



ICAART'09

# Arguing over motivations within the V3A-architecture for self-adaptation

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# Modular architecture for self-adaptive agents



- **Aim** : Increase the flexibility of computer systems
- **Approach** : multiagent
  - autonomous agents !
  - open multiagent systems
  - agents must be adaptive
- **Proposal** :
  - V3A, a component-based agent architecture
  - Design of self-adaptive agents
  - Vowels approach
  - Management of conflicts during the adaptation with **argumentation** depending on the agent **personality**

## Component-based agents



- Adaptation= restructuring of the component assembly
- The antinomic properties of the self-adaption :
  - the **coherence**, i.e. the behaviour of the assembly must be as expected ;
  - the **automation**, i.e. no human intervention.



## Vowels Approach [Demazeau 95]



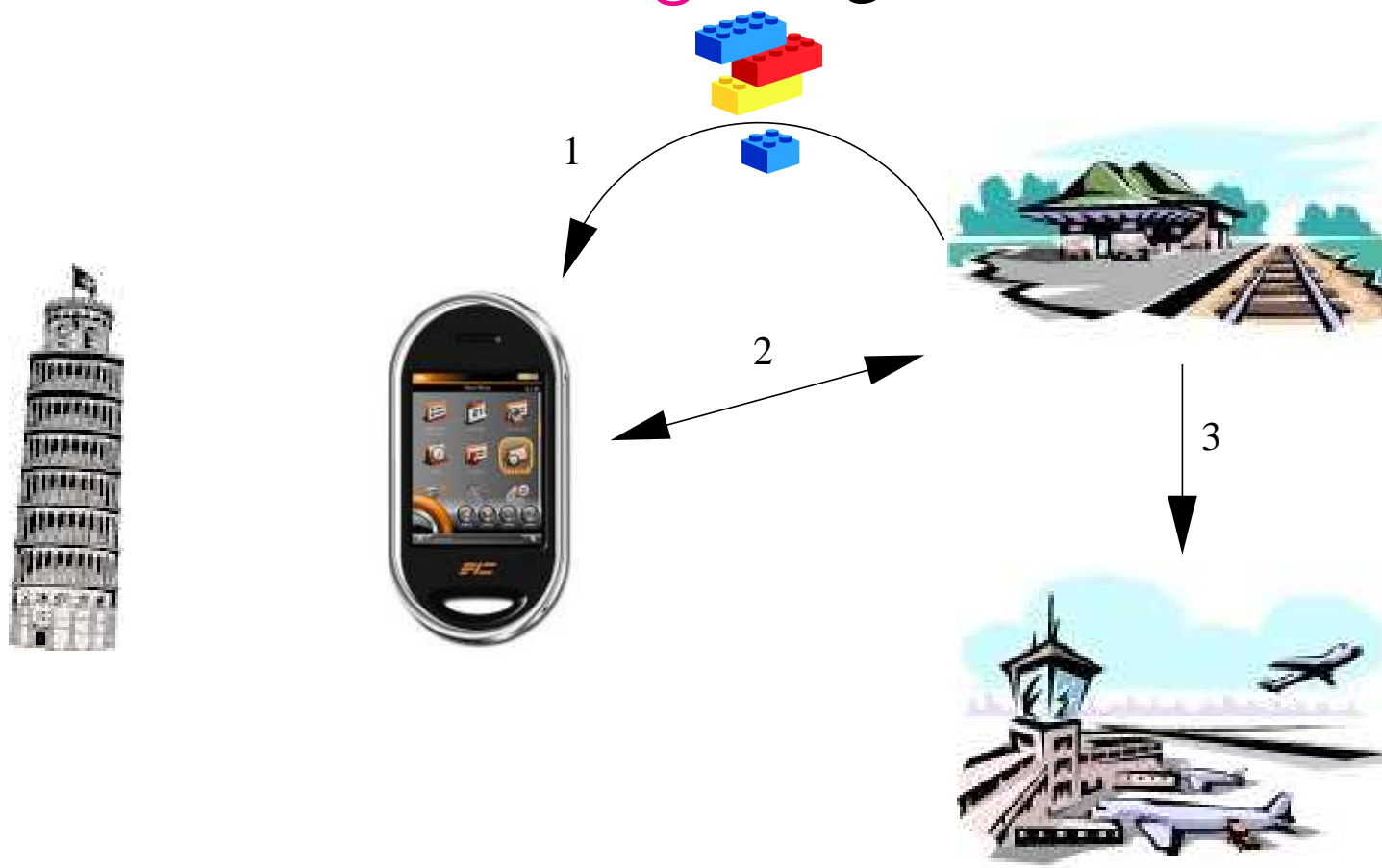
During the analysis stage, we divide the problem according to the five following dimensions :

- **Users.** goals, preferences and constraints of users.
- **Agents.** representation of the other agents.
- **Environments.** observations perceived in the environment and the representation of its physical laws.
- **Interactions.** messages and interaction protocols.
- **Organisations.** roles, norms, ...

