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sustainability consulting + software

openLCA

```java
private LcaResult solve(CalculationSetup setup, int type) {
    log.info("calculate result for {}", setup.target());
    var techIndex = TechIndex.of(db, setup);
    var subs = solveSubSystems(setup, techIndex);
    log.trace("solved {} sub-systems", subs.size());
    var data = MatrixData.of(db, techIndex)
        .withSetup(setup)
        .withSubResults(subs)
        .build();
    var context = SolverContext.of(db, data)
        .withLibraries(libraries)
        .withSolver(solver);

    var provider = switch (type) {
        case LAZY  → ResultProviders.solveLazy(context);
        case EAGER → ResultProviders.solveEager(context);
        default → ResultProviders.solve(context);
    };
    log.info("selected provider {}", provider);

    var result = new LcaResult(provider);

    for (var sub : subs.entrySet()) {
        var techFlow = sub.getKey();
        var subResult = sub.getValue();
        // for sub-systems add the sub-result
        if (techFlow.isProductSystem()) {
            result.addSubResult(techFlow, subResult);
        }
    }

    return result;
}
```

Inside the openLCA calculation engine

Michael Srocka, srocka@greendelta.com
openLCA.conf 2024

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Content

mathematical concepts

this talk

informal description

software implementation

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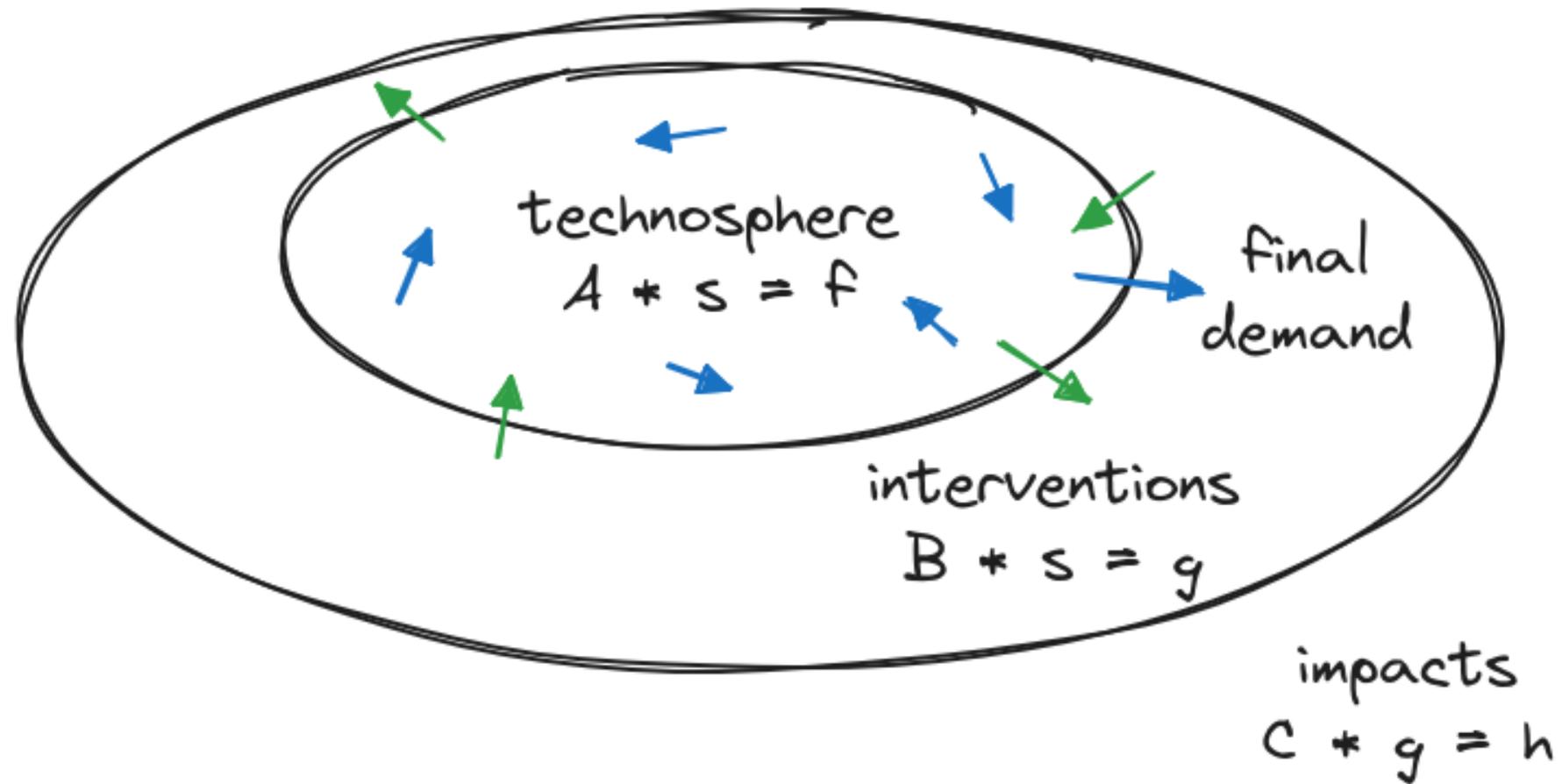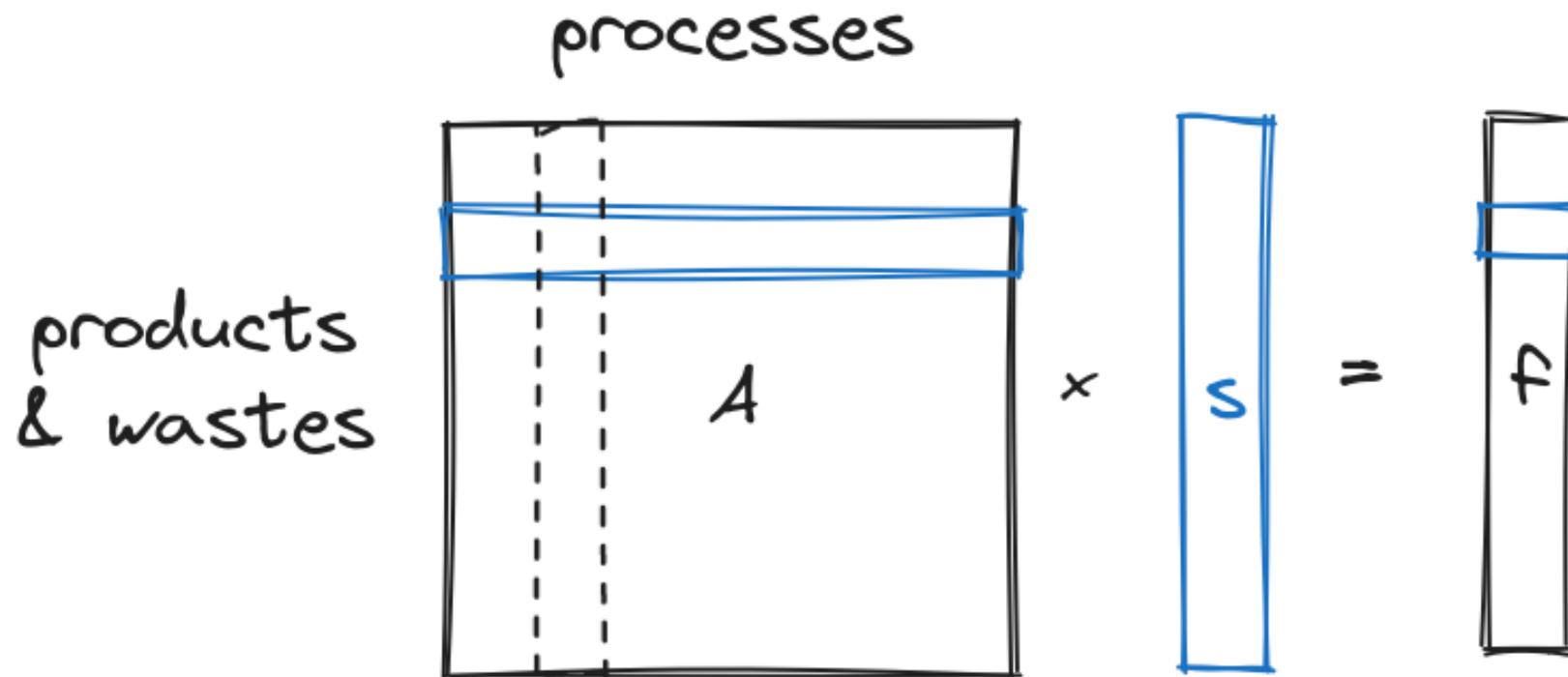
General concepts

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The technosphere

processes

products & wastes

$$A \times s = f$$

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Product balance

processes

products
& wastes

$s[1]*$ | | $+$ $s[2]*$ | | $+ ... + s[n]*$ | | $=$ | f |

$A[:,1]$

$A[:,2]$

$A[:,n]$

Interventions

GReenDeLTa

Impact assessment

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Data flow

user interface

import & export

scripting

...

