
# The Frankenpredictor

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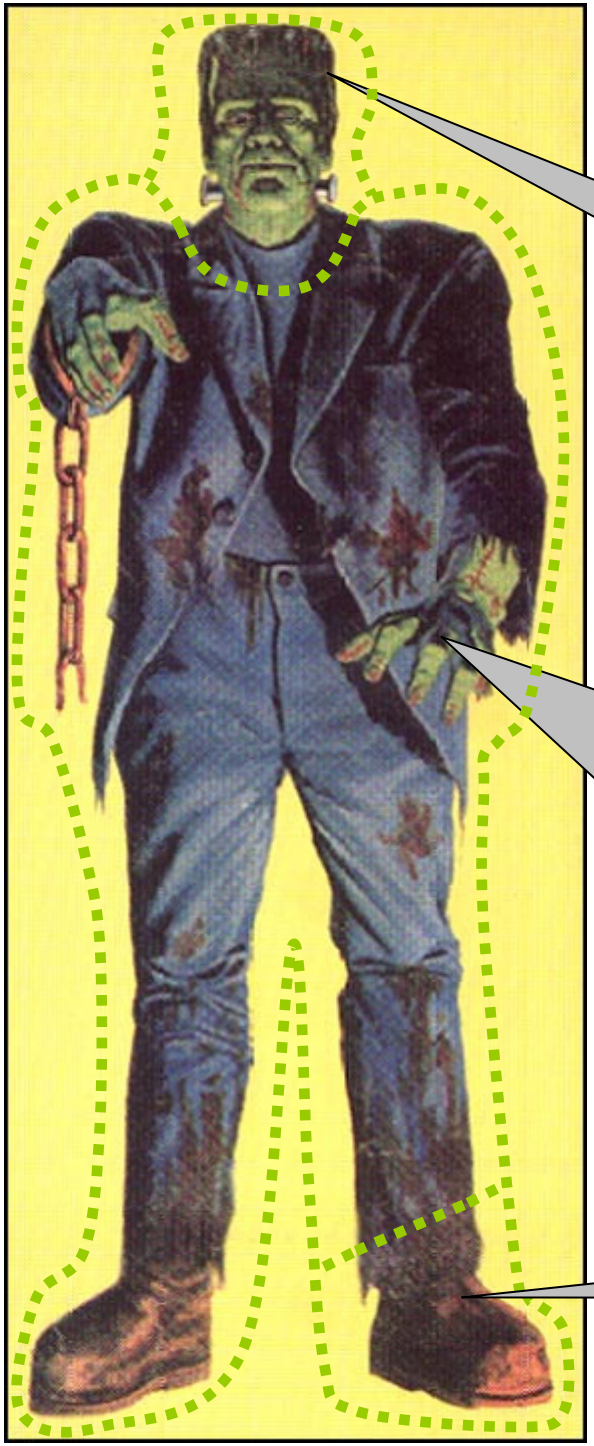
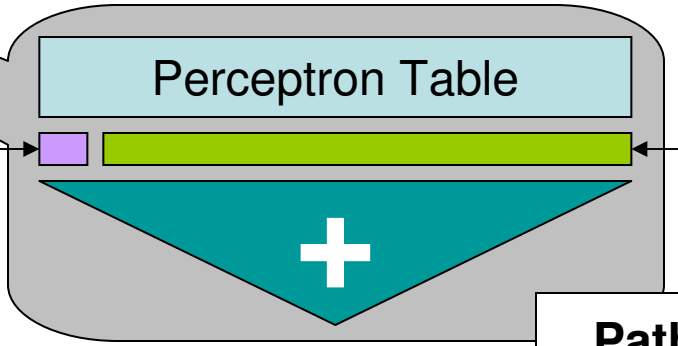
# Design Objectives

- Capacity
  - SERV has large branch footprint
- Long history length correlation
  - INT and MM benefit from this
- 8KB makes interference a big issue

