

# The 5<sup>th</sup> Competition on Syntax-Guided Synthesis



---

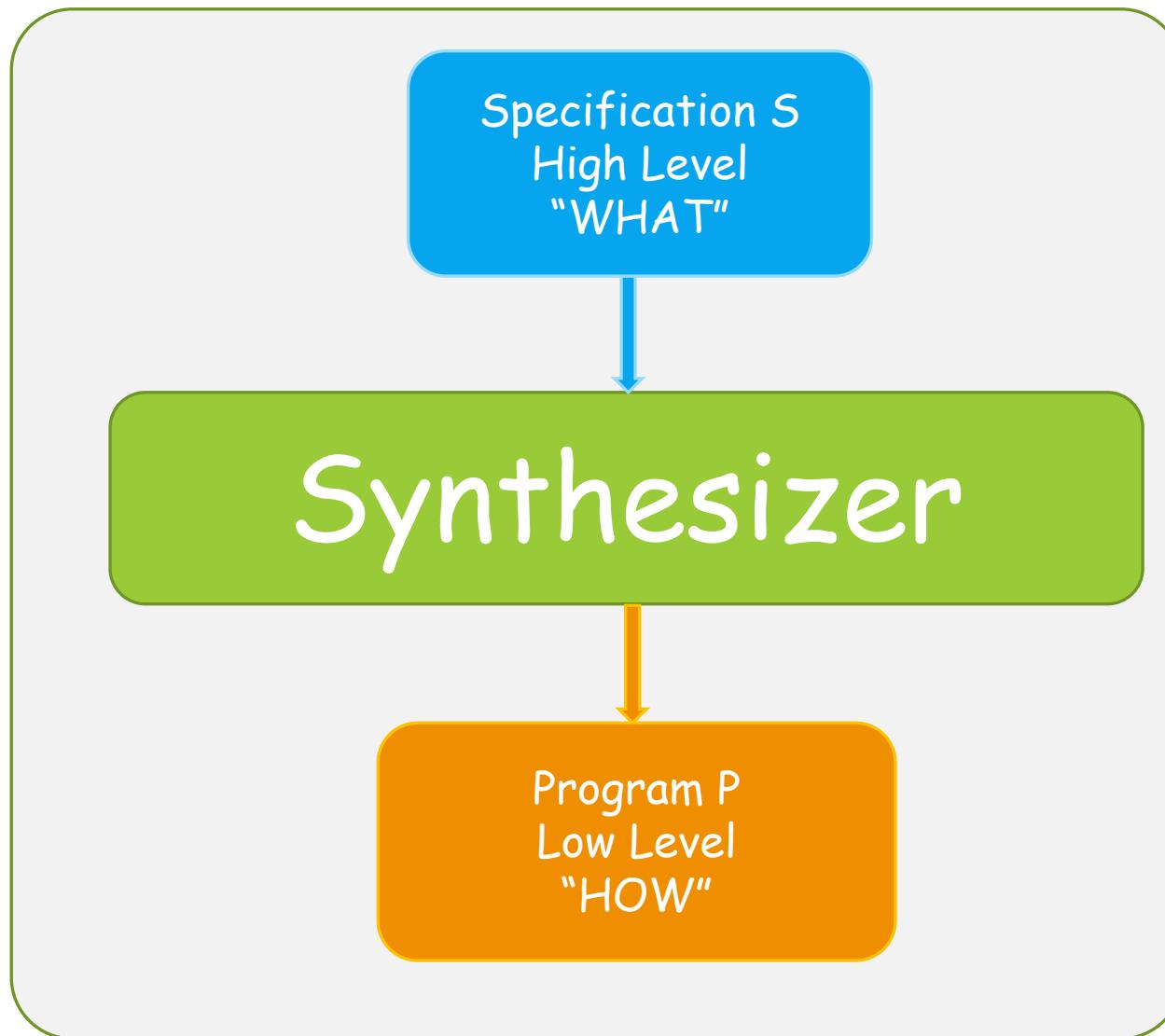
Rajeev Alur, Dana Fisman,  
Rishabh Singh and Abhishek Udupa