# Automatic booking of train in an ubiquitous environment

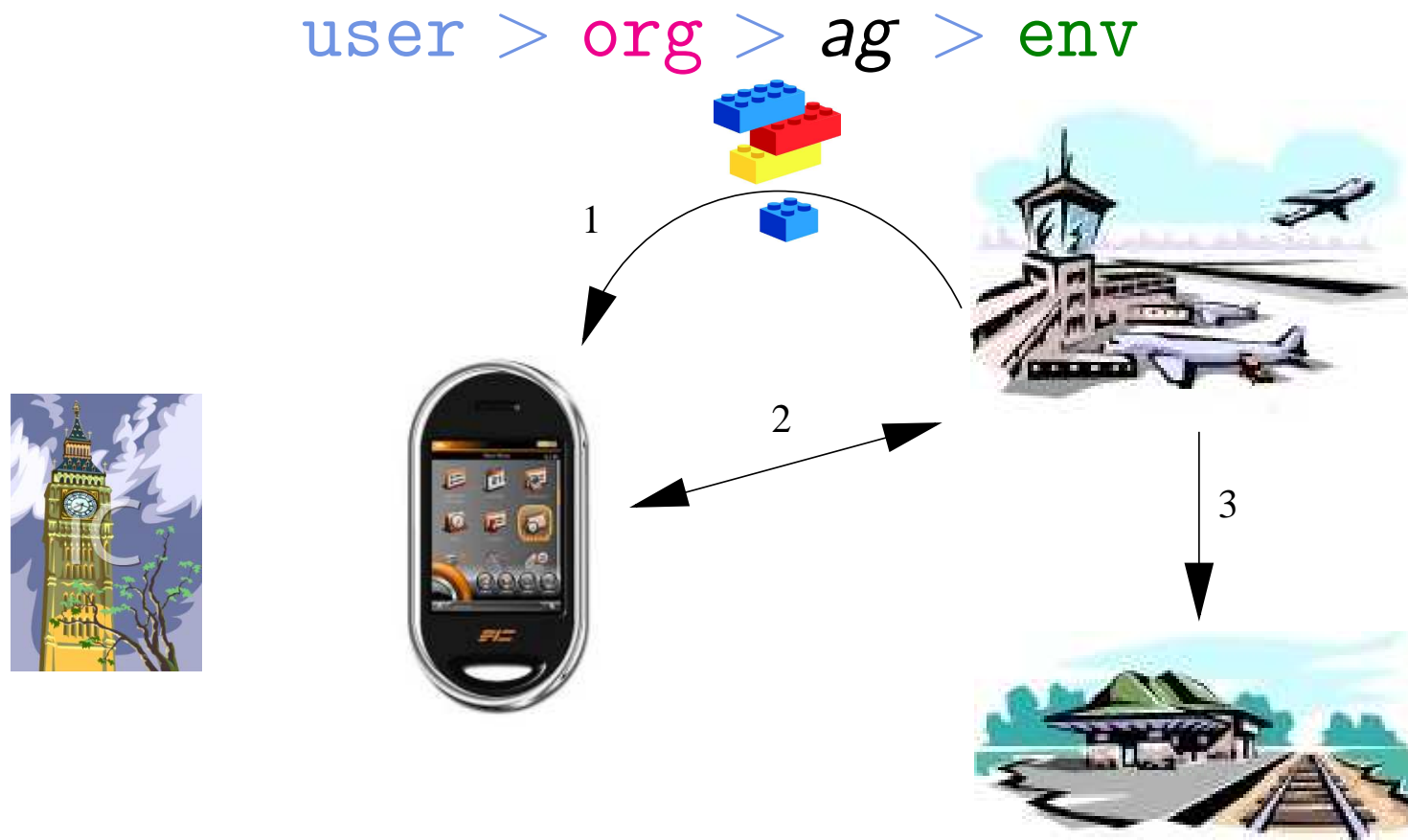


user > org > ag > env



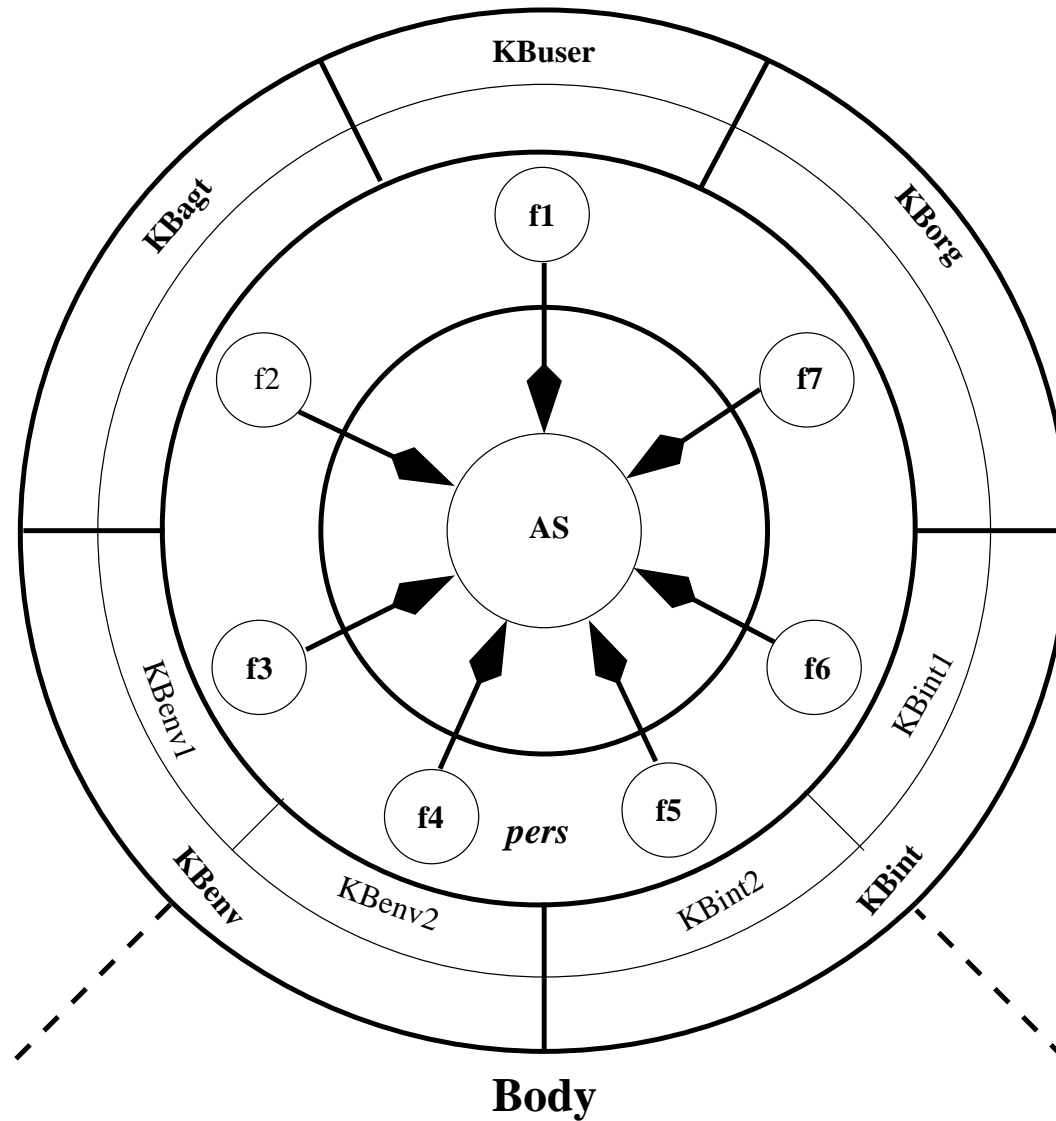
The train is automatically booked since the system can do it (org).

# Automatic booking of train in an ubiquitous environment



The train is not automatically booked since it is too expensive (env).

# V3A agent architecture

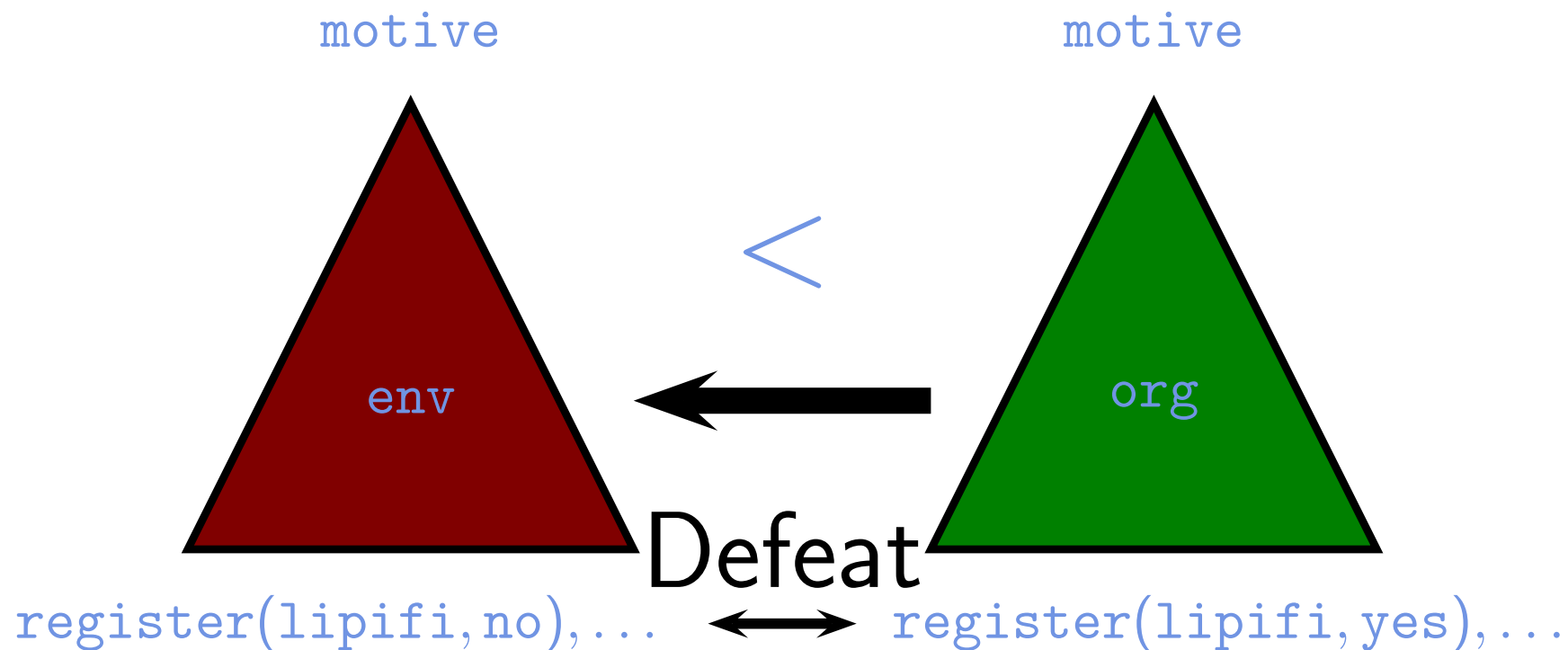


# Knowledge representation



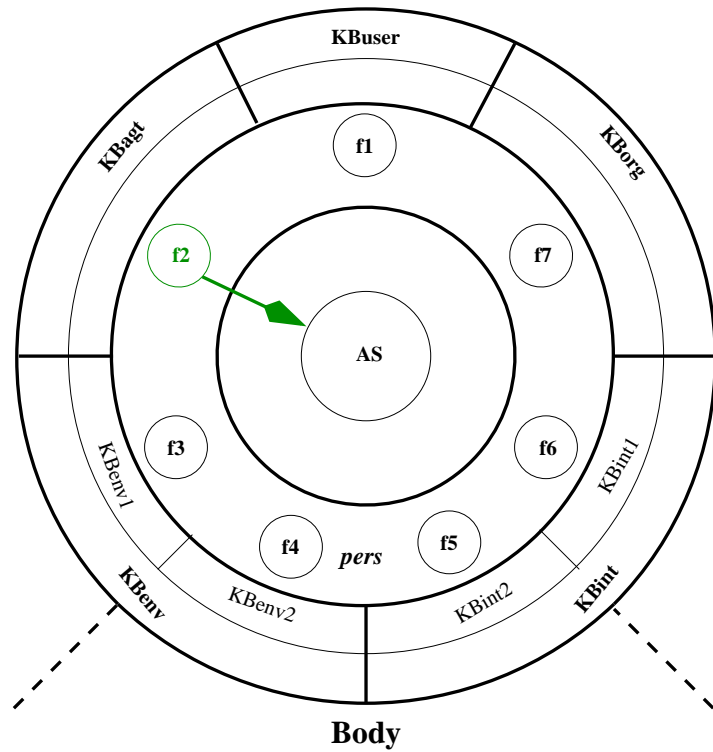
	$\mathcal{T}$	$\mathcal{A}sm$
KB <sub>user</sub>	$user(f_1, r_1) : motive \leftarrow be(apisa, 18)$ $user(f_1, r_2) : motive \leftarrow be(london, 22)$	$user(f_1, a_1, price, comm) :$ $\neg pay(psa, aid, price, comm)$ avec $comm \neq 0$
KB <sub>agt</sub>	$agt(f_2, r_2(ticket)) : buy(psa, sa, ticket, 4, 0) \leftarrow accept(psa, sa, ticket, 4, 0)$	
KB <sub>env</sub>	$env(f_3, r_1) : be(apisa, 18) \leftarrow be(pisa, 17), \sim strike, take\_train(lipifi)$ $env(f_3, r_2(train)) : take\_train(train) \leftarrow register(train, yes)$ $env(f_3, r_3(train)) : take\_train(train) \leftarrow register(train, no)$	$env(f_3, a_1(train)) :$ $register(train, no)$
KB <sub>int</sub>		$env(f_4, a_1) : \sim strike$ $env(f_4, a_2) : be(pisa, 17)$
	$int(f_6, r_1(aid_1, aid_2, ticket, price, comm)) : accept(aid_1, aid_2, ticket, price, comm) \leftarrow request(aid_2, aid_1, ticket)$ $int(f_6, r_2(aid_1, aid_2, ticket, price, comm)) : \neg accept(aid_1, aid_2, ticket) \leftarrow request(aid_2, aid_1, ticket)$	$int(f_5, a_1(aid_1, ticket)) :$ $request(psa, aid_1, ticket)$
KB <sub>org</sub>	$org(f_7, r_1(train, ticket, price, comm)) : register(train, yes) \leftarrow buy(psa, sa, ticket, price, comm),$ $\quad\quad\quad pay(psa, sa, price, comm)$ $org(f_7, r_2(train, ticket, price, comm)) : \neg register(train, yes) \leftarrow \neg buy(psa, sa, ticket, price, comm)$ $org(f_7, r_3(train, ticket, price, comm)) : \neg register(train, yes) \leftarrow buy(psa, sa, ticket, price, comm),$ $\quad\quad\quad \neg pay(psa, sa, price, comm)$	$org(f_7, a_1(price, comm)) :$ $pay(psa, sa, price, comm)$
pers	$pers(f_1, f_2, x_1, x_2) : prior(user(f_1, x_1), agt(f_2, x_2)) \leftarrow$ $pers(f_1, f_2, x_1, x_2) : prior(org(f_1, x_1), env(f_2, x_2)) \leftarrow$	$int(f, x), org(f, x),$ $agt(f, x), env(f, x),$ $user(f, x)$