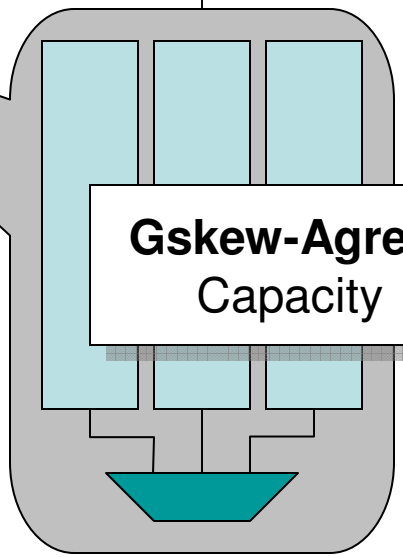
- … and don’t mess up FP

# Overview






**Path-Neural:**
Long History
Fusion



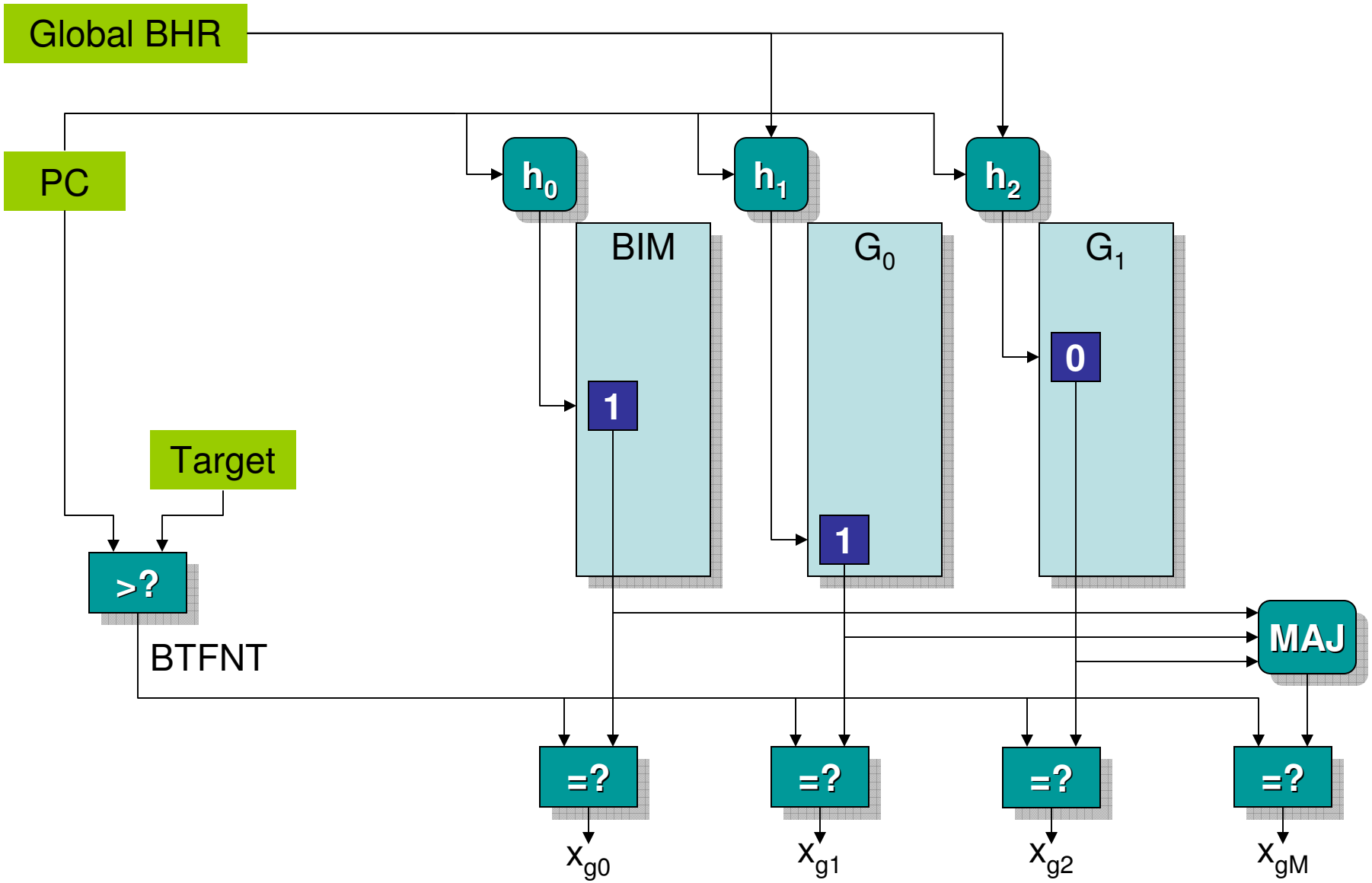
**Gskew-Agree:**
Capacity

Misc Other Ideas

**Ideas from:**

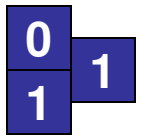
static branch prediction, gskewed, agree, perceptron, path-based neural, 2bcgskew, fusion, MAC-RHSP, machine learning

