Academic Mentoring Workshop

Writing Competitive Research Proposals

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First Principles

- Get to know the agency’s programs in your area
  - Lay of the land
- Review program “summary of awards”
  - Past trajectory
- Get to know your program officer(s)
  - Current trajectory
- Participate in agency-sponsored workshops
  - Help set future trajectories
- Serve on review panels and as an ad hoc reviewer
  - Exposure to lots of proposals
  - Exposure to many proposal evaluators
- Stay informed
  - NSF email updates: Daily Digest Bulletin
- Develop good proposal-writing habits

Adapted from Bryant York, PSU
Types of Proposals

- **Research**
  - Single-investigator
  - Multi-investigator

- **Research Infrastructure**

- **Education**
  - Curriculum Development and Innovation
  - Training and Advancement

- **Special Opportunities**
  - NSF RAPID, EAGER, FASED, Travel, Workshops, GRFs, Postdoctoral Fellowships, Faculty Fellowships (industry or foundations), Special Projects, etc.

- **Supplements** – standard, REU, RET, ROA
- **SBIR, STTR**

Adapted from Bryant York, PSU
First Principles and Types of Proposals

- Funding Agency Information: NSF
- Research Proposal Preparation
- Tips for Writing Competitive Proposals
2009 DOD does not show adds Congress will insert in the appropriations bill.

NSF ‘14 budget request: $7.625 billion (>7.7% over enacted ‘13 level)
CISE 2014 budget request: $950 million (~10% increase over ‘13)
NSF CISE Directorate

Office of the Assistant Director for CISE

Computing and Communications Foundations (CCF)
- Algorithmic Foundations (AF)
- Communications and Information Foundations (CIF)
- Software, Hardware Foundations (SHF)

Computer and Network Systems (CNS)
- Computer System Research (CSR)
- Networking Technology and Systems (NeTS)

Information and Intelligent Systems (IIS)
- Human-Centered Computing (HCC)
- Information Integration and Informatics (III)
- Robust Intelligence (RI)

Crosscutting CISE, NSF Emphasis Areas
- EiC
- I-Corps
- CPS
- XPS
- SaTC
- SCH
- NRI, CE21
- CRI, MRI
- REU, RET
- CAREER
- CDI, ADVANCE
- IGERT, GK-12

Division of Advanced Cyberinfrastructure
Outline

✓ First Principles and Types of Proposals

✓ Funding Agency Information: NSF

• Research Proposal Preparation
  (some slides adapted from NSF)

• Tips for Writing Competitive Proposals
Research is a wonderful process of inquiry and discovery for making advancements on critical societal challenges.
A fundable proposal describes a good idea and attainable goal, well expressed and motivated, with a clear indication of methods for pursuing the idea, evaluating the findings, making them known and having broad impact.
Properties of a Research Goal

- Simple to state
- Not obvious how to do it
- Clear benefit
- Progress and solution are testable
- Can be broken into smaller steps
  - So that you can see intermediate progress

By Jim Gray, Turing Award Winner
http://research.Microsoft.com/~Gray/talks/Turing2.ppt
Proposal Life Cycle

Conceptualize
Write & Revise
Funded!
Declined
Try again
End
What next?
Start
Conceptualize
NSF Proposal Review and Award Process & Timeline

Organizations submit proposals via FastLane to the NSF Program Processing Unit. After receipt, the NSF Program Director conducts an initial administrative review. If necessary, proposals may undergo a minimum of three merit reviews, either through mail, panel, or both. The Program Director analyzes and recommends proposals, which are reviewed and concurred by the Division Director. If the proposal is deemed inappropriate or withdrawn, it is returned. Proposals that are awarded are processed by the NSF Proposal Review and Award Unit. The timeline includes 90 days for proposal receipt, 6 months for proposal review and decisions, and 30 days for DGA review and processing of award.
Proposal Submission Preliminaries

- **Who can submit NSF proposals?**
  - Universities and colleges
  - Non-profit, non-academic organizations
  - For-profit organizations
  - State and local governments

- **What to submit?**
  - Letter of Intent, Preliminary Proposal, Full Proposal

- **When to submit?**
  - Target date, deadline, and submission window

- **Where to submit proposals?**
  - FastLane (https://www.fastlane.nsf.gov)
  - Grants.gov (http://www.grants.gov)

- **Why submit?**
  - Enables the advancement of research and education

- **How to know about funding opportunities?**
  - Program Descriptions, Program Announcements, Dear Colleague Letters, and Program Solicitations
  - via NSF email updates or NSF website (other distribution lists)
Step 1: Carefully Read the Program Descriptions and Solicitations

• **Find the right program early!**
  – It’s better to do this well before you write than after you get your reviews back

• **Talk with your Program Director to make sure your ideas fit in the program**
  – If the Program Director (PD) tells you that your ideas are too narrow or don’t fit the program, look for other sources

• **Make sure your project is worthwhile, realistic, well-planned, and innovative**
Step 2: Develop Your Good Idea

- **Key Questions**
  - What do you intend to do and how will you do it?
  - Why is it important?
  - What does the literature provide?

