



Request For Information – Energy Efficient Computer Architectures **RFI Number: IARPA-RFI-16-05**

Agency: Office of the Director of National Intelligence
Office: Intelligence Advanced Research Projects Activity

IARPA-RFI-16-05

Synopsis

Request for Information (RFI): Energy Efficient Computer Architectures

The Intelligence Advanced Research Projects Activity (IARPA) is seeking information on developing novel computer architectures to achieve energy efficient calculations beyond the limitations of current CMOS technologies, and in particular for applications involving Artificial Neural Networks (ANN). This request for information (RFI) is issued solely for information gathering and planning purposes; this RFI does not constitute a formal solicitation for proposals. The following sections of this announcement contain details of the scope of technical efforts of interest, along with instructions for the submission of responses.

Background & Scope

Artificial neural networks show promise for making sense out of patterns in data, such as facial recognition or object detection, however, executing software emulations of neural networks is currently much less efficient than the brains from which they were derived. This RFI seeks ideas on more effective computer technologies for this class of algorithm. Existing applications of interest to IARPA include:

- The Go game playing program (a 280 GPU cluster beats a very good human player)
- Unsupervised learning programs that scan videos to discover common features
- Various software packages that include code libraries for common ANN building blocks (convolutional network layers, backpropagation, etc.). An example code library can be found at <http://www.robots.ox.ac.uk/~vgg/practicals/cnn/>. This will serve as the principal reference for this RFI because its software is open source.

This RFI seeks approaches to improve execution of the underlying algorithms through novel computing architectures. These architectures need not execute the same source codes, but must execute code that would provide the same results irrespective of implementation. Respondents are requested to provide information on approaches along with quantitative estimates of:

- Hardware design and complexity
- Execution/learning time and relative computational time advantage
- Computational energy requirements

One end of the anticipated range of responses would be architecture ideas for CMOS processors that are more efficient than GPUs for this class of algorithm. The other end of the range includes novel physical devices such as memristors and phase change memory cells that would perform the low-level, computing intensive algorithms using an electrical circuit directly.

Responses to this RFI should answer the following:

1. Describe your approach to executing ANNs
2. If the approach is less general than the software package referenced above, describe the class of problems for which the approach is suitable
3. Compared to current approaches utilizing GPU clusters, quantify:
 - a. Improvement in energy efficiency (for both first generation and theoretical limits)
 - b. Reduction in hardware cost/complexity (for both first generation and theoretical limits)
4. Identify all research challenges

Preparation Instructions to Respondents

IARPA requests that respondents submit ideas related to this topic for use by the Government in formulating a potential program. IARPA requests that submittals briefly and clearly describe the potential approach or concept, outline critical technical issues/obstacles, describe how the approach may address those issues/obstacles and comment on the expected performance and robustness of the proposed approach. If appropriate, respondents may also choose to provide a non-proprietary rough order of magnitude (ROM) estimate regarding what such approaches might require in terms of funding and other resources for one or more years. This announcement contains all of the information required to submit a response. No additional forms, kits, or other materials are needed.

IARPA appreciates responses from all capable and qualified sources from within and outside of the US. Because IARPA is interested in an integrated approach, responses from teams with complementary areas of expertise are encouraged.

Responses have the following formatting requirements:

1. A one page cover sheet that identifies the title, organization(s), respondent's technical and administrative points of contact - including names, addresses, phone and fax numbers, and email addresses of all co-authors, and clearly indicating its association with RFI-16-0x;
2. A substantive, focused, one-half page executive summary;
3. A description (limited to 5 pages in minimum 12 point Times New Roman font, appropriate for single-sided, single-spaced 8.5 by 11 inch paper, with 1-inch margins) of the technical challenges and suggested approach(es);
4. A list of citations (any significant claims or reports of success must be accompanied by citations);
5. Optionally, a single overview briefing chart graphically depicting the key ideas.

Submission Instructions to Respondents

Responses to this RFI are due no later than 4:00 p.m., Eastern Time, on July 15, 2016. All submissions must be electronically submitted to dni-iarpa-rfi-16-05@iarpa.gov as a PDF document. Inquiries to this RFI must be submitted to dni-iarpa-rfi-16-05@iarpa.gov. Do not send questions with proprietary content. No telephone inquiries will be accepted.

Disclaimers and Important Notes

This is an RFI issued solely for information and planning purposes and does not constitute a solicitation. Respondents are advised that IARPA is under no obligation to acknowledge receipt of the information received, or provide feedback to respondents with respect to any information submitted under this RFI.

Responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. Respondents are solely responsible for all expenses associated with responding to this RFI. IARPA will not provide reimbursement for costs incurred in responding to this RFI. It is the respondent's responsibility to ensure that the submitted material has been approved for public release by the information owner.

The Government does not intend to award a contract on the basis of this RFI or to otherwise pay for the information solicited, nor is the Government obligated to issue a solicitation based on responses received. Neither proprietary nor classified concepts or information should be included in the submittal. Input on technical aspects of the responses may be solicited by IARPA from non-Government consultants/experts who are bound by appropriate non-disclosure requirements.

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