# Gskew-Agree Lookup



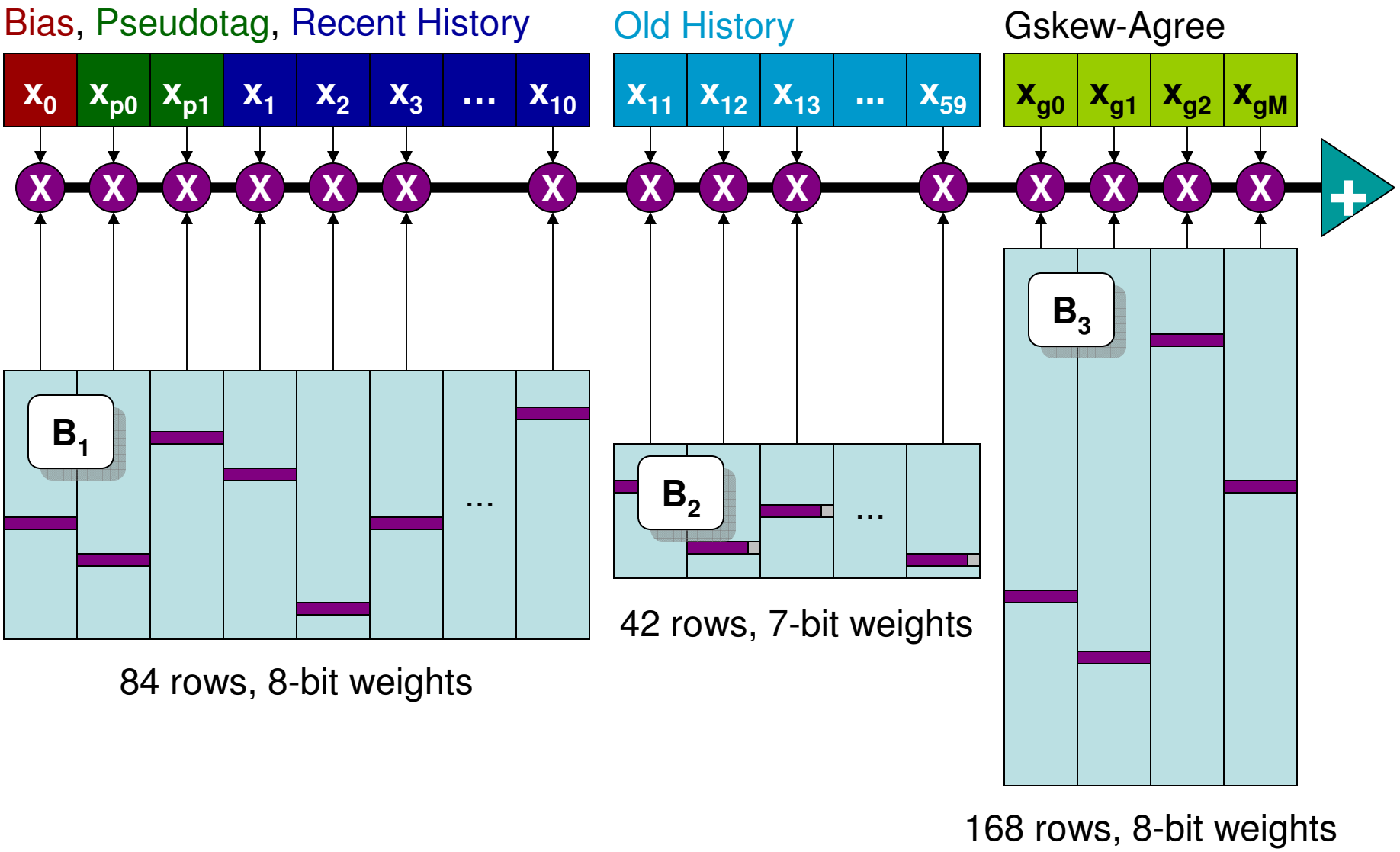
# Gskew-Agree Update

- Shared Hysteresis
  - Every two counters share one hyst. bit

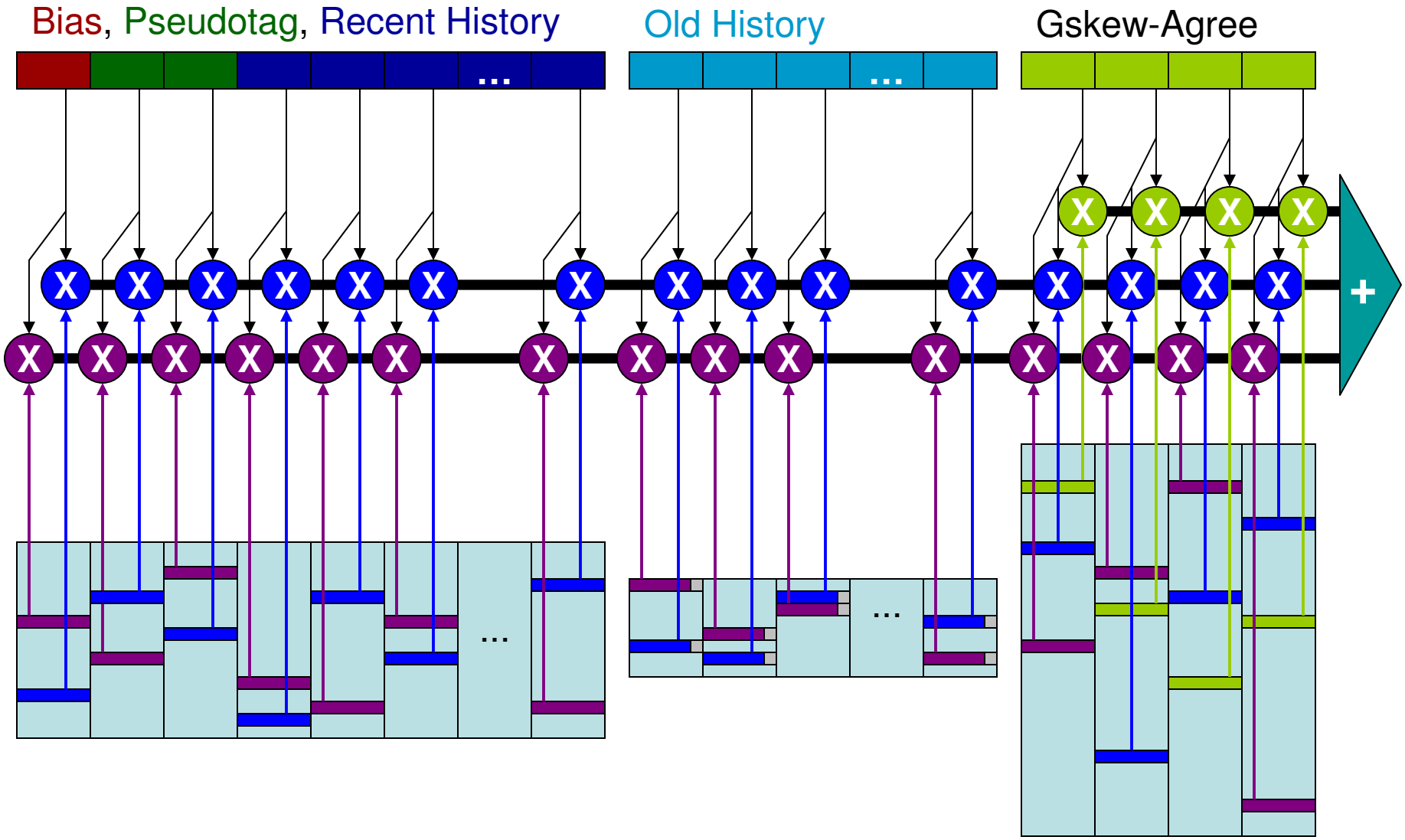



- Partial Update
  - Modified from 2bcgskew (no meta rules)
  - On mispred, update all three tables
  - If correct:
    - If all agree, do nothing
    - Else update the two correct tables

