oueees-202206 topic 05:

Network fault-tolerance

Network services and programming trends

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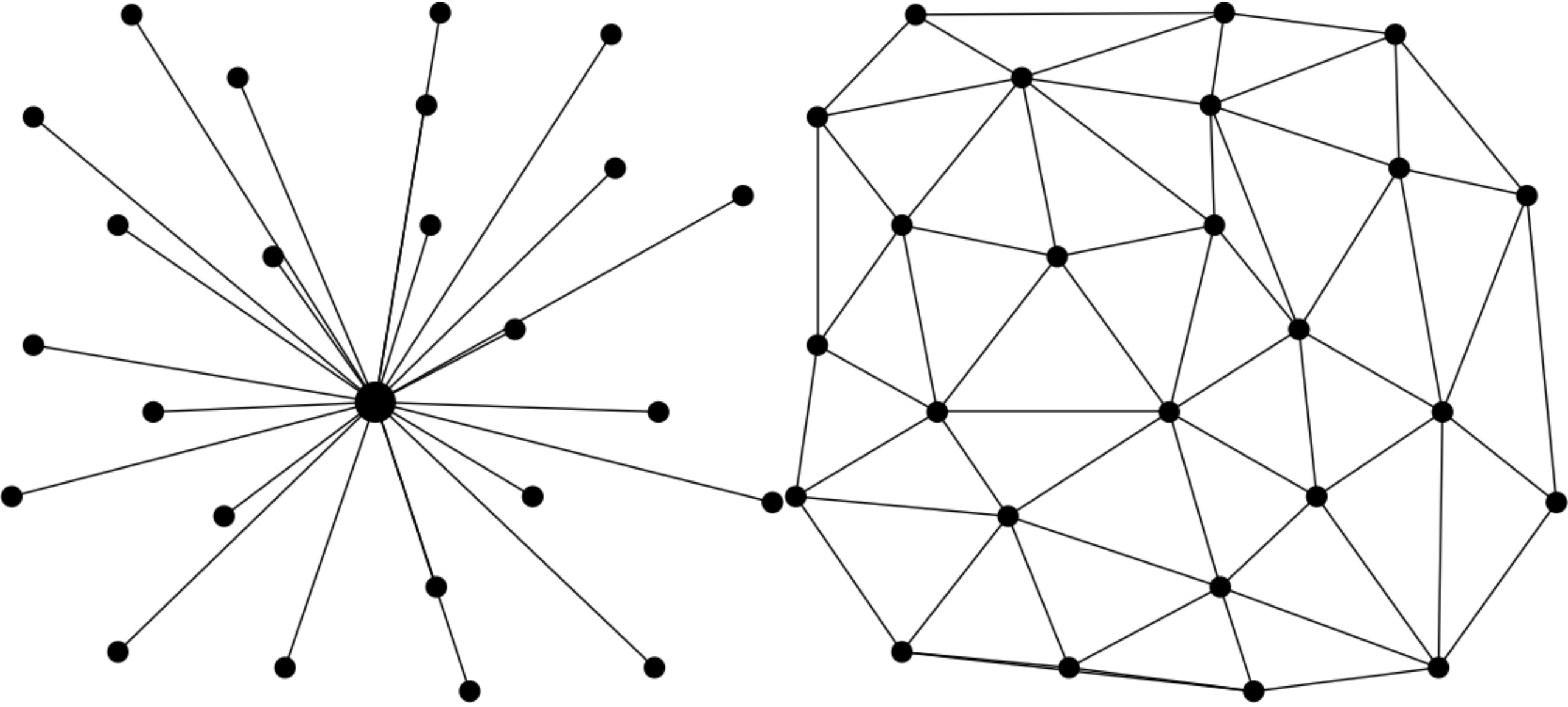
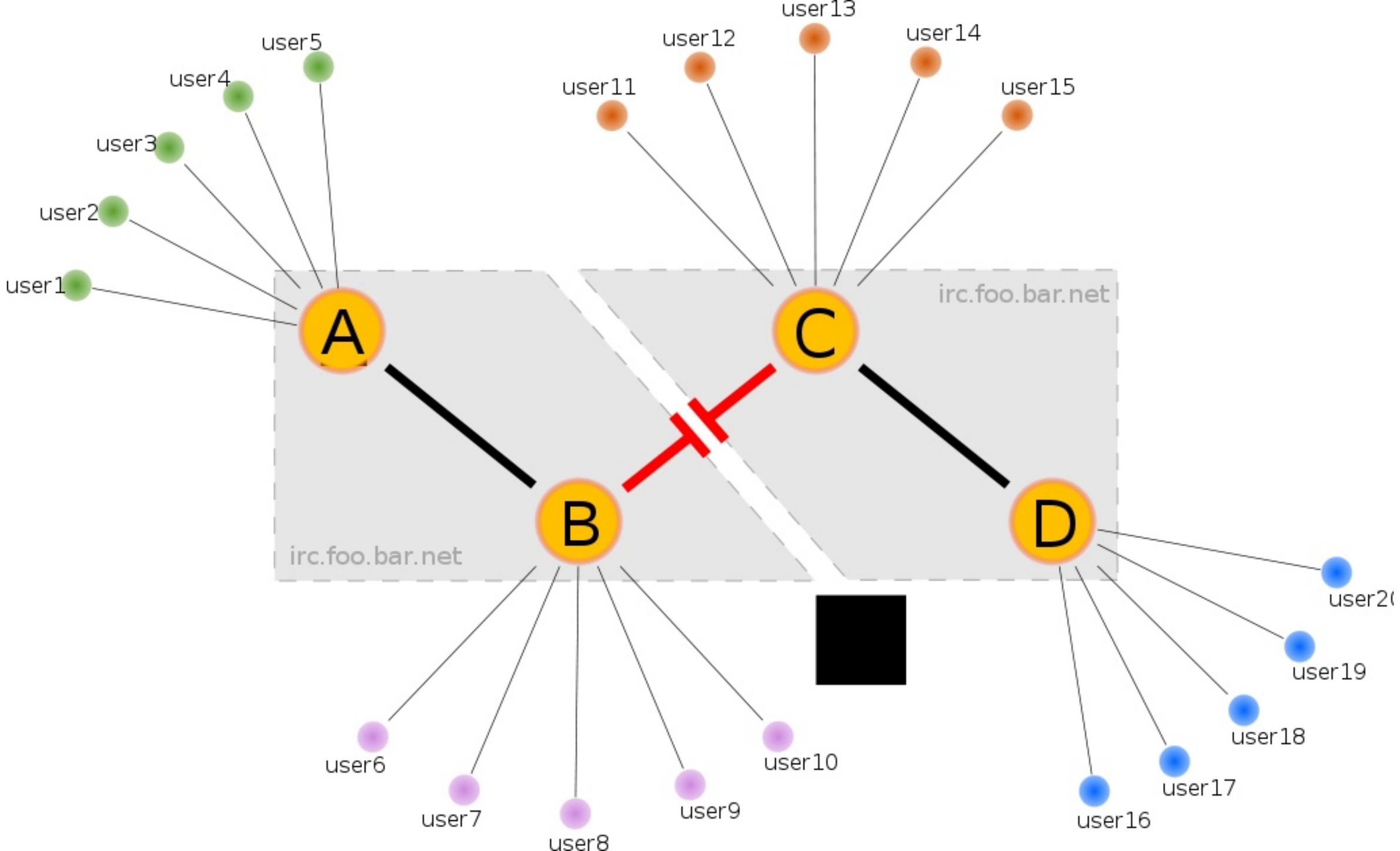
Lecture notes and reporting

