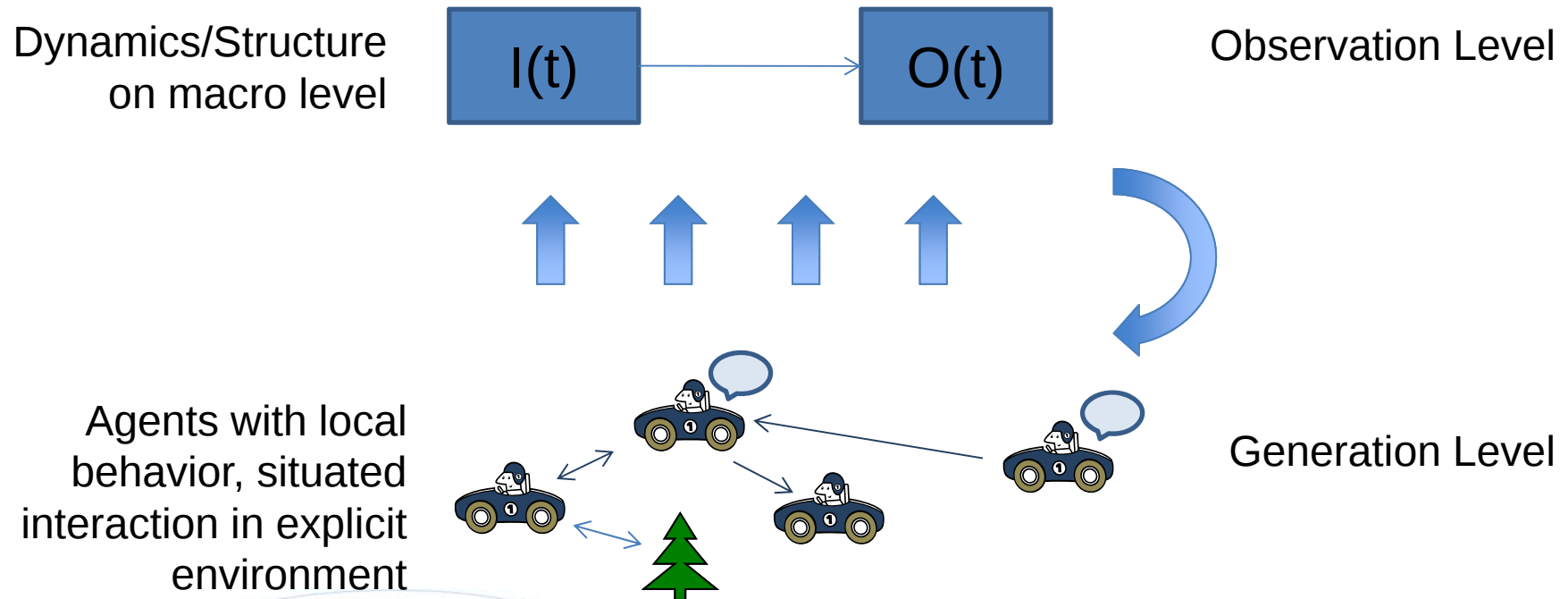




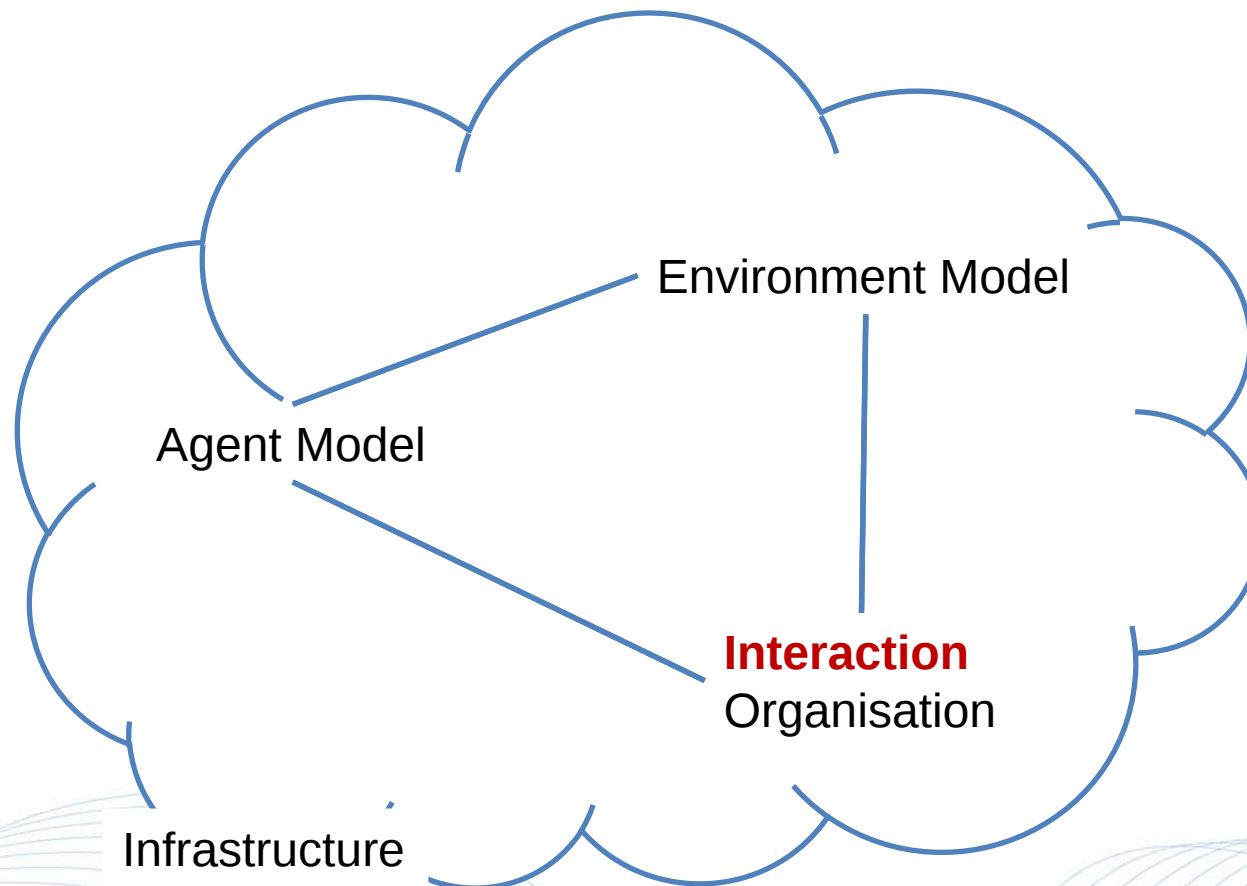
Approaching Interactions in Agent-Based Modelling with an Affordance Perspective

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Agent-Based Simulation is generative



Model Triangle



Interaction in Focus

Whereas agent behavior can be captured in a process-oriented way, interaction as the central issue

- Interactions are flexible; explicit organization models can not help in cases in which interaction partner is selected depending on dynamic context
- Whether interaction actually happens may be governed by diverse conditions (location, individual state...)
- Parallelism? Interaction concern activities at least at two elements/entities in the simulation

→ Interaction Design must be in the focus

Agenda

- Introduction
- Interaction and Affordances
- From Runtime to Model Design time and back
Affordance and Affordance Schema
- Illustration
- Wrap up

Affordances

Central element of **Theory of Direct Perception** (Gibson 1979)

Affordance as action opportunity provided by the environment to an agent

- Somehow "emergent"; exists in the environment that enables agent actions
- Perceivable relation between the ability of an agent and features of an environmental situation (Chemero, 2003)
- Applications in Human-Computer Interaction, Robotics, Spatial Ontologies for GIS, Simulation...
- Basis for a general approach for producing high quality multiagent models starting from interactions

Promises

- Provide an **higher abstraction** level for selecting activities and interaction partners
- More explicit causality of interactions between two entities
- Determining affordances offered by environmental entities **is independent** of the decision making architecture
- general approach
- Identification of affordances can be partially **automatized** based on object category information
- Conceptual decoupling → facilitates overall model development, extensions and reuse

Adapting "Affordance" to ABS

"Emerging" potential for interaction in a simulation that is fully controlled by a pre-defined model?

