Meta-langage endomorphique et planification abstraite pour la reconnaissance d'intention en temps réel

Soutenance de Thèse

Antoine Gréa

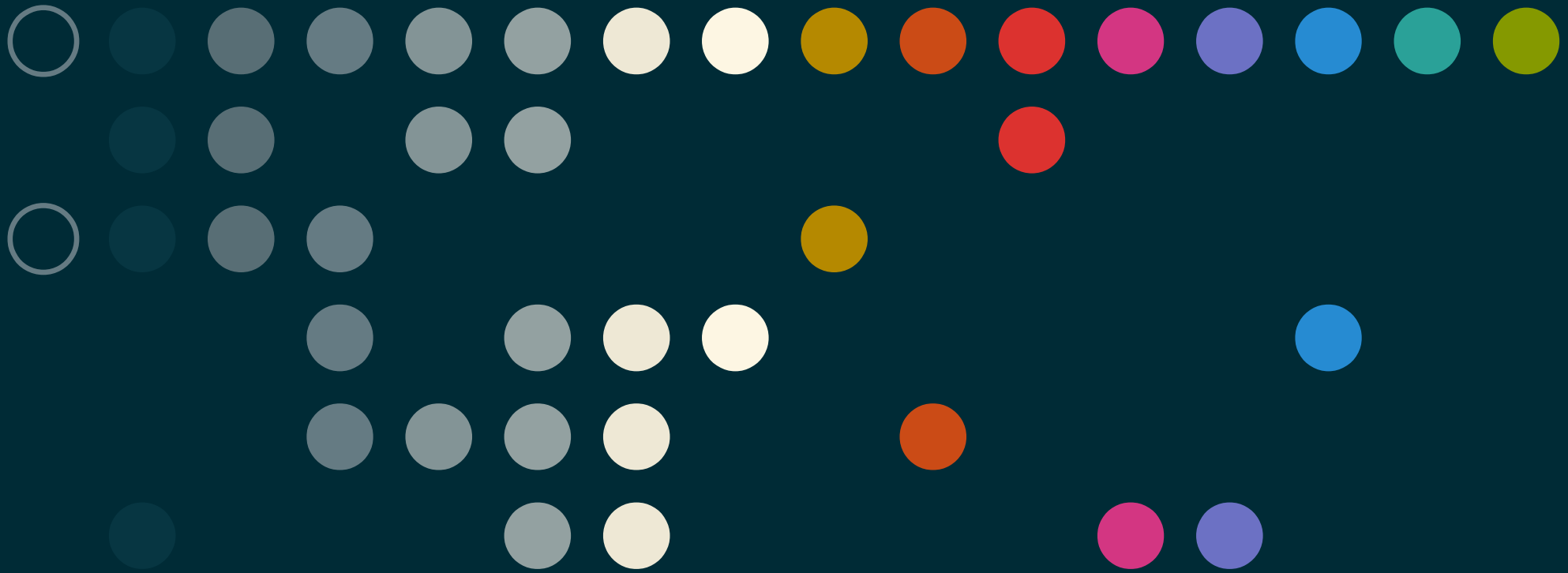
- *Encadrants*
  - Samir Aknine
  - Laetitia Matignon
- *Rapporteurs*
  - Eva Onaindia
  - Damien Pellier
- *Jury*
  - Hamamache Kheddouci
  - Ivan Varzinczak

1 Introduction

- Financements
- Contexte
- Sujet
- Problématique

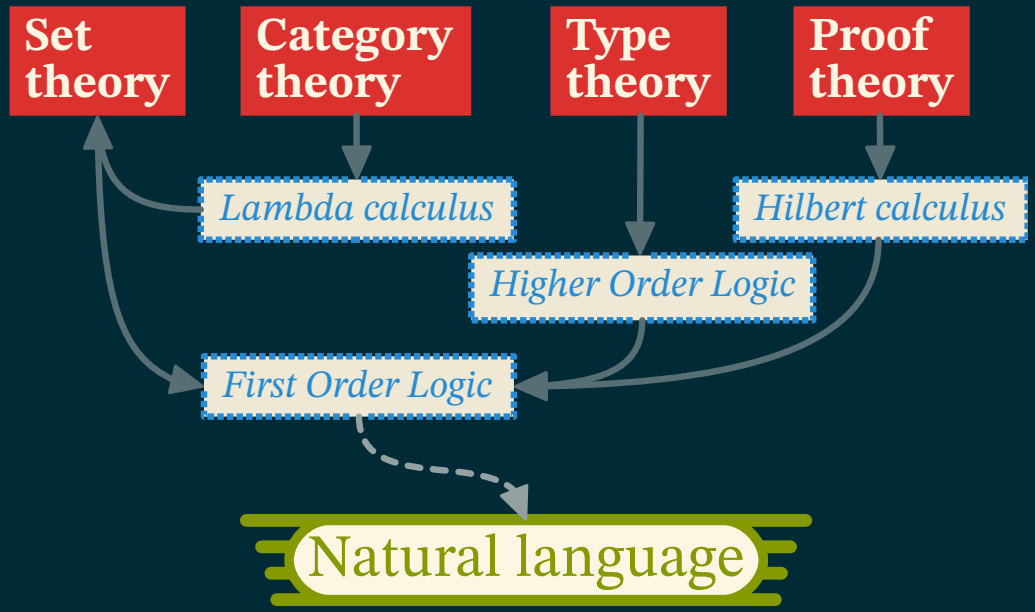
Plan

2 Fondamentaux



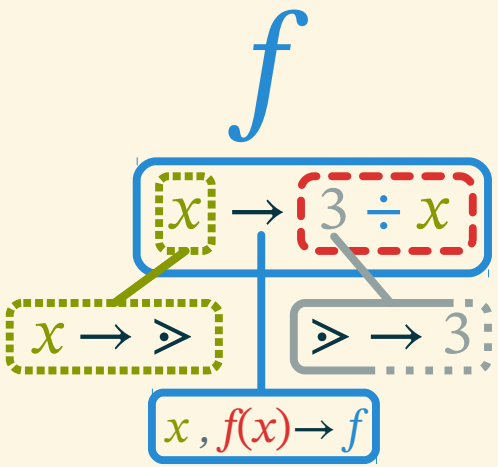
Fondation et Formalismes

- Qu'est-ce qu'une fondation ?
  - Abstraction
  - Formalisation
  - Circularité



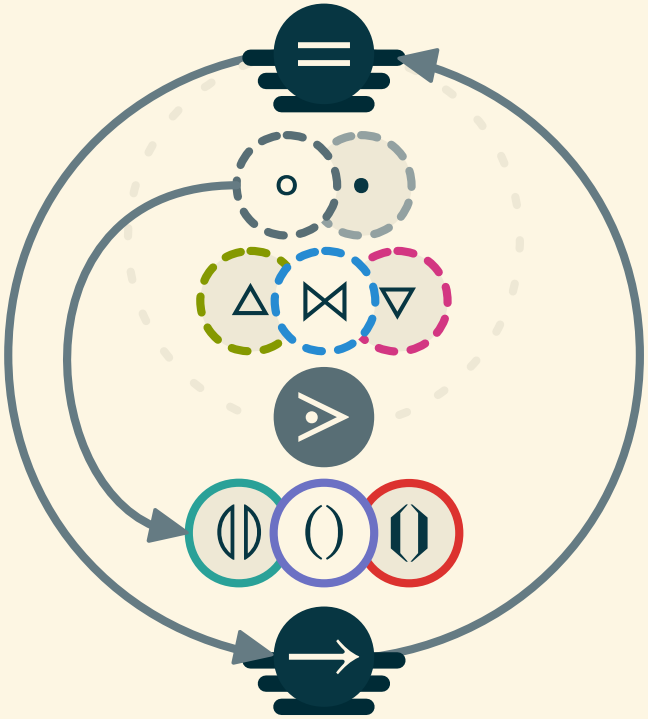
Théorie Fonctionnelle

- Basé sur la théorie des Catégories
- Axiomes
- Définitions
- Algèbre fonctionnelle



Legend

- *definition*
- *variable*
- literal
- *expression*



Legend

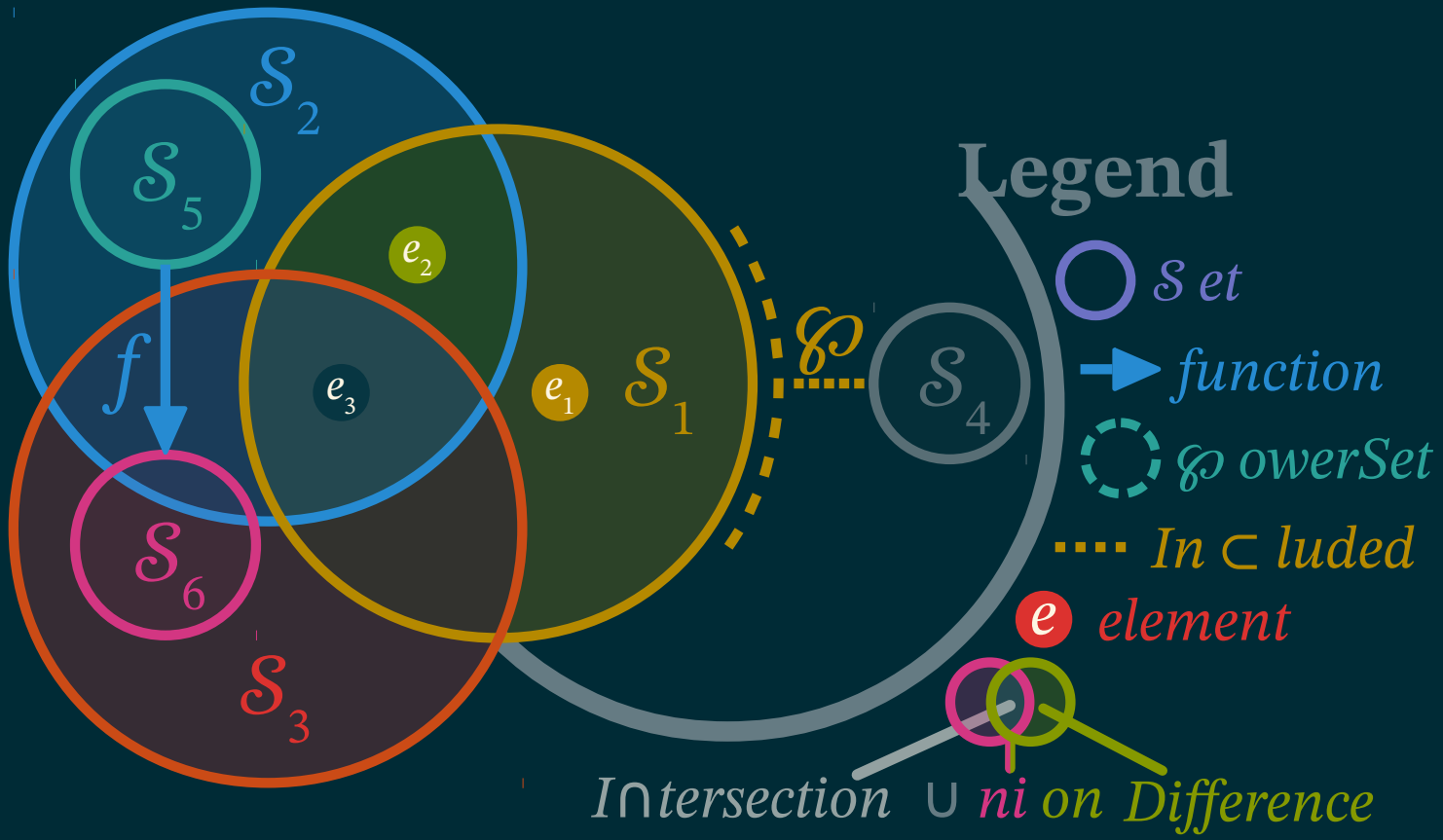
- axioms
- bases
- complement
- algebraic
- bounds
- boundaries
- depends