- https://github.com/jj1bdx/oueees-202206-public/
- Check out the README.md file and the issues!
- Keyword at the end of the talk
- URL for submitting the report at the end of the talk

Network fault-tolerance




Networks *split*


user5
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irc.foo.bar.net
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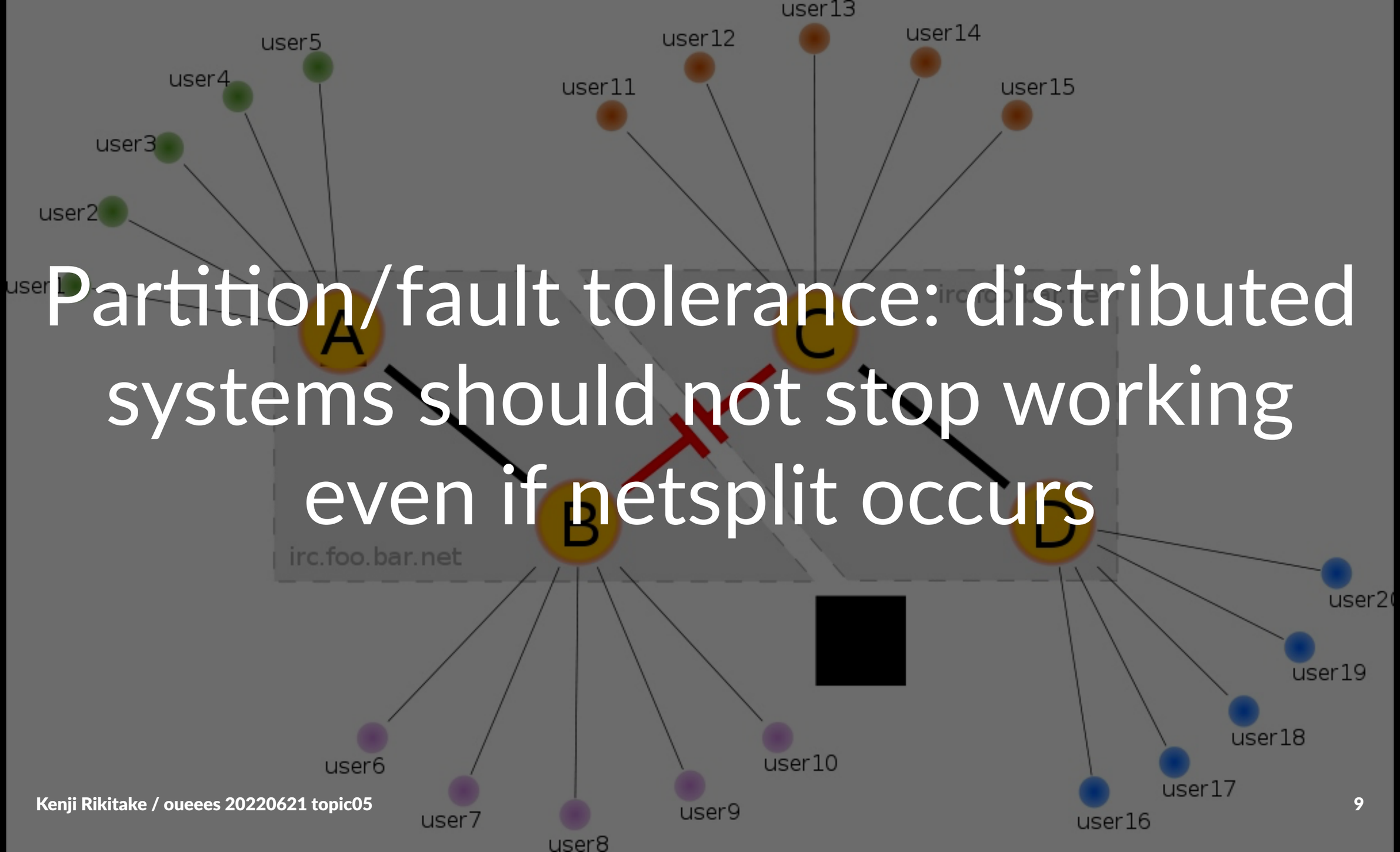


Partition/fault tolerance: distributed systems should not stop working even if netsplit occurs

Real-world challenges

- Natural disasters
- Device failures
- Human operation errors
- Political impediments
- Social resentments

Handling *failures*

- Redundancy: keeping backup units ready
- Fault tolerance: keeping systems running even the components fail
- Resilience by failing fast: early detection of failures and invocation of the recovery procedures

Why fault tolerance?

