

Interlude: The Digital World



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Schahram: Computing Continuum

focusses Implementation

IOT, Fog computing, Cloud computing

holistic ecosystem

distributed intelligence

Deep SLOs (service level objectives)

Markov Blankets

Active Inference

Human in the Loop

... for which world?

the Digital World,

.. not just data,

but also including

humans, organizations,

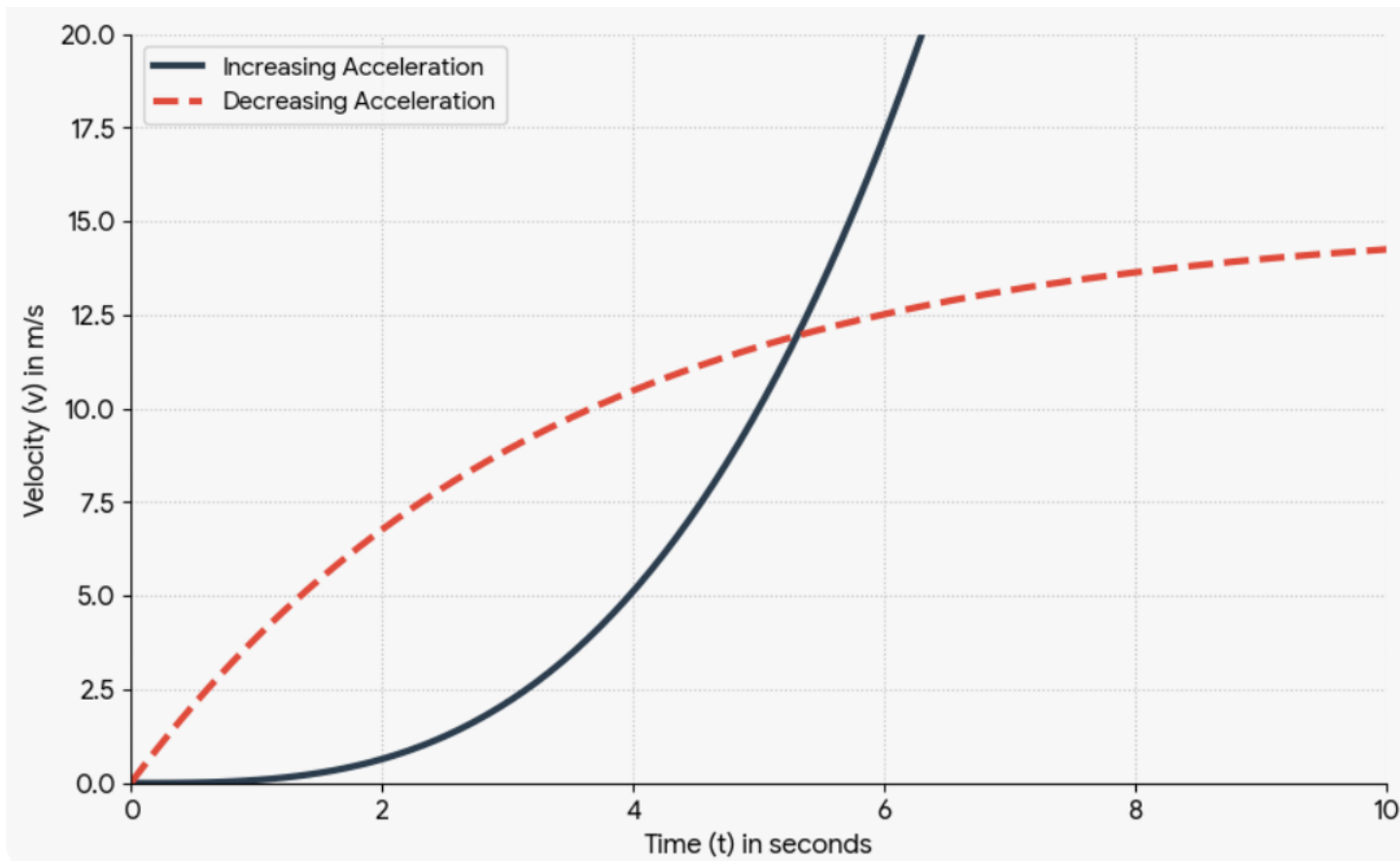
technical devices, items

requires decent modeling

History of modeling

since Descartes:

Dynamics is modeled in a „Cartesian diagram“



since the 1950ies: discrete models

Automata Theory:

„Centralized“ is the normal case.

A single behavior is a sequence of states and steps,
structured by time.

Schahram:

We need a representation of
locality, composition, and hierarchy!

„Built-in causality is a first-class citizen of a system“

You can't *observe* causality!

Can you *represent* causality? ... discuss this later

The digital World...

What is the scientific basis of this world?