domain model

database

calculation model

A B C

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Domain model

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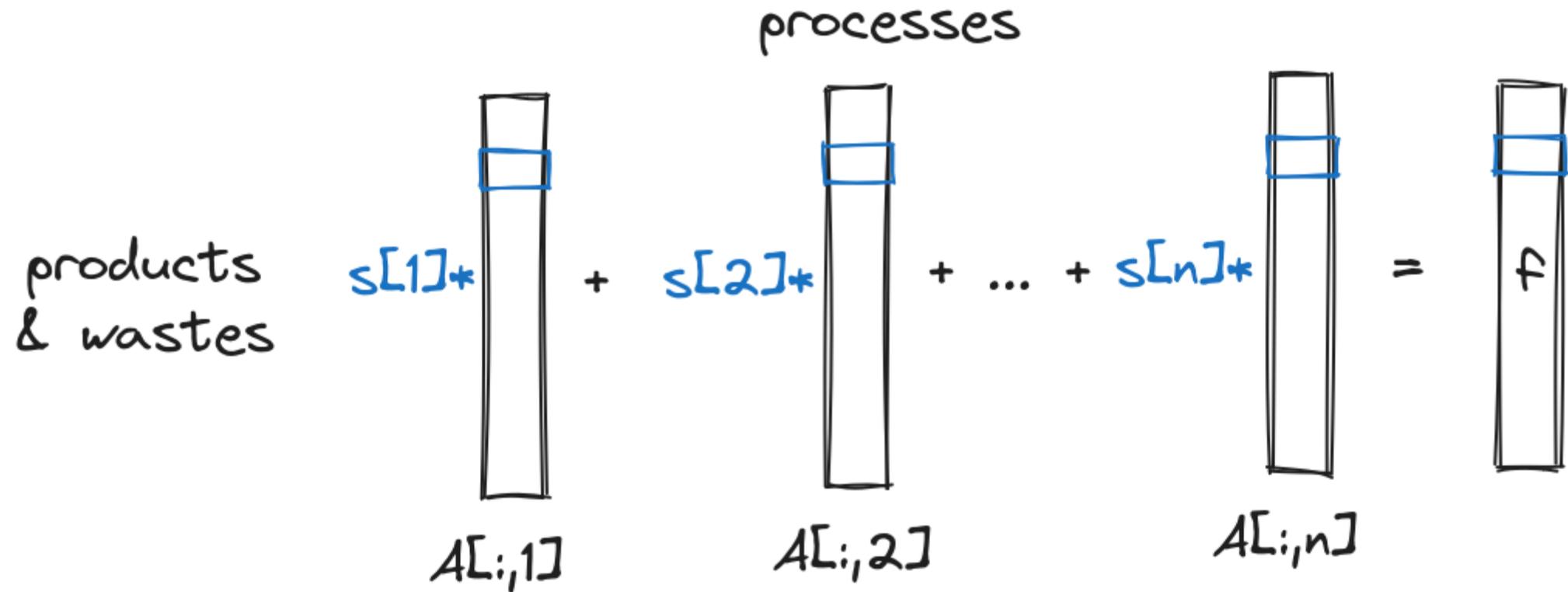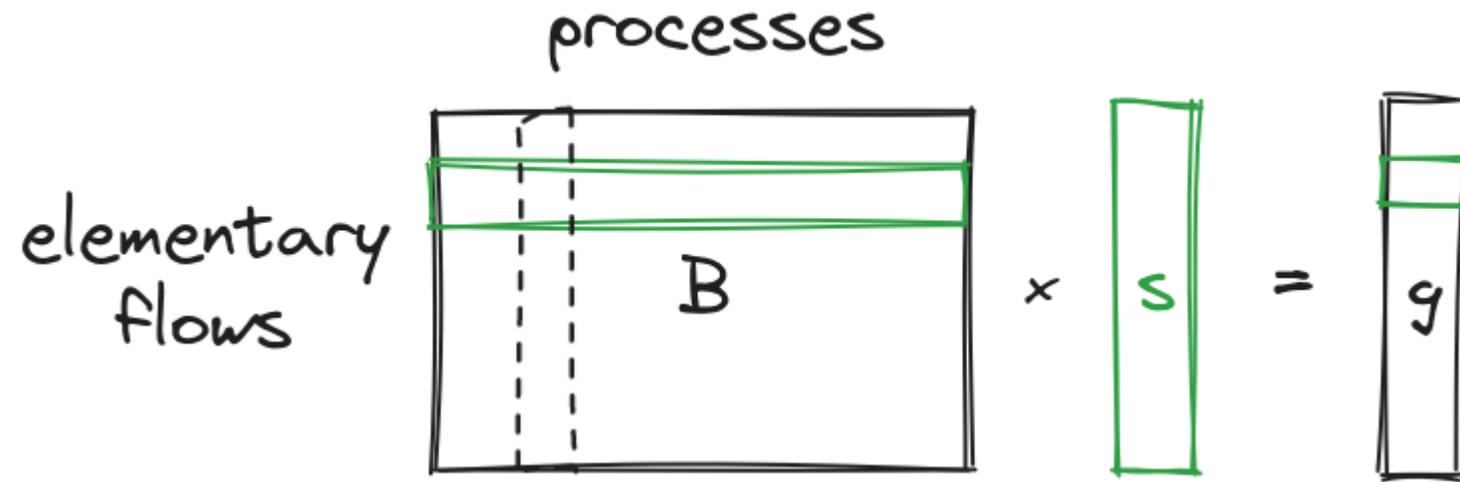