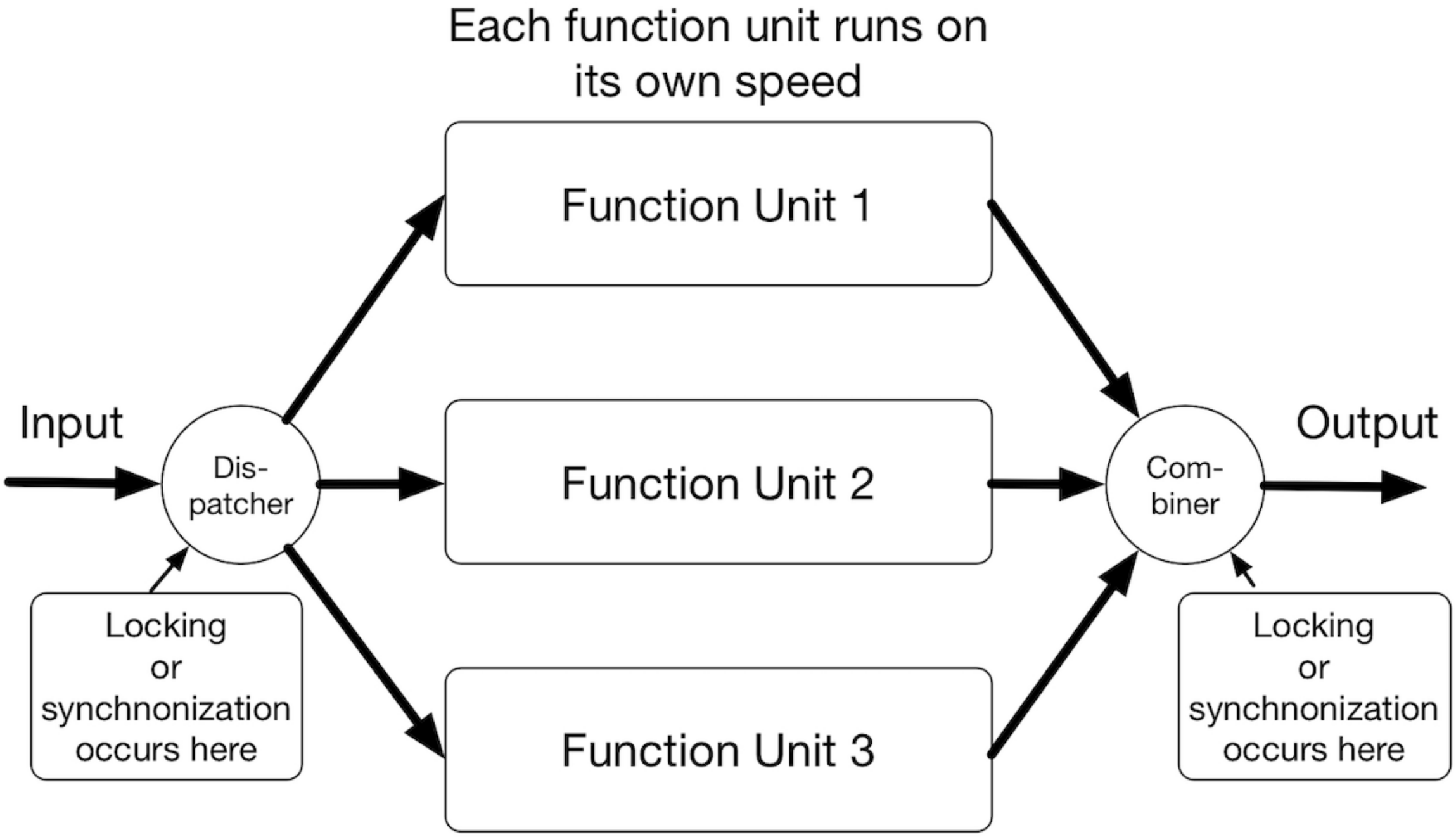
- Hard disk MTBF ~= 1 million hours
- 1000 hard disks running 24 hours x 365 days = 8.76 million hours
- If you're running a system with 1000 hard disks, **9 out of 1000** will fail in a year
- Recovery of a disk content takes often *a day*; you can't stop a system for *a day*, can you?

