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Machine learning for timing estimation



OMERISA

1. CONTEXT

The execution time is calculated in specific cases depending on the needed application domain, (e.g, worst case execution for realtime applications, average case for compiler optimization).

Challenges Machine of using Learning for timing estimation :

- Context-awareness (Cache and Pipline).
- Representativity of training data.
- Reliability of the estimations.

Pipeline



2. TIMING WORST CASE



WE-HML [1] (WCET Estimation using an Hybrid Machine-Learning based technique) estimates the WCET for processors that have caches.

- Learning phase : Training on Basic Block and WCET.
- Estimation phase : ILP for longest path combined with ML model.



Modern



Figure 1 Execution time estimation classification

Figure 2 Challenges to estimate the execution time of modern processor

Figure 3 Training/Estimation workflow of WE-HML

3. TIMING AVERAGE CASE





4. RESULTS



- ITHEMAL [3] uses 2 stacked LSTMs layers to estimate the execution time for a BB in isolation.
- CATREEN [2] improves ITHEMAL to estimate the execution time of a BB in its context.
 - Instruction == Word.
 - Basic block == Sentence.
 - Sequence of basic blocks == Paragraph.

[CMP, [R2, R3]] For each Opcode and Operand



hlo^{t=0}



Figure 7 Absolute Percentage Error on MiBench for CATREEN, ITHEMAL and MLP regressor

in the sequence

Figure 4 Unfolding of a LSTM cell of the instruction layer on a machine instruction

hlo^{t=1}

hlo^{t=2}

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Figure 5 Architecture of CATREEN

5. PERSPECTIVE



• Transformers [4] are able to handle sequential data, but this is done in parallel, which drastically reduces both training and inference times.

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