This paper describes objective technical results and analysis. Any subjective views or opinions that might be expressed in the paper do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

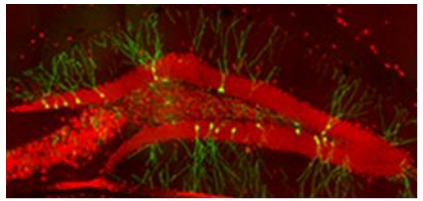
SAND2021-8557C

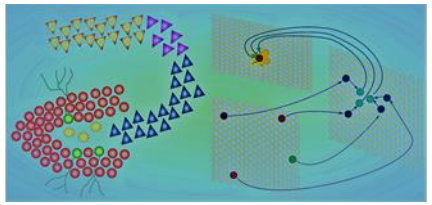
Space Computing Conference 2021

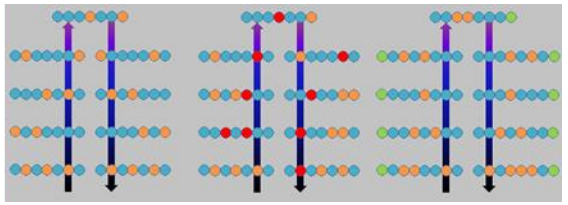
Sandia National Laboratories

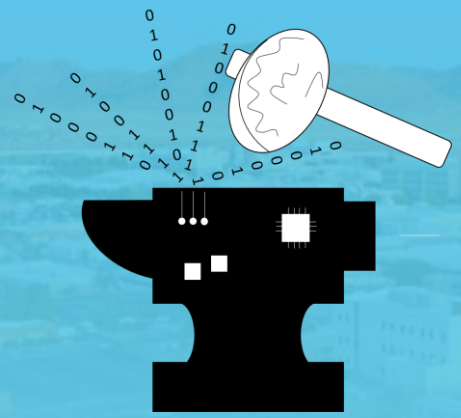
Machine Learning/Neural Computing Track Introduction

WHETSTONE









Track Organizers

Craig M. Vineyard (SNL), William M. Severa (SNL), Srideep Musuvathy (SNL), James MacKinnon (NASA)

