PerfTuner

- Vectorizing Programs by Exploiting LLMs -

Final Presentation

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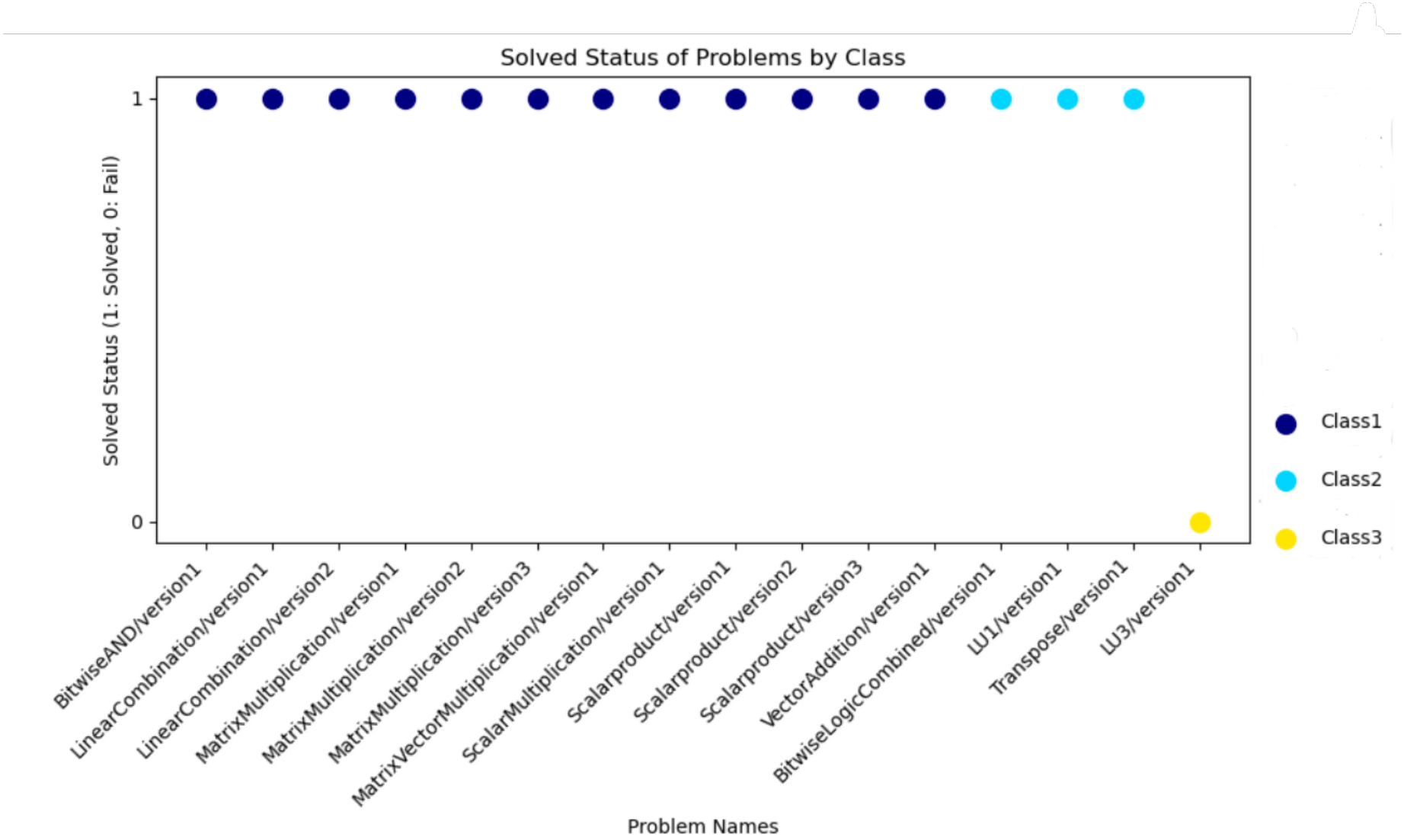
Best Results: Could All Problems Be Solved?

