INRC FORUM UPDATE AND RFP OVERVIEW

MARCH 18, 2020

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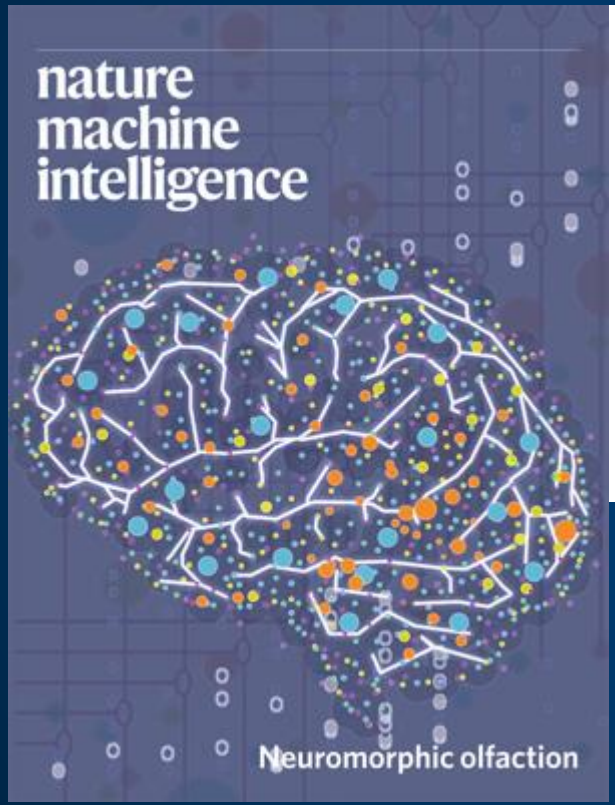
AGENDA

1)	Quick Intel Announcements	Mike Davies
2)	RFP Overview	Mike Davies + Melissa Cowan
3)	Q&A	

LOIHI SMELLS!



Neuromorphic olfaction

Neuromorphic chips are designed to use computational machinery inspired by the brain, but it has been challenging to use that machinery in real-world practical problems. In a paper in this issue, Imam and Cleland describe a neural algorithm for the learning and identification of odour samples based on the architecture of the mammalian olfactory system. They implement their neural algorithm in the Intel Loihi neuromorphic system.

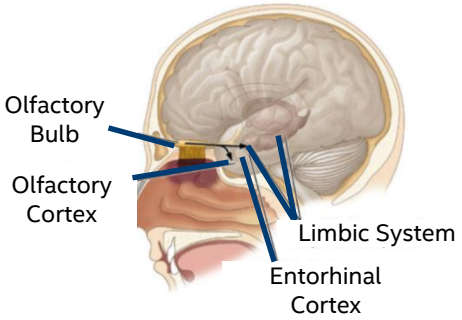
Nabil Imam and Thomas A. Cleland.