- **Make sure the idea is innovative and exciting**
  - Survey the literature
  - Talk with others in the field

- **Convince people you can accomplish it**
  - Obtain preliminary data to support feasibility
  - Determine available facilities and resources
    - What infrastructure do you have to work with?
    - With whom will you work (students, collaborators, industry partners)?
Step 3: Prepare the Submission

NSF Grant Proposal Guide (GPG)
http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_index.jsp

• Preparation and submission instructions
  – Proposal format and contents
  – Collaborative proposals from multiple institutions
    • One submission with “sub-awards” from lead institution
    • Separate simultaneous proposal submissions (FastLane)
  – Return without review criteria

• Review criteria and review process
  – Withdrawal
  – Invite/Not-Invite, Encourage/Not-Encourage
  – Award/Declination

• Post Award Processes
NSF Proposal Contents

- Cover Sheet and Certifications
- Project Summary *(one page max)*
- Table of Contents
- Project Description *(typically 15 pages max.)*
- References cited
- Biographical Sketches *(2 pages/Senior Investigator)*
- Budget and Budget Justification *(3 pages max.)*
- Current and Pending Support *(all sources)*
- Facilities, Equipment and Other Resources
- Supplemental Documentation
  - all proposals must include *Data Management Plan*
  - support for postdocs require *Postdoc Mentoring Plan* *(1 page)*
  - add’l allowed docs may vary by programs and directorates
- Single Copy Documents
  - Reviewer suggestions, confidential information, etc.
This one page summary is critical
- Not an abstract; a self-contained description of the activity
- May affect which program or panel will review your proposal
- Must address both Intellectual Merit and Broader Impacts

Written in third person

Intellectual Merit
- Describe the scientific/engineering problem and its importance
- State the overall objective and specific aims of the project
- Describe how the objectives and aims will be achieved

Broader Impacts
- Educational & outreach activities; infrastructure; dissemination of results; underrepresented groups; benefits to society
The *Intellectual Merit* of the proposed activity

- Creativity, originality, *and potentially transformative*
- Potential to advancing knowledge and understanding within and across fields
- Conceptualization and organization
- Qualifications of investigators
- Access to resources
Objectives, method/approach, potential impact compelling?

How important is the activity to advancing knowledge and understanding within the field or across different fields?

- Significance of expected results: incremental? high impact? high-risk but high-gain?

How well qualified are you to conduct the research?

- Not necessary to have track record on specific topic, but quality of prior work usually a consideration, as are preliminary results

How creative, original are the concepts and ideas?

- Should be ground-breaking in some aspect

How well conceived, organized is the proposed activity?

- Well-articulated problem and well-structured research plan

Is there sufficient access to resources?

- Ownership is not necessary, only access to equipment, facilities, human capital, …
The **Intellectual Merit** of the proposed activity

- Creativity, originality, and potentially transformative
- Potential to advancing knowledge and understanding within and across fields
- Conceptualization and organization
- Qualifications of investigators
- Access to resources

• The **Broader Impacts** of the proposed activity

- Discovery while promoting teaching, training and learning
- Participation of underrepresented groups
- Enhancement of infrastructure for research and education
- Dissemination of results to enhance scientific and technological understanding
- Benefits to society
Does the activity advance discovery and understanding while promoting teaching, training and learning?

Does the activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?

Will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?

Will the results be disseminated broadly to enhance scientific and technological understanding?

What may be the benefits of the proposed activity to other disciplines and society as a whole?

