The 6th Answer Set Programming Competition

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13th International Conference on Logic Programming
and Non-monotonic Reasoning

Outline

1. The Sixth ASP Competition
2. Format and Setup
3. Participants and Results

The Sixth ASP Competition

An event back to the usual timeline

- One year after the FLoC Olympic Games
- Hosted by LPNMR
- Biennial event

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Goals

- Measure the progress of the state of the art in ASP solving
- Improve benchmarks suite for robust evaluation
- Study the behavior of different solving techniques

The 6th Competition Setting

Improvements on the format

- Basic design choices maintained
- Some important novelties

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Competition Setting

- System competition only and modeling competition on site
- Benchmark classification based on language features
- Benchmarks from past editions
  - $\rightarrow$ The best encodings from 2014
  - $\rightarrow$ Updated instance sets
  - $\rightarrow$ New “real-world” benchmarks
- New instance selection process
- Updated versions of solvers, and newcomers

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System Competition Format

Sub tracks based on language features

Track 1 (Basic) normal LP + simple built-ins

Track 2 (Advanced) + choices, aggregates, HCF disjunction, query

Track 3 (Optimization) + weak constraints

Track 4 (Unrestricted) + non-HCF disjunction

Two Categories

- Single-Processor (restricted to 1-CPU Core)
- Multi-Processor (up to 8-CPU Cores)

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Marathon ← *NEW*!!

- The best solver of each team
- Time limit extended by one order of magnitude

  → Assess solvers on hard instances

Setup

System Inputs

- Fixed input in ASP-Core-2
- Scripts run with fixed parameters
- Fixed encoding + instance from STD input

System Environment

- Debian Linux 64bit with Intel Xeon E5-4610v2 CPUs
- Time limits
  - Competition: 20 minutes
  - Marathon: 3 hours
- Memory Limit: 12 GB
- Multi-processor track: up to 8 cores (16 virtual CPUs)

Scoring

ASP Competition 2014 Scoring

- Consider number of solved instances for decision problems
- Rank solvers on optimization problems by solution quality
- Runtime for tiebreaking

Decision and Query Problems

$$\text{Score(Solver, Problem)} = \#\text{Solved(Solver)} * 5$$

Optimization Problems

$$\text{Score(Solver, Problem)} = \sum_{\text{Instances } I} \frac{\#\text{NotBetter(Solver}, I) * 5}{\#\text{Participants}}$$

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Additional Criteria

- Problems are equally weighted up to 100 points each
- Incorrect answers: disqualification on per problem basis
- Final scores by summing over all problems

Benchmark Suite

Benchmarks from 2014

- Considered all the domains from 5th edition
- Selected the encoding variant that exhibited better performance in the 5th edition
- Updated instance sets for
  - Knight Tour with Holes, Stable Marriage,
  - Ricochet Robots, and Maximal Clique
- Hardness-based classification of instances
  - Inspired of SAT Competition
  - Exploiting best solvers from the 5th competition
  - Robust selection

Benchmark Suite: Domains from past editions

Domain	App	Problem	Encoding	
Graph Colouring		Decision	2014	**Track #1**
Hanoi Tower		Decision	2014	
Knight Tour with Holes		Decision	2014	
Labyrinth		Decision	2013	
Stable Marriage		Decision	2014	
Visit-all		Decision	2014	
Bottle Filling		Decision	2013	**Track #2**
Graceful Graphs		Decision	2013	
Incremental Scheduling	√	Decision	2014	
Nomystery		Decision	2014	
Partner Units	√	Decision	2014	
Permutation Pattern Matching		Decision	2014	
Qualitative Spatial Reasoning		Decision	2014	
Reachability		Query	2013	
Ricochet Robots		Decision	2013	
Sokoban		Decision	2014	
Solitaire		Decision	2014	
Weighted-Sequence Problem		Decision	2014	
*Connected Still Life**		Optimization	2013	**Track #3**
Crossing Minimization	√	Optimization	2014	
Maximal Clique		Optimization	2014	
Valves Location	√	Optimization	2013	
Abstract Dialectical Frameworks		Optimization	2013	**Track #4**
Complex Optimization	√	Decision	2014	
Minimal Diagnosis	√	Decision	2014	
Strategic Companies		Query	2013	

Benchmark Suite: New domains

Domain	App	Problem	
Combined Configuration	√	Decision	Tr. #2
Consistent Query Answering	√	Query	
MaxSAT	√	Optimization	Track #3
Steiner Tree	√	Optimization	
System Synthesis	√	Optimization	
Video Streaming	√	Optimization	

Benchmark Classification (1)

Run the three best solvers of 5th ASP Comp

- clasp, lp2normal+clasp, wasp1.5
- same setting as competition
- 40 min TO (twice the timeout)

Some numbers

- 32 domains
- 5058 instances
- about 212 days of execution

Benchmark Classification (2)

(non-groundable) Instances that could not be grounded by any top-performing system within the timeout.

(very easy) Instances solved by all top-performing systems in less than 20 seconds.

(easy) Instances solved by all top-performing systems in less than 2 minutes.

(medium) Instances solved by all top-performing systems within the timeout.

(hard) Instances solved by at least one among the top-performing systems within 40 minutes.

(too hard) Instances that could not be solved (no solution produced in case of Optimization problems) by any of the top-performing systems within 40 minutes.

Instance Selection

Instance Selection (Criteria)

- 20 instances are included in each domain
- Exclude non-groundable instances
- Each class shall contribute 20% to each domain
- Discard domains mostly made of easy instances
- Balance satisfiable and unsatisfiable instances for decision
- Prefer satisfiable instances for optimization and query
- Random selection from each class + 20% totally random

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- Selection implemented in ASP!!!!!
- **Random seed:** the concatenation of winning numbers in the EuroMillions lottery of 23rd June 2015

Selection Statistics

Benchmark Suite

- 28 selected problems
- 4 too easy/uneven problems discarded
  - BottleFillingProblem
  - HanoiTower
  - Solitaire
  - Weighted-SequenceProblem
- 88 non-groundable instances
  - 86 IncrementalScheduling
  - 2 Sokoban
- Statistics about old solvers
  - Can be used for measuring the improvement of the state of the art

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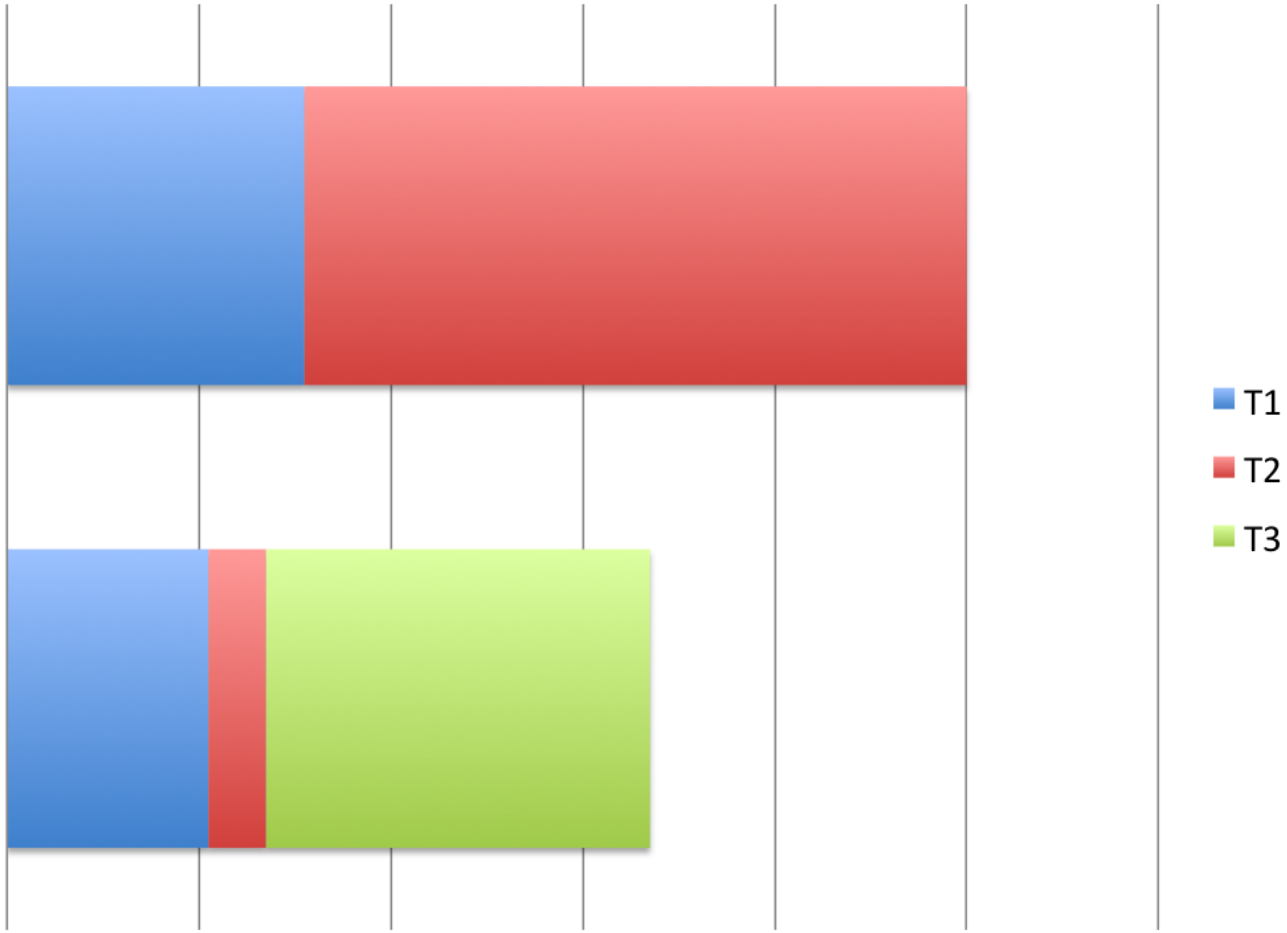
Participants

The competition featured 13 systems coming from three teams

- **Aalto Team**, Aalto University (9 solvers):
  LP2SAT+LINGELING, LP2SAT+PLINGELING-MT, LP2ACYCASP+CLASP, LP2ACYCPB+CLASP, LP2ACYCSAT+CLASP, LP2ACYCSAT+GLUCOSE, LP2MIP, LP2MIP-MT, LP2NORMAL+CLASP
- **ME-ASP Team**, University of Genoa, University of Sassari, University of Calabria (1 solver):
  ME-ASP
- **Wasp Team**, University of Calabria (3 solvers):
  WASP, WASP+DLV, JWASP

Results: Multi Processor Track



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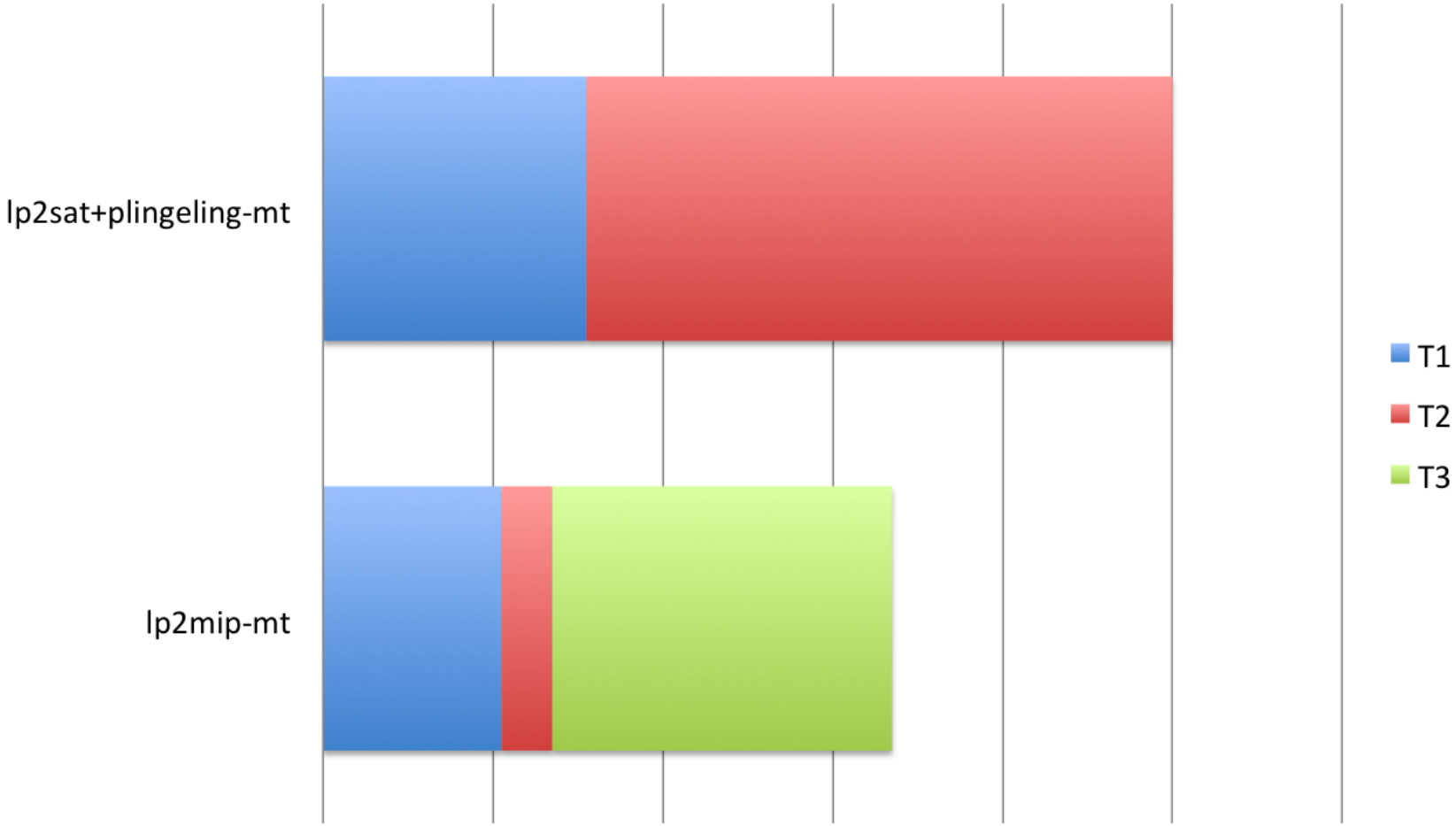
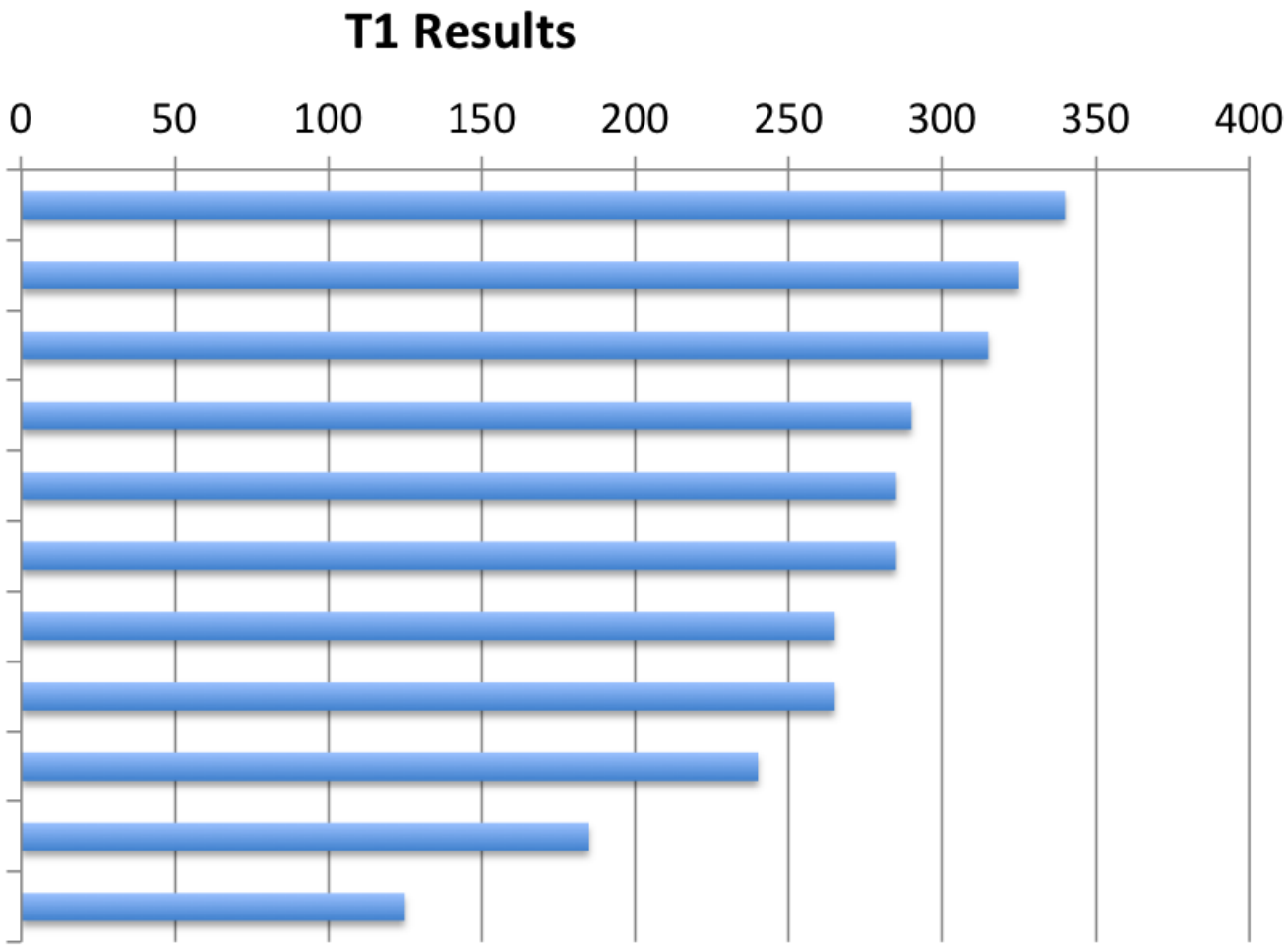


