TWELVE FACTOR APPS

methodology for building software-as-a-service apps

THE TWELVE FACTORS

1. Codebase
2. Dependencies
3. Config
4. Backing services
5. Build, release, run
6. Processes

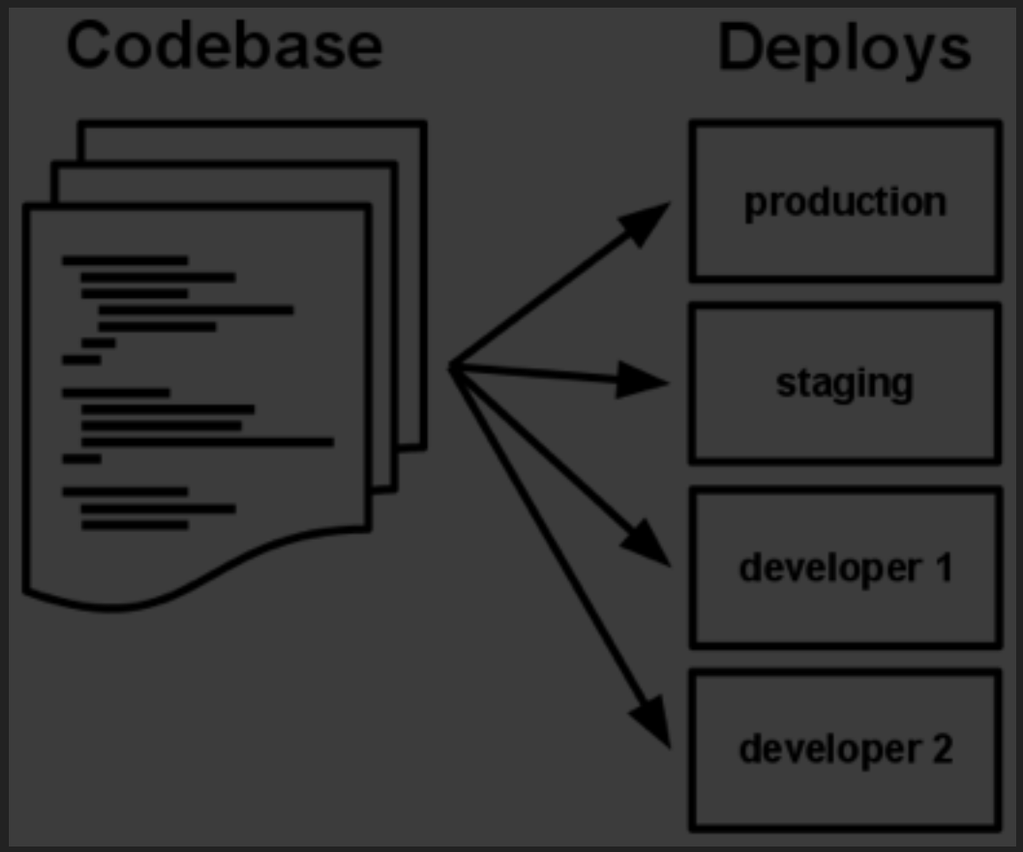
THE TWELVE FACTORS

7. Port binding
8. Concurrency
9. Disposability
10. Dev/prod parity
11. Logs
12. Admin processes

1. CODEBASE

- code is tracked in a version control system (e.g. Git)
- codebase is single repository
- one codebase per app
- multiple apps share code via libraries

A deploy is a running instance of the app



2. DEPENDENCIES

- explicitly declare and isolate dependencies
- never rely on implicit existence of system-wide packages

NPM VS. YARN

- NPM is not 100 percent deterministic
  - different versions might be installed on another computer (even if you use NPM shrinkwrap)
- Yarn was built to be deterministic, reliable, and fast
  - VCS: add `package.json` and `yarn.lock`, ignore `node_modules`

3. CONFIG

- Resource handles to the database, Memcached, and other backing services
- Credentials to external services such as Amazon S3 or Twitter
- Per-deploy values such as the canonical hostname for the deploy

CONFIG VS. CODE

- strict separation of config from code
- config varies substantially across deploys, code does not

CONFIGURATION FILES

Disadvantages:

- easy to mistakenly check in to the repo
- tendency to be scattered about in
  - different places
  - different formats

ENVIRONMENT VARIABLES

store config in environment variables

- easy to change between deploys without changing any code
- not accidentally checked into repo
- language- and OS-agnostic standard
- don't name after specific deploys

ENVIRONMENT VARIABLES CONSIDERED HARMFUL FOR YOUR SECRETS

When you store your secret keys in the environment, you are still prone to accidentally expose them -- exactly what we want to avoid.