# SyGuS

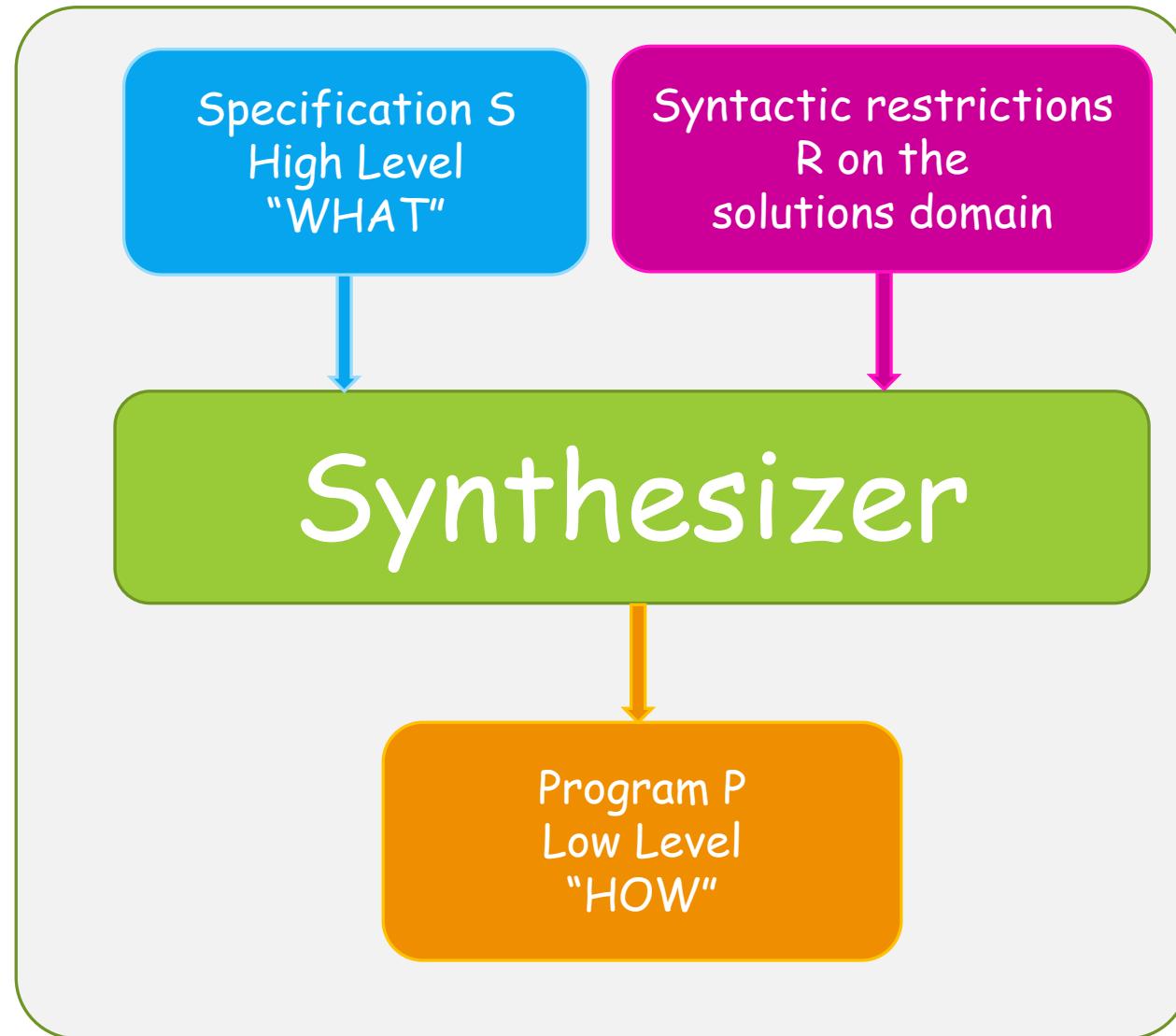
---

Idea and Definition  
in a Nutshell

# Program Synthesis



# Recent Trends in Synthesis



# Syntax Guided Synthesis - Idea

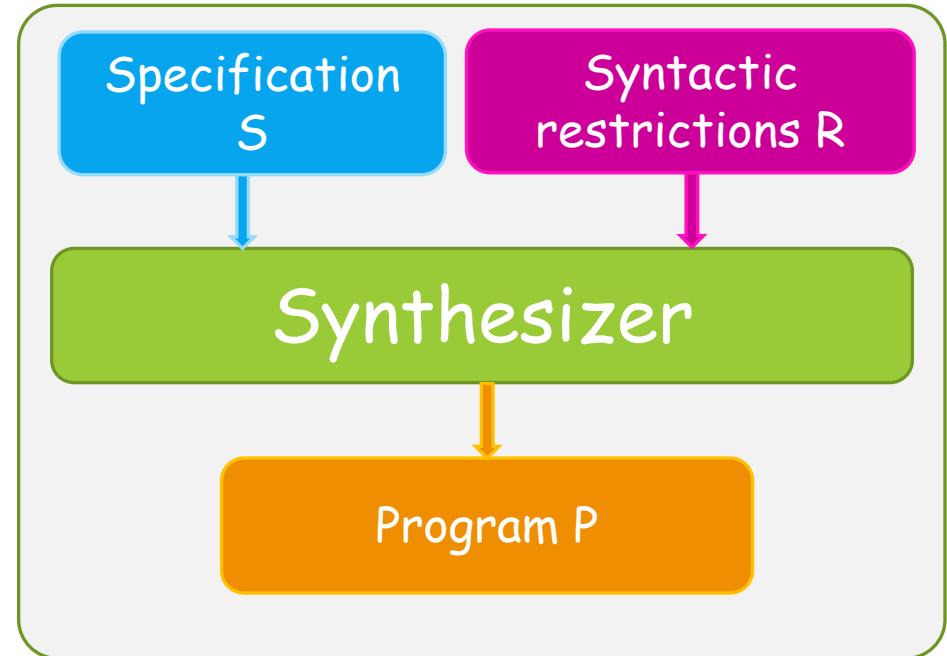
## Motivation:

- Tractability
- Combine

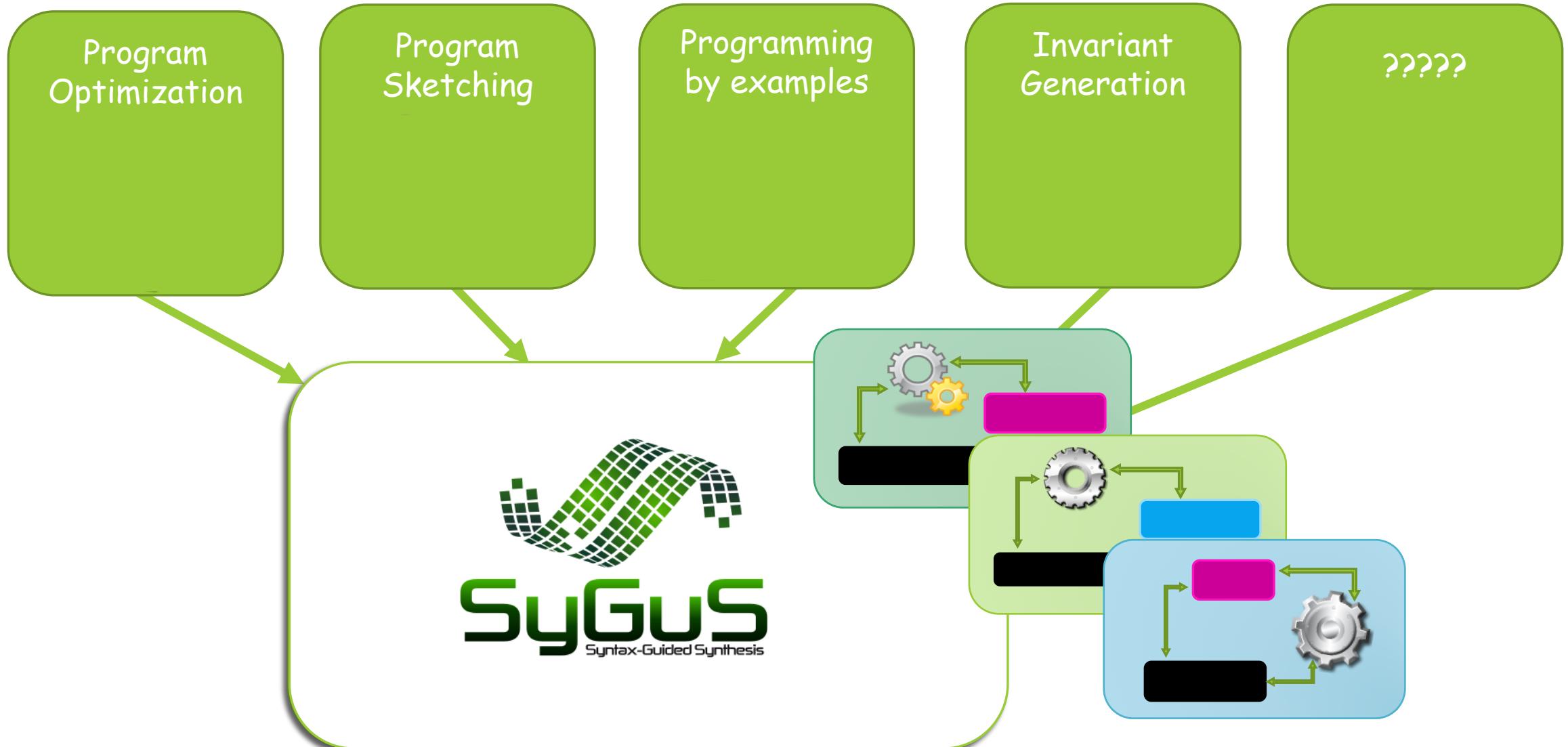
human expert insights with

computers exhaustiveness & rapidness

- Benefit progress SAT & SMT Solvers

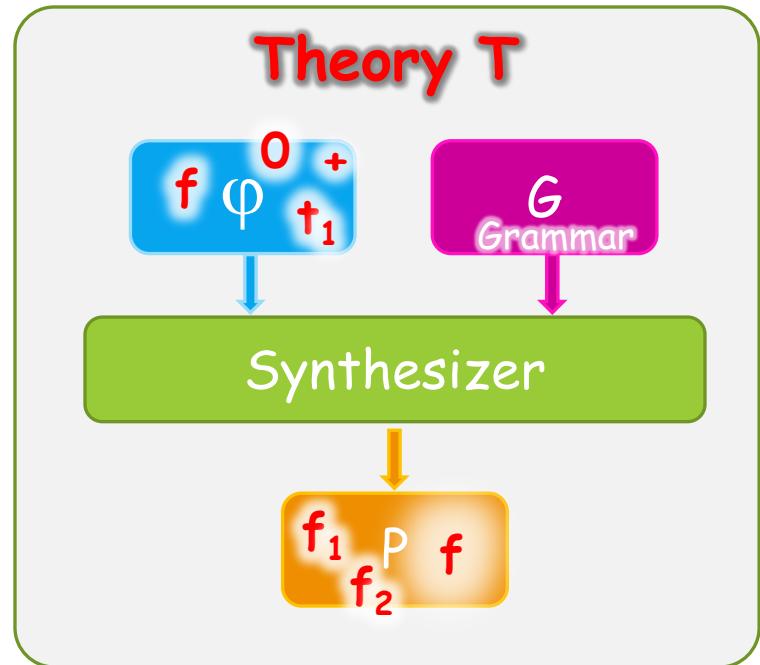


# SyGuS - The Vision

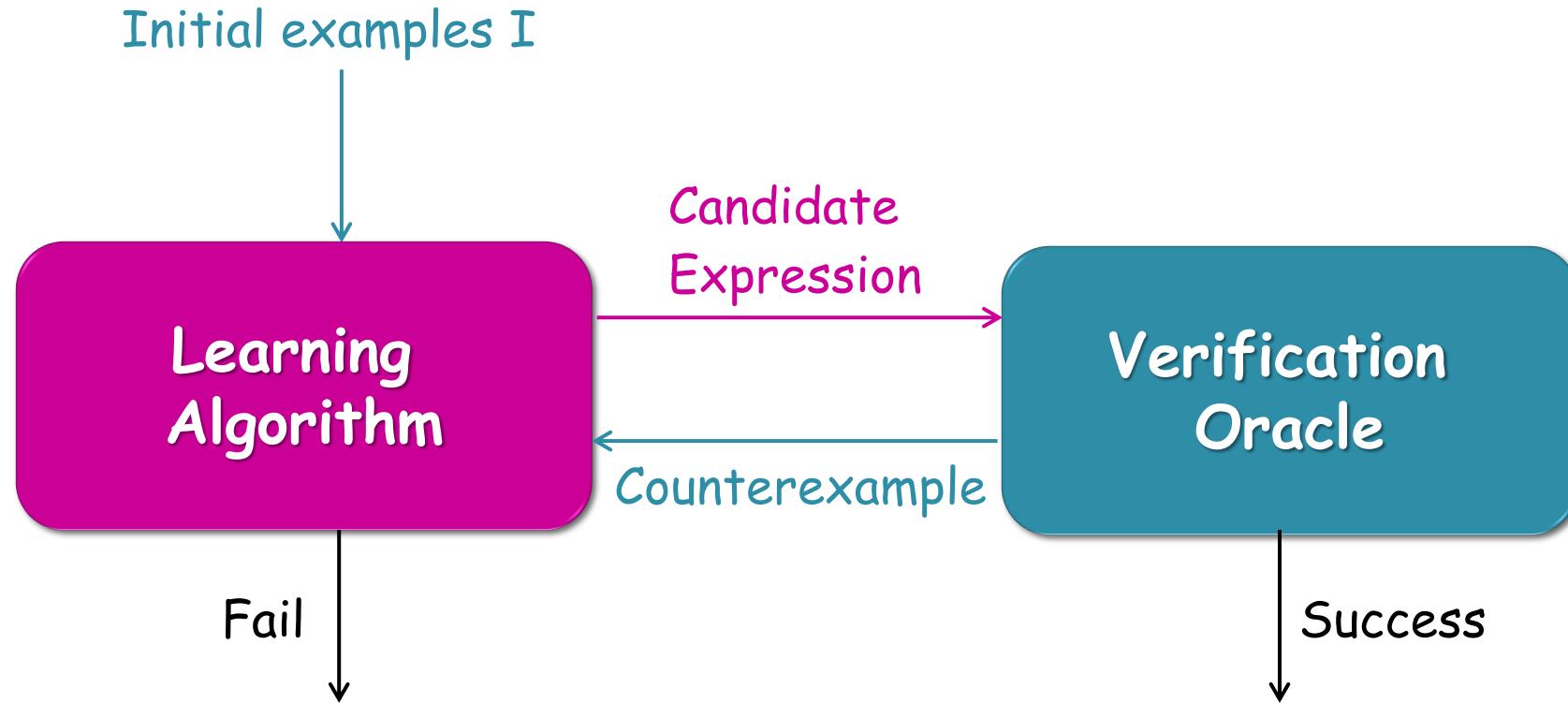


# Syntax-Guided Synthesis (SyGuS) Problem

- Fix a background **theory T**: fixes types and operations
- Function to be synthesized: **name f** along with its type
  - ❖ General case: multiple functions to be synthesized
- Inputs to SyGuS problem:
  - ❖ **Specification  $\varphi$**   
Typed formula using symbols in  $T +$  symbol **f**