Results: Track 1 - Basic



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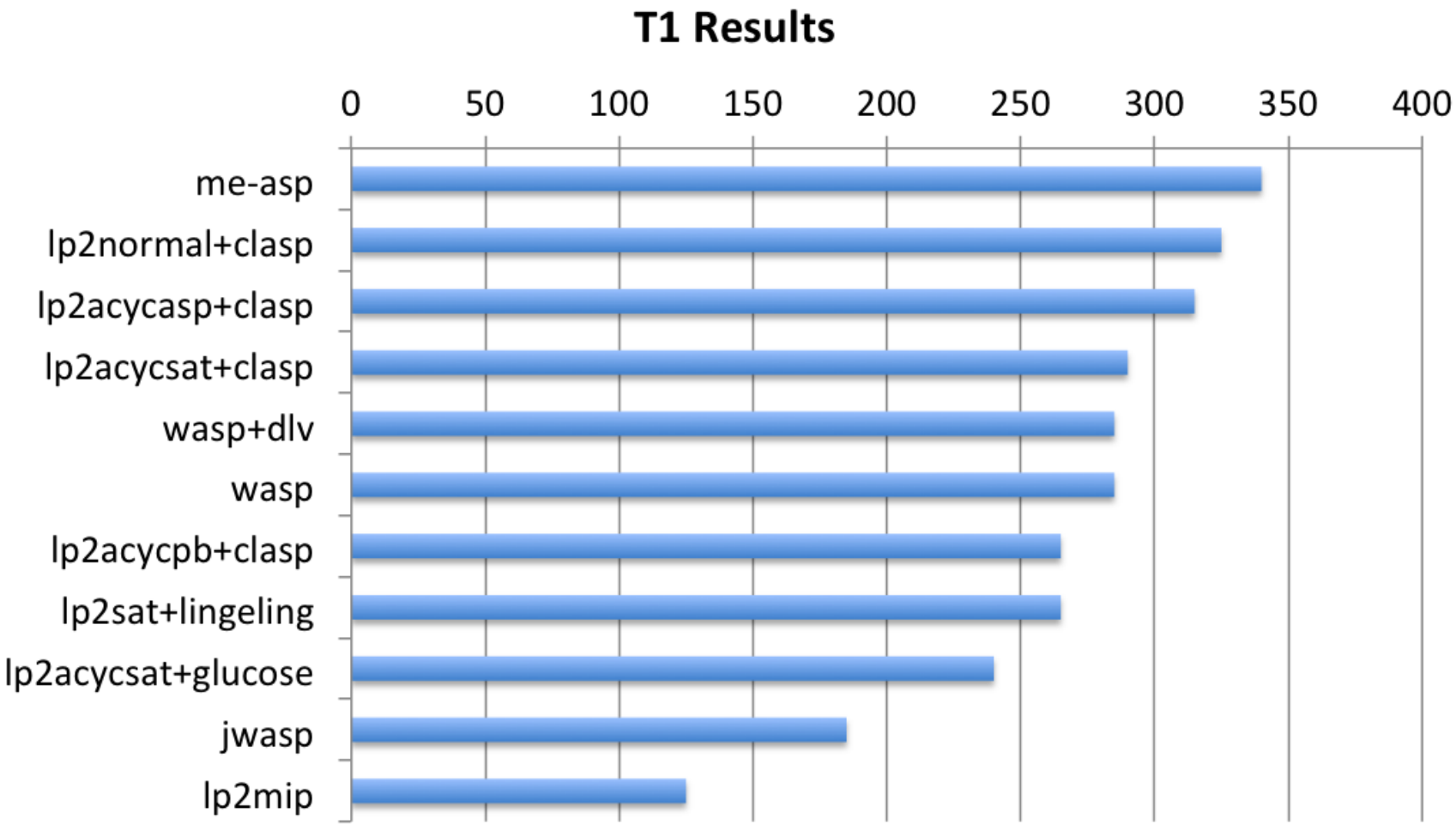
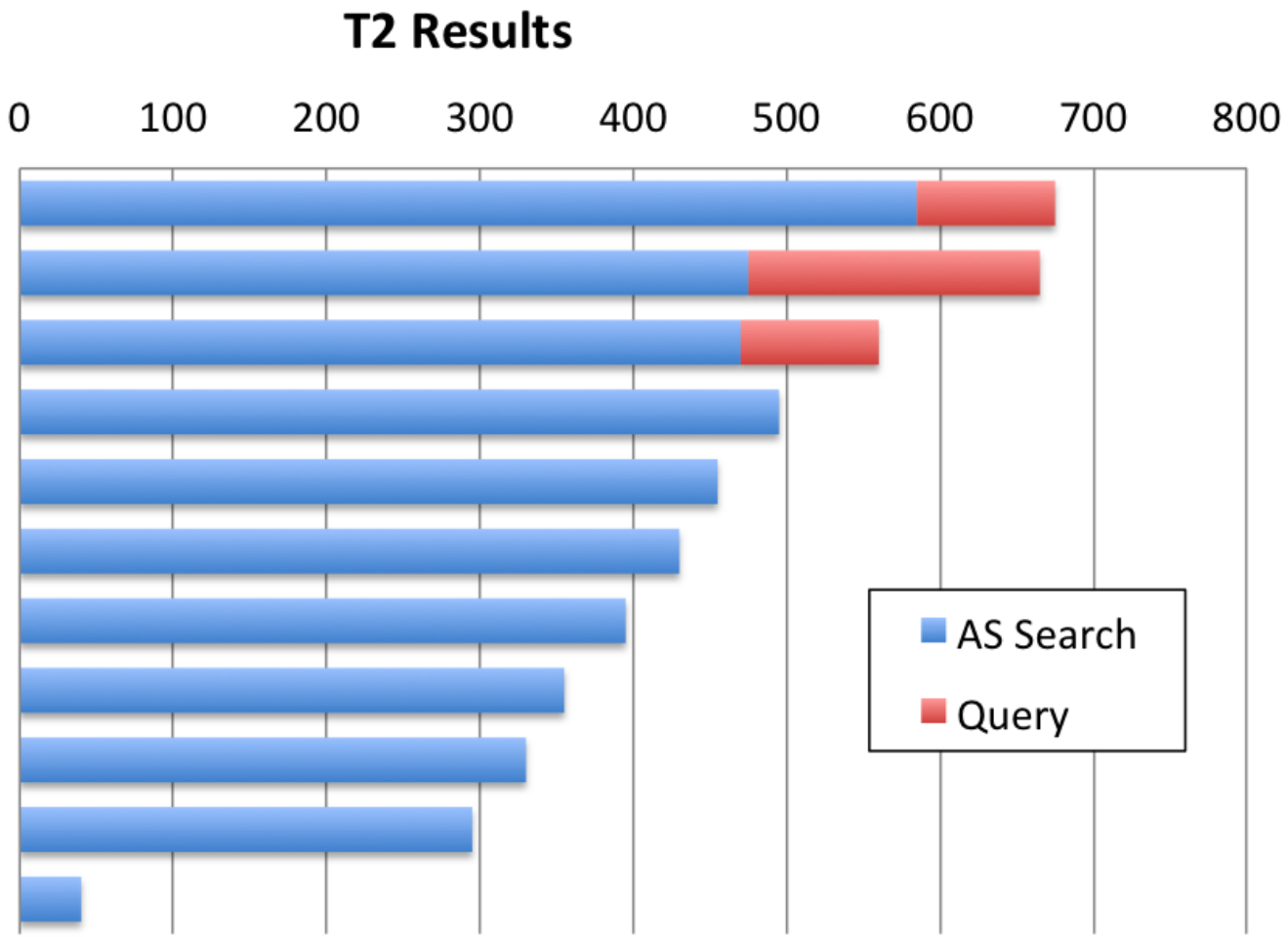
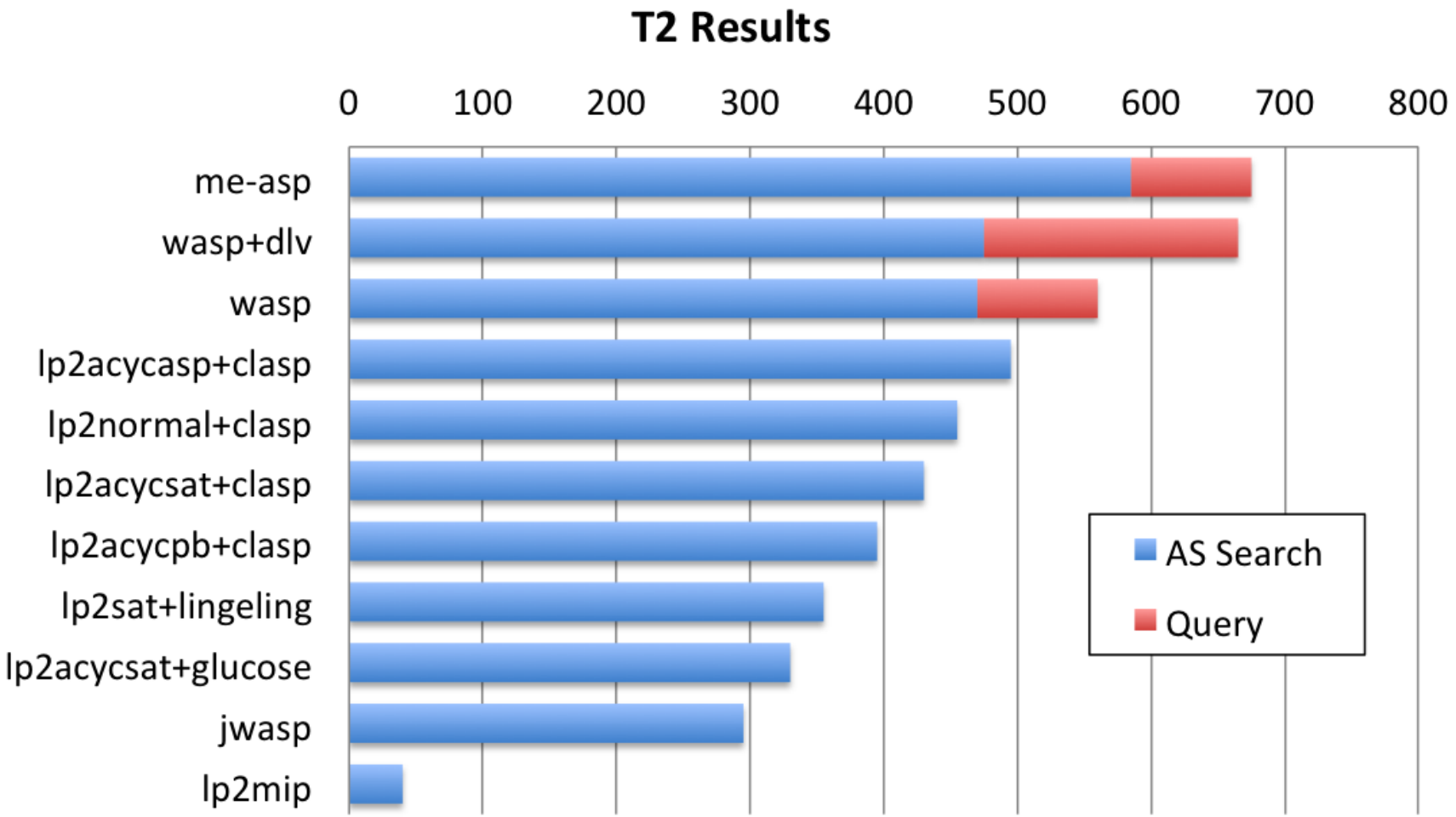


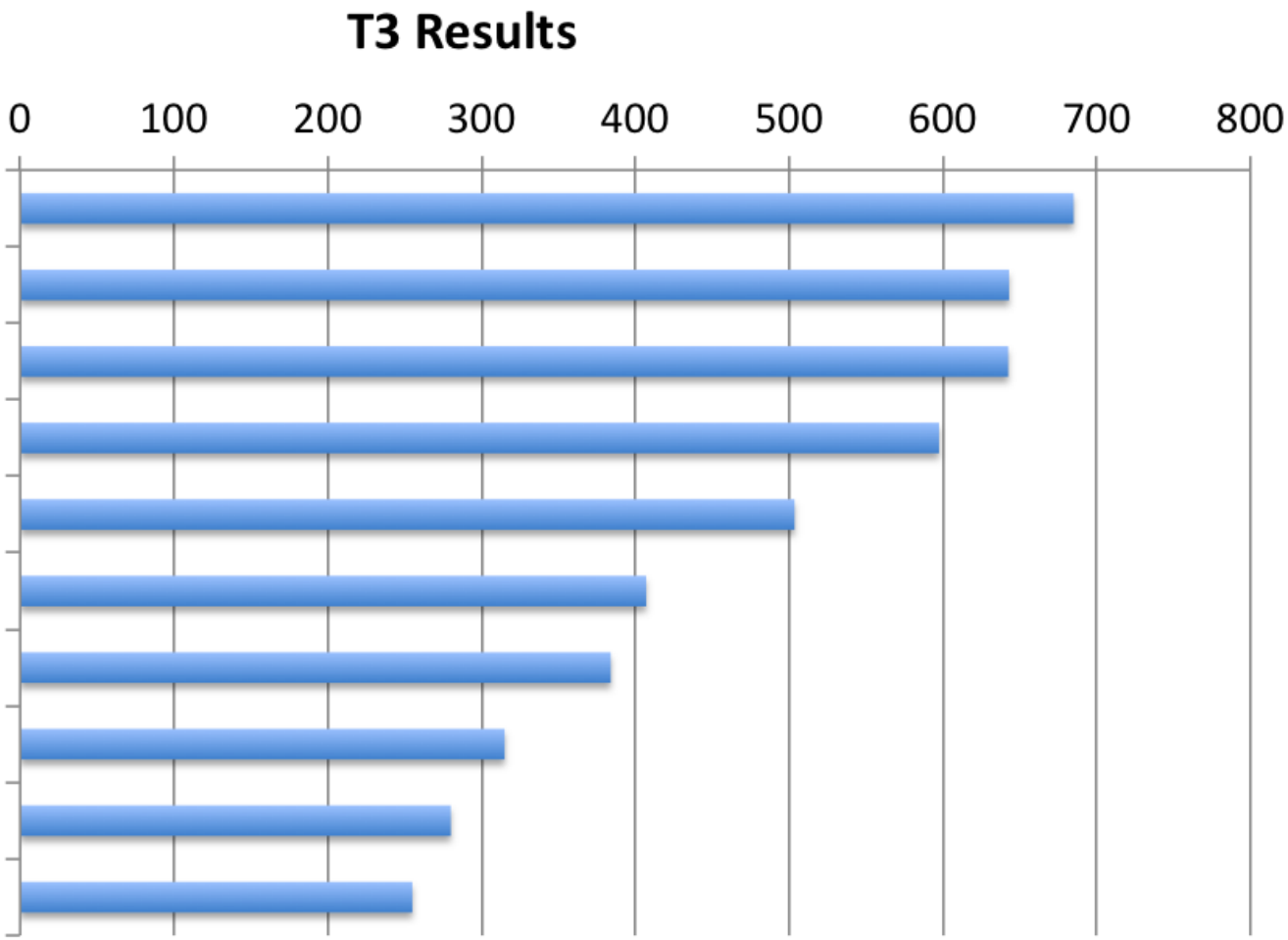
Results: Track 2 - Advanced



Results: Track 2 - Advanced



Results: Track 3 - Optimization



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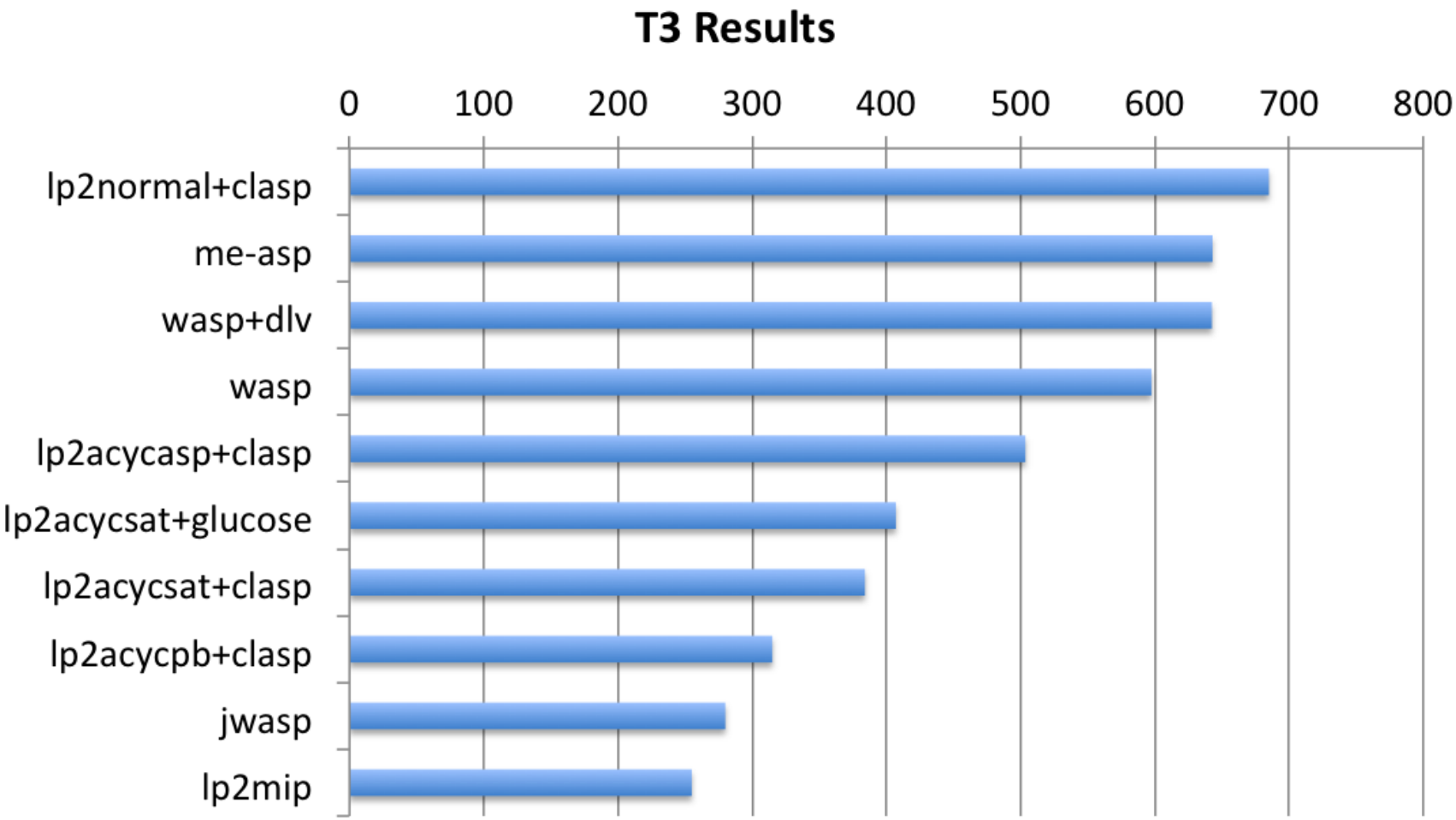
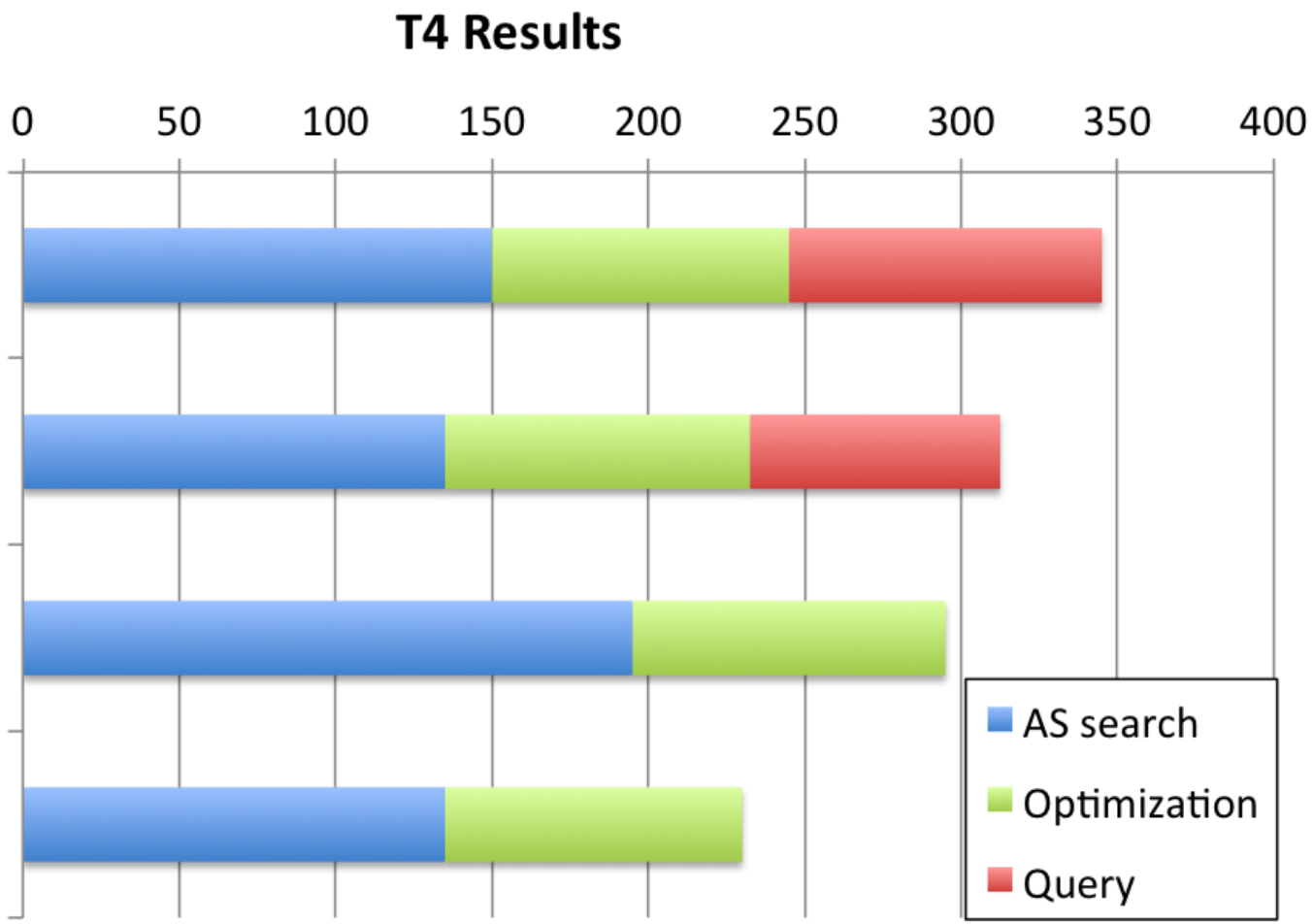


Results: Track 4 - Unrestricted



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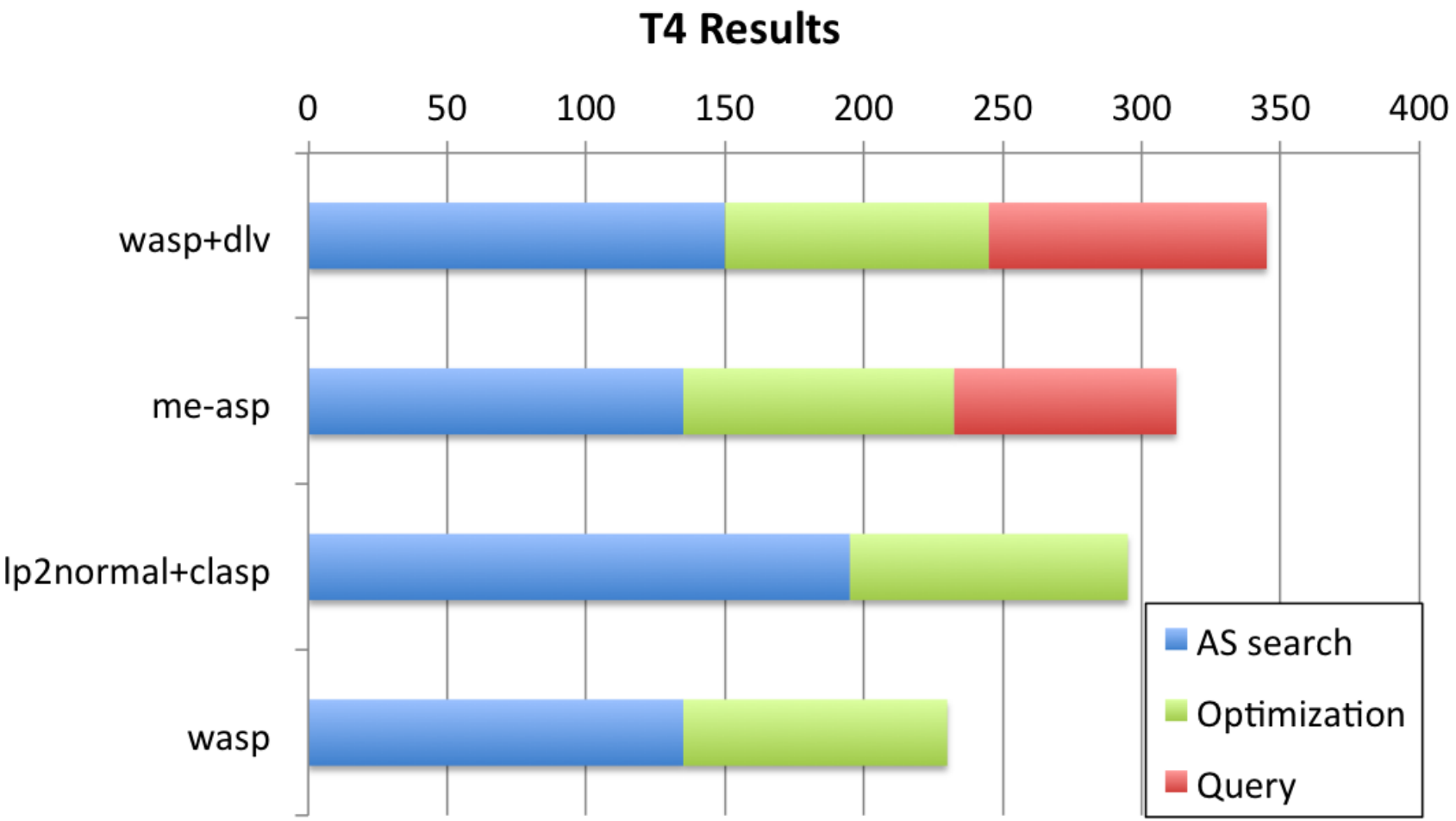

