses selected CURL)

London
- subscribe_to_options
- get_current_offer
- propose_purchase
- exercise_option()

New York
- subscribe_to_options
- get_current_offer
- propose_purchase

Hong Kong
- subscribe_to_options
- get_current_offer
- propose_purchase

Me
- Manage Subscriptions
- Make purchase decisions
- Spawn(...)
- send(…,contract)
- send(make_payment) (uses selected CURL)
- Local resource database
- get ...
- put
Design Intuitions #2: CURLs

- CURLs convey the right to communicate
- May carry limitations of many varieties
- Can be used to support, e.g., time-limited offers
- Critical to the security model of COAST
Ex. 6: Video as a “SOA”
Ex. 6: Animated version

- User starts a client and constructs a video flow
- Uses local and remote deployment of mobile computations
- Uses lightweight subscription protocol (also based on mobile code)
Ex. 6, Live

A

B
Ex. 7: Picture-in-Picture
Take-Aways

- COAST is “performant”
  - Each video frame was shipped as an encrypted closure
  - Security need not unduly impede performance
E-Commerce

- One obvious area of payoff
- Other domains:
  - Process monitoring
  - Energy management
  - Intelligent transportation and vehicle systems
  - Healthcare Systems
  - Games
COAST Credits

- Michael Gorlick
- Kyle Strasser
- Justin Erenkrantz
- Alegria Baquero

More Info? Come to the Open House: DBH 5209