IPC-4

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(joint work with

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Overview

- IPC History
- PDDL
- Evaluation
- Benchmarks
- Organisation
- Summary

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IPC-1, IPC-2, and IPC-3

- ***AIPS-98*** *McDermott* PDDL (STRIPS & ADL); **5 competitiors**: IPP, HSP, STAN, Blackbox, SGP; no clear-cut winner
- ***AIPS-00*** *Bacchus*; automated vs. hand-coded, **16 competitors, awards:** FF/TALplanner, STAN, System R, *MIPS*, HSP-2 / Shop
- ***AIPS-02*** *Fox & Long*; PDDL2.1 (numbers, duration and optimization metrics), **15 competitors, awards:** LPG / TLplan, *MIPS* / Shop2, VHPOP

IPC-4

- ***Co-Chairs***

Edelkamp & Hoffmann: Classical Planning

Littman & Younes: Probabilistic Planning

- ***Committee***

Maria Fox, Derek Long, Fahiem Bacchus, Drew McDermott, David Smith, Daniel Weld, Alessandro Cimatti, Jussi Rintanen, Enrico Giunchiglia, Blai Bonet

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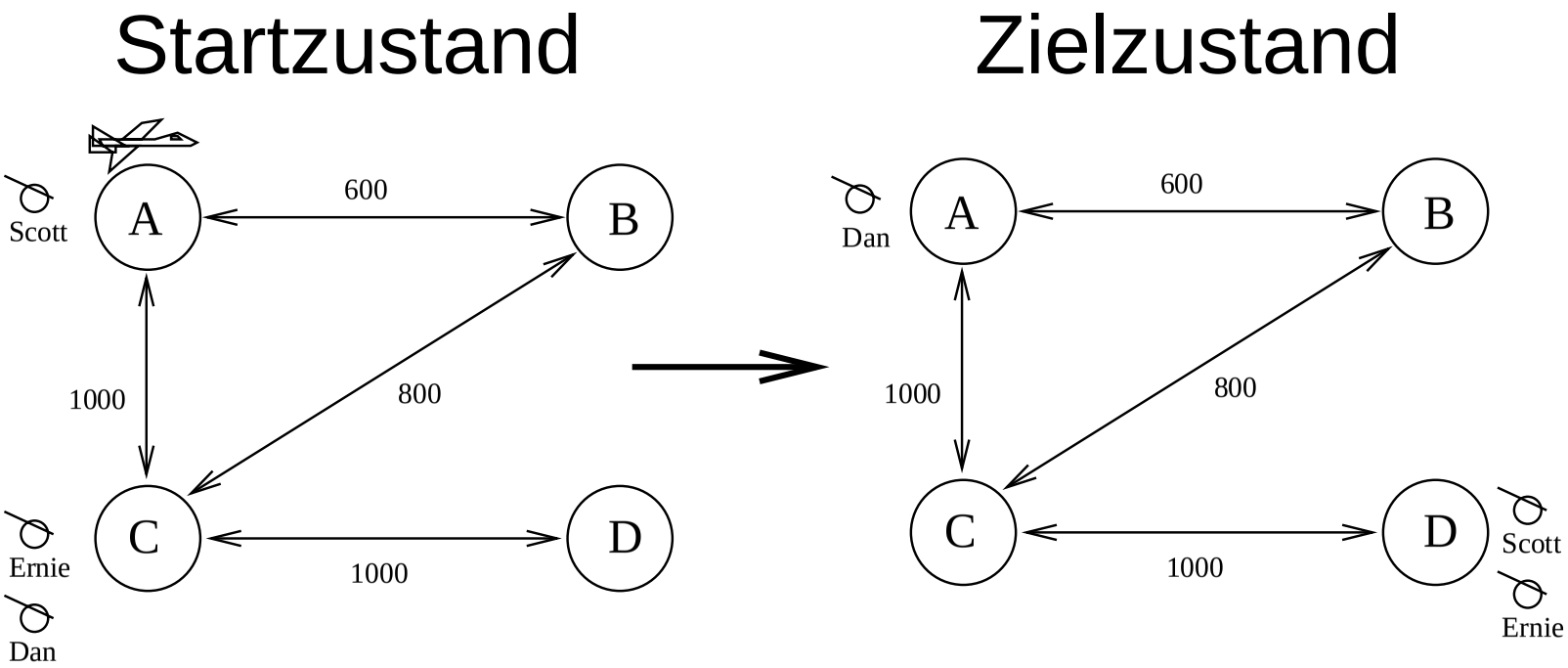
Example