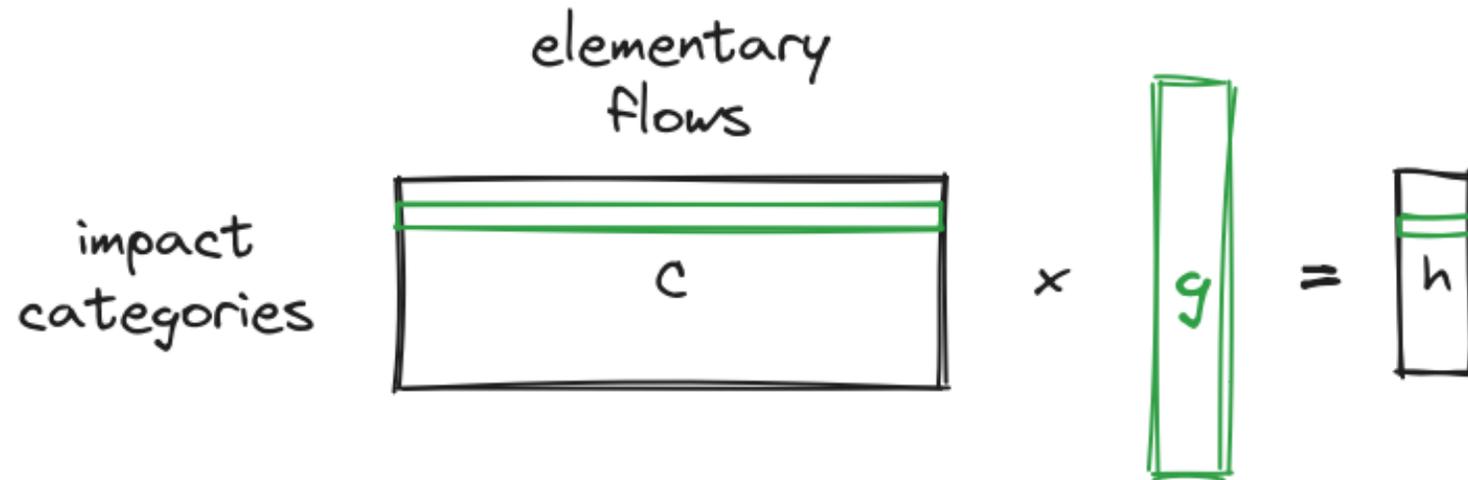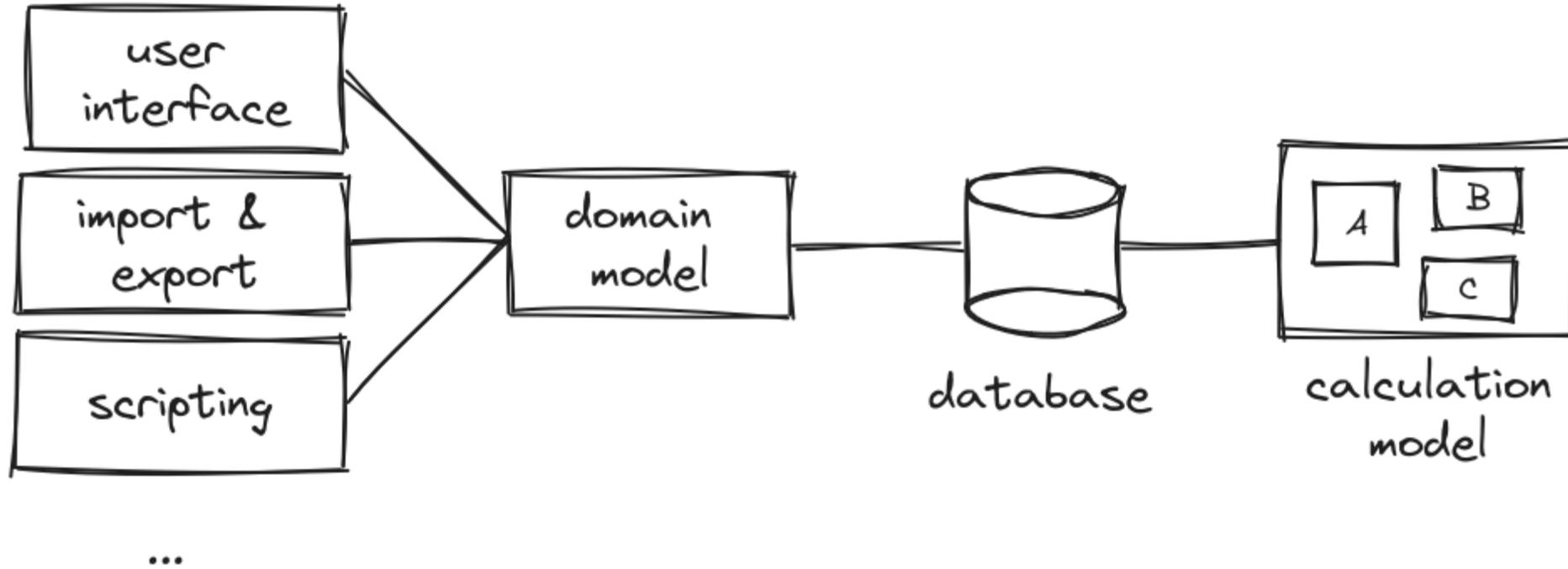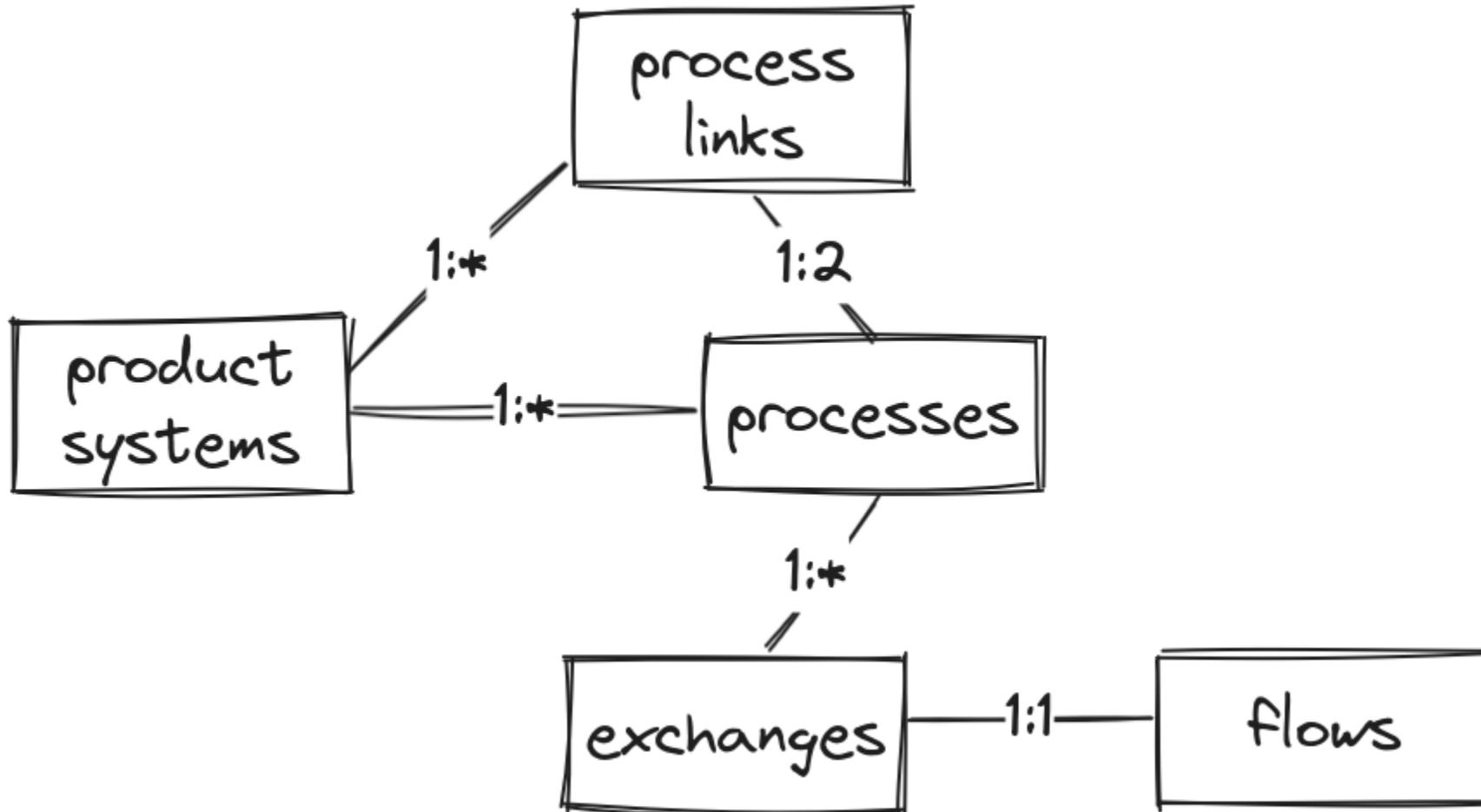
Indexing the technosphere
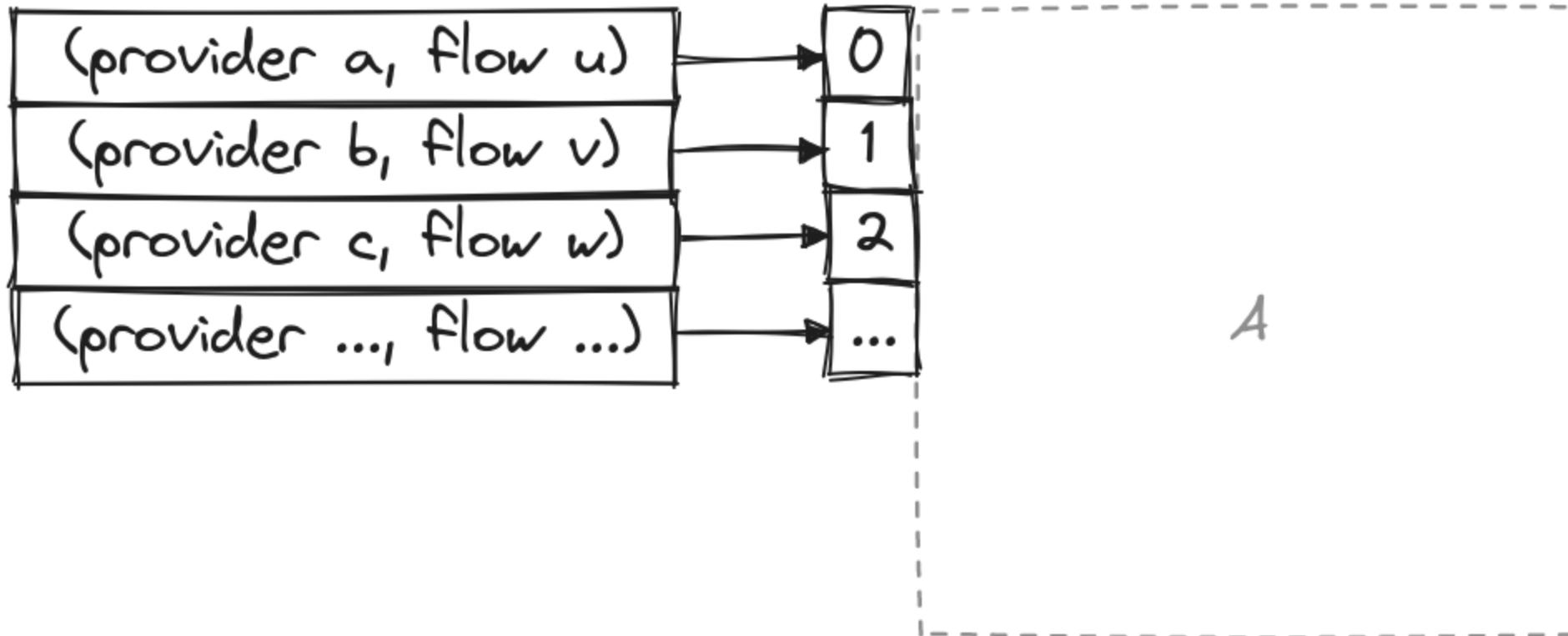
Provider flows & linkable exchanges