Yet another modeling language after UML, BPMN, ... ?

Yet another syntax, a semantics ... ?

NO!

Ludwig Wittgenstein:

The limits of my language mean the limits of my world.

Let's learn from physics:

The calculus as a modeling language fits extremely well with physics

We need a corresponding language for discrete dynamics!

A universal language for the Digital World

the relation between the model and the modeled must be tight!

computability theory?

only for symbol sequences

What we have so far for the general case: a collection of technicalities.

since the times of Aristotle:

A proposition holds or doesn't hold.

The sun sends light.

A predicate applies or doesn't apply.

Jear... is a leap year.

Carl Adam Petri:

Extend logic from static to dynamic!

A proposition sometimes holds and sometimes doesn't.

The restaurant is open.

A predicate sometimes applies and sometimes doesn't.

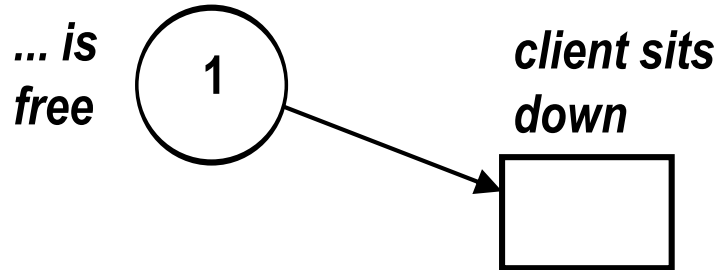
Table ... is free.

An epistemic basis: sets and predicates

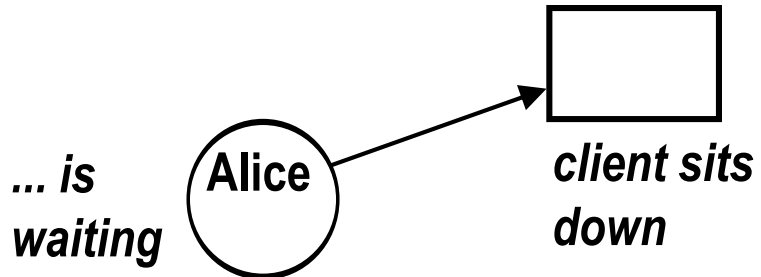
Predicates can be *updated*,
using *events*.

predicates and their update:

the seed of the theory of discretely evolving systems



set: *tables of the restaurant*
predicate: ... is free

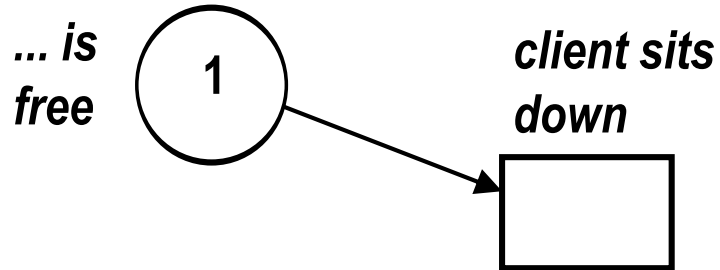


set: *clients of the restaurant*
predicate: ... is waiting

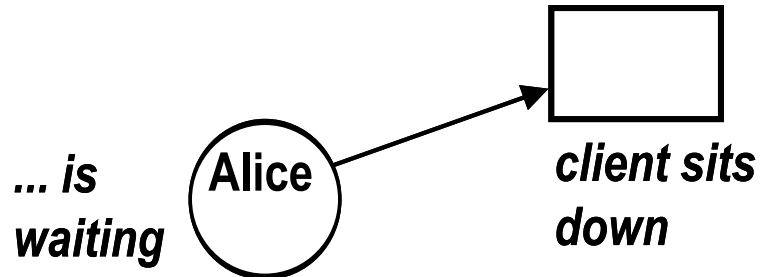
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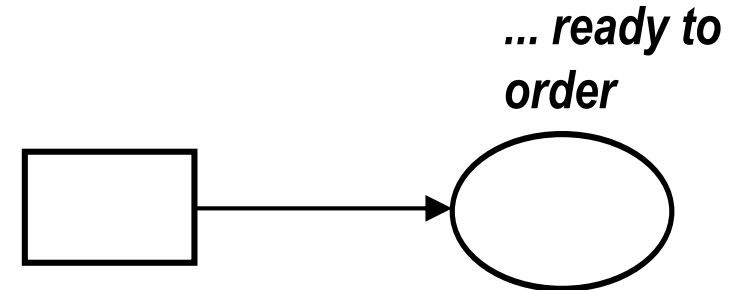
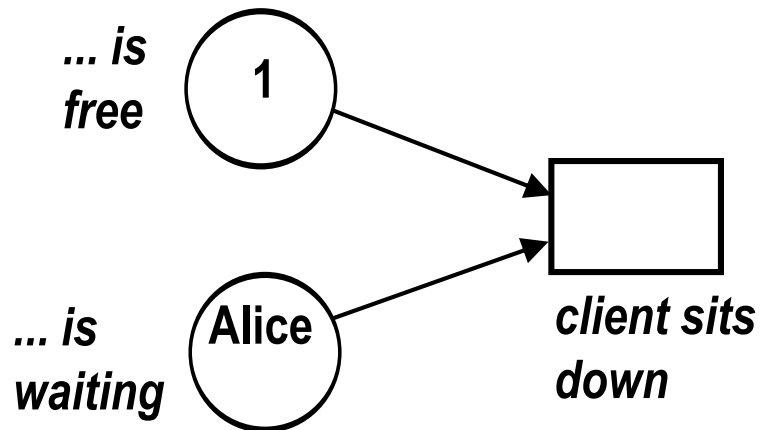
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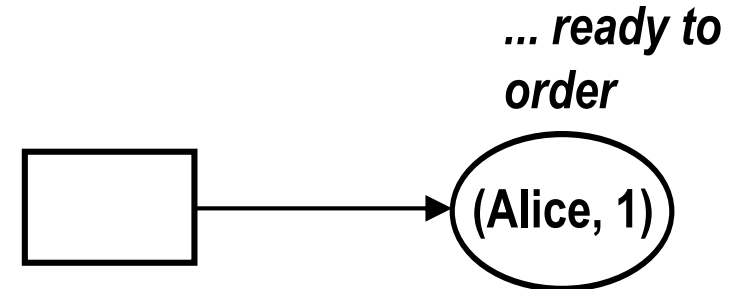
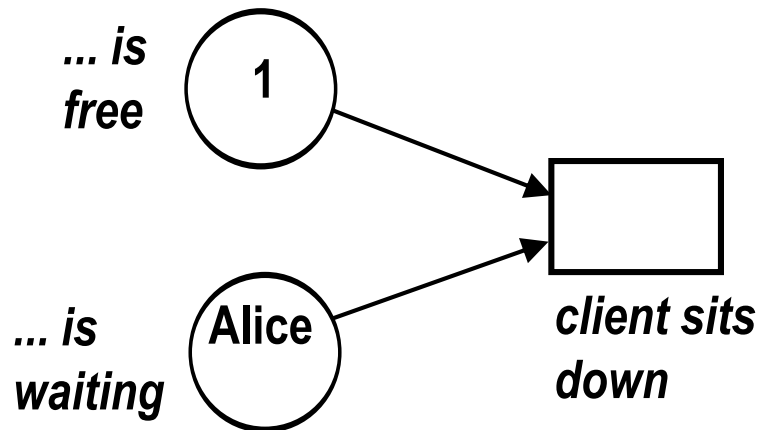


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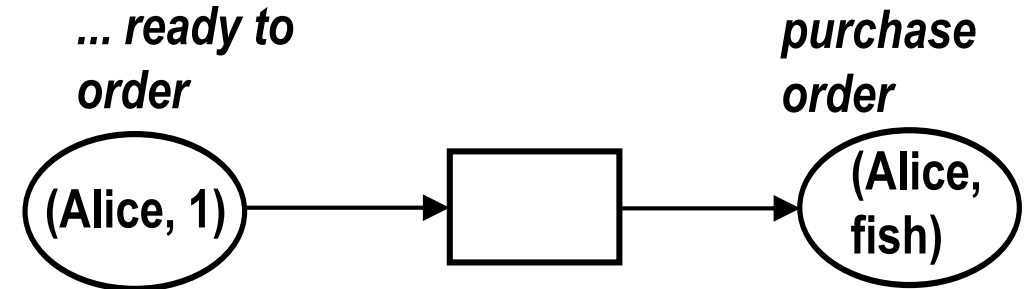
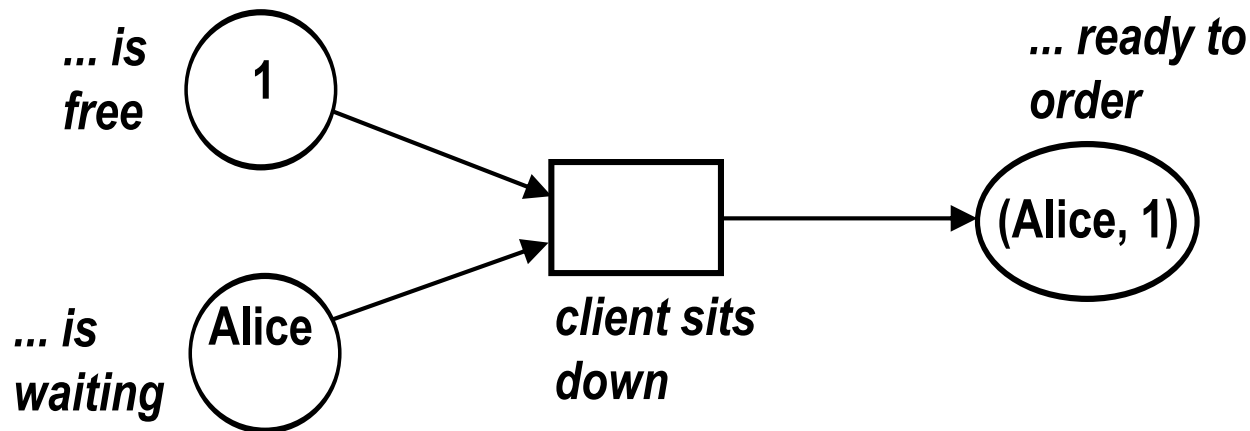