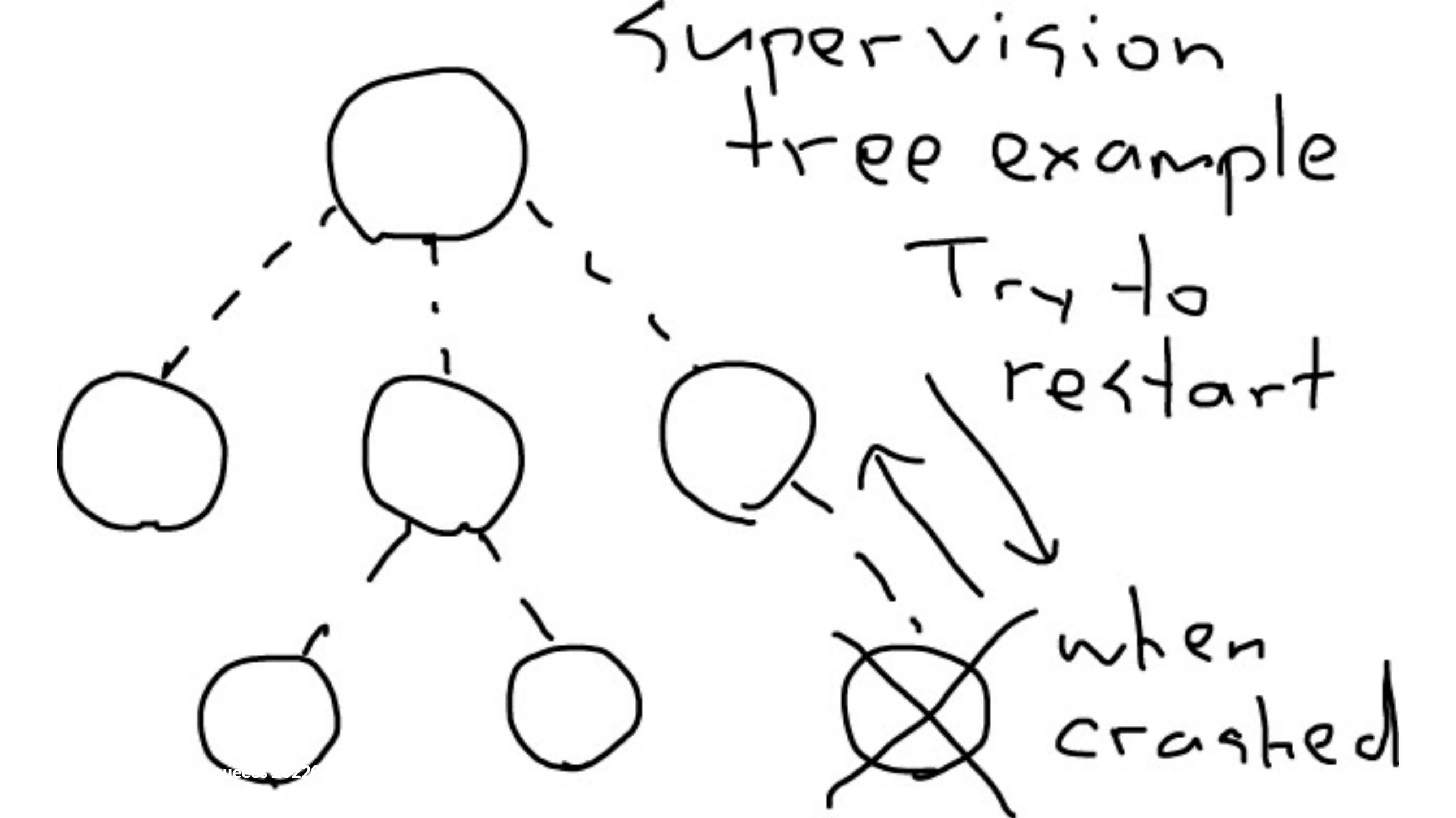
Requirement to keep the systems fault tolerant

- Redundancy: two or more resources for each unit of processing
- Supervising the failure of the units by an independent supervisor
- Rollback capability: undo the incomplete operations and retry

Consistency issues of distributed systems

- Locking/synchronization: waiting all data to be ready to compute or proceed to next step
- Choosing the *right* data: which data is *correct*?
- Supervision: fault detection and restarting


Each function unit runs on its own speed
Function Unit 1
Function Unit 2
Function Unit 3
Input
Dis-patcher
Com-biner
Output
Locking or synchnonization occurs here
Locking or synchnonization occurs here


Supervision
tree example
Try to
restart
when
crashed

Eight Fallacies of Distributed Computing[3] (1/2)

- **The network is reliable**
- **Latency is zero**
- **Bandwidth is infinite**
- The network is secure

[3] https://blog.fogcreek.com/eight-fallacies-of-distributed-computing-tech-talk/

Eight Fallacies of Distributed Computing (2/2)

- Topology doesn't change
- There is one administrator
- Transport cost is zero
- The network is homogeneous

Summary: centralized computing is fragile; distributed computing is fault tolerant but hard

Network services and programming trends

Trends of (network) services

- Becoming hybrid and more complex, many different parts
- Web design: user experience (UX), accessibility, usability
- Development: database, web frontend, web backend
- Site Reliability Engineering (SRE), infrastructure and operation
- Security: vulnerability assessment, incident response

Why learning programming?

Programming = making software

Programming is the only way to fabricate a system

Computers can only do their job through programming

It's often *you* need to write the code, not somebody else

Programming is a language

There are various languages which fit and don't fit your requirement

There are no good or bad programming languages

Modern software development: team, library, and ecosystem

- Development as a *team*, not just individual
- Depending on *libraries*, not just newly-written code
- Depending on the *ecosystem*, not just you and your team

So what to learn?

