**Title:** ICES: Large: Modeling Social and Economic Behavior using Narratology

**Sponsor:** NATIONAL SCIENCE FOUNDATION

**Investigator(s) Information:**
- PI: MANDELL, LAURA
- E-mail: mandell@neo.tamu.edu
- College: TAMU-COLLEGE-LIBERAL ARTS
- Department: TAMU-ENGLISH(00037)
- Sys Pt.: TAMU

**Human Subjects:** Yes

**Lab Animals:** Yes

**Recombinant DNA:** Yes

**Conflict of Interest:** Yes

**Infectious Biohazards:** Yes

**Commercial Potential:** Yes

**International Effort:** Yes

**Scientific Diving:** Yes

**Radioactive Material:** Yes

**Involves University Faculty:** Yes

**Use of University Facilities:** Yes

**Renovations Required:** Yes

**BUDGET INFORMATION**


25. Duration: 3 Yr(s) 0 Mo(s)

26. Total Sponsor Support: $577,044.00

27. Total F&A Cost: $158,956.00

28. Total F&A Cost Base: $341,840.00

28a. F&A Amount Waived: $0

**COST SHARING INFORMATION**

33. Institutional Services:

Account Number | $ Amount
--- | ---

34. External Sources:

(Name): $0

35. Total Project Cost ($ = #26 + #31 + #32): $577,044

**ANNUAL REPORT CODES**

17. Activity

18. Field of Science

19. Area of Special Interest


21. Selection

22. Sponsor

23. LBB Requirement

**DOCUMENT REVIEW/APPROVAL SHEET**

- Project Function:
  - Research
  - Public Service/Extension
  - Scholarship/Fellowship

- Multi. Submission: Yes

- CFDA No.: 47.075

- TAMU #:

- TAMRF #:

- Other #:

- Mail by: 12/6/2011
# Routing Progress

**1201146 - LAURA MANDELL** "ICES-Large: Modeling Social and Economic Behavior using Narratology"

Submitted by **RESEARCH FOUNDATION ROUTING on behalf of LAURA MANDELL**

<table>
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<th>Notified</th>
<th>Completed</th>
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**Comments**

LAURA MANDELL  
ERGUN AKLEMAN  
TAKASHI YAMACHI  
STEFANO FRANCHI  
VPR OFFICE  
NANCY B WARREN  
TIMOTHY MCLAUGHLIN  
LUDY T BENJAMIN  
ALBERTO MOREIRAS  
GERIANNE M ALEXANDER  
LOUIS G TASSINARY

Comments by HELEN WISE on behalf of ROUTING COORDINATOR

*HELEN WISE bypassed this routing step on 20-Dec-2011 9:42:44 AM*
REQUIRED ASSURANCES

Investigator's Name  Laura Mandell  RF Number  1201146

Please check the appropriate box:

→ Each investigator on the project must complete the financial interest check boxes below
(attach additional pages if necessary)

☑ To the best of my knowledge and belief, I have no significant financial interest* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed.

☐ I have significant financial interests* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed. I will provide confidential supporting documentation to The Texas A&M University System Member designated in the proposal.

Please indicate if the following items will be involved in this research project. (Please check one of the responses for each category, as these responses will be the basis for certifying your proposal.)

→ This section only needs to be completed by the Principal Investigator.

☑ Yes  ☐ No - Human Subjects  ☑ Yes  ☑ No – Human Embryonic Stem Cells

☑ Yes  ☑ No – Explosives  ☑ Yes  ☑ No – Drug Enforcement Administration (DEA) Controlled Substance

☑ Yes  ☑ No – Infectious Biohazards  ☑ Yes  ☑ No – Recombinant DNA

☑ Yes  ☑ No – GLP/GMP/GCP Practices (If Required by Sponsor)  ☑ Yes  ☑ No – Radioactive Materials/Radiation Producing Devices

☑ Yes  ☑ No – Classified or Proprietary  ☑ Yes  ☑ No – Commercial Potential

☑ Yes  ☑ No – Scientific Diving  ☑ Yes  ☑ No – Nepotism

☑ Yes  ☑ No – Environmental Release of Infectious, Hazardous or Genetically Altered Substances

☑ Yes  ☑ No – Vertebrate Animals  ☑ Yes  ☑ No – International Effort  ☑ Yes  ☑ No – Facility Renovations  ☑ Yes  ☑ No – Involves Work at BSL3 Lab

Species: __________________________

Involved Nations: __________________________

If renovations are required - ☑ Under $4 million  ☐ Over $4 million

BSL3 Location: __________________________

Other PIs involved in BSL3 work: __________________________

* - "Significant financial interests" are defined as (1) An equity interest that when aggregated for the Investigator and the investigator's spouse and dependent children, meets both of the following tests: Exceeds $10,000 in value as determined through reference to public prices or other reasonable measures of fair market value, and represents more than a five percent ownership interest in any single entity; or (2) Salary, royalties or other payments that when aggregated for the Investigator and the investigator's spouse and dependent children over the next twelve months, are expected to exceed $10,000.
REQUIRED ASSURANCES

Investigator's Name  Stefano Franchi  RF Number 1201146

Please check the appropriate box:

☑ Each investigator on the project must complete the financial interest check boxes below (attach additional pages if necessary)

☑ To the best of my knowledge and belief, I have no significant financial interest* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed.

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REQUIRED ASSURANCES

Investigator's Name Takeshi Yamauchi RF Number 1201146

Please check the appropriate box:

➢ Each investigator on the project must complete the financial interest check boxes below (attach additional pages if necessary)

☐ To the best of my knowledge and belief, I have no significant financial interest* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed.

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REQUIRED ASSURANCES

Investigator's Name  Ergun Akleman  RF Number 1201146

Please check the appropriate box:

☑ Each investigator on the project must complete the financial interest check boxes below (attach additional pages if necessary)

☐ To the best of my knowledge and belief, I have no significant financial interest* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed.

☐ I have significant financial interests* involved in this proposal that may affect, or be perceived to affect, the results of the research proposed. I will provide confidential supporting documentation to The Texas A&M University System Part designated in the proposal.

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PROPOSAL SUBMISSION CONFIRMATION

Proposal 7208185 has been successfully submitted to NSF

Dec 06 2011 4:24PM EST

This proposal has now been assigned the following NSF Proposal Number:
1216078

Please make a note of this number, it is the official NSF proposal number.
Your Signature has been recorded

Download Adobe Acrobat Reader for viewing PDF files

National Science Foundation
4201 Wilson Boulevard, Arlington, Virginia 22230, USA
Tel: 703-292-5111, FIRS: 800-877-8339 | TDD: 703-292-5090

Privacy and Security
Submit only ONE copy of this form for each PI/PD and co-PI/PD identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. **DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.**

**PI/PD Name:** Laura Mandell

**Gender:** □ Male ☒ Female

**Ethnicity:** (Choose one response) □ Hispanic or Latino □ Not Hispanic or Latino

**Race:** (Select one or more)
□ American Indian or Alaska Native
□ Asian
□ Black or African American
□ Native Hawaiian or Other Pacific Islander
□ White

**Disability Status:** (Select one or more)
□ Hearing Impairment
□ Visual Impairment
□ Mobility/Orthopedic Impairment
□ Other
□ None

**Citizenship:** (Choose one) □ U.S. Citizen □ Permanent Resident □ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project □

**Ethnicity Definition:**
**Hispanic or Latino.** A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

**Race Definitions:**
**American Indian or Alaska Native.** A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

**Asian.** A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

**Black or African American.** A person having origins in any of the black racial groups of Africa.

**Native Hawaiian or Other Pacific Islander.** A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

**White.** A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

**WHY THIS INFORMATION IS BEING REQUESTED:**

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization’s eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information received from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational opportunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information 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", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).
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**PI/PD Name:** Ergun Akleman

**Gender:**
- [x] Male
- [ ] Female

**Ethnicity:** (Choose one response)
- [ ] Hispanic or Latino
- [x] Not Hispanic or Latino

**Race:**
- (Select one or more)
  - [ ] American Indian or Alaska Native
  - [ ] Asian
  - [ ] Black or African American
  - [ ] Native Hawaiian or Other Pacific Islander
  - [x] White

**Disability Status:**
- (Select one or more)
  - [x] Hearing Impairment
  - [ ] Visual Impairment
  - [ ] Mobility/Orthopedic Impairment
  - [ ] Other
  - [ ] None

**Citizenship:**
- (Choose one)
  - [x] U.S. Citizen
  - [ ] Permanent Resident
  - [ ] Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name):
- [ ]

**REQUIRED:** Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project
- [x]

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PI/PD Name: Stefano Franchi

Gender: ☑ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☑ Not Hispanic or Latino

Race: (Select one or more)
☑ American Indian or Alaska Native
☐ Asian
☐ Black or African American
☐ Native Hawaiian or Other Pacific Islander
☐ White

Disability Status: (Select one or more)
☐ Hearing Impairment
☐ Visual Impairment
☐ Mobility/Orthopedic Impairment
☐ Other
☐ None

Citizenship: (Choose one) ☑ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☐

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☐

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02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS (PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form for each PI/PD and co-PI/PD identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.C.a. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. **DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.**

**PI/PD Name:** Takashi Yamauchi

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<tr>
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<th>☒ Male</th>
<th>☐ Female</th>
</tr>
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<td>Ethnicity: (Choose one response)</td>
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</tr>
<tr>
<td>Race: (Select one or more)</td>
<td>☒ Asian</td>
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<td>Disability Status: (Select one or more)</td>
<td>☐ Hearing Impairment</td>
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</table>

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List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:
Not Listed

REVIEWERS NOT TO INCLUDE:
Not Listed
COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO.: CLOSING DATE(s) not in response to a program announcement/solicitation enter NSF 11-1

NSF 11-584 12/06/11

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S): (Indicate the most specific unit known. I.e. program, division, etc.)

SES - Inter Com Sci Econ Soc S (ICE)

DATE RECEIVED NUMBER OF COPIES DIVISION ASSIGNED FUND CODE DUNS# (Data Universal Numbering System) FILE LOCATION

12/06/2011 2 04050000 SES 8052 020271826 12/06/2011 4:44pm

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

746000531

SHOW PREVIOUS AWARD NO. IF THIS IS A RENEWAL:

☐ YES ☐ NO If YES, list acronym(s)

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? ☐ YES ☐ NO

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Texas A&M University Main Campus

AWARDEE ORGANIZATION CODE (IF KNOWN)

0036327000

ADDRESS OF Awardee ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Texas A&M University Main Campus
2701 General Services Complex
College Station, TX. 778431260

NAME OF PRIMARY PLACE OF Perf

Texas A&M University Main Campus

ADDRESS OF PRIMARY PLACE OF Perf, INCLUDING 9 DIGIT ZIP CODE

Texas A&M University Main Campus
400 Harvey Mitchell S., Ste 300
College Station ,TX ,778454321 ,US.

IS Awardee ORGANIZATION (Check All That Apply)

☐ SMALL BUSINESS ☐ MINORITY BUSINESS

☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT

ICES: Large: Modeling Social and Economic Behavior using Narratology

REQUESTED AMOUNT

$ 577,044

PROPOSED DURATION (1-40 MONTHS)

36 months

REQUESTED STARTING DATE

09/01/12

SHOW RELATED PRELIMINARY PROPOSAL NO.

IF APPLICABLE

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.D.2)

☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)

☐ PROPRIETY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)

☐ HISTORIC PLACES (GPG II.C.2.j)

☐ EAGER" (GPG II.D.2) ☐ RAPID** (GPG II.D.1)

☐ VERTEBRATE ANIMALS (GPG II.D.6) ACUC App. Data

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HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

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Electronic Signature
CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, lobbying activities (see below), responsible conduct of research, nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 11-1). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

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(If answer 'yes', please provide explanation.)

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Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

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This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

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Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

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(2) for other NSF Grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

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* EAGER - Early-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

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Project Summary
Modeling Social and Economic Behavior Using Narratology

In this grant request, we propose a general framework for designing and constructing non-deterministic models that simulate social and economical interactions. Our general framework re-interprets the concept of “framing,” as understood in classic behavioral economics, based upon narratology, a formal sub-discipline of literary and digital media studies. Our general framework allows us to create a simple mathematical and computational representation from which we can develop narrative models that can be used to evaluate specific situations.