An epistemic basis: sets and predicates

Predicates can be *updated*,
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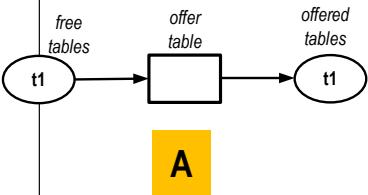
predicates and their update:
the seed of the theory of discretely evolving systems

events are composed



Does this idea scale? to really big runs?

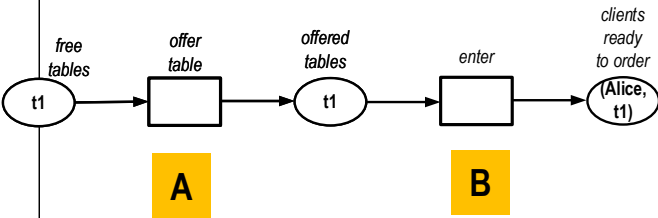
Ablauf A₀



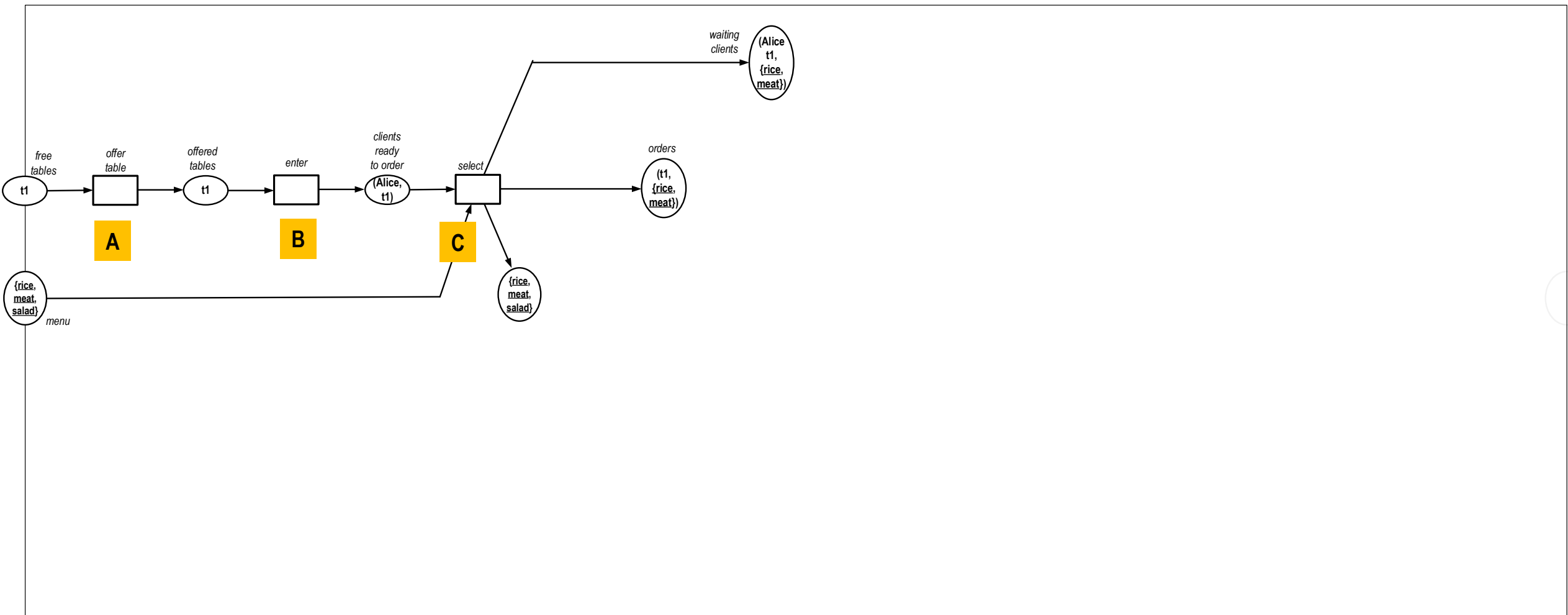
written as algebraic expression: **A**

Does this idea scale? to really big runs?

