BUILDING A GOOD CACHE BY COMBINING THE INITIAL SEGMENTS OF TWO LISTS

$|T_1| + |T_2| = C$

ARCLING: HELURISTIC FOR SETTING A GOAL COMBINATION
- NO REFETCHING
  ADJUST CACHE TOWARDS GOAL
- W. REFETCHING
  SET CURRENT CACHE TO GOAL

RELATIVE LOSS BOUNDS

$\forall$ SEQUENCES OF REQUEST $S$

$M_{alg}(S) \leq a M^*(S) + \text{small additional terms}$

IDEALLY 1
ONE EXPERT PER COMBINED CACHE

\[ n \]

LOSSES \( \in \{0, 1\} \) HIT OR MISS

PROBLEM:
- HOW DO WE PRODUCE A CACHE FROM THE WEIGHT VECTOR OVER EXPERTS
- CAN'T USE WEIGHTED AVERAGE
  \[ \bar{W}_t, \bar{X}_t \]
  ↑ BINARY, ONLY AVAILABLE AFTER REQUEST
\textit{n+1 Weights \( w_0, \ldots, w_m \) on Gaps}

\textbf{Idea 1:} \( \hat{y}_t = \frac{1}{2} \sum_{i=0}^{m} w_i \cdot i \) \textnormal{ Mean}

- Why \( i \)

- When miss, need to halve of total weight by \( \beta = e^{-\alpha} \)

\[ w_0 \quad w_1 \quad w_2 \quad w_3 \quad w_4 \quad \cdots \quad w_m \]

\[ 0 \quad 1 \quad 2 \quad 3 \quad 4 \quad m \]

Gaps

\textbf{Mean:} \( a = \sum_{i=0}^{m} w_i \cdot i \)

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(left) \total (right) \total

\not necessarily

50/50 split
Can this be fixed?
Different potential?

Idea 2: Predict W, Weighted Median

Weights on gaps of left list

\[ w_0 \cdot w_1 \cdot w_2 \cdot \ldots \cdot w_{i-1} \cdot w_i \cdot w_{i+1} \cdot w_{n-1} \cdot w_n \]

\[ \geq \frac{1}{2} \]

Equal to

\[ \geq \frac{1}{2} \]

Weights on gaps

Either Median upwards

Or "downwards multiplied by \( \frac{1}{3} \)"

\[ \Rightarrow \frac{1}{2} \]

Bounds work fine for net case

\[ M \leq 2 M + O(\sqrt{1+\log n} + 1/n) \]

Ideally median does not move too fast?
RANDOMIZED HEDGE ALG:
- \( i \sim w_i \)
- CONSTANT OF \( i \) IN FRONT OF \( M^k \)
- TOO MUCH REFETCHING

OPEN: IS CONSTANT OF \( i \) POSSIBLE
W. NO REFETCHING, I.E.

\[
E(MA) \leq 1 \cdot M^k + O \left( \sum_{i=1}^{m} \frac{1}{m} \ln n + \ln n \right)
\]

\( k \) LISTS

\[
\sum_{i} \text{INITIAL SEGMENTS} = n
\]

\( O \left( n^{k-1} \right) \) EXPERTS

HEDGE ALG. W. ONE WEIGHT PER COMPOSITE CACHE
- DYNAMIC PROGRAM, \( O(\ln^2 n) \) FANLY \( O(\ln n) \)
- TOO MUCH REFETCHING

FOR ANY DETERM. ALG, \( \# \) MISSES CAN BE \( \geq k \cdot M^k \)