After testing hypotheses consonant with this framework by asking participants in our study to make choices based on carefully framed questions, we will develop a modular and web-based system for the visualization, design, and construction of models that can be used to effectively simulate a broad range of social and economic interactions. The availability of the system on the web, open-source, will allow researchers to use narrative structures in order to interpret network behavior and will encourage them to extend the model by adding new tools to the underlying structure. Thus we envision our system growing beyond the life of the grant.

**Intellectual Merit:**
We are motivated by the desire to bring story-making to bear on understanding human choices in as robust a manner as has been done with game theory. The basic premise of our grant proposal is that narrative colors an agent's perception and consequently his or her choices about how to act. There is a rich intellectual history behind this premise.

Applying narrative theory to understanding decision-making fills a gap in the way we have been thinking about network behavior intellectually. Emotional influences on rational decisions need to be rendered calculable—graphable—while the concept of “bias” is at once too subjective and too blunt an instrument for calculating human action and reaction. Narratology fills the breach, allowing us to measure what actants might do based on the stories in which they imagine themselves situated, and yet, to our knowledge, this science that has been developed fully over the course of the twentieth century, has not yet been applied to narrowing decision-making models into a tractable computational problem.

**Broader Impact:**
This highly interdisciplinary research bring concepts from digital humanities and philosophy to bear upon economics, psychology, mathematics, computer graphics, visualization, computer science, and software development. In addition to benefiting students who work on the project, those who learn from them, including groups under-represented in STEM, using our framework to understand network behaviors will, we believe, inspire students who learn about it to consider that their "opponents" in any given conflict are mentally simulating stories in the context of which their behavior makes sense, however destructive the opponent’s actions may be. Ideally, our work will help people able see other points of view despite their own emotional investments in their own stories.

**Keywords:** narratology, computer science, social science, economics, decision-making
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3 PROJECT DESCRIPTION

In this grant request, we propose a general framework for designing and constructing non-deterministic models that simulate social and economical interactions. Our general framework re-interprets the concept of framing, as understood in classic behavioral economics, based upon narratology, a formal sub-discipline of literary and digital media studies. This general framework can potentially be used to design and construct models that have significantly more "explanatory" power than deterministic models of networked interactions.

Based on this general framework, our goal in this proposal is to develop a modular and web-based system for the visualization, design, and construction of decision models that can be used effectively in a broad range of social science and economic applications. We will develop the system as an open-source project. The modularity of the system will encourage people to add new tools while taking advantage of the powerful underlying structure, even long after the NSF-sponsored phase of the project has ended.

To make this goal a reality we have formed a multidisciplinary team of researchers with a comprehensive background in digital humanities, mathematics, computer science, philosophy, and psychology. This will permit the development of generalized theoretical and practical methods, based on powerful insights, and will facilitate the sharing of our methods and implementations.

3.1 Research Hypothesis

Our research hypothesis is that the concept of framing, as understood in classic behavioral economics [52] can be analyzed as a story understood in the standard narratological sense [30, 39, 26, 27].

In other words, the framing context within which a decision-maker forms a choice can be understood as a particular stage in the development of a narrative with clearly individuated actors (actants, in narratology terms) and a specific story-line (an unfolding plot). The choice actually made will thus depend—to an extent to be empirically determined—on the degree to which any particular actant / decision-maker identifies with a particular role (hero, antagonist, and so on) in a dynamically evolving storyline. Our overall research objective is to apply what is known about story to the decision-making process in order to achieve better predictions of network states.

This research hypothesis can be assessed by providing:

1. A general framework of story narratives that allows us to design and construct formal models of social and economical interactions;

2. An empirical study that applies the formal models to actual social and economic interactions and evaluates actual choices with respect to the models.

The section below provides more details about these two items in turn.

3.2 Research Objectives

1. General framework of story narratives: Our first objective is the development of a general framework of story narratives. We propose to represent narratives as sequences of "observational states." The transition from one observed state to the next (the narrative event) is governed by narratological rules prescribing which events are allowed and which are not within any given story structure. Our formal representation will therefore have a static aspect—pertaining to the representation of states —and a dynamic aspect—pertaining to the event-based transition from one observed state to the next:

   (a) Static representation: In our general framework at any isolated moment actants are represented by a series of internal and relational states that are described simply by a graph (or a network)
in which the actants are placed in the vertices of the graph and the relationships between actants are represented by the edges of the graph. Edges and vertices of the graph carry five layers of information that can provide physical, expressional, observational, and narratinal states of actants and their actions. See subsection 3.4.1 below for more details.

(b) Events: We represent events as a transformation from one state to another state. To represent transformations, we will develop narratological story grammars. These grammars will be based on classical grammars [12]. However, like L-systems will provide parallel and context-sensitive evolution [40] to handle parallel and context-sensitive natures of events. As a result, the events will be the result of the application of narratological story grammars within particular narrative types. Research in narratology has shown that the unfolding of a narrative can be modeled via the application of a small set of functions over actants. Our work will extend this model by adapting the functions provided by narratology's story grammars to the network-based, static representation for the sake of assessing its predictive power.

2. The assessment of our approach: Our second objective is the assessment of our approach in actual decision-making situations. Our hypothesis to be assessed is that much of known economic decision problems that arise in a complex interconnected environments (e.g., information cascading; decision made in aggregate; information contagion; decisions due to psychological biases) can be explained by the parameters of narratives. When confronted with a choice, people form stories according to their narratological stance, and their decisions are framed and executed according to their sense-making contexts.

3.3 Motivations and Previous Work

The notion of bounded rationality by Simon and Gigerenzer [24, 48] as well as prospect theory by Tversky and Kahneman [49, 50, 51, 29, 28] have revealed the crux of the problems in traditional expected utility-based theories of economic decision making. The fundamental insight developed in these theories is that people as information processors have limited cognitive capacity (e.g., working memory and attention span). Thus, decision makers settle with satisfactory choices rather than exhausting their search space to obtain the optimal outcome. To overcome processing limitations, people are said to apply "toolboxes" of heuristics that produce quasi-optimal decisions in a bounded environment [24].

The idea of people as information processors is at the heart of the Cognitive Revolution, where prevailing shortcomings of behaviorism were fatally exposed. Its credo is epitomized in Simon and Newell's notion that physical symbols and hypothesis-symbol manipulations are the prerequisite for any intelligent system. People as information processors need to deal with their limited resources; thus, various heuristics are said to be hardwired into the human processing mechanism. Decision biases such as our excessive focus on recent events, representative samples, and prospective happiness are consequences of relying upon such heuristics.

In the last twenty years, research on behavioral decision making has been dominated by the discovery of "biases." Although the bias-based theories of decision making have advanced the field enormously, their popularity also highlighted their weaknesses. For one, there are so many "biases" in decision theories that the term "bias" itself lost its explanatory power. Just to name a few, impact bias, projection bias, recency bias, memory bias, distinction bias, or sampling bias are assigned to every deviation from rational behavior. In this regard, behavioral decision making research has become more like bookkeeping than thinking.

We propose that the latest research in cognitive linguistics, cognitive neuroscience, and cognitive science can offer a unifying paradigm: human information processing is "symbolic" and "embodied" [7, 6]. Abstract symbols are not so abstract in the sense that they are loaded with concrete experience of bodily states such as emotion, perception, and sensation. For example, given an abstract sentence such as "I fully grasped your proposal," sensori-motor neurons that process actual activities of hand movements (i.e., grasping) are shown to be reactivated in the process of comprehending the sentence [41, 42]. Given this framework, we think
that the notion of bounded rationality and cognitive biases can be subsumed by the theory of embodiment, or more broadly the narratological stance—
the way people understand the world by creating a "story." How is embodiment related to narrative?

During the 1980s, linguists George Lakoff and Mark Johnson [30] began to investigate how language that comes from observation of the physical world—embodied language—is used to encode the kinds of objects that things are imagined to be. Literal language has been formed out of dead metaphors drawn from our physical relationship to the word: the word "impediment," for instance, comes from the Latin im/not ped/foot—my foot cannot go there. When people say that they would like to spend more time at home, "Time" is metaphorically conceived as a commodity or precious resource like money, something that can be "spent." We haven't always spoken about time this way. Time was said to spend itself, or the verb was used reflexively: "time spent me little" meant "it took me a little amount of time," the Oxford English Dictionary tells us. That changed until around the time that John Locke began writing about humans owning property in their own labor. It is only common to say "I spent my time," in other words, after wages began to be paid for hourly labor, and from this one can see the meaning of Ludwig Wittgenstein's adage: "To imagine a language is to imagine a form of life" [54].

Lakoff and Johnson posited that metaphors about objects cohere in a gestalt that is a narrative structure. When one sees a gun, for instance, one imagines a well-defined set of possible stories into which such an object can fit. Published shortly after Metaphors We Live By in 1980, Jerome S. Bruner's Actual Minds, Possible Worlds [11] also investigated how linguistic forms spawn narrative structures that in turn inform perception, thinking, and ultimately human action. A 21st-century book articulates the assumptions that we adopt in our research: "We define our conscious experience by constructing narratives about ourselves and the people with whom we interact. Narrative pervades our lives—conscious experience is not merely linked to the number and variety of personal stories we construct with each other within a cultural frame, but is subsumed by them" [21].

Do people think in stories? The narrative revolution in cognitive psychology in which Lakoff, Johnson, and Bruner participated supplanted approaches in which conscious processes seemed predominantly rational. In the psychological science of decision-making, there have been over the last four decades similar challenges to rational-choice theory. In reflecting upon what he now calls "prospect theory" [51] and how he and Amos Tversky developed it in the 1970s, Daniel Kahneman from the retrospect of 2000 regrets having chosen the term "frame" for both the form of expression "to which decision-makers are exposed" and "the interpretation" made by people making decisions on the basis of that expression [29, p. xiv]. "Bias" is the term for the latter used by Kahneman in his most recent work [28]. The problem with such a term from our perspective is that it does not take into account the fact that "bias," though subjective, is structured by narrative.

Just recently, in theorizing human behavior in networks, David Easley and Jon Kleinberg have adopted game theory in order to understand choices people make. In combining network, game, and graph theory, they are able to analyze choices and behaviors at a scale not yet possible. They cannot, however, engage in "extensive analysis" [15, p. 179]. But all possible choices and all possible ramifications can in fact become calculable when we examine economic behavior not as rationally profit-maximizing alone but also as limited by stories that agents tell themselves as they observe activities and events. Just as cognitive science crossed disciplinary boundaries into narratology in order to explain human thought processes, in other words, economists who are analyzing networks now need to move toward narratology in order to explain risk taking and interactive response.

In discussions about digital games in the 1990s, theorists debated over the usefulness of narratology for understanding them. These debates were capped by a conference in which Janet Murray insisted that every game, even checkers, tells a story, and Espen Aarseth, responding partly to her paper, insisted that they do not: chess, he said, involves no narrative; "The 'royal' theme of the traditional pieces is all but irrelevant to our understanding of chess" [53, pp. 2; 48].

But although narratology may not be useful for analyzing games, in fact choices amongst possible moves in a game are subtly motivated by narrative. When one tries to play chess using a different story, using pieces from
star wars, for instance, rather than the traditional set, it takes a long time before one can even "see" possible moves: one has to think consciously about equivalents with the traditional pieces. From Segall, Campbell, and Herkovits's 1966 treatise on perception describing the Carpentered World Hypothesis [46] to Roy D'Andrade's Development of Cultural Anthropology [14], we have known that cultural knowledge influences even immediate perception of the physical world. Even apparently instantaneous perceptions of what to do, such as how to move pieces in a chess game, are motivated by any agent's belief that he or she is playing a role in a particular story.

Narratological analysis was started in the 1920s by Vladimir Propp [39], who developed a grammar covering a restricted corpus of Russian folktales. Propp's analysis decomposed each specific story that he analyzed into an initial state comprising a small collection of characters (dramatis personae) and a set of narrative functions over states. The application of a function to a state produces either the end state (the end of the story) or a new state (events as they occur, progressing toward the end). Propp showed that a small set of about 30 narrative functions plus a few constraints on the ordering of functions could generate the whole chosen corpus of Russian folktales.

Propp's analysis was used in some early story-telling programs in Artificial Intelligence [33, 34, 31, 32], with limited results. One reason for this is that Propp's account of characters is imprecise and overly generic, while the set of functions he identified is too redundant and ad hoc, in fact reflecting the specific features of the stories that he chose to analyze. Consequently, it is difficult to apply Propp's theory to other categories of stories and even more difficult to obtain a truly general theory of all possible stories from it. Thus, shortcomings of early attempts in AI to use narrative are a direct consequence of problems in applying Propp: the range of stories the programs could generate was very limited and any effort to broaden their scope was inherently ad hoc.