(See www.nsf.gov/pubs/gpg/broaderimpacts.pdf)
The **Intellectual Merit** of the proposed activity

- Creativity, originality, and potentially transformative
- Potential to advancing knowledge and understanding within and across fields
- Conceptualization and organization
- Qualifications of investigators
- Access to resources

- The **Broader Impacts** of the proposed activity

  - Discovery while promoting teaching, training and learning
  - Participation of underrepresented groups
  - Enhancement of infrastructure for research and education
  - Dissemination of results to enhance scientific and technological understanding
  - Benefits to society

- **Program-specific merit review criteria**
  - Some programs have additional review criteria in solicitation

- **There are NSF general statements regarding intellectual merit and broader impact, but also some programs list examples of these criteria specific to the program**
Project Description

- Max. 15 pages (preliminary proposals fewer)
- Objectives and expected significance
- Relation to present state of knowledge
- General plan of work
- Experimental methods and procedures
- Broader impacts
- Results from prior agency-sponsored support
  - required, if applicable (5 pages max., typically fewer)
- (Optional: relation to your longer term goals)
- URLs not to be used; unlimited references--add’l pages
- Unbudgeted substantial collaborations documented
  - letters of commitment in supplementary documents
Project Description (Possible Outline)

- **Introduction (~2 pages)**
- **Related Work and Research Scope (~2-3 pages)**
- **Proposed Research (~5-6 pages)**
- **Research Plan (~2 pages)**
  - How proposed techniques will be evaluated
  - Experimental set-up/tools/methods
  - Timeline of major milestones (by year)
- **Broader Impact (~1-2 pages)**
  - Research Community/Industry
  - Education
  - Outreach to broaden participation
- **Results from Prior NSF Support (~1 page)**
- **References (unlimited pages, but typically < 6 pages)**
Project Description

• **Tip: Know your audience – reviewers, PD!**
  - Write accurately, concisely, and clearly
  - Make it easy for reviewers to like your proposal
  - First few pages engage or lose the reviewer
  - Figures and tables help get points across clearly
  - Some reviewers (particularly on interdisciplinary proposals) may not be experts in your specific field
Biographical Sketch

- **Limited to only two pages—prescribed format**
- **Professional preparation**
  - degrees, postdoc(s)
- **Appointments**
  - reverse chronological order
- **Publications—submitted, accepted, appear**
  - up to 5 closely related
  - up to 5 other significant publications
- **Synergistic activities**
  - up to 5 examples that demonstrate broader impact, service
- **Collaborators & other affiliations (for COIs)**
  - collaborators, co-authors (last 4 yrs) & co-editors (last 2yrs)
  - graduate and postdoctoral advisors
  - thesis and postgraduate-scholar (past 5 years) advisees
Budget

• **Budget should be**
  - for each year of support requested
  - reasonable, but request what is needed
  - for personnel, equipment (> $5K), travel, participant support and other direct costs (sub-awards, consultants, materials & supplies publication costs)
  - for cost of educational activities associated with research, where appropriate

• **A separate budget needed for each sub-awardee**

• **No NSF expectation of cost sharing component**

• **Budget must be accompanied by Budget Justification for direct cost line items (3 pages max.)**
  - 2 months salary maximum in any one year
  - admin staff salaries counted in indirect cost (few exceptions)
  - list only number of grad and undergrad students in budget
Current and Pending Support

• List all current and pending support, including the proposal being submitted
  – Fed, state, local, foreign, industrial, private
  – all funded activities requiring a portion of your time

• Be careful of overlap
  – perceived overlap could be detrimental in review
  – same work not to be funded twice!

• Concurrent submissions of same proposal (not BIO)
  – allowed to multiple programs (bad idea); agencies OK
  – must withdraw proposal if gets funded elsewhere

• Resubmission of prior proposals
  – if funded before, must include last period in current/pending list
  – if declined before, must be revised substantially for resubmission; otherwise can be returned without review
Supplementary Documentation

All materials included in merit review (seen by reviewers)

- **Data Management Plan (2 pages max.)**
  - required of *all* proposals (can say “no plan needed”)
  - must conform to dissemination/sharing policy

- **Postdoctoral Researcher Mentoring Plan (1 page max.)**
  - required if postdoc support is requested
  - description of mentoring activities
  - included in merit review

- **Program-specific Management Plans**
  - typically for large and center-scale proposals

- **Letters of Commitment**
  - unbudgeted collaborations of significance
  - “letters of support” endorsements not to be included
Outline

✓ First Principles and Types of Proposals

✓ Funding Agency Information: NSF

✓ Research Proposal Preparation

• Tips for Writing Competitive Proposals (some slides adapted from NSF)
Access Available Help

**Proposal Writing Workshops and Resources:**

- [http://www.clarku.edu/offices/research/pdfs/NSFProposalWritingTips.pdf](http://www.clarku.edu/offices/research/pdfs/NSFProposalWritingTips.pdf)

**Read:**

- Sponsoring agency publications
- Successful proposals

**Look before you leap:**

- Serve as a proposal reviewer and panelist

**Talk with people in-the-know:**

- Current and former Program Directors
- Successful colleagues, mentors, reviewers
Access Other Sources

- **Agency Publications**
  - Program Solicitations
  - Grant Proposal Guide
  - Web Pages
  - Funded Project Abstracts
  - Reports, Special Publications

- **Program Directors**
  - Incumbents
  - Former “Rotators”, “IPAs”

- **Mentors on Campus**

- **Previous Panelists**

- **Sponsored Research Office**

- **Successful Proposals**
Be Reasonable

- **Start early and get feedback**
  - Write, rewrite, and rewrite again...