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Graph traversal


linkable
exchange

process links

provider index

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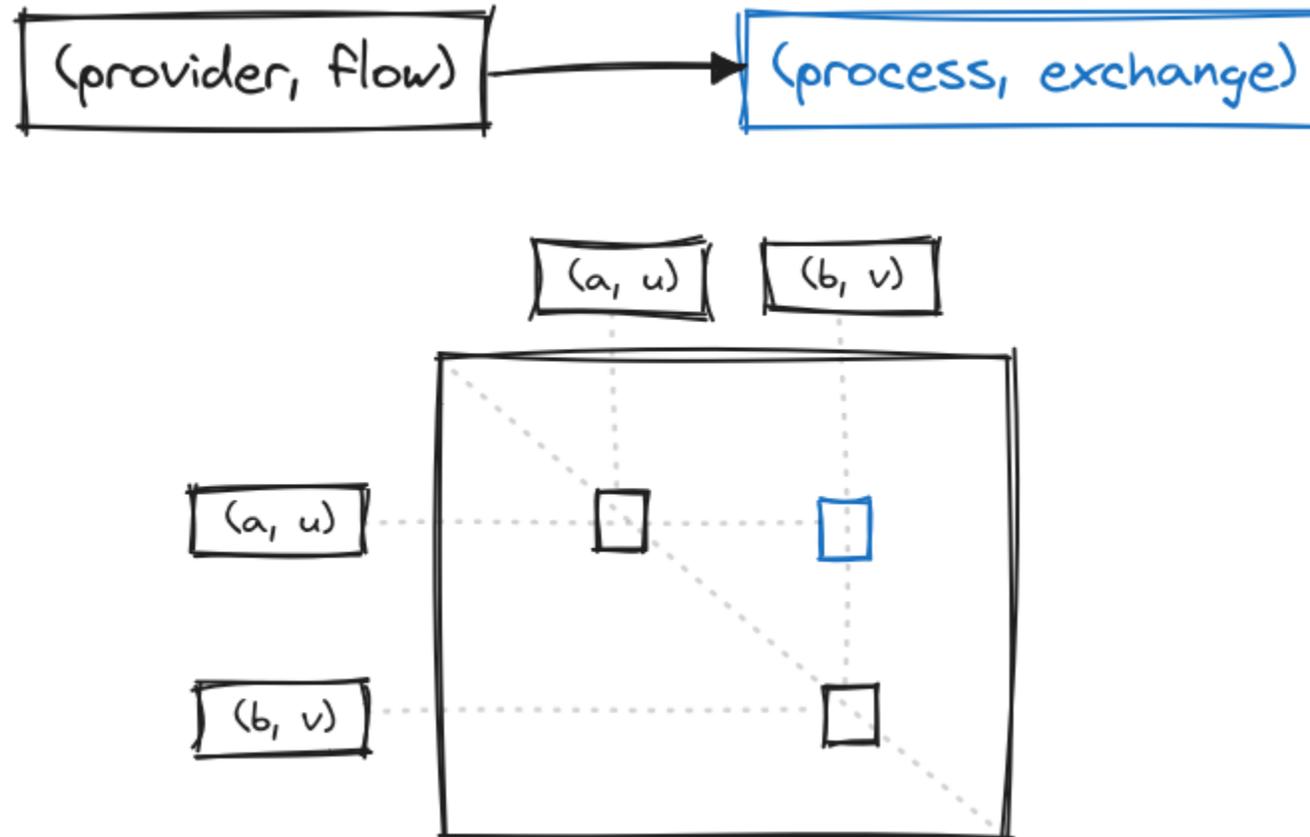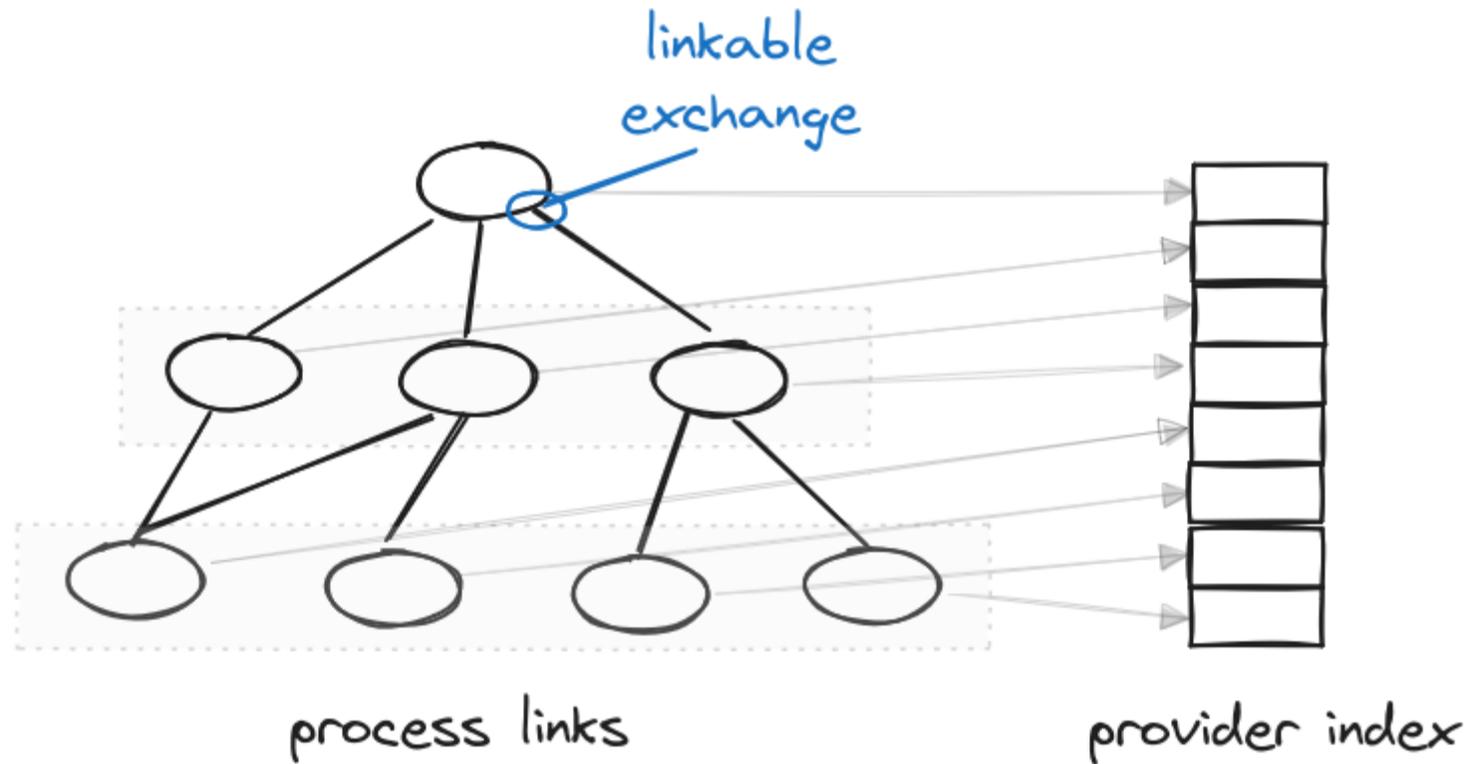
Filling the inventory