Propp's theory was substantially refined by the French Structuralists in the 1960s [8, 26, 10], when a distinct discipline called "narratology" emerged. Our proposal follows the approach first advanced by Greimas [26]. Greimas introduced the concept of "actant" in place of Propp's characters and showed that a generic story could be analyzed in terms of the circulation—regulated by strict rules—of valuable objects among a very limited number of actants. Artificial Intelligence research in story-understanding and story-telling ignored post-Propp narratological research until very recently. Partly as a result of the work of Herman [27] and Ryan [43], computational approaches to narrative [35] have gained a renewed impetus and the computational representation of standard narratological models is one of explicit goals in the field [44, 23, 37, 20].

3.4 Proposed Work

Our proposed work consists of four stages. The first stage is the development of a general framework of story narrative which can be used for developing models that can simulate social and economic interactions. In the second stage, we will build a system based on this framework. This system will then be used to simulate particular social and economic interactions. We will make the system available on the web as an open source project so that other researchers can also construct their own context-specific models. In the third stage, we will solve specific problems using our models, trying to predict some social and economic behaviors. In the last stage, we will conduct experimental studies to validate our results.

3.4.1 General Framework of Story Narratives

We are currently developing a general framework of story narratives that can be used for modeling social and economic interactions between individuals and groups. Our general framework is based upon the observation that humans are not rational agents who act "only" to maximize certain cost functions. On the other hand, we point out that humans do not act arbitrarily. Their actions result from imperfect knowledge combined with personal, social and behavioral threads. Thus, in our general framework we consider humans as narrative
characters called actants who may act irrationally, but their actions are not arbitrary and are still governed by discernible rules.

First we model the physical human who can never been fully observed and known. It is just one of the layers in the model. Another is the "actant" who has a narratological existence and can act based on limited knowledge using narratological rules. This layering allows us to develop a general framework that can consider both rational and irrational behaviors. Our framework ultimately consists of five layers which are connected via causality relationships. The layers and causality relationships between them are shown in Figure 1. The layers are following:

- **Physical Layer**: This is the layer where all actants physically exist and interact. We assume that at any given moment in time the physical layer has a well-defined state, which is given as the collection of all the states of all humans involved. In our model, the physical versions of actants are nothing but boxes or containers that carry states. Physical versions of actants have two types of physical states:
  
  - **Internal states**: These states are only about the actants themselves. For instance, being dead is a possible internal state for an actant. However, that actant's "container" does not cease to exist by being dead. Its container still exists but the state of that container is "not-living." Internal states can be emotional in nature—agents can be "angry" or "happy"—or of a physical type: "tired" or "sleepy."
  
  - **Relational states**: These are the internal states that define one actant's "real" relation to and "real" feeling towards another actant. For instance, one actant can be the daughter of another, or one actant may hate another actant. Note that relational states are not necessarily reciprocal.

We call any change in the state of the physical layer a **physical event**. For instance, "dying" is an event that turns a physical version of an actant from "living state" into a "non-living" state. Similarly "falling in love" is an event in which one of the physical states of an actant, an emotional one, turns from "neutral" to "love." Note that these events are all factual. Physical versions of actants do not have the capability to observe even themselves. They are just boxes or containers that carry states which are continuously changing. Other layers turn these physical versions of actants into more complicated beings.

- **Expression Layer**: This is the layer in which some of the states of the physical layer become expressed. An expression can be formalized in terms of a transformation from the physical layer to the expression layer. A wide variety of forms of expressions can be created such as facial expressions, verbal expressions, or postural expressions. Relatively small changes in state can cause widely different expressions as shown in Figure 2. It is therefore hard to include expressions into our model. One of our contributions
in this proposal is that we do not consider all these forms nor how all expressions are produced. Instead, we focus on the source of expressions. Our approach simplifies dealing with expressions. In terms of sources, we consider two types of expressions:

- **Expressions of internal states:** These expressions demonstrate only the internal states. For instance, an angry actant may have a frown, may shout, or may simply smile, like Claudius in Shakespeare's *Hamlet*. Shouting and frowning may clearly suggest that the actant is angry. On the hand, smiling can hide the fact that the actant is angry internally. Note that expressions that hide internal states may not necessarily be intentionally hidden. The actants themselves may not know that they are, in fact, angry.

- **Expressions of relational states:** These are expressions of one actant’s feeling towards or relationship to another. For instance, one actant who hates another may say "I hate you" or simply look annoyed. On the other hand, the actant can even act as if s/he likes the other person by hiding his/her true feelings. Even a relationship between two people can be expressed or denied. For instance, a father may tell his son "You are not my son." Again, these misleading expressions may not necessarily be intentional. It may be the case that the actant is angry, but it could also be that he does not know that he is the actual father. Expression itself does not change the physical fact that he is the father.

As can be seen from this discussion, expressions may unintentionally or intentionally hide or demonstrate the facts. However, they do not change the facts about physical states. We call any change in expression a **expression event**. An expression event usually manifests a physical event. On the other hand, without any change in physical states, an expression may change.

- **Observation Layer:** Actants can observe expressions, and observations can also be misleading about physical states and the meaning of expressions. We consider several types of observations.

  - **Self observation (Self awareness):** This is the actants’ observations of their own internal states. Note that this observation may affect the expression. Therefore, in the Figure 1 we show that observation layer affects the expression layer. The effect can work two ways. A actant who is aware of his/her internal state can hide it or show it based on its narrational layer. On the other hand, an actant who is not aware of his/her internal state cannot deliberately choose to show it regardless of its narrational layer. Therefore, both narrational and observation layers affect the expression layer.

  - **Observations of expressions of others’ internal states:** These observations are transformations that can also be misleading. For instance, based on their own narrational layers, two actants can observe/interpret the same expression differently. For instance, an angry expression can be observed as tired by one actant whose story is about love and as anger by another whose narrational layer involves competition.
3.4 Proposed Work

- **Observations of expressions of relational states:** These observations can also be misleading. For instance, an actant says "I love you" and one receiving actant can observe it as a manipulation, another receiving actant observes it as a manifestation of real love.

Just as we also have observational events, changes in observation will be defined as events. In such events, nothing in the physical or expression layers need change; however, at least one actant changes its observation. A far-fetched example comes from the movie *6th Sense*, in which the character of Bruce Willis was not aware that he was already dead. The movie ends as he realizes that he is dead. This new observation did not change any existing facts, but, we consider it to be an event since observation changes.

- **Narrational Layer:** The key in our framework is this narrational layer. It affects all the other layers directly or indirectly. The actants place themselves in a story and act, observe and express. We assume that everybody in society plays role and acts according to these roles [25]. Each role may change through time. The actants' behaviors also depend upon their observation of which "story" they think they are participating in: in other words, different stories offer a finite number of roles, and specific roles suggest particular stories. We can effectively assign descriptions of roles to actants and make them behave based on their assigned archetypes. Thus, we divide the narrational layer into two parts:

- **Archetype:** Actants see themselves as narratological characters, here called an archetype. Our archetypes will be extracted from stories [45]. These archetypes include but are not limited to heroes and heroines, villains, leaders, conquerers, rebels, outlaws, badboys; actants can play the roles of best friend, nice guy, confidant, charmer, playboy, rogue, lost soul, wanderer, outcast, professor, absent-minded, organized, adventurer, daredevil, explorer, warrior, avenger, knight, boss, princess, seductress, dark lady, siren, spunky kid, girl next door, working girl, free spirit, comedian, darling, waif, innocent, orphan, librarian, know-it-all, bookworm, crusader, zealot, rescuer, nurturer, caregiver, wise woman, gossip, snob. It is also possible to use more abstract Archetypes such as Hippocrates' Four Temperament Styles: worker, talker, watcher, and thinker. There are many other classifications [13, 45].

- **Plot:** This classification describes which "story" the actants think they are participating in. Based on classical narratology theory [39, 37, 36, 38], we consider a plot as a linear chain of observation-layer events. The reason we only consider observation-layer events is that physical- and expression-layer events may not necessarily be observed. That is also the reason why only the observation layer affects the narrational layer. Note that observation events are actant based. In other words, the same sequence of physical events can be observed as two different stories by two different actants. For instance, consider the Snow White story. The events in the story can be understood differently from the viewpoint of a bystander actant, the stepmother, Snow White, the Prince, or one of the seven dwarves.

Any change in plot or archetype is called an event in the narration. If an archetype change manifests itself in the observation layer, that may define a plot. There are three plots that are based on archetype changes, namely maturation, metamorphosis and transformation.

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1Examples of classifications include the Enneagram classification: perfectionists, helpers, achievers, romantics, observers, questioners, adventurers, asserters, peacemakers. There are also others such as Jungan Characters: the Extrovert vs. the Introvert; people who rely upon Intuition Based Perception vs. Observation (Sense) Based Perception; those who judge by Thinking vs. those who judge by Feeling. Divari provides another classification: mover, observer, relater, energizer. The DISK Method classifies archetypes as dominant/driver (fast paced and task oriented), influencing/inspiring (fast paced and people oriented), stable/steady (slower paced and people oriented), compliant/correct (slower paced and task oriented).
• **Action Layer:** The action layer is where actants act to create events. Events in the action layer can precipitate events in all other layers including the narration layer as shown in Figure 1. In other words, the action layer controls and produces events in every layer – transitions from one state to another state – as the application of narratological story grammars within particular narrative genres. Research in narratology has shown that the unfolding of a narrative can be modeled via the application of a small set of functions occurring over time. Our work will extend this model by adapting the functions provided by Greimas’s story grammar in order to represent changes in the states of networks based on the choices, actions, and reactions of individual actants.

This general framework conceptualizes the social and economic relations and allows us to create a simple mathematical and computational representation from which we can develop a system and construct context-specific models. In the next section, we present how we will turn this general framework into a mathematical and computational structure.

### 3.4.2 Mathematical and Computational Representation

One of the advantages of the framework is that it clearly assigns different functions to different layers thus making it possible to develop a mathematical and computational representation. We will represent the system as a graph where each vertex will carry the information about internal states and each edge will carry information about relational states. Thus, each vertex and directed edge of the graph will present information about the physical, expression, observation, narrational and action layers corresponding to each actant.

More importantly for this proposal, we treat each layer in Figure 1 as a black box. Each block box has a state and has inputs and outputs as shown in the figure. What we call information is simply the current state of the box. Based on the inputs, the state of the boxes changes and outputs are created. Note that although each layer is represented by a separate black box, the layers are vertically connected since they share the same graph. Let $\mathcal{S}$ denote the space of all possible states and for all layers on the graph and $S_i$ denote the space of all states in any given layer in the graph where $i = 0, \ldots, 4$ with layer 0 being physical, layer 1 being expression, layer 2 being observation, layer 3 being narrational, layer 4 being action layers.

Although $S_i$'s may look complicated, they are simply a collection of all the possible information that can exist in vertices and edges. For the sake of simplicity, we assume that we give a unique index $j$ to every vertex of the graph. If we assume that the graph is completely connected, every directed edge can be indexed by two numbers $(j_0, j_1)$. Note that we allow the cases where $j_0 = j_1$, since we consider an actant's feeling towards itself. We can, then, simply denote the information in layer $i$ and vertex $j$ with two subscripts, $v_{i,j}$, and denote the information in layer $i$ and directed edge $(j_0, j_1)$ as three subscripts, $e_{i,j_0,j_1}$.

We propose to represent any information in vertices as a point in an $n_{i,0}$-dimensional unit hypercube, such that $v_{i,j} \in [0, 1]^{n_{i,0}}$ and edges as a point in $n_{i,1}$-dimensional unit hypercube, such that $e_{i,j_0,j_1} \in [0, 1]^{n_{i,1}}$. Note that the dimensions of the information in all vertices are the same. Similarly, the dimensions of the information in all edges are also the same.

