Critical Techniques, Technologies and Methodologies for Advancing Foundations and Applications of Big Data Sciences and Engineering (BIGDATA)

PROGRAM SOLICITATION
NSF 17-534

REPLACES DOCUMENT(S):
NSF 16-512

National Science Foundation

Directorate for Computer & Information Science & Engineering

Directorate for Biological Sciences

Directorate for Education & Human Resources

Directorate for Engineering

Directorate for Mathematical & Physical Sciences
Division of Mathematical Sciences

Directorate for Social, Behavioral & Economic Sciences

Office of Financial Research

Submission Window Date(s) (due by 5 p.m. submitter's local time):

March 15, 2017 - March 22, 2017

IMPORTANT INFORMATION AND REVISION NOTES

Amazon Web Services (AWS), Google, and Microsoft are now participating in the solicitation by providing cloud credits/resources to qualifying projects. The solicitation provides details regarding the participation of these companies, and the use of their cloud resources.

Additionally, slight revisions of the Program Description have been introduced.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 17-1), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Critical Techniques, Technologies and Methodologies for Advancing Foundations and Applications of Big Data Sciences and Engineering (BIGDATA)

Synopsis of Program:

The *BIGDATA* program seeks novel approaches in computer science, statistics, computational science, and mathematics, along with innovative applications in domain science, including social and behavioral sciences, education, biology, the physical sciences, and engineering that lead towards the further development of the interdisciplinary field of *data science.*

The solicitation invites two categories of proposals:

- *Foundations (F):* those developing or studying fundamental theories, techniques, methodologies, and technologies of broad applicability to big data problems, motivated by specific data challenges and requirements; and
- *Innovative Applications (IA):* those engaged in *translational* activities that employ new big data techniques, methodologies, and technologies to address and solve problems in specific application domains. Projects in this category must be collaborative, involving researchers from domain disciplines and one or more methodological disciplines, e.g., computer science, statistics, mathematics, simulation and modeling, etc.

Proposals in both categories must include a clear description of the big data aspect(s) that have motivated the proposed approach(es), for example: the scalability of methods with increasing data volumes, rates, heterogeneity; or data quality and data bias; etc. Innovative

Applications proposals must provide clear examples of the impacts of the big data techniques, technologies and/or methodologies on (a) specific domain application(s).

Proposals in all areas of sciences and engineering covered by participating NSF directorates and partnering agencies [the Office of Financial Research (OFR)], are welcome.

Before preparing a proposal in response to this BIGDATA solicitation, applicants are strongly urged to review other related programs and solicitations and contact the respective NSF program officers listed in them should those solicitations be more appropriate. In particular:

- For the development of robust and shared data-centric cyberinfrastructure capabilities, applicants should consider the *Data Infrastructure Building Blocks (DIBBs)* program, https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504776;
- For computational and data science research not specifically addressing big data issues, applicants should consider the *Computational and Data Enabled Science and Engineering (CDS&E)* program, https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504813;
- For work that is focused more on scaling of software, rather than data-related issues, applicants should consider the *Scalable Parallelism in the Extreme (SPX)* program, https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505348;
- Proposals that are specific to the geosciences, and respond to the community needs and requirements expressed by the geosciences community, should consider the NSF EarthCube program for *Developing a Community-Driven Data and Knowledge Environment for the Geosciences*, https://www.nsf.gov/geo/earthcube/;
- Proposals that focus on research in mathematics or statistics that is not tied to a specific big data problem should be submitted to the appropriate program within the MPS Division of Mathematical Sciences (DMS); see a list of DMS programs at https://www.nsf.gov/funding/programs.jsp?org=DMS; and
- Proposals that focus on research in the computer and information sciences not tied to a specific big data problem should be submitted to the appropriate CISE core program:
    - Computer and Network Systems (CNS) Core Programs: https://nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=12765&ods_key=nsf16579;
    - Computing and Communication Foundations (CCF) Core Programs: https://nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=503220&ods_key=nsf16578; and
    - Information and Intelligent Systems (IIS) Core Programs: https://nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=13707&ods_key=nsf16581 .