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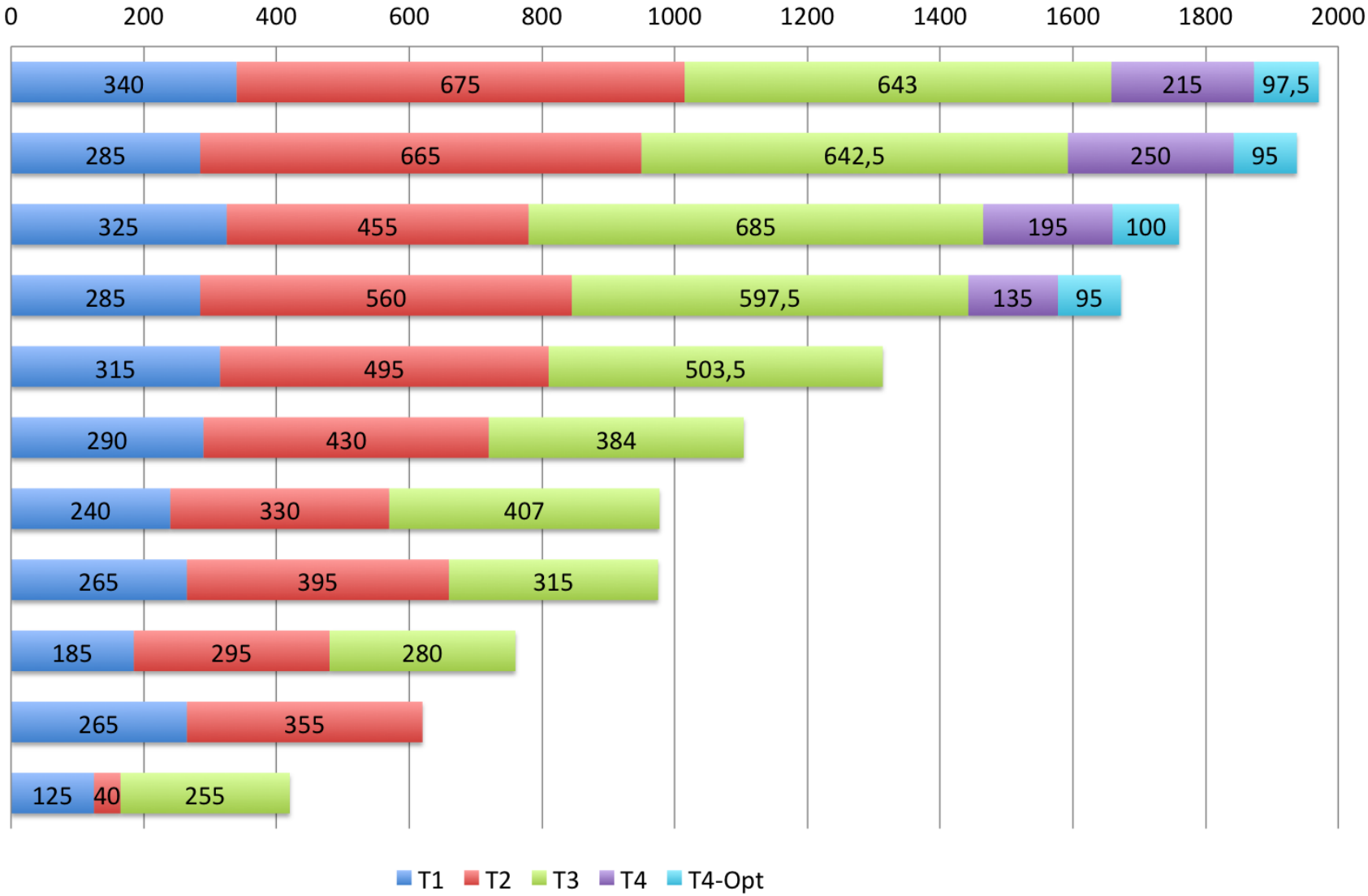

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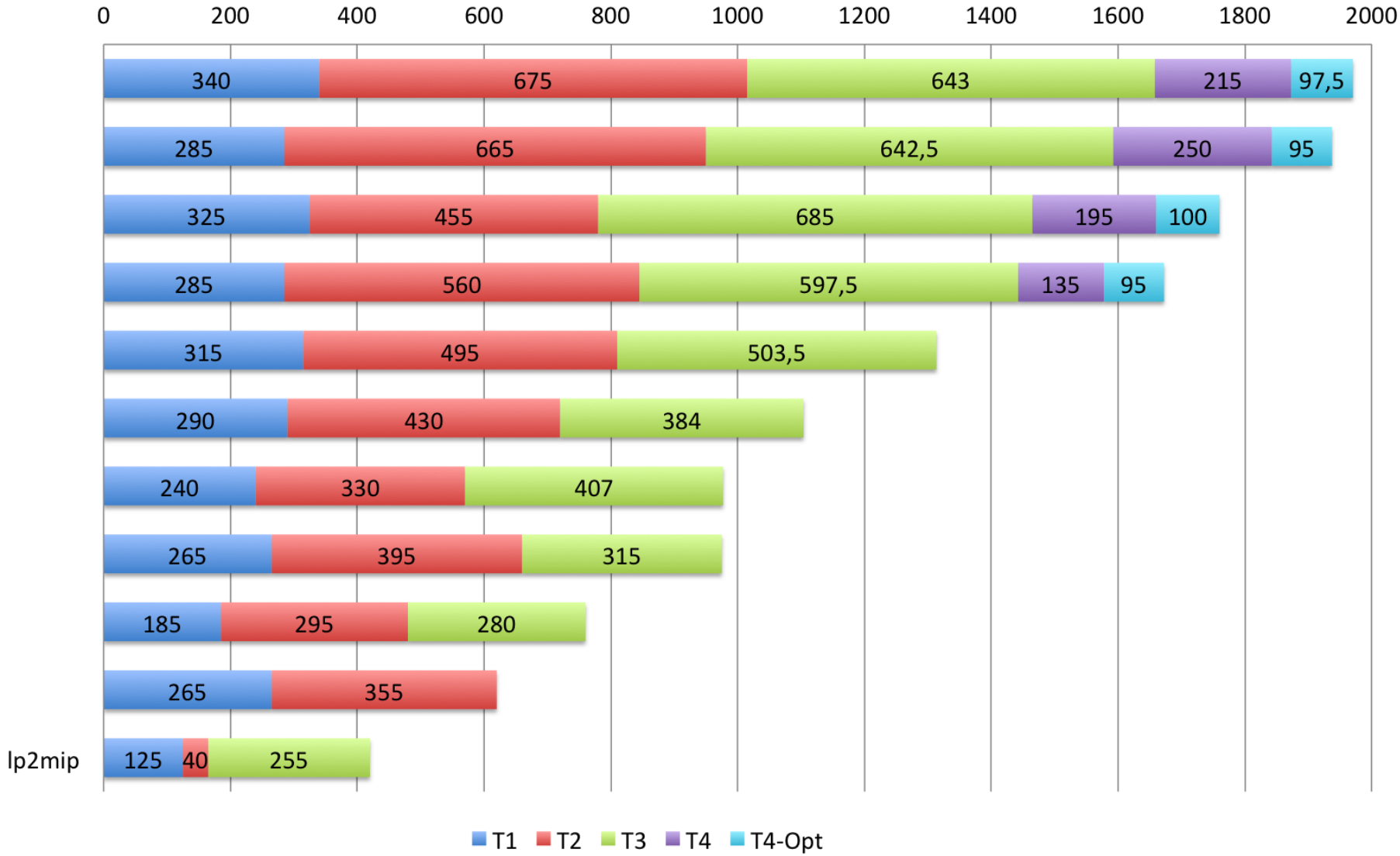

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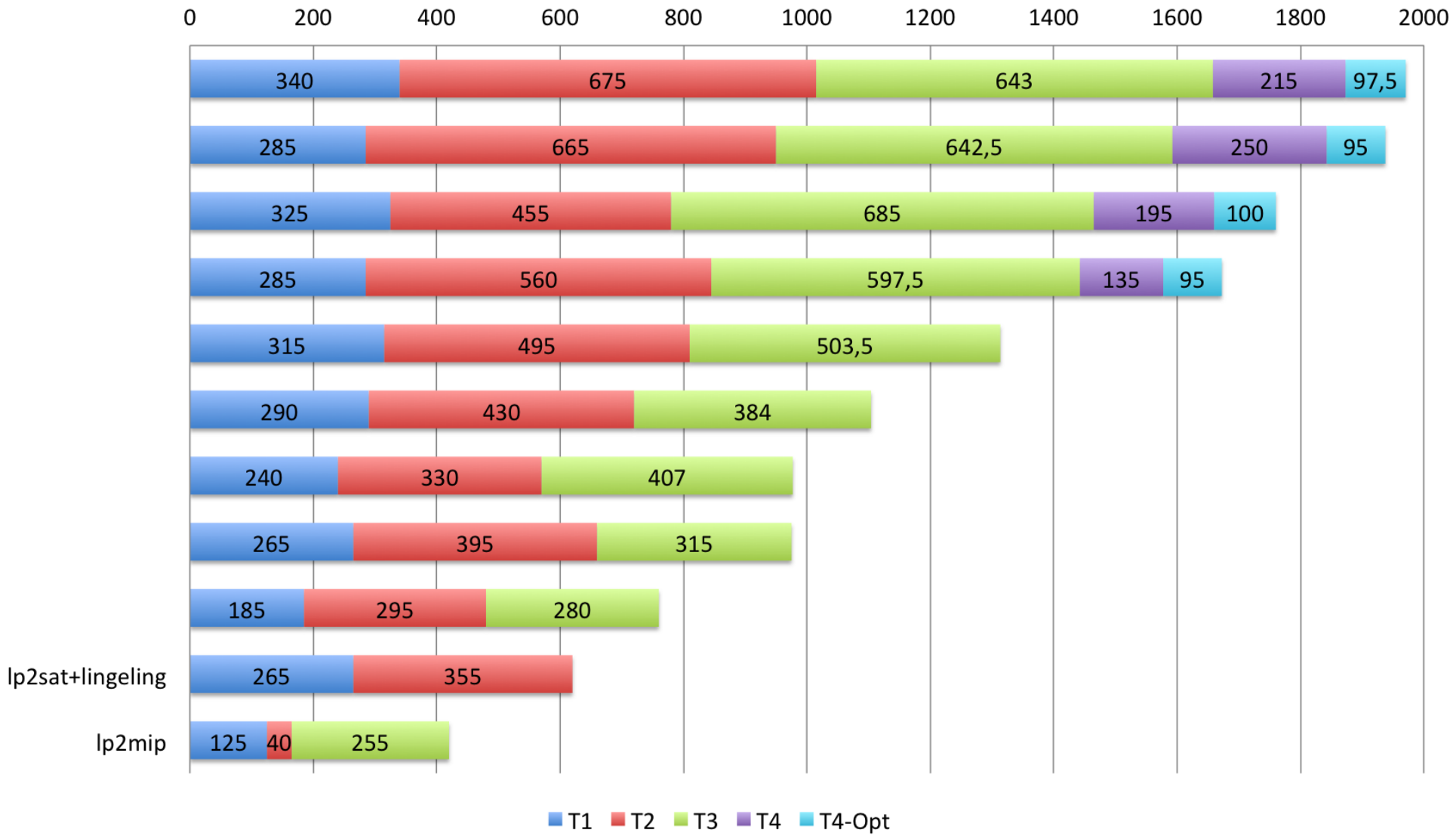

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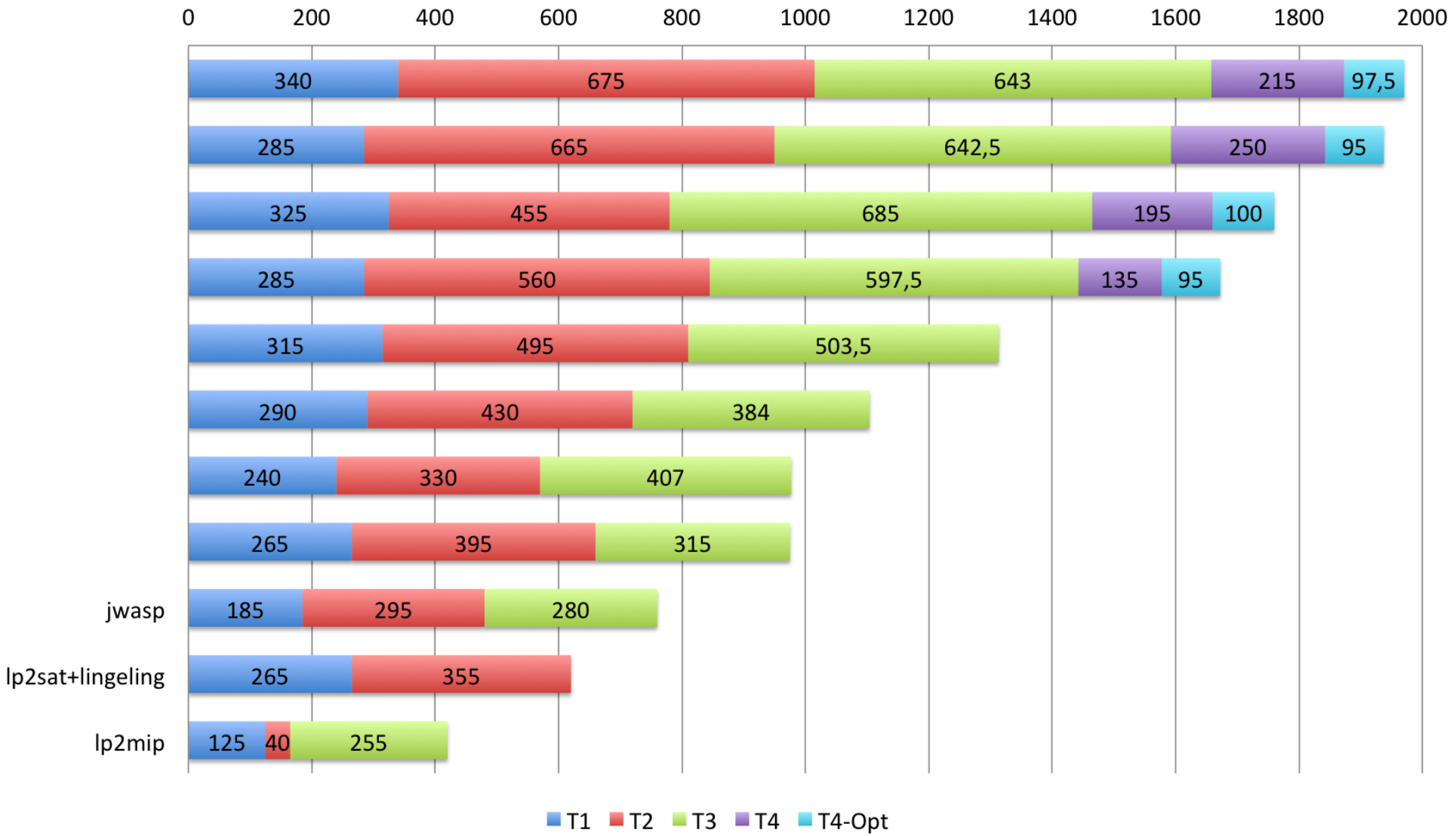

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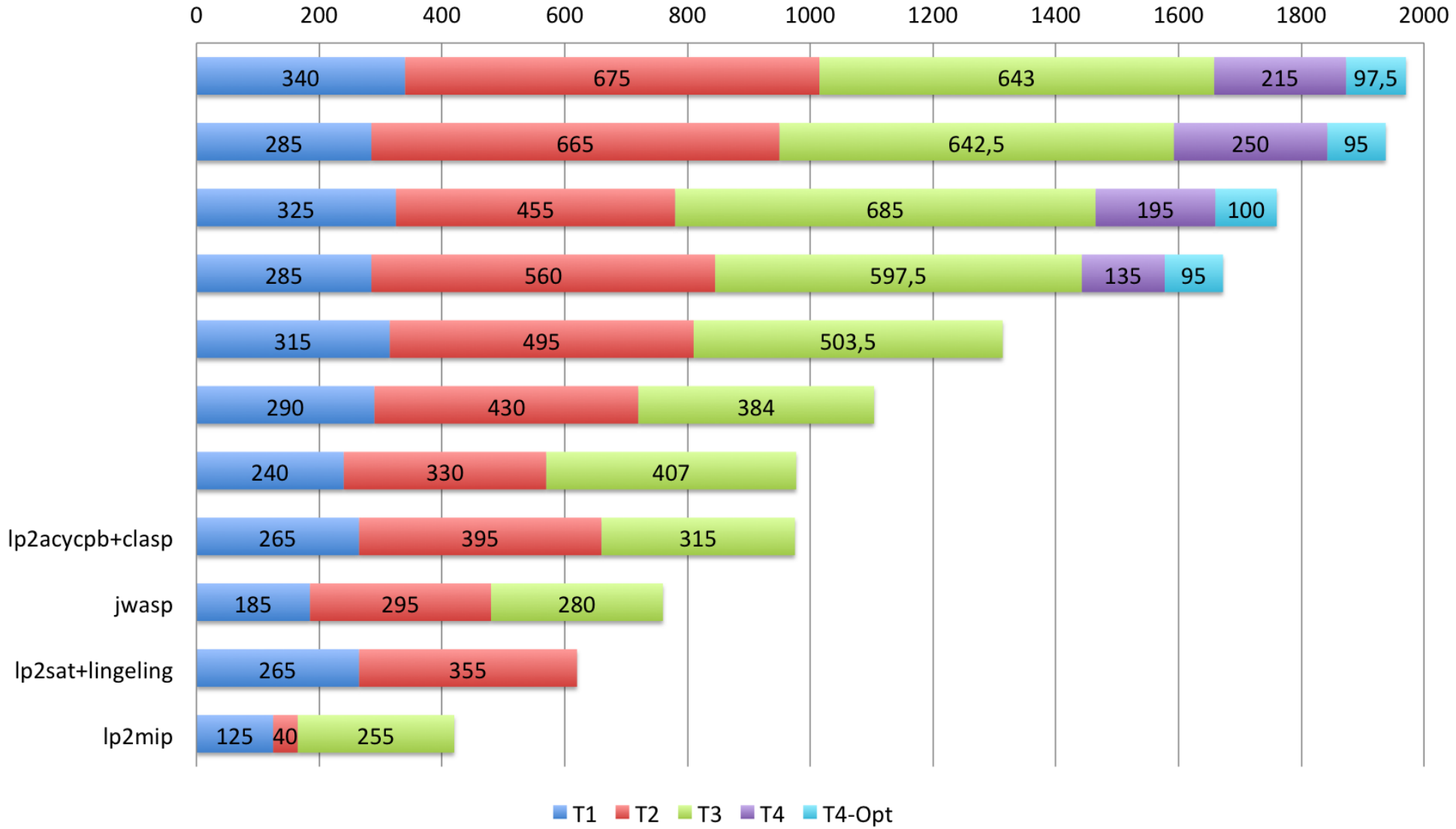

