MCC 2020
Model Counting Competition

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SAT 2020, Virtual Event
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Idea of MCC

Idea

*Deepen **relationship** between latest theoretical and practical development on the various **model counting problems** and their **practical applications***

1. Success of SAT due to **theoretical advancements** and **numerous efficient solver implementations**
2. Requires **in-depth insights** into how to implement the algorithms for obtaining **efficient and robust solvers**
3. Several **competitive combinatorial challenges** regularly organized, e.g., SAT, QBF, MaxSAT, SMT
4. Winners regularly **set new standards**
5. Follow up on **beyondnp.org** and establish a **regular event**

Tracks of MCC 2020

Track 1: Model Counting

Problem: Propositional **Model Counting**
           (also: #SAT / SharpSAT / NumberSAT)
Input: Propositional **formula F** in CNF
Task: Output the **number** of **satisfying assignments** to F

- Generic prototypical problem
- Computational complexity: #P-complete [Valiant'79]
- $PH \subseteq P^{\#P}$, implied by [Toda'91]

Track 2: Weighted Model Counting

Problem: Propositional **Weighted Model Counting**
             (also: WMC / Sum-Of-Products)
Input: Propositional **formula F** in CNF **+ weight** for each literal in F

Task: Output **sum of weights of all models**, where the weight of
             a model is the product of the weights of its literals.

- Computational complexity: same as before
- Applications to probabilistic reasoning

Track 3: Projected Model Counting

Problem: **Projected Model Counting Problem (PMC)**
Input: Propositional **formula F** in CNF **+**
                                        set P of **projection variables**
Task: Output the **projected model count** of F
                (number of satisfying assignment wrt. to variables in P)

- Computational complexity: one level up
- Applications to probabilistic reasoning

Procedure

Evaluation Procedure

- Open call for benchmarks
- Evaluated submitted benchmark instances + known sets

We selected 200 instances and split them in public / private.

1) Public instances and public challenge
   Submission open for a few weeks.
   You can update and see how the others perform.
   -> Real live competition (on optil.io)
2) Private instances
   After a final deadline, we evaluate solver on our cluster.

Submission Requirements

Bottom Line

Almost no limits regarding requirements on the software
Only: at least 10% accuracy (initially lower)

Submission

Initial submission on optil.io

System Limits

1. 30min or 60min per instance
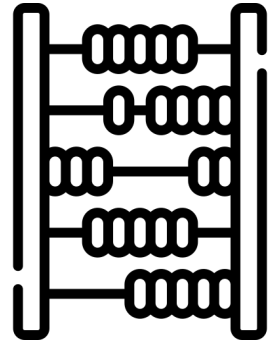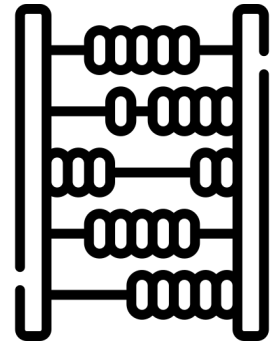2. 8 GB main memory (RAM) per instance

Participants

Participants

Track	Versions	Groups
MC	17	8
WMC	11	6
PMC	6	5

Results of MCC 2020

Results of MCC 2020

15 M

Results of Track 1: MC

POS	Submission	#(private)
1	**nus-bareganak**	**75**
2	**nus-narasimha**	**73**
3	**c2d**	**71**
4	nus-onlyapprox	56
5	d4	48
6	swats	33
7	MCSim	23
8	addmc	19
9	ispence	16

Results of MCC 2020
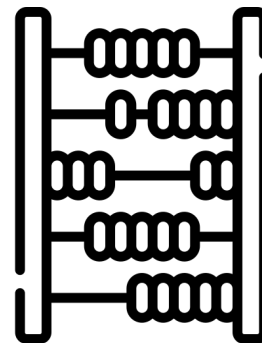
Results of Track 2: WMC

POS	Submission	#(private)
1	**d4**	**69**
	addmc	**69**
3	c2d	38
4	**nus-smsharma**	**27**
5	nus-onlyapprox	22

Results of MCC 2020
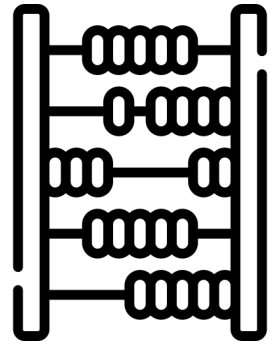
Results of Track 3: PMC

POS	Submission	#(private)
1	**nus-onlyapprox**	**100**
	nus-narasimha	**100**
	nus-bareganak	**100**
2	**k-hasimt**	**93**
3	d4	37
4	nus-smsharma	23

Conclusion & Future of MCC

Instances + Report

1) Instances
   (public+private) -> Zenodo (prepared on Zenodo, but not released)
2) Submissions of Instances
   -> Zenodo (hopefully before summer holidays in about two weeks)
3) Full Report on ArXiv or mccompetition.org in a few weeks

Improvements?