Rapid online learning and robust recall in a neuromorphic olfactory circuit

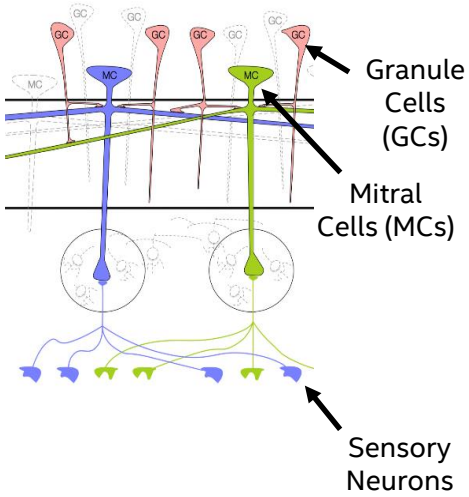
Volume 2 Issue 3,
March 2020

OLFACTION-INSPIRED PATTERN MATCHING

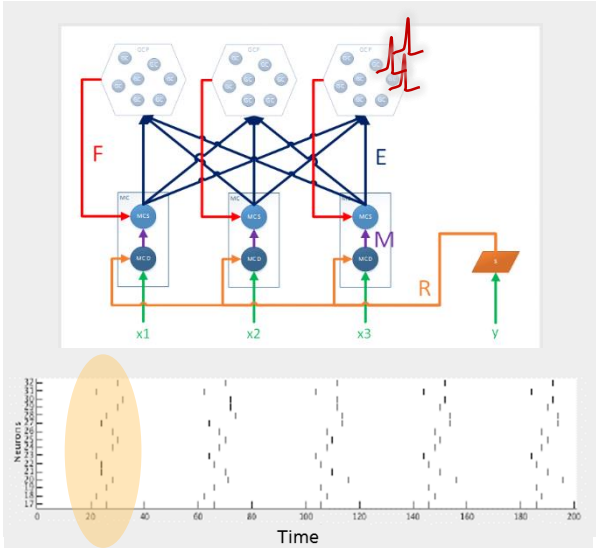
Olfactory System



Olfactory Bulb Neural Circuit



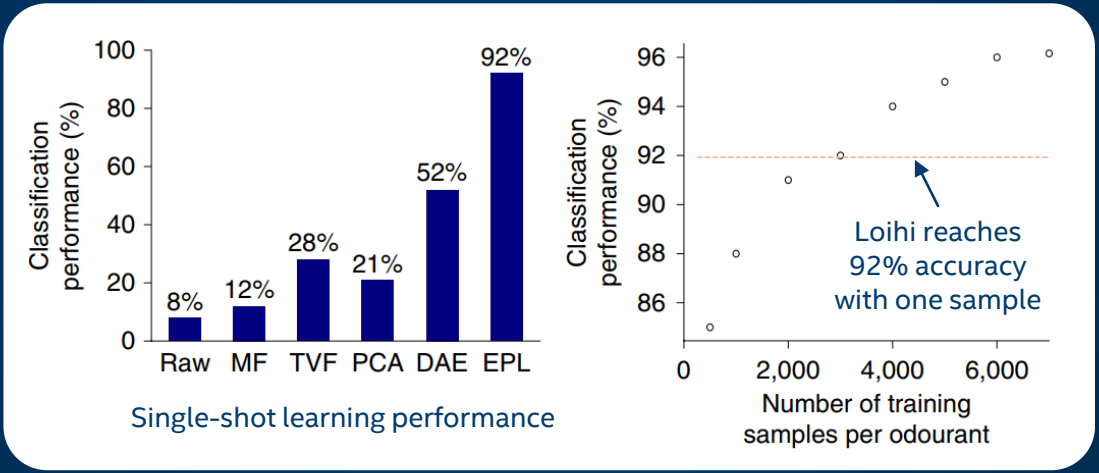
Spatiotemporal Attractor Model



Example of a novel ML algorithm abstracted from detailed systems neuroscience model

[Nabil Imam and Thomas Cleland, arXiv preprint arXiv:1906.07067][Nature Machine Learning, March 2020]

AN EXAMPLE THAT OUTPERFORMS DEEP LEARNING



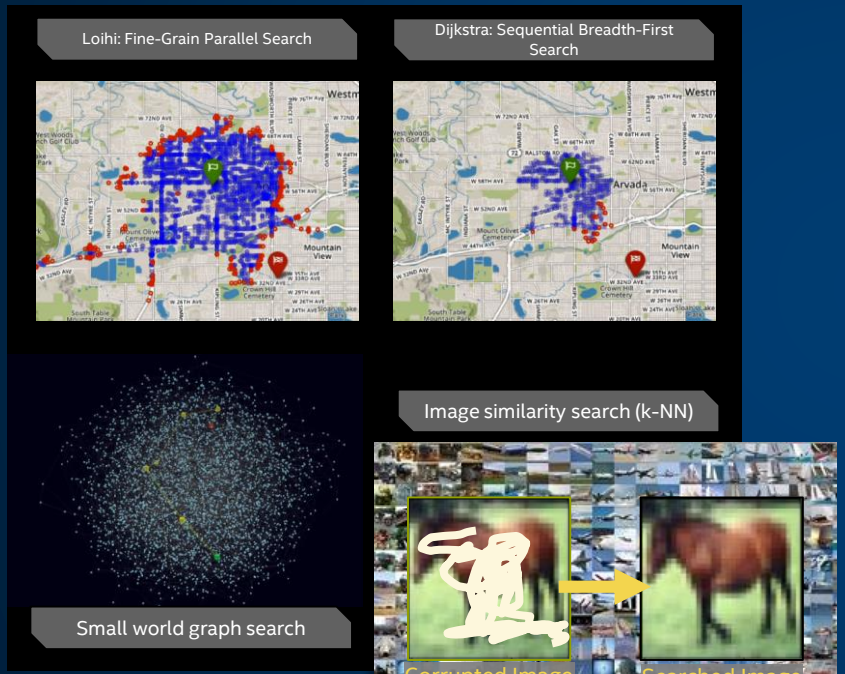
POHOIKI SPRINGS: ANNOUNCED TODAY

Key stats:

- 768 Loihi Chips
- 100 million spiking neurons
- 3+ Arria10 hosts
- Flexible partitioning
- Ethernet networking
- 5U rack-mount chassis
- 300 Watts
- Available for INRC use (soon)

RETHINKING SEARCH, PLANNING, OPTIMIZATION

SCALING UP IN PURSUIT OF NATURAL INTELLIGENCE



Brains are fast and efficient problem solvers. Many of the problems we solve effortlessly, often barely consciously, are computationally difficult (e.g. NP complete) and pervasive in computing systems of all kinds. These include problems like graph search, similarity search, constraint satisfaction, and optimization.

Loihi can solve a growing number of such problems, in some cases over 100x faster and with thousands of times lower energy than conventional processors.

What's exciting about this class of problem is that we often find that the neuromorphic advantage in speed and energy increases as the scale of the problem increases. This leads us to build large neuromorphic systems like Pohoiki Springs.

Such scaled up neuromorphic systems could rapidly search image and video databases for patterns. They could alleviate city traffic by optimizing traffic light timing. They could rapidly make asset allocations decisions, such as for a stock portfolio. They could even help discover new drugs by modeling protein folding.

INRC GOALS

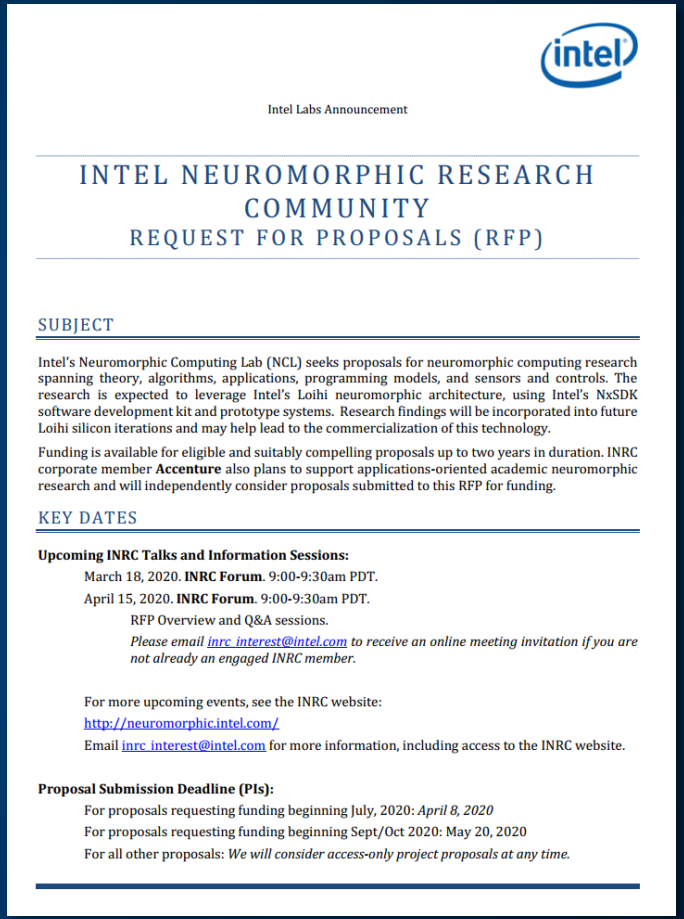
1) **Accelerate** research in neuromorphic computing
   Primarily by stimulating *algorithms* and *applications* research using a specific hardware architecture (Loihi) to encourage focus.
2) **Quantify** the value of neuromorphic computing today using the best available hardware
   A quantitative approach helps "follow the gradient" to maximize value, prioritize architectural optimization, and move neuromorphic computing into the mainstream.
3) **Guide Loihi's architectural development**
   Algorithms & application findings provide insights for future silicon revisions
4) **Build an ecosystem** that can eventually provide a market for neuromorphic chips
   Intel hopes neuromorphic computing will lead to commercially viable technology with widespread usages.