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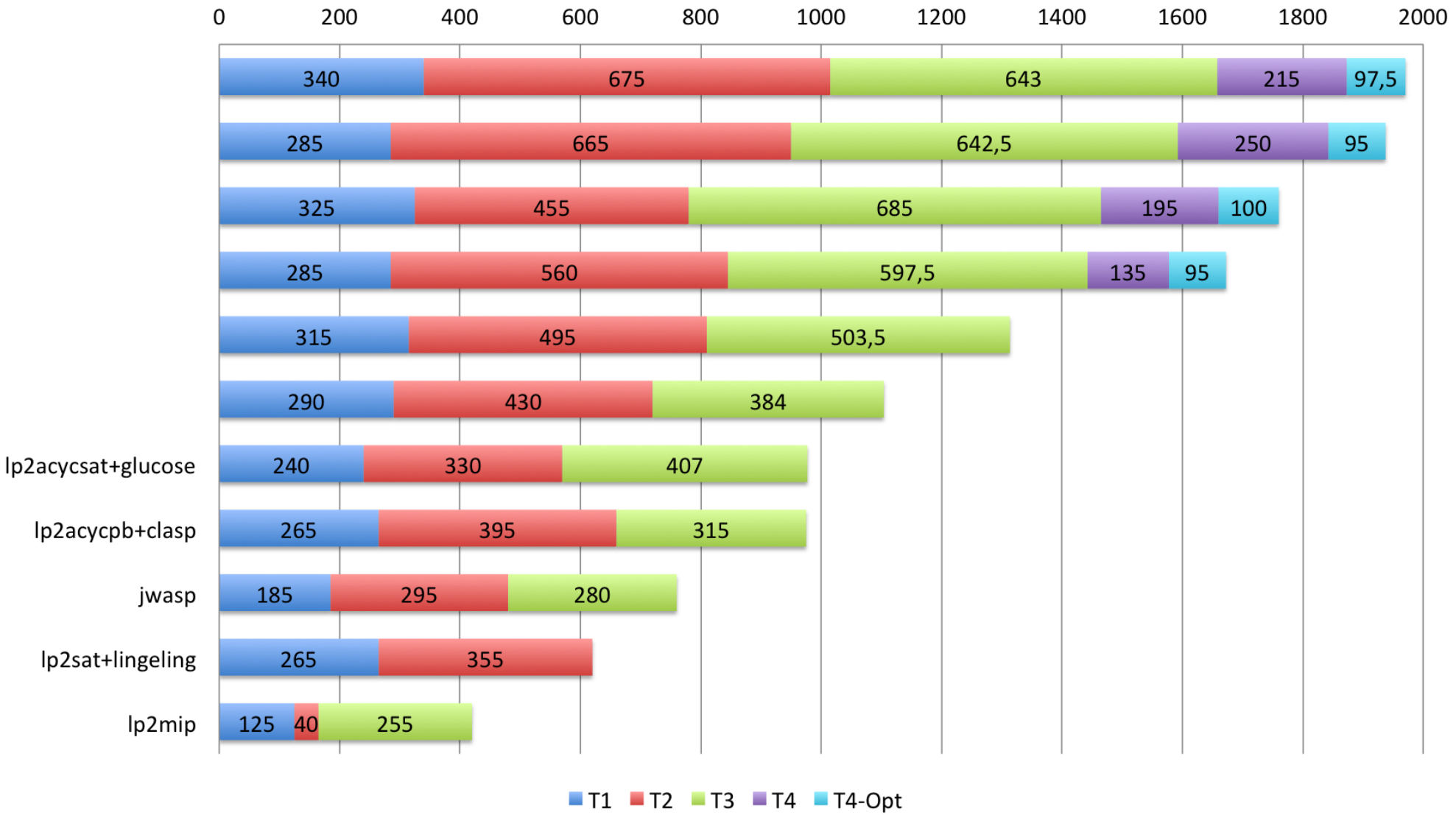

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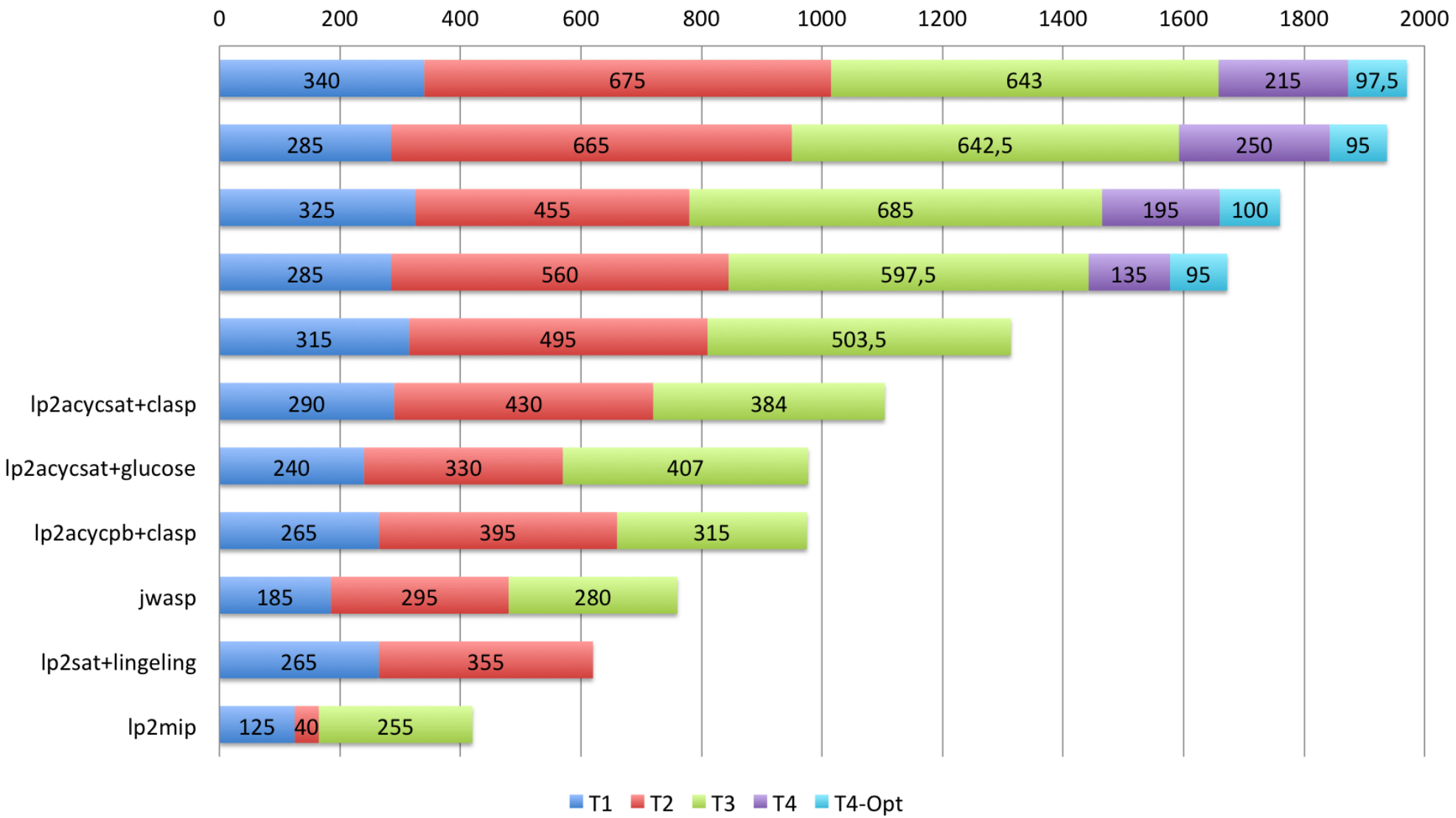

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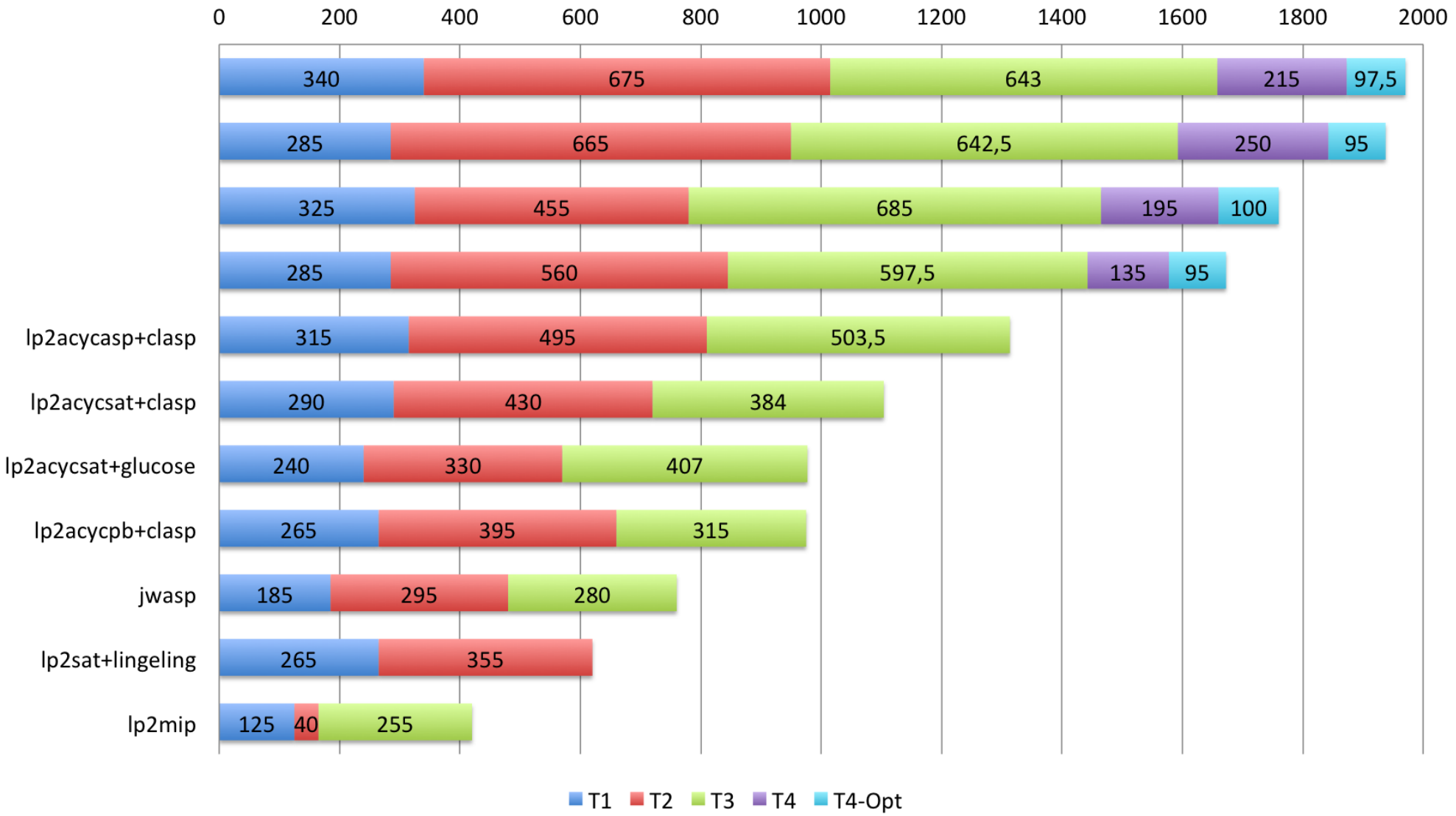

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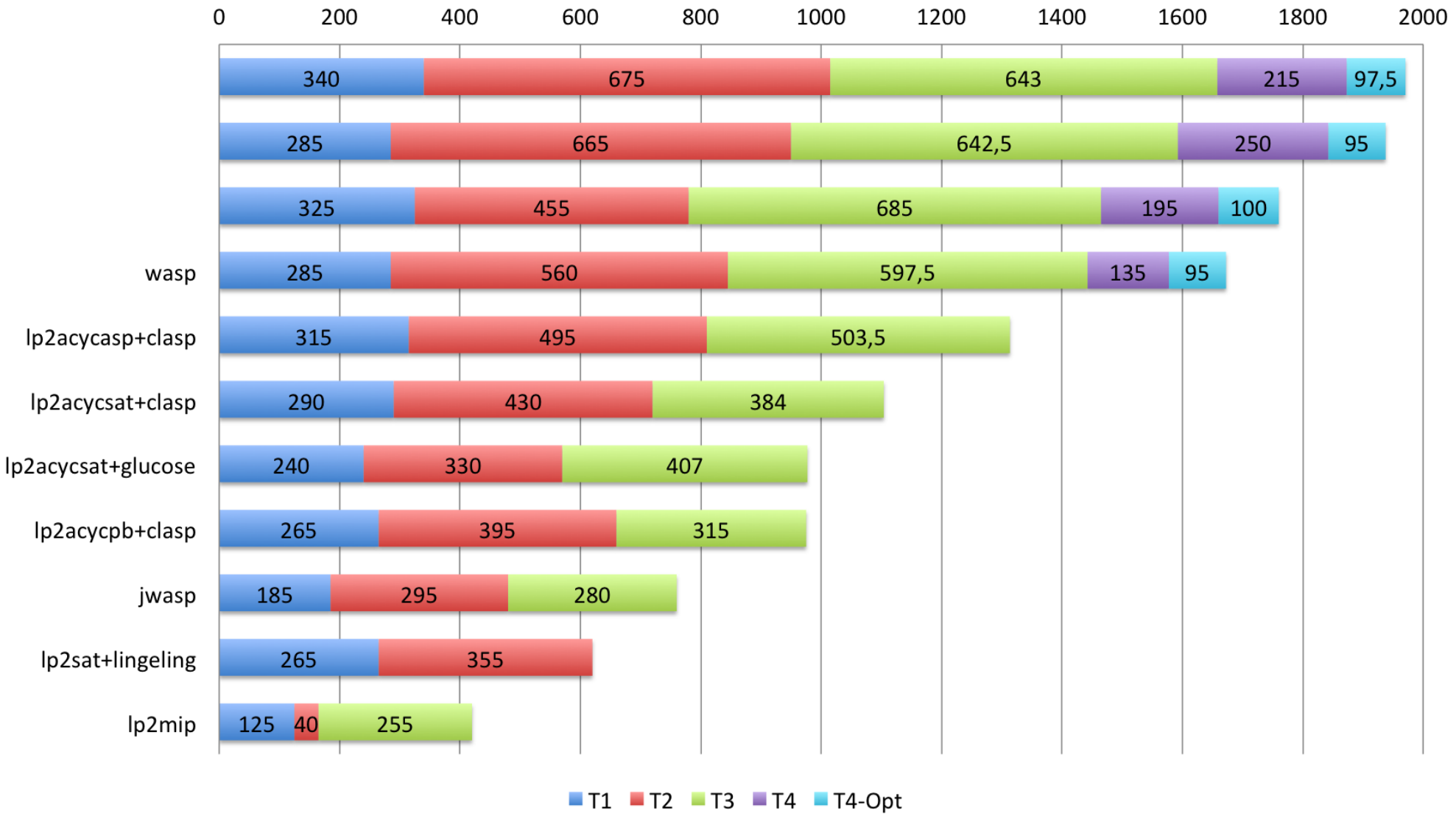

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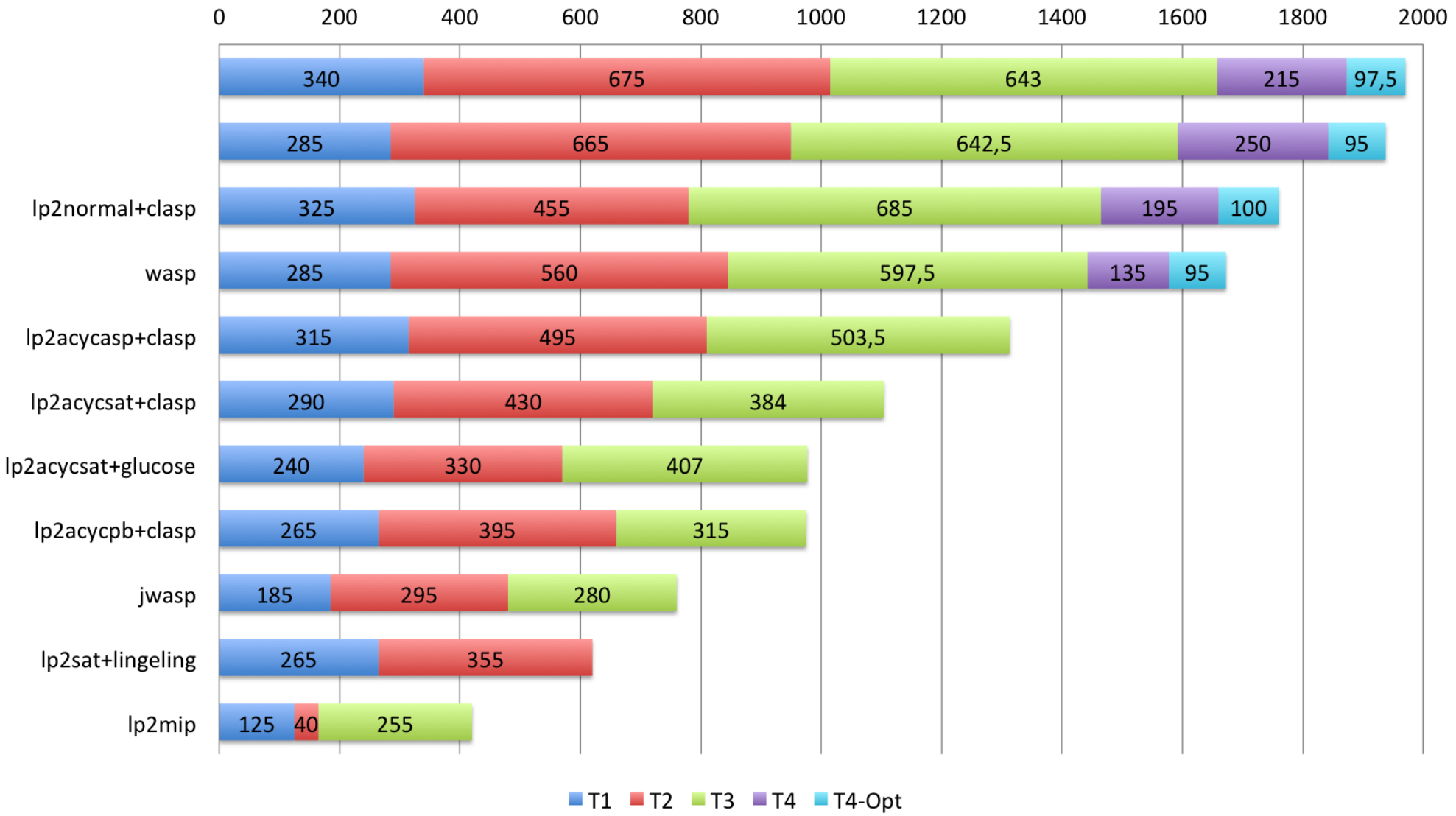

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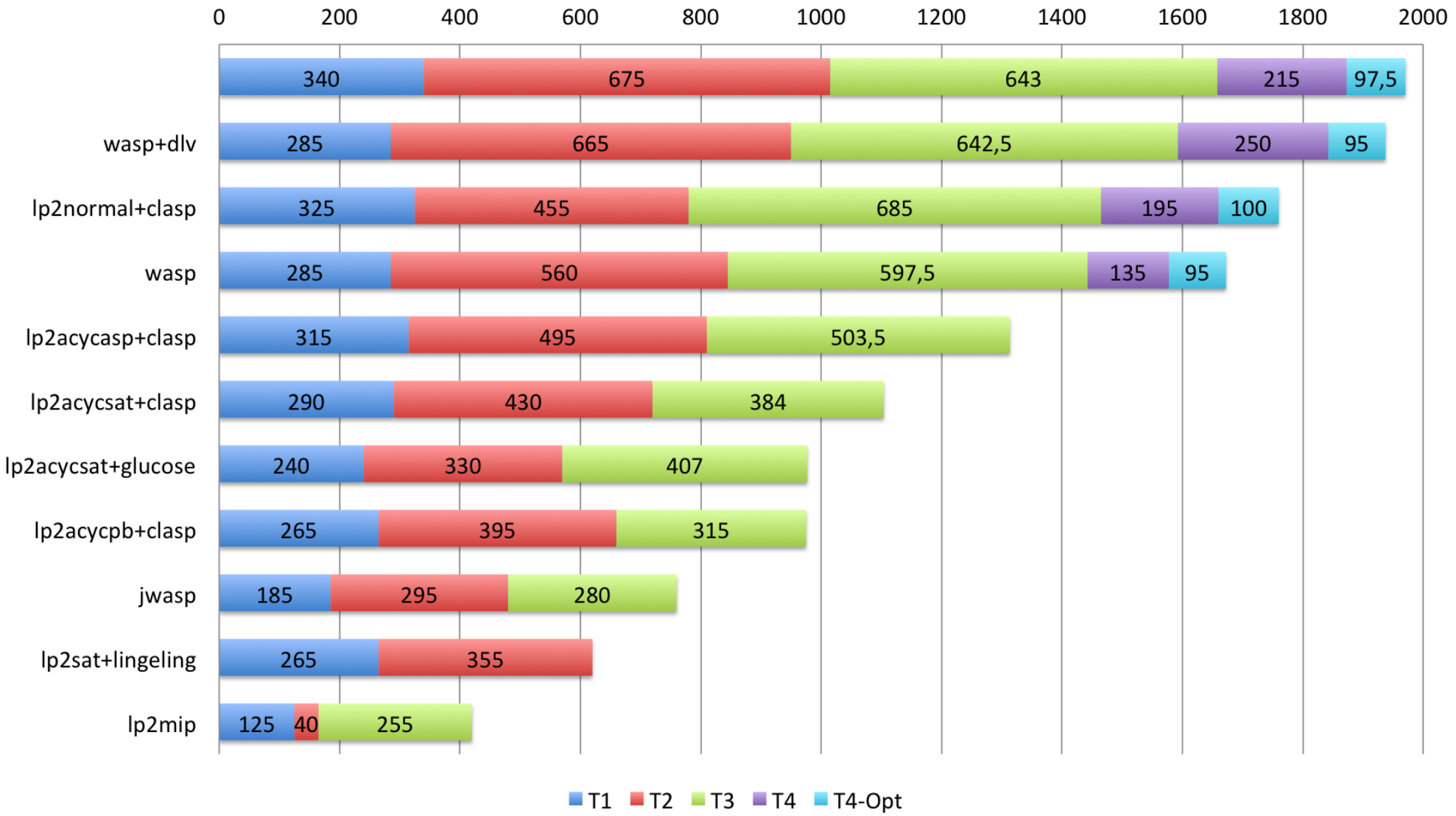