What we should have asked for?

1) Uniform handling of exit codes
2) Do not mess with our disk (whole competition took up of ~500GB tmp data)
3) Do some housekeeping and cleanup after yourself
4) More rigorous enforcement of solver descriptions
5) Free academic license and open source

Lessons Learned

- Selecting instances of moderate difficulty
  (we have limited resources)
- Don't publicly disclose runtime restriction/timeouts (just hardcoded…)
- Cluster resources essential
  - optil.io submission:
    uniform submissions, not easy to use, but provided a running leaderboard
  - State cluster in Dresden went south mid May
  - -> It's good to have a Toni
- Uniform format/return codes would be nice
  (we tried a format, but were not happy -> second try)
- Better submission system would be nice
  -> next year either StarExec or github based submission
  Full access to cluster was an advantage

Thanks go to

- All the **participants of MCC2020**!
  - For their submissions and active participation and
  - Their incredible patience
- **Jan Badura** at **optil.io**
  - Using results of several runs for the final results
  - Customizing our judges for optil.io
  - ...
- **Toni Pisjak** at **TU Wien**, who was just incredible
  - Making resources available at short notice
  - Preparing requirements on the cluster in Vienna

MCC 2020

Organizers

Johannes K. Fichte
TU Dresden
Markus Hecher
TU Wien, U. Potsdam

Student:
Florim Hamiti
TU Dresden

Sponsors…

OPTIL.io

TU WIEN — TECHNISCHE UNIVERSITÄT DRESDEN

ZIH
Zentrum für Informationsdienste und Hochleistungsrechnen

data experts — Systemberatung Softwareentwicklung Informationsverarbeitung

Future Editions

mccompetition.org

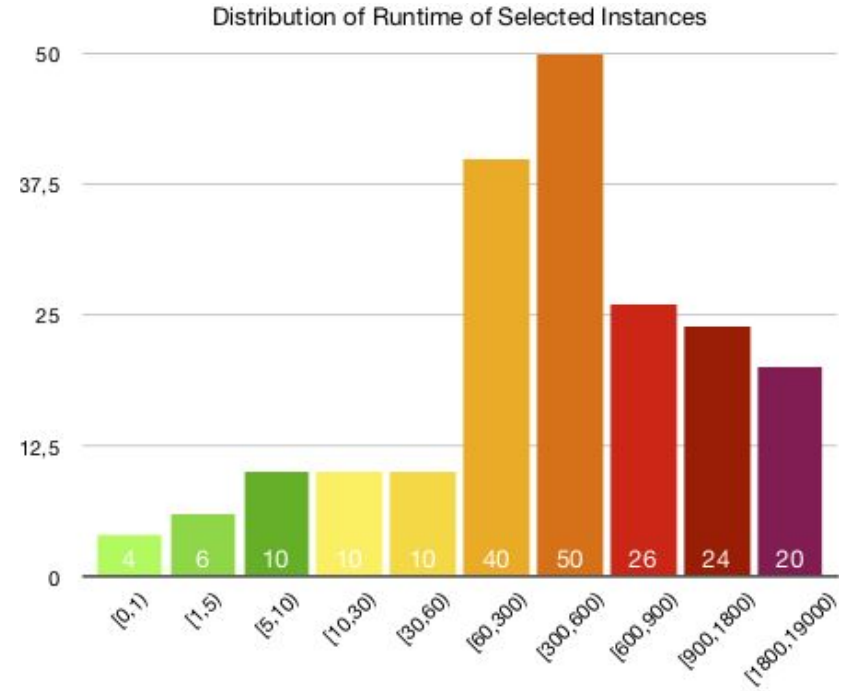Hope we see you at MCC 2021.

Instance Selection MCC2020

Instances Track 1

- 2657 instances among various different origins
  Garavel, Bouvier (100); **Lai, Golia, Meel** (303); **Moehle, Biere, Ge** (596); **Pehousek** (139); **Spence** (12); **Wang** (70); **Fremont Collection** (1437)