→ Technical term supporting a modeler

- Affordance shall make potential for interaction explicit
- Flexibility needed: agent should be able to choose if more than one possibility
- Agent may memorize perceived affordances – not just as immediate reaction
- Well integrated into agent architecture

Distinguish:

- Runtime → Affordance
- Modelling Time → Affordance Schema

Affordance

- Affordance = Possibility of establishing a relation between an agent a and an environmental object x with respect to action act :
$$\langle a, act, x \rangle \in pAff_{a,t}$$
- Both a and x are in a particular state
- $pAff_{a,t}$ as set of affordances that the agent a may access at time t
- Agent a has a set explicit set of distinct potential actions
- Not just x is relevant, but its context
→ more or less suitable as interaction partner
- Actual selection process depends on agent architecture

Affordance Schema

"Pattern" for creating affordances at runtime

→ contains information about type and context
(hard and soft)

→ **defined by the modeller**

$\langle AType, act, EType, hContext, sContext \rangle$

→ Abstraction!

→ possibly needed: Ontologies for Objects populating the simulated environment; action hierarchies...

Park Example

Agent FKL is tired and wants to get some rest → enters a park with diverse options to rest

⟨Visitor, relax, FlatSurfaceObject, (stable, ...), (dry, shadowy)⟩

→ ⟨FKL, sitDown, BenchWithBrokenBack⟩

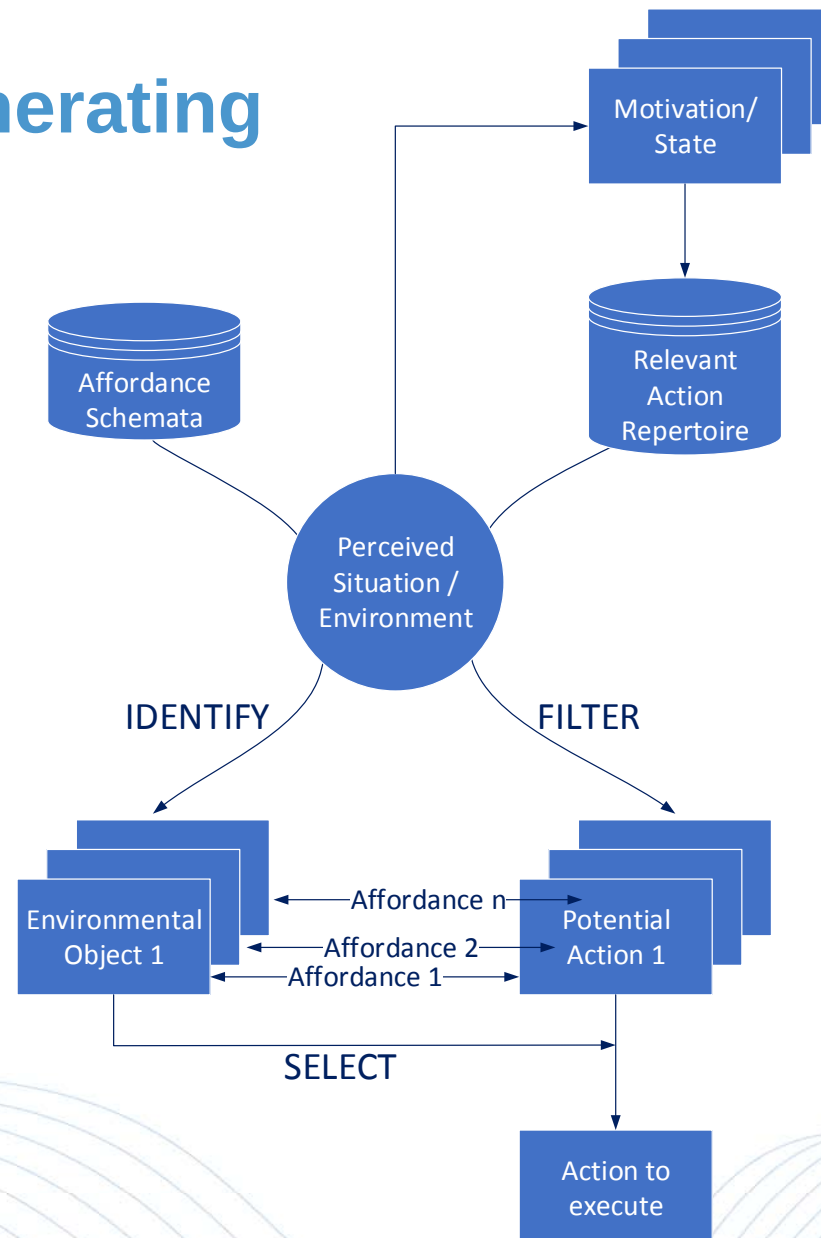
→ ⟨FKL, sitDown, BenchInShadow⟩

→ ⟨FKL, layDown, WarmLargeStone⟩

Approach to modeling

- Modeler makes explicit under which circumstances an environmental entity can be an interaction partner, instead of hiding this into some conditions on the action level
- Can be also used to generate affordance, if directly used in the action selection mechanism of the agents' model

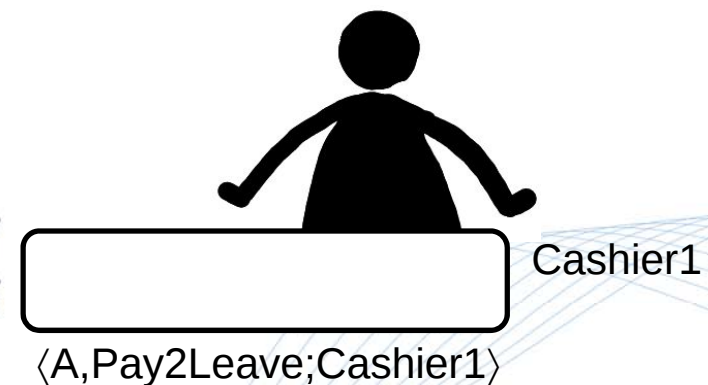
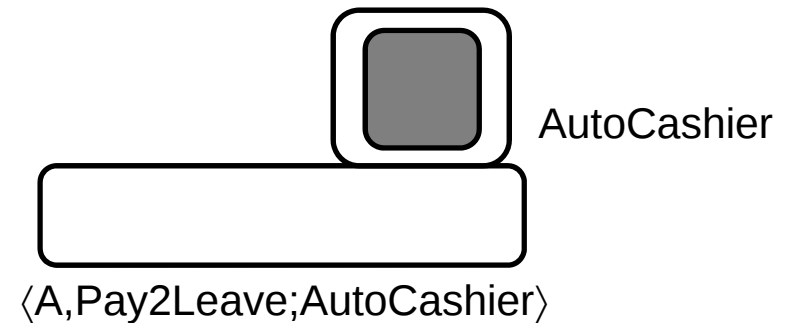
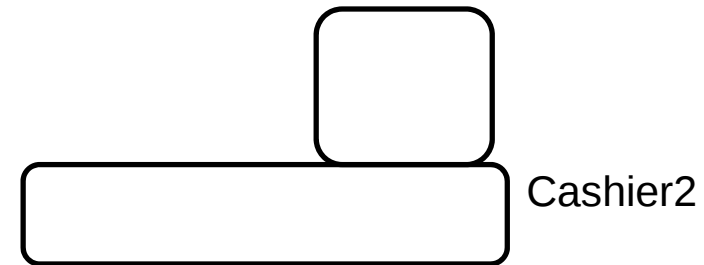
Process Generating Affordances



Supermarket Scenario



⟨SHOPPER,
Pay2Leave;
CASHIER,
Cashpoint manned or
(working and A has card),
Queue length, friendly appearance, ...⟩