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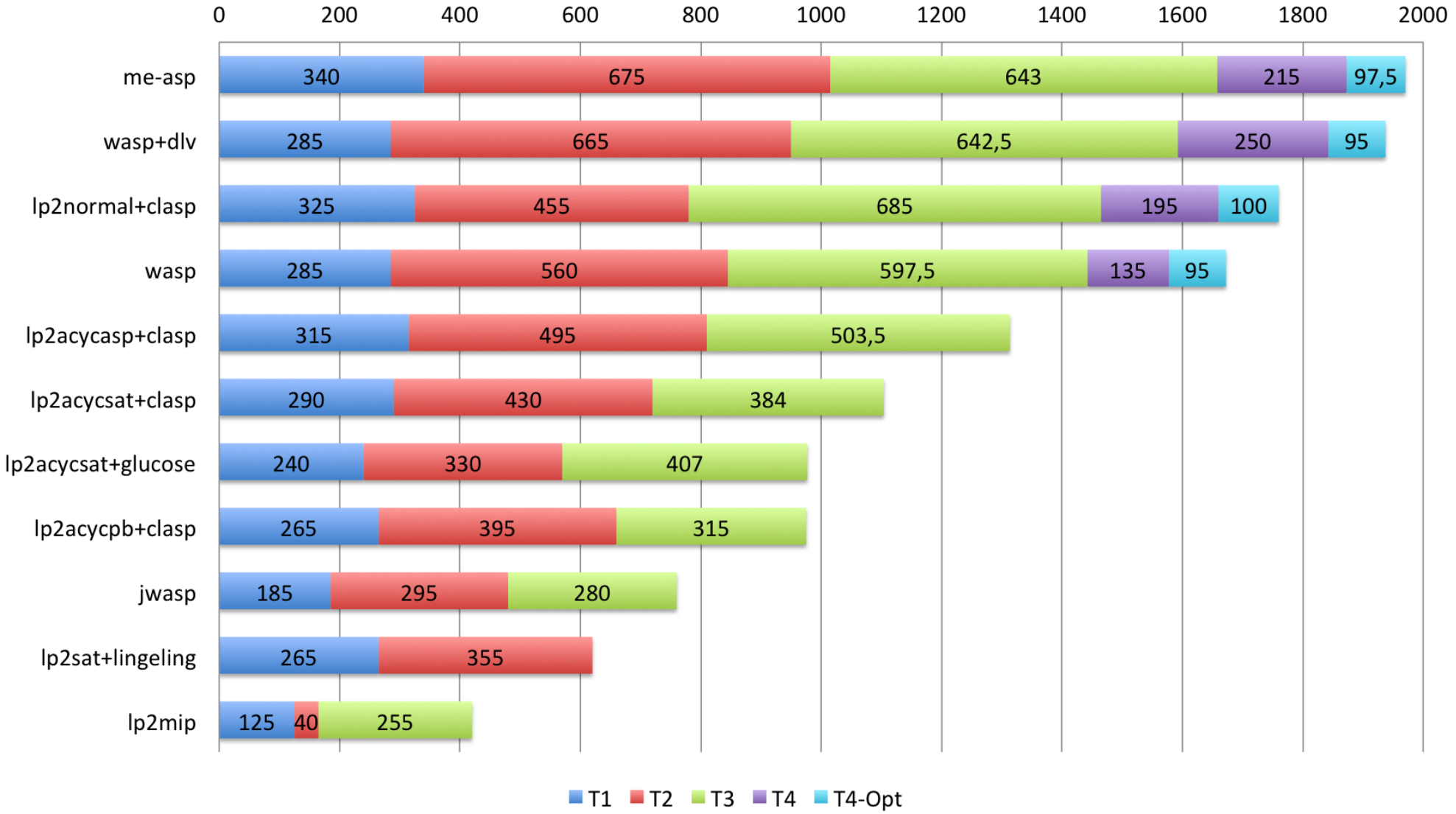
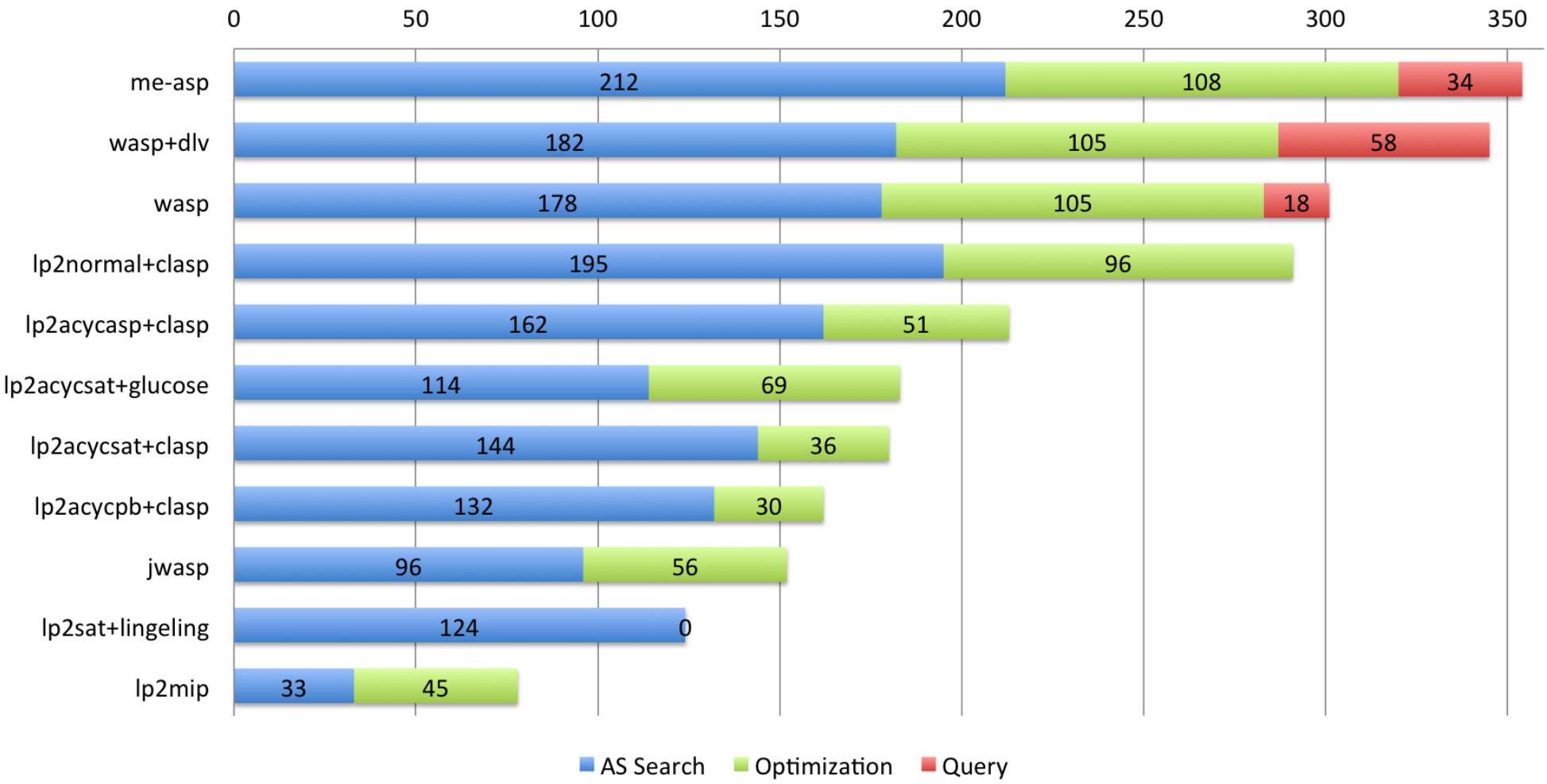
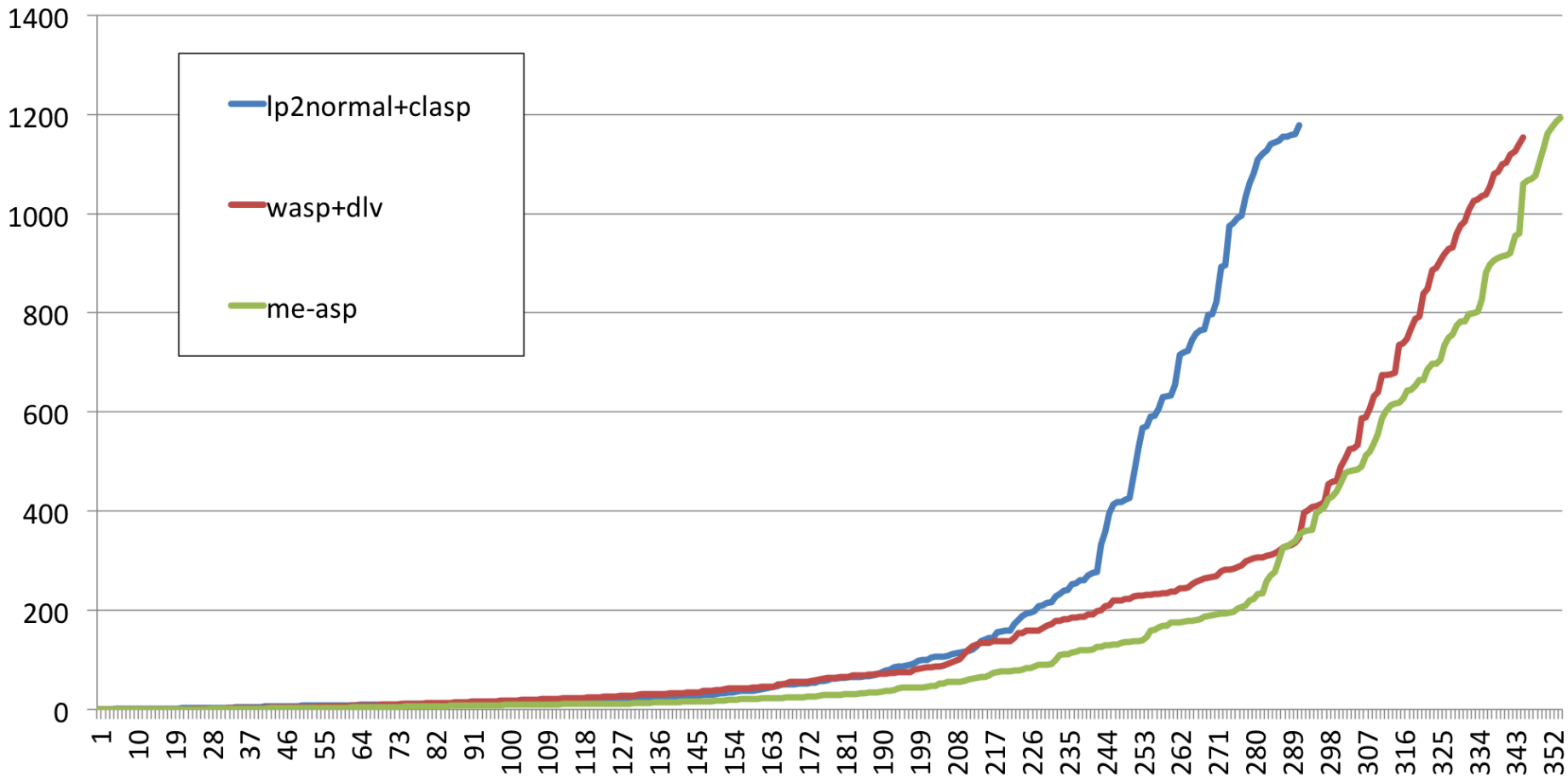