- **Be aware of the research scope:**
  - “Too ambitious” vs. “Too narrow”

- **Be honest and up-front:**
  - Address issues instead of trying to hide them
  - Acknowledge possible experimental problems and have alternatives
Make It Easy for Reviewers

• **Know your audience:**
  – All reviewers may not be experts in your specific field

• **Simplify and streamline:**
  – Make sure you get your main idea(s) across

• **Pay attention to details:**
  – Run the spell checker and proof-read
  – Prepare clear photos, graphs, etc.
  – Make the font size as big as you can (minimum of 6 lines per inch with 1” page margins!)
Basis for Decisions: Reviewer Input

• **Reviews**
  – Content/justification of the reviews by reviewers oftentimes is more important than just the rating

• **Panel Ranking**
  – Proposals (competitive ones) often ranked by panel

• **Program Director uses reviews and panel summary/recommendation in award decisions**
  – Fairness
  – How substantive the reviews are
  – Technical problems raised in the reviews
    • major vs. minor issues
  – Reasons for the reviewer concerns or enthusiasm
Evaluation: Ad Hoc and Panel Reviews

• **A minimum of 3 reviews/proposal** (typically 4 or more)
  • A score of E, V, G, F, P is given by each reviewer
  • Comments on intellectual merit and broader impacts
  • Typically, a recommendation to fund (or not) is given

• **Panel Review:**
  • Proposals are discussed and **evaluated collectively**
  • **Proposal summary** is written—couple of sentences
  • Intellectual merits are described: strengths, weaknesses
  • Broader impacts are described: strengths, weaknesses
  • Improvements may be suggested (optional)
  • **Panel recommendation:** Highly Competitive (HC), Competitive (C), Low Competitive (LC), Not Competitive (NC)

• **Comments are intended to help unsuccessful PIs improve their proposals for the next competition**
Basis for Decisions: Balanced Portfolio

- Program Director uses other information in addition to reviewer input in making decisions
  - Innovation and creativity
    - High risk, high reward projects
  - Breadth of research areas
  - Priority areas and systems
  - Demographics, diversity along many dimensions
    - Broadening participation
    - Institutional impact: EPSCOR, MSI, PUI, etc.
    - International collaborations
  - Integration of research & education
Number of FY'03 Proposals: 29,164 Declines, 10,791 Awards (37% success)
Why Do Some Proposals Fail?

- **Absence of innovative ideas**
  - At best, provides only incremental advances
  - Not exciting or cutting edge
  - “just another proposal about”

- **Errors**
  - Unclear or incomplete expression of aims
  - Faulty logic or experimental design
  - Less than rigorous presentation

- **Unrealistic, sloppy or incomplete**

- **Resources and facilities not in place**
  - PI qualifications/expertise not evident
  - Necessary collaborations not documented
Seven Deadly Sins of Proposal Writing

1. Failure to focus on the key problems and payoffs
2. No persuasive structure: *poorly organized*
3. No clear differentiation: *competitive analysis*
4. Failure to offer a compelling value proposition: *potential impact*
5. Key points are buried: *no highlights, impact is lost*
6. Difficult to read or appreciate: *full of jargon, too many low-level technical details or not enough details*
7. Credibility killers: *misspellings, grammatical errors, wrong technical terms, inconsistent format,* ...
There may be no “best” (or only) way to write a competitive research proposal, but many successful ones share similar characteristics

- clearly written, well motivated, organized, original, targeted, important, accomplishable, impactful, significant

Funding depends on many things, some of which are beyond your control

- availability of funds, portfolio of existing funded research projects, set of reviewers, timing, ...

Be persistent and give your best effort; success will come!
Useful NSF On-line Documents

- **FY 2014 NSF Budget Request**

- **FY 2012 NSF Budget**

- **Grant Proposal Guide (NSF 04-23)**

- **Science and Engineering Statistics**

- **General Information**