DOCKER SECRETS

```
docker secret create [OPTIONS] SECRET [file|-]
```

- stored in the encrypted Swarm Raft log
- replicated among Swarm hosts
- mounted as read-only tmpfs volume `/run/secrets/`

```
docker exec <container_id> cat /run/secrets/<secret-name>
```

GRANT ACCESS TO A SECRET

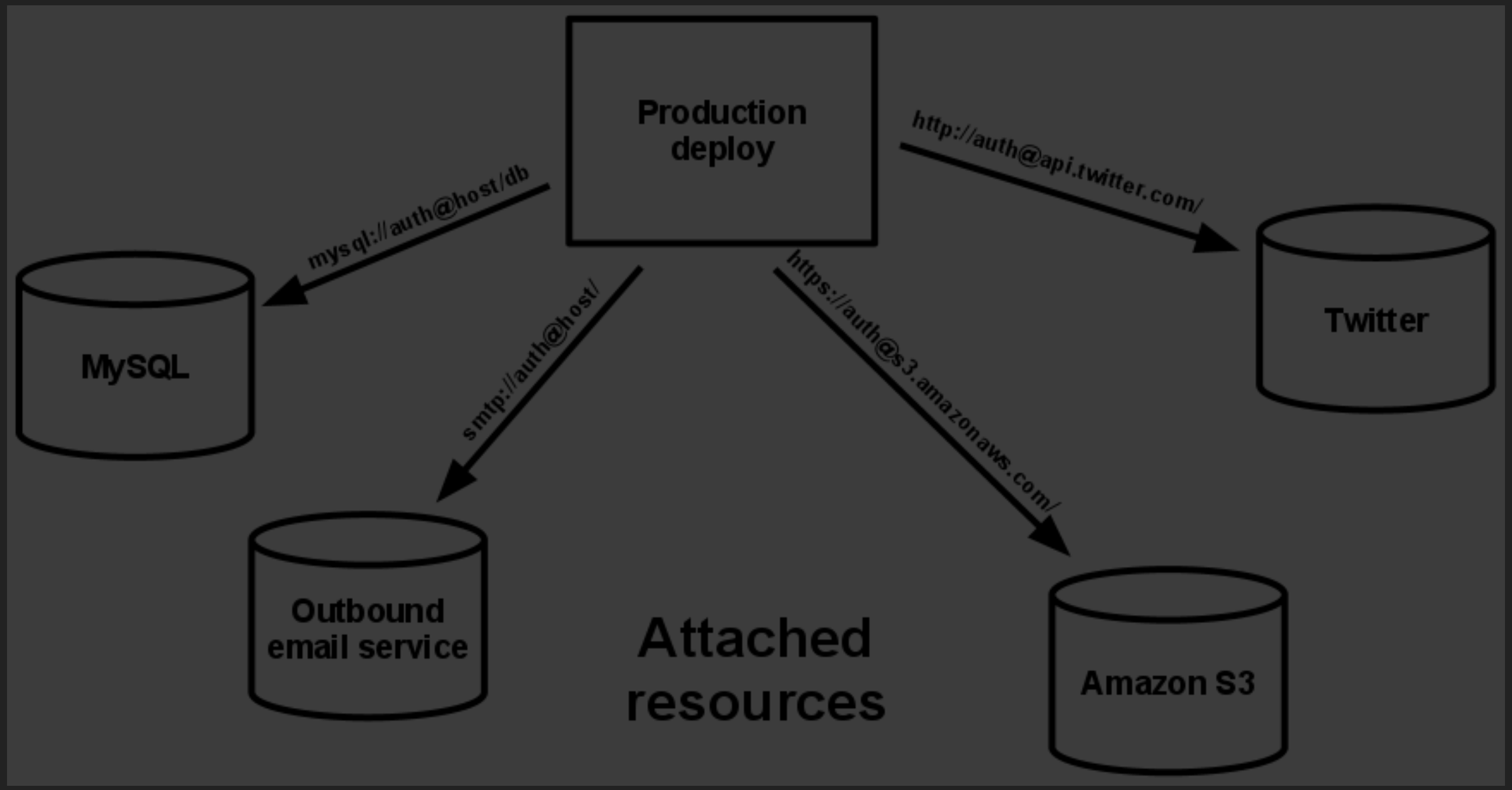
docker-compose.yml

```
version: "3.1"
services:
  <service_name>:
    <...>
    secrets:
      - <secret-name>
    <...>
secrets:
  <secret-name>:
   external: true
```