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Chaitanya Baru, Senior Advisor for Data Science, CISE/OAD, telephone: (703) 292-4541, email: cbaru@nsf.gov
- Sylvia Spengler, Lead Program Director for BIGDATA, CISE/IIS, telephone: (703)292-8930, email: sspengle@nsf.gov
- Reed S. Beaman, Program Director, BIO/DBI, telephone: (703) 292-7163, email: rsbeaman@nsf.gov
- John C. Cherniavsky, Program Director, EHR/DRL, telephone: (703) 292-5136, email: jchernia@nsf.gov
- Almadena Y. Chtchelkanova, Program Director, CISE/CCF, telephone: (703) 292-8910, email: achtchel@nsf.gov
- David Corman, Program Director, CISE/CNS, telephone: (703) 292-8754, email: dcorman@nsf.gov
- James C. French, Program Director, CISE/IIS, telephone: (703) 292-8930, email: jfrench@nsf.gov
- Edward Garnett, Program Manager, Office of Financial Research, telephone: (202)927-8025, email: edward.garnett@ofr.treasury.gov
- Jun (Luke) Huan, Program Director, CISE/IIS, telephone: (703) 292-8930, email: jhuan@nsf.gov
- Nandini Kannan, Program Director, MPS/DMS, telephone: (703)292-8104, email: nakannan@nsf.gov
- Sara Kiesler, Program Director, SBE/SES, telephone: (703) 292-8643, email: skiesler@nsf.gov
- Bogdan Mihaila, Science Advisor, MPS/OAD, telephone: (703) 292-8235, email: bmihaila@nsf.gov
- Rahul T. Shah, Program Director, CISE/CCF, telephone: (703) 292-2709, email: rshah@nsf.gov
- Stathis Tompaidis, Assoc Director, Office of Financial Research, telephone: (202)927-0758, email: stathis.tompaidis@ofr.treasury.gov
- Ralph Wachter, Program Director, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Chengshan Xiao, Program Director, ENG/ECCS, telephone: (703) 292-4753, email: cxiao@nsf.gov
- Maria Zemankova, Program Director, CISE/IIS, telephone: (703) 292-7348, email: mzemanko@nsf.gov
- Aidong Zhang, Program Director, CISE/IIS, telephone: (703) 292-5311, email: azhang@nsf.gov
- Nan Zhang, Program Director, CISE/IIS, telephone: (703) 292-8930, email: nanzhang@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant or Cooperative Agreement

Estimated Number of Awards: 27 to 35

About 27-35 projects will be funded, subject to availability of funds.

Anticipated Funding Amount: $26,500,000

Up to $26,500,000 will be invested by NSF and the Office of Financial Research (OFR), in proposals submitted to this solicitation, subject to the availability of funds. Up to $9,000,000 will be invested by Amazon Web Services (AWS), Google, and Microsoft (up to $3,000,000 each) in the form of cloud credits/resources.

Projects will typically receive NSF funding in the range of $200,000 to a maximum of $500,000 per year, for 3 to 4 years of support. The minimum award size will be $600,000 of total NSF/OFR funding, reflecting the minimum expected level of effort for BIGDATA projects, which are expected to be multidisciplinary in nature and include significant student involvement. Any allocation of cloud credits/resources from AWS, Google or Microsoft will be in **addition** to the NSF/OFR funding.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

An individual may participate as PI, co-PI, Senior Personnel, consultant, or any other role in **no more than one proposal**, or related subaward, submitted in response to this solicitation.

In the event that an individual exceeds this limit, any proposal submitted to this solicitation with this individual listed as a PI, co-PI, senior personnel, consultant or any other role after the first proposal is received at NSF will be returned without review. **No exceptions will be made.**

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals concurrently under consideration by NSF.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp .
  - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  March 15, 2017 - March 22, 2017

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The NSF BIGDATA program is focused on techniques, technologies, and methodologies to assist today's scientists, engineers, educators, citizens and decision makers in dealing with unprecedented amounts and types of data. These data may originate from many disparate sources, ranging from scientific instruments to social media; from transactional data to machine-generated data from the Internet of Things (IoT); and from administrative data to large-scale simulation data. The data could be temporal, spatial, or dynamic; structured or unstructured; and, particularly when from different sources, may differ in representation, complexity, granularity, context, quality, provenance, reliability, trustworthiness, and scope.