# Opposition calculus [Dung 95] with assumption-based argumentation [Dung 07]





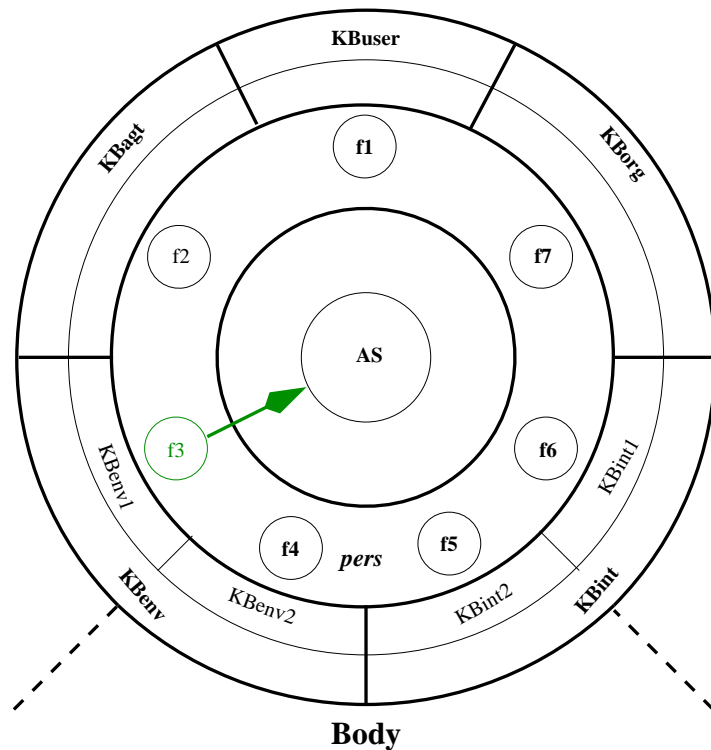
# Dialectics between facets



f<sub>2</sub> unknown

motive  
be(apisa, 18)

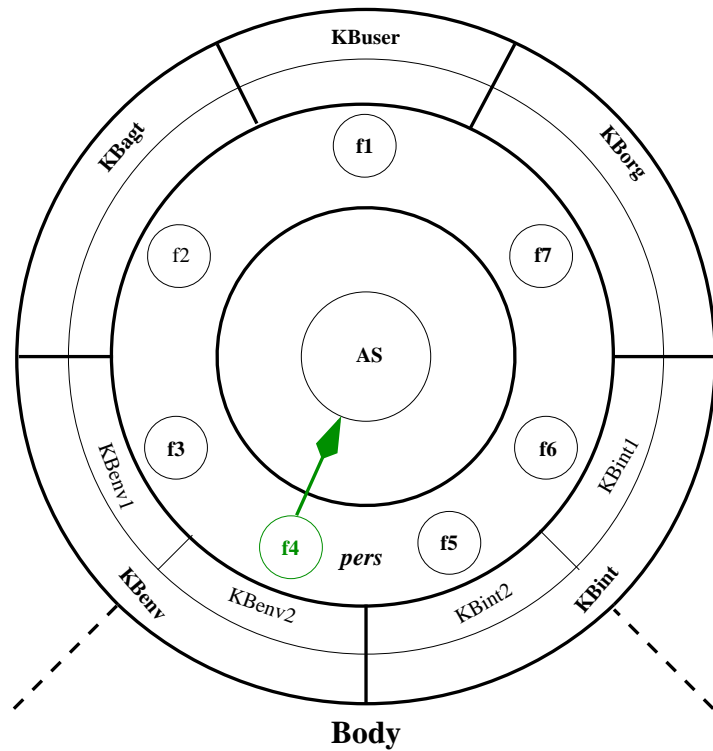
## Dialectics between facets



`f3 claim be(pisa, 17),  
 ~ strike,  
 take_train(lipifi)`

`motive  
 be(apisa, 18)  
 be(pisa, 17)  
 ~ strike  
 take_train(lipifi)`

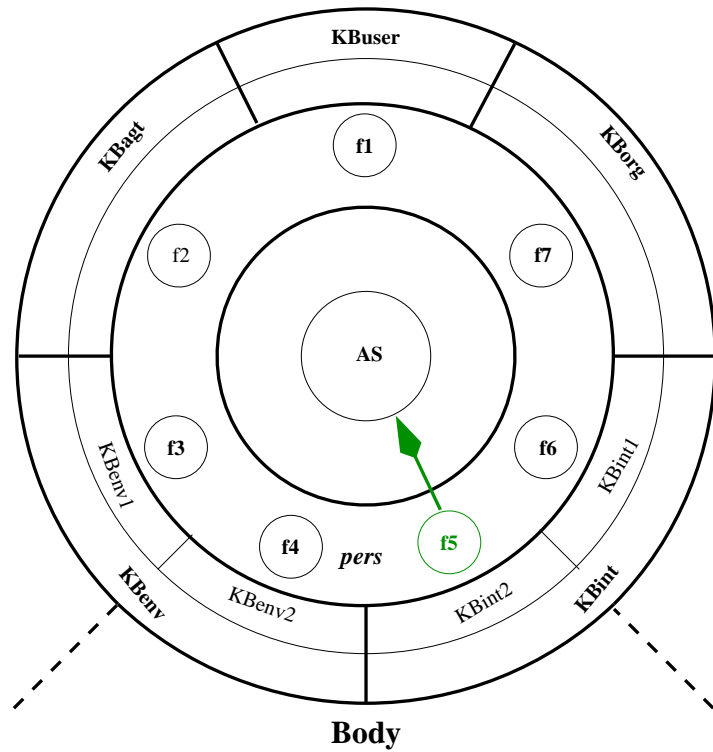
# Dialectics between facets



f<sub>4</sub> concede be(pisa, 17)