- Popular ones (C++, JavaScript, Python, etc.)
- *Required* ones by your tasks (old languages)
- For experiments and prototyping (esoteric languages)
- Learning a programming language can change your mind

My suggestions: Erlang/Elixir for concurrency

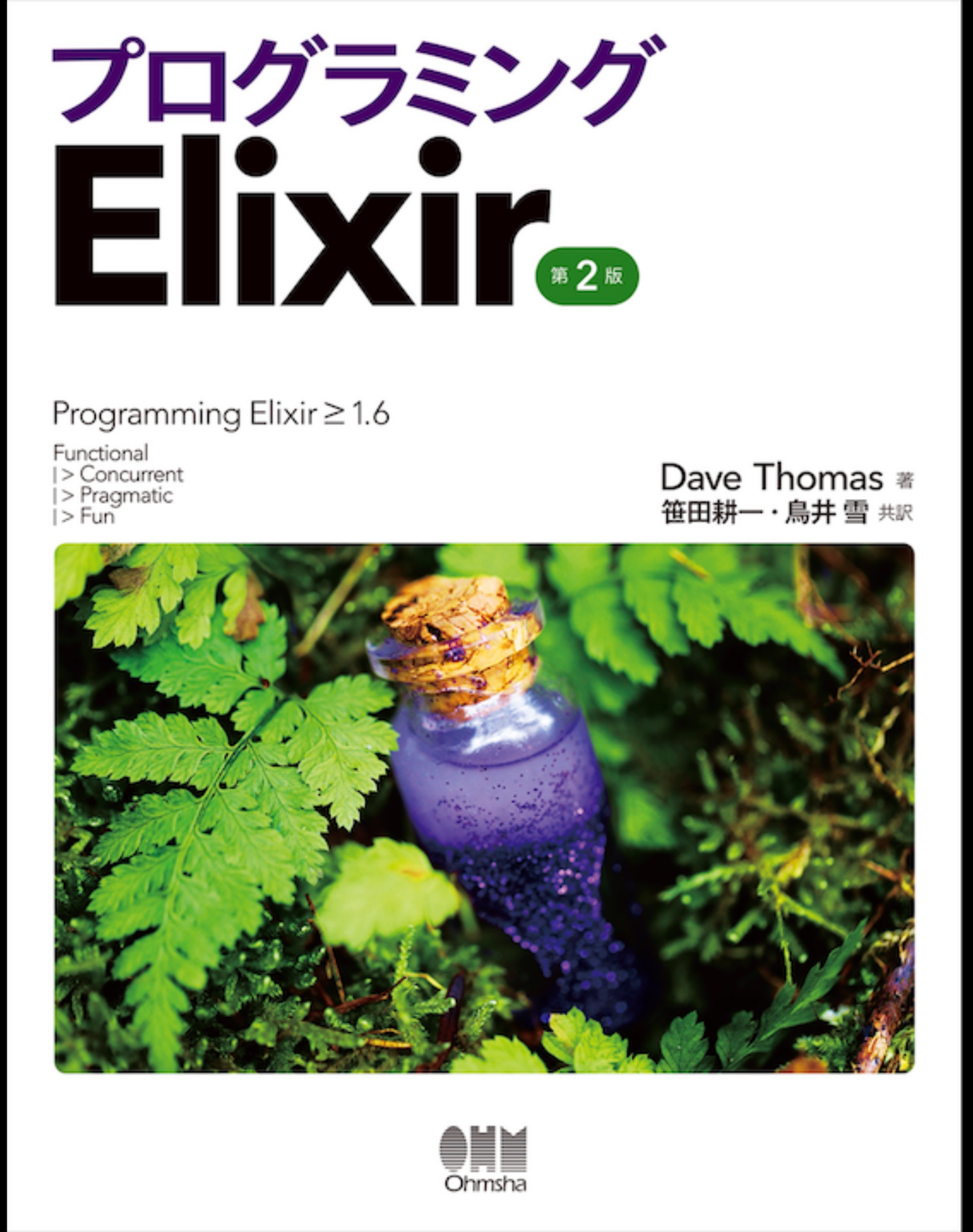
- Concurrency is the key for distributed network programming
- Erlang for learning the basic functional programming
- Elixir for applying functional programming for web
- Disclaimer: these languages are not necessarily popular, but will surely change how you understand computer programming

すごいErlangゆかいに学ぼう!

- オーム社 ISBN 9784274069123
- 達人出版会の電子書籍

プログラミングElixir 第2版

- オーム社 ISBN 9784274226373
- 達人出版会の電子書籍



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