Startzustand
Zielzustand
Scott
A
600
B
1000
800
Ernie
C
1000
D
Dan
Dan
A
600
B
1000
800
C
1000
D
Scott
Ernie

Domain Description

Predicates & Functions

```
(define (domain zeno-travel)
 (:predicates
    (at ?x - aircraft ?c - city)
    (in ?p - person ?a - aircraft))
  (:functions (fuel ?a - aircraft)
    (distance ?c1 - city ?c2 - city)
    (slow-speed ?a - aircraft)
    (fast-speed ?a - aircraft)
    (slow-burn ?a - aircraft)
    (fast-burn ?a - aircraft)
    (capacity ?a - aircraft)
    (refuel-rate ?a - aircraft)
    (total-fuel-used)
    (boarding-time)
    (debarking-time))
```

Actions

```
(:durative-action zoom
  :parameters (?a - aircraft
                    ?c1 ?c2 - city)
  :duration
   (= ?duration  (/ (distance ?c1 ?c2)
                        (fast-speed ?a)))
  :condition
    (and (at start (at ?a ?c1))
         (at start (>= (fuel ?a)
      (* (distance ?c1 ?c2) (fast-burn ?a)))))
   :effect
     (and (at start (not (at ?a ?c1)))
          (at end (at ?a ?c2))
          (at end (increase total-fuel-used
      (* (distance ?c1 ?c2) (fast-burn ?a))))
           (at end (decrease (fuel ?a)
      (* (distance ?c1 ?c2) (fast-burn ?a)))))
```

Proble Description

```
define (problem zeno-travel-1)
  (:domain zeno-travel)
  (:objects plane - aircraft  ernie scott dan – person
                city-a city-b city-c city-d city)
 (:init
   (= total-fuel-used 0) (= debarking-time 20) (= boarding-time 30)
   (= (distance city-a city-b) 600)     (= (distance city-b city-a) 600)
   (= (distance city-b city-c) 800)     (= (distance city-c city-b) 800)
   (= (distance city-a city-c) 1000)   (= (distance city-c city-a) 1000)
   (= (distance city-c city-d) 1000)   (= (distance city-d city-c) 1000)
   (= (fast-speed plane) (/ 600 60)) (= (slow-speed plane) (/ 400 60))
   (= (fuel plane) 750)                    (= (capacity plane) 750)
   (= (fast-burn plane) (/ 1 2))         (= (slow-burn plane) (/ 1 3))
   (= (refuel-rate plane) (/ 750 60))
   (at plane city-a) (at scott city-a) (at dan city-c) (at ernie city-c))
 (:goal (and (at dan city-a) (at ernie city-d) (at scott city-d)))
 (:metric minimize total-time))
```

PDDL 2.2: Being Conservative

- ***Consolidate* existing *techniques*** for PDDL2.1, so that planners can catch up
- ***Understand results*** in IPC-3 by making sense of data
- ***Handle existing features***, in particular complex optimization criteria
- ***Widen applicability focus***

PDDL Extensions

- ***Axioms:*** derived predicates

```
(:derived (above ?x ?y)
  (or (on ?x ?y)
      (exists (?z) (and (above ?x ?z)
                        (above ?z ?y)))))
```

PDDL Extensions

- ***Timed initial facts:*** propositions that occur independently of actions taken by planner