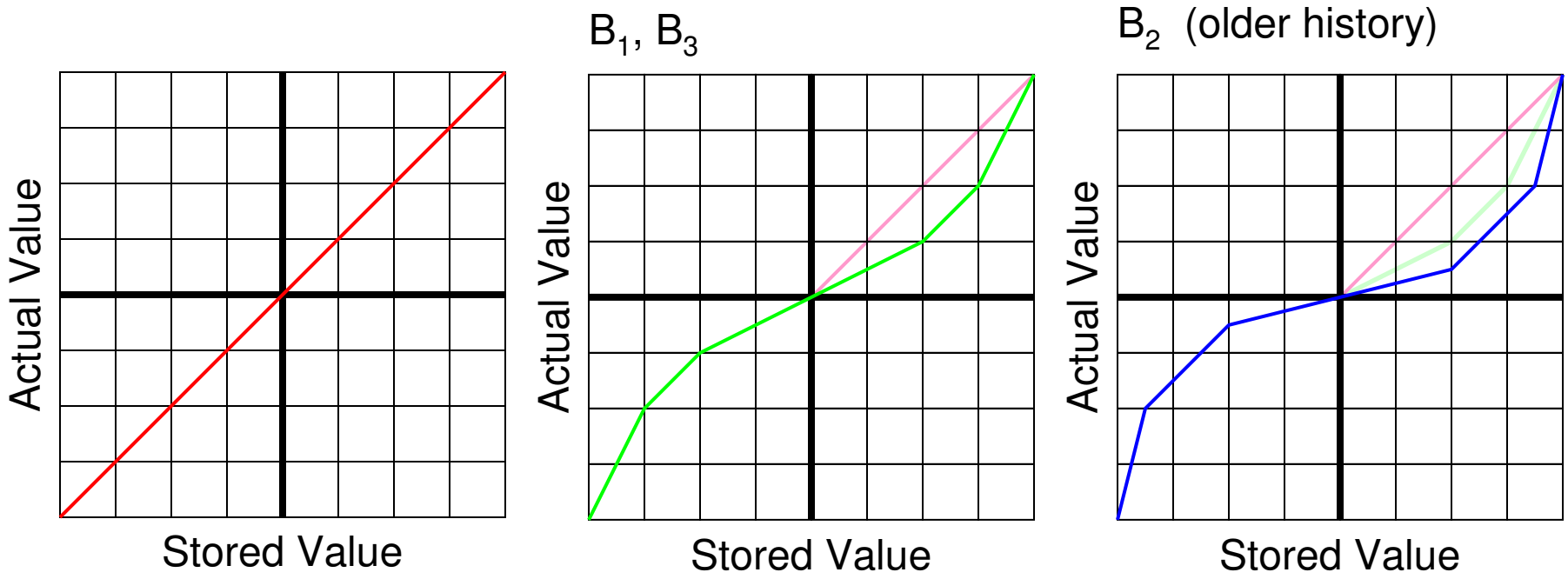
# Path-Based Perceptron



# Redundant Indexing

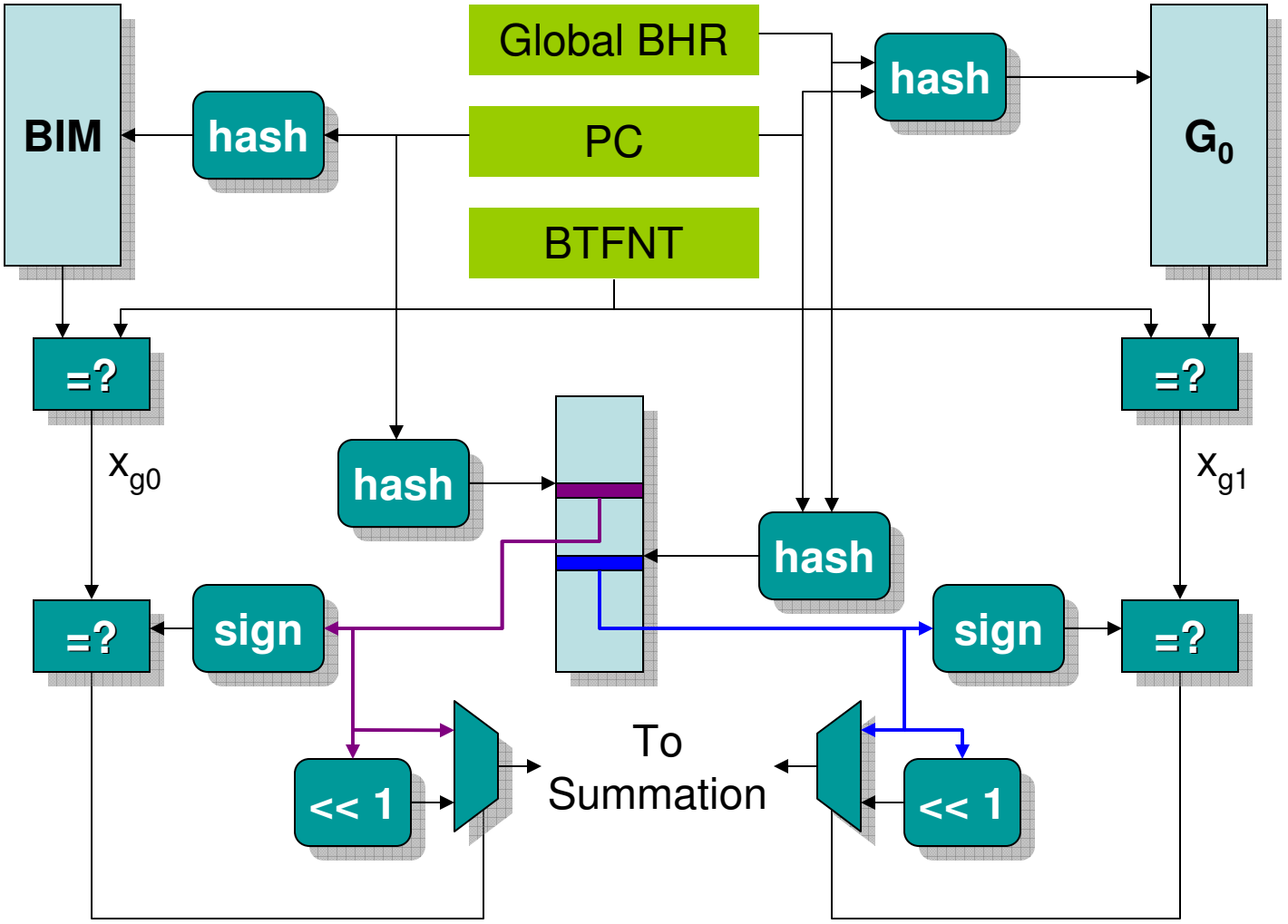