Logique et Raisonnements

- Logique du premier ordre
  - Booléen
- Logique d’ordre supérieure
- Logique Modale

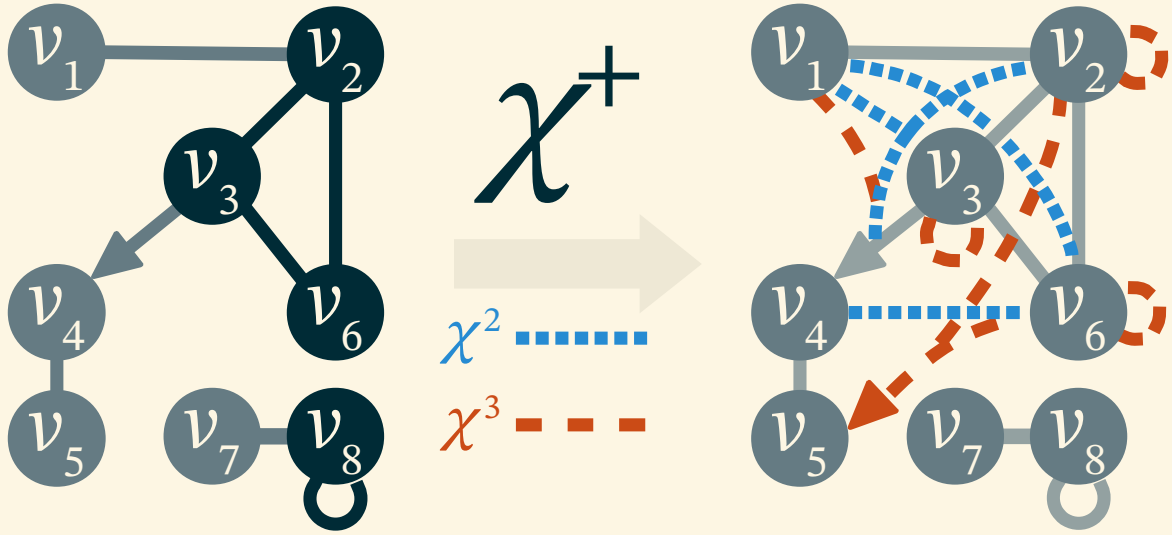
Théorie des Ensembles

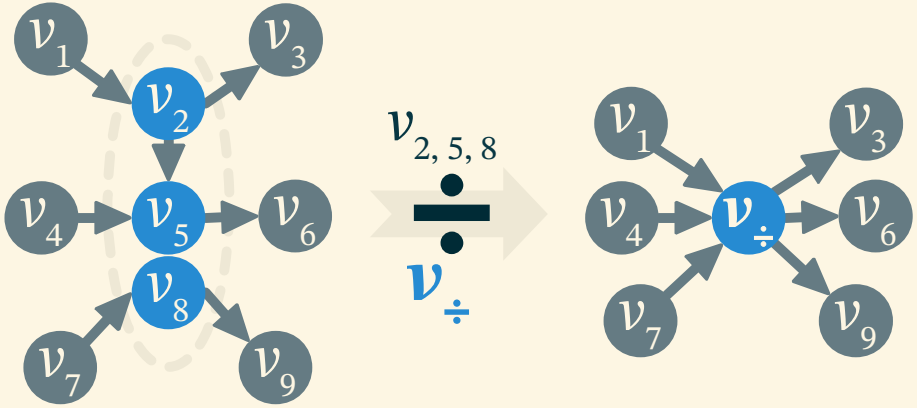
- Définitions
- Opération
- ZFC



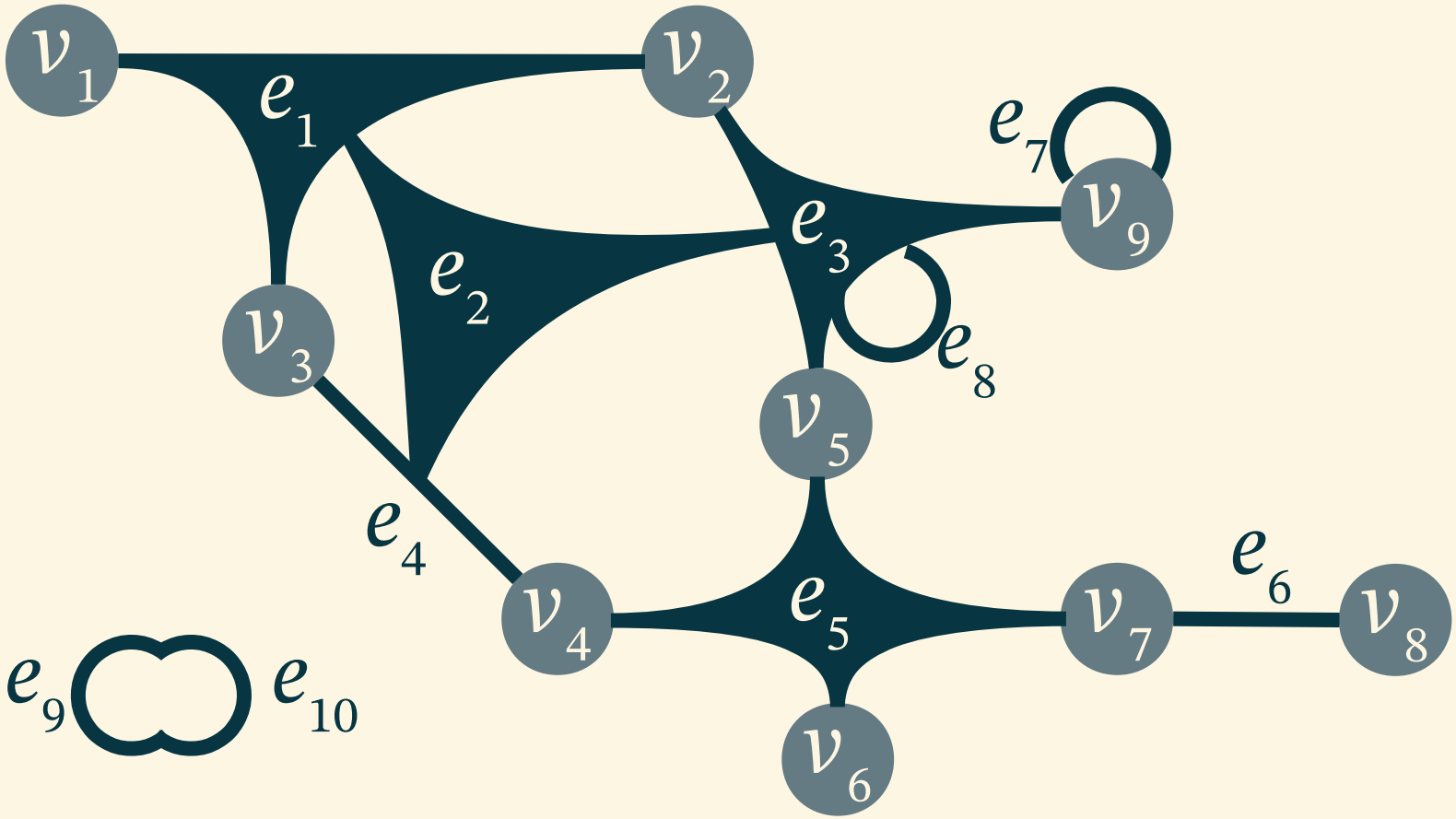
Graphes

- Adjacence, Incidence et Connectivité
- Propriétés
- Quotient

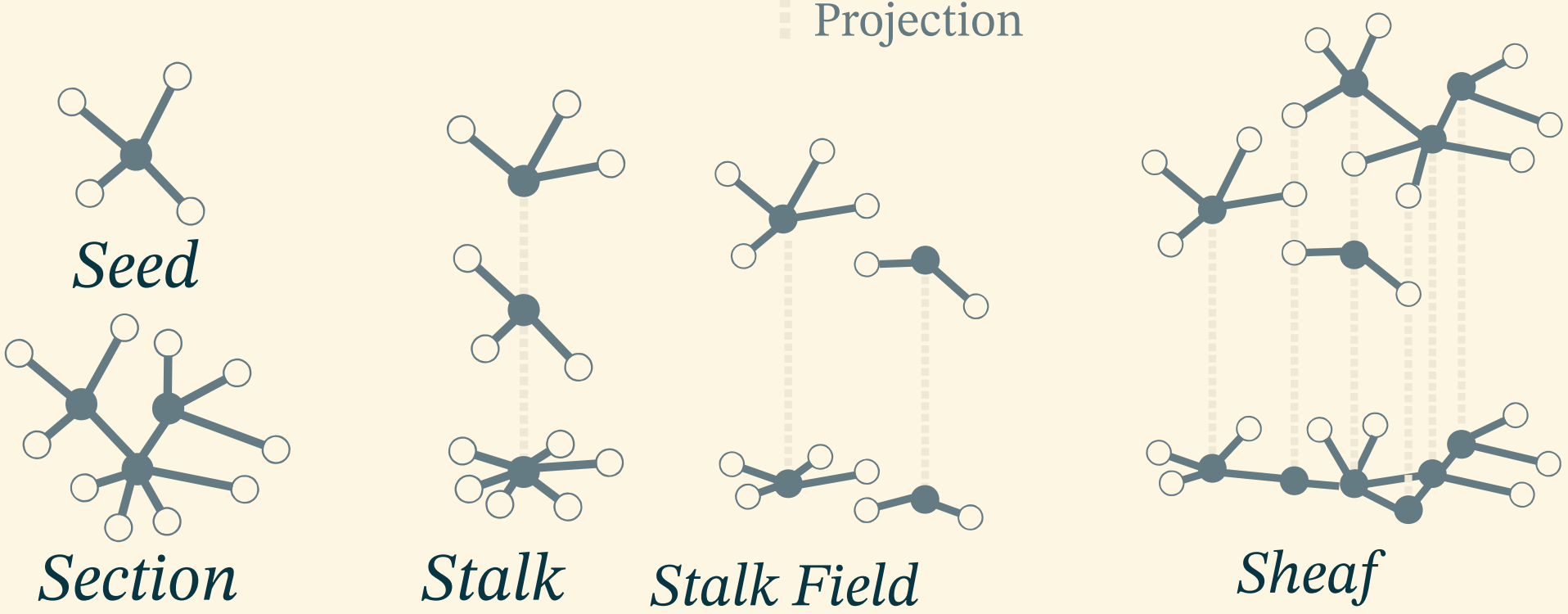




Hypergraphs

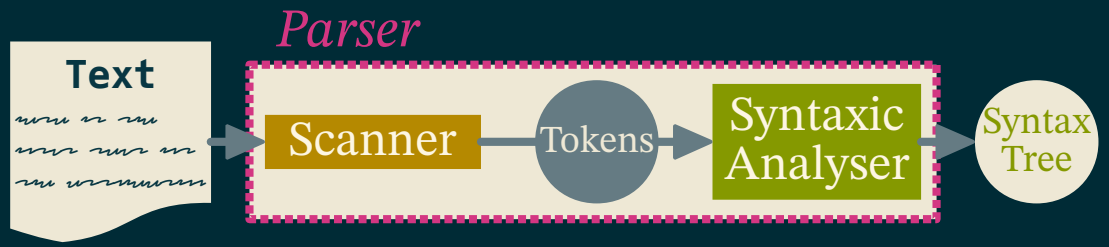


Faisseaux