(at 9 (open shop))

(at 17 (close shop))

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(Sub)optimal Planning

- ***Hardness*** [Helmert] Optimisation in many domains much harder than satisfiability
- ***Special prices*** for optimal planners or ones that give performance guarantees
- Comparison with existing ***special-purpose*** optimal ***solvers***
- …

Effort of Hand-Coding

- Measuring ***coding time*** invested for adding control knowledge
- Measure (compressed) ***ASCII text length***
- Let ***users other than the programmers*** generate the knowledge
- …

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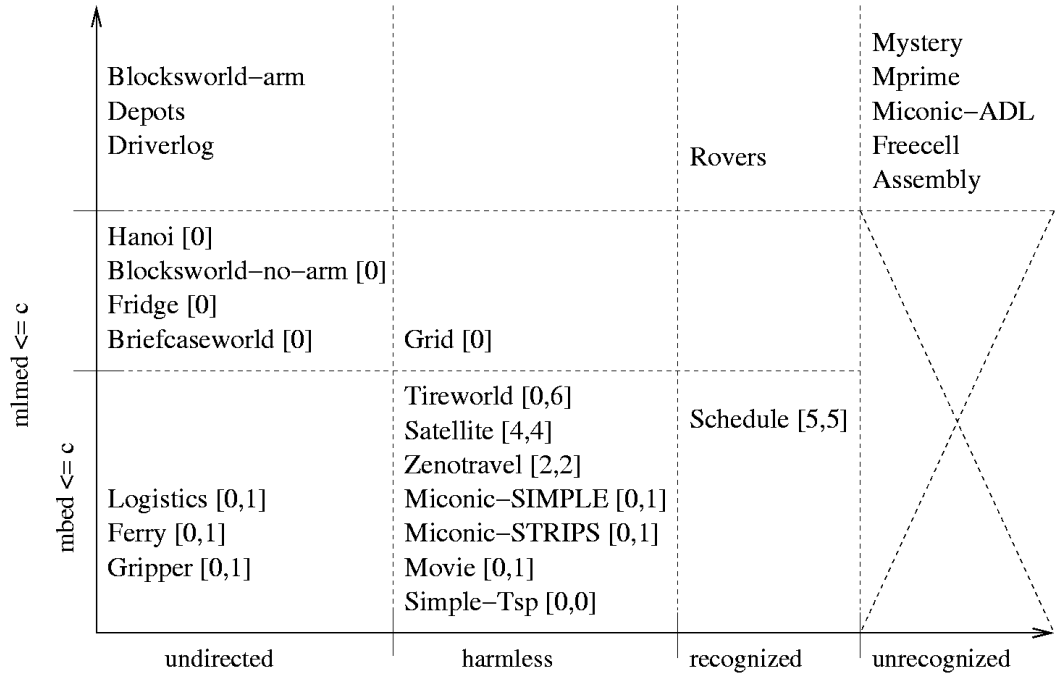
Benchmarks...

- ...have an important impact on the field
- ...are more and more taken from the IPC collections
- ...should:
  - be realistic
  - cover diverse problem structures

Problem Structure – wrpto h^+



„Heuristic planners are fast.“ --- „Across certain classes of domains!“

Problem Structure, ctd.

- The benchmarks ought to cover the „range of interesting problem structures“
  - ... in particular, they shouldn‘t all have the same structure
- How to measure „structure“?
  - Intuitively: Logistics ≠ Blocksworld
  - Wrpto h^+
  - Wrpto computational complexity

Realistic...

- ...is a word with two meanings:

  1. „not restricted to a too simplified model“

  2. „close to applications“
- 1. is a prerequisite of 2.
- IPC-3 made great progress on 1., as well as some steps towards 2.
- There is more to be done on 2.