NEW RFP IS RELEASED

All **academic groups** qualify for funding

Project scope:
One student or postdoc for 1-2 years

	Submission Deadline	Project Start
Round 1	April 8	July
Round 2	May 20	Sept-Oct



Intel Labs Announcement

INTEL NEUROMORPHIC RESEARCH COMMUNITY
REQUEST FOR PROPOSALS (RFP)

SUBJECT

Intel's Neuromorphic Computing Lab (NCL) seeks proposals for neuromorphic computing research spanning theory, algorithms, applications, programming models, and sensors and controls. The research is expected to leverage Intel's Loihi neuromorphic architecture, using Intel's NxSDK software development kit and prototype systems. Research findings will be incorporated into future Loihi silicon iterations and may help lead to the commercialization of this technology.

Funding is available for eligible and suitably compelling proposals up to two years in duration. INRC corporate member **Accenture** also plans to support applications-oriented academic neuromorphic research and will independently consider proposals submitted to this RFP for funding.

KEY DATES

Upcoming INRC Talks and Information Sessions:

March 18, 2020. **INRC Forum**. 9:00-9:30am PDT.

April 15, 2020. **INRC Forum**. 9:00-9:30am PDT.

RFP Overview and Q&A sessions.

Please email inrc_interest@intel.com to receive an online meeting invitation if you are not already an engaged INRC member.

For more upcoming events, see the INRC website:
http://neuromorphic.intel.com/
Email inrc_interest@intel.com for more information, including access to the INRC website.

Proposal Submission Deadline (PIs):

For proposals requesting funding beginning July, 2020: *April 8, 2020*
For proposals requesting funding beginning Sept/Oct 2020: May 20, 2020
For all other proposals: *We will consider access-only project proposals at any time.*

https://intel-ncl.atlassian.net/wiki/download/attachments/44532116/INRC%20RFP%20March%202020.pdf

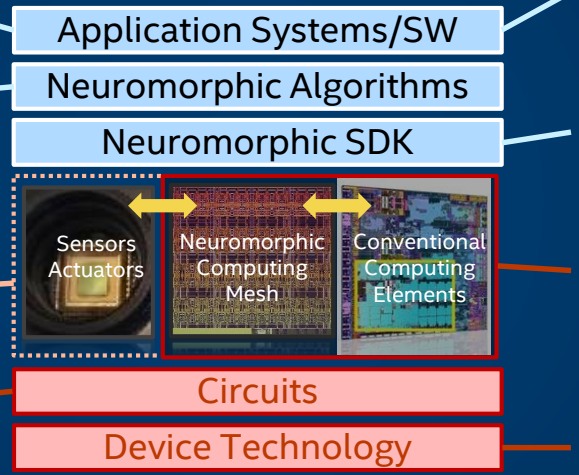
NEUROMORPHIC COMPUTING RESEARCH VECTORS

RV1: Theory
- Abstract and quantify features of neuroscience
- Figures of merit
- Complexity analysis

RV2: Algorithms
- Principled development of SNNs to solve well defined computational problems (+ learning/adaptation)

RV5: Event-Driven Sensing & Control
- Sparse, event-driven I/O for SNN systems

RV7: Circuits
- Novel memory circuits
- Asynchronous pipelines and control



RV3: Applications
- Applications of Loihi and future Intel neuromorphic architectures.
- Benchmarking and value analysis methodologies.

RV4: Programming Models
- New paradigms for conceptualizing and specifying SNN/neuromorphic algorithms

RV6: Architecture and Design
- Neuromorphic hardware realizations that deliver application value