VAULT – A SECRET STORE

- stores credentials encrypted
- provision credentials dynamically
- completely free and open source
- orchestrator independent

4. BACKING SERVICES



5. BUILD, RELEASE, RUN

strict separation between stages:

1. **build** = code repo converted into executable bundle
2. **release** = build + config
3. **run** release in the execution environment

RELEASES

- every release has a unique ID
- any change must create a new release

DOCKER

- **Build:** Defined in *Dockerfile* and created by

```
docker build --tag name:version .
```

- **Release:** Defined in *docker-compose.yml*
- Run:

```
docker-compose up name
```

or

```
docker stack deploy -c docker-compose.yml name
```

6. PROCESSES

- app is executed in the execution environment as one or more processes
- processes are stateless and share-nothing
- persist data using stateful backing service (DB)
- memory space or filesystem as brief, single-transaction cache

7. PORT BINDING

- app is completely self-contained
- export services via port binding
- app can become the backing service for another app

8. CONCURRENCY

- scale out via the process model
- processes are a first class citizen
- app must be able to span multiple processes running on multiple physical machines

9. DISPOSABILITY

- fast startup and shutdown
- shut down gracefully when receiving a SIGTERM
  - refuse new requests
  - allow current requests to finish

CRASH ONLY SOFTWARE

Stop = Crash Safely

Start = Recover Fast

10. DEV/PROD PARITY

	Traditional	12-factor
Time between deploys	Weeks	Hours
Code authors vs code deployers	Different people	Same people
Dev vs. production environments	Divergent	As similar as possible

11. LOGS

- treat logs as event streams
- write unbuffered to `stdout`
- execution env. completely manages streams

LOGGING TOOLS

- log routers: Logplex, Fluentd
- log indexing and analysis system: Splunk
- general-purpose data warehousing system: Hadoop/Hive
- ELK-Stack (Elasticsearch, Logstash, and Kibana)

12. ADMIN PROCESSES

ONE-OFF ADMINISTRATIVE OR MAINTENANCE TASKS

- database migrations
- console to run arbitrary code
- one-time scripts committed into the app’s repo

HOW TO RUN ADMIN PROCESS

- identical environment
- run against a release
- use the same codebase and config

RUN ADMIN PROCESS IN DOCKER CONTAINER

- In General

```
docker exec [OPTIONS] CONTAINER COMMAND [ARG...]
```

- Run MongoDB client on admin database in service container `db` in deployed stack `app`.

```
docker exec --interactive --tty \
  app_db.1.$(docker service ps -f 'name=app_db.1' app_db -q) \
  mongo admin
```

- Run JavaScript file from host (sent on stdin)

