Modern Compiler Optimization

WAX SRCPR

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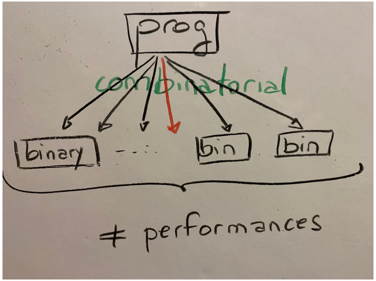
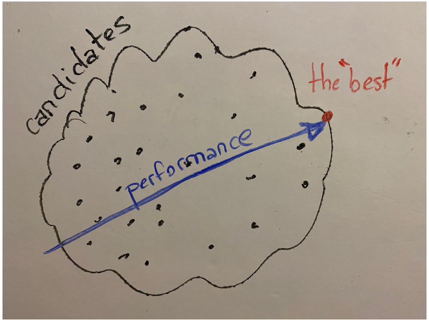
Compiler Optimization



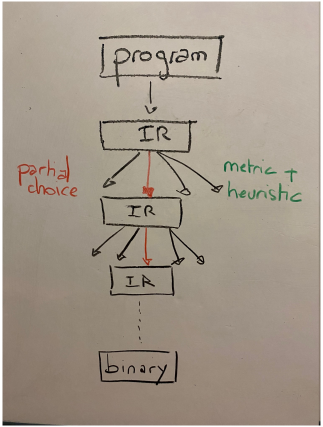
- A compiler transforms a program into a binary.
- A combinatorial number of possible candidates exists.
- Each showing different performance (speed, energy consumption).
- The objective of compiler optimization is to generate/choose the “best” one.

Performance model & Inverse Function



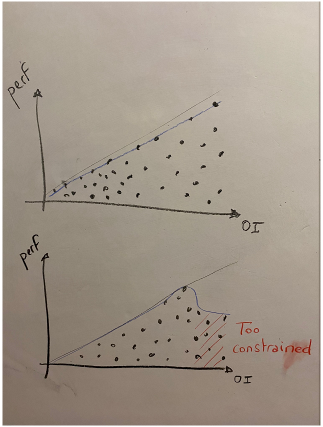
The compiler needs a performance model and a search strategy.

Classical Compiler Framework



- The classical framework consists of several consecutive phases that iteratively transforms the intermediate representation (IR).
- They use metrics to drive heuristics.
- With regard to the overall search space, each phase makes partial choices.

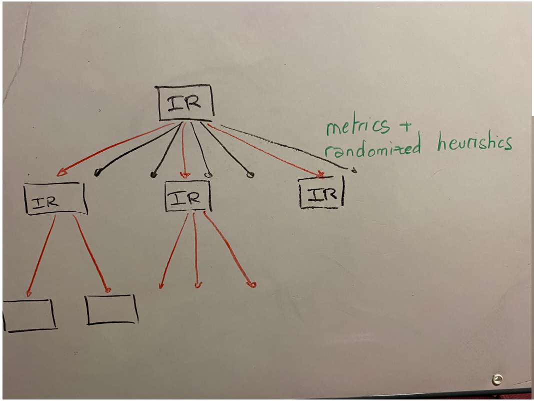
Metric vs Performance

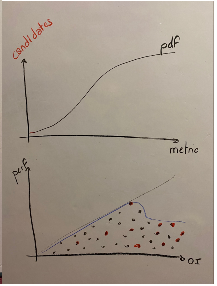


- Even with “good” metric, early decision without any knowledge of further search space may loose opportunities.
- For example, maximizing the operational intensity might constrain too much other choices (e.g. parallelism)).

Operational intensity:
$OI = \#Computed\_Flops / \#Communicated\_Bytes$

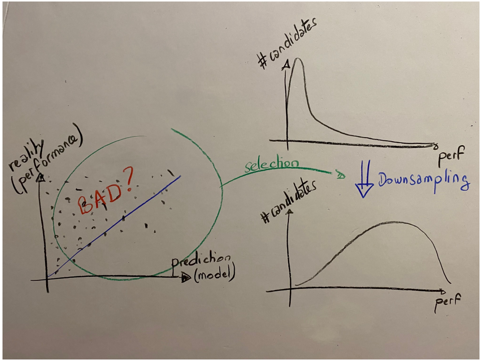
Make Multiple Random Choices





Take several candidates (instead of one) and use random draws instead of deterministic total order.

Model: Prediction vs Reality



- A model is only as good as it can.
- But it does not has to perfectly predict actual performance.
- Its quality should be measured as its ability to reinforce the probability to select good candidates.

The Compiler of my Dreams

Modern compiler optimization needs

- Randomized heuristics to take partial decisions
- To measure/express the quality of used metrics and adapt the search strategy consequently (expansion vs exploitation)
- Metrics/models fast to evaluate
- Compiler infrastruture that handles very efficiently transformations as transactions

Time for Questions

Short Quiz

Which Conv2D binary is faster between the one from?

- A generic compiler (e.g. icc, gcc, LLVM)
- The manufacturer optimized library (e.g. oneDNN)
- A domain specific compiler (e.g. TVM Ansor)

How much faster?