It will be easier to give an example to explain how such a system can work. The expression layer has three inputs coming from the physical layer, the action layer, and the observation layer, and it has only one output going to observation layer. For simplicity, let us consider a graph with one one vertex, i.e. a system only with one actant. Let this actant have only one dimension in every layer. In the physical layer, a number between $[0, 1]$ defines whether the actant is internally happy or unhappy with 1 being happy and 0 being unhappy. In the observation layer, we also have a number between $[0, 1]$ that defines whether the actant knows its internal state, where 1 means that the actant observes its internal state and 0 means that the actant does not observe it. In the action layer, 1 means that the actant wants to show the emotion, 0 means that the actant wants to conceal the emotion. In the expression layer, 1 means that the actant smiles and 0 means that the actant’s facial expression remains neutral. If happiness is $v_0 = 0.8$, observation is $v_2 = 0.7$, and $v_4 = 0.6$, then, based on these three
values, we will write a function that will assign a value to \( v_1 \). Designing these functions will be an important part of our research. For the sake of discussion, let us assume that we compute \( v_1 = v_0 v_2 v_4 \), then adopt the given value \( v_1 = 0.336 \), which means that there will be 33.6% of a smile. In other words, although there is a strong feeling of happiness, this particular actant is not likely to express it in this moment. However, note that this expression is fed to the observation layer. In the observation layer, we now have an inconsistency since \( v_2 = 0.7 \) provides a positive feedback to make the actant to smile more by increasing \( v_1 \). On the other hand, if the smile exceeds a certain value, the action layer will start to decrease \( v_1 \).

This simple example demonstrates that the key concept in our proposal is to have a conflicting feedback mechanism that can result in an equilibrium by self-correction. However, such a system can also have a positive feedback and create destruction and oscillation, which we also see in social and economic systems.

We believe that, if we let people design their own specific models, this representation can be great tool to test and verify assumptions about how networks will change in a wide variety of applications. In the next section, we discuss how we will implement a system that can provide such a tool.

3.4.3 Implementation

Our ultimate goal in this proposal is to develop a modular and web-based system for the visualization, design, and construction of models that can be used effectively in a broad range of social science and economic applications. The underlying structure of our system will be based on our general framework that can potentially provide significantly more power than any deterministic model in predicting network behavior. We will develop the system as an open-source project. The modularity of the system will encourage people to add new tools while taking advantage of the powerful underlying structure, even long after the NSF-sponsored phase of the project has ended.

To make this goal a reality we have formed a multidisciplinary team of researchers with a comprehensive background in digital humanities, mathematics, computer science, philosophy, and psychology. This will permit the development of generalized theoretical and practical methods, based on powerful insights, and will facilitate the sharing of our methods and implementations. The power of our system will derive from the underlying structure based on the general framework that is described here. Our first goal is to implement the underlying structure as a simple software kernel which will then help to design and construct specific models for specific problems. Our kernel will also provide strong visualization capabilities in order to develop user interfaces that can simplify design and construction processes.

Implementation of such an internet-based basic kernel is not really difficult because of the conceptual simplicity of our general framework. Using such a kernel, it will also be easy to design and construct simple models in which the number of actants is small and the number of states is limited. On the other hand, the real challenge will be the construction of the models with a large number of actants and states. Thus, a significant amount of our effort will go to developing intuitive interfaces that can help researchers in social sciences and economics design and construct their own complicated models. We will also provide tools for researchers to custom tailor user interfaces for their own purposes.

To achieve this goal, we will first be sure that the kernel is simple and extensible, allowing modular development, and then we will provide strong visualization tools. This extensibility and modularity will allow to build a variety of user interfaces based on the same kernel. We expect that the classical theory of narratology can provide useful approaches for the development of some user interface concepts. These approaches make it possible for researchers using our tool to automatically construct a model with large number of actants and behaviors based on the type of the stories that might exist in the model. For instance, if we want to create model in which there will be one or two quest plots, a few love plots and one rivalry plot, we can automatically create main heroes and heroines. We can also automatically create supporting actants such as the best friend, confidant, charmer or absent-minded sidekick. Pre-fabricated story elements can be composed to investigate larger, more complicated network interactions.
Another user-interface issue involves the description of states, expressions and observations. Although the underlying framework could be the same, for intuitive understanding of behavior it important to assign intuitive labels to states, expressions and observations. In the earlier examples we chose labels from human social interactions. However, using labels such as "anger" or "smile" may not be meaningful for modeling stock-market or internet interactions. For instance, in the case of the stock market, one may want to consider physical states as decisions to buy or sell stocks. Expressions may be actual buying or selling actions and observations can be stock prices and other market information. Note that this is just one possible way to view stock market interactions. Another researcher may choose a completely different set of labels for physical states, expressions and observations. Note that regardless of how we assign labels, the underlying mathematical and computational structure will be the same and it will use the same kernel. Therefore, a good user interface with intuitive labeling makes evaluation of the model easier.

3.4.4 Design and Construction of Specific Models for Specific Problems

Although our ultimate goal is to provide a system for other researchers, we will also work on some problems to demonstrate the power of our general framework. We will also investigate approaches for automatically finding model parameters that can produce desired output. We will investigate two approaches:

- **Simulating stories**: In this problem, we will investigate whether we can automatically create model parameters from a given story defined as a sequence of observational events. We will start with a set of graphs and create sequences of observational events from a given graph. Then, by using genetic algorithms, we will create new descendant graphs based on a fitting function. This idea may seem to be too far-fetched. However, if it is possible to automatically create actants that match related story descriptions, then we will have validated that our general framework can be used to identify personalities of real people from a given sequences of news events.

- **Story construction**: In this problem, we will investigate whether it is possible to semi-automatically create a particular story, which is again a sequence of observational events. In this case, we will provide an web-based interface for people who want to create stories. We still plan to use genetic algorithms; however, in this case, the users will decide which models can have offspring. If such a semi-automatic method can create a desired story structure, this approach again can be used to to identify personalities of real people from a given sequences of news events. For instance, it may be possible to identify how people narrativize their activities in committing terrorist acts.

An interesting application of our general framework lies in economic decision-making, and this application can also be used for evaluating the effectiveness of the approach.

3.4.5 Evaluating the Effectiveness of the Approach

**Goal**: The goal of this stage is to verify our general framework of story narratives by designing and testing a computational model for behavioral decision-making. Our hypothesis is that much of "irrational" decision behavior (e.g., cognitive biases and framing effects) can be explained by the parameters of narratology: decision makers form mental stories according to the narratological context in which they believe themselves to be situated.

We will address classic network problems of behavioral decision making such as the diffusion effect, information cascading, coordination problems, and preferential attachment, and we will investigate the extent to which our narratology-based accounts can offer alternative explanations for these decision problems. 

**Experiments**: We aim to test our narratology-based computational system and theory by (1) conducting behavioral experiments and (2) analyzing the results with respect to our computational model. Our central hypothesis is that a decision maker constructs a mental simulation of the events in interpreting a decision situation
The mental simulation is guided by narratological structures; thus, our formal analysis of narratology is expected to offer specific predictions with a broader scope than the existing theories of behavioral decision making. Below are samples of the materials with which we aim to test our narratology hypotheses and computational vehicle. In the experiments, approximately 2000 participants will be recruited from an online survey site (https://www.mturk.com/mturk/welcome) as well as from the psychology subject pool. Participants will read a series of vignettes (20 vignettes / participant) describing certain choice situations. Participants’ preferences will be assessed by their ratings given to particular choice options as well as their own explicitly articulated narratives (verbal justifications and explanations of their choices).

**Specific Hypothesis 1: direction of action.** Hypothesis 1 supposes that mental pictures involving the direction of action such as "into" versus "out of" tailor people's story construction. Thus, subtle variations of the decision scenarios shown below are expected to influence people's choice about behavior. To articulate hypothesis 1, we provide a coordination problem, such as deciding whether to participate in a political demonstration or not [15]. The standard account of the coordination problem is that the degree of participation is predicted by the activity of one's cohorts. As his neighbors, siblings, and friends participate in an activity, he is more likely to participate in the activity.

**Prediction from hypothesis 1.** As Kleinberg and Easley point out, the imitation proposal does not explain why people choose to imitate others [15]. We predict that the coordination problem will be modified with an introduction of different mental narratives. Below, scenario A creates a metaphor of moving toward the action as a protagonist (e.g., "You are walking into an Occupy Wall Street demonstration"), whereas scenario B creates a metaphor of moving "out of" action as an antagonist ("You are walking away from an Occupy Wall Street demonstration"). This subtle difference in mental narratives are expected to result in different choice patterns. We predict that scenario A is more likely to induce participation than scenario B based upon the narrative structure implied by "into" and "away from" respectively.

| Scenario A: You are walking into an Occupy Wall Street demonstration in New York. On a 0-100 scale, please rate the likelihood that you would join the demonstration if: |
| 1. Your fiancée is in the demonstration. |
| 2. Your boss is in the demonstration. |
| 3. Your neighbors are in the demonstration. |
| Scenario B: You are walking away from an Occupy Wall Street demonstration in New York. On a 0-100 scale, please rate the likelihood that you would join the demonstration if: |
| 1. Your fiancée is in the demonstration. |
| 2. Your boss is in the demonstration. |
| 3. Your neighbors are in the demonstration. |

Table 1: Example 1a. The direction of action: into vs. from

The next example uses different verbs to formulate different narrative structures. Scenario A creates a mental picture of static action such as "shielding" motion of a moving object ("In order to contain the European debt crisis,") while scenario B creates an image of diverting a moving object ("In order to divert the European debt crisis,"). Thus, choice 1 is consistent with scenario A whereas choice 2 is consistent with scenario B. Accordingly, our model predicts that choice 1 should receive a higher rating in Scenario A than Scenario B.

**Specific hypothesis 2a: dualism in people.** Organizing the world in terms of "us" versus "others" is a strong predisposition predicted by our narratological model. This tendency is prevalent in many political and economic discourses dating back to ancient Greece and China. Our narratology hypothesis predicts that shifting the identification of actors from "we" to "others / people" should create a significant deviation of choice behavior. Specifically, ratings given to choice 1 should be lower in scenario A ("We should stop driving SUVs") than in scenario A ("People should stop driving SUVs") (Table 3).

**Specific hypothesis 2b: dualism modulates preferential attachment.** In highly interconnected environments, people's choice behavior is influenced by what others do. This creates so-called "preferential attach-
Scenario A: In order to contain the European debt crisis, what policy should be adopted? On a 0-100 scale please rate the policies that you favor.
1. Strict fiscal austerity plans should be placed in the Euro zone countries.
2. Strict regulations that curb excessive spending of the Euro zone countries should be introduced.

Scenario B: In order to divert the European debt crisis, what policy should be adopted? On a 0-100 scale please rate the policies that you favor.
1. Strict fiscal austerity plans should be placed in the Euro zone countries.
2. Strict regulations that curb excessive spending of the Euro zone countries should be introduced.

Table 2: Example 1b. The direction of action: contain vs. divert

Scenario A: To tame global warming, which policy should be adopted? Please rate the effectiveness of the policies on a 0-100 scale.
1. We should stop driving SUVs.
2. We should develop new green technologies.

Scenario B: To tame global warming, which policy should be adopted? Please rate the effectiveness of the policies on a 0-100 scale.
1. People should stop driving SUVs.
2. People should develop new green technologies.

Table 3: Example 2a. Dualistic relations-"we" vs. "people"

"We" or rich-get-richer phenomena. One typical example of the rich-get-richer phenomena is the technology diffusion effect, which states that what your cohorts have chosen influences what you choose to do. That is, your likelihood of adopting a new technology is proportional to the degree in which your cohorts already have the technology. Thus, a popular technology becomes even more popular. This is the basis of a power law distribution of large-scale networks [47, 5].

Prediction from hypothesis 2b. Our narratology hypothesis predicts that the degree of preferential attachment is modulated by the direction of action—whether the action is directed to oneself or someone else. Our narratology hypothesis claims that information about cohorts is weighted far more when action is directed to yourself. For example, if you are to decide to buy a new tabloid computer for yourself (scenario A), the information about how many other people already have the tabloid computer is important. This information is not so important when action is directed toward someone else (scenario B). In other words, the information about your cohorts will be valued more in scenario A than scenario B, because action is directed to yourself in scenario A ("buy a tabloid computer for yourself") and action is directed to someone else in scenario B ("buy a tabloid computer for your sister").

Scenario A: You are going to buy a tabloid computer for yourself. Please rate the likelihood that you would choose product A if:
1. More than 1 million copies of product A have been sold.
2. Product A is less than $400.