Ablauf A₀



written as algebraic expression: $A \bullet B$

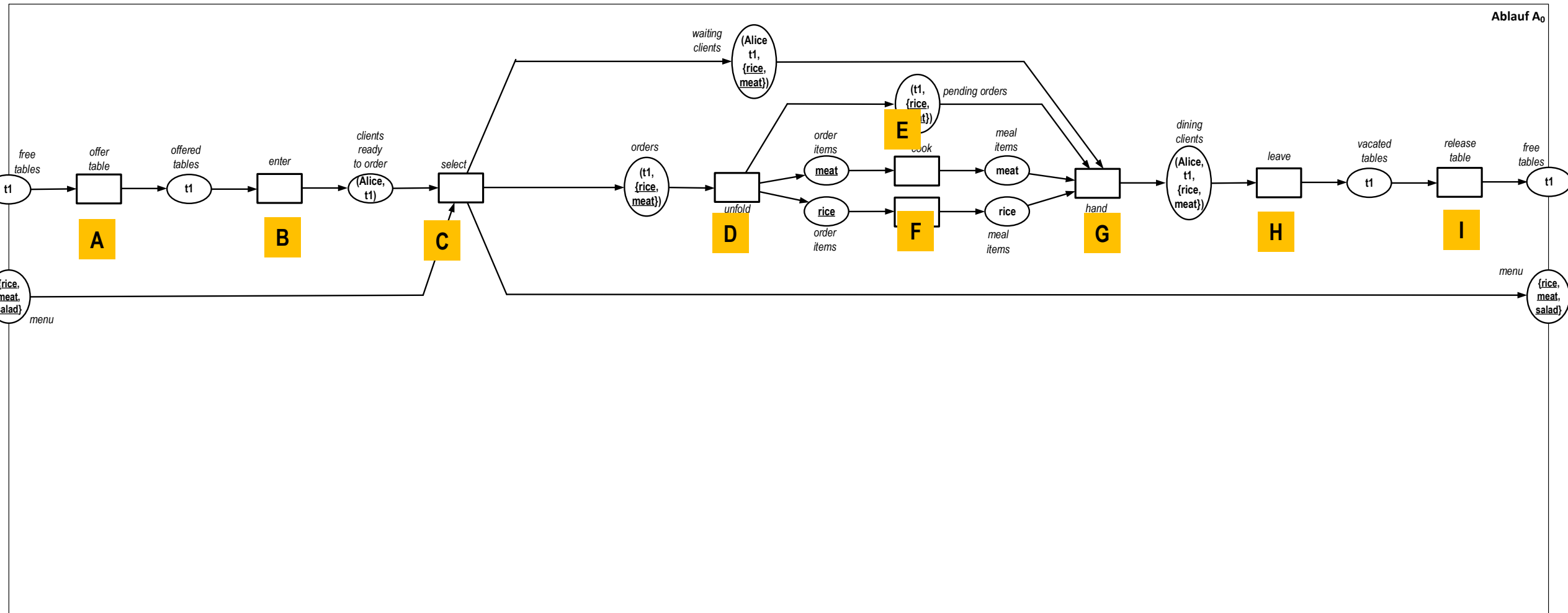


written as algebraic expression:

$A \bullet B \bullet C$

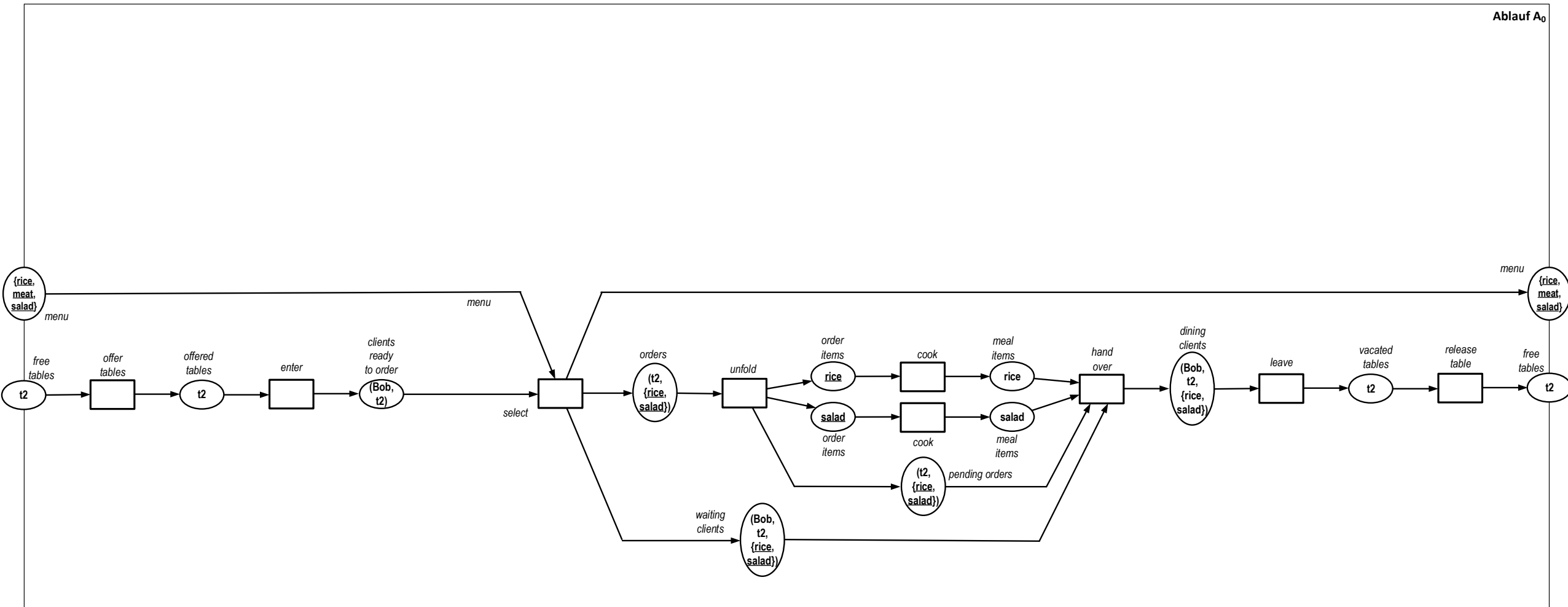
... a monoid!

Does this idea scale? to really big systems?



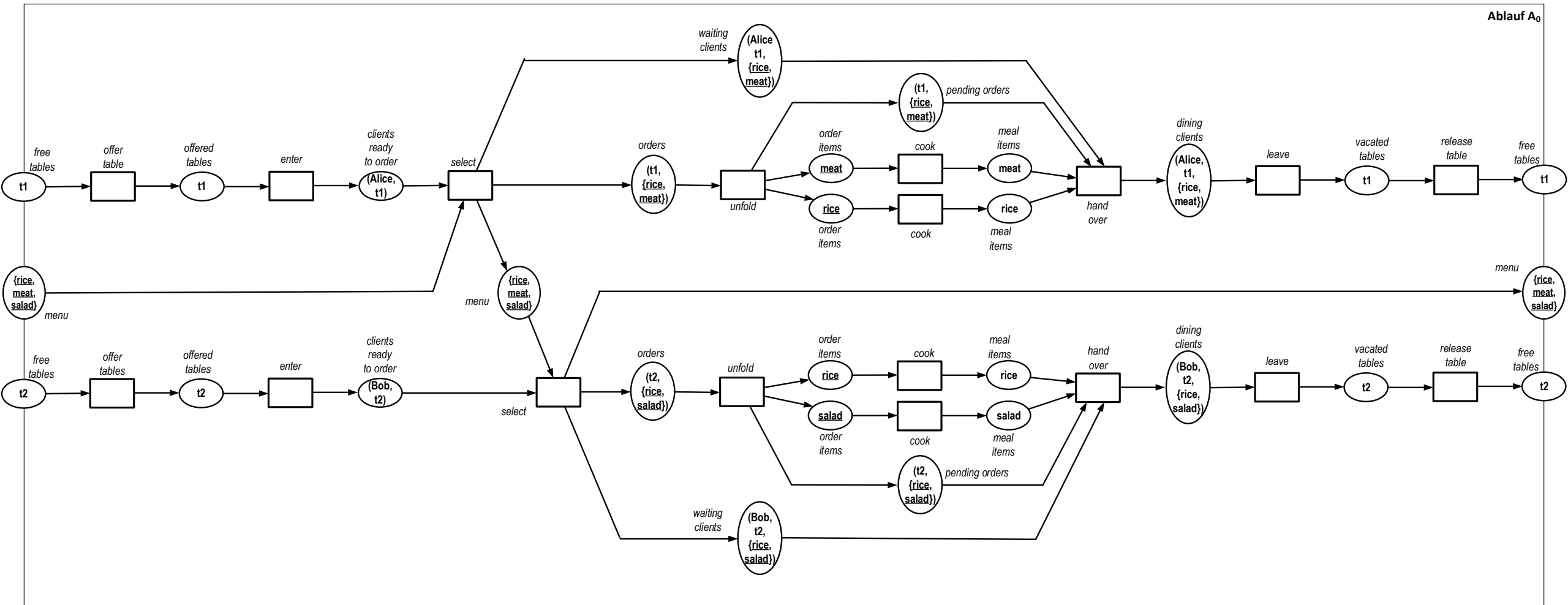
written as algebraic expression: $\text{Alice} = A \cdot B \cdot C \cdot D \cdot E \cdot F \cdot G \cdot H \cdot I$