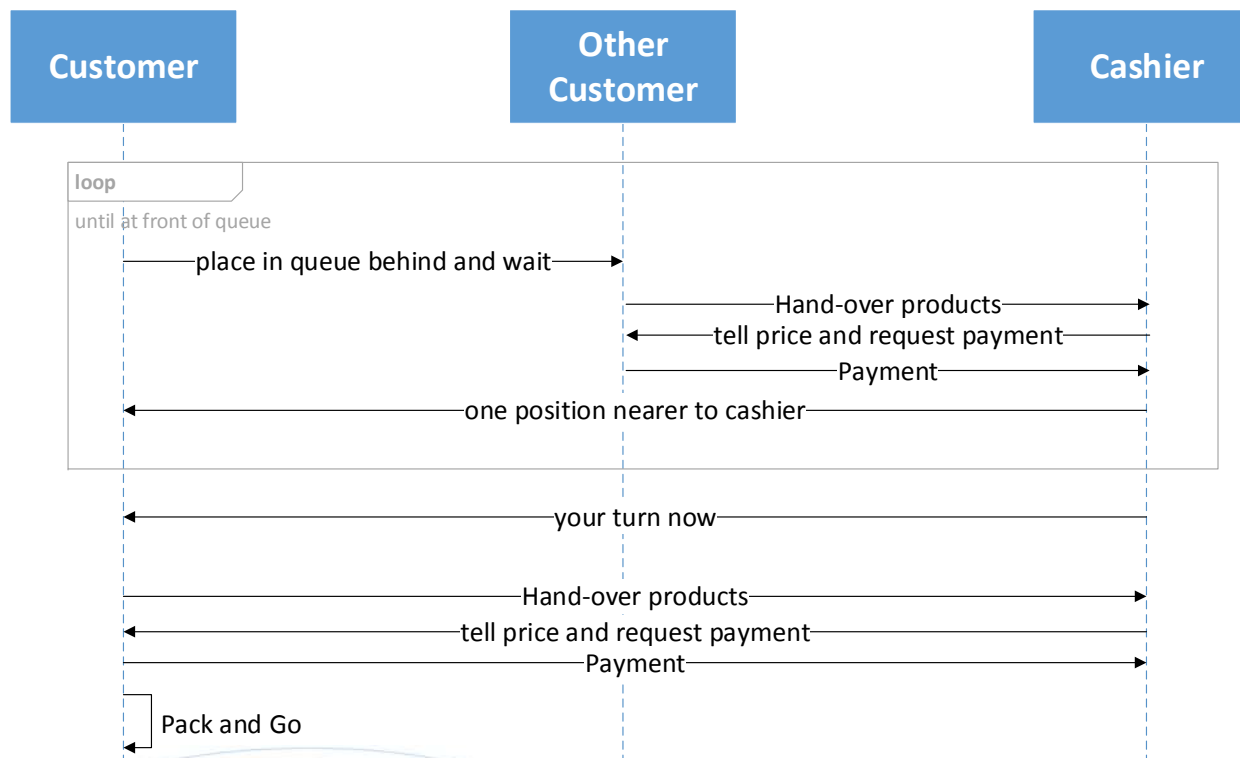


What would be an alternative? for example IODA

Source \ Target	Shelf	Customer	Employee	Cashier
Customer	TakeGoods (d=0)	WaitBehind (d=2)	AskForHelp (d=2)	Pay&Pack (d=3)
Employee	ReFill (d=0)			
Cashier		RequestPayment (d=3)		

- Connects interaction participant (families, not instances)
- "Simpler language" for conditions

What would be an alternative? for example AUML



- Interaction partner is given
- Specifies explicitly what happens during interaction

Wrap up

- Affordances as interesting concept for an interaction-based modelling approach
- Affordance schema defines pattern of interaction; Affordance what can be perceived in particular situation
- Makes situations in which interactions may happen explicit → prerequisite for deeper analysis
- Affordance Schema for generating affordances → supporting analysis
- Just at beginning → languages, tools, methodology, evaluation....