  - ❖ **Context-free grammar G**  
Characterizing the set of allowed **expressions  $[[G]]$**  (in theory **T**)
- **Computational problem:**  
Find **expression e** in  $[[G]]$  such that  $\varphi[f/e]$  is valid (in theory **T**)



# SyGuS as Active Learning



Concept class: Set  $[[ G ]]$  of expressions

Examples: Concrete input values

# SyGuS-Comp18

---

The 5<sup>th</sup> competition on Syntax Guided  
Synthesis

# Solvers

- **CVC4 2018** - Andrew Reynolds (Univ. of Iowa), Haniel Barbosa (Univ. of Iowa), Andres Notzli (Stanford), Cesare Tinelli (Univ. of Iowa) and Clark Barrett (Stanford)
- **Horndini** - Deepak D'Souza (IISc Bangalore), P. Ezudheen ( IISc Bangalore), P . Madhusudan - (UIUC), Pranav Garg (Amazon), Daniel Neider (MPI-SWS) and Shubham Ugare (IIT Guwahati)
- **DryadSynth** - KangJing Huang (Purdue Univ.) , Xiaokang Qiu (Purdue Univ.) , Qi Tian (Nanjing University), and Yanjun Wang (Purdue Univ.)
- **LoopInvGen** - Saswat Padhi (UCLA) ,Todd Millstein (UCLA) and Rahul Sharma (MSR)
- **EUSolver 2017** - Arjun Radhakrishna (MSR) and Abhishek Udupa (MSR)

# Tracks

- General
- Inv
- CLIA
- PBE Strings
- PBE Bitvectors

Extensions  
suggestions?