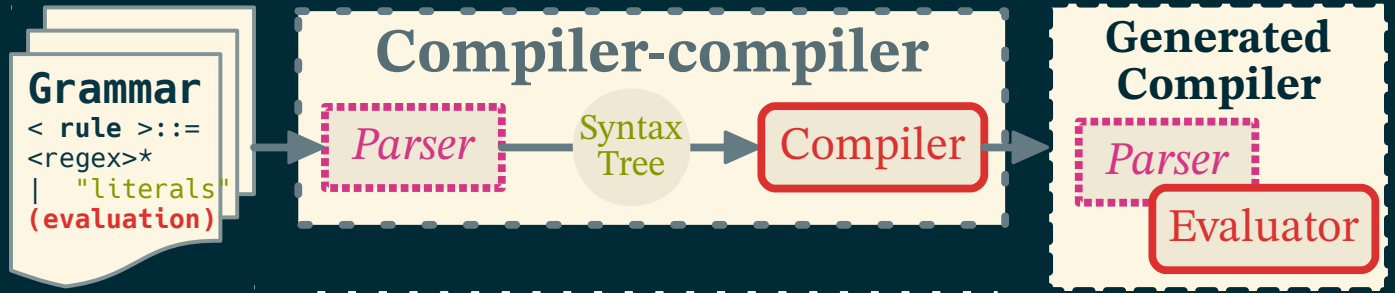

Legend
Germ
Connector
Edge
Projection
Seed
Section
Stalk
Stalk Field
Sheaf

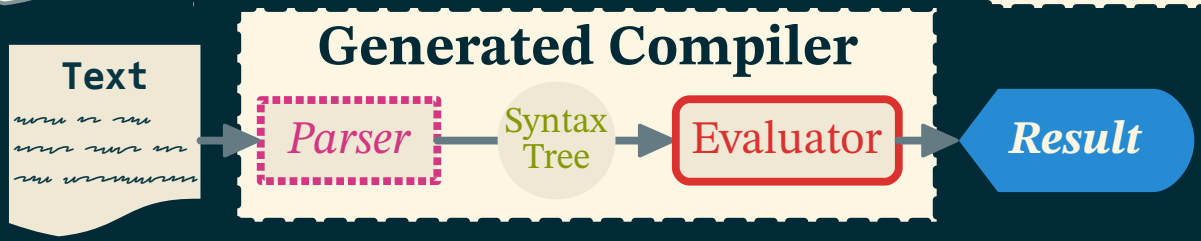
3 Représentation des Connaissances

Grammaire


Text
Parser
Scanner
Tokens
Syntaxic Analyser
Syntax Tree

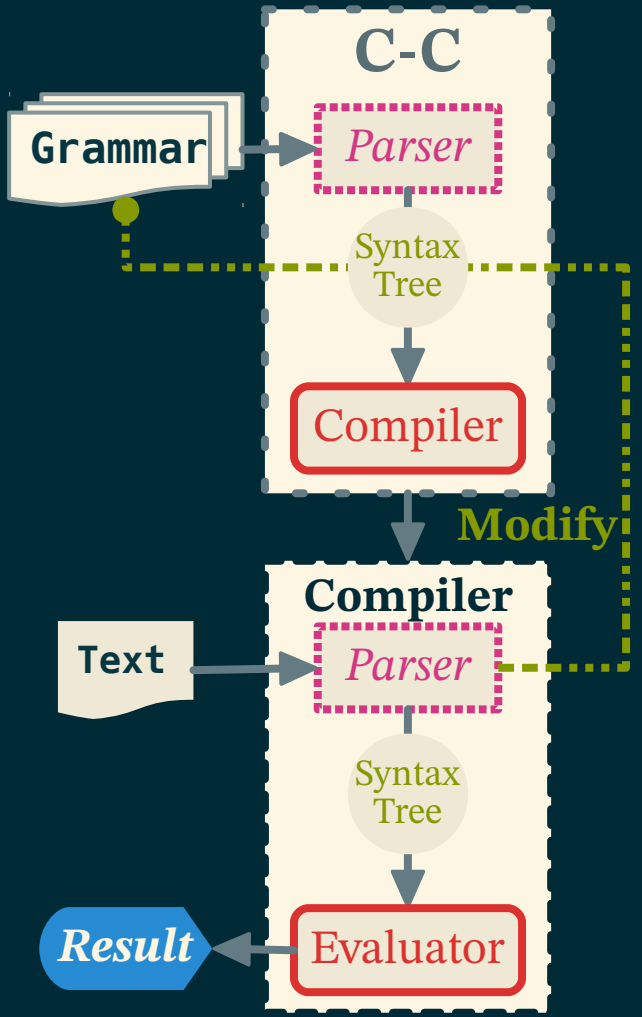

Legend
Process
Evaluator
Input
Data
Output


Grammar
< rule >::=
<regex>*
| "literals"
(evaluation)
Compiler-compiler
Parser
Syntax Tree
Compiler
Generated Compiler
Parser
Evaluator