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

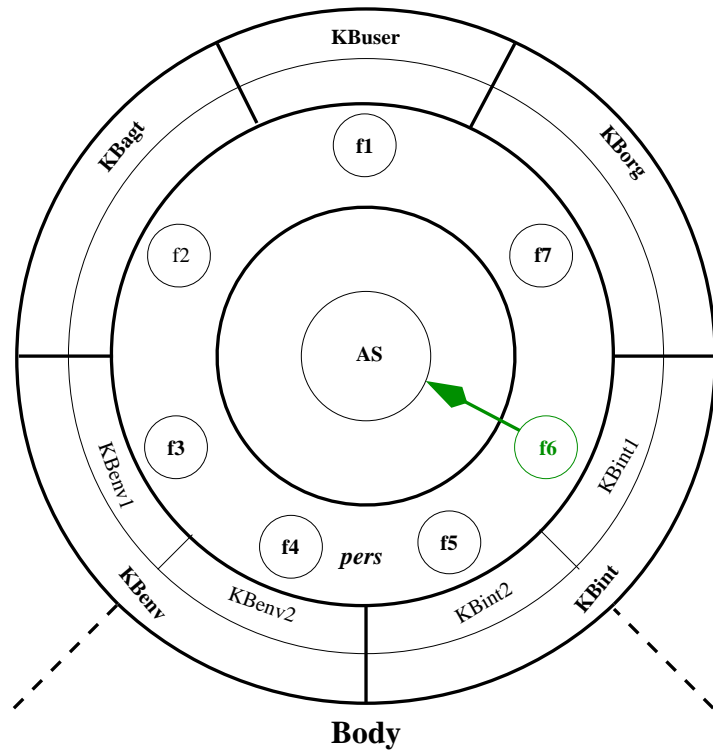
# Dialectics between facets



f<sub>5</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

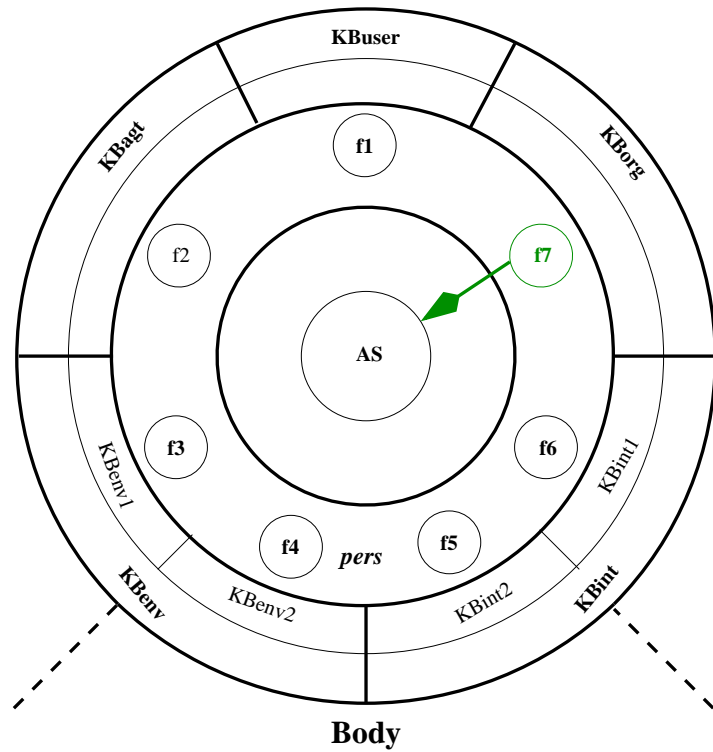
# Dialectics between facets



f<sub>6</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

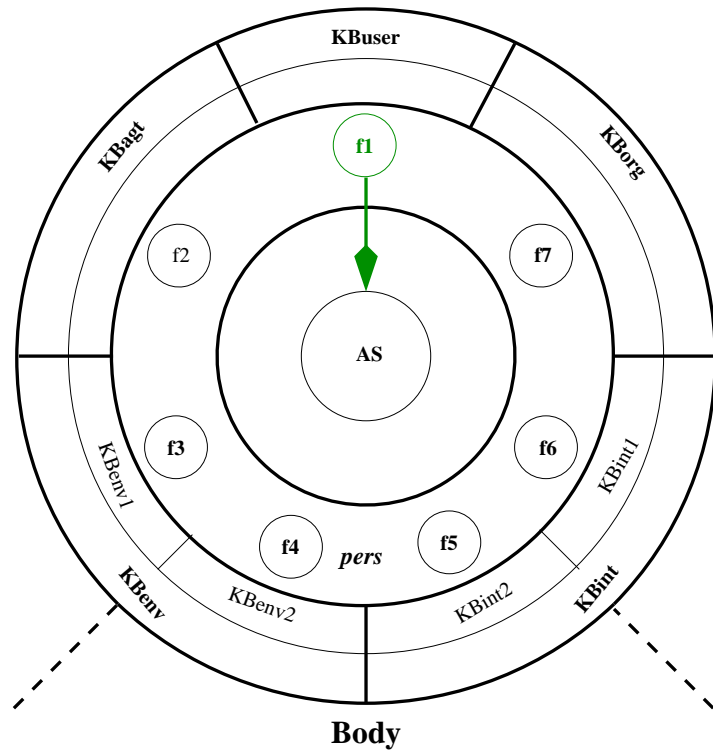
# Dialectics between facets



f<sub>7</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

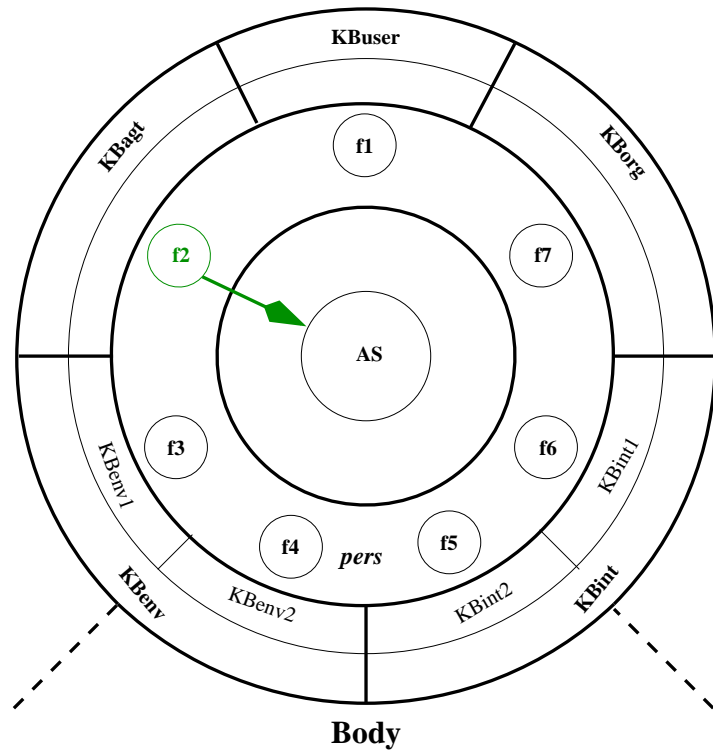
# Dialectics between facets



$f_1$  unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

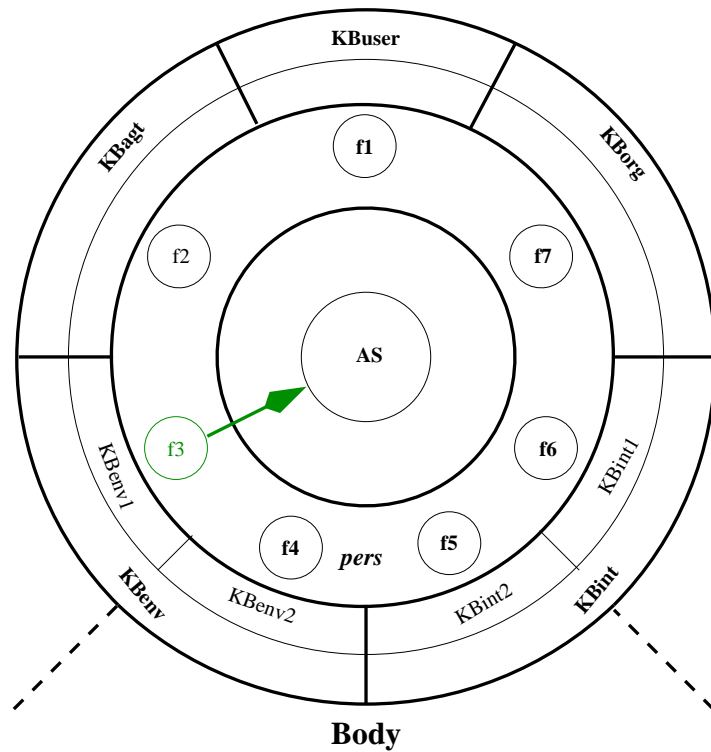
# Dialectics between facets



f<sub>2</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
 take\_train(lipifi)

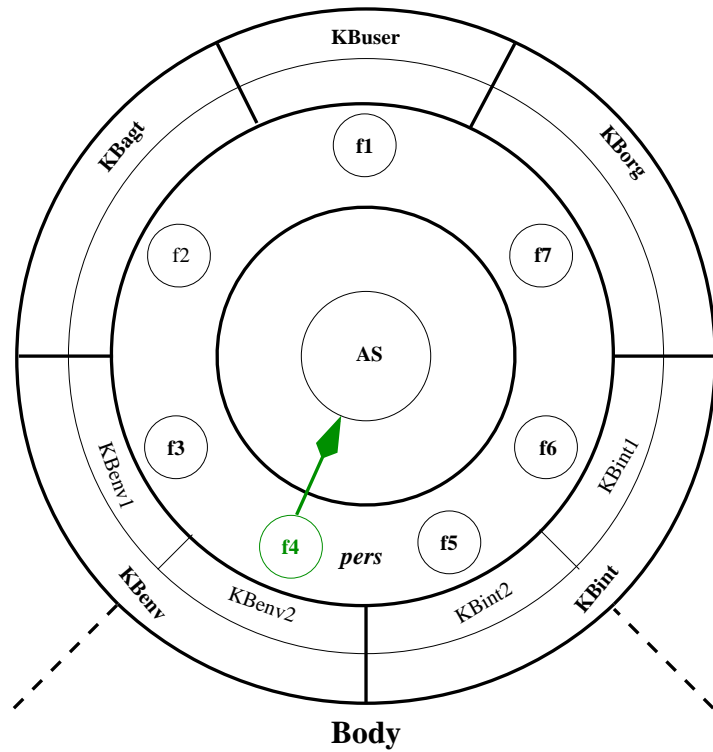
## Dialectics between facets



f<sub>3</sub> claim  
register(lipifi, no)

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
 register(lipifi, no)

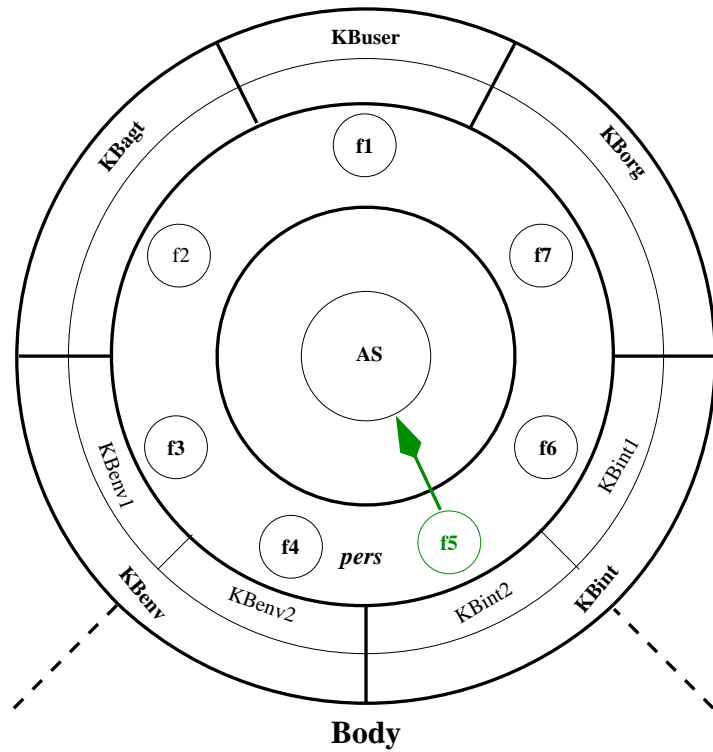
# Dialectics between facets



f<sub>4</sub> concede ~ strike

motive  
 be(apisa, 18)  
 be(pisa, 17)  
~ strike  
 take\_train(lipifi)  
 register(lipifi, no)