Close to Applications

- Airport ground traffic control [Hoffmann et al.]
- Biological Pathway Discovery? [Khan et al.]
- Miconic (fully fledged) [Koehler]
- Pipesworld [Milidiu et al.]
- Promela Verification [Edelkamp]
- PSR [Thiebaux]
- Space applications [NASA]
- Pressure networks [Kurien]

IPC-4 Benchmarks

- How to combine „close to applications“ and „cover broad range of structures“?
  - With application-oriented domains that cover a broad range of structures...
  - Maybe: one group for very application-oriented domains (eg. Miconic, Pipes, PSR,...), another group for structurally very characteristic domains (eg. Blocks, Log, Mystery, n^2-*1* puzzle, Sokoban, Settlers,...)

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Infrastructure

- Test Domains: Blocks + Derived, ZenoTravel + Timed-Initial Facts (compiled and explicit)
- Validator VAL: PDDL 2.1 -> PDDL 2.2 [Durham]
- Converter: ADL -> STRIPS [Hoffmann]
- Grounder: PDDL2.2 -> Grounded PDDL 2.2 [Edelkamp]

Time Table

- Now: Language extensions fixed (PDDL 2.2), first testing examples out
- 01/04: registration deadline for planners
- 02/04 – 03/04: data collection
- 05/04: data evaluation
- 06/04: detailed results presentation at ICAPS'04
- Summer 05: competitors publication

IPC-4 at ICAPS‘04

- Detailed results presentation:
  - extra room throughout conference, maybe after award ceremony
  - in form of posters, assisted with (visualisation, eg.) tools
- Competitors handout:
  - extended abstracts describing all the competitors, distributed to ICAPS participants

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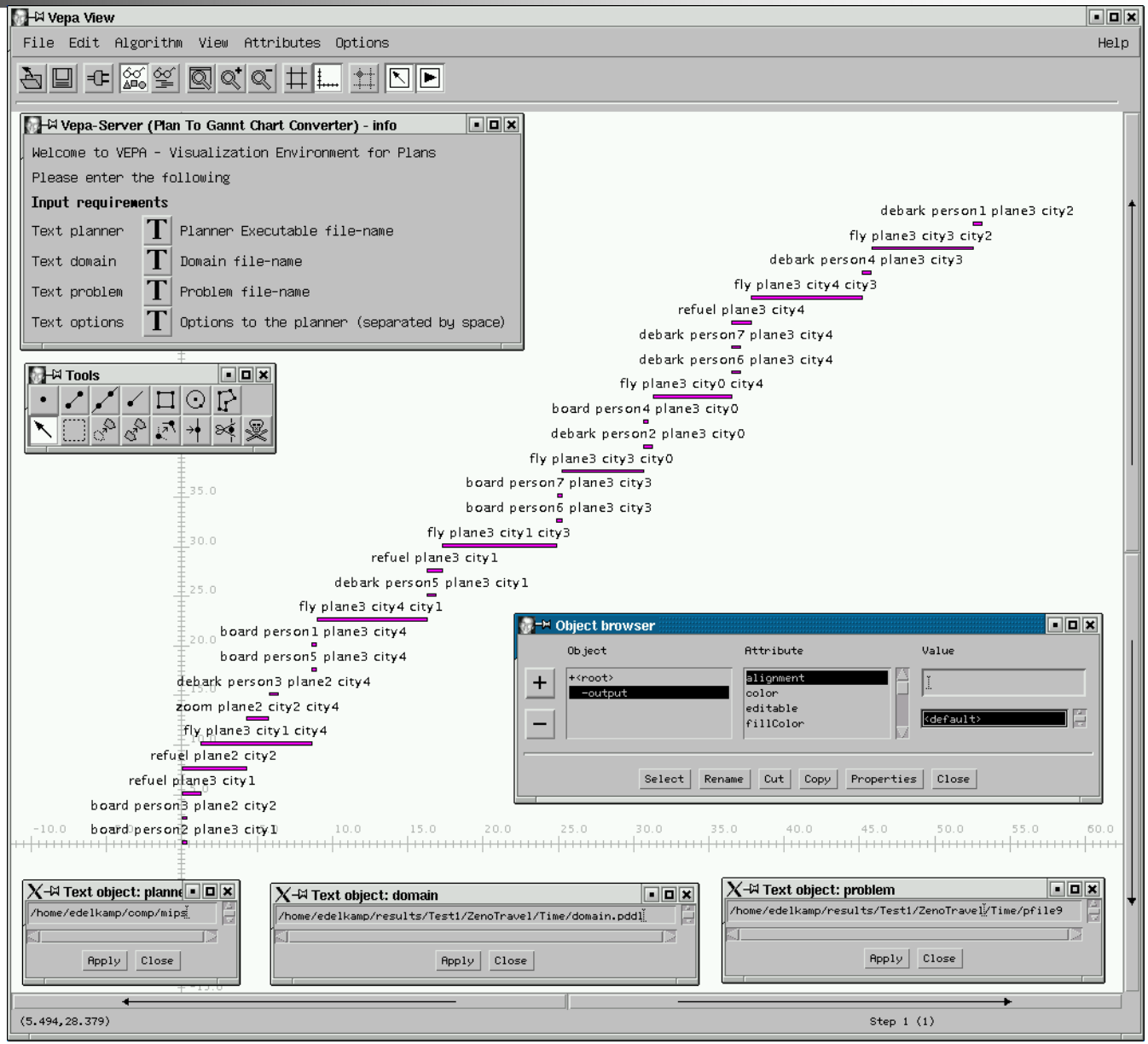
Summary