Scenario B: You are going to buy a tabloid computer for your sister. Please rate the likelihood that you would choose product A if:
1. More than 1 million copies of product A have been sold.
2. Product A is less than $400.

Table 4: Example 2b. Dualistic relations between people: giver vs. receiver.

Specific hypothesis 3: Morality as an intrinsic value. Another important narratological stance is morality. Stories almost always convey some moral message. Statements can be valued if the actor is consistent with
some culturally shared moral value. Below we predict that the likelihood of (1) ("Bank A used off-shore tax shelters") will be high in scenario A and low in scenario B.

<table>
<thead>
<tr>
<th>Scenario A:</th>
<th>Scenario B:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank A avoided more than $500 million dollars in its income tax payment in the last 10 years in order to sustain the bonus plans for its senior executives. Please rate the likelihood that Bank A.</td>
<td>Bank A avoided more than $500 million dollars in its income tax payment in the last 10 years in order to sustain the medical insurance plans for its employees. Please rate the likelihood that Bank A.</td>
</tr>
<tr>
<td>1. used off-shore tax shelters to hide its profits.</td>
<td>1. used off-shore tax shelters to hide its profits.</td>
</tr>
<tr>
<td>2. hired highly acclaimed tax lawyers to create a special financial vehicle.</td>
<td>2. hired highly acclaimed tax lawyers to create a special financial vehicle.</td>
</tr>
</tbody>
</table>

Table 5: Example 3. Morality.

3.5 PIs’ Qualifications

PI Laura Mandell is an English Professor and Director of the newly launched Initiative for Digital Humanities, Media, and Culture at Texas A&M University. She received her Ph.D. from Cornell University in 1992. Her first book and numerous articles focus on humanities topics, while forthcoming books focus on the digital and programming for Humanities professors (XSLT). Her research has involved creating a tool for teaching narrative structure (http://www.muohio.edu/update/160elements/FullBook.html), funded by the Ohio Learning Network in 2004-2005 while she was a Professor at Miami University. As Affiliate of Interactive Media Studies, Mandell developed a course called "Narrative and Digital Technology" (ENG/IMS 238), which became part of Miami University’s Game Studies Minor. She currently works on aggregating huge amounts of textual data for research as Director of 18thConnect.org, and on collaborative projects with STEM researchers at Texas A&M. She organized IDHMC’s first major conference on Optical Character Recognition Programs (October 2011; http://idhmc.tamu.edu/ocr-summit-meeting/). The IDHMC will be hosting an interdisciplinary narrative working group during 2012.

Co-PI Ergun Akleman is a Professor of Visualization at Texas A&M University. He received his Ph.D. degree in Electrical and Computer Engineering from the Georgia Institute of Technology in 1992. He is also a professional cartoonist, and he has a strong background in applied mathematics. His research interests require the skills and talent of an artist, an intuitive and rigorous knowledge of mathematics, and theoretical and practical knowledge of computer science. As a person with both artistic and scientific expertise, Akleman has extensive experience at successfully integrating art with science and technology in education, as well as in research. Akleman’s research has been extensive on implicitly specified shapes, on topological mesh modeling and computer aided sculpting. He has also developed a wide variety of techniques on visualization, on visual-storytelling, and on both photorealistic and non-photorealistic rendering — such as camera painting, 3D Chinese painting, 3D caricatures, cubist, futurist and hair rendering (For detailed list of his papers see website [1]).

Co-PI Takashi Yamauchi is an Associate Professor of Psychology at Texas A&M University. He received his Ph.D. degree in Psychology from Columbia University in 1997. His research has involved human computer interaction of collaborative learning, which is funded by NTT corporation (a Japanese telecommunications company ranked the 31st in Fortune Global 500), as well as cognitive science of knowledge formation, inductive reasoning and decision making. He currently works on a project of affective computing, detecting emotions from non-verbal human behavior using various sensors and applying the technique for the development of an intelligent tutoring system. He has extensive experience in designing and developing behavioral experiments, conducting computer simulation and mathematical modeling, and statistical analysis of a large data set.
3.6 Impact of the Proposal

Co-PI Stefano Franchi is Associate Research Professor in the Department of Hispanic Studies, Texas A&M University. He received his Ph.D degree in Philosophy from Stanford University in 1997. He worked as a software developer between 1984 and 1989. From 1990 to 1995, he was also a research intern at Xerox Parc in the Embedded Computation Area, under the direction of Dr. Brian Cantwell Smith. He has published extensively on 20th Century European philosophy, the history and philosophy of science in the 20th century, and on the history of Artificial Intelligence and cognitive science. He is the editor (with Güven Güzeldere) of Mechanical Bodies, Computational Minds (MIT Press, 2005) and (with Francesco Bianchini) of The Search for a Theory of Cognition. Early Mechanisms and New Ideas (Rodopi, 2011). See http://www.cleinias.org/stefano for a full list of publications.

3.6 Impact of the Proposal

Insofar as our central method proves true, we will have developed systems and web resources for analyzing complex social interactions that involve narratives such as social comments, blogs, product reviews, and twitter streams. We will have made it possible to perform extensive analysis of how social discourses evolve over time and how different narrative framings lead to collective intelligence or extremities. Our proposal will have tremendous impact on predicting the behavior of networks; the system that we will develop will be also useful for social scientists, legal scholars, computer scientists, and marketers. If our hypothesis that narrative structures decision making proves false, we will have performed the service of attempting to limit extensive analysis based on one way of understanding decision-making behavior, a narratological model deployed as rigorously as possible.

Intellectual Merit:

In recent years, there has been an increasing consensus about the need to broaden our understanding of action selection in everyday behavior and to go beyond the standard theories that model behavior as governed by rational choice. Increasingly, these alternative models have focused on the all too important and often neglected role of emotions (and especially strong emotions like fear, love, hatred, etc.). The difficulty intrinsic in providing a satisfactory theory of emotion has proved to be a significant stumbling block toward that goal. Current models diverge between the micro-level explanations provided by cognitive neuroscience and very high-level theories coming from the tradition of Artificial intelligence and traditional symbol-based cognitive science. The micro-level theories are still too limited in scope to provide a satisfactory account of human action, while the high-level theories are still confined to an account of emotions as mere "coloring" of everyday experience. The work we propose to carry out in this project will explore an alternative solution: we see human action as being always mediated by narrative structures which, in turn, emerge from the actors' internal emotional states. Thus, our model combines the virtues of the micro- and high-level descriptions.

Broader Impact:

The proposed research is highly interdisciplinary by nature, involving in studies in Computer Science, Psychology, English, Philosophy, Mathematics, computer graphics and software development. A special strength of the project is the research opportunity for graduate and undergraduate students for English, Psychology, Philosophy, Computer Science and Visualization programs. Although the implementation requires software development experience and certain mathematical background and preparation, some directly related work will attract students who are interested in concept development as well. The research in the proposed project demonstrates how useful rigorous theoretical work can be—the science of narratology—when it is applied. Our project will include the participation of three PhD students and at least two undergraduate students. We expect that, through this research, these students will gain extensive research and working experience in theoretical study, graphical software development, and optimization. The results of this research will be made available on the web, also through papers in journals and conferences, where they will be presented by the graduate students.

We are planning a significant benefit to undergraduates as well as involvement of under-represented groups.
Our students will demonstrate the method that we have developed in animation, game, and storytelling classes, and we will also seek undergraduate participation in research teams. Undergraduate participation will span the Colleges of Architecture, Liberal Arts, and Engineering, thus involving both non-scientists and scientists. Based on 20 years of experience with a related interdisciplinary Visualization program which offers an MS Degree, we expect strong participation of women. The content of our MS program and our recruiting efforts have resulted in a student population consisting of 40% women in a highly technical field.

3.7 Curriculum Development Activities

Akleman already teaches a graduate level Visual Storytelling course that is closely related to this project. He created the course in Spring 2005 and he been teaching it by continuously improving it since then. Storytelling is important since story development is one of the hardest problems in movie or game making. This is particularly important for Department of Visualization, because of our close connection with movie and game industry. Although the Visualization department was founded just two years ago, Visualization program is based on the Visualization Sciences MS program that has been in existence since 1991 in Department of Architecture at Texas A&M University. Twenty years after its founding, former students of MS program now constitute one of the largest groups in animation, special effect and game industry. Specifically, more than 150 of our former students are currently working in animation and special effect industry including PIXAR, ILM, Dreamworks, Electronic Arts, Blue Sky, and Rhythm & Hues. It is therefore very important for us to develop courses for preparing our students the most crucial part of movie and game making: storytelling.

Mandell developed the course "Narrative and Digital Technology" for a course offered in the Game Studies Minor at Miami University; she hopes to create a similar course at graduate and undergraduate levels here at Texas A&M. Ideally Mandell and Akleman can team teach with each other as well as others in Psychology, Computer Science, and Philosophy.

3.8 Previous and Recent NSF Support

CCF-0917288: Topological Graph Theory Revisited: With Applications in Computer Graphics
- **PIs:** J. Chen and E. Akleman $386,663, 09/01/2008 to 08/30/2011
- **Summary:** This research, guided by its applications in computer graphics, will refine and extend the classical topological graph theory by including geometry and provide connections between graph embeddings on non-orientable surfaces and surface weaving. Two Ph.D. students are currently supported by this grant.
- **Publications:** Two journal articles and 13 conferences papers and posters are published (See [2, 3, 55, 56, 4]).

ECS-0300071: Importance Based Visualization of Energy Networks via Progressive Simplification
- **PIs:** A. Abur and E. Akleman, $204,822, 09/01/2003 to 08/30/2006
- **Summary of Results:** In this project, we have developed visualization methods to observe steady state and transient operation of power systems to assist the existing analytical and computational tools in analysis, design, control and protection of these complex systems. Two PhD students are completed their degrees by this grant.
- **Publications:** Journal Articles: [17, 16]; Conference Papers: [9, 18, 18, 19].
4 REFERENCES

References


Laura Mandell  
NSF Biographical Sketch  

(a) Professional Preparation:  

University of New Mexico  
Cornell University  
Cornell University  

English / French (double)  
English  
English  
BA 1986  
MA 1991  
Ph.D. 1992  

(b) Appointments  

Texas A&M University  
Texas A&M University  
Miami University  
Miami University  
Miami University of Ohio  

Director, Initiative for Digital Humanities, Media, & Culture  
Professor, English  
Professor, English  
Affiliate Professor, Armstrong Interactive Media Studies  
Associate Professor, English  
Assistant Professor, English  
Professor, English  
2011  
2011  
2008  
2007  
1999  
1993  
2008  

(c) Publications  

(i) "Disciplining the Real," *Eighteenth-Century Studies* (forthcoming 2011) [on history of disciplinarity]  
"Non-Consuming Relevance: the Grub Street Project," *Online Humanities Scholarship: The Shape of Things*, ed. Jerome McGann (Rice Univ. Press, 2010), and online: http://shapeofthings.org/papers/  

"The Poetess Archive Database" (poster), *Digital Humanities Quarterly* 3.3 (2009)  

**(d) Synergistic Activities**

Director, *18thConnect* (<http://www.18thConnect.org>), 2009 to present  
Associate Director, *NINES* (<http://www.nines.org>), 2007 to present  
General Editor, *The Poetess Archive* (<http://www.poetessarchive.org>), 2001 to present  
Primary Author, *Digital Humanities* <http://www.muohio.edu/technologyandhumanities>,  
22 August 2003: the bibliographies, course modules complete with assignments, and teaching instructions were written by me; they have been published by ELA (the Ohio Learning Network's *Electronic-Learning Athenaeum* <http://cscc.edu/oln>/  
Co-editor with Alan Liu, *Romantic Chronology*  

**(e) Collaborations and Other Affiliations**

- Collaborators and Co-editors:  
  Dr. Steve Olsen, the Modern Language Association (MLA)  
  Prof. Brad Passanek, University of Virginia, Department of English  
  Dr. Susan Schreibman, Trinity College, Dublin, Digital Humanities  
  Prof. Andrew Stauffer, University of Virginia, Department of English

- Graduate Advisors  
  Prof. Fredric Bogel, Cornell University, English  
  Prof. Mary Jacobus, Cornell University, English  
  Prof. Reeve Parker, Cornell University, English  
  Prof. Neil Saccamano, Cornell University, English / Comparative Literature

