

CLAIMS

1. A computer-implemented method executed on a processor for performing matrix sketching by employing an analog crossbar architecture, the method comprising:

low rank updating a first matrix for a first period of time;

copying the first matrix into a dynamic correction computing device;

switching to a second matrix to low rank update the second matrix for a second period of time;

as the second matrix is low rank updated, feeding the first matrix with first stochastic pulses to reset the first matrix back to a first matrix symmetry point;

copying the second matrix into the dynamic correction computing device;

switching back to the first matrix to low rank update the first matrix for a third period of time; and

as the first matrix is low rank updated, feeding the second matrix with second stochastic pulses to reset the second matrix back to a second matrix symmetry point.

2. The method of claim 1, wherein the first and second matrices are placed in the analog crossbar architecture.

3. The method of claim 1, wherein the first and second matrices include streaming data.

4. The method of claim 3, wherein the streaming data is normalized to prevent asymmetry effects.
5. The method of claim 4, wherein the low rank updating of the first and second matrices is scaled to adjust a final sketching matrix to between $(-0.1, 0.1)$ for a full range of $(-1, 1)$ to operate near the first and second matrix asymmetry points.
6. The method of claim 5, wherein once the matrix sketching is applied to an entire input, a final sketching matrix is moved to a digital computer to perform a regression analysis.
7. The method of claim 1, wherein the dynamic correction computing device concurrently corrects the first and second matrices.
8. A non-transitory computer-readable storage medium comprising a computer-readable program executed on a processor in a data processing system for performing matrix sketching by employing an analog crossbar architecture, wherein the computer-readable program when executed on the processor causes a computer to perform the steps of:
 - low rank updating a first matrix for a first period of time;
 - copying the first matrix into a dynamic correction computing device;
 - switching to a second matrix to low rank update the second matrix for a second period of time;

as the second matrix is low rank updated, feeding the first matrix with first stochastic pulses to reset the first matrix back to a first matrix symmetry point;

copying the second matrix into the dynamic correction computing device;

switching back to the first matrix to low rank update the first matrix for a third period of time; and

as the first matrix is low rank updated, feeding the second matrix with second stochastic pulses to reset the second matrix back to a second matrix symmetry point.

9. The non-transitory computer-readable storage medium of claim 8, wherein the first and second matrices are placed in the analog crossbar architecture.

10. The non-transitory computer-readable storage medium of claim 8, wherein the first and second matrices include streaming data.

11. The non-transitory computer-readable storage medium of claim 10, wherein the streaming data is normalized to prevent asymmetry effects.

12. The non-transitory computer-readable storage medium of claim 11, wherein the low rank updating of the first and second matrices is scaled to adjust a final sketching matrix to between $(-0.1, 0.1)$ for a full range of $(-1, 1)$ to operate near the first and second matrix asymmetry points.

13. The non-transitory computer-readable storage medium of claim 12, wherein once the matrix sketching is applied to an entire input, a final sketching matrix is moved to a digital computer to perform a regression analysis.

14. The non-transitory computer-readable storage medium of claim 8, wherein the dynamic correction computing device concurrently corrects the first and second matrices.

15. A system for performing matrix sketching by employing an analog crossbar architecture, the system comprising:

a memory; and

one or more processors in communication with the memory configured to:

low rank update a first matrix for a first period of time;

copy the first matrix into a dynamic correction computing device;

switch to a second matrix to low rank update the second matrix for a second period of time;

as the second matrix is low rank updated, feed the first matrix with first stochastic pulses to reset the first matrix back to a first matrix symmetry point;

copy the second matrix into the dynamic correction computing device;

switch back to the first matrix to low rank update the first matrix for a third period of time; and

as the first matrix is low rank updated, feed the second matrix with second stochastic pulses to reset the second matrix back to a second matrix symmetry point.

16. The system of claim 15, wherein the first and second matrices are placed in the analog crossbar architecture.
17. The system of claim 15, wherein the first and second matrices include streaming data.
18. The system of claim 17, wherein the streaming data is normalized to prevent asymmetry effects.
19. The system of claim 18, wherein the low rank updating of the first and second matrices is scaled to adjust a final sketching matrix to between $(-0.1, 0.1)$ for a full range of $(-1, 1)$ to operate near the first and second matrix asymmetry points.
20. The system of claim 19, wherein once the matrix sketching is applied to an entire input, the final sketching matrix is moved to a digital computer to perform a regression analysis.
21. The system of claim 15, wherein the dynamic correction computing device concurrently corrects the first and second matrices.
22. A computer-implemented method executed on a processor for performing matrix sketching by employing an analog crossbar architecture, the method comprising:

applying dimensionality reduction to streaming data using outer product low rank updates;
and

once the dimensionality reduction is applied to an entire input, moving a sketched matrix to a digital computer to perform regression analysis.

23. The method of claim 22, wherein the sketched matrix is derived from a first matrix and a second matrix used in parallel in a toggling manner.

24. The method of claim 23, further comprising:
low rank updating the first matrix for a first period of time;
copying the first matrix into a dynamic correction computing device;
switching to the second matrix to low rank update the second matrix for a second period of time;
as the second matrix is low rank updated, feeding the first matrix with first stochastic pulses to reset the first matrix back to a first matrix symmetry point;
copying the second matrix into the dynamic correction computing device;
switching back to the first matrix to low rank update the first matrix for a third period of time; and
as the first matrix is low rank updated, feeding the second matrix with second stochastic pulses to reset the second matrix back to a second matrix symmetry point.

25. A system for performing matrix sketching by employing an analog crossbar architecture, the system comprising:
- a memory; and
 - one or more processors in communication with the memory configured to:
 - apply dimensionality reduction to streaming data using outer product low rank updates; and
 - once the dimensionality reduction is applied to an entire input, move a sketched matrix to a digital computer to perform regression analysis.