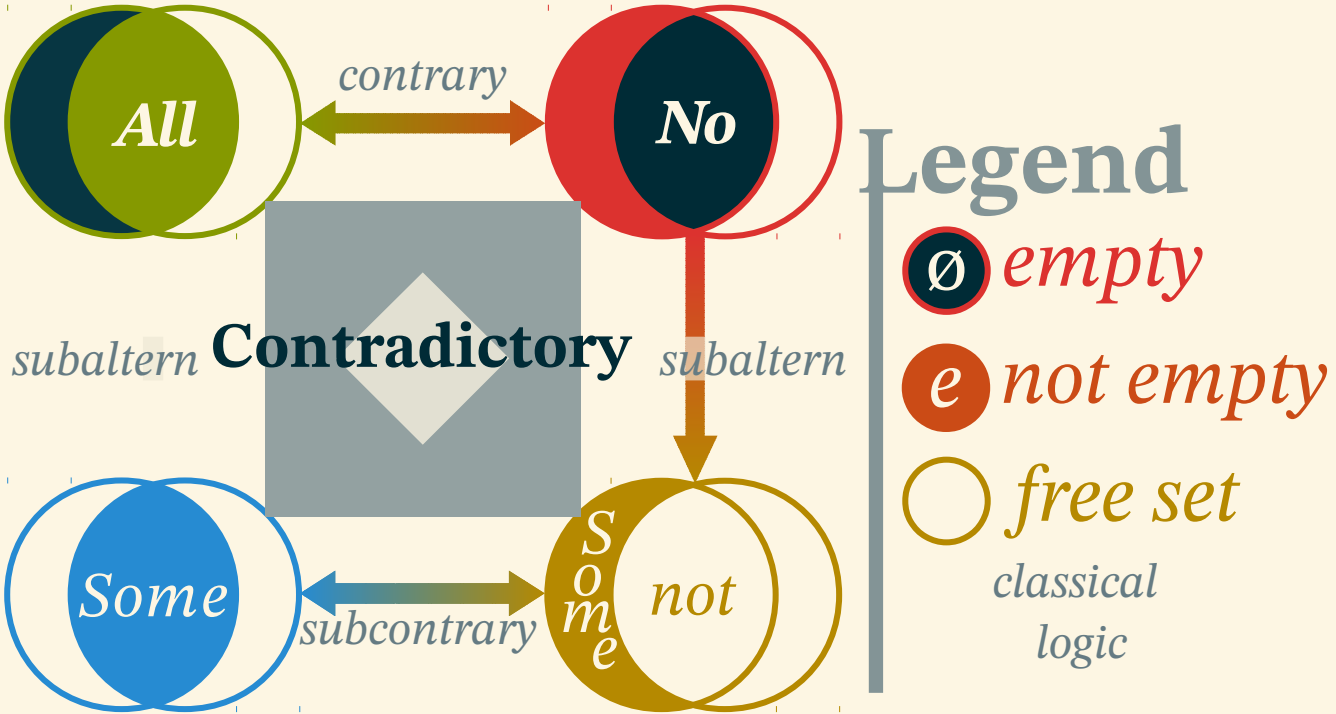

Text
Generated Compiler
Parser
Syntax Tree
Evaluator
Result


Legend
Process
Evaluator
Input
Data
Output

Grammaire Dynamique



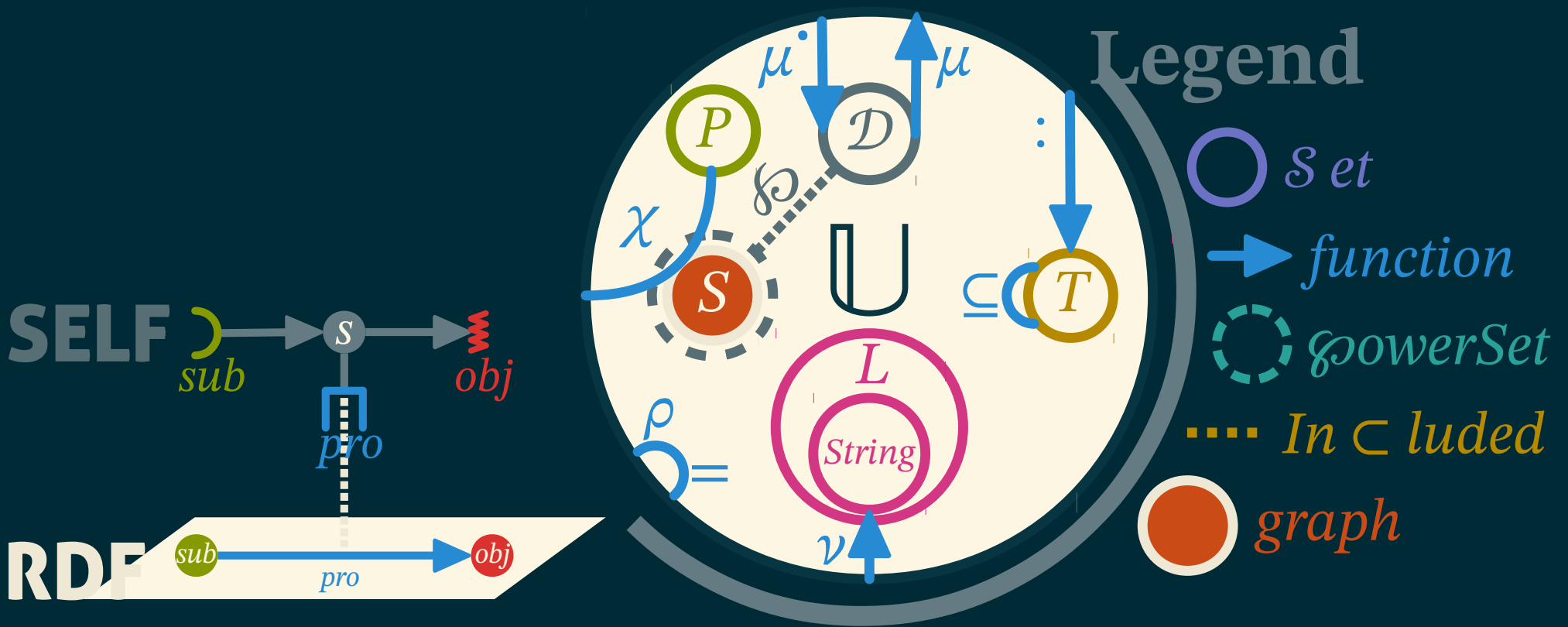
Logique de Description



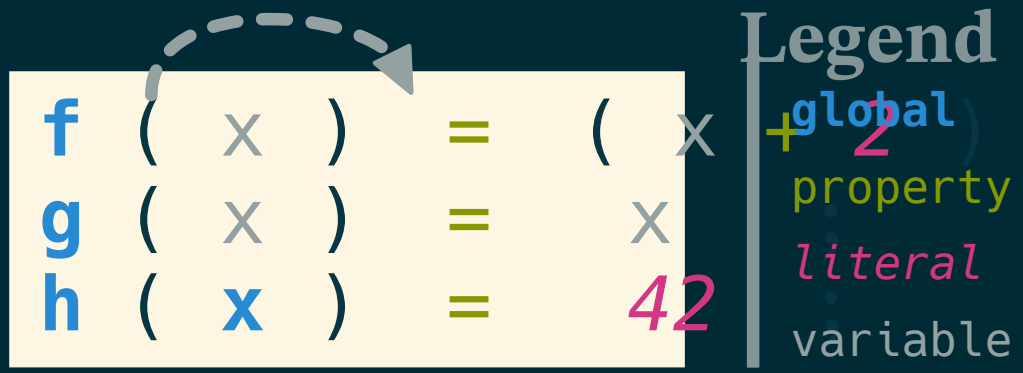
Ontologies

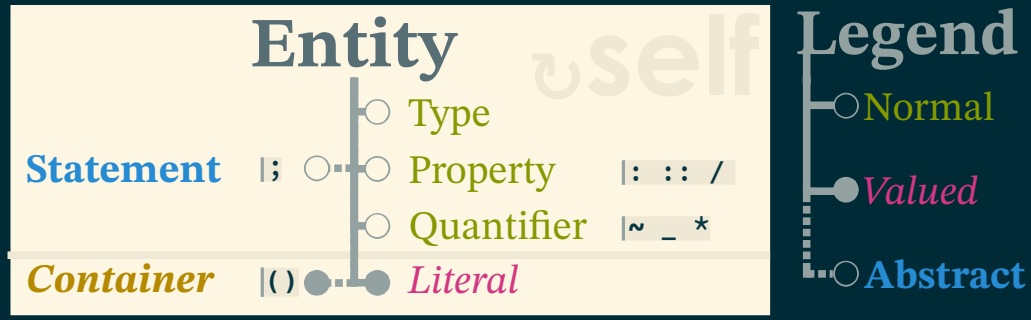
- Formes
- Langages
- Limites

SELF


SELF
sub
s
obj
pro
RDF
sub
obj
pro
μ
μ
P
𝒟
℘
χ
S
T
L
String
ρ
ν
Legend
Set
function
℘owerSet
In ⊂ luded
graph

