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Algebraic Coding in the Era of AI

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The emergence of AI, particularly large language models (LLMs), has dramatically reshaped the requirements for error-correcting codes, particularly in the realm of memory I/O during training. Massive data transfers involved in training LLMs necessitate extremely robust error correction to prevent costly retraining scenarios triggered by undetected errors (Silent Data Corruption). Traditional iterative decoding techniques are inadequate due to their latency constraints, pushing the field towards combinational logic implementations capable of achieving multiple-error correction under extremely tight latency budgets. Algebraic codes, which once seemed to have lost ground to iterative decoding algorithms, are experiencing a renaissance driven by these stringent AI-driven performance demands. By exploiting deep results from algebra, notably Galois theory, algebraic codes are now being implemented in fully combinational hardware circuits that offer both the necessary decoding speed and robust error-correction guarantees. This development underscores algebraic coding theorys renewed relevance and critical importance for future high-performance AI systems.