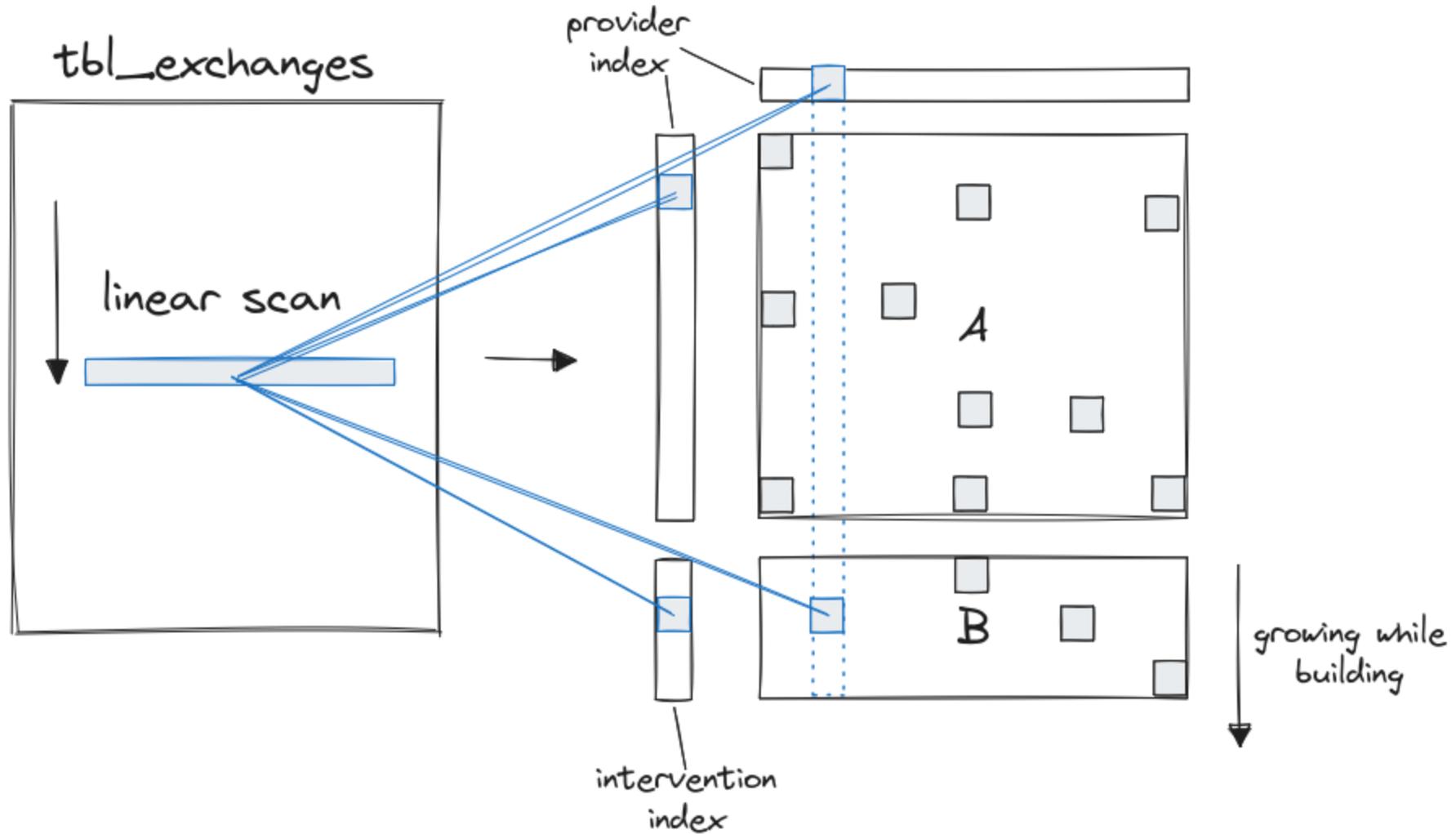
Filling the characterization matrix
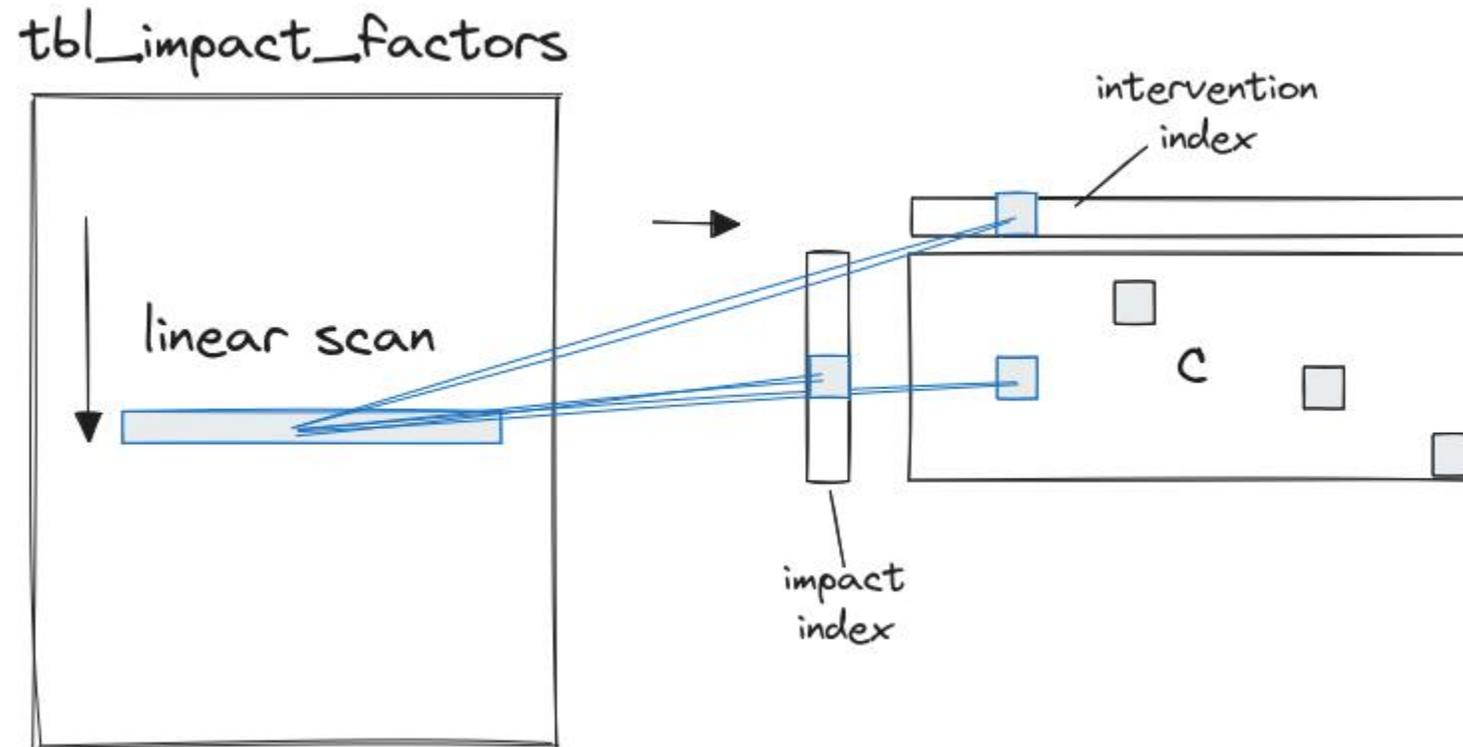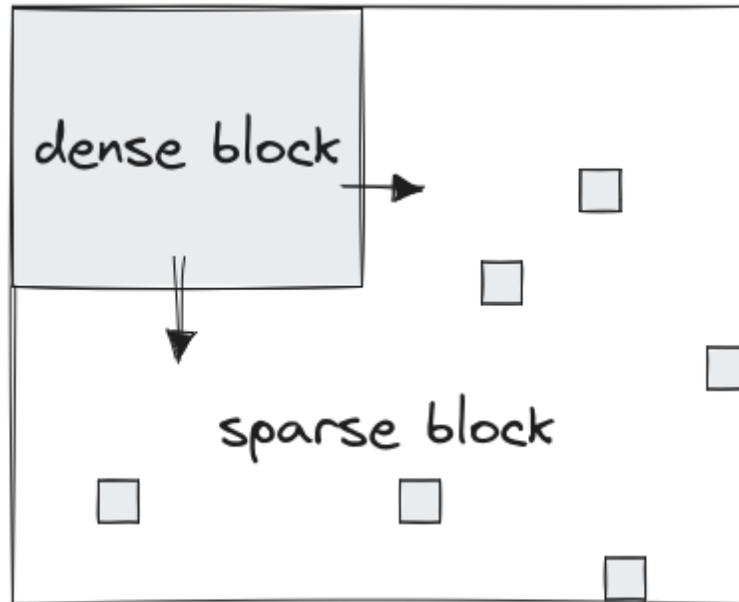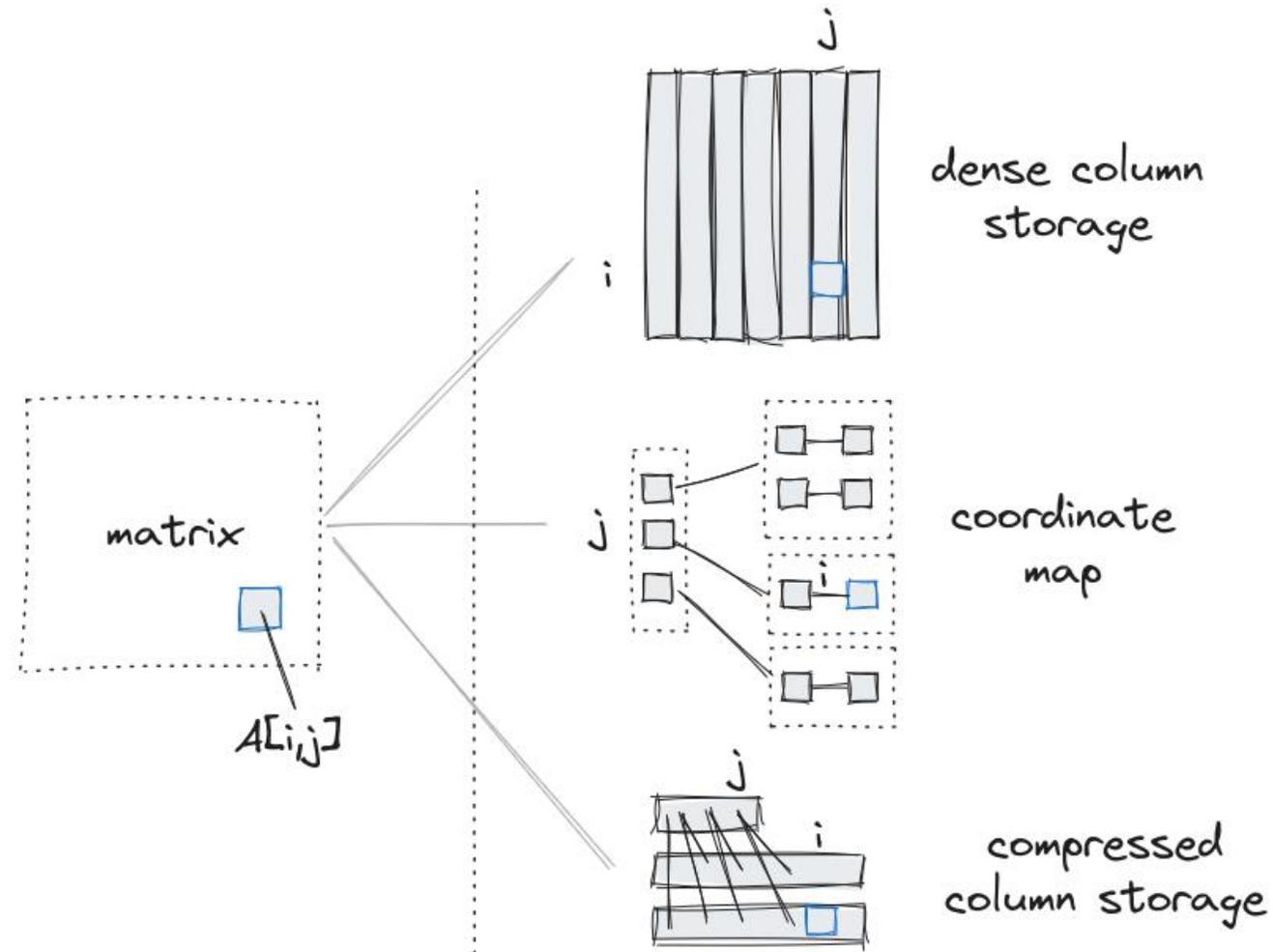
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Matrix building