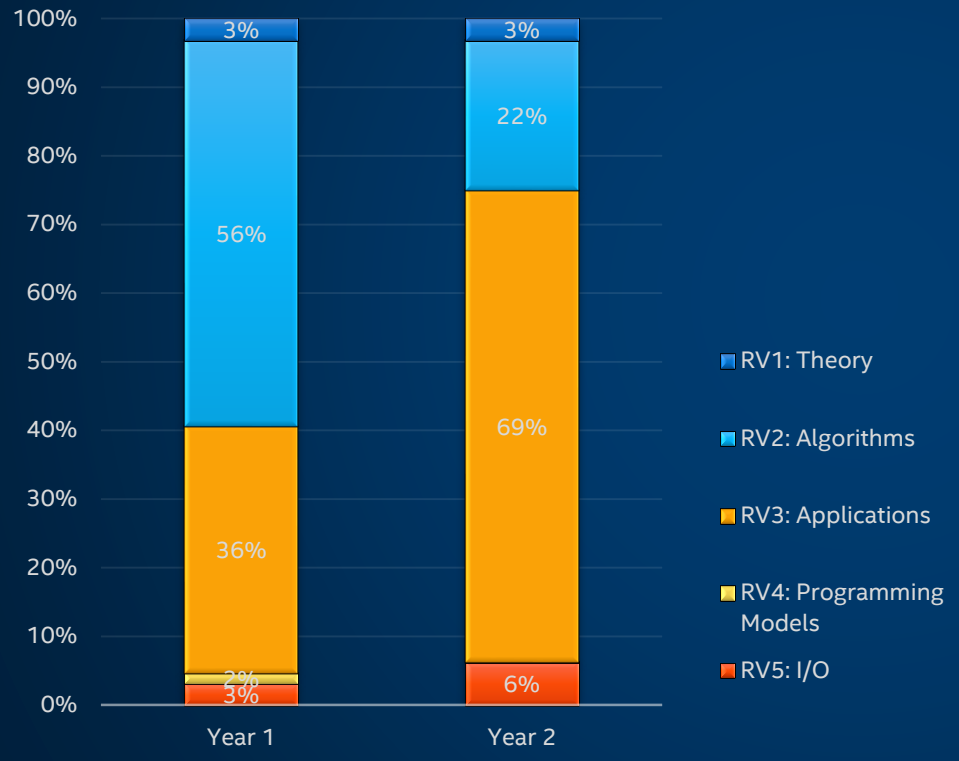
RV8: New Devices
- Memristors, spintronics, etc.

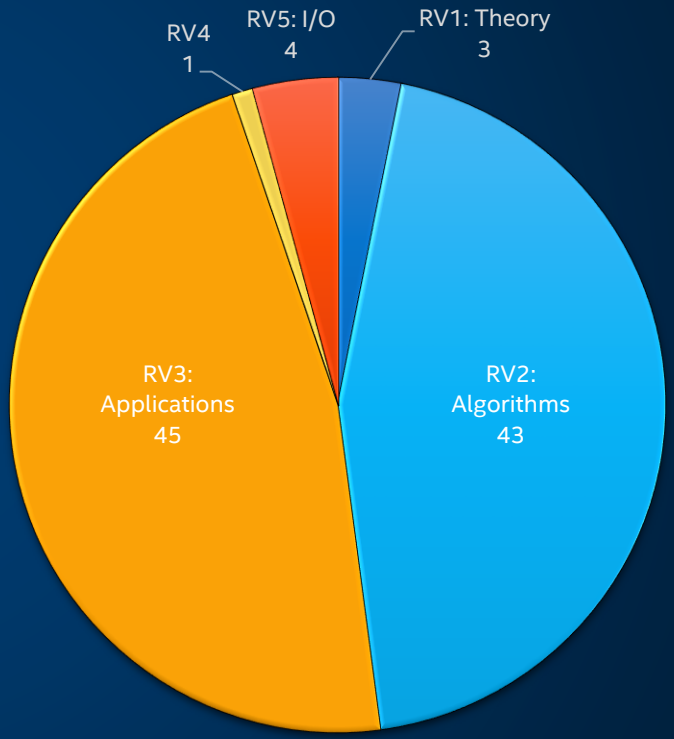
Expected emphasis of Research Vectors for INRC collaborations:

	1	2	3	4	5
2018-2019					
2020+					

6 7 8
Outside the scope of INRC (internal, SRC/CBRIC, etc.)