Principled approaches are needed to address data management, modeling, and analysis of big data, and to apply novel big data techniques to solve domain science and engineering problems. The challenges in managing and analyzing the volumes and rates of available data can require fundamentally new hardware and software techniques and technologies, foundational algorithmic, mathematical and statistical theory, as well as new algorithms and modeling approaches, in order to handle the complexity, size, or rate of these data. Methods are needed for supporting *data experiments*: for browsing through the data; for characterizing, summarizing and integrating the data; and for hypothesis generation and testing. Methods and technologies are needed for big data "at rest" as well as for real-time analytics on data streams. Novel techniques are also needed for fairness, data confidentiality, and privacy for big data. To be effective and have impact, research design and project implementation should ideally take place with a *partnership model*—among the various technical and domain science and engineering communities.

II. PROGRAM DESCRIPTION

The Critical Techniques, Technologies and Methodologies for Advancing Foundations and Applications of Big Data Sciences and Engineering (BIGDATA) program invites proposals in two categories, **Foundations (F)** and **Innovative Applications (IA)**, as described below. **All proposals must clearly identify the big data issues, and provide a clear articulation of success measures and validation approaches for the proposed methods.**

All proposals must state the name of the relevant NSF directorate(s) or agency (OFR) on a separate line at the bottom of the Broader Impacts text box. (See instructions in Section V.A.2, under Project Summary).

Foundations (F): Proposals in this category are expected to address the development of highly innovative, fundamental techniques, theories, methodologies, and technologies for big data management and/or analytics—including knowledge management, semantic technologies, and foundational mathematical, statistical, and probabilistic approaches—that have wide applicability beyond specific narrow domains.

Proposals focusing on design and development of novel systems addressing emerging challenges in big data such as *fairness, algorithmic accountability*, *reproducibility*, and *multi-modal interfaces to data (e.g., query, question/answer, dialog, data exploration, etc.)* are encouraged. Proposals that focus only on the scaling up of existing methods should not be submitted, unless the technique used to scale the existing method is itself highly innovative.

Innovative Applications (IA): Proposals in this category must focus on the development of innovative big data techniques, methodologies and technologies for

specific application areas, or innovative adaptations of existing big data techniques, methodologies and technologies to new application areas. Proposals in this category must address a big data challenge of key importance to at least one application domain from one of the participating NSF directorates and/or agencies (OFR). Proposals should be clear about how research in the domain is enabled by the availability of big data and insights provided by the analysis of these big data, i.e., how new problems can be addressed that could not previously be addressed.

It is expected that projects in this category will require close interaction among researchers from technical/methodological disciplines and those from the science and engineering application domains, in order to explore complex, data-driven questions, including development of domain knowledge structures, in one or more domains. Thus, projects are expected to be collaborative in nature, involving researchers from domain disciplines and one or more technical disciplines such as computer science, mathematics, statistics, computational science, etc., stimulating further research on all sides of the collaboration. Of particular interest for engineering-oriented projects are topics that address understanding and application of large-scale dynamic data arising from ubiquitous sensing and control in engineered and natural systems, through multitudes of heterogeneous sensors and controllers instrumenting these systems.

Applicants considering submitting proposals in this category are strongly encouraged to discuss their planned research with a program officer from the respective NSF directorate or participating agency (OFR) in advance of submitting the proposal. It is anticipated that proposals awarded in this category will be jointly, or fully, funded by the participating NSF directorate(s) and/or participating agency (OFR) interested in the application area.

Office of Financial Research (OFR): OFR has a mandate to research, identify and assess risks to the financial stability of the United States and to monitor, investigate, and report such risks to Congress and the Financial Stability Oversight Council. OFR and NSF have shared interests at the intersection of Financial Research and Big Data Analysis. Candidate proposals of interest to OFR must clearly address a big data research question or problem concerning financial stability that involves one or more of the scalability issues that characterize big data analysis, and present a clear pathway from the proposed research to applications or policymaking within OFR's core mission (see http://financialresearch.gov/). Topics of interest for financial stability include, but are not limited to, use of big data in financial stress testing, systemic interactions and feedback effects on financial networks; monitoring of financial systems; identification and quantification of data gaps for financial stability; system-wide integration of financial data; and forensic investigation of failures and disruptions in financial markets. Interdisciplinary teams are strongly encouraged.