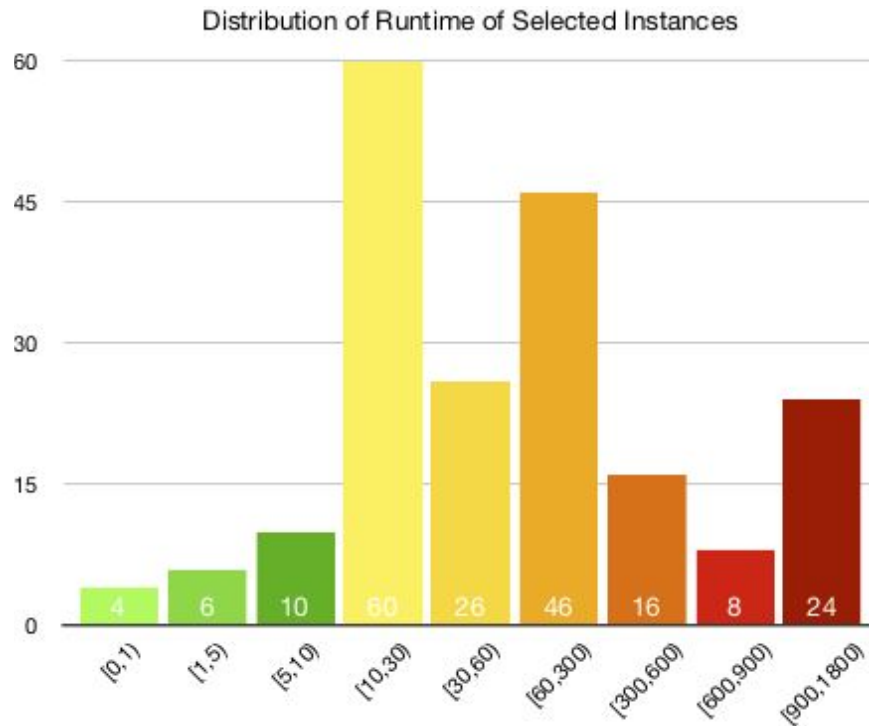- Preprocessing using B+E and PMC -> Classification by "Difficulty"

Distribution of Runtime of Selected Instances

instances	$|V_{\min}|$	$|V_{\max}|$	$|V_{\mathrm{avg}}|$	$|C_{\min}|$	$|C_{\max}|$	$|C_{\mathrm{avg}}|$
public	1	7,695,558	112,885	95,182	5,729,026	95,182
private	78	205,198	42,639	78	539,109	40,462

Instances Track 2

- 1080 instances
  Fremont Collection
- No Submissions
- Preprocessing using B+E and PMC -> Classification by "Difficulty"

Distribution of Runtime of Selected Instances

instances		$|V_{\min}|$	$|V_{\max}|$	$|V_{\mathrm{avg}}|$	$|C_{\min}|$	$|C_{\max}|$	$|C_{\mathrm{avg}}|$
public		100	12,300	2,030	181	5675	1,257
private		100	12,300	1,465	216	12,832	1184

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Instances Track 3

- 1550 instances
  Baluta et al. (420); **Golia, Meelai** (324);
  Fremont Collection (806)
- Preprocessing using B+E and PMC
  -> Classification by "Difficulty"

Distribution of Runtime of Selected Instances
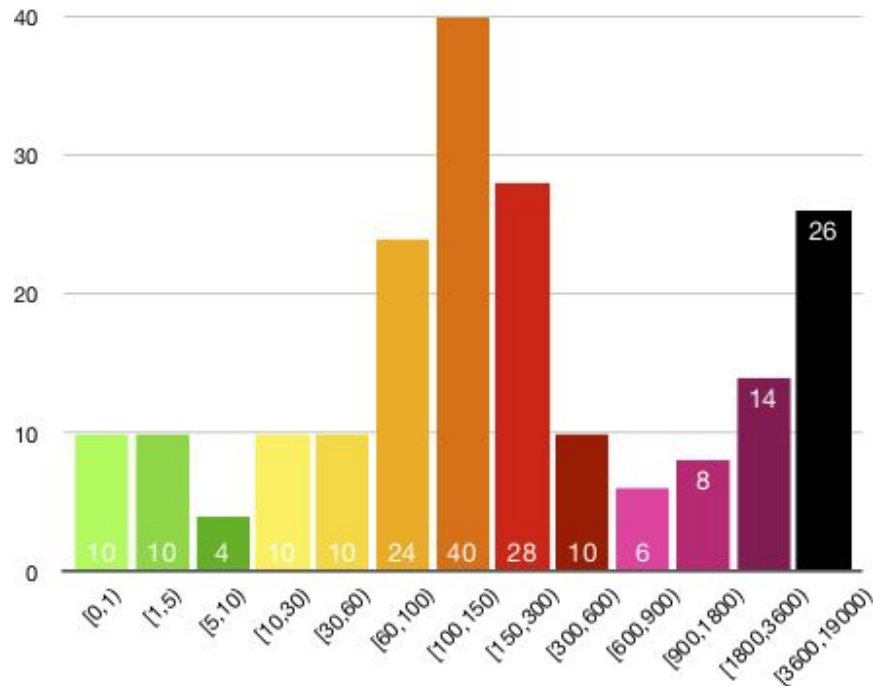
instances		$|V_{min}|$	$|V_{max}|$	$|V_{avg}|$	$|C_{min}|$	$|C_{max}|$	$|C_{avg}|$
public		431	2,364,209	463,283	1,154	1,776,164	780,021
private		301	4,623,417	522,040	772	6,177,994	871,411