U.S. DEPARTMENT OF ENERGY NNSA

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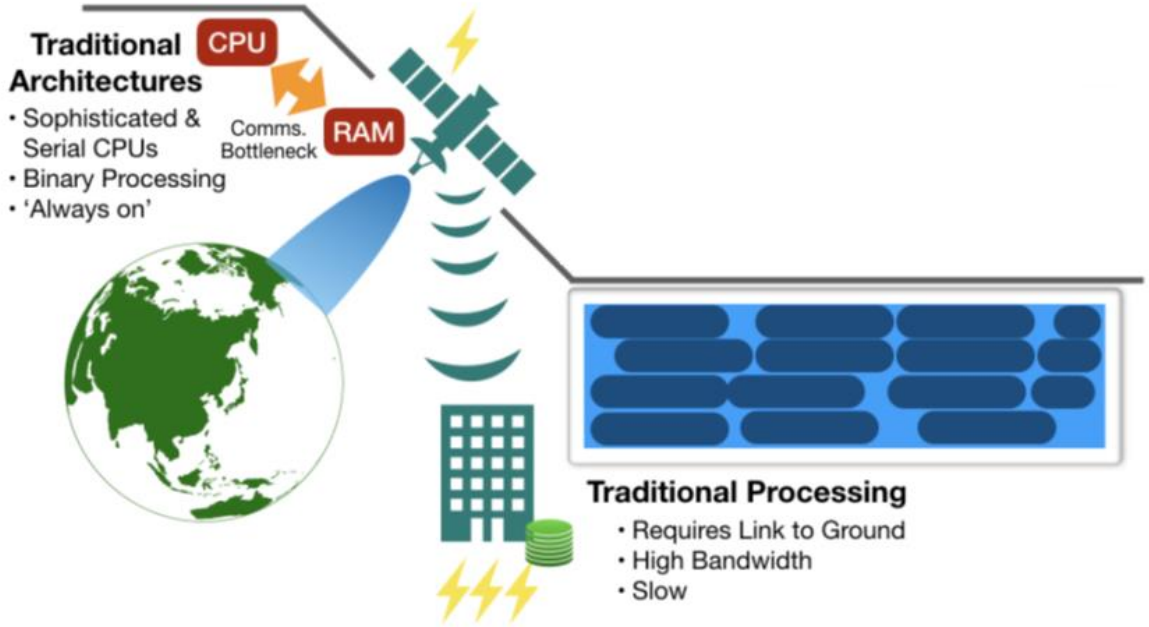
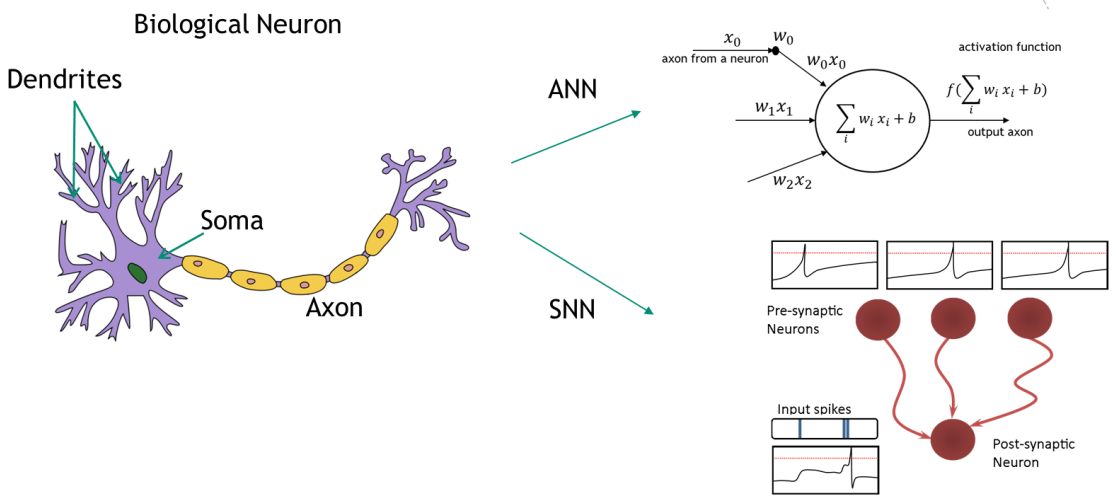
Von Neumann Bottleneck

- In a classic computer architecture, the von Neumann bottleneck describes the computing limitation arising due to communication limits between processing and memory
- Extreme case – in many space based computing scenarios data is moved from the sensor to ground stations for processing
- An intuitive resolution to the von Neuman bottleneck is to bring processing & memory together
  - Analogously, moving more computation to space based platforms offers hope for addressing bandwidth limitations, enabling more autonomy, etc.
- BUT there are computational challenges
  - Extreme environment of space
  - Limits of traditional computing

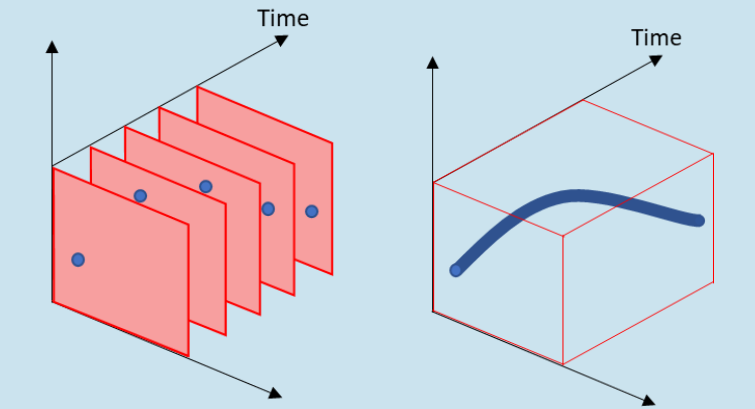


Machine Learning/Neural Computing

- What is neural-inspired, neuromorphic, brain-inspired computing?
  - Many terms
  - Fundamental notion of taking inspiration from how the brain performs computation