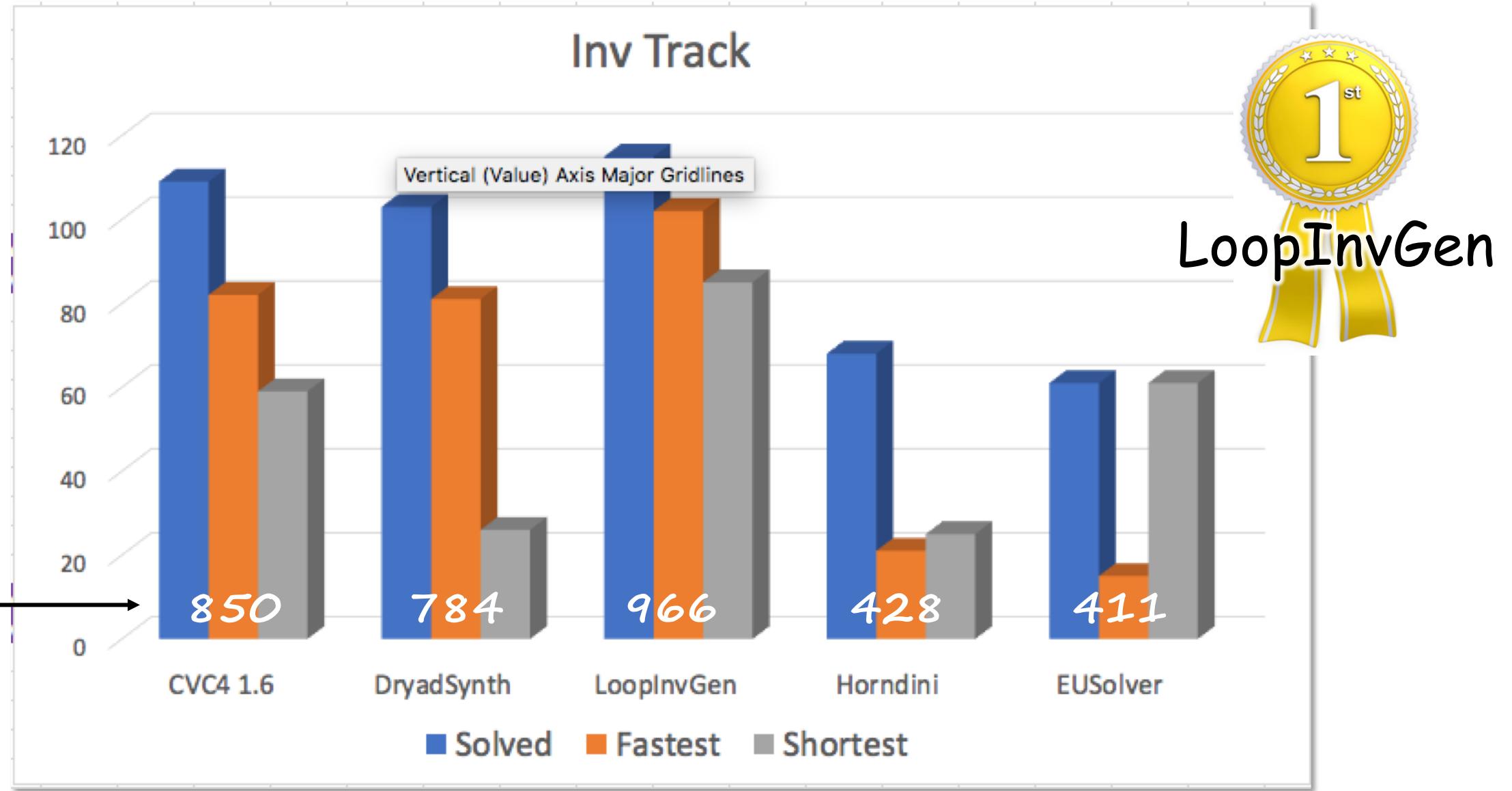
# Tracks Participation

- **CVC4-2018:** all 5 tracks
- **EUSolver-2017:** all 5 tracks
- **DryadSynth:** CLIA and INV tracks
- **LoopInvGen:** INV track
- **Horndini:** INV track

# New Benchmarks

- General (29)  
by Qinheping HU and Loris D'Antoni (Univ. of Wisconsin-Madison)
- Invariant Generation (21+32)  
by Saswat Padhi (UCLA) + Kangjing Huang (Purdue Univ)
- Conditional Linear arithmetic (15)  
by Kangjing Huang (Purdue Univ)
- PBE Strings (10)  
by Woosul Lee (Penn)