- Graduate Students  
  Gerald Egan, University of California, Santa Barbara, Ph.D. Candidate  
  Dr. Laila Ferreira, University of British Columbia, English, Ph.D. rec'd 2010  
  Kristin Gagliardi, Miami University, English; Ph.D. Candidate  
  Kirstyn Leuner, University of Colorado, Boulder; English, Ph.D. Candidate  
  Shawn Moore, Texas A&M University, English, Ph.D. Candidate  
  Lacie Adell Osbourne, Texas A&M University, English, Ph.D. Candidate  
  Eleni Siatra, Miami University, Ph.D., 2010  
  Michael Templeton, Miami University, Ph.D., 2007  
  D. Christopher Washington, Miami University; English, Ph.D. Candidate

8 Ph.D. Candidates total; Postdoctoral Scholars sponsored.
Biographical Sketch

Name/Title: Ergun Akleman, Ph.D., Professor
Address: C418 Langford Center 
Department of Visualization 
Texas A&M University 
College Station, Texas 77843-3137 
Phone & Fax: (979) 845-6599, (979) 862-2705 
E-mail: ergun@viz.tamu.edu, ergun.acleman@gmail.com

Education:

Ph. D. in Electrical and Computer Engineering, 1992, Georgia Institute of Technology
M.S. in Electrical and Computer Engineering, 1986, Georgia Institute of Technology
B.S. in Electrical and Electronic Engineering, 1979, Istanbul Technical University

Academic Experience:

2008 - present: Professor, Department of Visualization, Texas A&M University
2007 - 2008: Professor, Department of Architecture, Texas A&M University
2007 - 2008: Ph.D. coordinator, Visualization Sciences, Department of Architecture, Texas A&M University
2005 - 2007: M.Sc. coordinator, Visualization Sciences, Department of Architecture, Texas A&M University
2001 - 2007: Associate Professor, Department of Architecture, Texas A&M University
1995 - 2001: Assistant Professor, Department of Architecture, Texas A&M University
1992 - 1995: Assistant Professor, Department of Computer Science, Yildiz Technical University
1993 - 1995: Adjunct Professor, Department of Computer Science, Marmara University
1995 - 1995: Adjunct Professor, Department of Computer Science, Bosphorus University
1989 - 1992: Graduate Research Assistant, GVU Laboratory, Georgia Institute of Technology
1982 - 1984: Graduate Teaching Assistant, Istanbul Technical University

Commercial Art Experience:

1978-97: Professional Caricaturist, Cartoonist and Illustrator; Over 500 caricatures, cartoons and illustrations have been published by various newspapers and magazines.

Research Interests:


Five Synergistic Activities:

Panel Reviewer: NSF;
Paper Reviewer: SIGGRAPH;
Paper Reviewer: Transaction of Visualization and Computer Graphics;
Paper Reviewer: Shape Modeling International;
Editor: Hyperseeing

Current Support:

*Topological Graph Theory Revisited: With Applications in Computer Graphics, NSF-CCF. Co-PI, 09/01/09-12/31/12, $386,663.*
Five Significant Publications:


Five Relevant (Cartoon and Caricature) Publications:


Graduate Advisors:

Russell M. Mersereau, Electrical and Computer Engineering Department and Larry F. Hodges, Graphics, Visualization and Usability Lab., College of Computing, Georgia Institute of Technology (currently in Clemson University).

The People I served as thesis Advisor:

Jon Reich (Pixar), Jaewook Lee (Reel FX3D), Karthik Swaminathan (Reel FX3D), Xiao Zhang (Dreamworks), Jacob Brooks (Pixar), Brian Clark (ILM), Wonchan Song (Reel FX3D), Ozgur Gonen (Reel FX3D), Grant Rice III (topsearchwebsitese), Jinnah Yu (Reel FX3D), Esan Mandal (Disney Animation), Avneet Kaur (Disney Animation), Jeff Smith (Dreamworks), Lori Green (Digital Domain), Hyemee Choi (Electronic Arts), Jaemin Lee (Rhythm and Hues), Vinod Srinivasan (Texas A&M University), Sajan Skaria (Pixar), Clara Chan (Sony Imageworks), James Palmer (Northern Arizona University), John Peterson (Blue Sky), Cody Star (MultiGen-Paradigm), Ryan Logan (Southwest Research Institute), Preyas Kamath (Motorola), Burak Meric (Knowledge Based Systems), Fusun Eryoldas (Knowledge Based Systems), Gavin McMillan (Rhythm and Hues), Stephen Parker (Sony Imageworks), Aaron Ottsot (Microsoft), Quintin King (Rhythm and Hues), Rady Hammock (PDI-Dreamworks), Jason Rosson (ILM), John Ferguson, Katherine Calkins, Carlos Javier Ugaz, Scott Meadows, Ryan Mitchell.
STEFANO FRANCHI

Department of Hispanic Studies
Texas A&M University,
College Station, TX 77843-4237
Voice: (979) 862-2211
e-mail: stefano@tamu.edu

Education

1997                        Stanford University, Ph.D. in Philosophy
1984                        Università di Bologna, Laurea in Filosofia, summa cum laude

Academic Positions

2011-present                Texas A&M University, Associate Research Professor
2006-2009                   Texas A&M University, Visiting Associate Professor
2004-2006                   The University of Auckland, Senior Lecturer (equivalent to Associate Prof. with tenure in the USA)
2000-2003                   The University of Auckland, Lecturer (equivalent to Assistant Prof. in the USA)
1997-1999                   Stanford University, Lecturer

Research interests

History and Philosophy of Artificial Intelligence and Cognitive Science, 20th Century European Philosophy, French Structuralism.

Other academic and professional experiences

Research Intern           Xerox Palo Alto Research Center (PARC), September 1990-July 1995. Research member of the Embedded Computation Area, directed by Prof. Brian Cantwell Smith.
Five Significant Publications


Five relevant publications


Graduate advisors

Brian Cantwell Smith, Xerox Palo Alto Research Center (PARC) and, by courtesy, Professor of of Computer Science, Stanford University (now Canada Research Chair in the Foundations of Information, University of Toronto); John Perry, Professor of Philosophy, Stanford University; Eckart Förster, Professor of Philosophy, Stanford University (now Professor of Philosophy at The Johns Hopkins University); Jean-Pierre Dupuy, Professor of Philosophy (by courtesy), Stanford University and École Polytechnique, Paris.

Current NSF Support

None
Takashi Yamauchi

http://psychology.tamu.edu/Fac_Ext.php?ID=37
http://people.tamu.edu/~takashi-yamauchi/

Texas A&M University

Mail Stop: 4235 Psychology Building, College Station TX 77843-4235
Ph: (979) 845-2503; Fax: (979) 458-0703

(i) Professional Preparation

<table>
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<th>Columbia University</th>
<th>New York, USA</th>
<th>Psychology</th>
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<tr>
<td>Columbia University</td>
<td>New York, USA</td>
<td>Cognitive Psychology</td>
<td>Ph. D. 1997</td>
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</table>

(ii) Appointments
- Associate Professor of Psychology, Texas A&M Univ., August 2008 – present.
- Research Assistant, Department of Psychology, Columbia University, August 1992 – May 1997.

(iii) Publications:

(a) Five Publications Relevant to Proposed Research


(b) Five Other Significant Publications

(iv) Synergistic Activities

Associate editor / Cognitive Studies: Bulletin of the Japanese Cognitive Science Society; Psychologia;
Editorial board

Ad hoc reviewer Behavioral and Brain Sciences, Cognitive Psychology, Journal of Experimental
Psychology: General, Cognition, Developmental Psychology, Cognitive Science,
Journal of Experimental Psychology: Learning, Journal of Memory and Language,
Psychological Science, NSF

Invited Kyoto University, Japan; Max Planck Institute Cognitive Neuroscience Unit,
presentations Germany; Pusan National University, South Korea; University of Iowa School of
Medicine

Conference Annual Meetings of Cognitive Science Society, 2008~2009
Program manager

Minority I taught disadvantaged grade-school children (6-10 years old) in Harlem for 2 years as
Education a member of Harlem Tutorial Program of International House, New York, NY.

(v) Collaborators and Other Affiliations

(ii) Graduate and Postdocital Advisors
Graduate Advisor: Arthur B. Markman (University of Texas, Austin)
Postdocital sponsor: Micheleen T. Chi & Kurt VanLen (Arizona State University)

(i) Collaborators
M. T. Chi (Arizona State Univ.) B. C. Love (UT, Austin)
Kurt VanLehn (Arizona State Univ.) T. Kusumi (KyotoUniv. Japan)
R. Gutierrez-Osuna (TAMU) T. Ohno; M. Nakatani; Y. Kato (NTT R&D Cyber
Solutions Lab)

(c) Thesis Advisor/Co-advisor: Ph.D. Students (1 graduated, 2 current) 2 women and 2 minority:
Graduated: Na Yung Yu
Current: Casady Bowman, Kunchen Xiao

(vi) Honors and Awards
• Highlight Paper Award: International Semantic Web Conference (ISWC '07) and 2nd Asian
  Semantic Web Conference (ASWC '07)
• Research Award / Contract: NTT (Nippon Telephone Telegram) R&D Cyber Solutions Lab
## Summary Proposal Budget

### Year 1

<table>
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<tr>
<th>Item Description</th>
<th>CAL</th>
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<th>Funds Granted by NSF (if different)</th>
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**PI/PO Name**: Laura Mandell  
**Org. Rep. Name**:  

---

1. **Electronic Signatures Required for Revised Budget**
# Summary Proposal Budget

**Organization:**
Texas A&M University Main Campus

**Principal Investigator / Project Director:**
Laura Mandell

<table>
<thead>
<tr>
<th>Category</th>
<th>Personnel</th>
<th>Funds Requested By Proposed</th>
<th>Funds Granted by NSF (if different)</th>
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<tr>
<td><strong>A. SENIOR PERSONNEL</strong></td>
<td><strong>PI/PD, Co-PI's, Faculty and Other Senior Associates</strong></td>
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<td>2. Ergun Akleman - Co-PI</td>
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<td>3. Stefano Franchi - Co-PI</td>
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<td>4. Takashi Yamauchi - Co-PI</td>
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<td><strong>B. OTHER PERSONNEL</strong></td>
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**I. INDIRECT COSTS**

**MTDC (less $25,416 - tuition) (Rate: 46.5000, Base: 113920)**

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**P/I/PD Name:**
Laura Mandell

**Org. Rep. Name:**

---

2 *Electronic signatures required for revised budget*
### Summary Proposal Budget

#### Texas A&M University Main Campus

**Principal Investigator / Project Director**

- **Laura Mandell**

#### A. Senior Personnel: PI/Co-PI’s, Faculty and Other Senior Associates

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>NSF Funded Person/Months</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF (If Different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laura Mandell - PI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>8,842</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ergun Akgun - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>5,239</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stefano Franchi - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>3,183</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Takashi Yamauchi - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td>4,189</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### B. Other Personnel (Show Numbers in Brackets)

1. (0) Post Doctoral Scholars: 0.00
2. (0) Other Professionals (Technician, Programmer, etc.): 0.00
3. (3) Graduate Students: 62,344
4. (0) Undergraduate Students: 0
5. (0) Secretarial - Clerical (If Charged Directly): 0
6. (0) Other: 0

**Total Salaries and Wages (A + B): 84,087**

#### C. Fringe Benefits (If Charged as Direct Costs)

- Fringe Benefits: 17,571
- Total Salaries, Wages and Fringe Benefits (A + B + C): 101,658

#### D. Equipment (List Item and Dollar Amount for Each Item Exceeding $5,000.)

**Total Equipment: 0**

#### E. Travel

1. Domestic (Incl. Canada, Mexico and U.S. Possessions): 2,000
2. Foreign: 3,000

#### F. Participant Support Costs

1. Stipends: 0
2. Travel: 0
3. Subsistence: 0
4. Other: 0

**Total Number of Participants: 0**

**Total Participant Costs: 0**

#### G. Other Direct Costs

1. Materials and Supplies: 5,000
2. Publication Costs/Documentation/Dissemination: 0
3. Consultant Services: 0
4. Computer Services: 0
5. Subawards: 0
6. Other: 39,416

**Total Other Direct Costs: 35,416**

#### H. Total Direct Costs (A Through G)

- Total Direct Costs: 142,074

#### I. Indirect Costs (F&A)(Specify Rate and Base)

- MTDC (less $25,416 - tuition) (Rate: 46.5000, Base: 116658): 54,246
- Total Indirect Costs (F&A): 196,320