Problem	**solved?**
BitwiseAND	✓
LinearCombination (2 versions)	✓
MatrixMultiplication (3 versions)	✓
MatrixVectorMultiplication	✓
ScalarMultiplication	✓
Scalarproduct (3 versions)	✓
VectorAddition	✓
BitwiseLogicCombined	✓
LU1	✓
Transpose	✓
LU3	✓

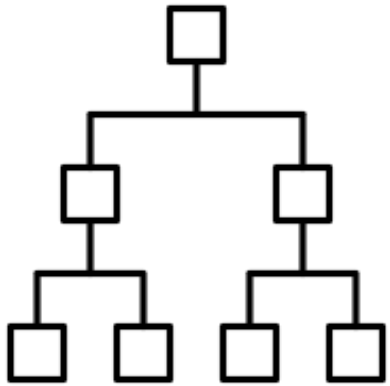
$\Rightarrow$ ***Eventually*** **we can solve everything**

Best Results: Could All Problems Be Solved *Constantly*?



Finding the Snippet List: Meta-Strategies

(a) Voting



(b) Tournament

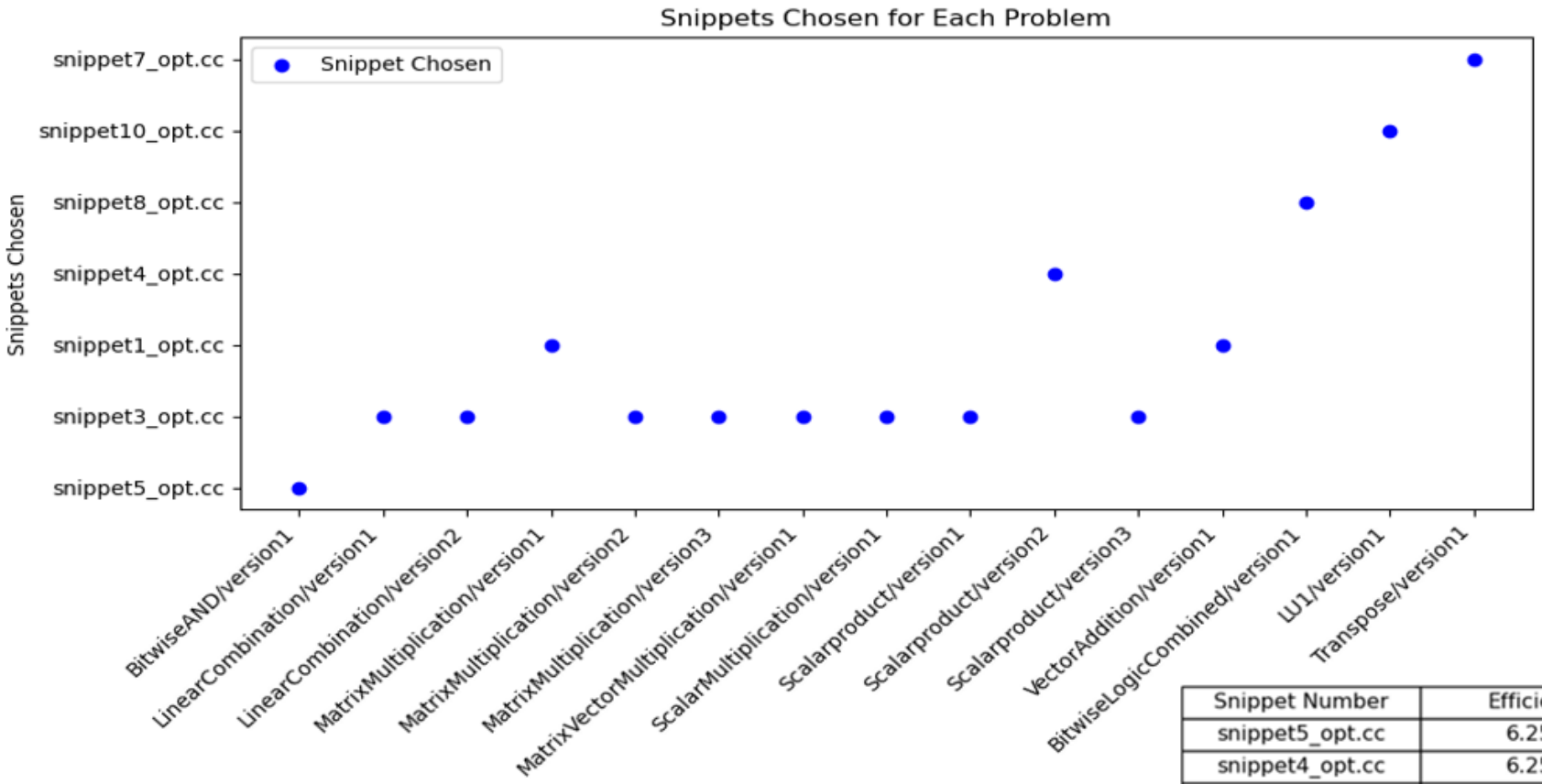
(c) Default

Comparing the Meta-Strategies: Snippet, Quality, Success

Problem	**Voting**			**Tournament**			**Default**		
BitwiseAND	9	−2.1	0.2	5	−0.1	0.9	10	−1.2	0.2
LinearCombination	9	−2.3	0.1	3	−1.3	0.3	10	−1.4	0.1
MatrixMult.	9	−2.0	0.0	6	−2.0	0.0	10	−2.0	0.1
MatrixVectorMult.	9	−2.1	0.0	3	−1.9	0.0	10	−1.9	0.1
ScalarMult.	11	−1.4	0.2	3	−1.9	0.3	10	−0.7	0.5
Scalarproduct	11	−1.4	0.1	3	−1.3	0.4	10	−1.9	0.1
VectorAddition	9	−2.0	0.0	1	−0.8	0.4	10	−1.8	0.0
BitwiseLogicComb.	9	−1.1	0.4	5	−1.5	0.2	10	−1.2	0.4
LU1	9	−2.0	0.0	10	−1.6	0.1	10	−2.1	0.0
Transpose	9	−2.1	0.0	2	−2.0	0.0	10	−2.1	0.0
LU3	1	−2.0	0.1	11	−2.1	0.0	10	−2.2	0.0
Arithmetic mean		−1.86	0.1		−1.5	0.24		−1.68	0.13