All Proposals: Proposals may involve both themes, i.e., *Foundations* (F) and *Innovative Applications (IA)*. However, only one, F or IA, should be selected as the primary thrust of the proposal. See Section V.A.1, Proposal Titles, below on how to identify proposals.

All proposals must be clear about how the proposed work addresses one or more big data challenges such as speed of data generation/rate of data updates; volume of data movement; characteristics of data, such as size and, heterogeneity; large diversity in the user base; etc. Proposals should clearly address why existing techniques cannot be scaled up to address the stated problem.

When possible, proposals should also support efforts for the expansion of the scientific workforce to confront new challenges in big data through training and education activities.

Use of Cloud Resources

In FY 2017, Amazon Web Services (AWS), Google Cloud, and Microsoft Azure are participating in the program to provide cloud credits/resources to projects that can justify the need for significant storage and computational resources. The objective is to encourage projects that focus on large-scale experimentation and scalability studies. AWS, Google, and Microsoft will each provide up to $3,000,000 in cloud resources for relevant BIGDATA projects funded in FY 2017.

While the technical description and justification for use of cloud resources would be expected to be part of the Project Description, details of the cloud resource costing and annual cloud resource usage should be included in the Supplementary Documents section of a given proposal. See Section V.A.6.b, Cloud Costing and Annual Usage Plan, for details on how to provide detailed costing and annual usage information for cloud resources under Supplementary Documents.

Requests for cloud credits/resources must adhere to a 70-30 split in funding between the requested NSF funds and the requested cloud resources, respectively. In other words, if a project requests $700,000 in NSF funds, then it may request up to a **maximum** of $300,000 in cloud credits/resources. The request must be for only one of AWS, Google Cloud, or Microsoft Azure (i.e., not for cloud resources from multiple providers). The **minimum** request for cloud resources for any BIGDATA proposal, regardless of the NSF budget request, may be $100,000—since the objective of this program is to support large-scale experimentation using the cloud resources, and not “routine” use. As an example, a proposal that requests $1,000,000 in NSF funds could request between $100,000 (the minimum allowed) and $430,000 (following the 70-30 split) in cloud credits/resources—on AWS, Google Cloud, **or** Microsoft Azure. The $1,000,000 would be requested in the NSF Budget, with the usual NSF Budget Justification; the cloud credit/resource request—in the range $100,000 to $430,000 for this example—would **not appear** in the NSF Budget pages nor in the NSF Budget Justification section, but rather under Supplementary Documents as described in Section V.A.6.b.

The technical justification for use of cloud resources (to be included in the Project Description), coupled with the cost computation used to arrive at the requested amount of credits/resources as well as the detailed annual plan for usage of these credits/resources over the duration of the project (to be included in the Supplementary Documents*),* will all be carefully reviewed as part of the proposal review process.

III. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. An estimated 27-35 projects will be funded, subject to availability of funds. Up to $26,500,000 will be invested by NSF and the Office of Financial Research (OFR) in proposals submitted to this solicitation, subject to the availability of funds.

AWS, Google, and Microsoft are providing up to $9,000,000 in cloud credits/resources (up to $3,000,000 each).

Projects will typically receive NSF funding in the range of $200,000 to a maximum of $500,000 per year, for 3 to 4 years of support. The minimum award size will be $600,000 of total NSF/OFR funding, reflecting the minimum expected level of effort for BIGDATA projects, which are expected to be multidisciplinary in nature and include significant student involvement. Any allocation of cloud credits/resource from AWS, Google, or Microsoft will be in **addition** to the NSF/OFR funding.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

An individual may participate as PI, co-PI, Senior Personnel, consultant, or any other role in **no more than one proposal**, or related subaward, submitted in response to this solicitation.

In the event that an individual exceeds this limit, any proposal submitted to this solicitation with this individual listed as a PI, co-PI, senior personnel, consultant or any other role after the first proposal is received at NSF will be returned without review. **No exceptions will be made.**

Proposals submitted in response to this solicitation may not duplicate or be substantially similar to other proposals concurrently under consideration by NSF.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp . Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

1. Proposal Title. The proposal title must indicate the BIGDATA program, followed by a colon, then the category (F for "Foundations", IA for “Innovative Applications”), followed by the title of the project. Thus, titles would be **BIGDATA: F: Title** or **BIGDATA: IA: Title**. Titles of collaborative proposals should be prepared in a similar manner, but should also include "Collaborative Research" immediately after F or IA. Thus, the title of each proposal for a collaborative set of proposals would be **BIGDATA: F: Collaborative Research:** or **BIGDATA: IA: Collaborative Research:**, followed by the project title.