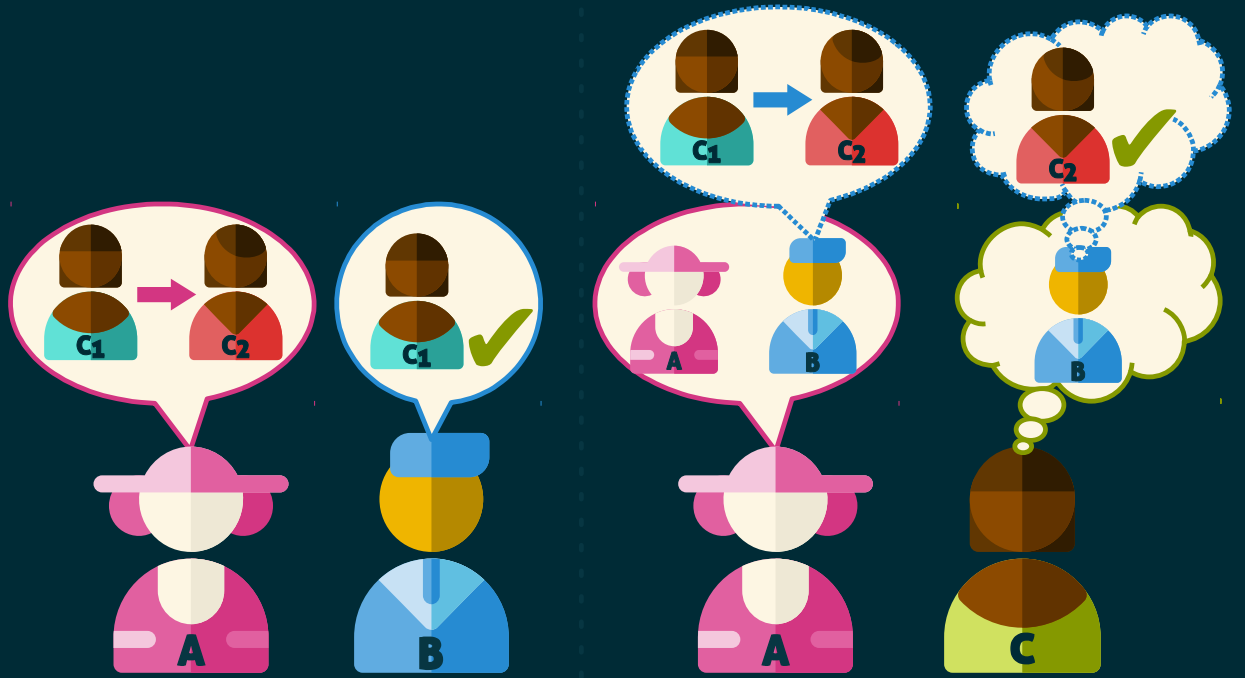
Interprétation





Inférence

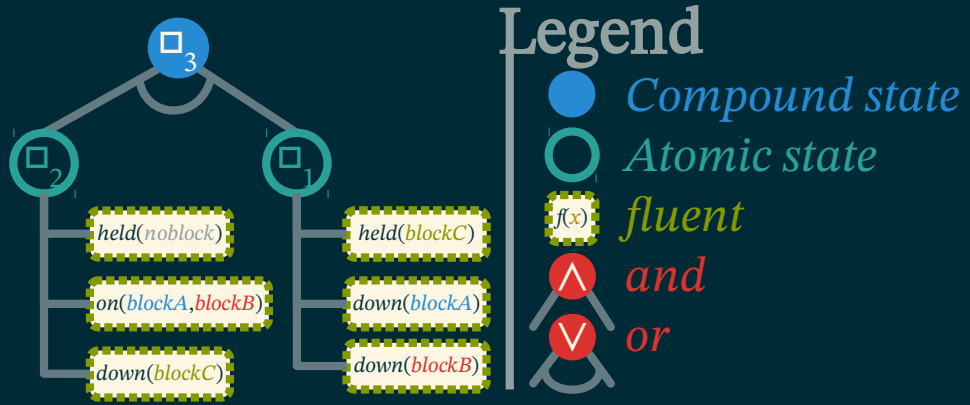
Exemple

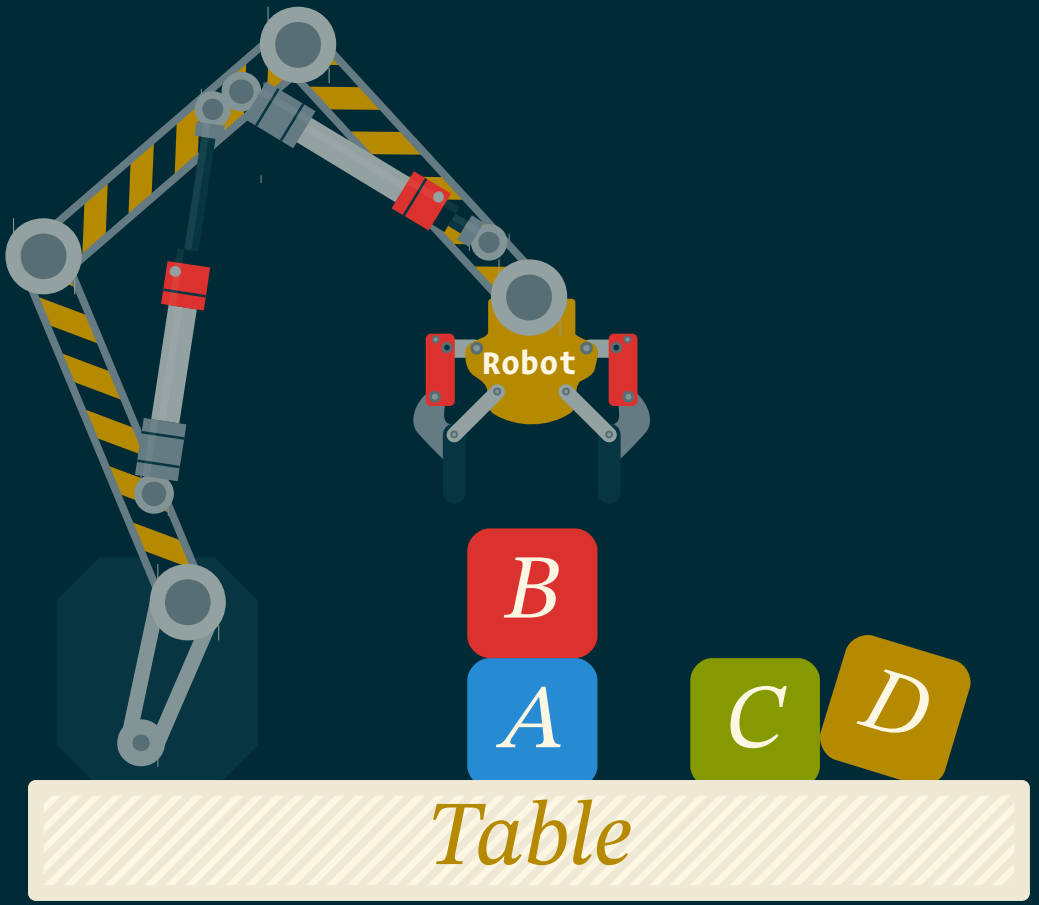


4 Formalisme de Planification Générale

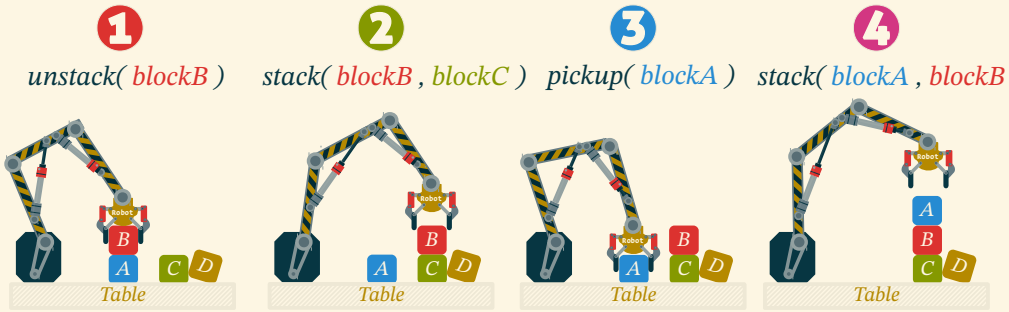
Domaine

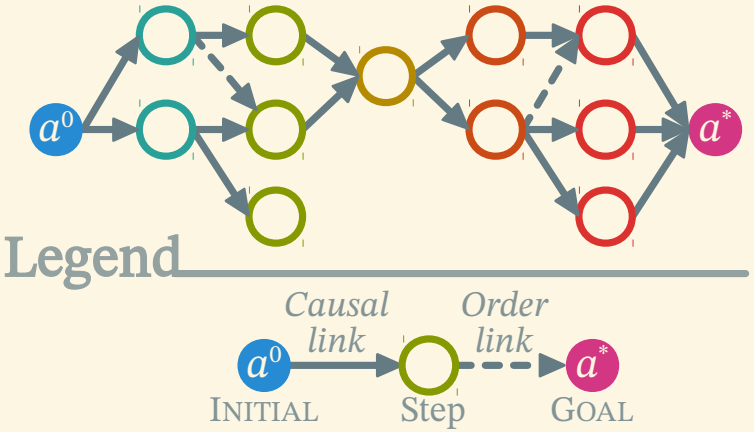
- Fluents
- États
- Action





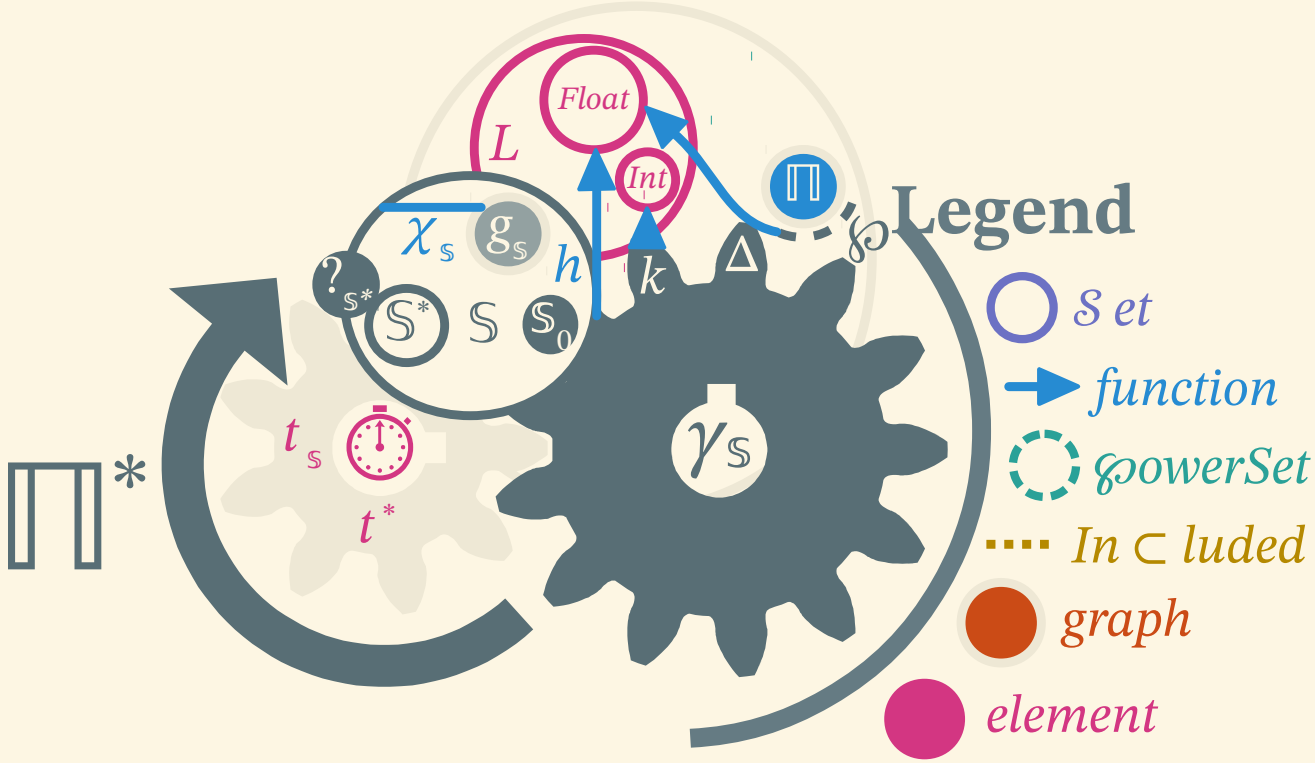
Problèmes et Solutions





Espace de Recherche

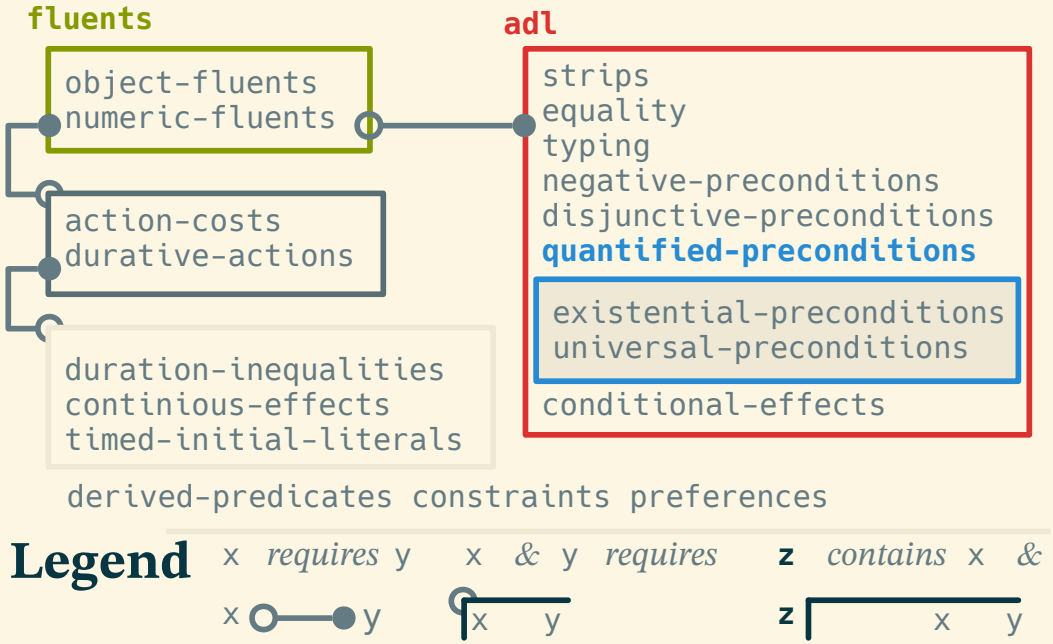
Algorithme général



Instances Classiques

5 Cadriciel COLOR

PDDL et Autre Langages



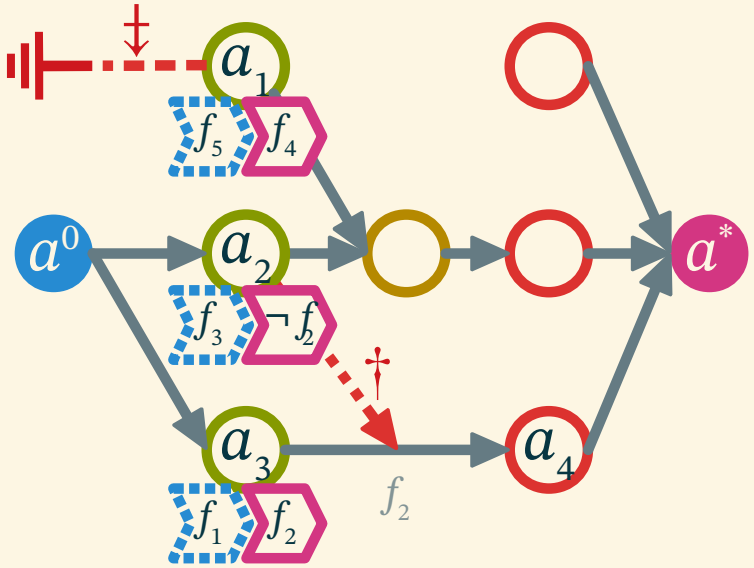
Le Cadriciel COLOR

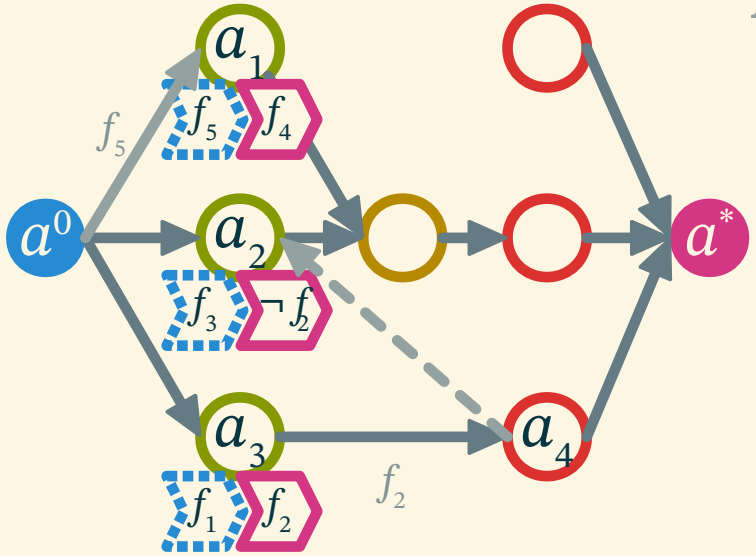
6 Algorithmes de Planification Temps-réel et Flexible

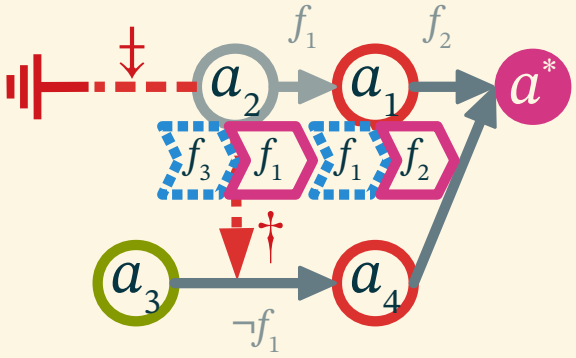
Algorithmes Existants

- Espace de Plan
- HTN

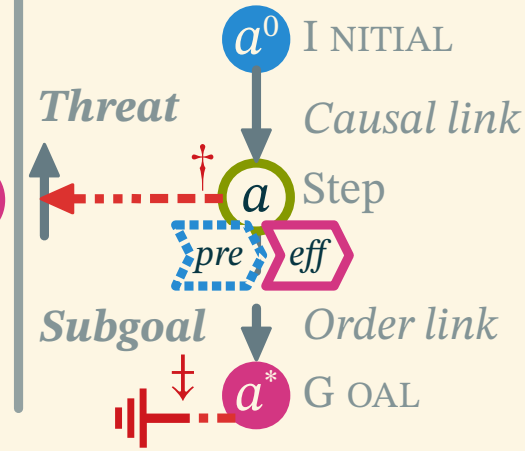