PROJECT BREAKDOWN BY RV



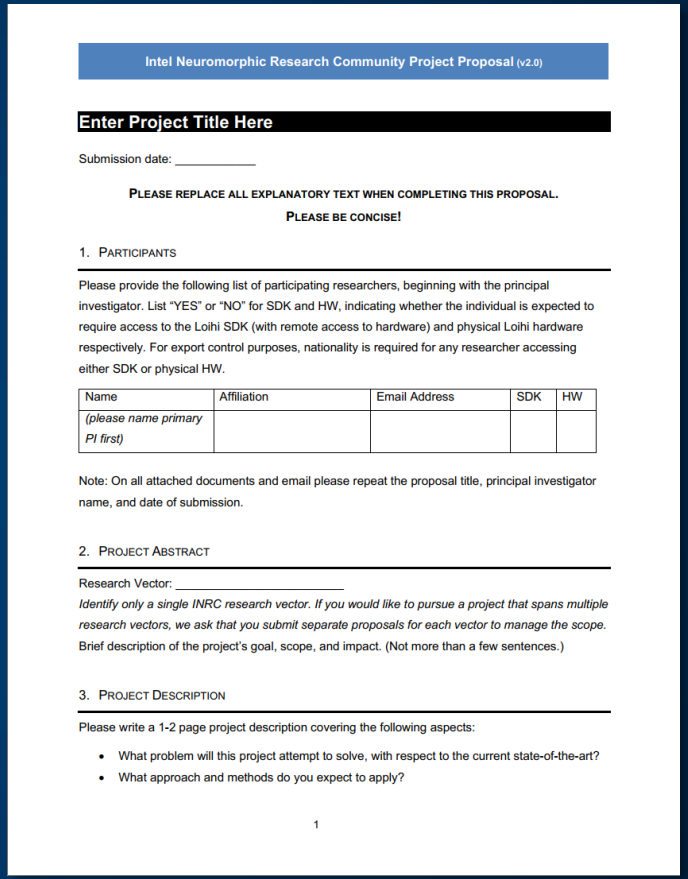


Distribution of all 96 engaged projects

PROJECT PROPOSAL

Template is on the INRC website

1. Participants
2. Project Abstract
3. Project Description
4. Research Plan
5. Loihi Research Needs
6. INRC Dependencies
7. Material Deliverables
8. Intellectual Property
9. Administrative Matters
10. Submission Process
11. Grant/Gift Coversheet (+ cost analysis)



Intel Neuromorphic Research Community Project Proposal (v2.0)

Enter Project Title Here

Submission date: _____

PLEASE REPLACE ALL EXPLANATORY TEXT WHEN COMPLETING THIS PROPOSAL.
PLEASE BE CONCISE!

1. PARTICIPANTS

Please provide the following list of participating researchers, beginning with the principal investigator. List "YES" or "NO" for SDK and HW, indicating whether the individual is expected to require access to the Loihi SDK (with remote access to hardware) and physical Loihi hardware respectively. For export control purposes, nationality is required for any researcher accessing either SDK or physical HW.

Name	Affiliation	Email Address	SDK	HW
(please name primary PI first)				

Note: On all attached documents and email please repeat the proposal title, principal investigator name, and date of submission.

2. PROJECT ABSTRACT

Research Vector: _____

Identify only a single INRC research vector. If you would like to pursue a project that spans multiple research vectors, we ask that you submit separate proposals for each vector to manage the scope.
Brief description of the project's goal, scope, and impact. (Not more than a few sentences.)

3. PROJECT DESCRIPTION

Please write a 1-2 page project description covering the following aspects:

- What problem will this project attempt to solve, with respect to the current state-of-the-art?
- What approach and methods do you expect to apply?

1

Email to INRC_Project_Proposals@intel.com

REQUESTING LOIHI HARDWARE

Kapoho Bay
For edge processing
(e.g. DAVIS 240C)

Nahuku
32 chips, plugs into Arria10
development kit

We will loan hardware to qualified groups

- Your project must require on-site real-time processing
- First demonstrate functionality using our cloud systems

RECOMMENDATIONS

Carefully consider dependencies

Algorithms you will need, software features & maturity, Loihi needs, etc.

Indicate acceptable range of scope

(i.e. low/high funding levels)

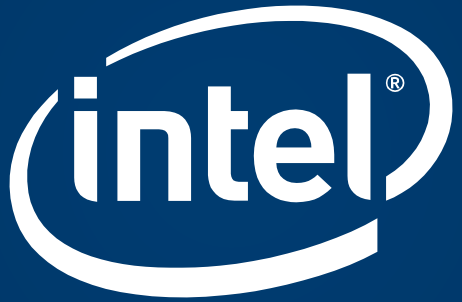
Convince us you will succeed

Relate to other similar accomplishments

Relate proposed research to the state-of-the-art

Leverage INRC participation for other funding

Thank You!



Email questions at any time to inrc_interest@intel.com