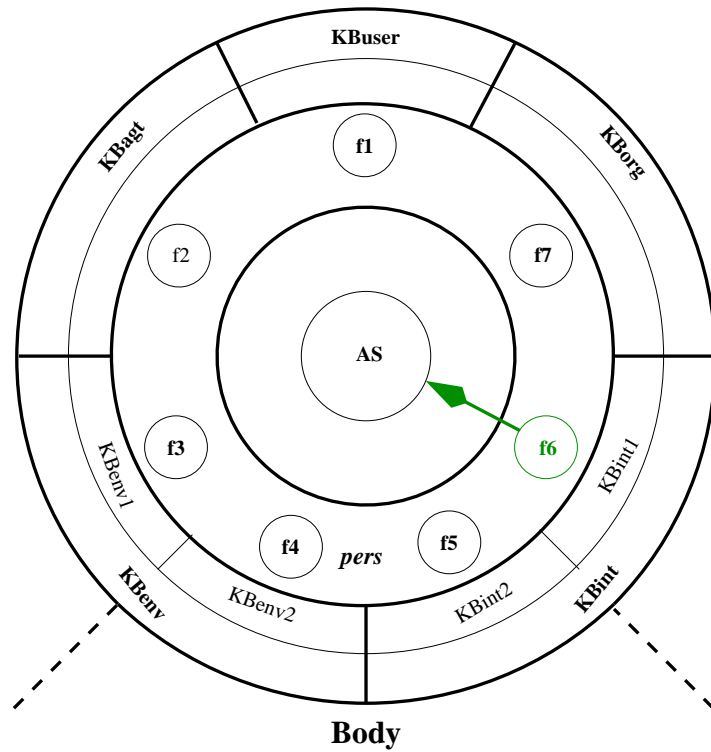
# Dialectics between facets



f<sub>5</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
 register(lipifi, no)

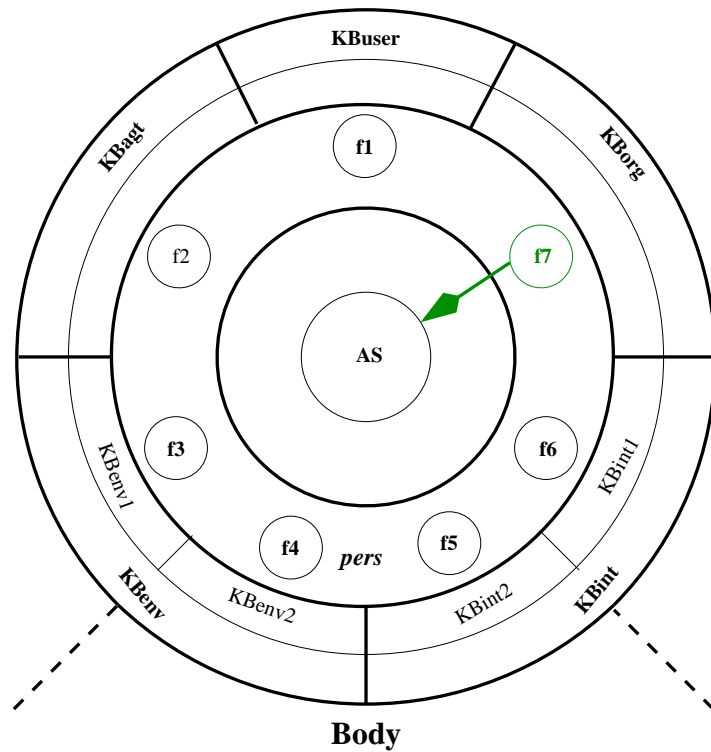
## Dialectics between facets



$f_6$  unknown

~~motive~~  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
 register(lipifi, no)

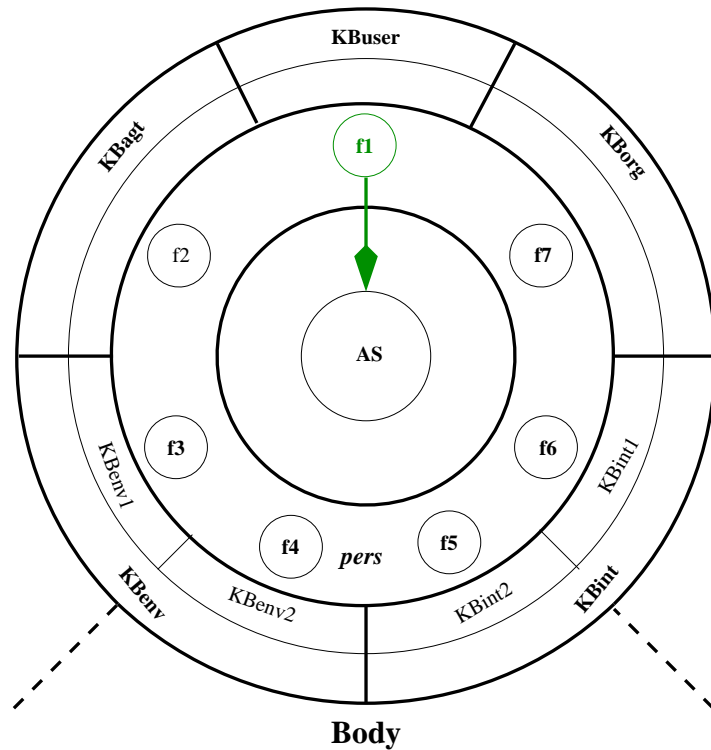
## Dialectics between facets



f7 oppose  
register(lipifi, yes)

~~motive~~  
 ~~be(apisa, 18)~~  
 ~~be(pisa, 17)~~  
 ~ strike  
 ~~take\_train(lipifi)~~  
 ~~register(lipifi, no)~~  
register(lipifi, yes)

## Dialectics between facets



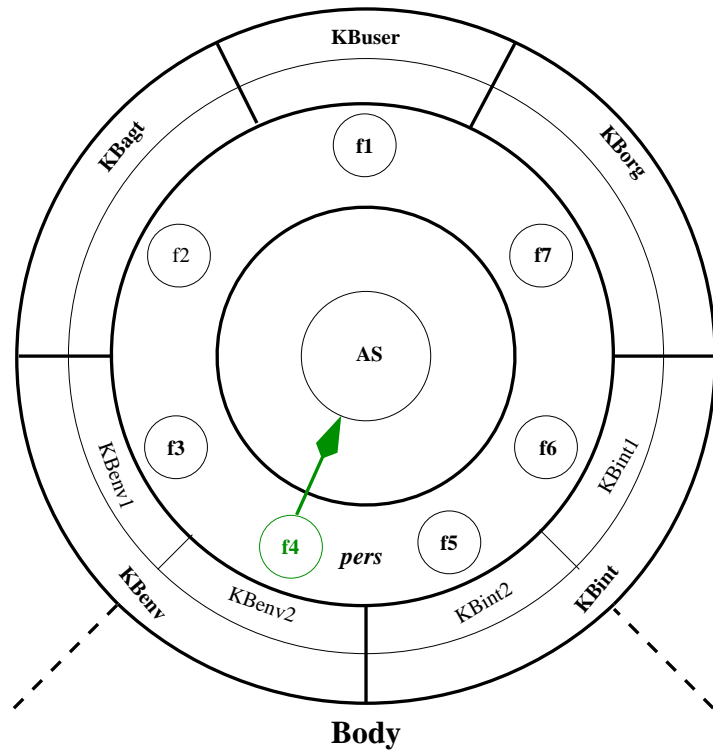
$f_1$  unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
 register(lipifi, yes)





# Dialectics between facets

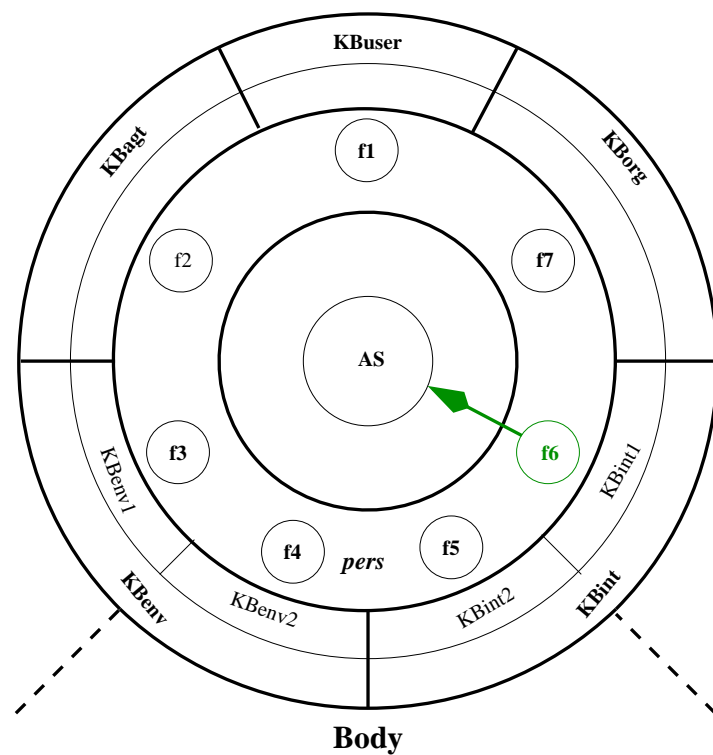


f<sub>4</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
 register(lipifi, yes)