Does this idea scale? to really big systems?



written as algebraic expression: Bob =

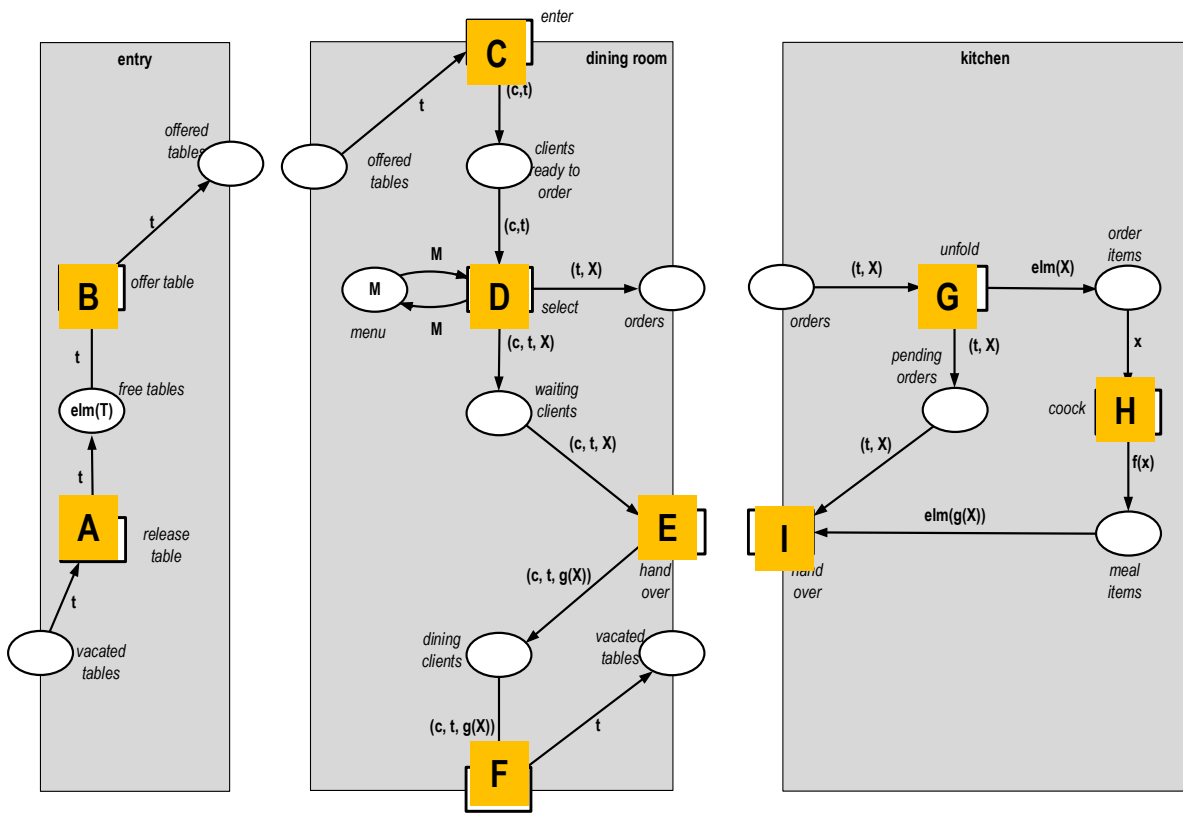
Does this idea scale? to really big runs?



written as algebraic expression:

Alice • Bob

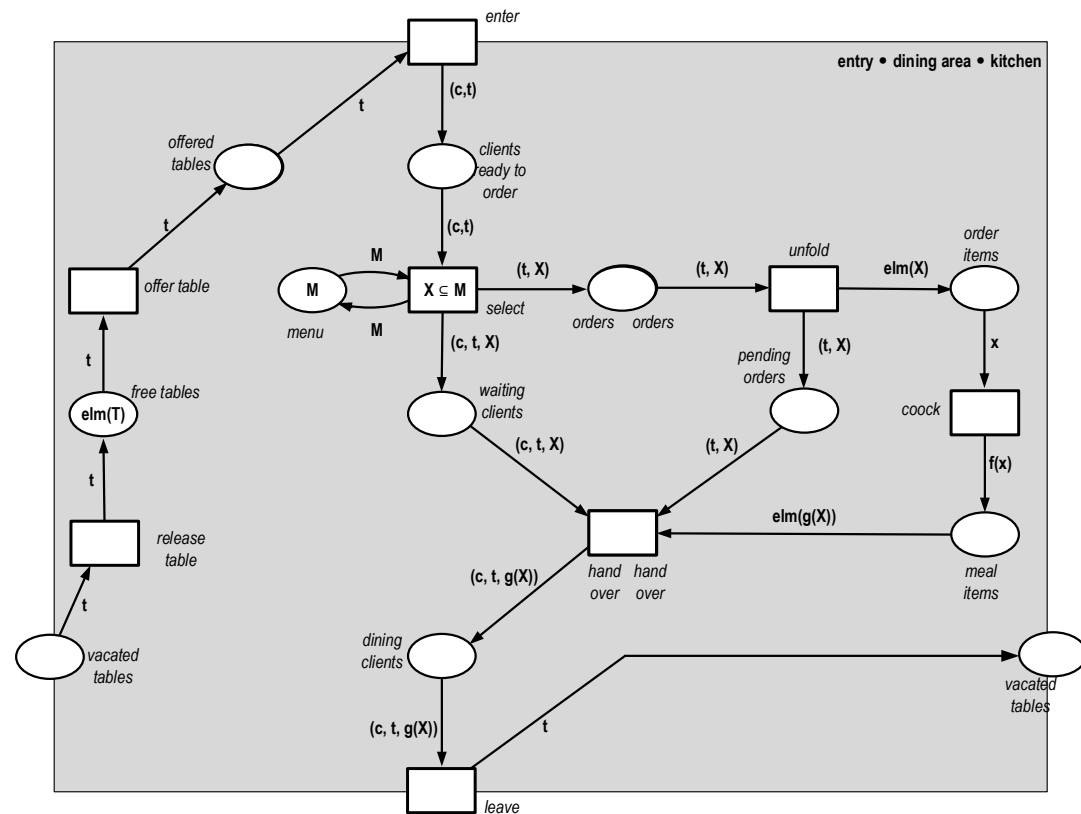
...and on the system level ...



entry := A • B

dining room := C • D • E • F

kitchen := G • H • I



Restaurant :=

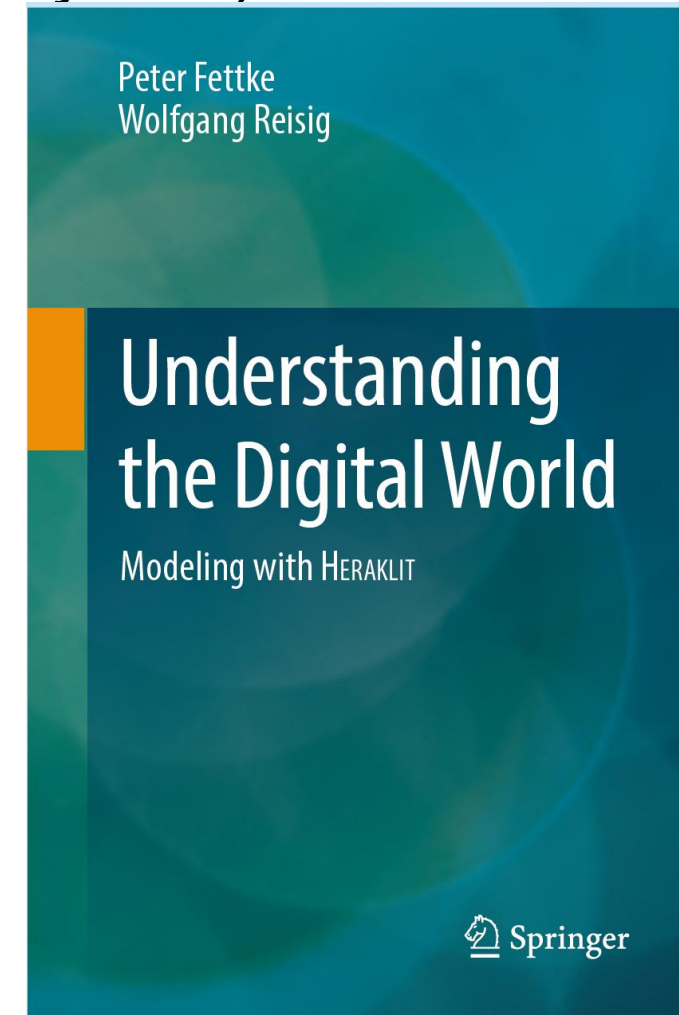
entry • dining room • kitchen

What has been gained?

- an epistemologically based representation of real-world items and data
e.g. invariants of real-world items differ from invariants of data;
- a universal composition operator;

refinement/abstraction, correctness: in the afternoon.

... the formal basis of Sharam's computation continuum;
for details, see



Interlude: The Digital World (Schahram: Computing Continuum)

the end

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