# Non-Linear Learning Curves

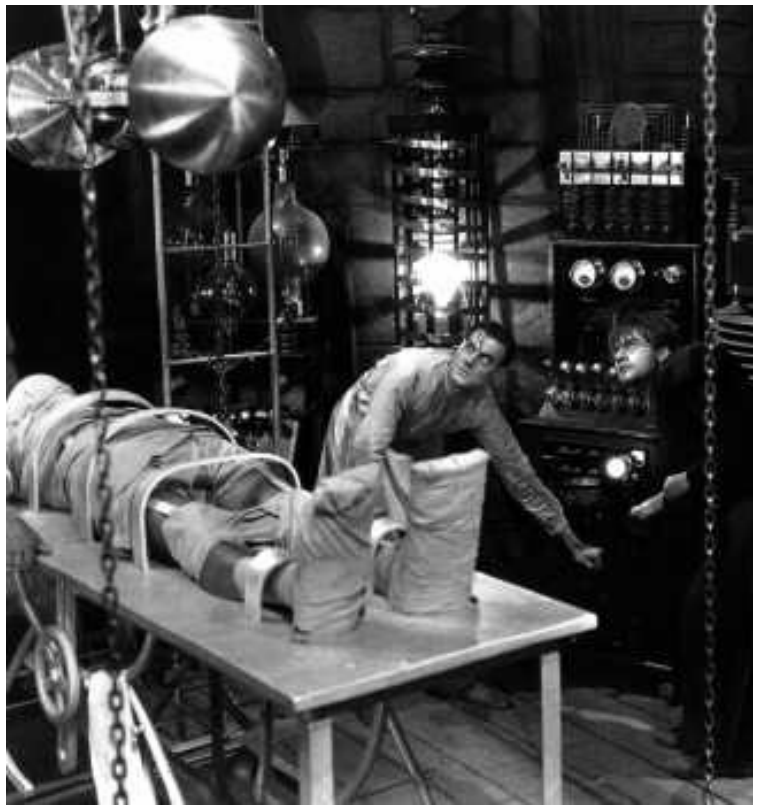



- Slow start:
  - avoids transient/coincidental correlation
- Steep End:
  - quick unlearning