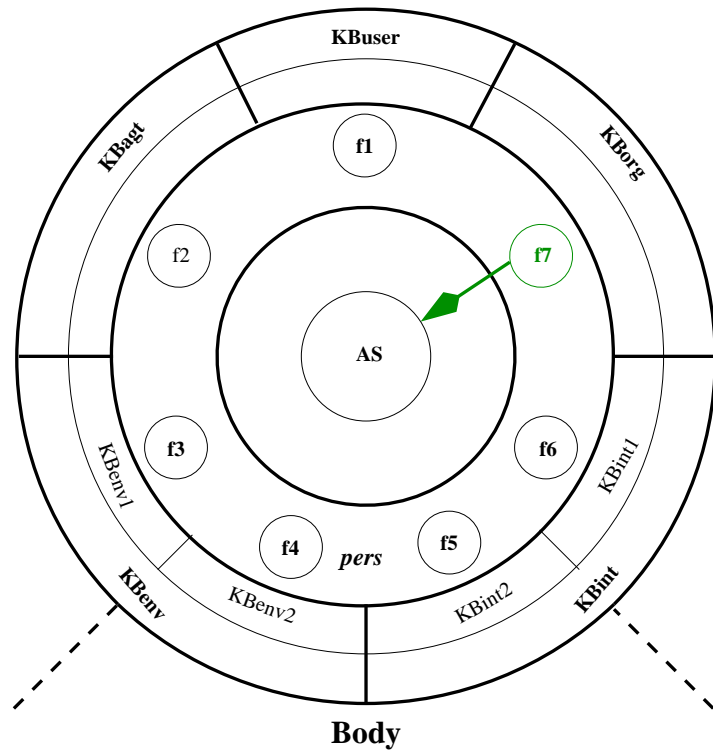
## Dialectics between facets



$f_6$  unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
 register(lipifi, yes)

# Dialectics between facets

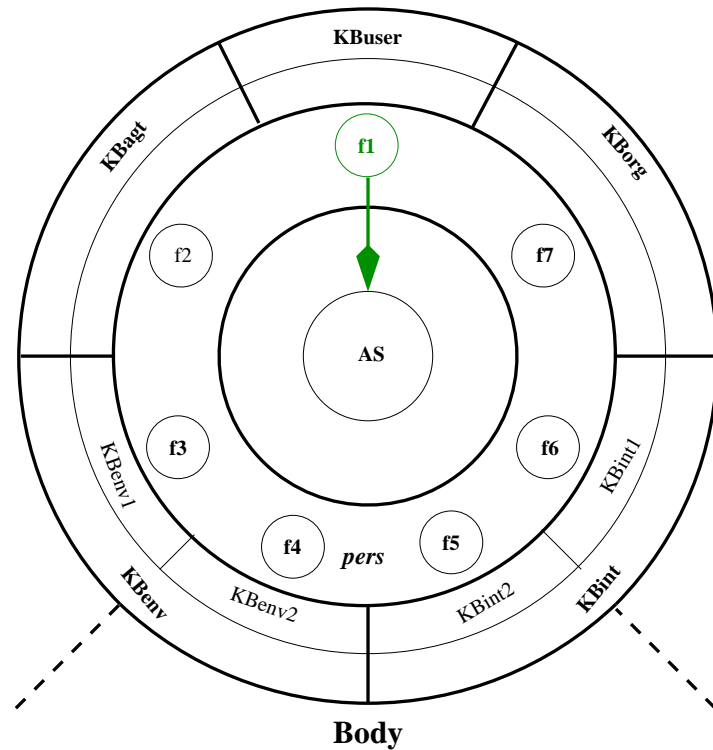


f7 claim

buy(psa, sa, ticket, price, comm)  
pay(psa, sa, 4, 0)

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
buy(psa, sa, ticket, price, comm)  
pay(psa, sa, 4, 0)