*`runs_useSnippet = 1, runs_buildSnippet = 10`

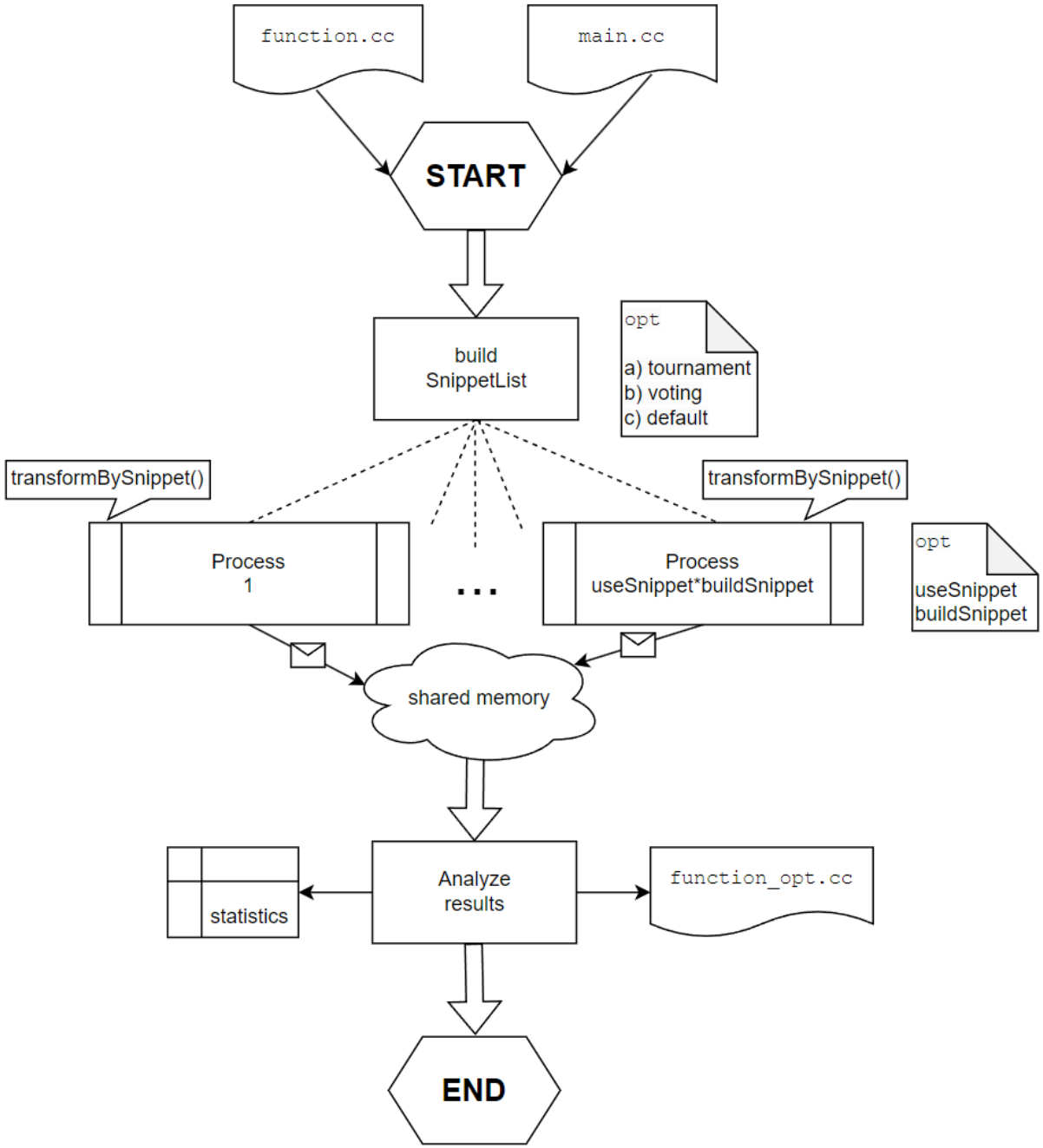
Which Snippet Is Chosen?