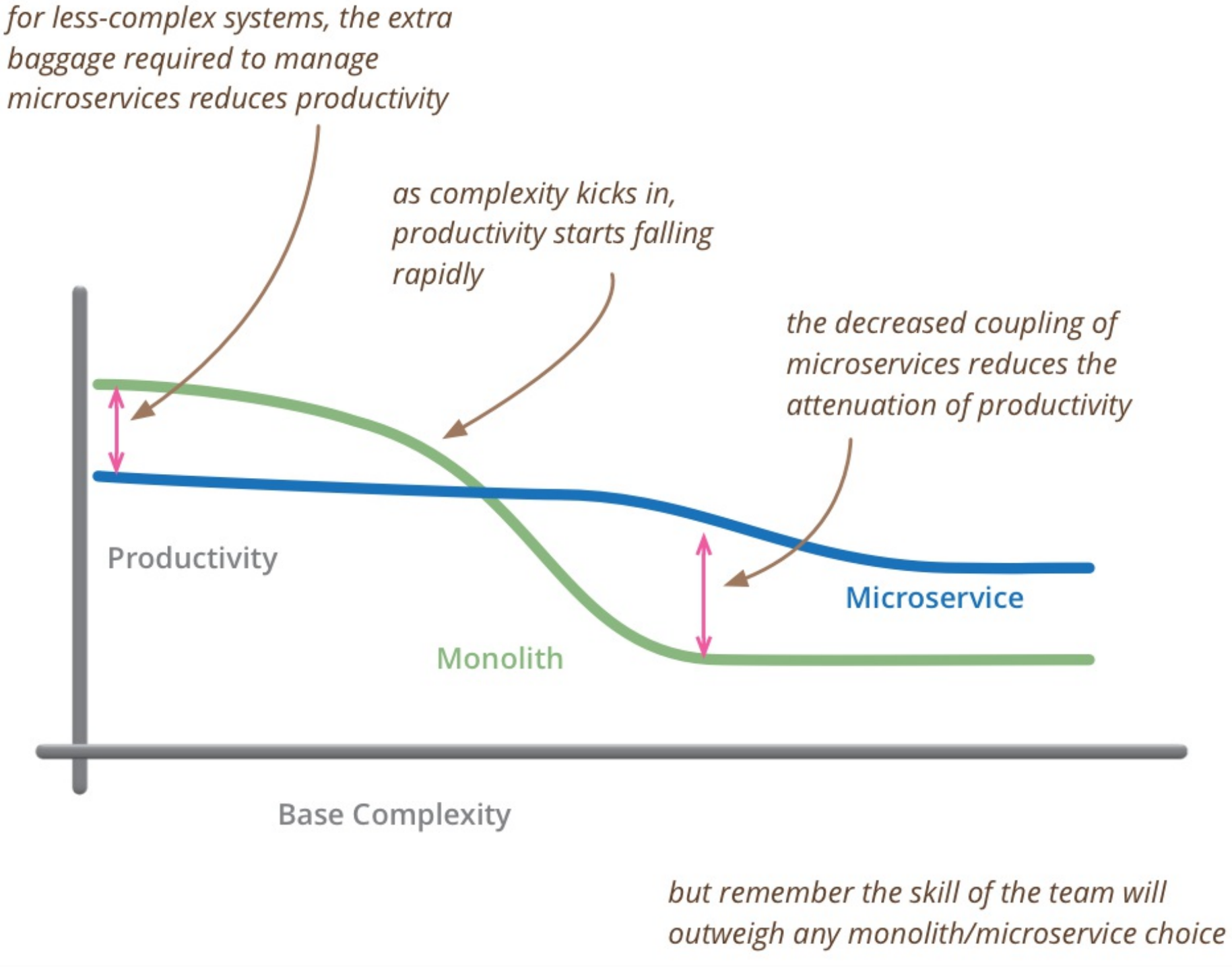
```
cat script.js | docker exec --interactive ${CONTAINER} mongo --quiet
```

SHOULD I USE MICROSERVICES?

any decent answer to an interesting question begins, "it depends..."
(Kent Beck)

WHEN YOU USE MICROSERVICES YOU HAVE TO WORK ON

- automated deployment
- monitoring
- dealing with failure
- eventual consistency
- other factors that a distributed system introduces



but remember the skill of the team will outweigh any monolith/microservice choice

don't even consider microservices unless you have a system that's too complex to manage as a monolith

Martin Fowler

The End.

BONUS

MONITORING

- Grafana
- Prometheus