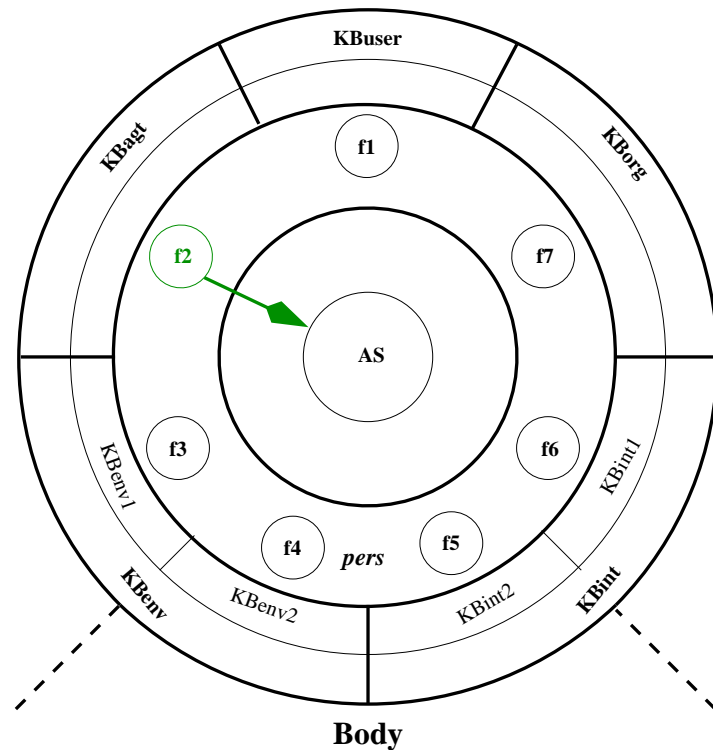
## Dialectics between facets



$f_1$  unknown

~~motive~~  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
~~~ strike~~  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
 buy(psa, sa, ticket, price, comm)  
 pay(psa, sa, 4, 0)

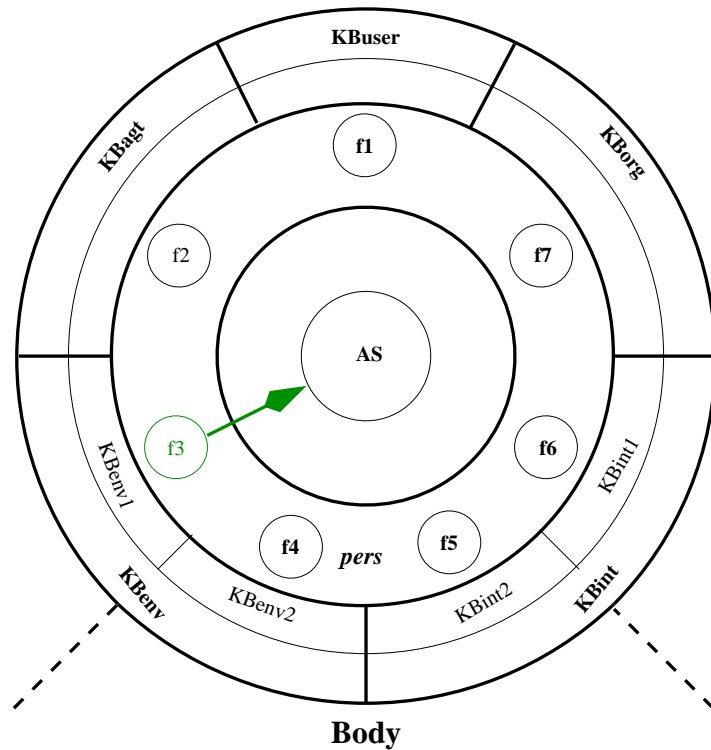
## Dialectics between facets



$f_2$  *assert*  
 $\text{accept}(\text{psa}, \text{sa}, \text{ticket}, 4, 0)$

*motive*  
 $\text{be}(\text{apisa}, 18)$   
 $\text{be}(\text{pisa}, 17)$   
 ~ strike  
 ~~$\text{take\_train}(\text{lipifi})$~~   
 ~~$\text{register}(\text{lipifi}, \text{no})$~~   
 ~~$\text{register}(\text{lipifi}, \text{yes})$~~   
 ~~$\text{buy}(\text{psa}, \text{sa}, \text{ticket}, \text{price}, \text{comm})$~~   
 $\text{pay}(\text{psa}, \text{sa}, 4, 0)$   
 $\text{accept}(\text{psa}, \text{sa}, \text{ticket}, 4, 0)$

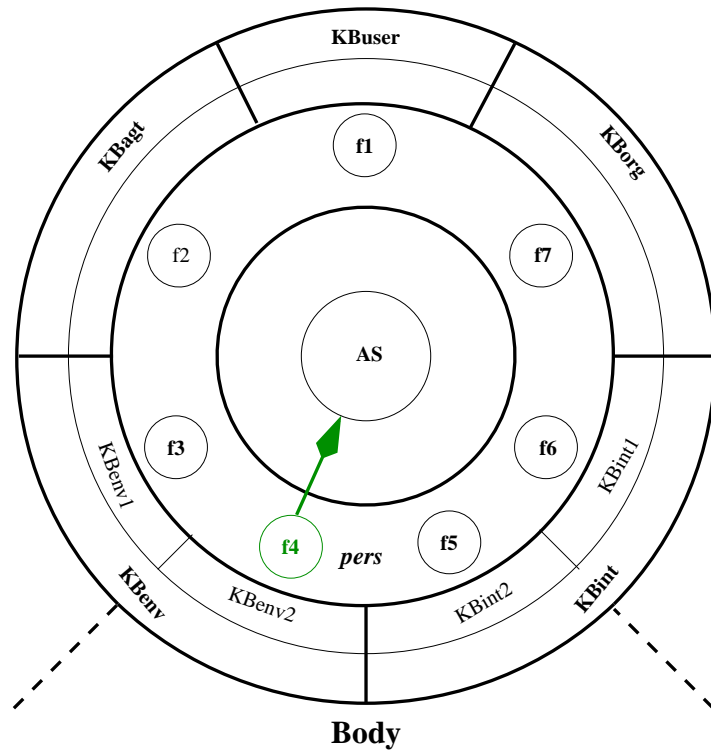
## Dialectics between facets



$f_3$  unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
 pay(psa, sa, 4, 0)  
 accept(psa, sa, ticket, 4, 0)

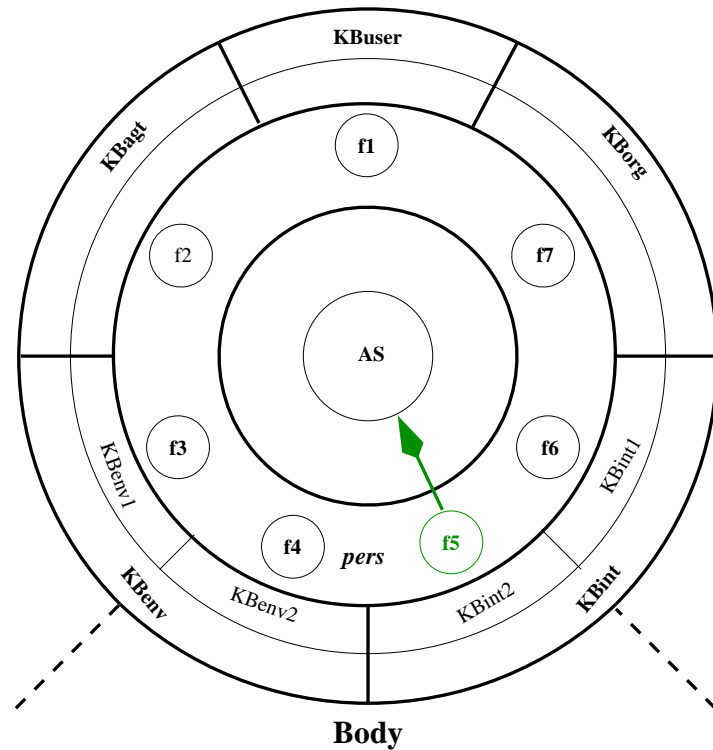
## Dialectics between facets



$f_4$  unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
 pay(psa, sa, 4, 0)  
 accept(psa, sa, ticket, 4, 0)

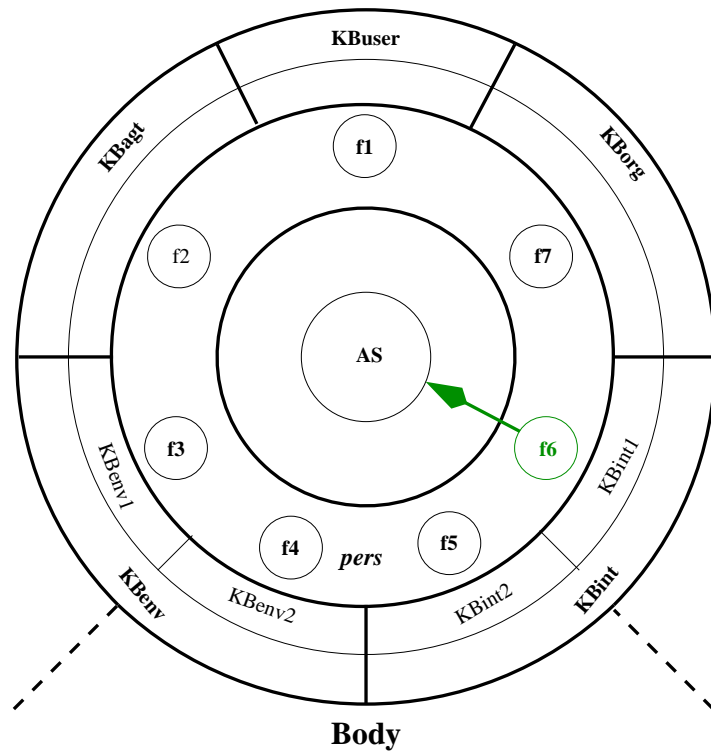
## Dialectics between facets



f<sub>5</sub> unknown

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
 pay(psa, sa, 4, 0)  
 accept(psa, sa, ticket, 4, 0)

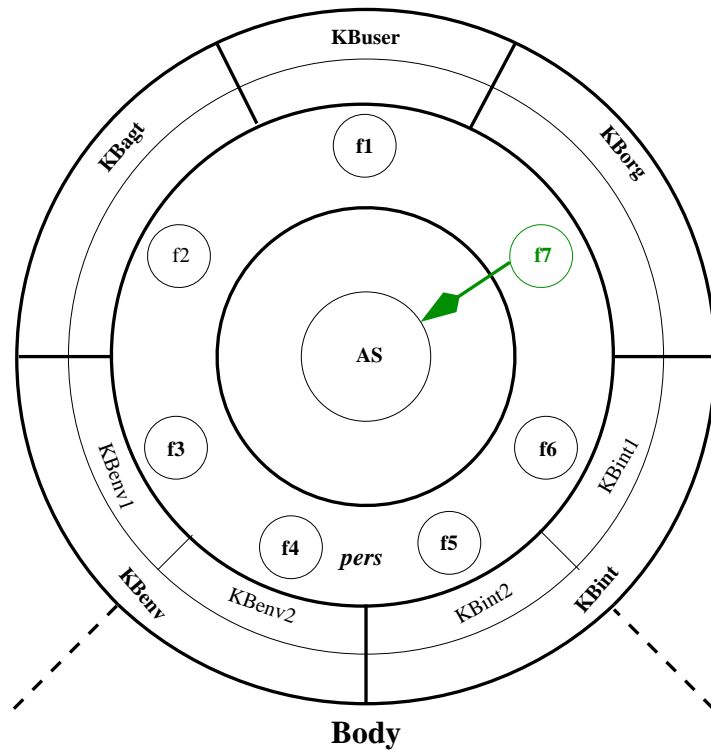
## Dialectics between facets



**f<sub>6</sub> claim**  
**request(sa, psa, ticket)**

~~motive~~  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
~~request(sa, psa, ticket)~~

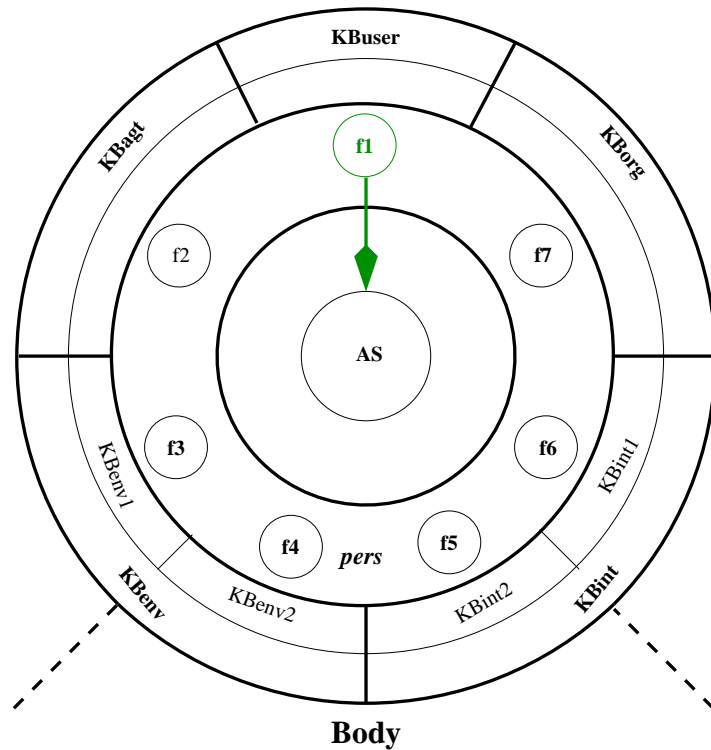
## Dialectics between facets



f7 concede  $\text{pay}(\text{psa}, \text{sa}, 4, 0)$

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
 request(sa, psa, ticket)

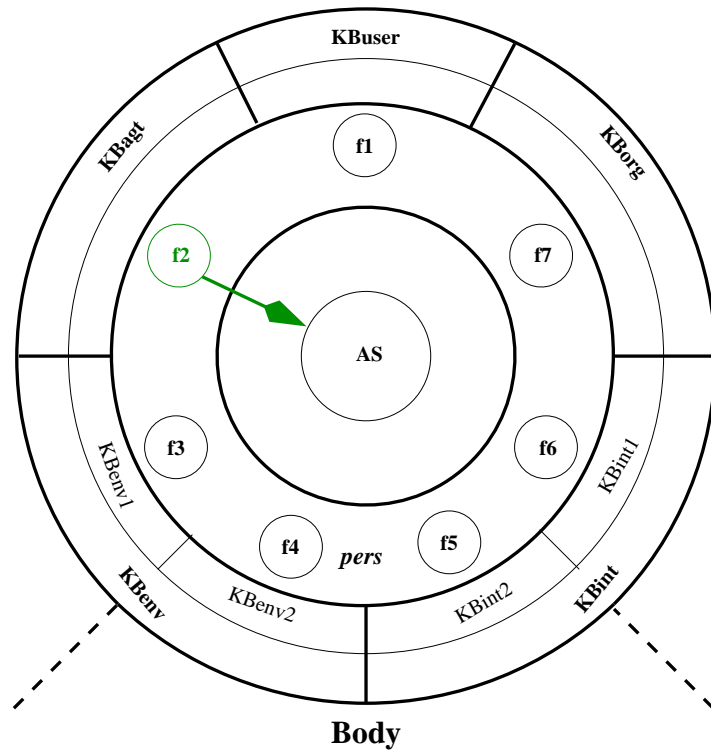
## Dialectics between facets



$f_1$  unknown

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
 request(sa, psa, ticket)

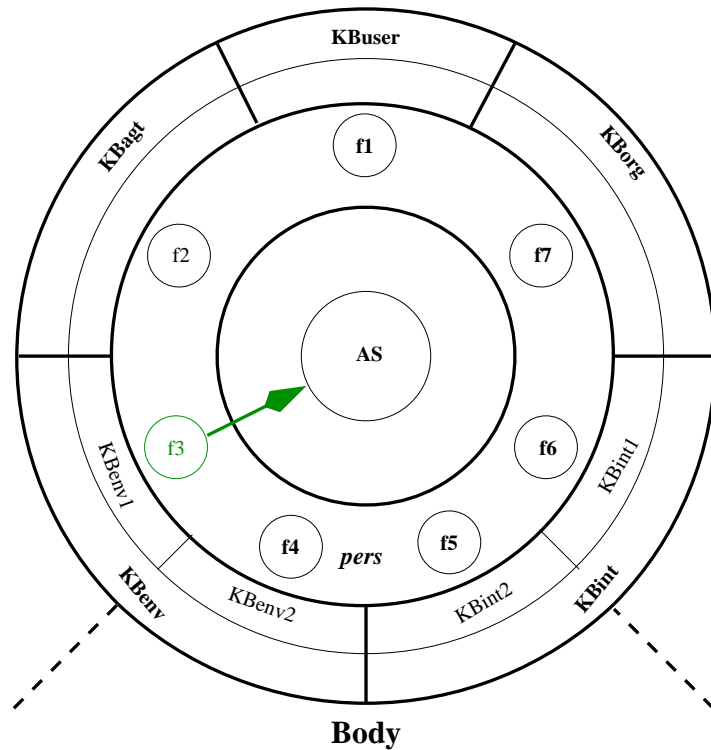
## Dialectics between facets



$f_2$  unknown

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
 request(sa, psa, ticket)

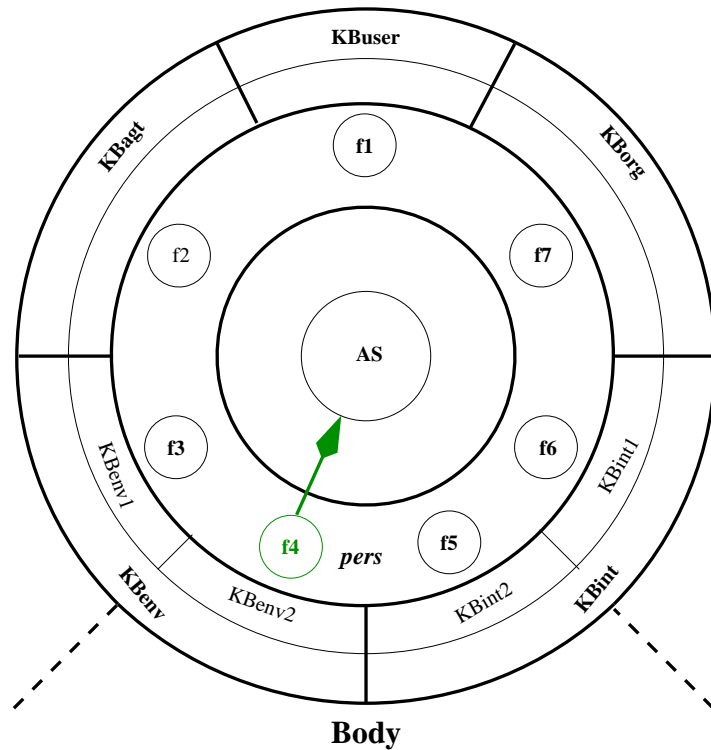
# Dialectics between facets



f<sub>3</sub> unknown

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
 request(sa, psa, ticket)

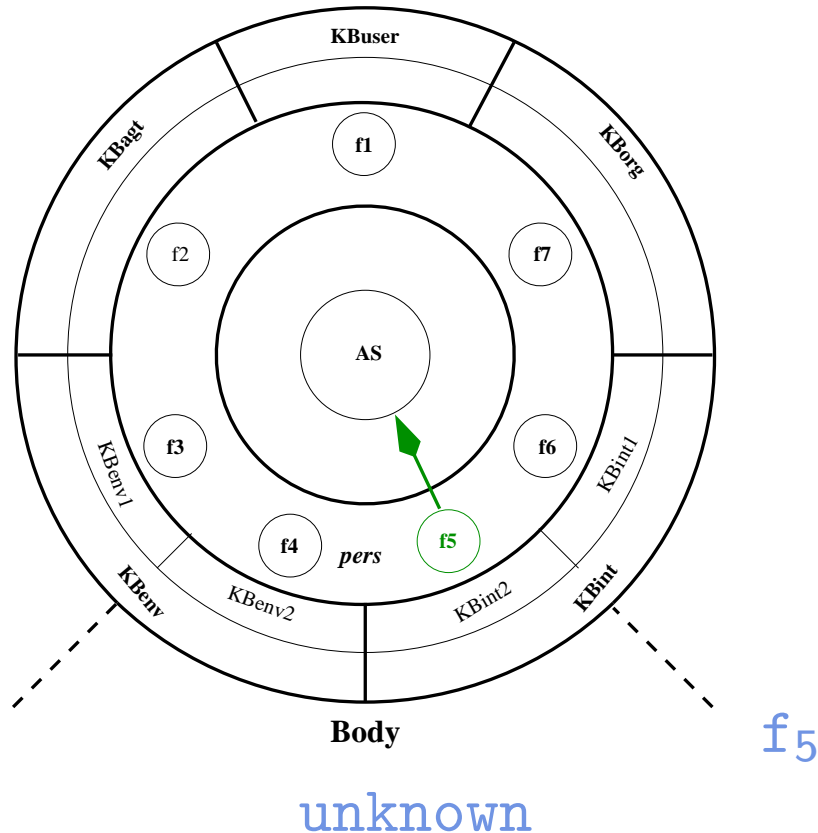
## Dialectics between facets



f<sub>4</sub> unknown

motive  
~~be(apisa, 18)~~  
~~be(pisa, 17)~~  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
~~pay(psa, sa, 4, 0)~~  
~~accept(psa, sa, ticket, 4, 0)~~  
 request(sa, psa, ticket)

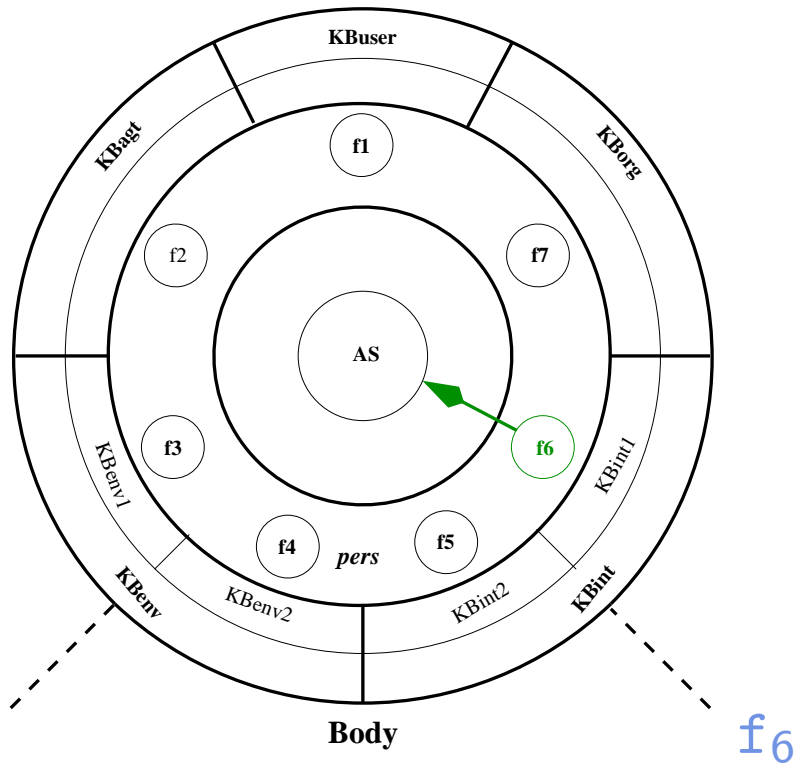
# Dialectics between facets