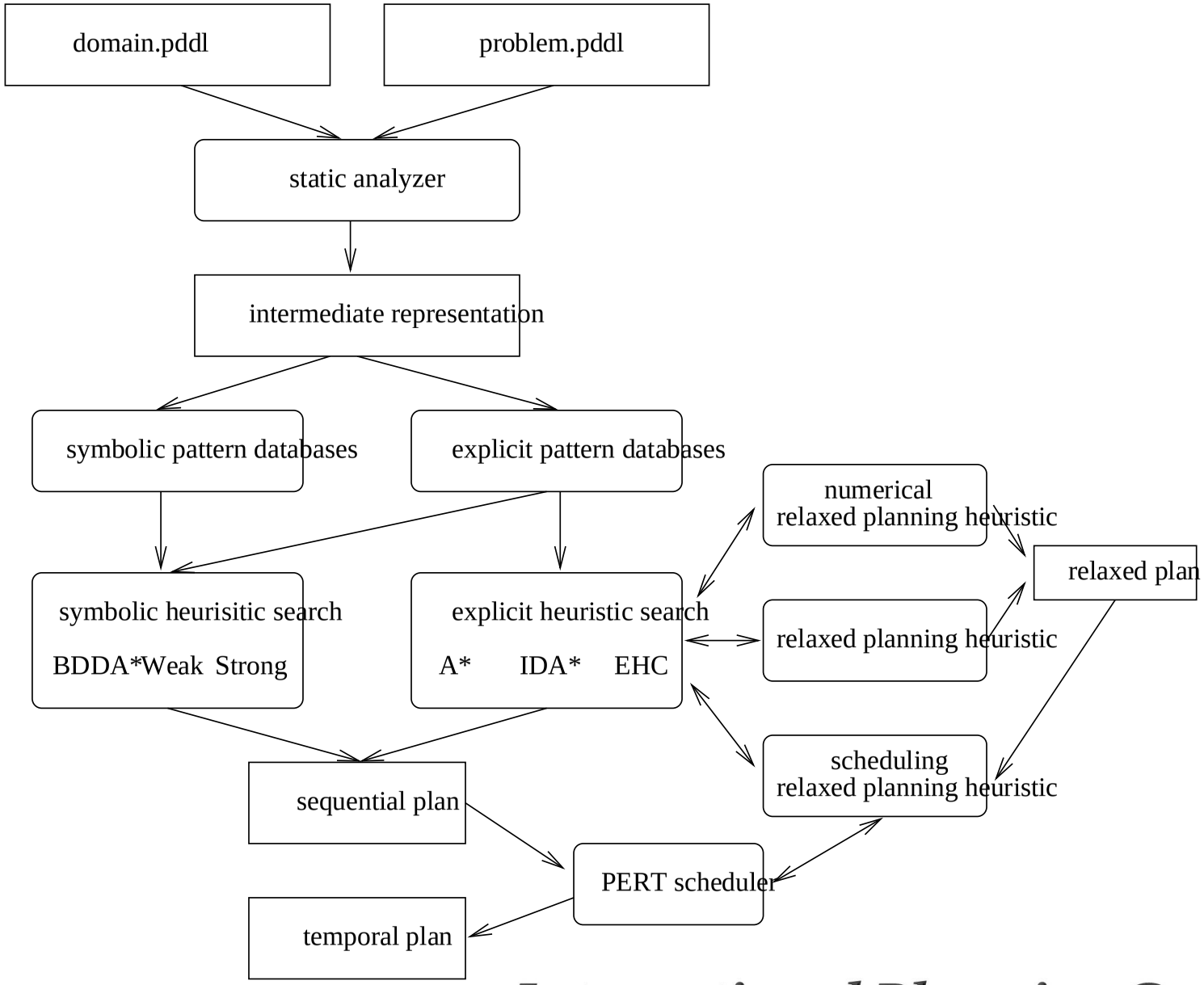
- There will be classical and probabilistic (and non-deterministic?) *parts* of IPC-4
- The ingrediences for the classical part are:
  - Moderate PDDL extensions
  - Careful choice of benchmark domains
  - Separate prize(s) for best *optimal* planner(s)
  - Detailed information available online

