“For the Record” - Update #2 (November 27, 2022)

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To my colleagues in EDA and IC design:

Again with thanks to many for discussions and expressions of interest, here is a second update to follow up on “For the Record” and “For the Record” - An Update (August 26, 2022).

Students at UCSD have continued to make progress. A poster was presented at the TILOS AI Institute’s “Industry Day” on October 20. Updates continue to be added in our repo and in the live Doc. Recent advances span **methodology**, **baselines**, and **ablation studies**.

Methodology.

- **Testcases.** Two testcases, BlackParrot (220 macros, 675K standard cells) and MemPool Group (324 macros, 2.4M standard cells), have been added. We find that these are more challenging for macro placers than Ariane.[1]
- **Confirmation with commercial 12nm technology.** Studies of Ariane, BlackParrot and MemPool Group have been repeated with a commercial foundry’s 12nm technology and a commercial 3rd-party IP provider’s cell library and generated memories. We find that results are consistent with those seen in our previous studies with the NanGate45 technology. See here.
- **Correlation between proxy cost and “Nature Table 1” metrics.** We have evaluated correlation (Kendall rank) between *proxy cost*, i.e., the reward function used by Google’s Circuit Training when optimizing the macro placement, and the metrics reported in Table 1 of the Nature paper. Correlation was found to be poor. See here.

Baselines.

- **A second “human baseline”.** A manual floorplan was contributed by Dr. Jinwook Jung (IBM Research) for the Ariane133-NG45-68% testcase. The floorplan achieves quality of results similar to that of the CT solution.[2] See here.
- **A “pure commercial” flow without Circuit Training.** Google’s Circuit Training is preceded by commercial macro placement and physical synthesis, and then followed by commercial placement optimization, clock tree synthesis, routing and post-route optimization. We find that if we skip the Circuit Training step, the “pure commercial” flow achieves better quality of results. See here.

Ablation Studies.

- **Effect of placement information in the input.** We have studied the effect of having placement information (from a commercial physical synthesis tool) in the input to Circuit Training (cf. our updates here). We find that having placement information from physical synthesis significantly improves Circuit Training’s final quality of results.[3] See here.

Work continues along these directions. As always, the community's participation and support – along with a calm, open technical dialogue – would be wonderful to see and is warmly invited.

Thank you and best wishes to all.

NOTES

- **[1]** BlackParrot (6 types of memory macros) and MemPool Group (4 types of memory macros) bring diversity of macro shapes, whereas Ariane has a single macro type. Q3 of the previous update had asked, *"Is a testcase such as Ariane-133 "probative", or do we need better testcases?"* We find that Ariane is not a difficult testcase, in that randomly shuffling locations in a macro placement solution does not degrade timing and power. By contrast, shuffling BlackParrot macros significantly degrades quality of results. Shuffling MemPool Group macros leads to P&R flow failure. See here.
- **[2]** Dr. Jung's contribution raises the issue of whether we should re-calibrate the human effort (e.g., whether it is hours, rather than weeks or months) that is needed for a human to achieve "high-quality" floorplan solutions.
- **[3]** Q1 of the previous update asked, *"How does having an initial set of placement locations (from physical synthesis) affect the (relative) quality of the CT result?"* We have now answered this question.