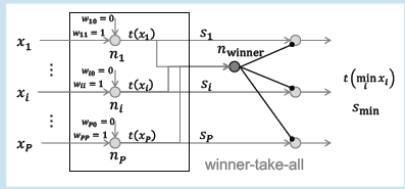
Neural-Inspired Sensing

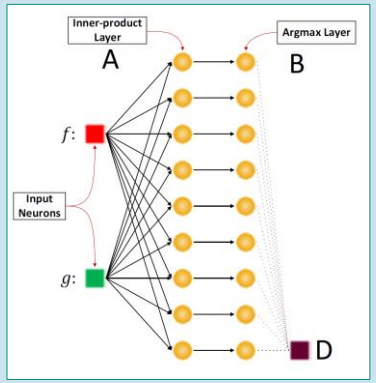


Canonical framed-sensing

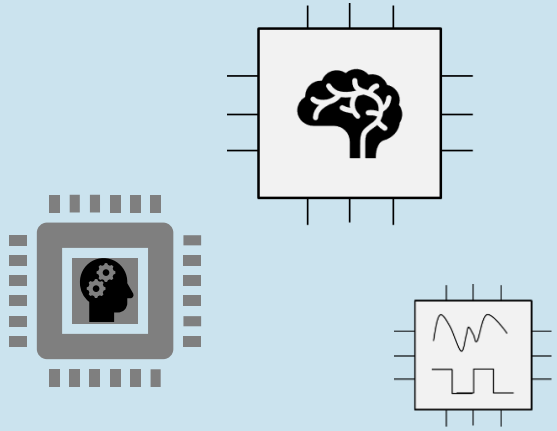
Event-based sensing

Neural-Inspired Computation





Neural-Inspired Processing



Schedule

Thursday, August 26, 2021						
Start	**Duration**	**End**	**Description**	**Presentation Title**	**Presenter**	**Organization**
1:25 PM	0:10	1:35 PM	Track #5 Introduction	**Track 5: Machine Learning: Craig Vineyard**	**Craig Vineyard**	**Sandia National Laboratories**
1:35 PM	0:20	1:55 PM	Track #5 Presentation 1	Implementation and Performance Analysis of Machine Learning Algorithms on Spaceflight Hardware	Mike Koets	Southwest Research Institute
1:55 PM	0:20	2:15 PM	Track #5 Presentation 2	Improving Dependability of Onboard Deep Learning with Resilient TensorFlow	Tyler Garrett	University of Pittsburgh
2:15 PM	0:20	2:35 PM	Track #5 Presentation 3	A Methodology for Evaluating and Analyzing FPGA-Accelerated, Deep-Learning Applications for Onboard Space Processing	Sebastian Sabogal	University of Pittsburgh - NSF SHREC
2:35 PM	0:20	2:55 PM	Track #5 Presentation 4	JENOVA: Joint Exploration of Neuromorphic Orbital Vehicle Architectures	Josh Donckels	AFRL RV
2:55 PM	0:20	3:15 PM	Live Q&A Session			
3:15 PM	0:30	3:45 PM	Break			
3:45 PM	0:20	4:05 PM	Track #5 Presentation 5	Neuromorphic Computing for Spacecraft's Terrain Relative Navigation: A Case of Event-Based Crater Classification Task	Kariya Kazuki	Japan Aerospace Exploration Agency
4:05 PM	0:20	4:25 PM	Track #5 Presentation 6	Designing a Radiation-Tolerant, Reconfigurable Computing Platform for Deep Learning Acceleration using Xilinx Kintex UltraScale FPGAs	Jason Vidmar & Troy Jones	Xilinx
4:25 PM	0:20	4:45 PM	Track #5 Presentation 7	SpikePropamine, Meta-Learning Synaptic Plasticity for Spiking Neural Networks	Joe Hays	Naval Research Lab
4:45 PM	0:20	5:05 PM	Track #5 Presentation 8	Creating AI/ML Applications in RT PolarFire® FPGAs with the VectorBlox™ SDK	Ken O'Neill	Microchip
5:05 PM	0:20	5:25 PM	Live Q&A Session			