# Inv Track (127)



# CLIA Track (88)

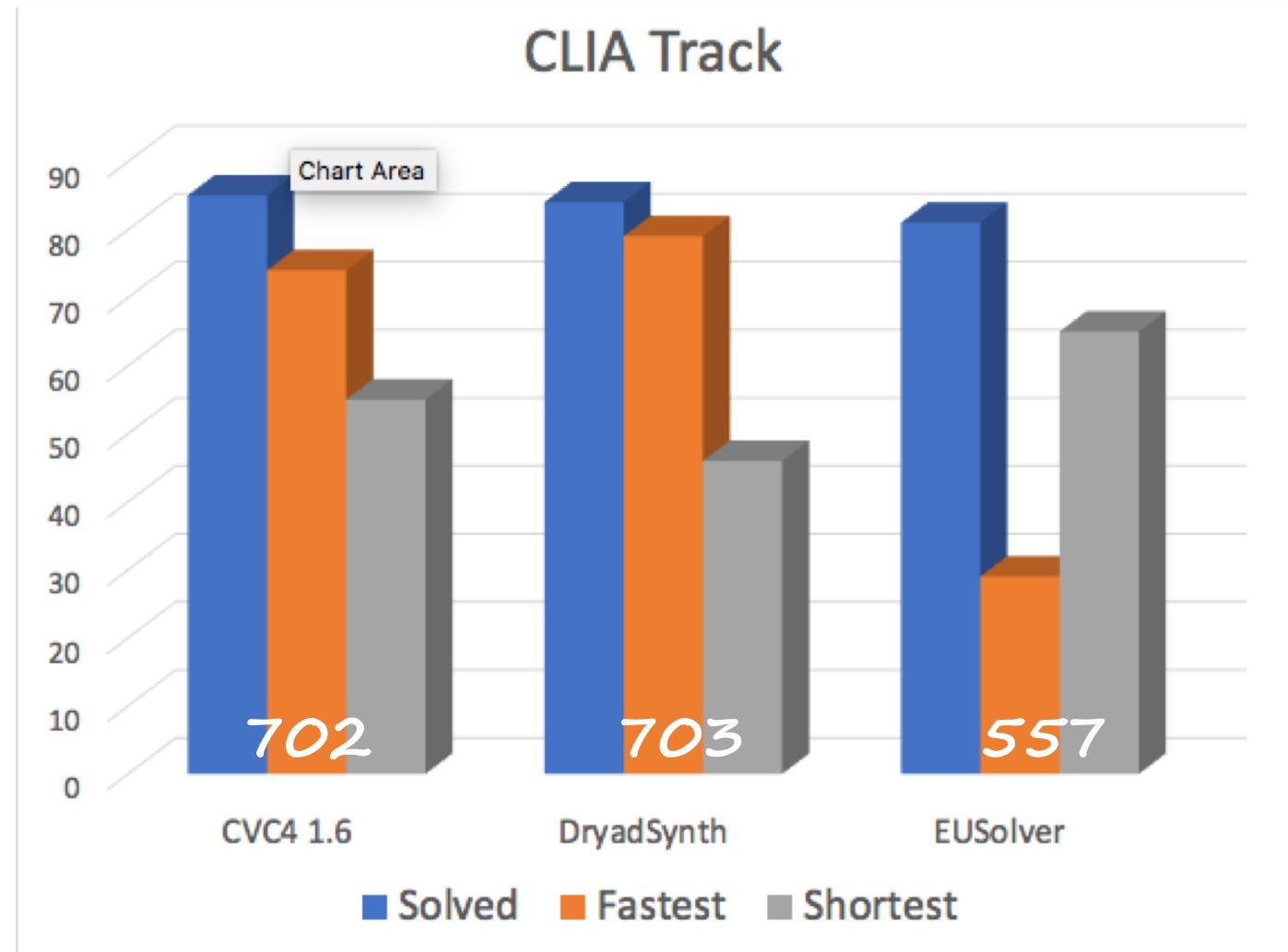


DryadSynth  
& CVC4

Last year  
CVC4  
solved  
73/73

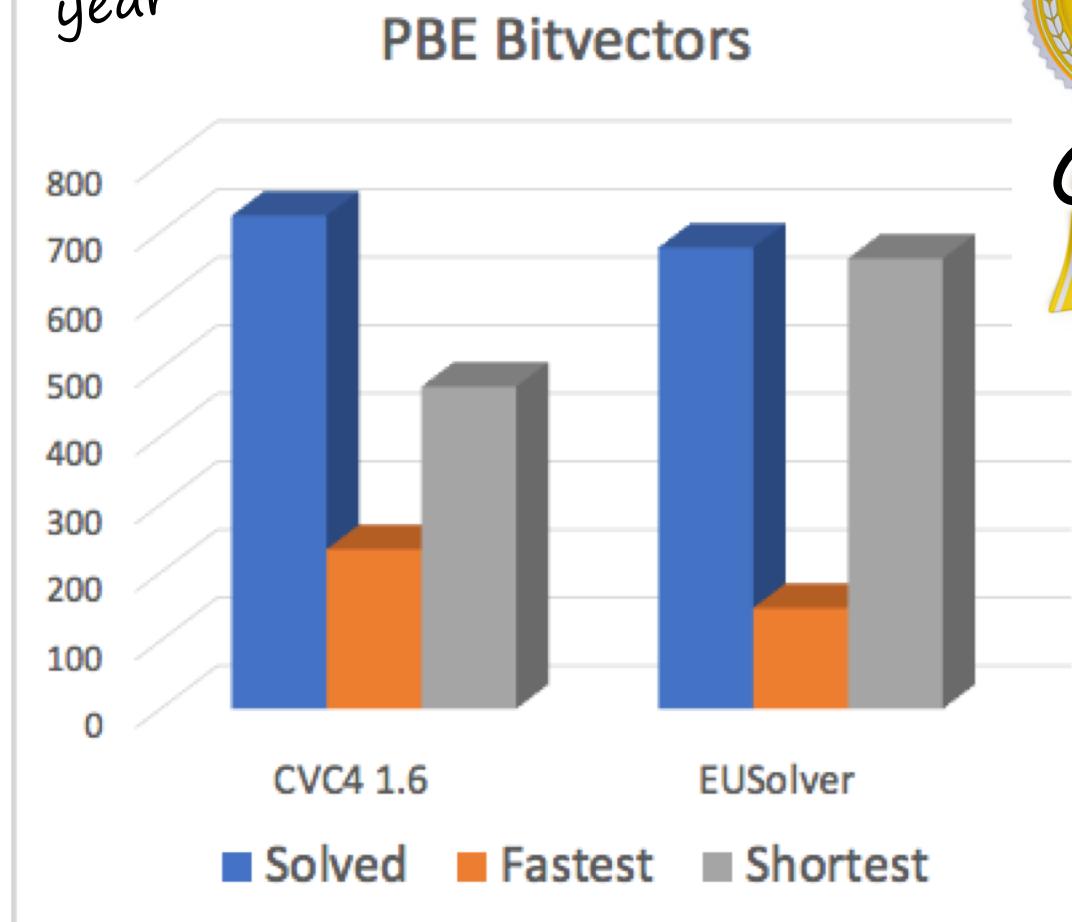
Last year  
DryadSynth  
solved  
32/73