PSP


a_1
f_5
f_4
a^0
a_2
f_3
$\neg f_2$
a_3
f_1
f_2
a_4
a^*


a_1
f_5
f_4
f_5
a^0
a_2
f_3
$\neg f_2$
a_3
f_1
f_2
a_4
f_2
a^*

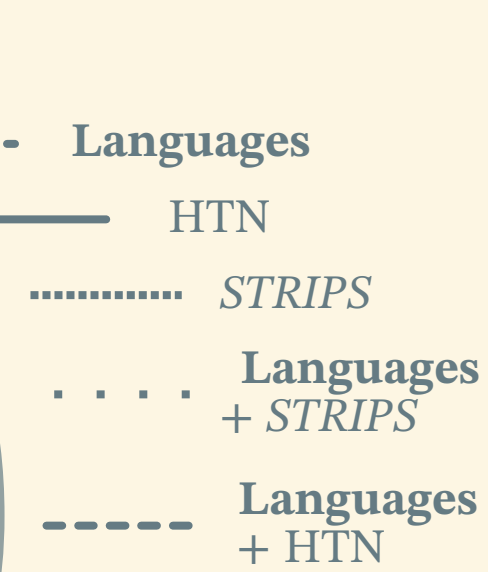

f_1
f_2
a_2
a_1
a^*
f_3
f_1
f_1
f_2
a_3
a_4
$\neg f_1$

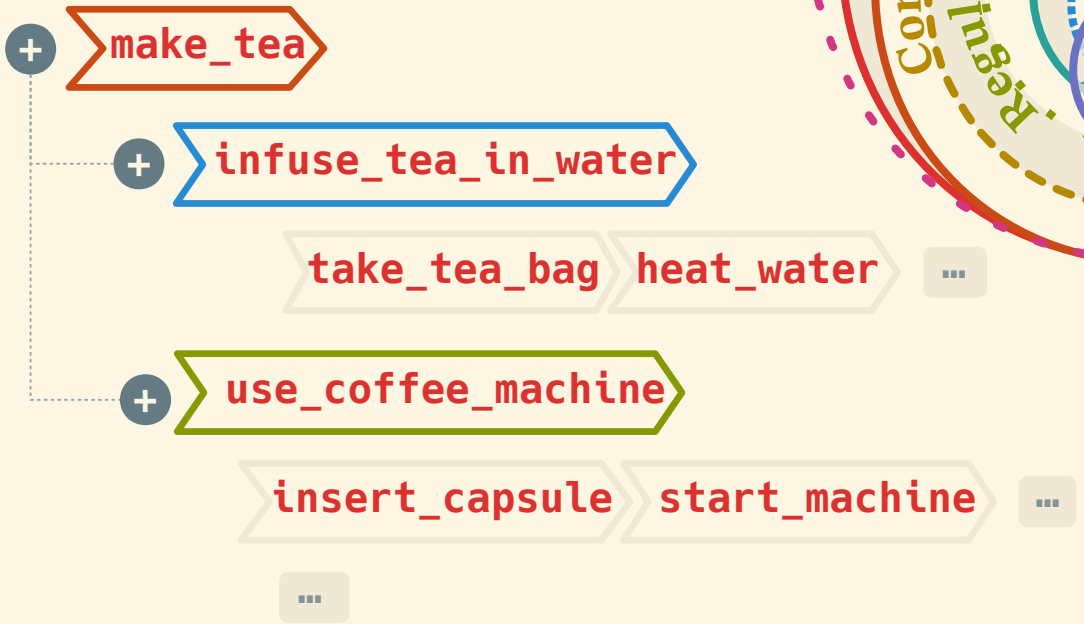
Legend


a^0
INITIAL
Threat
Causal link
a
Step
pre
eff
Subgoal
Order link
a^*
GOAL

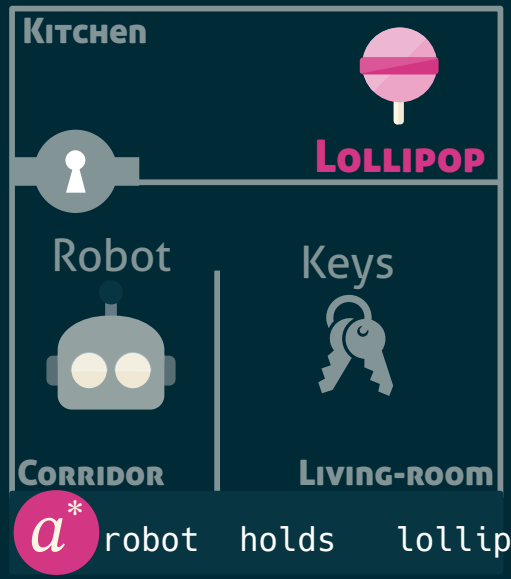
HTN


Context-Sesitive Languages
Hierarchical Tasks Network
No Precondition & Effects
Context Free Languages = Totally Ordered
Regular Languages = Conditional Effects
Task Insertion
STRIPS
Acyclic

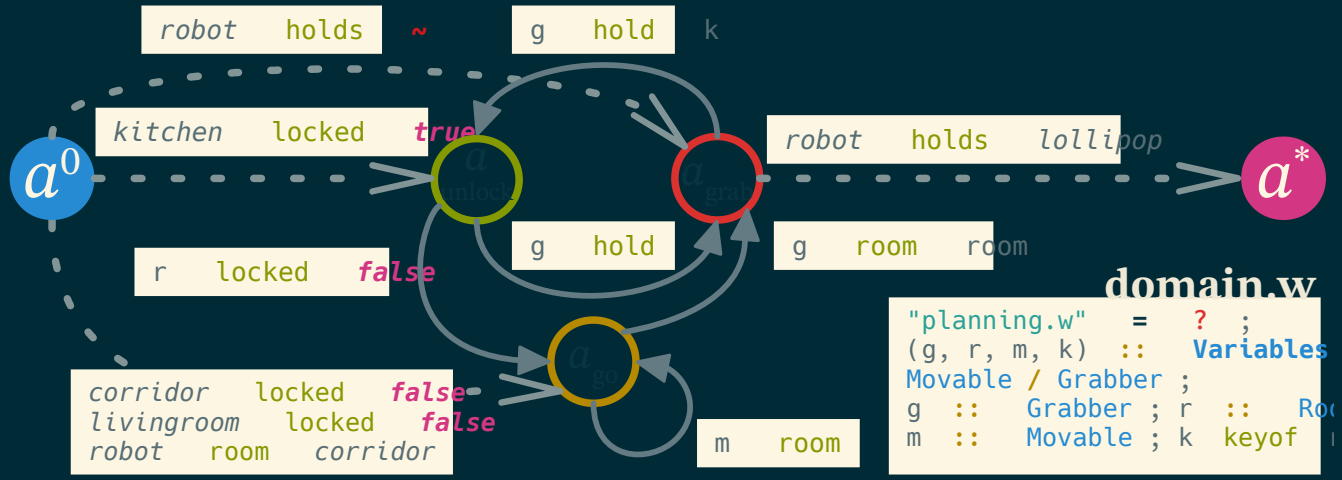

Legend
Languages
HTN
STRIPS
Languages
+ STRIPS
Languages
+ HTN


make_tea
infuse_tea_in_water
take_tea_bag
heat_water
...
use_coffee_machine
insert_capsule
start_machine
...
...