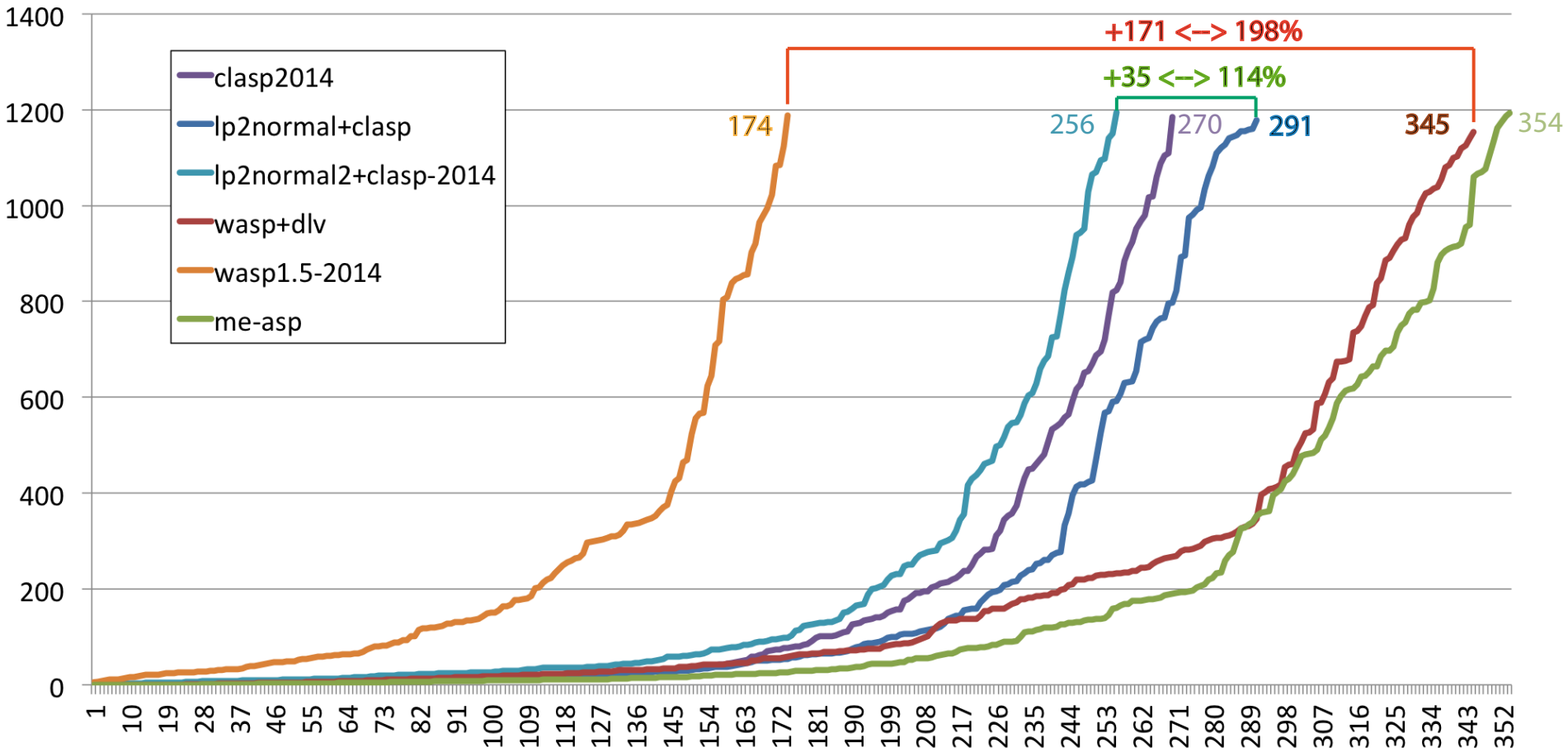
Results: Solved By Task



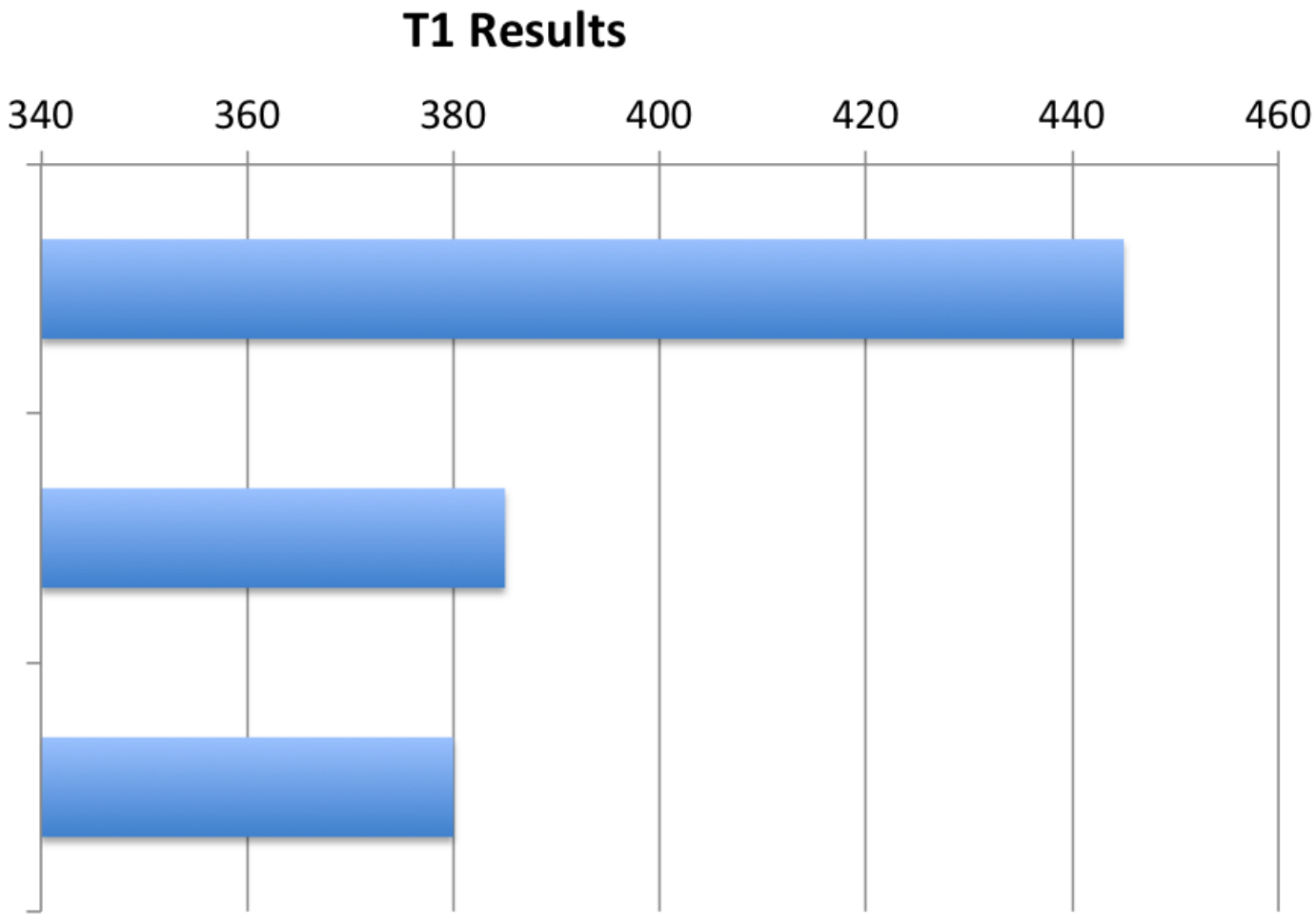
Results: Cactus Plot



Results: State of the art



Results: Marathon Track 1 - Basic



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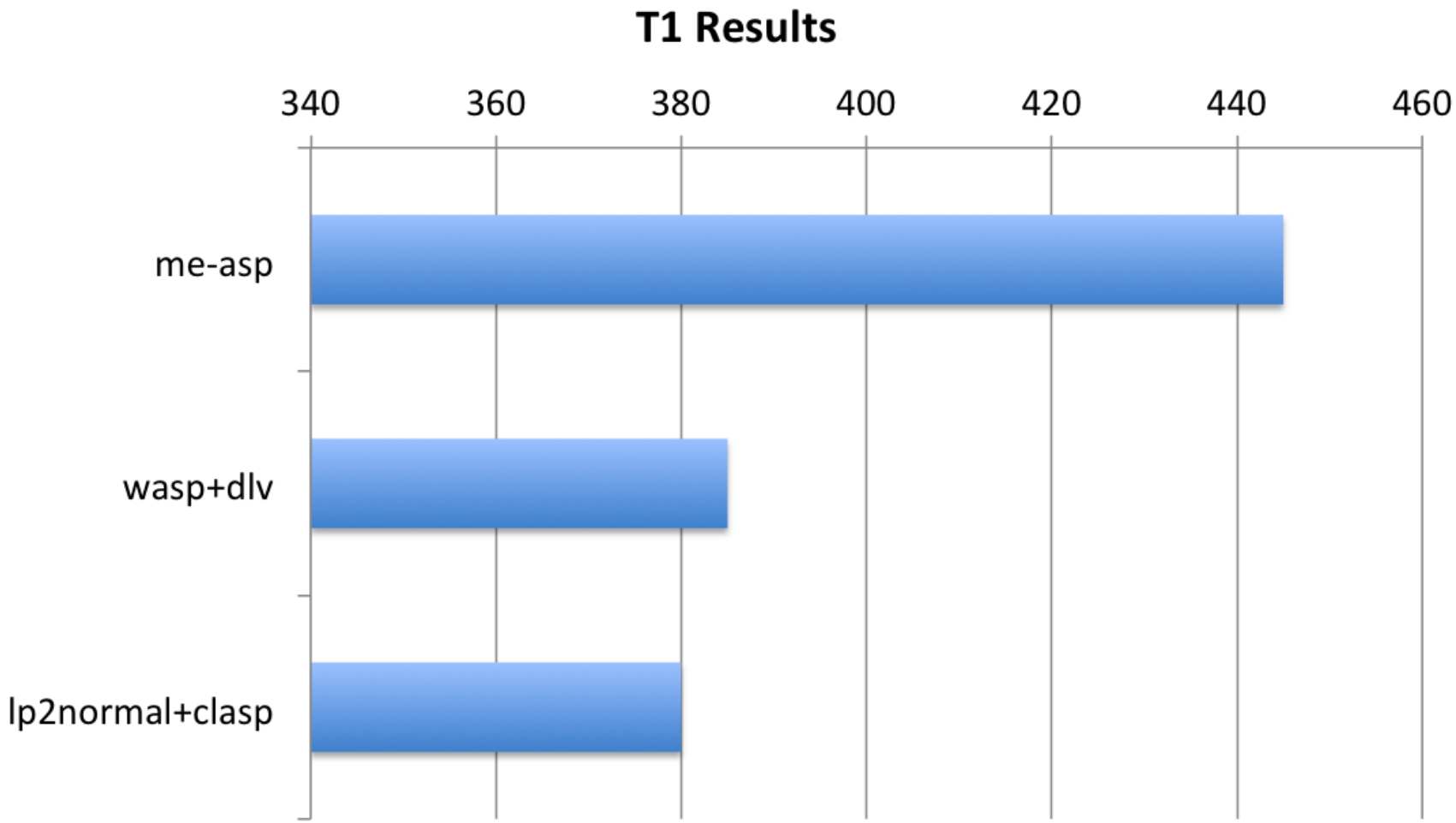
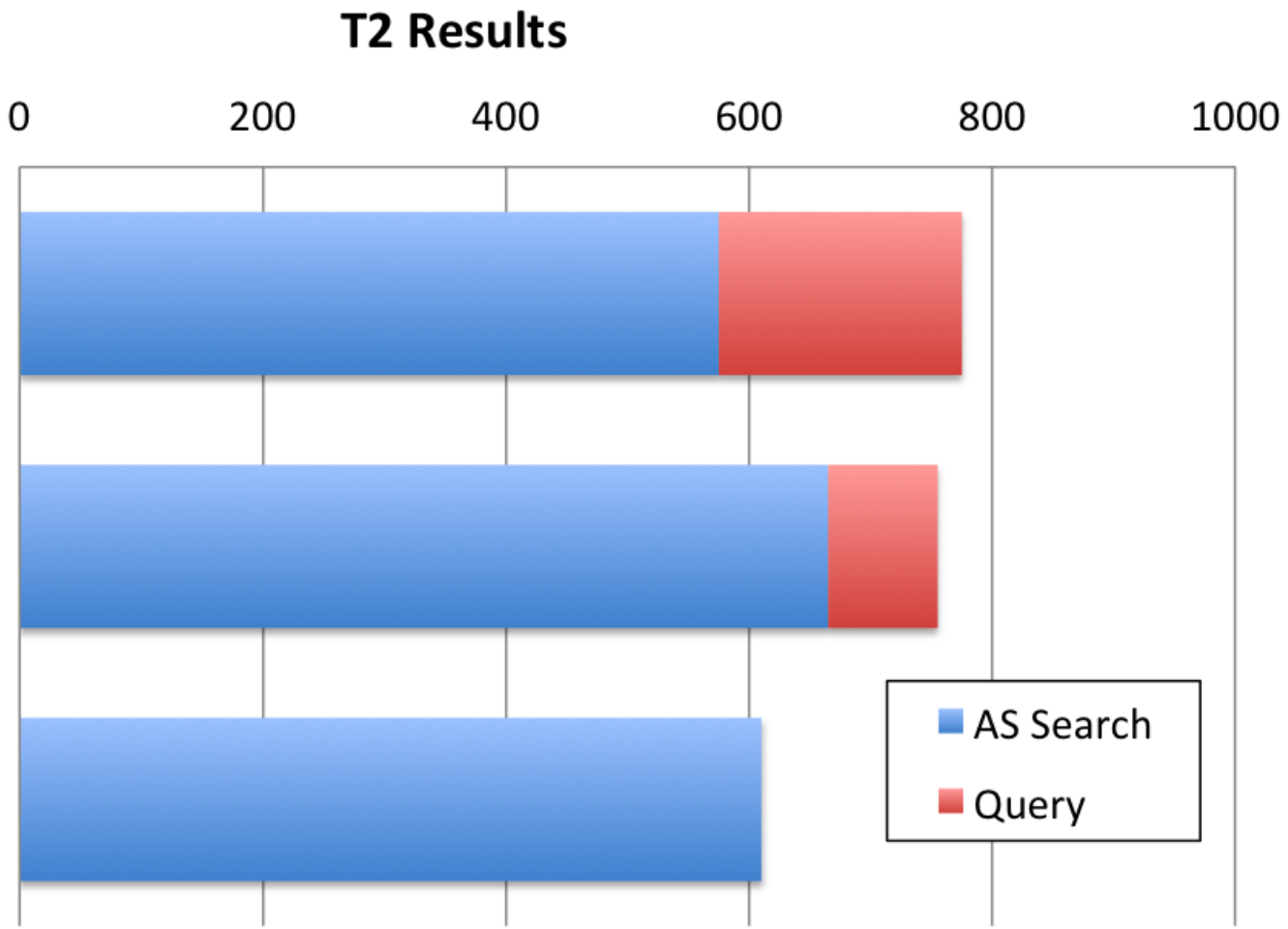


Results: Marathon Track 2 - Advanced



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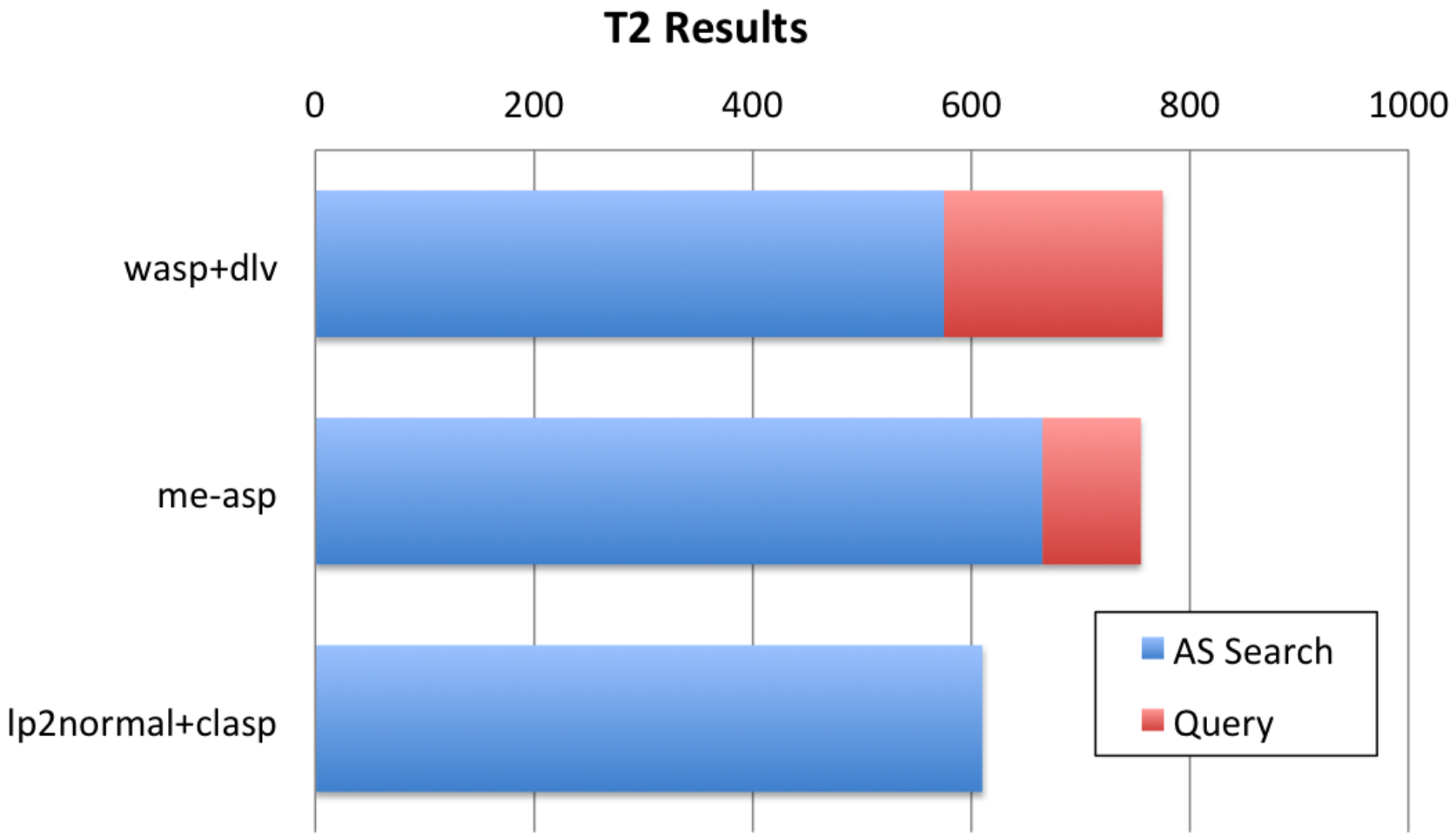
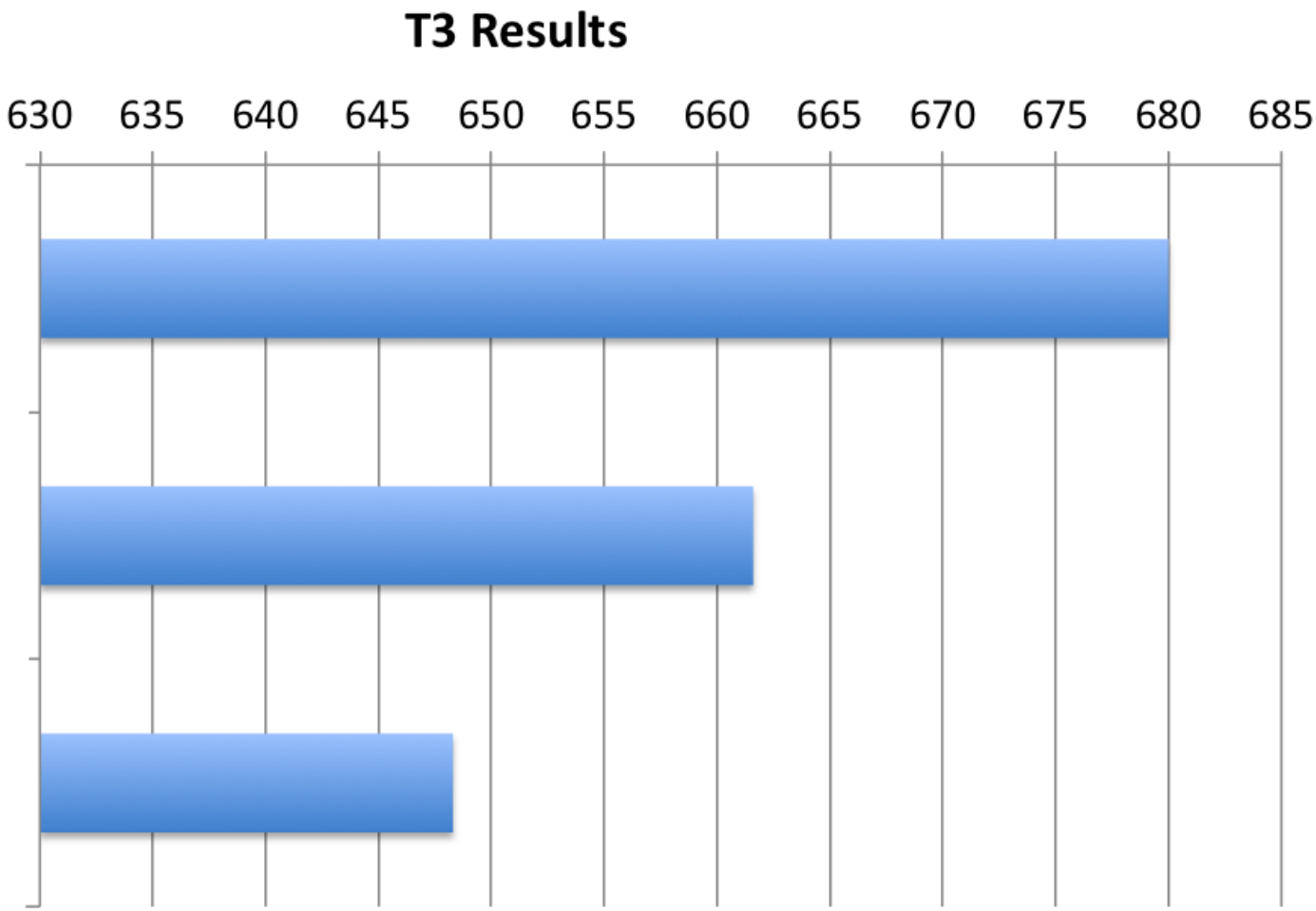


Results: Marathon Track 3 - Optimization



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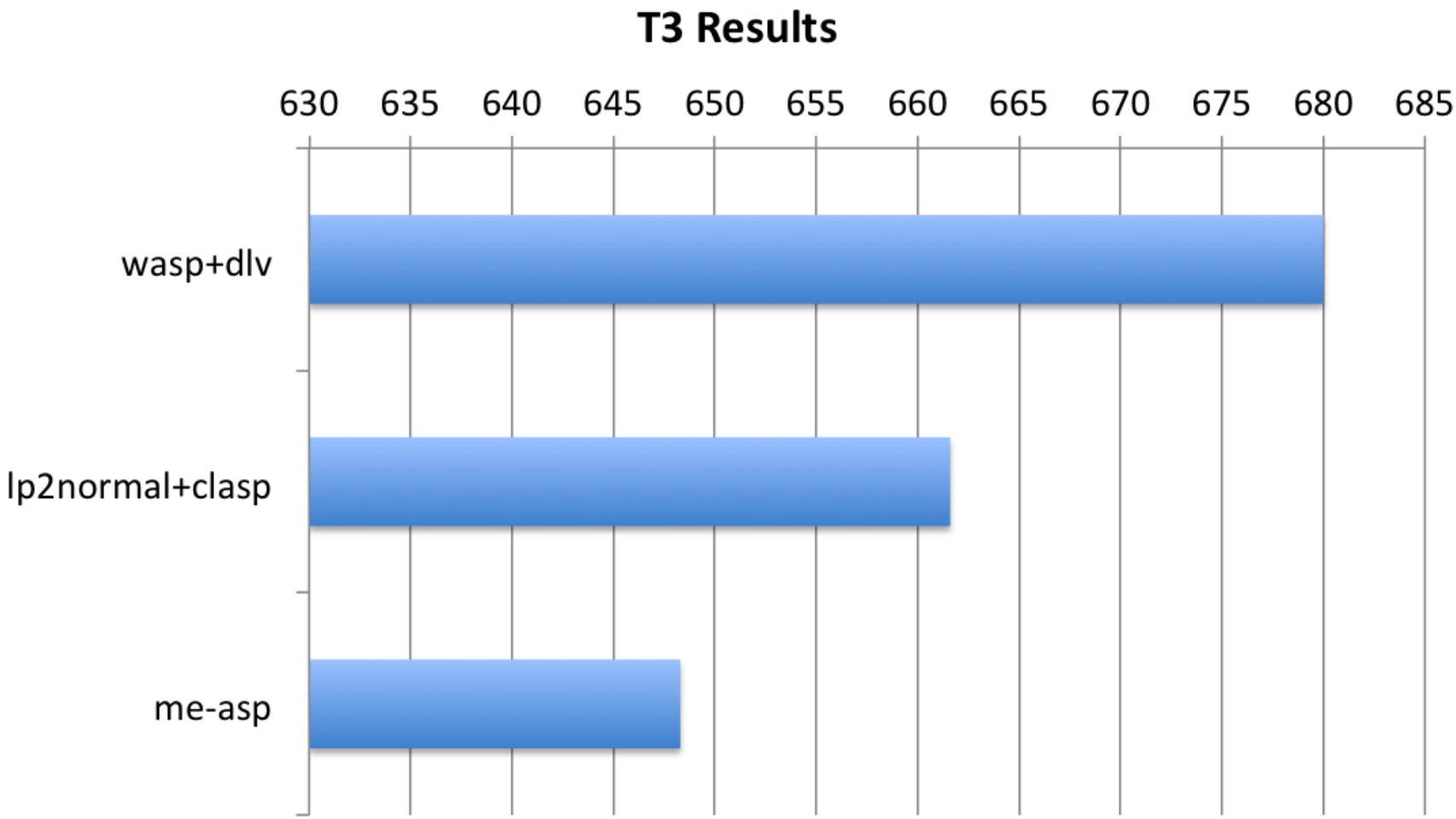
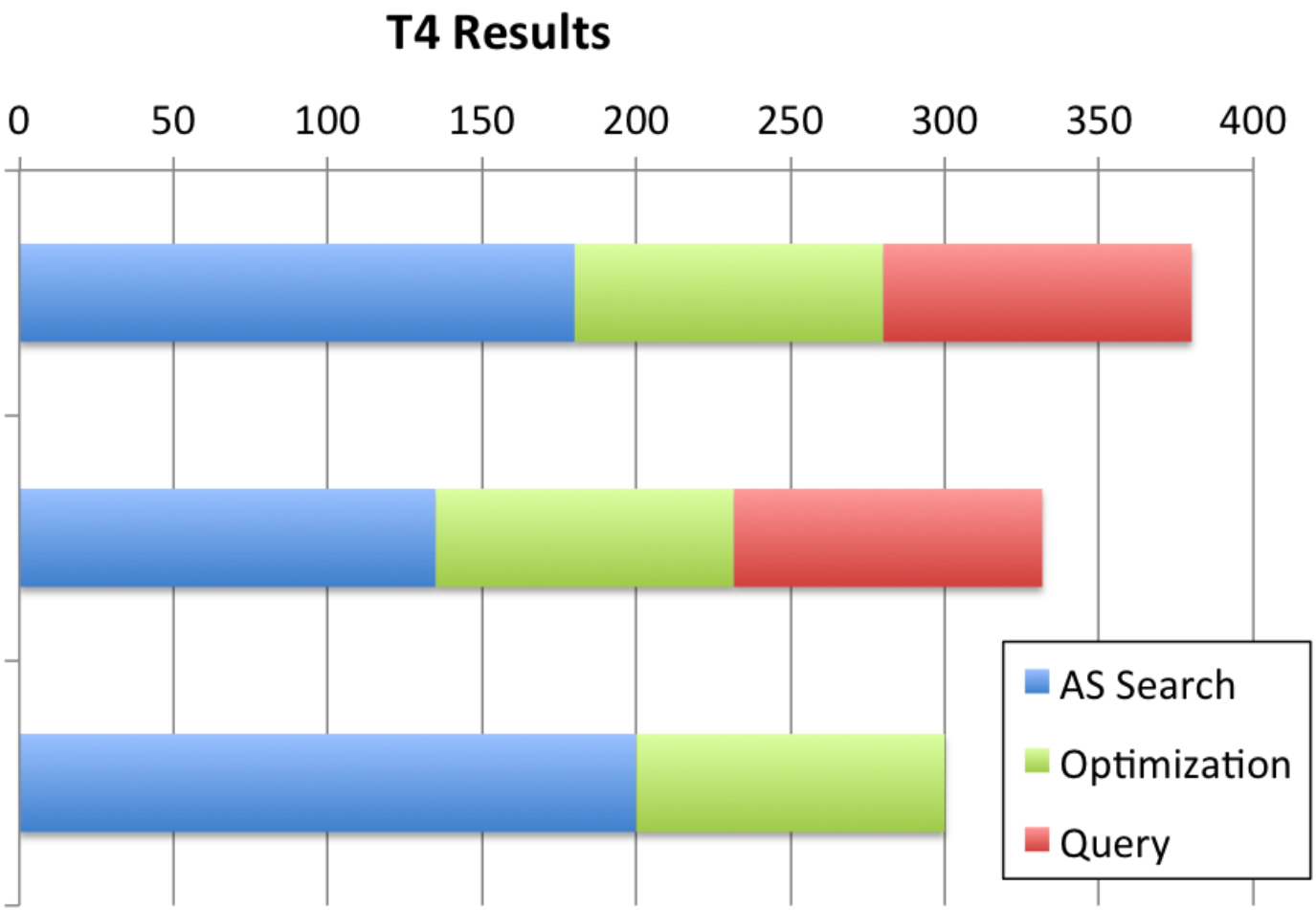