Outstanding  
improvement!

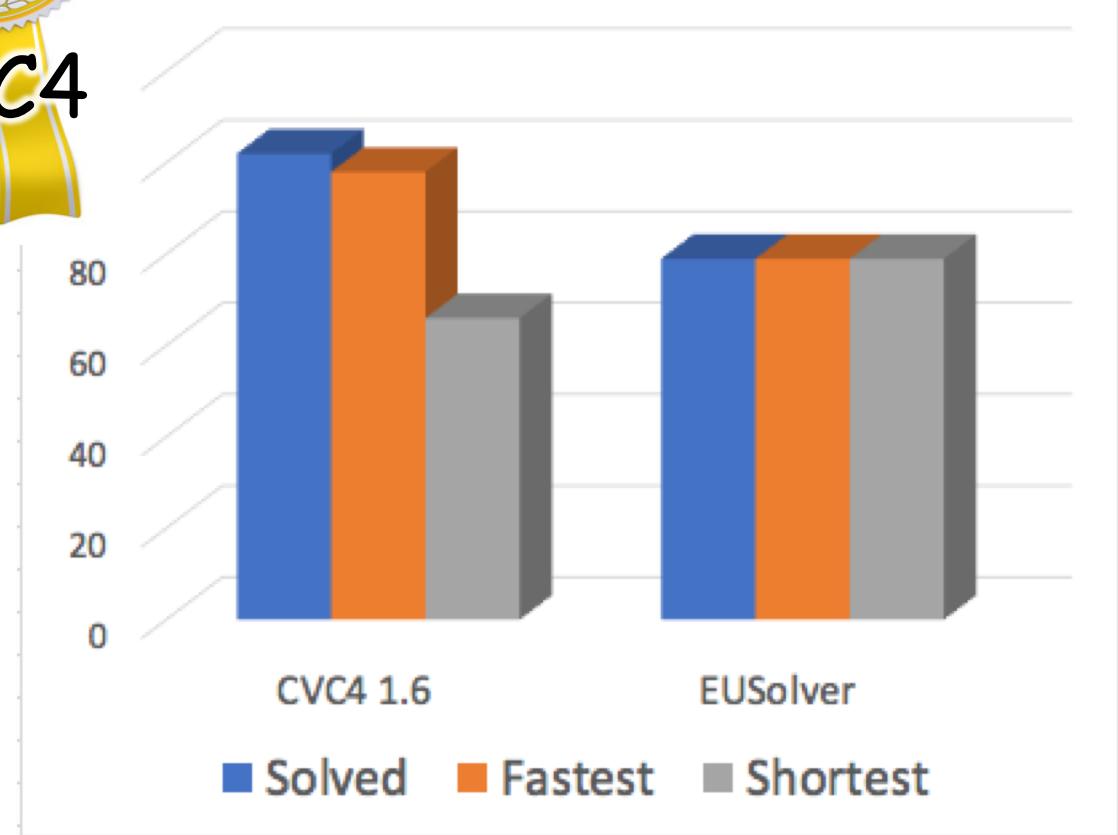


# PBE: Strings (118) Bitvectors (750)

#4 last  
year



#1 last  
year



# General Track (598)



Great  
improvement  
from last year  
(#2)