2. Project Summary (1-page limit). At the top of the Overview text box enter the title of the BIGDATA project, the name of the PI and the lead institution. Provide a summary description of the BIGDATA project, including its transformative research and education goals, and the community (communities) that will be impacted by its results. In the separate text boxes, provide a succinct summary of the intellectual merit and broader impacts of the proposed project.

All proposals—*Foundations (F)* as well as *Innovative Applications (IA)*—must specify one or more relevant participating NSF directorates or agency (OFR) for the project on a separate line at the bottom of the Broader Impacts text box.

- **List of participating NSF directorates:**
  - Biological Sciences (BIO);
  - Computer and Information Science and Engineering (CISE);
  - Education and Human Resources (EHR);
  - Engineering (ENG);
  - Mathematical and Physical Sciences, Division of Mathematical Sciences (DMS); and
  - Social, Behavioral and Economic Sciences (SBE).

- **Participating agency:**
  - Department of Treasury Office of Financial Research (OFR)

Keywords. All project summaries must include a list of three to six keywords at the bottom of the Broader Impacts text box.

3. Project Description. There is a 15-page limit for the Project Description.

The Project Description should clearly identify:

1. How it addresses a big data challenge;
2. The novelty of the approach;

3. The transformative potential of the proposed research; and
4. The applicability of the proposed technique or technology to a specific domain, if appropriate; and how it enables significant advances in that domain and, potentially, beyond that single domain as well.

An **evaluation plan** is expected in any BIGDATA proposal, and should be provided within the Project Description. The evaluation plan should describe how the techniques, methodologies, theories, and technologies would be evaluated, and can include results from applications of that technology to specific domains, efficacy or scalability studies, and other such activities. Where applicable, evaluation plans should specify benchmark datasets and competing methods that will be used to evaluate scalability and performance, or address the development of new benchmarks, if needed. If the proposal requests cloud resources, the evaluation plan must clearly describe use of these resources. The evaluation plan should be appropriate for the size and scope of the project.

The Project Description must contain, as a separate section within the narrative, a section labeled "Broader Impacts", as described in Chapter II.C.2.d.i of the NSF PAPPG. ***Proposals that omit a separate section that deals explicitly with Broader Impacts in the Project Description will be returned without review.***

4. Use of Cloud Resources. A proposal interested in utilizing AWS, Google Cloud, or Microsoft Azure resources (not more than one) for large-scale experimentation must provide the appropriate technical description(s) and technical justification(s) within the Project Description section. However, as described below in Section V.A.6.b, Cloud Costing and Annual Usage Plan, the computation of the total cost of cloud resources, along with an **annual resource usage plan** over the duration of the project (3 or 4 years) must be provided separately in the **Supplementary Documents** section.

5. Proposal Budget. Proposal budgets should include funds to support principal investigator (PI) travel to the annual BIGDATA PI meeting in Washington, DC. It is expected that at least one PI from each funded project will attend, in order to present project research findings and broader impacts. Collaborative proposals involving investigators from multiple disciplines should have PIs from each of the major disciplines for the grants attending the annual meeting.

6. Supplementary Documents. Supplementary documents are limited to the specific types of documentation listed in the PAPPG, with exceptions specified below. Proposals containing special information or supplementary documentation that has not been explicitly allowed in the PAPPG or this solicitation, such as article reprints or preprints, or appendices, **will be returned without review**. Simultaneously submitted collaborative proposals, and proposals that include subawards, are a single unified project. Supplementary documents for such proposals should only be provided in the proposal submitted by the lead institution. See below for specific instructions for each supplementary document type.

a. Project Coordination Plan - Required of all proposals (page limit: 2 pages). BIGDATA projects typically involve multidisciplinary teams of researchers and students. Thus, a Coordination Plan is an essential component of this activity. All proposals must include a supplementary document of no more than two pages labeled "Project Coordination Plan", which must include:

1. The specific roles of the collaborating PIs, Co-PIs, other Senior Personnel and paid consultants at all organizations involved;
2. How the project will be managed across institutions and disciplines;
3. Identification of the specific coordination mechanisms that will enable cross-institution and/or cross-discipline scientific integration, e.g., workshops, graduate student exchanges, project meetings at conferences, use of videoconferencing and other communication tools, software repositories, etc.;
4. Specific references to the budget line items that support these coordination mechanisms; and
5. A detailed timeline of project activities/milestones.

b. Cloud Costing and Annual Usage Plan (page limit: 3 pages). Projects that intend to use AWS, Google, or Microsoft cloud resources must include a detailed costing, showing a credit usage/resource consumption plan with the amount and type of storage, compute, and network resources (and any other cloud resources needed that incur costs) to be used during each year of the project.

The two important items of the costing plan are:

1. The *total cost* of cloud resources—showing the distribution across storage, compute, and network, etc., resources; and
2. The *annual usage plan*, i.e., how much of these credits/resources will be used each year.

As mentioned earlier, the minimum total request can be for $100,000. Requests for less than $100,000 in cloud credits/resources will not be considered. The maximum is based on a 70-30 split. For example, a project that requests, say, $700,000 on the NSF Budget page may request a maximum of $300,000 of cloud credits/resources. Or, a project that requests $1,000,000 from NSF/OFR can request a maximum of $430,000 of cloud credits/resources.

Cloud credits and/or resource costs should be computed using the information provided by AWS, Google, or Microsoft, respectively. **Proposers are strongly encouraged to contact the appropriate point of contact for each cloud vendor** to obtain assistance with estimating cloud resources needed for the project. The estimate for cloud resources should account for:

- Software development and testing;
- Code inefficiencies and code errors that may consume more resources than anticipated; and
- Additional experiments beyond those initially anticipated.

Proposers must use the following resources in order to develop the total cost of cloud resources, and to develop an annual usage plan over the duration of the projects:

- AWS
  - The website for computing AWS compute, storage and networking costs is https://calculator.s3.amazonaws.com/index.html.
  - The website for computing AWS SPOT prices is https://aws.amazon.com/ec2/spot/pricing/.
  - AWS cloud resources are provided as part of the AWS Promotional Credits program (https://aws.amazon.com/awscredits/). Use of AWS credits must adhere to this program. Please refer to the website for information about this program.
  - The AWS Technical Point of Contact is Sanjay Padhi, sanpadhi@amazon.com.
- Google Cloud
  - The website for computing Google credits/costs is https://cloud.google.com/products/calculator/.
  - The Google Cloud technical point of contact is Karan Bhatia, karanbhatia@google.com.
- Microsoft Azure
  - The website for computing Microsoft Azure costs is https://azure.microsoft.com/en-us/pricing/calculator/.
  - The Microsoft Azure technical point of contact is Vani Mandava, vanim@microsoft.com.

c. Data Management Plan, including Software Sharing - Required of all proposals (page limit: 3 pages). Data Management Plans are an important aspect of every proposal and play a critical role in ensuring public access to results of federally-funded research. All proposals must include a supplementary document of no more than three pages labeled "Data Management Plan", which must include a Software Sharing Plan (see below). This supplement is provided in full by the lead institution. The Data Management Plan should describe how the project will manage its data and software and share its research results (including software). The Data Management Plan will be fully evaluated by the reviewers, using NSF review criteria.

Data management requirements and plans specific to the NSF Directorates are available at: https://www.nsf.gov/bfa/dias/policy/dmp.jsp.

The Data Management Plan may include information on:

1. The types of data, software, curriculum materials, and other materials to be produced in the course of the project;
2. The standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be

documented along with any proposed solutions or remedies);
3. Policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements;
4. Policies and provisions for re-use, re-distribution, and the production of derivatives;
5. Plans for archiving data, samples, and other research products, and for preservation of access to them; and
6. A software sharing plan, with appropriate timelines, as described below.