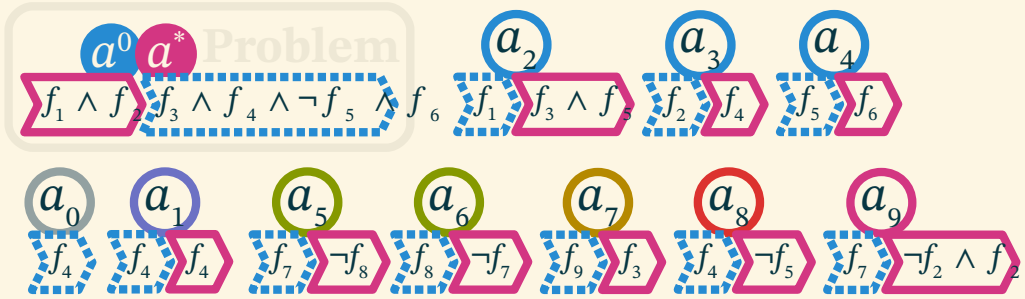
LOLLIPOP

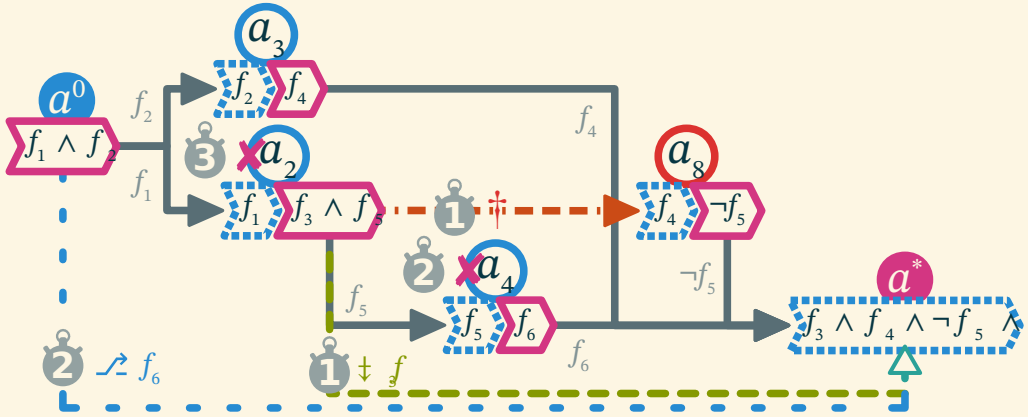



```
go (?movable, ?room)
      ?movable  is  Movable, ?room  is  Room
      pre  ?movable  room  != ?room,
           ?room  locked   false
      eff  ?movable  room  ?room

grab (?graber, ?pickable)
      ?graber  is  Graber, ?pickable  is  Picka
      pre  ?graber  holds   nothing ,
           ?graber  room  = ?pickable  room
      eff  ?graber  holds  ?pickable

unlock (?graber, ?room)
      ?graber  is  Graber, ?room  is  Room
      pre  ?room  locked , ?graber  holds   key
      eff  ?graber  holds   nothing ,
           ?room  locked   false
```

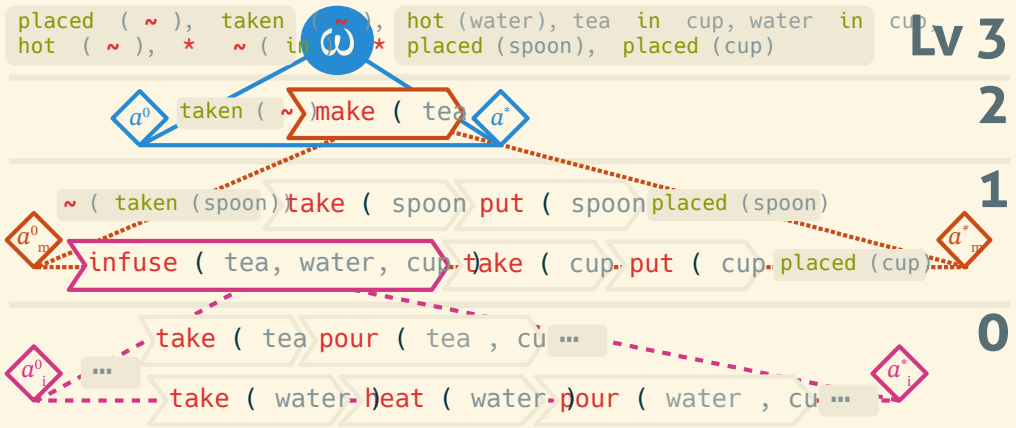


Résultats

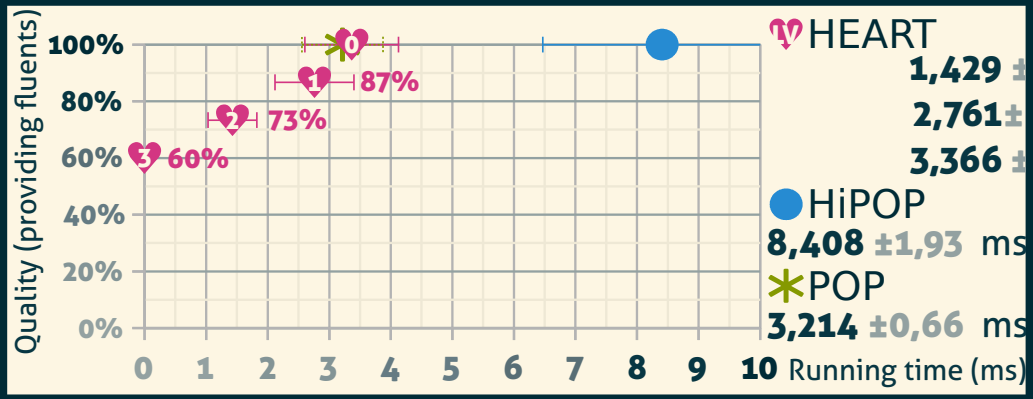

Problem
a^0
a^*
$f_1 \wedge f_2$
$f_3 \wedge f_4 \wedge \neg f_5 \wedge f_6$
a_2
f_1
$f_3 \wedge f_5$
a_3
f_2
f_4
a_4
f_5
f_6
a_0
f_4
a_1
f_4
f_4
a_5
f_7
$\neg f_8$
a_6
f_8
$\neg f_7$
a_7
f_9
f_3
a_8
f_4
$\neg f_5$
a_9
f_7
$\neg f_2 \wedge f_2$

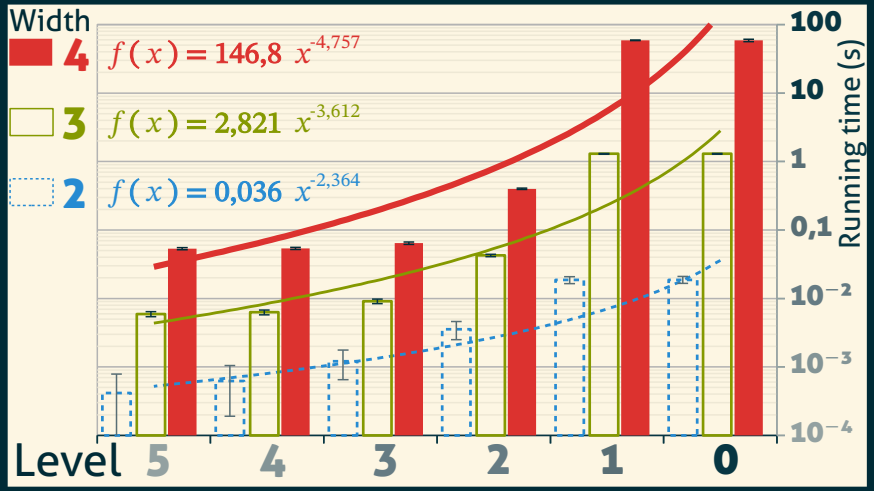

a^0
$f_1 \wedge f_2$
f_2
f_1
a_3
f_2
f_4
a_2
f_1
$f_3 \wedge f_5$
f_4
a_8
f_4
$\neg f_5$
a_4
f_5
f_6
f_5
$\neg f_5$
f_6
a^*
$f_3 \wedge f_4 \wedge \neg f_5 \wedge$
3
1
2
2
1

HEART

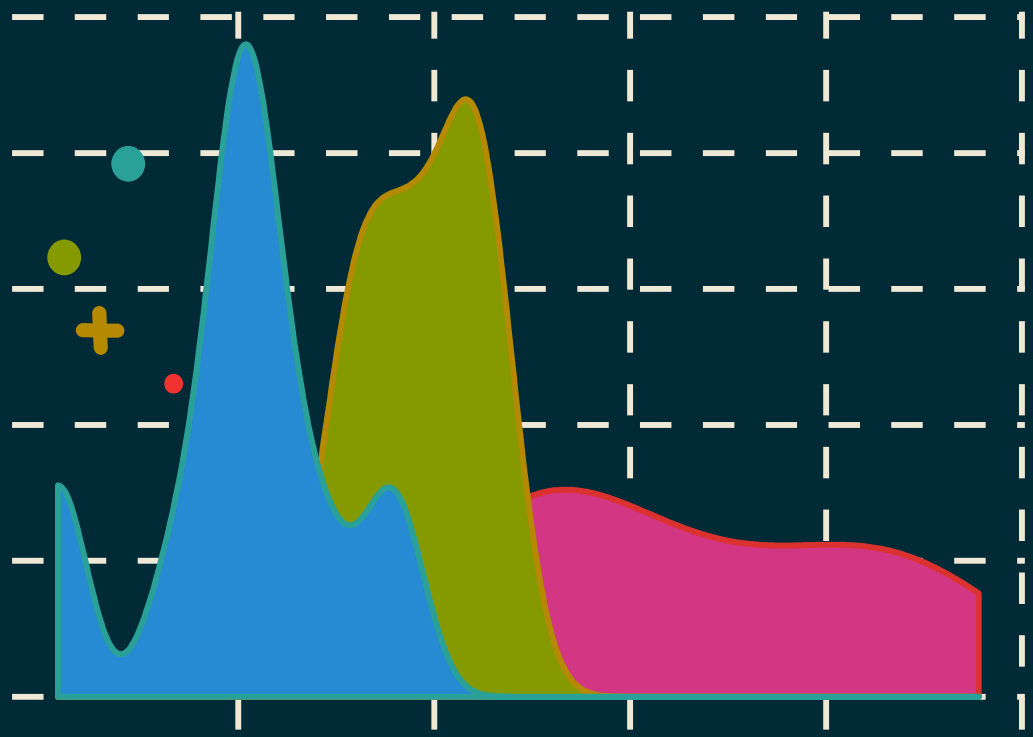

placed (~), taken (~),
hot (~), * ~ (in *
hot (water), tea in cup, water in cup
placed (spoon), placed (cup)
Lv 3
ω
a^0
taken (~)
make (tea
a^*
2
~ (taken (spoon)
take (spoon
put (spoon
placed (spoon)
1
a^0_m
infuse (tea, water, cup)
take (cup
put (cup
placed (cup)
a^*_m
take (tea
pour (tea , cu
…
0
a^0_i
…
take (water
heat (water
pour (water , cu
…
a^*_i