Results: Marathon Track 4 - Unrestricted



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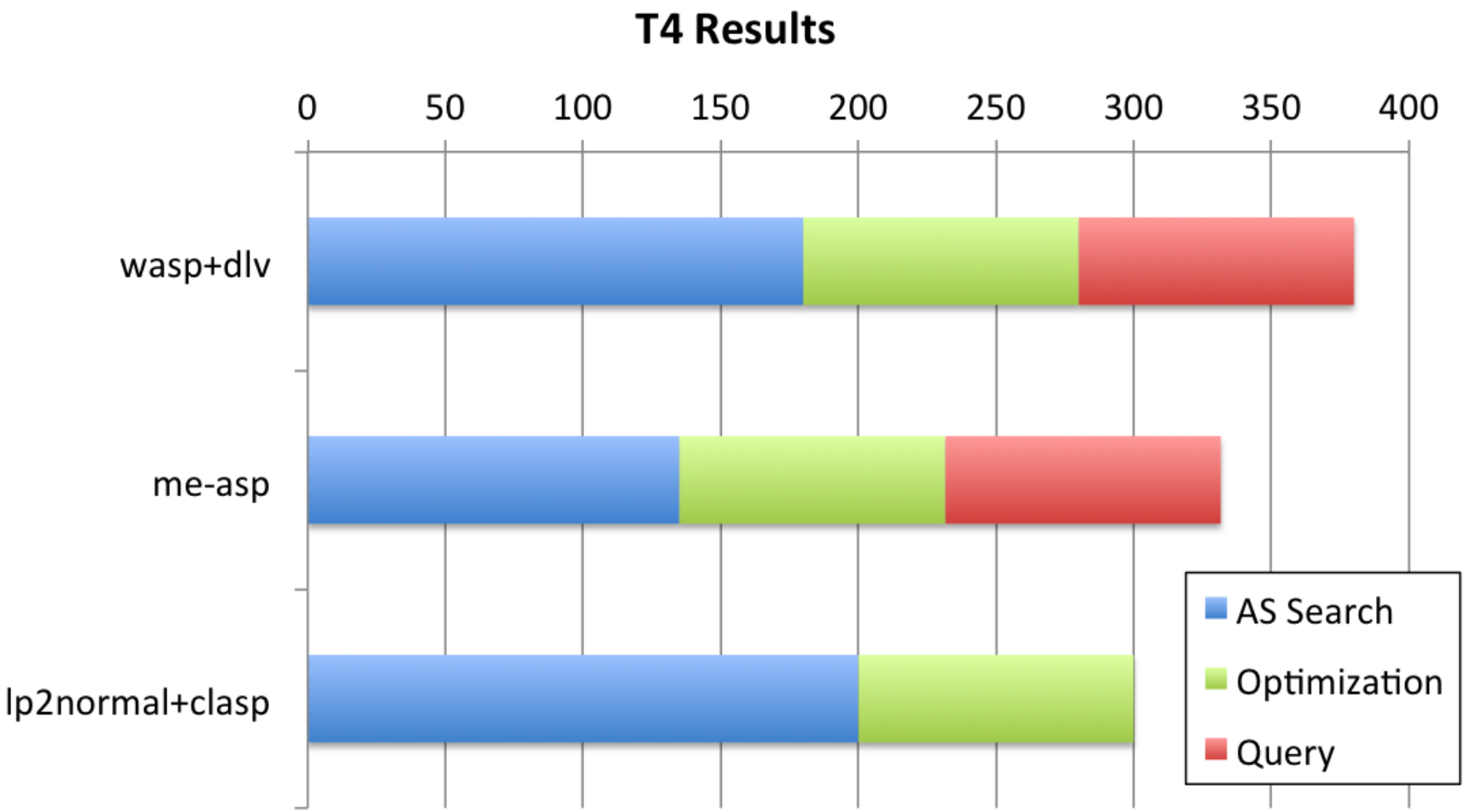

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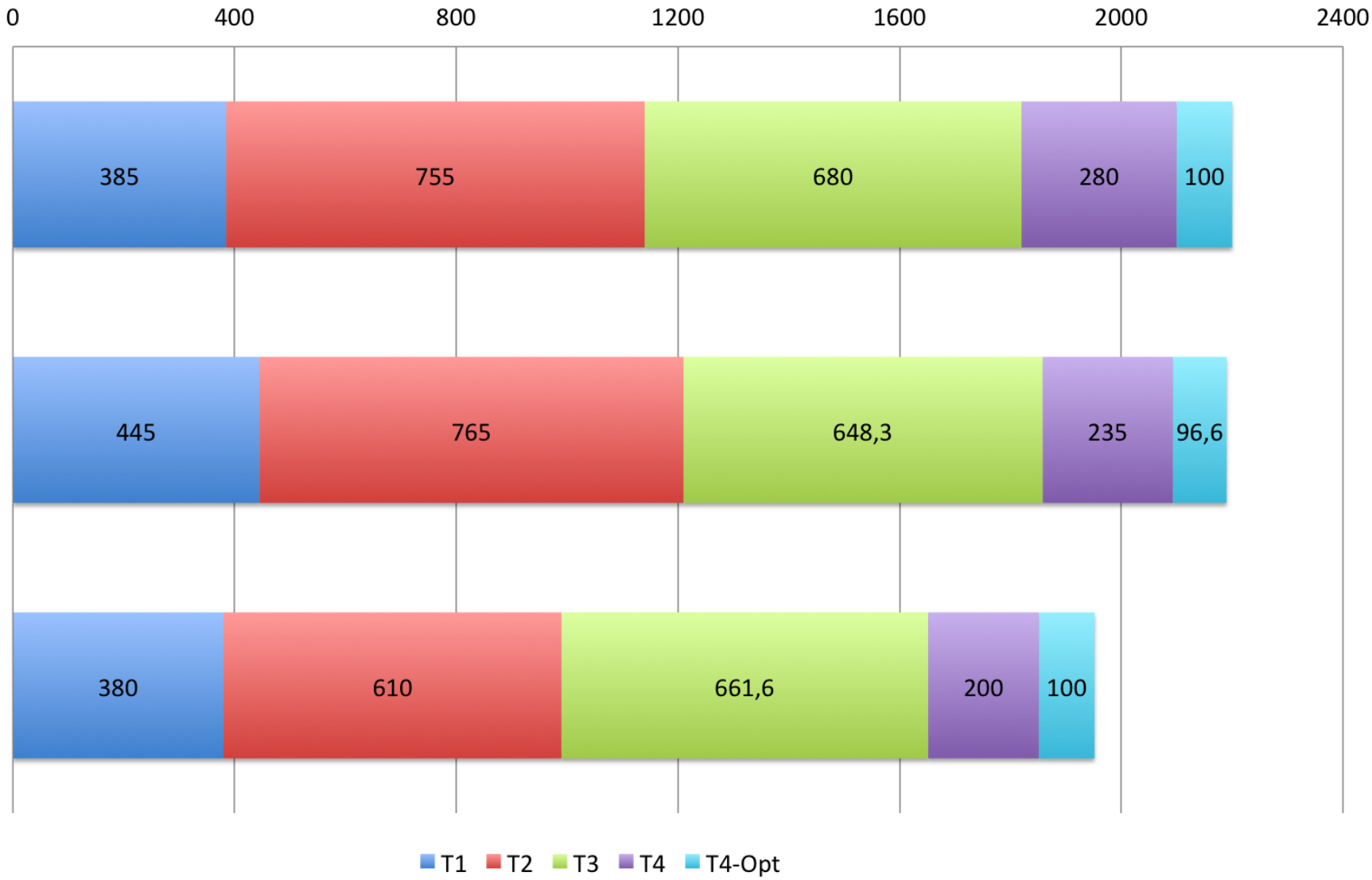

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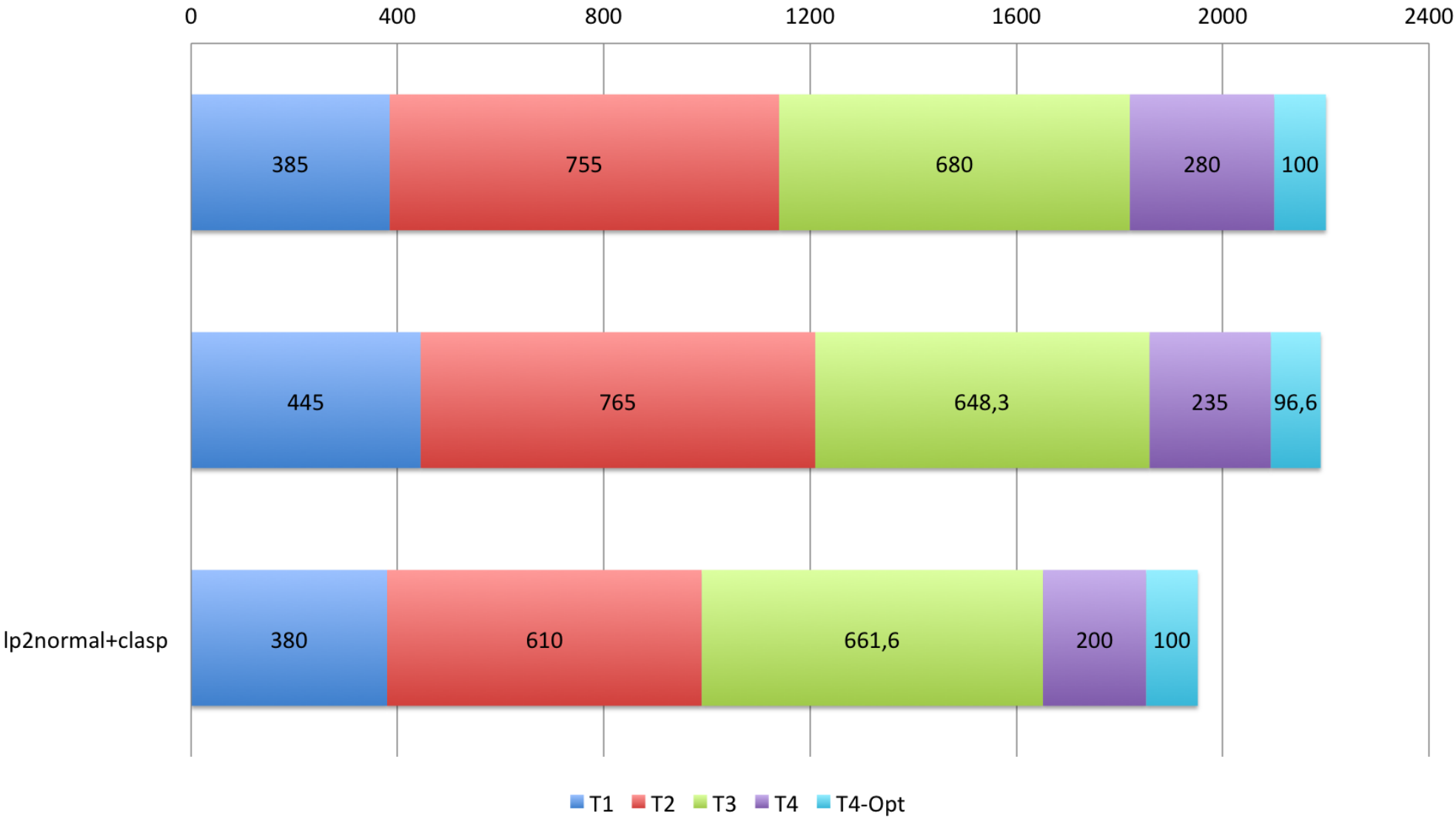

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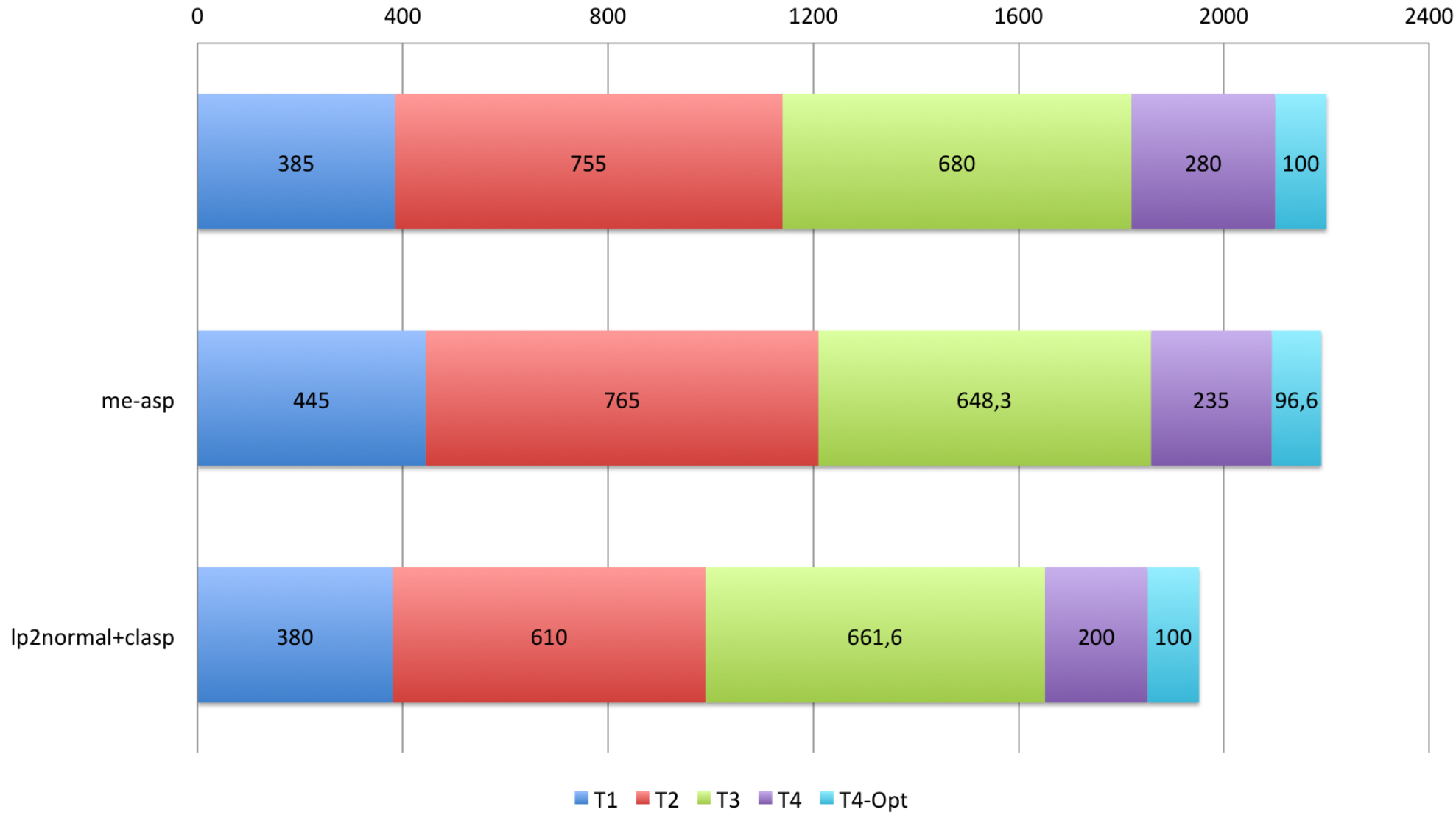

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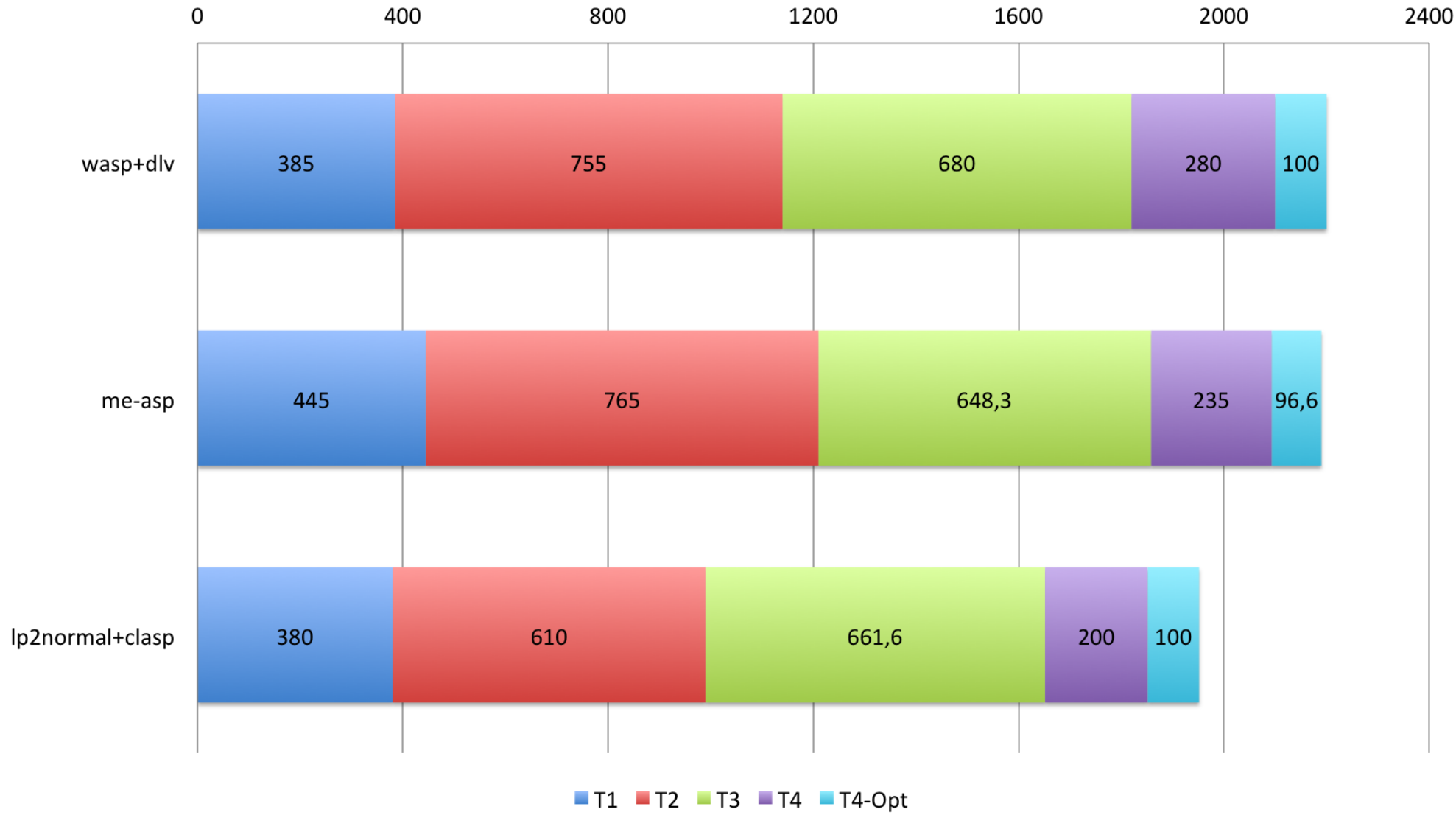
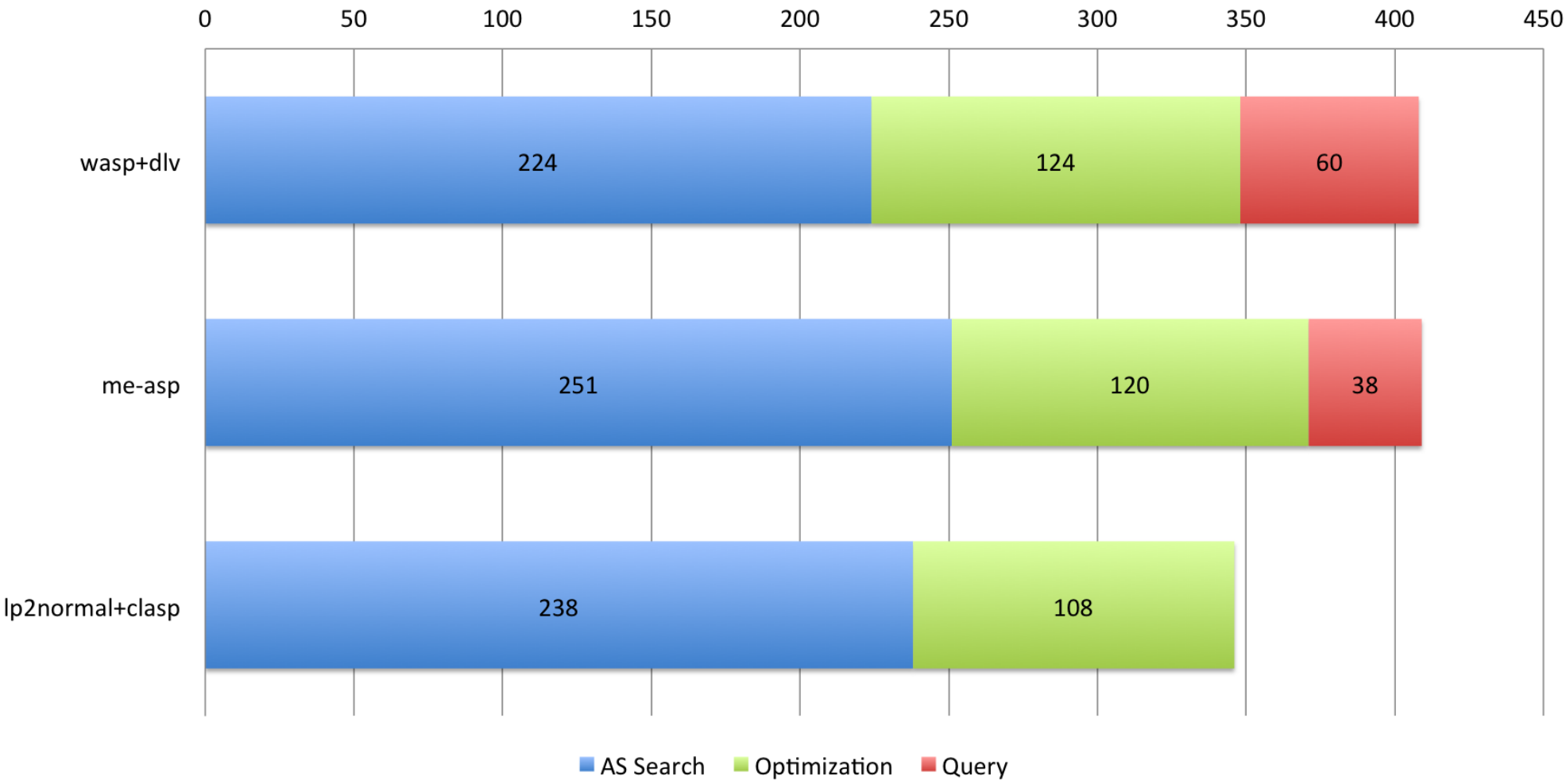
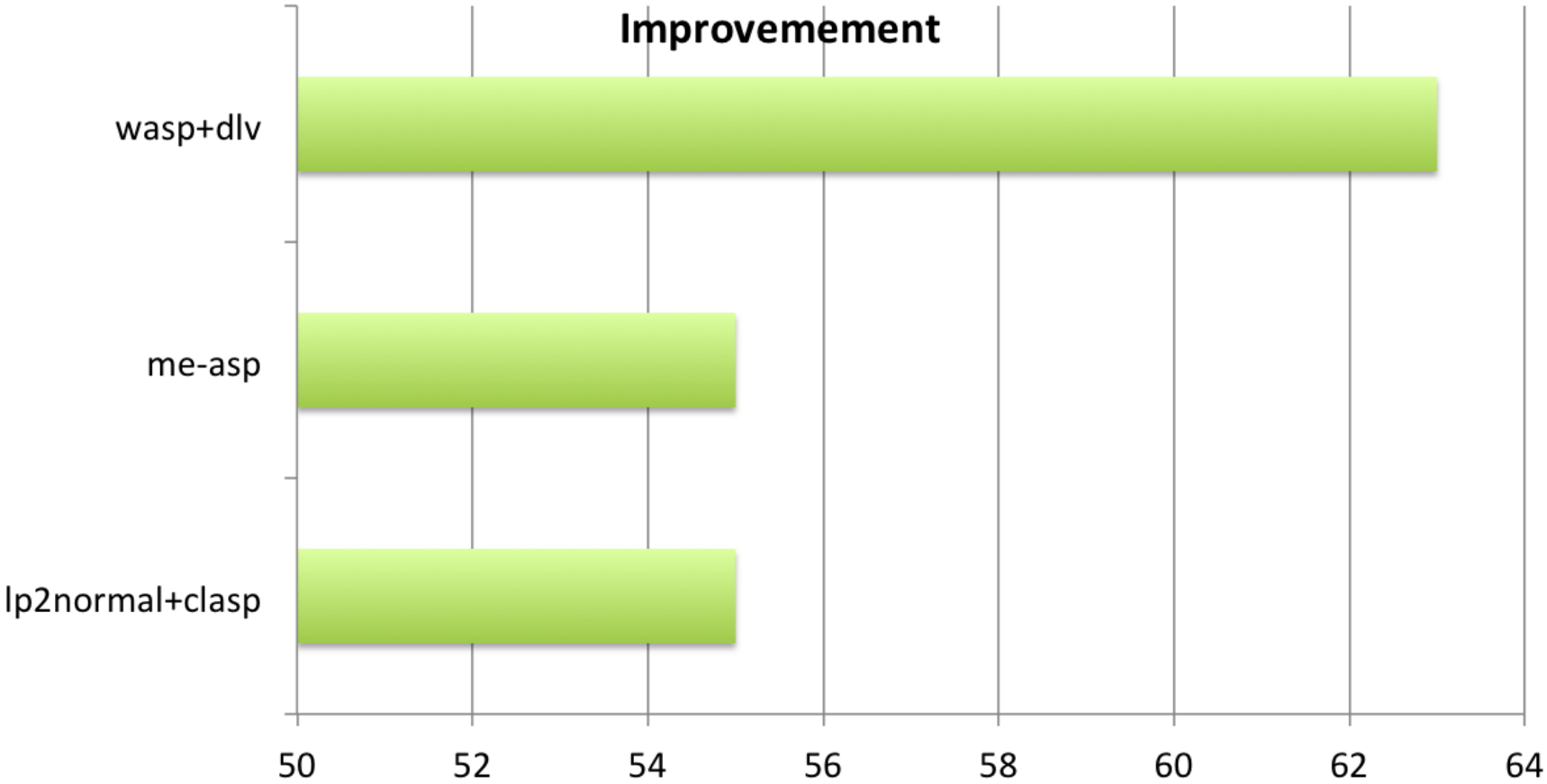