# Synergistic Reinforcement



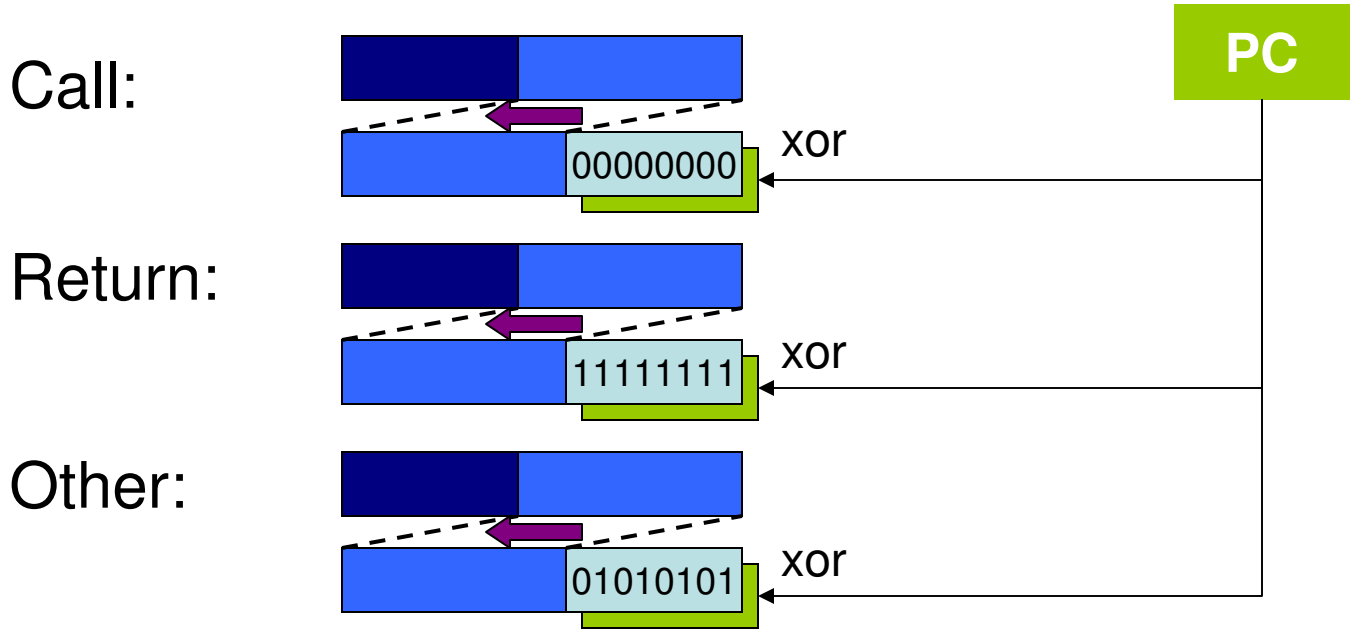
# Notes on Initialization



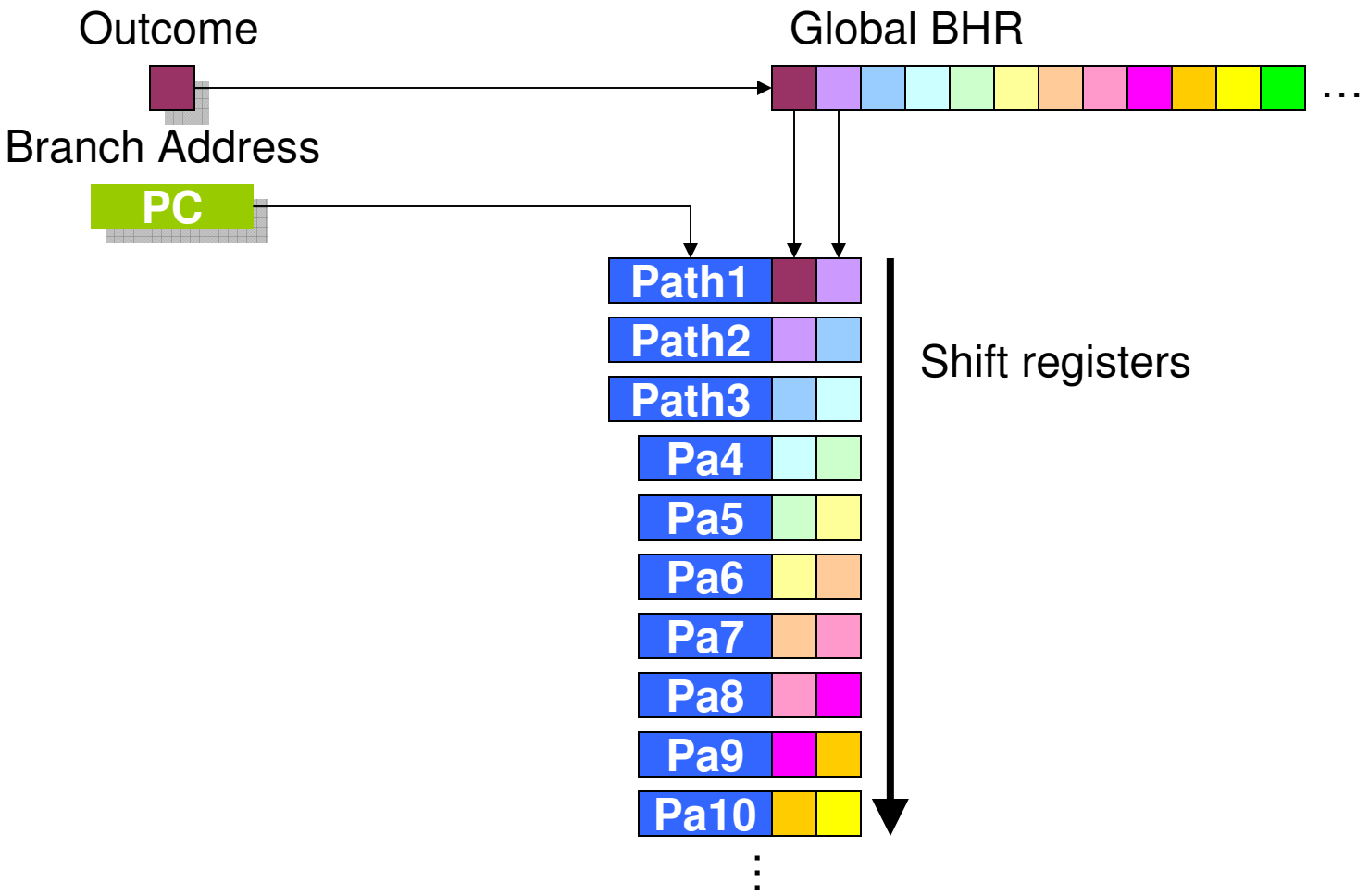
- All neural weights initialized to zero except those corresponding to $x_{gM}$
  - The perceptron will use the gskew-agree prediction until other correlations are established
- All PHT banks initialized to "Weakly Agree"
  - gskew-agree provides a BTFNT prediction at start of program