#### K. Residual Funds

- Residual Funds: 0

#### M. Cost Sharing Proposed Level $0

- Agreed Level If Different $0

---

**PI/PD Name**

- Laura Mandell

**Org. Rep. Name**

- Laura Mandell

---

3 "Electronic Signatures Required For Revised Budget"
# SUMMARY PROPOSAL BUDGET

**ORGANIZATION**
Texas A&M University Main Campus

**PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR**
Laura Mandell

### A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates

<table>
<thead>
<tr>
<th>Position</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>NSF Funded Personnel</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laura Mandell - PI</td>
<td>0.00</td>
<td>0.00</td>
<td>1.50</td>
<td>25,760</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ergun Akieman - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>1.50</td>
<td>15,263</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stefano Franchi - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>1.50</td>
<td>9,273</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Takashi Yamauchi - Co-PI</td>
<td>0.00</td>
<td>0.00</td>
<td>1.50</td>
<td>12,205</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

<table>
<thead>
<tr>
<th>Category</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( 0 ) Post Doctoral Scholars</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2. ( 0 ) Other Professionals (Technician, Programmer, etc.)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3. ( 9 ) Graduate Students</td>
<td>182,484</td>
<td></td>
</tr>
<tr>
<td>4. ( 0 ) Undergraduate Students</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5. ( 0 ) Secretarial - Clerical (If Charged Directly)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6. ( 0 ) Other</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Total Salaries and Wages (A + B)</td>
<td>244,985</td>
<td></td>
</tr>
<tr>
<td>Fringe Benefits (If Charged as Direct Costs)</td>
<td>51,855</td>
<td></td>
</tr>
<tr>
<td>Total Salaries, Wages and Fringe Benefits (A + B + C)</td>
<td>296,840</td>
<td></td>
</tr>
</tbody>
</table>

### D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

### E. TRAVEL

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domestic (Incl. Canada, Mexico and U.S. Possessions)</td>
<td>6,000</td>
</tr>
<tr>
<td>2. Foreign</td>
<td>9,000</td>
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</table>

### F. PARTICIPANT SUPPORT COSTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stipends</td>
<td>0</td>
</tr>
<tr>
<td>Travel</td>
<td>0</td>
</tr>
<tr>
<td>Subsistence</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Total Number of Participants</td>
<td>0</td>
</tr>
<tr>
<td>Total Participant Costs</td>
<td>0</td>
</tr>
</tbody>
</table>

### G. OTHER DIRECT COSTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials and Supplies</td>
<td>15,000</td>
</tr>
<tr>
<td>Publication Costs/Documentation/Dissemination</td>
<td>0</td>
</tr>
<tr>
<td>Consultant Services</td>
<td>0</td>
</tr>
<tr>
<td>Computer Services</td>
<td>0</td>
</tr>
<tr>
<td>Subawards</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>91,248</td>
</tr>
<tr>
<td>Total Other Direct Costs</td>
<td>106,248</td>
</tr>
</tbody>
</table>

### H. TOTAL DIRECT COSTS (A THROUGH G)

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect Costs (F&amp;A) (Specify Rate and Base)</td>
<td>418,088</td>
</tr>
<tr>
<td>Total Indirect Costs (F&amp;A)</td>
<td>158,956</td>
</tr>
<tr>
<td>Total Direct and Indirect Costs (H + I)</td>
<td>577,044</td>
</tr>
</tbody>
</table>

### K. RESIDUAL FUNDS

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Funds</td>
<td>0</td>
</tr>
</tbody>
</table>

### L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of This Request</td>
<td>577,044</td>
</tr>
</tbody>
</table>

### M. COST SHARING PROPOSED LEVEL $| AGREED LEVEL IF DIFFERENT $ | $0 |

**PI/PD NAME**
Laura Mandell

**ORG. REP. NAME**

---

**FOR NSF USE ONLY**

<table>
<thead>
<tr>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
</tr>
</thead>
</table>

*C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET*
Budget Justification

Salaries

Laura Mandel, Principal Investigator
The PI is on a 9-month contract at Texas A&M University and will devote 50% of her time during 1 summer months for each year of the project ($16,667/mo). The summer period will provide uninterrupted time for manuscript preparation by the research team.

An estimated 3% salary increase per year is computed for the PI's salary.

Ergun Akieman, Co-Principal Investigator
The PI is on a 9-month contract at Texas A&M University and will devote 50% of his time during 1 summer months for each year of the project ($9876.25). The summer period will provide uninterrupted time for manuscript preparation by the research team.

An estimated 3% salary increase per year is computed for the Co-PI's salary.

Stefano Franchi, Co-Principal Investigator
The Co-PI is on a 9-month contract at Texas A&M University and will devote 50% of his time during 1 summer months for each year of the project ($6,000/mo). The summer period will provide uninterrupted time for manuscript preparation by the research team.

An estimated 3% salary increase per year is computed for the PI's salary.

Yamauchi, Takashi, Co-Principal Investigator
The Co-PI is on a 9-month contract at Texas A&M University and will devote 50% of his time during 1 summer months for each year of the project ($7,898/mo). The summer period will provide uninterrupted time for manuscript preparation by the research team.

An estimated 3% salary increase per year is computed for the PI's salary.

To Be Named 3 Graduate Research Assistants

Funding is requested for three Graduate Research Assistants (GRA) for the 3 years of the project. One of these GRAs will be under the Department of Visualization Sciences, and the other two under the College of Liberal Arts. The GRAs will participate in the set-up, design, collection, analysis, and write-up of the proposed experiments as well as organize the day-to-day activities associated with the experiments and assist in the recruitment of participants. The graduate students will be a 2nd or 3rd year doctoral students at Texas A&M University.

An estimated 3% salary increase is computed into the GRA’s salary.

C. Fringe Benefits

These are computed at actual costs for the PI, at 17.2% of salary and medical at $474 per month. Fringe benefits and estimated health costs for the Graduate Research Assistant are calculated at 9.9% of salary plus medical at $374 per month.
Materials and supplies
Year 1 anticipated expenditures in this category are:
• $5,000 for miscellaneous laboratory, computer, and printing supplies.

Year 2 anticipated expenditures in this category are:
• $5,000 for miscellaneous laboratory, computer, and printing supplies.

Year 3 anticipated expenditures in this category are:
• $5,000 for miscellaneous laboratory, computer, and printing supplies.

Travel
The results of this research project will be presented at the international and national conferences. Funds are requested to defray travel costs to annual conferences each year for the PIs, graduate students, and possibly undergraduate students.

Other Direct Costs
Funds are requested for participant incentives. We expect to recruit about 2,000 participants for the proposed experiments ($5-$10/participant).

As requested by Texas A&M University, $8,448 per year, per student, is requested as tuition and fees for the Graduate Research Assistants.
**Current and Pending Support**

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Laura Mandell</th>
<th>Other agencies (including NSF) to which this proposal has been/will be submitted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support: □ Current ☑ Pending □ Submission Planned in Near Future □ *Transfer of Support</td>
<td></td>
</tr>
<tr>
<td>Project/Proposal Title: ICES: Large: Modeling Social and Economic Behavior using Narratology</td>
<td></td>
</tr>
<tr>
<td>Source of Support: NSF</td>
<td></td>
</tr>
<tr>
<td>Total Award Amount: $ 577,044</td>
<td>Total Award Period Covered: 09/01/12 - 08/31/15</td>
</tr>
<tr>
<td>Location of Project: Texas A&amp;M University</td>
<td></td>
</tr>
<tr>
<td>Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.50</td>
<td></td>
</tr>
</tbody>
</table>

| Support: □ Current □ Pending ☑ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: |
| Source of Support: |
| Total Award Amount: $ | Total Award Period Covered: |
| Location of Project: |
| Person-Months Per Year Committed to the Project. Cal: | Acad: | Sumr: |

| Support: □ Current □ Pending ☑ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: |
| Source of Support: |
| Total Award Amount: $ | Total Award Period Covered: |
| Location of Project: |
| Person-Months Per Year Committed to the Project. Cal: | Acad: | Sumr: |

| Support: □ Current □ Pending ☑ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: |
| Source of Support: |
| Total Award Amount: $ | Total Award Period Covered: |
| Location of Project: |
| Person-Months Per Year Committed to the Project. Cal: | Acad: | Sumr: |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
### Current and Pending Support

*(See GPG Section II.C.2.h for guidance on information to include on this form.)*

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Ergun Akleman</th>
<th>Other agencies (including NSF) to which this proposal has been/will be submitted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support: □ Current ☑ Pending □ Submission Planned in Near Future □ *Transfer of Support</td>
<td></td>
</tr>
<tr>
<td>Project/Proposal Title: Topological Graph Theory Revisited: With Applications in Computer Graphics</td>
<td></td>
</tr>
<tr>
<td>Source of Support: The National Science Foundation - CCF</td>
<td></td>
</tr>
<tr>
<td>Total Award Amount: $ 386,663 Total Award Period Covered: 09/01/09 - 08/31/12</td>
<td></td>
</tr>
<tr>
<td>Location of Project: Texas A&amp;M University</td>
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</tr>
<tr>
<td>Person-Months Per Year Committed to the Project: Cal:0.00 Acad:0.00 Sumr: 1.00</td>
<td></td>
</tr>
</tbody>
</table>

| Support: ☑ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: REU Supplement: Topological Graph Theory Revisited: With Applications in Computer Graphics The National Science Foundation |
| Source of Support: National Science Foundation - CCF |
| Total Award Amount: $ 16,000 Total Award Period Covered: 09/01/10 - 08/31/12 |
| Location of Project: Texas A&M University |
| Person-Months Per Year Committed to the Project: Cal:0.00 Acad:0.00 Sumr: 0.00 |

| Support: □ Current ☑ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: III: CGV: Large: Collaborative Research: Modeling and Visualization of 3-Manifolds |
| Source of Support: The National Science Foundation - III |
| Total Award Amount: $ 566,073 Total Award Period Covered: 06/01/12 - 06/01/15 |
| Location of Project: Texas A&M University |
| Person-Months Per Year Committed to the Project: Cal:0.00 Acad:0.00 Sumr: 1.00 |

| Support: □ Current ☑ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: EFRI-ODISSEI Preliminary Proposal: Synthesizing Complex Structures from Programmable Self-Folding Active Materials |
| Source of Support: National Science Foundation - EFRI |
| Total Award Amount: $ 1,995,956 Total Award Period Covered: 09/01/12 - 08/31/15 |
| Location of Project: Person-Months Per Year Committed to the Project: Cal:0.00 Acad:0.00 Sumr: 1.00 |

| Support: ☑ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| Project/Proposal Title: ICES:Large: Modeling Social and Economic Behavior using Narratology |
| Source of Support: National Science Foundation - ICES |
| Total Award Amount: $ 577,044 Total Award Period Covered: 09/01/12 - 08/31/15 |
| Location of Project: Texas A&M University |
| Person-Months Per Year Committed to the Project: Cal:0.00 Acad:0.00 Summ: 0.50 |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*

---

*Page G-2*  
USE ADDITIONAL SHEETS AS NECESSARY
Current and Pending Support
(See GPG Section II.C.2.h for guidance on information to include on this form.)
The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Stefano Franchi</th>
<th>Other agencies (including NSF) to which this proposal has been/will be submitted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Support:</strong> □ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support</td>
<td></td>
</tr>
<tr>
<td><strong>Project/Proposal Title:</strong> ICES: Large: Modeling Social and Economic Behavior using Narratology</td>
<td></td>
</tr>
<tr>
<td><strong>Source of Support:</strong> NSF</td>
<td></td>
</tr>
<tr>
<td><strong>Total Award Amount:</strong> $ 577,044 <strong>Total Award Period Covered:</strong> 09/01/12 - 08/31/15</td>
<td></td>
</tr>
<tr>
<td><strong>Location of Project:</strong> Texas A&amp;M University</td>
<td></td>
</tr>
<tr>
<td><strong>Person-Months Per Year Committed to the Project.</strong> Cal: 0.00 Acad: 0.00 Sumr: 0.50</td>
<td></td>
</tr>
</tbody>
</table>

| **Support:** □ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| **Project/Proposal Title:** |
| **Source of Support:** |
| **Total Award Amount:** $ **Total Award Period Covered:** |
| **Location of Project:** |
| **Person-Months Per Year Committed to the Project.** Cal: Acad: Sumr: |

| **Support:** □ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| **Project/Proposal Title:** |
| **Source of Support:** |
| **Total Award Amount:** $ **Total Award Period Covered:** |
| **Location of Project:** |
| **Person-Months Per Year Committed to the Project.** Cal: Acad: Sumr: |

| **Support:** □ Current □ Pending □ Submission Planned in Near Future □ *Transfer of Support |
| **Project/Proposal Title:** |
| **Source of Support:** |
| **Total Award Amount:** $ **Total Award Period Covered:** |
| **Location of Project:** |
| **Person-Months Per Year Committed to the Project.** Cal: Acad: Sumr: |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
### Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