Résultats

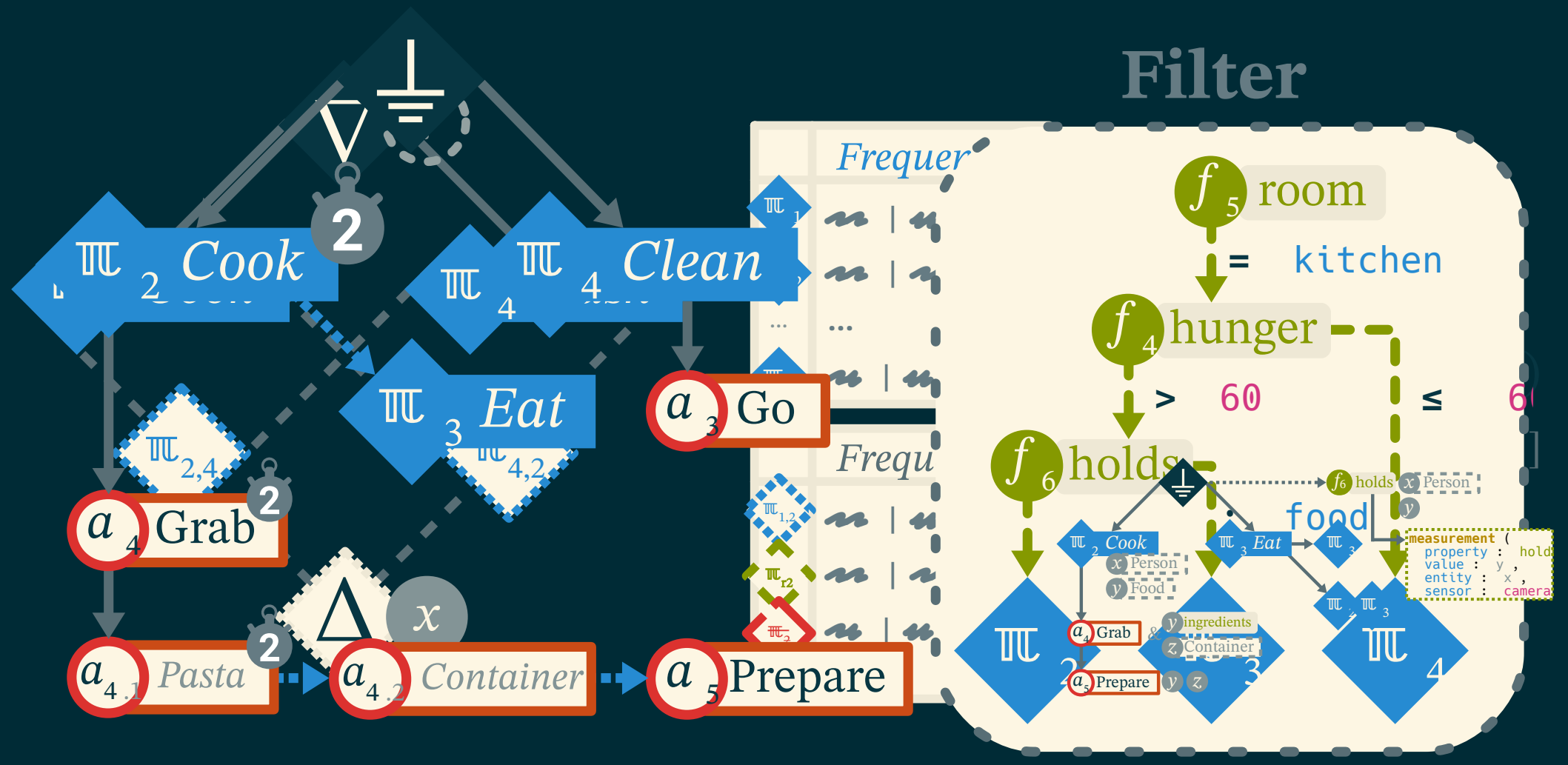

Quality (providing fluents)
100%
80%
60%
40%
20%
0%
0
1
2
3
4
5
6
7
8
9
10
Running time (ms)
87%
73%
60%
HEART
1,429 ±
2,761±
3,366 ±
HiPOP
8,408 ±1,93 ms
POP
3,214 ±0,66 ms


Width
4
3
2
$f(x) = 146{,}8\ x^{-4{,}757}$
$f(x) = 2{,}821\ x^{-3{,}612}$
$f(x) = 0{,}036\ x^{-2{,}364}$
100
10
1
0,1
10^{-2}
10^{-3}
10^{-4}
Running time (s)
Level 5 4 3 2 1 0

7 Vers la Reconnaissance d'Intention

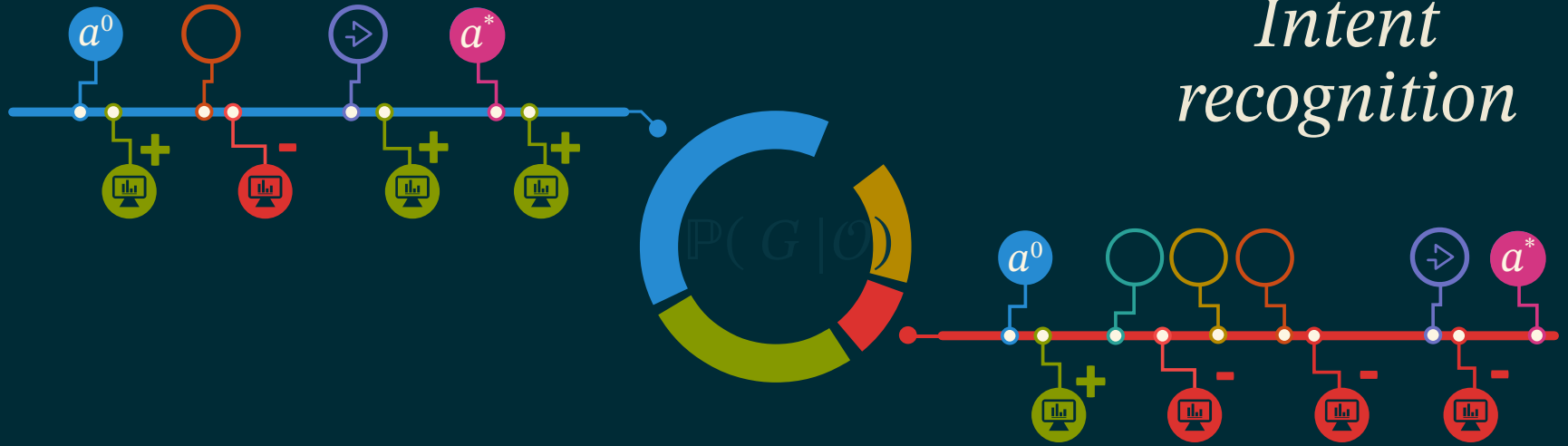


Approches Classiques

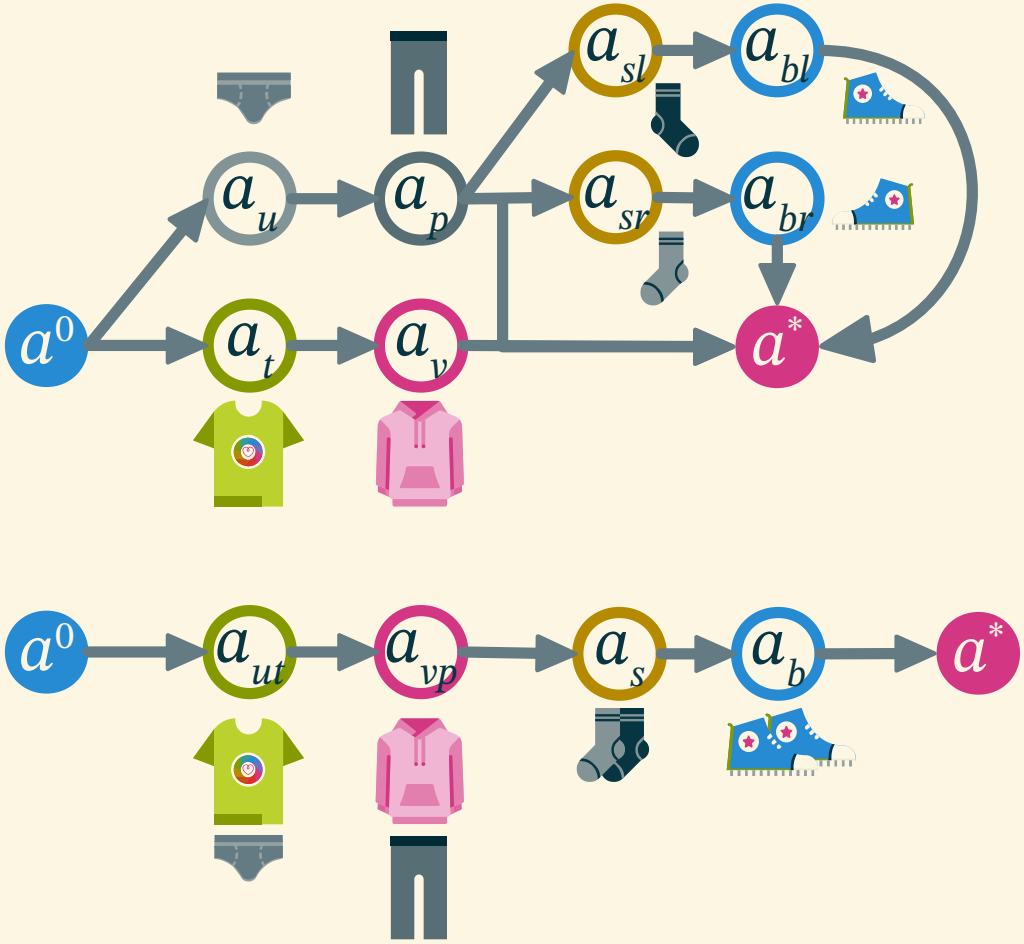


Planification inverse

Intent recognition



Adaptation de HEART



8 Conclusion

Merci de votre écoute !