CFP

- A competition without competitors is boring
- There will be terrific prizes
- We explicitly invite the optimal approaches to come back to us
- ...everybody else can come, too

Mips


Vepa View
File Edit Algorithm View Attributes Options
Help
Vepa-Server (Plan To Gannt Chart Converter) - info
Welcome to VEPA - Visualization Environment for Plans
Please enter the following
Input requirements
Text planner
Planner Executable file-name
Text domain
Domain file-name
Text problem
Problem file-name
Text options
Options to the planner (separated by space)
Tools
debark person1 plane3 city2
fly plane3 city3 city2
debark person4 plane3 city3
fly plane3 city4 city3
refuel plane3 city4
debark person7 plane3 city4
debark person6 plane3 city4
fly plane3 city0 city4
board person4 plane3 city0
debark person2 plane3 city0
fly plane3 city3 city0
board person7 plane3 city3
board person6 plane3 city3
fly plane3 city1 city3
refuel plane3 city1
debark person5 plane3 city1
fly plane3 city4 city1
board person1 plane3 city4
board person5 plane3 city4
debark person3 plane2 city4
zoom plane2 city2 city4
fly plane3 city1 city4
refuel plane2 city2
refuel plane3 city1
board person3 plane2 city2
board person2 plane3 city1
Object browser
Object
Attribute
Value
+<root>
-output
alignment
color
editable
fillColor
<default>
Select
Rename
Cut
Copy
Properties
Close
Text object: plann
/home/edelkamp/comp/mips
Apply
Close
Text object: domain
/home/edelkamp/results/Test1/ZenoTravel/Time/domain.pddl
Apply
Close
Text object: problem
/home/edelkamp/results/Test1/ZenoTravel/Time/pfile9
Apply
Close
(5.494,28.379)
Step 1 (1)


domain.pddl
problem.pddl
static analyzer
intermediate representation
symbolic pattern databases
explicit pattern databases
numerical
relaxed planning heuristic
relaxed plan
symbolic heurisitic search
BDDA*Weak Strong
explicit heuristic search
A* IDA* EHC
relaxed planning heuristic
scheduling
relaxed planning heuristic
sequential plan
PERT scheduler
temporal plan