SPM Problem Formulation

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June 4, 2023

1 Model Formulation

1.1 Constraints

Let $N \coloneqq \{n \mid n \text{ represents a tensor ID used in the DNN graph}\}$
Let $K \coloneqq \{k \mid k \text{ represents a scratchpad ID}\}$
Let $M \coloneqq \{m \mid m \text{ represents an operation in the DNN graph}\}$
Let $S \coloneqq \{s \mid \text{where } S_n \text{ represents the size of tensor}_n \in N\}$
Let $Q \coloneqq \{q \mid \text{where } Q_k \text{ represents the size of Scratchpad}_k \in K\}$

$x_{nkm} = 1$ represents a tensor n that occupies scratchpad k at operation m.

$$x_{nkm} \in \{0,1\} \forall n, k, m$$

- All necessary input and output tensors for a given operation will be present on the SPMs

  Let $A \coloneqq \{a \mid \text{where } A_n = 1 \text{ represents a tensor}_n \text{ is required as an input or output for operation}_m\}$

  $$A_{nm} \in \{0,1\} \forall n, m$$

  $$A_{nm} = 1 \implies \sum_{i \in K} x_{nim} = 1$$

- All tensors mapped on an SPM_k must fit on within the given scratchpad space

  $\sum_{i \in N} x_{ikm} * s_i \leq q_k \forall m, k$

- Tensors are not mapped before the operation in which they're lifetime begins

Let $B := \{b_n \mid b_n \text{represents the start time for tensor } n\}$

$x_{nmk} = 0 \forall m < B_m$

- Tensors are not mapped after the operation in which they're lifetime ends

Let $E := \{e_n \mid e_n \text{represents time for tensor } n\}$

$x_{nmk} = 0 \forall m > E_m$

1.2 Objective Function