dense block

sparse block

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Matrix interface

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Solver interface

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The formula interpreter

matrix

42*x - 31*y

x = 3
z = 3
z = 8

parameter
redefinitions

formula interpreter

x = 21
y = 2 * x

global scope

b = max(y, z)
z = 4

local scope

a = 3 + z
x = if(a>b, a, b)

z = 2*pi

...

...

Allocation

P: allocation factors

- physical
- economic
- causal

(P, u) (P, v)

A

B

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Regionalization

flow index

(flow u)
(flow v)
(flow w)
...

B

C

regionalization

flow-location index

(flow u, location a)
(flow u, location b)
(flow v, location a)
(flow v, location b)
(flow w, location a)
(flow w, location b)

...

B

C
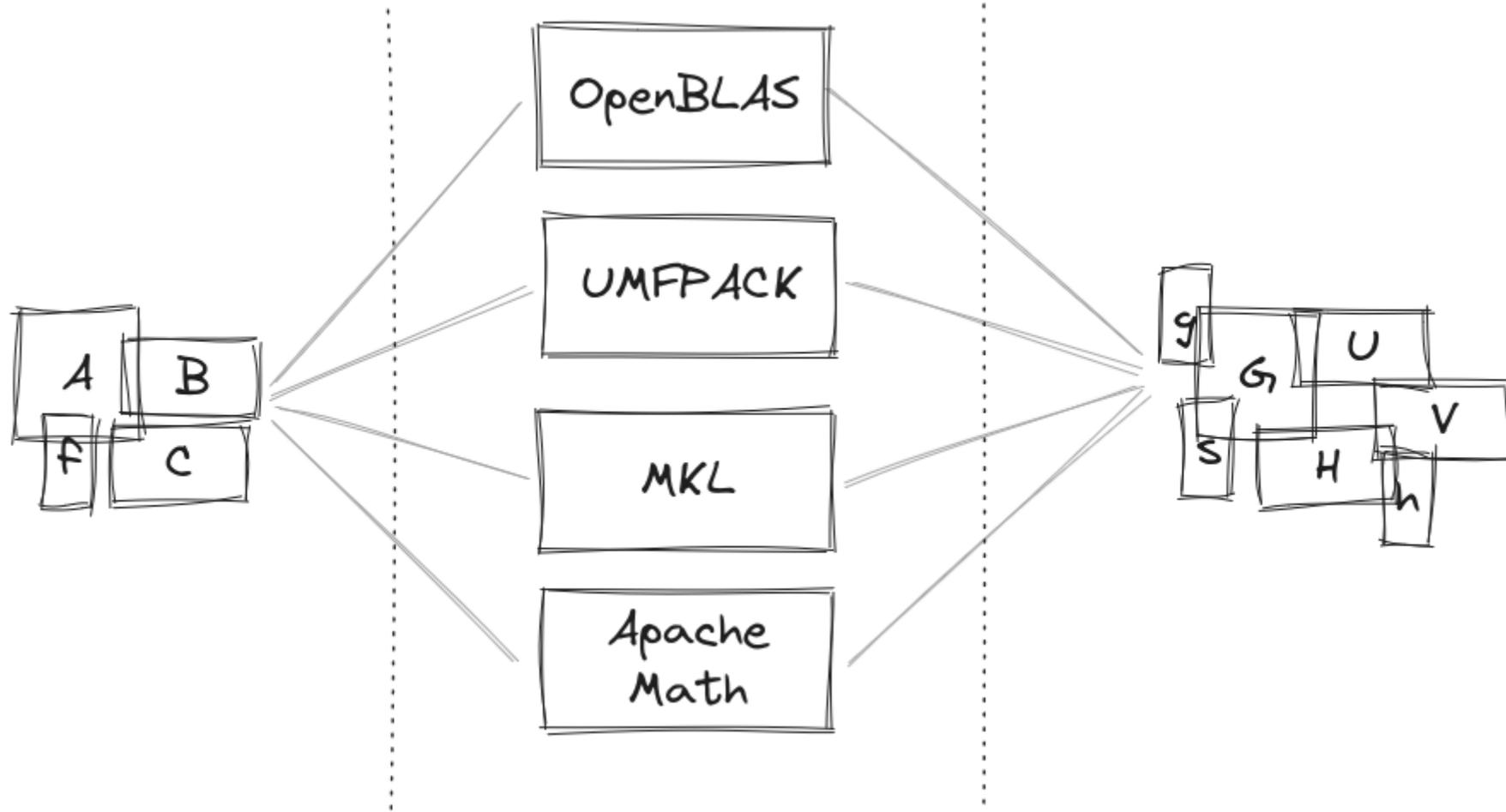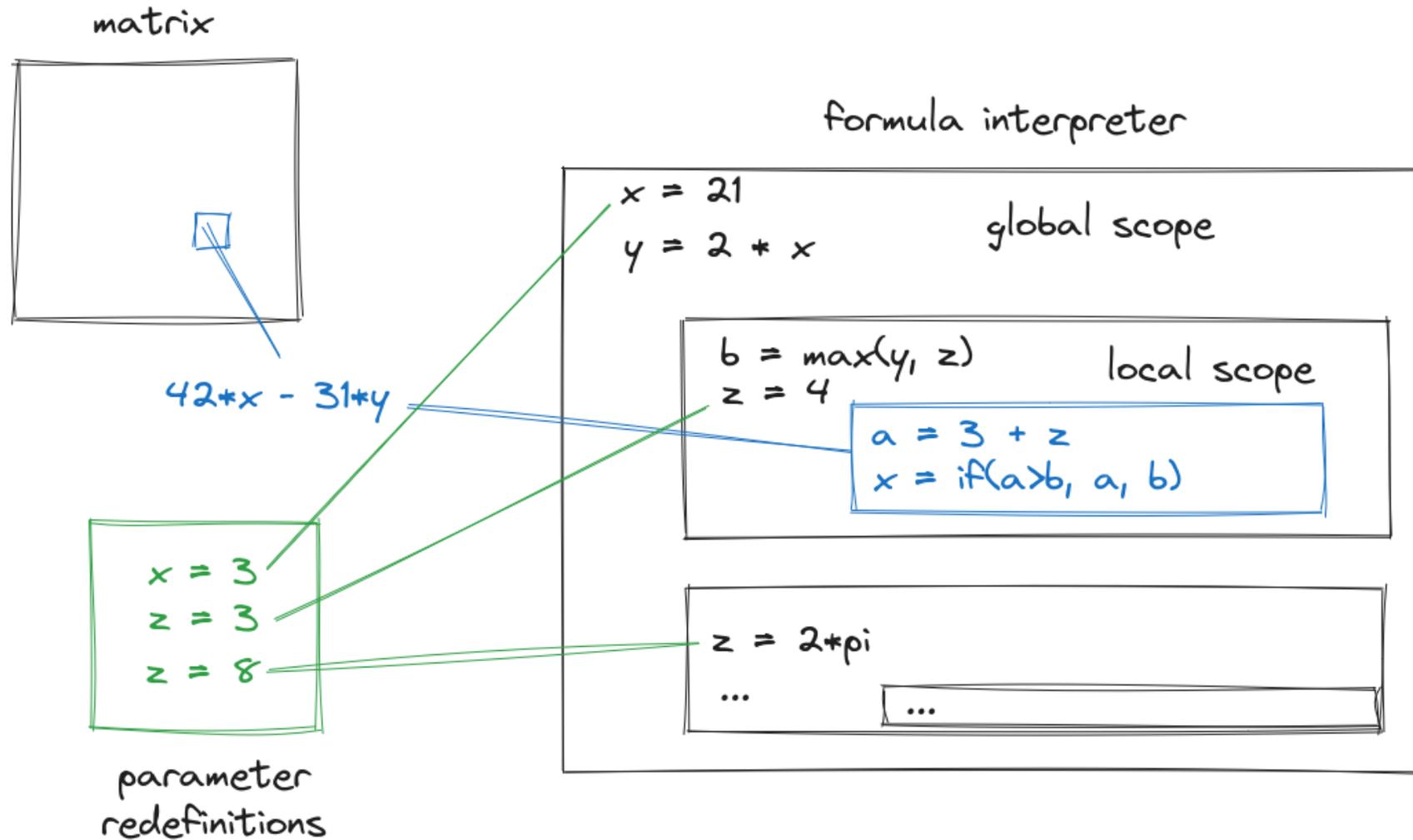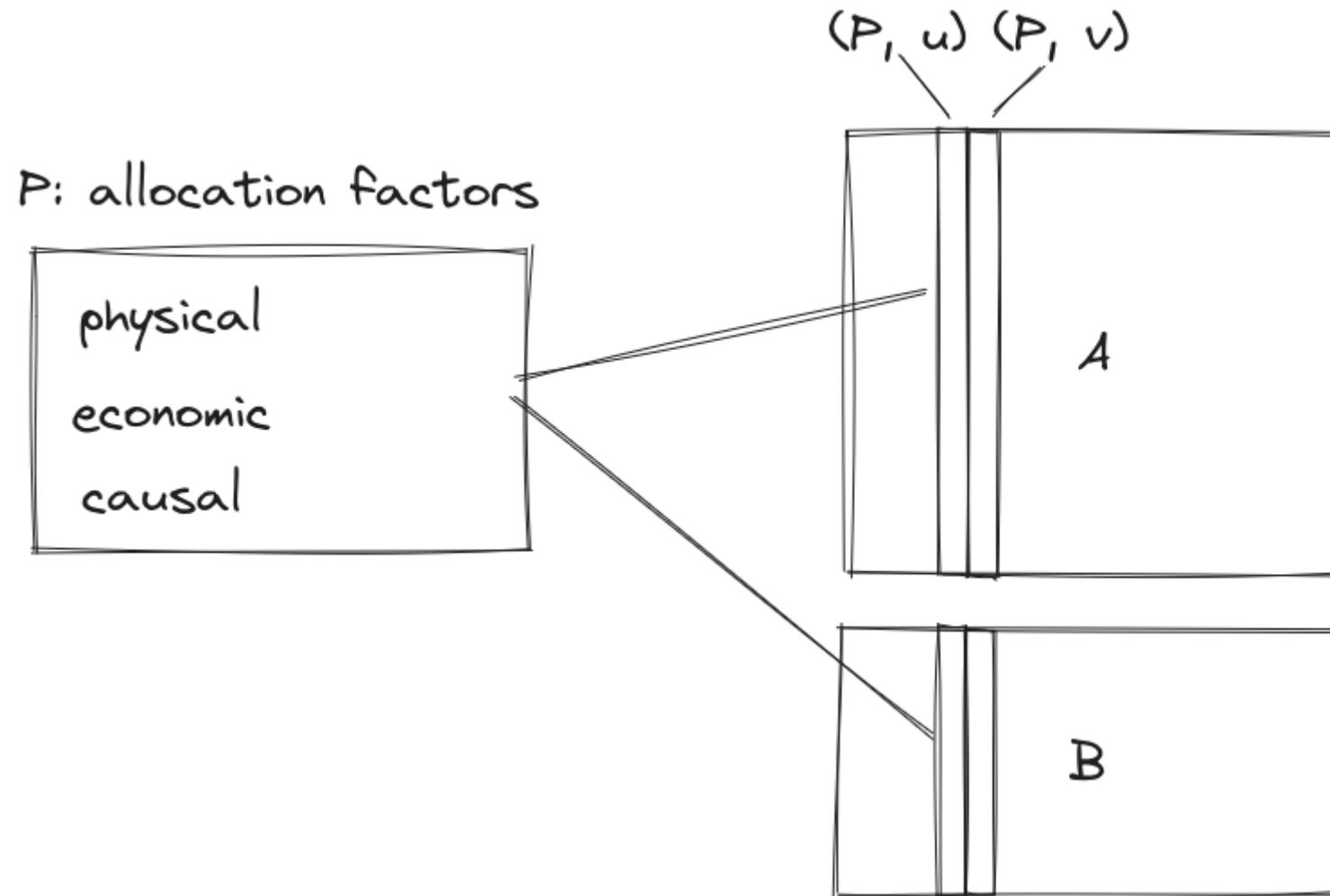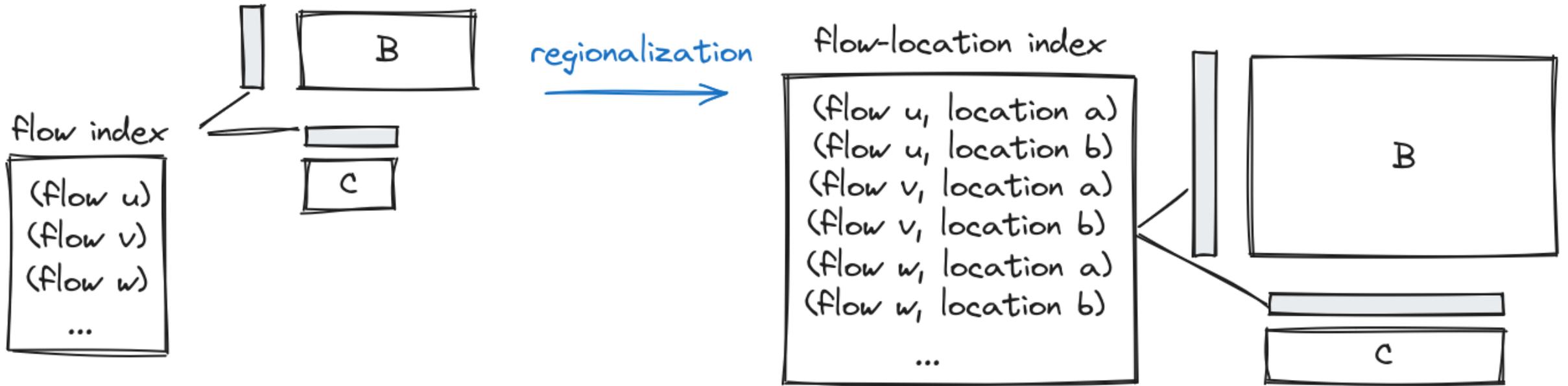
Sub-systems
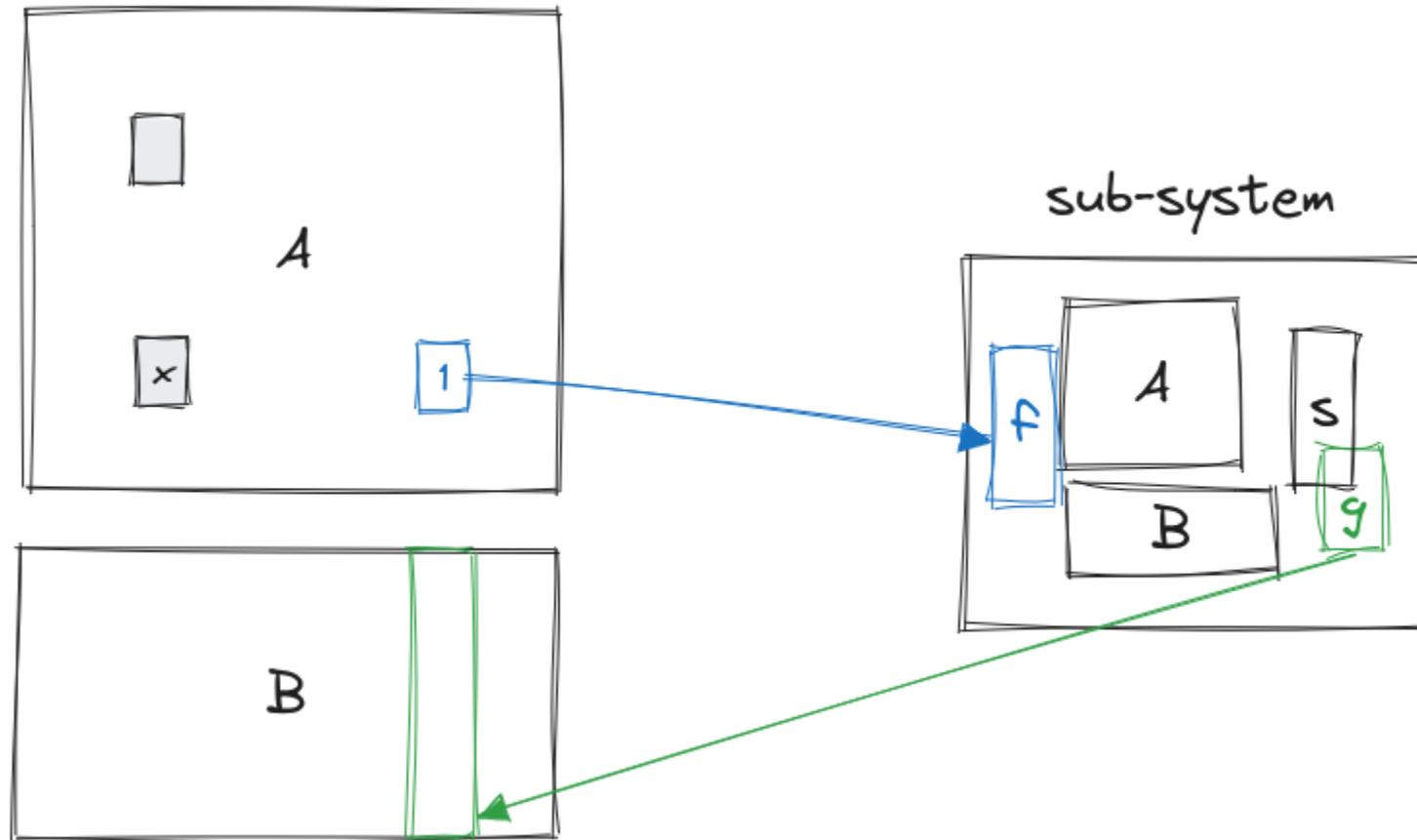
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Monte Carlo simulations
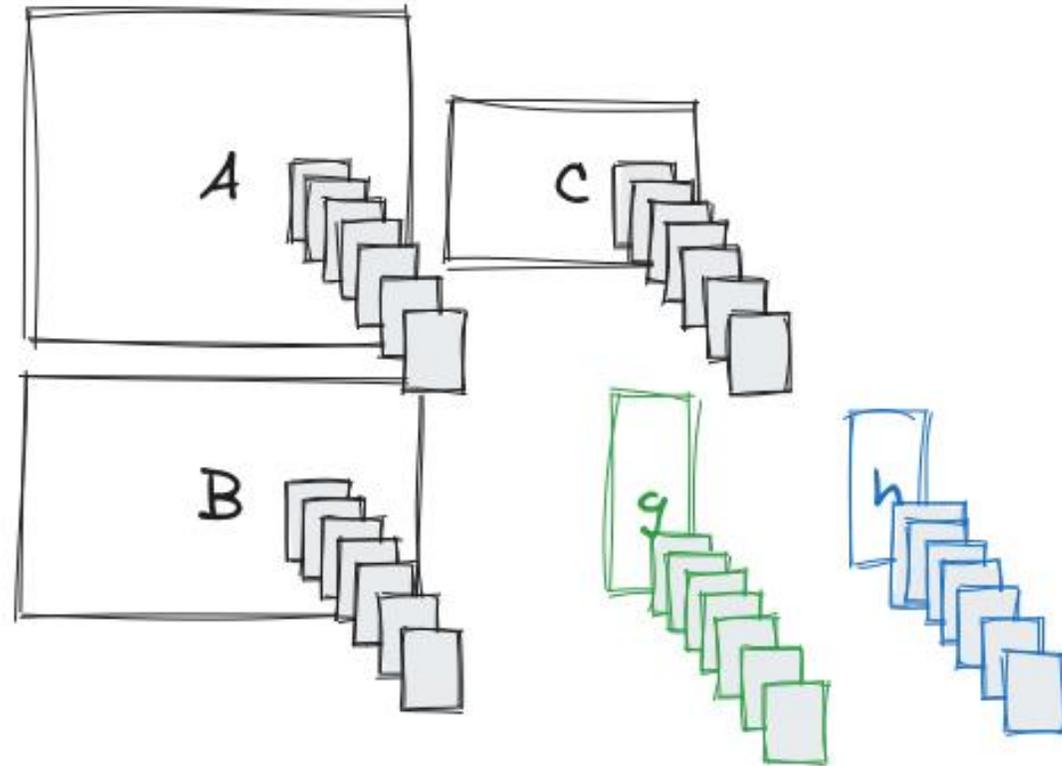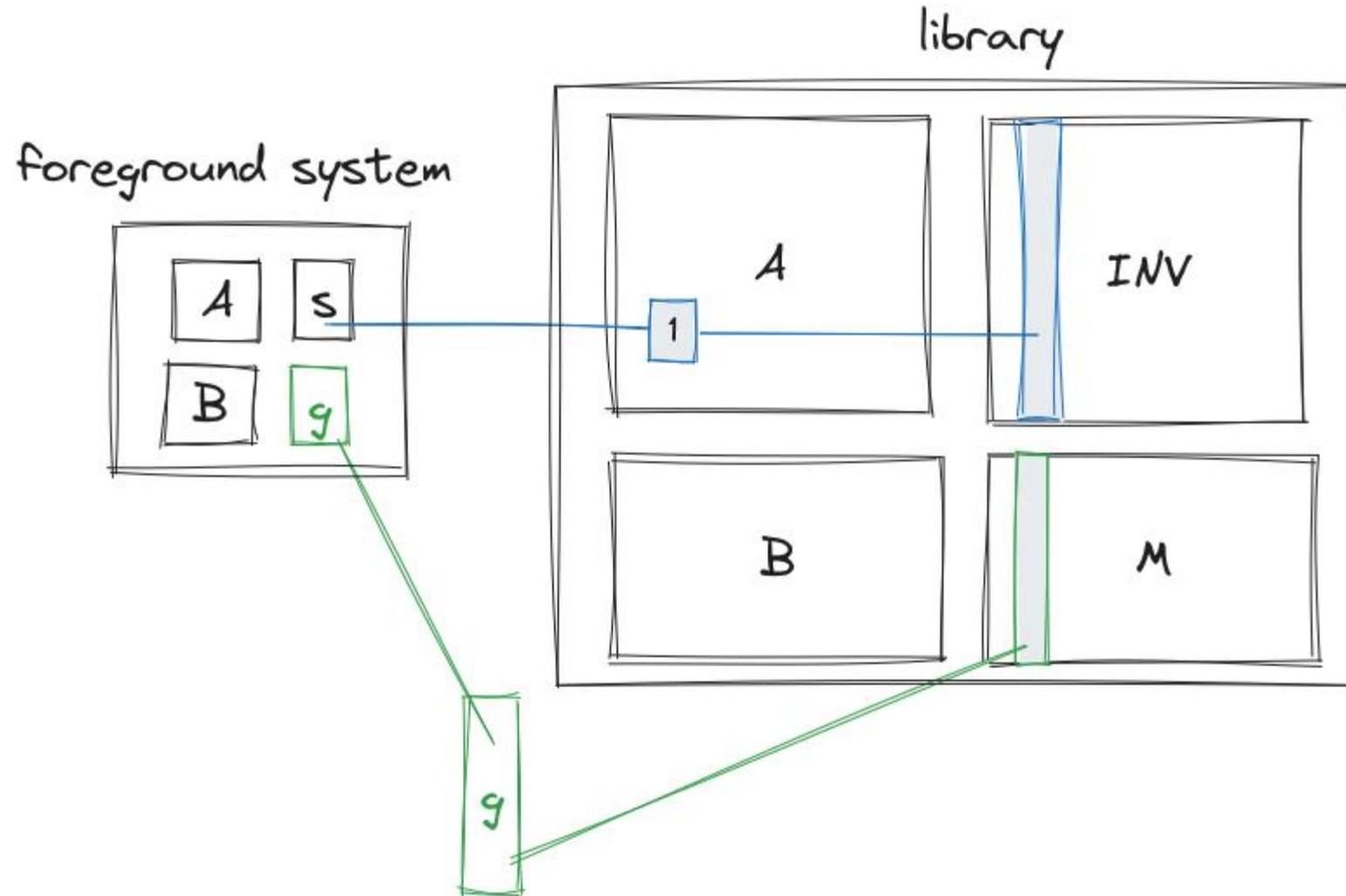
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Libraries