Results: Marathon Solved By Task

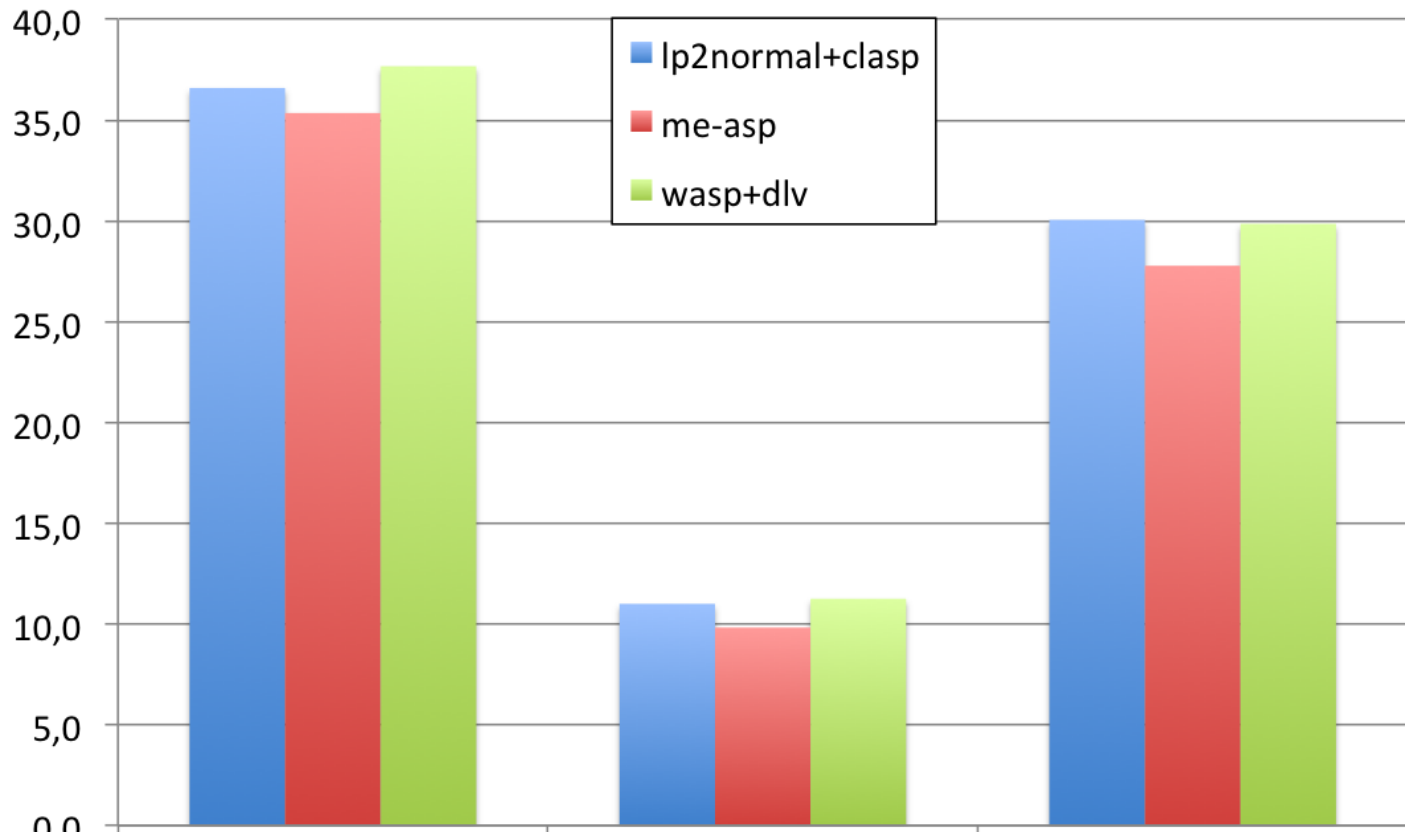


Results: Marathon Improvements



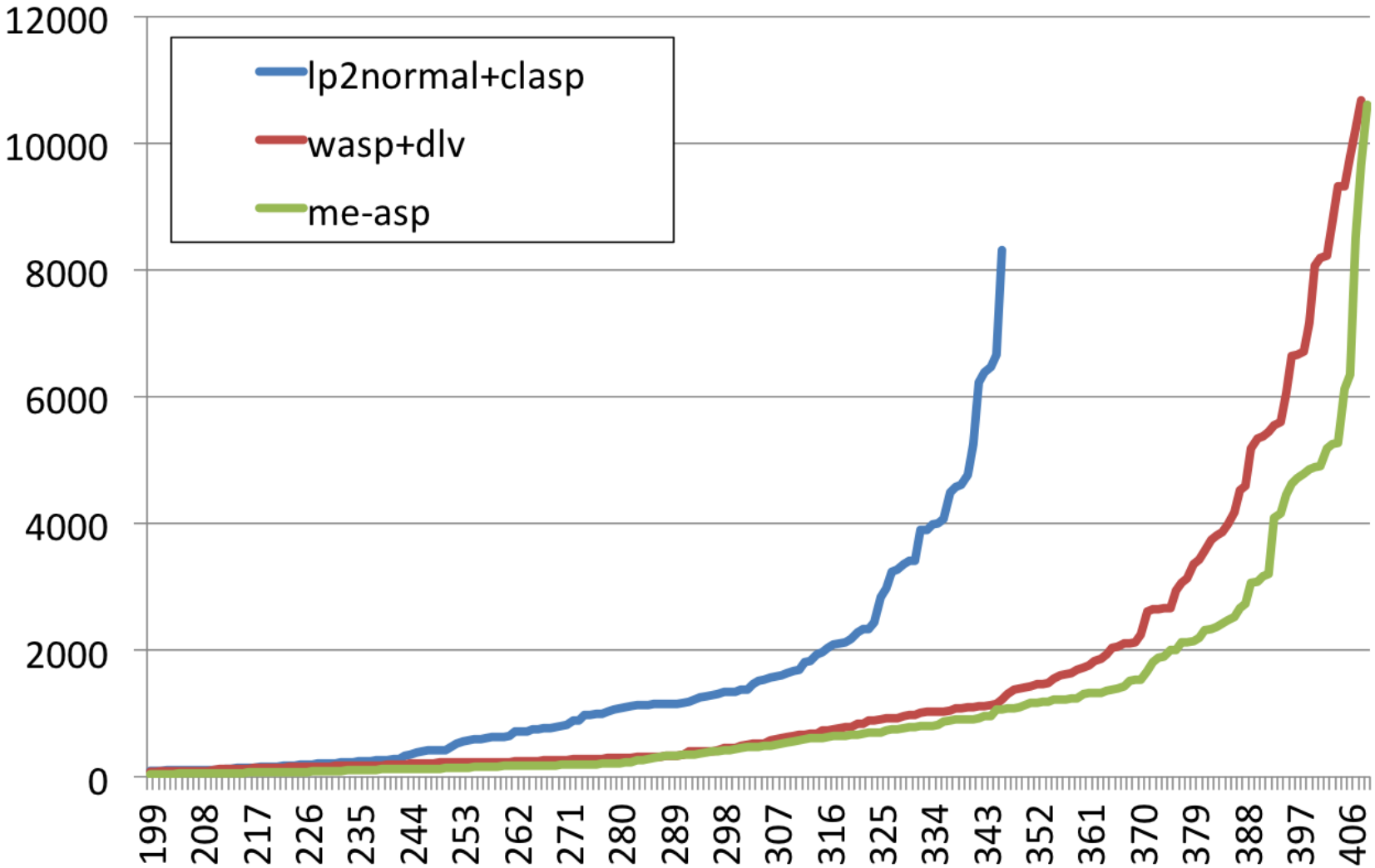
	lp2normal+clasp	me-asp	wasp+dlv
Improvemement	55	55	63

Results: Marathon Stats



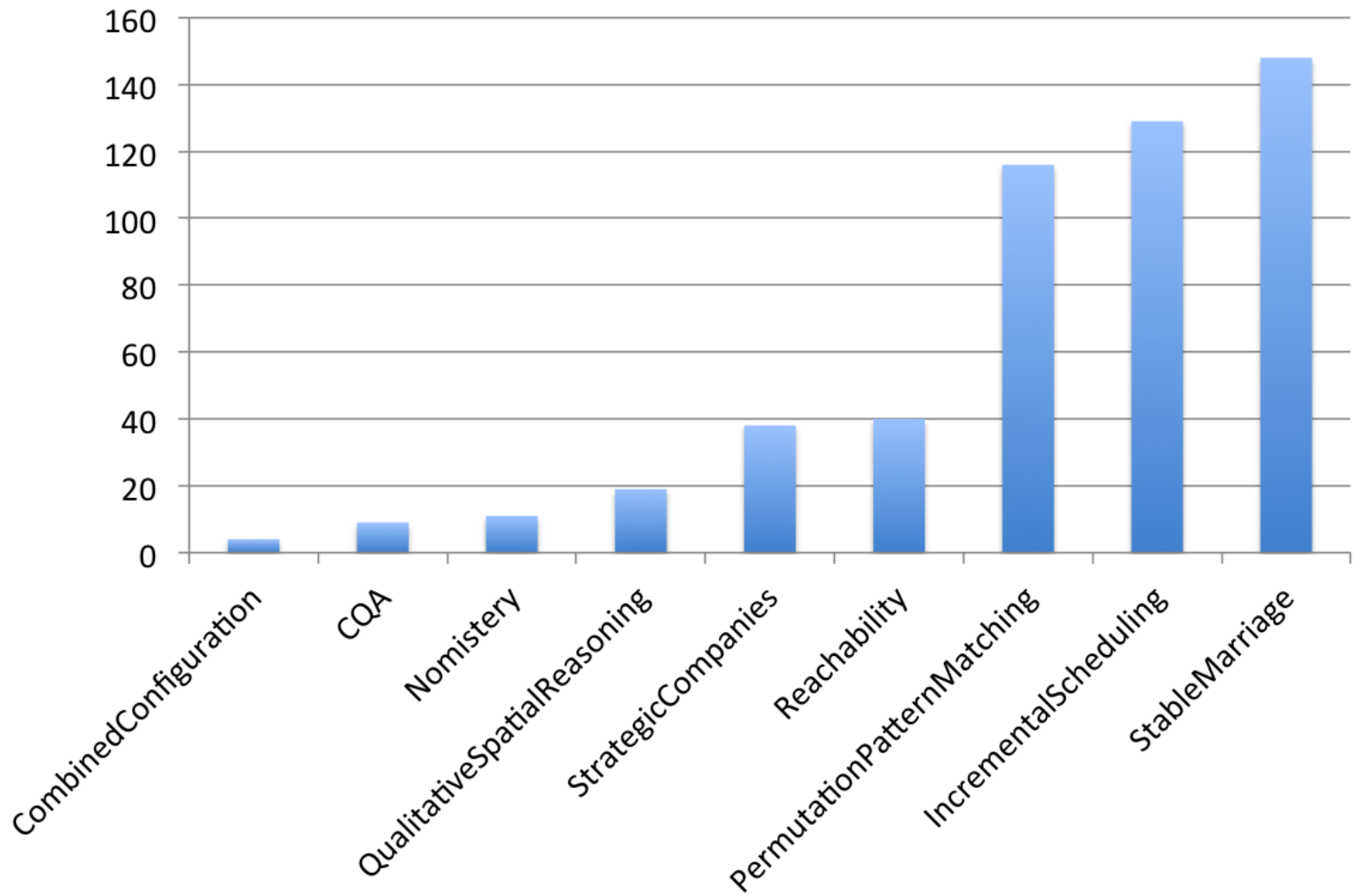
	% Potential Improvement	% Total Improvement	% Solved of Potential
lp2normal+clasp	36,6	11,0	30,1
me-asp	35,4	9,8	27,8
wasp+dlv	37,7	11,3	29,9

Results: Marathon Cactus Plot

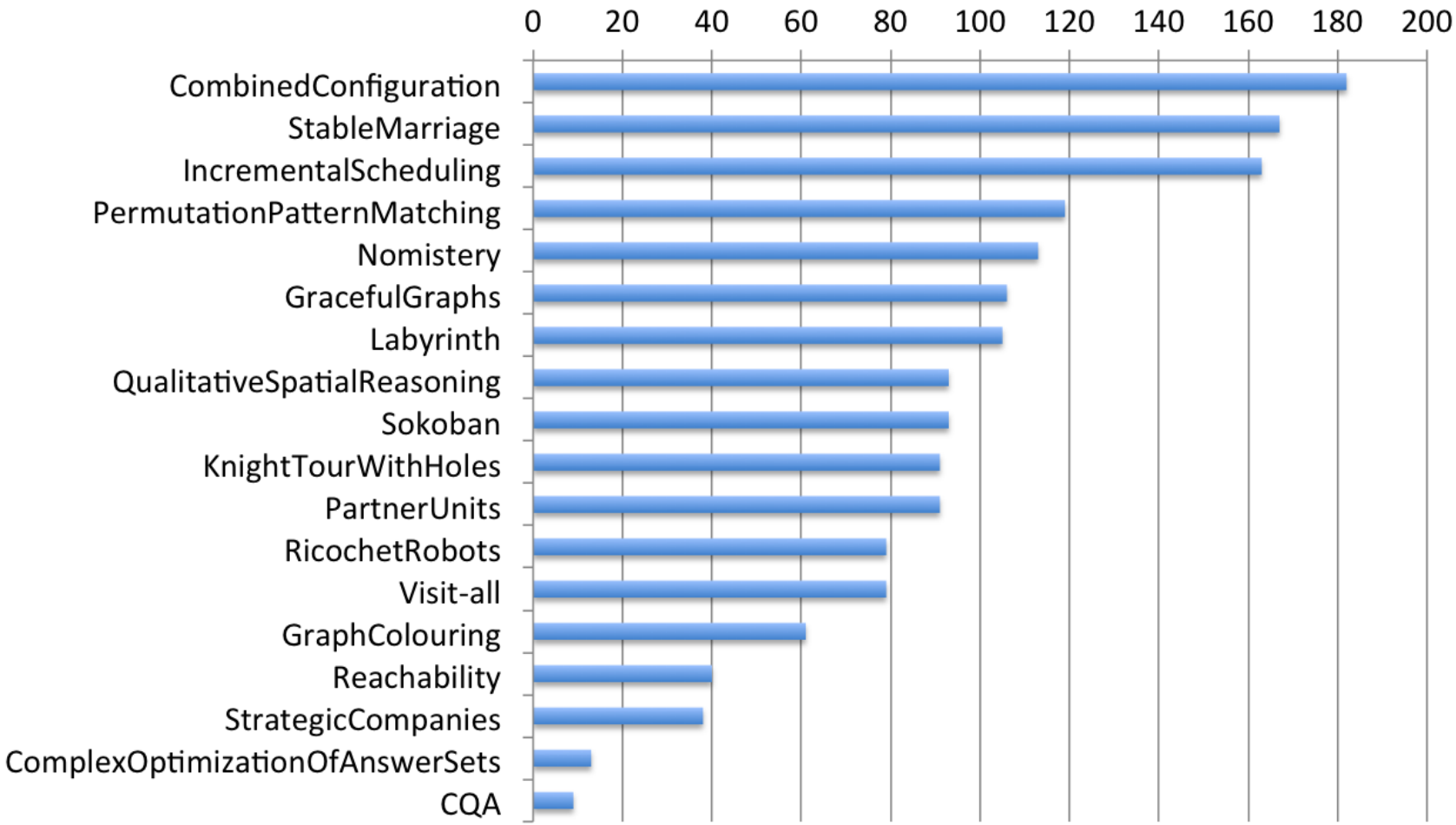


Results: Memory usage

Results: Memory out by domain



Results: Timeouts by Domain



(Implemented) Suggestions from 2014 Event

Simplify Output

- Unify output for tasks
- Reduce number of exit codes

Instance Selection

- Process for discarding very easy/hard
- More ASP-oriented real-world applications
- Enforce classification by language features
- Non-ground and ground tracks?
- Cautious/Brave Reasoning?

Modeling Competition

- Interactive event? Challenges? ...

(Implemented) Suggestions from 2014 Event

Simplify Output

- Unify output for tasks ← DONE!
- Reduce number of exit codes ← DONE!

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Modeling Competition

- Interactive event? Challenges? . . .

(Implemented) Suggestions from 2014 Event

Simplify Output

- Unify output for tasks ← DONE!
- Reduce number of exit codes ← DONE!

Instance Selection

- Process for discarding very easy/hard ← DONE!
- More ASP-oriented real-world applications ← DONE!
- Enforce classification by language features ← DONE!
- Non-ground and ground tracks? Need for more grounders!
- Cautious/Brave Reasoning? Brave reasoning is missing

Modeling Competition

- Interactive event? Challenges? . . . ideas?

Suggestions for future ASP events (1)

Simplify Output

- Avoid using exit codes with custom semantics

  → Easy choice for SAT, not for ASP solver scripts!
- Embrace POSIX-compatible convention

  → Zero for success and non-zero for error

Scoring

- Less dependent on number of participants
- More emphasis on solved (optimal) solutions

  → 5 points is too much for non-optimal witnesses
- Two rankings?

Suggestions for future ASP events (2)

Benchmark Suite

- Maintain classification by hardness
- Don't stop adding ASP-oriented real-world applications
- Maintain classification by language features
- Maintain some more easy domains

Reasoning Tasks

- Brave Reasoning
- Propositional program evaluation
- Tracks for extended language features

Suggestions for future ASP events (3)

Modeling Competition

- Keep it as it is... pure fun!
- Open to remote participation as LP/CP Contest at ICLP
- More advertisement

Extend the ASP Development community

- ASPLib web site
- Lower the entrance barrier

  $\rightarrow$ Emphasize winners of tracks...
- $\cdots$ ideas?

Thanks

Thank you for your attention!

Thanks

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Award ceremony during the social dinner!