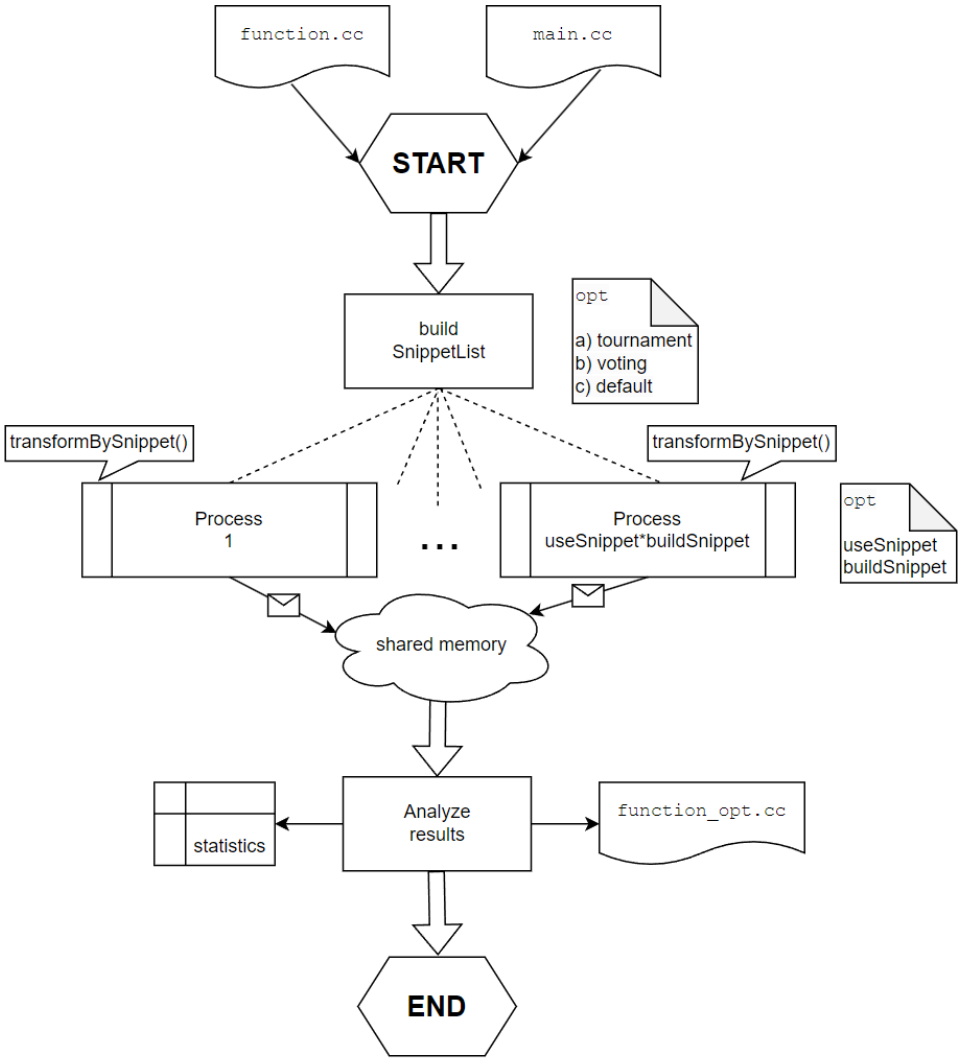
Snippet Number	Efficiency
snippet5_opt.cc	6.25%
snippet4_opt.cc	6.25%
snippet8_opt.cc	6.25%
snippet10_opt.cc	6.25%
snippet7_opt.cc	6.25%
snippet1_opt.cc	12.50%
snippet3_opt.cc	50.00%

Table: Snippet chosen in percentage of problems

Architecture



Architecture: Metrics



Type	LOC
main code	1248
tests	1266

Project Goals: Achieved?

Construct an usable AVX transformation program (✓)

Task	Done?
Use meta-strategies, profiling	✓✓
Prompt engineering	(✓)
Use human feedback if necessary	(✓)
Try model fine-tuning	✓
Evaluate different LLMs	✗
Implement iterative refinement	✗
Collect examples	✓
Implement environment for evaluation (unit tests)	✓
Evaluate on your examples	✓

Project Goals: Scope for Improvements?

1. Transform whole programs
2. Evaluate different LLMs
3. Implement iterative refinement

Lessons Learned

1. Choice of snippet is ambiguous
2. LLM does not possess supreme knowledge
3. Potential of Google Transform
4. Lacking ends of ChatGPT

Important Links

1. Code
   - https://github.com/pvs-hd-tea/23ws-PerfTuner
2. Docs (Accounting, Developer Documentation, Video, Presentation)
   - https://github.com/pvs-hd-tea/23ws-PerfTuner/tree/main/docs
3. Data
   - https://github.com/pvs-hd-tea/23ws-PerfTuner/tree/main/Product/Statistics
4. 1-click demo
   - https://github.com/pvs-hd-tea/23ws-PerfTuner/blob/main/Product/perftuner.py
   - let it run with: `python3 perftuner.py`