The Software Sharing Plan (with appropriate timelines) is required of all proposals as part of the Data Management Plan. There is no prescribed single license for software produced through grants responding to this announcement. However, the Big Data program does have goals for software dissemination, and reviewers will be instructed to evaluate the dissemination plan relative to these goals:

1. The software should be freely available to science and engineering researchers and educators in the non-profit sector, such as education institutions, research institutions, and government laboratories.
2. The terms of software availability should permit the dissemination and commercialization of enhanced or customized versions of the software, or incorporation of the software or pieces of it into other software packages.
3. To preserve utility to the community, the software should be transferable so that another individual or team can continue development in the event that the original investigators are unwilling or unable to do so.
4. The terms of software availability should include the ability of researchers to modify the source code and to share modifications with other colleagues. An applicant should take responsibility for creating the original and subsequent official versions of a piece of software.
5. To further enhance the potential impact of their software, applicants may consider proposing a plan to manage and disseminate the improvements or customizations of their tools and resources by others. This proposal may include a plan to incorporate the enhancements into the official core software, may involve the creation of an infrastructure for plug-ins, or may describe some other solution.
6. If a particular license is selected for the software distribution, it should be specified in the proposal. If an open-source license is not selected, the proposal should explain why this decision was made.

d. Human and vertebrate subjects. Documentation regarding research involving the use of human subjects, hazardous materials, vertebrate animals, or endangered species should be included where applicable. (See PAPPG Chapter II.D.4 and II.D.5).

e. Letters of collaboration. As per the NSF PAPPG (See PAPPG Chapter II.C.2.j), letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. The recommended format for letters of collaboration is as follows: “If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal.”

Please ensure that appropriate details are provided in the Project Description, and/or Facilities, Equipment or Other Resources. Proposals that plan to utilize specific resources, such as the NSFFutureCloud platforms, will be expected to provide letters of collaboration from the respective organization(s).

f. Postdoctoral mentoring plan (page limit: 1 page). This one-page supplementary document, describing how postdoctoral researchers will be mentored, is required of all proposals that include funding for postdoctoral researchers. The lead institution provides this mentoring plan for the entire project. Reviewers will be asked to review the mentoring plan, as appropriate.

g. A list of Project Personnel and Partner Institutions (Note: In separately submitted collaborative proposals, only the lead institution should provide this information):

Provide current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage conflicts of interest. The list must include all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, project-level advisory committee members, and writers of letters of support. If the project includes a Transition to Practice (TTP) option, this list must include personnel and institutions involved in the option. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel
3. Jane Brown; XYZ University; Postdoc
4. Bob Adams; ABC Inc.; Paid Consultant
5. Mary White; Welldone Institution; Unpaid Collaborator
6. Tim Green; ZZZ University; Subawardee

Single Copy Documents.

Collaborators and Other Affiliations Information:

For this solicitation, the *Collaborators & Other Affiliations* information specified in the *PAPPG* should be submitted using the spreadsheet template found at https://www.nsf.gov/cise/collab/. For each proposal, a completed spreadsheet for each PI, co-PI, or senior personnel must be uploaded directly into Fastlane in .xls or .xlsx format as a “Collaborator and Other Affiliations” Single Copy Document. NSF staff use this information in the merit review process to help manage reviewer selection; the spreadsheet will ensure the Collaborator and Other Affiliations information has a common, searchable format.

Note the distinction to (g) above for Supplementary Documents: the listing of all project participants is collected by the project lead and entered as a Supplementary Document, which is then automatically included with all proposals in a project. The Collaborators and Other Affiliations are entered for each participant within each proposal and, as Single Copy Documents, are available only to NSF staff. Collaborators and Other Affiliations due to participants listed on (g) that are not PIs, co-PIs, or senior personnel can be uploaded under Additional Single Copy Documents using Transfer File.

Proposals that do not comply with these requirements will be returned without review.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

It is expected that at least one principal investigator (PI) from each funded project will attend an annual BIGDATA PI meeting in Washington, DC, to present project research findings and broader impacts. Collaborative proposals involving investigators from multiple disciplines should have PIs from each of the major disciplines for the grants attending the annual meeting. Requested budgets should include funds for travel to this event.