# Unconditional Branches

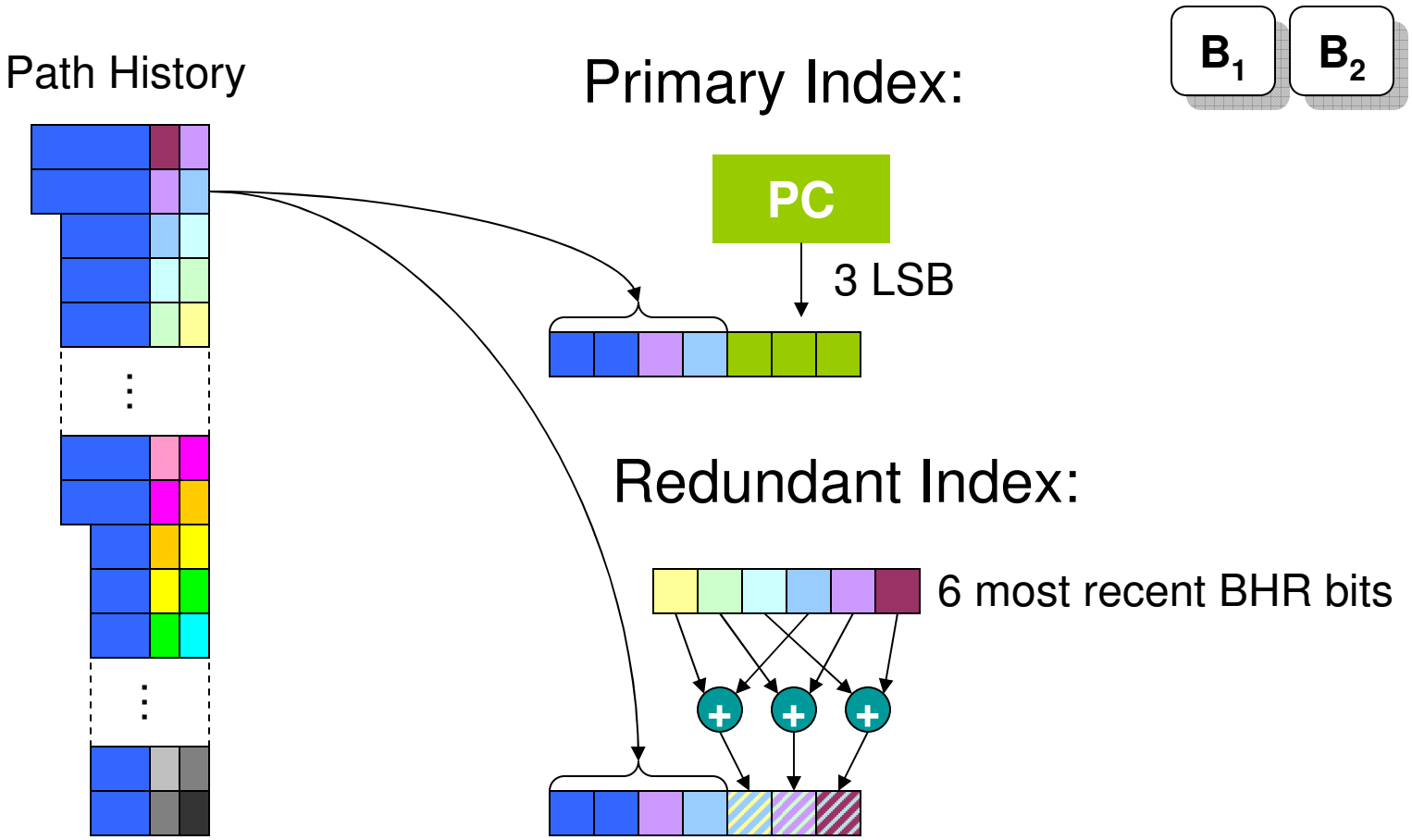
- Always predict taken, of course
- No update to PHTs, neural weights, path
- Update global BHR:



# “Path” History Update



# Index Generation



# Implementation Issues

- Frankenpredictor optimized for state
- Neural table sizes not power-of-two
- Redundant indexing biggest challenge
  - Many hash functions
  - Many ports
  - Huge adder tree

# Summary

- Gskew for capacity, Neural for long-history
  - Neural also for fusion
- Gskew-Agree
  - Skewing for interference-avoidance
  - Agree-prediction for interference-tolerance

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