CLAIMS

1. A computer-implemented method for pulse generation for updating analog crossbar arrays, the computer-implemented method comprising:

receiving, by a processor, a number used in matrix multiplication to represent using pulse generation for a crossbar array;

receiving, by the processor, a first bit-length to represent the number, wherein the bit-length is a modifiable bit length;

selecting, by the processor, pulse positions in a pulse sequence having the first bit length to represent the number;

performing, by the processor, a computation using the selected pulse positions in the pulse sequence; ~~and~~

updating, by the processor, the crossbar array using the computation; and

~~updating, by~~ identifying a pulse coincidence between a first pulse sequence and a second pulse sequence;

wherein at least one of the ~~processor,~~first pulse sequence or second pulse sequence comprises the ~~crossbar array using the computation.~~selected pulse positions.

2. The computer-implemented method of claim 1 further comprising:

selecting a second bit-length, wherein the second bit-length is different than the first bit-length;

selecting pulse positions for an updated pulse sequence having the second bit-length to represent the number;

performing a subsequent computation using the selected pulse positions in the updated pulse sequence; and

updating the crossbar array using the subsequent computation, wherein updating the crossbar array comprises updating a conductance value of one or more memristive devices of the crossbar array based at least in part on the computation and the subsequent computation.

3. The computer-implemented method of claim 1 further comprising modifying the first bit-length to the second bit-length during a training phase of a neural network.

4. The computer-implemented method of claim 1, wherein the computation comprises performing an outer product operation with the number used in the matrix multiplication and a second number used in the matrix multiplication.

5. The computer-implemented method of claim 1 further comprising generating a heat map, wherein the generated heat map is based at least in part on ~~a~~the pulse coincidence between ~~a~~the first pulse sequence and ~~a~~the second pulse sequence~~, wherein at least one of the first pulse sequence or second pulse sequence comprises the selected pulse positions~~, wherein at least one first pulse sequence corresponds to the number and the second pulse sequence corresponds to a second number.

6. The computer-implemented method of claim 5 further comprising comparing a true multiplication map to the generated heat map using the selected pulse positions, wherein the true multiplication map performs an element-wise multiplication for each element.

7. The computer-implemented method of claim ~~1~~6 further comprising:

determining an error between the true multiplication map and the generated heat map; and

displaying the error between the true multiplication map and the generated heat map.

8. A system for implementing pulse generation for updating crossbar arrays, the system comprising:

a crossbar array comprising one or more memristive devices;

a processor configured to:

receive a number used in matrix multiplication to represent using pulse generation for the crossbar array;

receive a bit-length to represent the number, wherein the bit-length is a modifiable bit-length;

select pulse positions in a pulse sequence having the bit length to represent the number;

perform a computation using the selected pulse positions in the pulse sequence; ~~and~~

update the crossbar array using the computation, wherein updating the crossbar array changes weights of the one or more memristive devices~~.~~; and

identify a pulse coincidence between a first pulse sequence and a second pulse sequence;

wherein at least one of the first pulse sequence or second pulse sequence comprises the selected pulse positions.

9. The system of claim 8, wherein the processor is configured to:

select a second bit-length, wherein the second bit-length is different than the first bit-length;

select pulse positions for an updated pulse sequence having the second bit-length to represent the number;

perform a subsequent computation using the selected pulse positions in the updated pulse sequence; and

update the crossbar array using the subsequent computation, wherein updating the crossbar array comprises updating a conductance value of the one or more memristive devices of the crossbar array based at least in part on the computation and the subsequent computation.

10. The system of claim 8, wherein the processor is configured to modify the first bit-length to the second bit-length during a training phase of a neural network.

11. The system of claim 8, wherein the computation comprises performing an outer product operation with the number used in the matrix multiplication and a second number used in the matrix multiplication.

12. The system of claim 8, wherein the selected pulse positions in the pulse sequence are based at least in part on the bit length.

13. The system of claim 8, wherein the processor is further configured to generate a heat map, wherein the generated heat map is based at least in part on ~~a~~the pulse coincidence between ~~a~~the first pulse sequence and ~~a~~the second pulse sequence~~, wherein at least one of the first pulse sequence or second pulse sequence comprises the selected pulse positions~~.

14. The system of claim 13 further comprising~~-~~:

comparing a true multiplication map to the generated heat map using the selected pulse positions, wherein the true multiplication map performs an element-wise multiplication for each element;

determine~~e~~ing an error between the true multiplication map and the generated heat map; and

displaying the error between the true multiplication map and the generated heat map.

15.—— A computer program product for pulse generation for updating analog crossbar arrays, the computer program product comprising:

a computer readable storage medium having stored thereon first program instructions executable by a processor to cause the processor to:

receive a number used in matrix multiplication to represent using pulse generation for a crossbar array;

receive a bit-length to represent the number, wherein the bit-length is a modifiable bit-length;

select pulse positions in a pulse sequence having the bit length to represent the number;

perform a computation using the selected pulse positions in the pulse sequence; ~~and~~

update the crossbar array using the computation, wherein updating the crossbar array comprises updating a conductance value of one or more memristive devices of the crossbar array based at least in part on the computation~~.~~; and

identify a pulse coincidence between a first pulse sequence and a second pulse sequence;

wherein at least one of the first pulse sequence or second pulse sequence comprises the selected pulse positions.

16. The computer program product of claim 15, wherein the instructions are further executable by the processor to cause the processor to:

select a second bit-length, wherein the second bit-length is different than the first bit-length;

select pulse positions for an updated pulse sequence having the second bit-length to represent the number;

perform a subsequent computation using the selected pulse positions in the updated pulse sequence; and

update the crossbar array using the subsequent computation, wherein updating the crossbar array comprises updating a conductance value of the one or more memristive devices of the crossbar array based at least in part on the computation and the subsequent computation~~.~~.

17. The computer program product of claim 15, wherein the instructions are further executable by a processor to cause the processor to modify the first bit-length to the second bit-length during a training phase of a neural network.

18.~~-~~ The computer program product of claim 15, wherein the instructions are further executable by a processor to cause the processor to determine the outer product of a first pulse sequence and a second pulse sequence for the neural network.

19.~~-~~ The computer program product of claim 15, wherein the instructions are further executable by a processor to cause the processor to generate a heat map, wherein the generated heat map is based at least in part on ~~a~~the pulse coincidence between ~~a~~the first pulse sequence and ~~a~~the second pulse sequence~~, wherein at least one of the first pulse sequence or second pulse sequence comprises the selected pulse positions~~.

20. ~~—~~The computer program product of claim ~~15~~19, wherein the instructions are further executable by a processor to cause the processor to:

compare a true multiplication map to the generated heat map using the selected pulse positions, wherein the true multiplication map performs an element-wise multiplication for each element;

determine an error between the true multiplication map and the generated heat map; and

display the error between the true multiplication map and the generated heat map.