```

    motive
    be(apisa, 18)
    be(pisa, 17)
    ~ strike
    take_train(lipifi)
    register(lipifi, no)
    register(lipifi, yes)
    buy(psa, sa, ticket, price, comm)
    pay(psa, sa, 4, 0)
    accept(psa, sa, ticket, 4, 0)
    request(sa, psa, ticket)
  
```

# Dialectics between facets



concede  
 request(sa, psa, ticket)

motive  
~~be(apisa, 18)~~  
be(pisa, 17)  
 ~ strike  
~~take\_train(lipifi)~~  
~~register(lipifi, no)~~  
~~register(lipifi, yes)~~  
~~buy(psa, sa, ticket, price, comm)~~  
pay(psa, sa, 4, 0)  
~~accept(psa, sa, ticket, 4, 0)~~  
request(sa, psa, ticket)

# Generic mechanism for the conflict resolution during self-adaptation.



- Main characteristics
  - declarative and formal semantics
  - allow self-adaptation
  - guarantee the coherent behaviour in unforeseen situations
- Perspectives
  - different dialogue-game protocols instantiating different semantics
  - improve the implementation (multi-thread)
  - $\neq$  kinds of reasoning : epistemic reasoning, practical reasoning and normative reasoning.






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 In Actes de JMAC'04, Paris, France, November 2004.
- 
 Yves Demazeau.  
 From interactions to collective behaviour in agent-based systems.  
 In Proc. of the First European Conference on Cognitive Science, pages 117–132, Saint Malo, 1995.

# Questions ?



- Questions ?