<table>
<thead>
<tr>
<th>Investigator: Takashi Yamauchi</th>
<th>Other agencies (including NSF) to which this proposal has been/will be submitted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support</td>
<td></td>
</tr>
<tr>
<td>Project/Proposal Title: ICES: Large: Modeling Social and Economic Behavior using Narratology</td>
<td></td>
</tr>
<tr>
<td>Source of Support: NSF</td>
<td></td>
</tr>
<tr>
<td>Total Award Amount: $577,044</td>
<td>Total Award Period Covered: 09/01/12 - 08/31/15</td>
</tr>
<tr>
<td>Location of Project: Texas A&amp;M University</td>
<td></td>
</tr>
<tr>
<td>Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.50</td>
<td></td>
</tr>
</tbody>
</table>

| Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support | |
| Project/Proposal Title: | |
| Source of Support: | |
| Total Award Amount: | Total Award Period Covered: |
| Location of Project: | |
| Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: | |

| Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support | |
| Project/Proposal Title: | |
| Source of Support: | |
| Total Award Amount: | Total Award Period Covered: |
| Location of Project: | |
| Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: | |

| Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support | |
| Project/Proposal Title: | |
| Source of Support: | |
| Total Award Amount: | Total Award Period Covered: |
| Location of Project: | |
| Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: | |

| Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support | |
| Project/Proposal Title: | |
| Source of Support: | |
| Total Award Amount: | Total Award Period Covered: |
| Location of Project: | |
| Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: | |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
H Facilities, Equipment, and Other Resources

This research is strongly supported by the College of Liberal Arts and College of Architecture of Texas A&M University. The PI Laura Mandell is from the College of Liberal Arts, one of the first liberal arts colleges in the U.S. to offer a certificate in Digital Humanities for Graduate Students willing to take courses in the Computer Science Program (http://dhcertificate.tamu.edu). Mandell is a Professor in the Department of English, which is one of the largest departments in the college with a strong Ph.D. program. Mandell was hired to direct the newly launched Initiative for Digital Humanities, Media, and Culture, one of eight Texas A&M Initial University Multidisciplinary Research Initiatives (and thus is the recipient of substantial start-up funding). She received her Ph.D. from Cornell University in 1992. Her first book and articles focus on humanities topics, while forthcoming books focus on computing (XSLT). Her research has involved creating a tool for teaching narrative structure, funded by the Ohio Learning Network in 2004-2005 while she was a Professor at Miami University, and she currently works on aggregating huge amounts of textual data for research as Director of 18thConnect.org, and on collaborative projects with STEM researchers at Texas A&M. She organized IDHMC's first major conference on Optical Character Recognition Programs (October 2011; http://idhmc.tamu.edu/ocr-summit-meeting/).

The IDHMC was started by Mandell in 2011. The most important priority in its mission statement is "to perform research on the global impact of computing, digitization, cyber-worlds, and digital communication on culture by fostering collaboration among various disciplines housed in different colleges across the University." The Initiative's goal, in other words, is to break down disciplinary boundaries between STEM and scientific sub-disciplines within liberal arts. Therefore this initiative is closely allied with the Center for the Study of Digital Libraries which has its home in the Department of Computer Science and Engineering. The TEES Center for the Study of Digital Libraries (CSDL) was founded in 1995 and is located on the Texas A&M University campus in College Station, TX. The mission of the CSDL is to foster pioneering research on the theory and application of digital libraries and to create flexible and efficient new technologies for their use. Directed by Prof. Richard Furuta, the CSDL currently serves as home to four faculty members, all with tenured or tenure-track appointments in Computer Science, and affiliated graduate and undergraduate students. The IDHMC and CSDL share servers and storage space at the Brazos High Performance Computing Cluster, hosted by Texas A&M’s Academy for Telecommunications and Learning Technologies. Together the CSDL and IDHMC can provide textual data from cultural artifacts stretching into billions of words.

By Fall 2012, the IDHMC will have offices and lab space in the new the Liberal Arts and Arts & Humanities (LAAH) Building. Construction is almost completed, and a third-floor wing has been set aside for the IDHMC. The new IDHMC lab is designed to be a collaborative space and will be the perfect venue for conducting experimental trials, holding meetings, demonstrating completed research, etc.

The Co-PI Ergun Akleman is a Professor in the Department of Visualization in the College of Architecture of Texas A&M University, one of the unique departments in the nation that provides strong interdisciplinary education and research between art and science. The College of Architecture is one of the most strongest and interdisciplinary Architecture colleges in the nation. The faculty in the college includes engineers, computer scientists, artists, social scientists, historians and designers.

The proposed work will be carried out on the Texas A&M University main campus in Col-
lege Station, TX. The project will initially be housed the IDHMC Lab as well as the Texas A&M University Visualization Laboratory (VizLab). VizLab provides integrated capabilities which support visualization research, visual design, three-dimensional modeling and animation, digital audio for soundtracks and multimedia presentations, video production and post-production, and media networking.

The research team will later move to the interdisciplinary space available for Visualization and Computer Science researchers in the new Emerging Technologies and Economic Development Interdisciplinary (ETED) Building. The construction of this $104 million dollar building started in 2008 and completed in Fall 2011. The ETED Building support university engineering and allied teaching and research programs and will contain offices, classrooms, faculty research labs (wet and dry), computer based teaching classrooms and a computer server room, and a computational science visualization area. In ETED building, a large space that includes four laboratories, one large research area and several classrooms is reserved for interdisciplinary research activities between Visualization and Computer Science departments. To use interdisciplinary research space in ETED, we have an approval process, but, the projects involving visualization and computer graphics such as this one has the priority. Akleman has already started to use interdisciplinary research space in ETED for other projects.

We will also be able to use facilities of Visualization Laboratory, The VizLab, which is one of the largest visualization facilities in the nation. The VizLab was established in 1988. The Laboratory's capabilities couple visualization, digital video, and multimedia to graduate and undergraduate degree programs in visualization. The mission of the Laboratory is to develop and support the resources needed to produce multimedia, computer graphics and animation at the highest level of achievement. Another major component of laboratory activity is the support of research and development initiatives in visualization sciences and related interdisciplinary areas. One major component of laboratory activity is the support of the MS and BS degree programs in Visualization, and the Ph.D. degree specialized in computer graphics and visualization.

The VizLab is primarily housed in the Langford Center’s Building C. This 7,500 square-foot resource contains a seminar room, faculty and staff offices, two sound-stage studios, color and black-and-white darkrooms, digital video editing facilities, image input and HDR inkjet and 3D printing output facilities, an electronic classroom, digital sound production facilities, a Cyberware 3D scanner, research suites, an immersive visualization lab, and approximately 25 visual workstations. All computational resources in the laboratory are interconnected by high-speed network to the laboratory’s central virtualized server plant, an 80-node computational cluster, an additional classroom and satellite workstation studios. The VizLab has a departmental domain connection to the University's network backbone.

The production facility serves the VizLab as a production research facility. It comprises two video studios, a video control room, and video post production equipment. The two studios measure over 2,000 square feet and contain complete studio lighting and cyclorama systems. The production facility also supports color and black-and-white photo processing including state-of-the-art darkrooms, photographic scanners, and film recorders. Images may input via component analog and digital video and high resolution scanning cameras. Using digital video techniques, computed images and image sequences can be created, composited, and edited with images from other sources to realize visualization research and production objectives. Production quality commercial software along with in-house custom software, are used to create and manipulate images.
and image sequences. 2D and 3D scanners are supported to facilitate the capture of geometric data. This facility also supports the creation, manipulation, and editing of digital audio.

Adjacent to the production facility is an electronic presentation room, equipped with multi-OS visual workstations, high-definition, multi-scan projectors, multiple format video and Blue-Ray decks. The presentation room is also furnished with multi-channel, high-fidelity surround audio systems. An adjacent 150-seat auditorium is equipped with high-definition projection and theater quality sound. The VizLab is permanently staffed by specialists in visualization network administration, visualization hardware and software systems, and visualization production practices.
Data Management Plan

We will create a website to share our ideas, our data and our code. The website will provide a forum, a gallery space, informative images, animations, videos and even games. Our goal is to develop a dynamic community that design and construct non-deterministic models for simulating social and economical interactions. Having a dynamic community testing and retesting our approach in a variety of situations will help us to continuously improve the different components of the system. We also want to be sure the modularity of our system such that other researchers can also join us to improve the software by adding new tools.

The multidisciplinary nature of our research team — with a large variety of backgrounds from digital humanities to mathematics, computer science, philosophy, and psychology — will also help us to reach researchers from a wide variety of backgrounds. We will not only restrict ourselves with researchers. The tools that we develop can also be useful in some unexpected applications. For instance, we expect the modular nature of the system can allow to create tools for collaborative storytelling, which can attract a large number of users to interactively create stories. To make this become a reality, we can provide visual tools that can make it attractive to use the system as if it is a game.

With a large number of people using the system, it can also be possible to convert existing/well-known stories into formal representations. These representations can be used to formally analyze similarities and differences between stories.

Co-PI Aklemán's earlier experience with TopMod was a strong example of the importance of creation of a community for the development, improvement and useability of software. For instance, once we have provided the TopMod, many people discovered ways to create unusually interesting shapes and shared their experiences by developing video tutorials. Other users, following video tutorials, created similar shapes. Figure 1 shows some examples of shapes that are created by users of TopMod. Aklemán and his students have used these ideas to improve and add new modules to TopMod.

![Shapes](image.png)

Figure 1: These are shapes produced by the users of TopMod, a topological shape-modeling system we have developed. These images are rendered by users with a commercial version of our software. Shapes (a) and (b) were created by Tórolf Sauermann, a sculptor from Germany. Shapes (c) and (d) were created by Oliver Miller, a designer from Great Britain. Shape (e) was created by Vladimir Alexeev, an artist from Russia. Our experience with the development of our very popular modeling system TopMod has motivated people around the world to create unusual shapes. We expect the same success for the outcome of this proposed project.

Having a community also helped to solve portability problems. For instance, the script editor was initially developed on the Mac platform and we had trouble compiling the code for Windows. One user from Italy provided a solution to this problem. Another user from France translated the user interface from English to French.

As a result of the TopMod's success, Texas A&M University decided to support commercialization of the product. Eventually, university was not able to commercialize the product and this direction practically stopped open source community formed around TopMod. As we have discussed in the proposal description, our research also evolved into non-orientable surfaces and solids. Therefore, the continuous development of TopMod based on the research results was not possible since its kernel was based on orientable 2-manifolds.

Based on our past experience, we clearly see the benefits of having a dynamic and open community to integrate research results into software and improving usability of the software. Thus, we will make one of the NSF-sponsored students responsible to initially create and maintain such a dynamic website. We will
also make our undergraduate and graduate students in the Visualization Department of Texas A&M University involve with the project developing content for website in variety of classes.

- Students taking VIST464 will design and develop the interface for website. They will deal with the problems such as making the design easy to navigate, simple and yet still attractive. The designs will need to be recognizable in a wide variety of devices and work similarly. Finally, they will observe the impact of their design in real environment.

- Students taking VIST 486 and VIST 487 can develop narrations of simple games by using our system. By letting students develop narrations with our system, we will find out ways to improve its user interface.

- Students taking VIST 305, VIST 405, VIZA 615 and VIZA 617 can develop stories by using our system and create animations. By documenting the process again as short movies, we can help researchers to use the software more efficiently.

- Students taking VIZA 641, Visual Storytelling, may develop visuals and software components for our system. By incorporating with our system, these software components will be immediately useful for larger community. These experiences will provide an additional learning opportunities that will be useful for students.

Our eventual goal is to develop a team of interested people – not necessarily supported by NSF and non necessarily from our own institutions – for maintaining the website. By involving other people, our goal is that not only we but also greater community of the people can continue to implement and add new results even long after the NSF-sponsored phase of the project has ended.