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  March 15, 2017 - March March 22, 2017

D. FastLane/Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.

Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.i., prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    1. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    2. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

1. BIGDATA Foundations proposals must be clearly motivated by application use cases and/or characteristics of real big data datasets and address the innovation with respect to the computer science, mathematical, statistical, and/or computational theories proposed.
2. BIGDATA Innovative Applications proposals must represent genuine partnerships between researchers in the technical community (i.e., computer scientists, statisticians, mathematicians) and in science and engineering domains (i.e., science, engineering, social sciences, finance, etc.).
3. All BIGDATA research proposals must include a description of what makes the project a big data research effort, as opposed to a traditional data research effort.
4. The Broader Impacts of BIGDATA proposals must be made clear. This may include:
    - Transforming interdisciplinary and collaborative research;
    - Enabling interdisciplinary training;
    - Developing infrastructure appropriate for advancing the development of novel techniques and technologies;
    - Providing sustainable shared data infrastructure;
    - Ensuring the availability of data and related source code and software to the scientific community and general public;
    - Enabling long-term stewardship of data and related software; and
    - Other similar impact(s).
5. All proposals must provide clear plans for *evaluation and validation* that demonstrate the effectiveness and efficacy of proposed solutions, in the context of specific big data datasets.
6. Proposals that request cloud resources must provide proper justifications for the use of these resources and the levels of the requests. It is expected that cloud resources will be requested and used for large-scale experimentation and scalability studies (and not for routine usage).

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will be completed and submitted by each reviewer. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

NSF will coordinate and manage the review of proposals. Relevant information about proposals and reviews of proposals will be shared with OFR program staff as appropriate. Proposals selected for support by OFR will be awarded by NSF using funds transferred from OFR.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division

Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

BIGDATA awardees receiving cloud credits/resources under this program are required to include appropriate acknowledgment of NSF and the corresponding cloud provider support in reports and/or publications on work performed under the awards. An example of such an acknowledgement would be: “This material is based upon work supported by the NSF under Award No. <NSF award number(s)>, using resources provided by <name of the cloud credit/resource provider> as part of the NSF BIGDATA program."

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp .

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Chaitanya Baru, Senior Advisor for Data Science, CISE/OAD, telephone: (703) 292-4541, email: cbaru@nsf.gov

- Sylvia Spengler, Lead Program Director for BIGDATA, CISE/IIS, telephone: (703)292-8930, email: sspengle@nsf.gov
- Reed S. Beaman, Program Director, BIO/DBI, telephone: (703) 292-7163, email: rsbeaman@nsf.gov
- John C. Cherniavsky, Program Director, EHR/DRL, telephone: (703) 292-5136, email: jchernia@nsf.gov
- Almadena Y. Chtchelkanova, Program Director, CISE/CCF, telephone: (703) 292-8910, email: achtchel@nsf.gov
- David Corman, Program Director, CISE/CNS, telephone: (703) 292-8754, email: dcorman@nsf.gov
- James C. French, Program Director, CISE/IIS, telephone: (703) 292-8930, email: jfrench@nsf.gov
- Edward Garnett, Program Manager, Office of Financial Research, telephone: (202)927-8025, email: edward.garnett@ofr.treasury.gov
- Jun (Luke) Huan, Program Director, CISE/IIS, telephone: (703) 292-8930, email: jhuan@nsf.gov
- Nandini Kannan, Program Director, MPS/DMS, telephone: (703)292-8104, email: nakannan@nsf.gov
- Sara Kiesler, Program Director, SBE/SES, telephone: (703) 292-8643, email: skiesler@nsf.gov
- Bogdan Mihaila, Science Advisor, MPS/OAD, telephone: (703) 292-8235, email: bmihaila@nsf.gov
- Rahul T. Shah, Program Director, CISE/CCF, telephone: (703) 292-2709, email: rshah@nsf.gov
- Stathis Tompaidis, Assoc Director, Office of Financial Research, telephone: (202)927-0758, email: stathis.tompaidis@ofr.treasury.gov
- Ralph Wachter, Program Director, CISE/CNS, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Chengshan Xiao, Program Director, ENG/ECCS, telephone: (703) 292-4753, email: cxiao@nsf.gov
- Maria Zemankova, Program Director, CISE/IIS, telephone: (703) 292-7348, email: mzemanko@nsf.gov
- Aidong Zhang, Program Director, CISE/IIS, telephone: (703) 292-5311, email: azhang@nsf.gov
- Nan Zhang, Program Director, CISE/IIS, telephone: (703) 292-8930, email: nanzhang@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

General Correspondence email

For general correspondence, please reply to bigdata@nsf.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-

5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at https://www.nsf.gov

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center)**:** (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230