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It's not just g and h ...

$t = diag(A).*s$

$G = B*diag(s)$

$INV = inv(A)$

$U = M*diag(t')$

$H = C*diag(g)$

$M = B*INV$

$t' = t.*l$

$l = 1/(diag(A).*diag(INV))$

$V = C*B*diag(t')$

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Lazy calculation

$= A \backslash f'$

INV

$= B * INV[j]$

M

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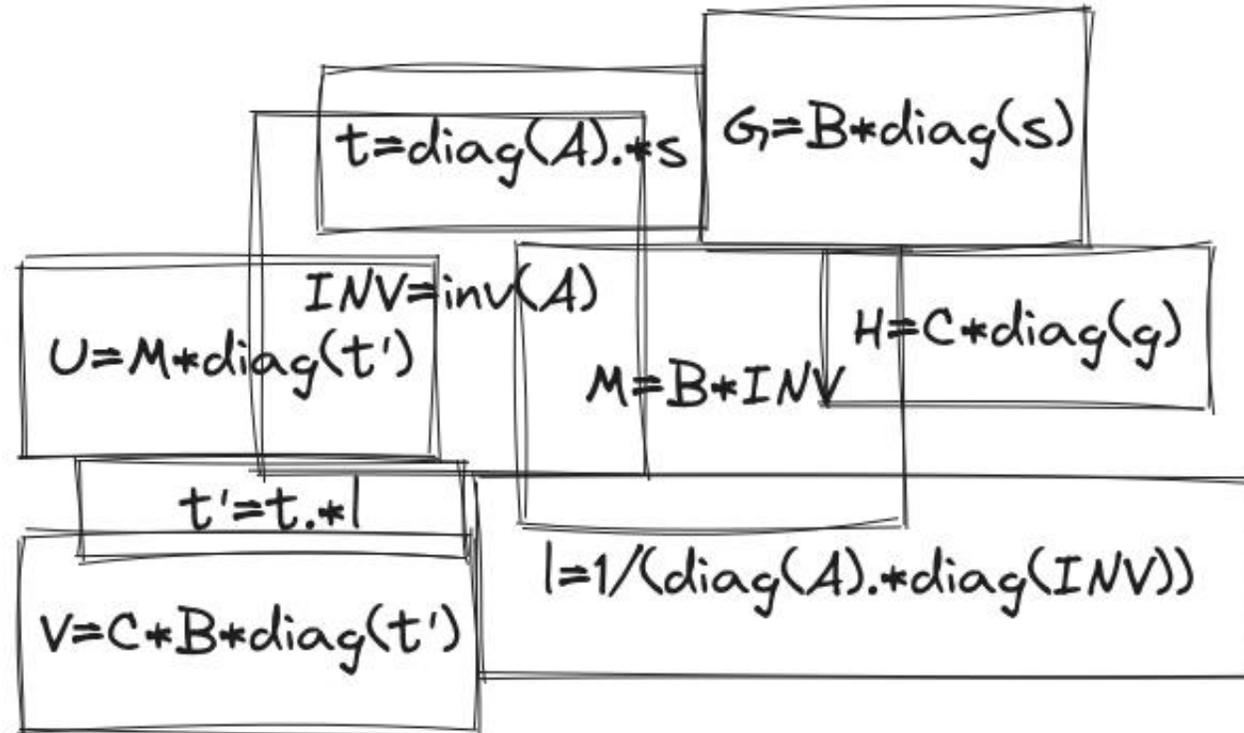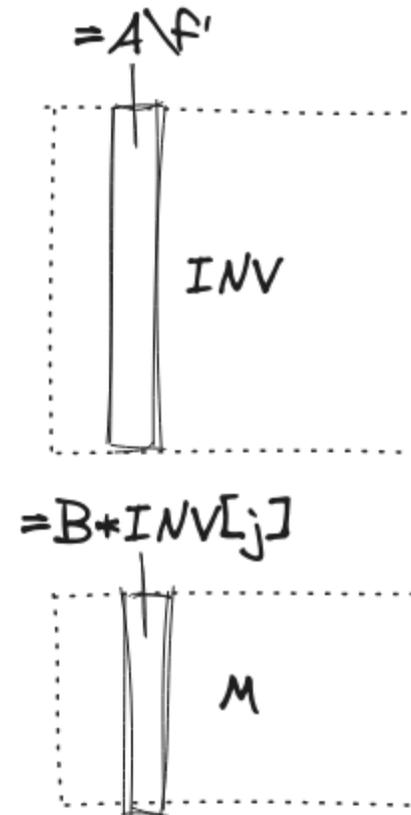
Thank you!

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