UNIVERSITY OF WASHINGTON

OFFICE OF THE PRESIDENT

May 29, 2012

Vice Chancellor Susan Jeffords
University of Washington, Bothell
Box 358522

Dear Susan:

Based upon the recommendations of the Executive Council, the General Faculty Organization has recommended approval of an option in Mathematical Thinking and Visualization within the Bachelor of Arts degree in Interdisciplinary Studies. A copy of the approval is attached.

I am writing to inform you that the Interdisciplinary Arts and Sciences program is authorized to specify these requirements beginning autumn quarter 2012.

The new requirements should be incorporated in printed statements and in individual department websites as soon as possible. The *General Catalog* website will be updated accordingly by the Registrar's Office.

Sincerely yours,

Michael K. Young
President

Enclosure

cc: Ms. Michele Libin (with enclosure)
Mr. Robert Corbett (with enclosure)
Dr. Deborah H. Wiegand (with enclosure)
Ms. Virjean Edwards (with enclosure BIS-20110601)

301 Gerberding Hall • Box 351230 • Seattle, Washington 98195-1230 • 206-543-5010 • FAX: 206-616-1784

UNIVERSITY OF WASHINGTON

CREATING AND CHANGING UNDERGRADUATE ACADEMIC PROGRAMS

NOV

After college/school/campus review, send a signed original and 8 copies to the Curriculum Office/FCAS, Box 355850.

For information about when and how to use this form: http://depts.washington.edu/uwcr/1503instructions.pdf

College/Campus Bothell	**Department/Unit** Interdisciplinary Arts and Sciences	**Date** 6/1/2011

New Programs

- ☐ Leading to a Bachelor of _____ in _____ degree.
- ☐ Leading to a Bachelor of _____degree with a major in _____.
- ☒ Leading to a Mathematical ~~Reasoning~~ and Visualization Option within the existing major in Interdisciplinary Studies.
- ☐ Leading to a minor in _____Thinking @ 3/8/12

Changes to Existing Programs

- ☐ New Admission Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Admission Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Program Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Requirements for the Option in _____within the major in _____.
- ☐ Revised Requirements for the Minor in _____.

Other Changes

- ☐ Change name of program from _____ to _____.
- ☐ New or Revised Continuation Policy for _____.
- ☐ Eliminate program in _____.

Proposed Effective Date: **Quarter:** ☒ Autumn ☐ Winter ☐ Spring ☐ Summer **Year:** 20 12

Contact Person: Jessica Trenkamp	Phone: 425-352-3286	Email: jtrenkamp@uwb.edu	Box: 358530

EXPLANATION OF AND RATIONALE FOR PROPOSED CHANGE

For new program, please include any relevant supporting documentation such as student learning outcomes, projected enrollments, letters of support and departmental handouts. (*Use additional pages if necessary*).

Please see attached.

OTHER DEPARTMENTS AFFECTED

List all departments/units/ or co-accredited programs affected by your new program or changes to your existing program and acquire the signature of the chair/director of each department/unit listed. Attach additional page(s) if necessary. *See online instructions.

Department/Unit:	Chair/Program Director:	Date:
Department/Unit:	Chair/Program Director	Date:

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Reflecting requested changes (include exact wording as you wish it to be shown in the printed catalog. Please underline or otherwise highlight any additions. If needed, attach a separate, expanded version of the changes that might appear in department publications). Please note: all copy will be edited to reflect uniform style in the General Catalog.

The option in Mathematical Reasoning and Visualization in the Interdisciplinary Studies major is housed in Interdisciplinary Arts and Sciences at the University of Washington Bothell. The degree educates students in knowledge and capacities related to mathematical and quantitative reasoning and data visualization. The curriculum mixes courses that introduce and develop these topics with workshops that enable students to create their own data visualization projects.

APPROVALS

Chair/Program Director:	Date: 10-17-11
College/School/Campus Curriculum Committee:	Date: 10/17/11
Dean/Vice Chancellor:	Date: 11-1-11
Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date: 10/17/11

POST TRI-CAMPUS APPROVAL (when needed)

Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date: 3/29/12

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Post Tri-campus signatures

APPROVALS

Chair/Program Director:	Date: 3-22-12
College/School/Campus Curriculum Committee:	Date: 3-26-12
Dean/Vice Chancellor:	Date: 3-26-12
Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date:

POST TRI-CAMPUS APPROVAL (when needed)

Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date:

UNIVERSITY OF WASHINGTON

BOTHELL

Office of the General Faculty Organization

GFO Executive Council Motion:

The General Faculty Organization's Executive Council endorses forwarding the Interdisciplinary Arts and Sciences Program's Mathematical Reasoning and Visualization Option to the UW Registrar for Tri-campus review.

Approved by the Executive Council of the General Faculty Organization on

Date 5/31/11

Chancellor's Approval:

☒ I approve this action.

☐ I do not approve this action (please include an explanation).

Signed [signature]

Date 11/17/11

UNIVERSITY of WASHINGTON | BOTHELL
OFFICE OF THE CHANCELLOR

June 2, 2011

TO: Steve Holland, Chair, GFO Executive Council

FROM: Kenyon Chan, Chancellor

SUBJECT: GFO Executive Council Endorsement to forward the Interdisciplinary Arts and Science Program's Mathematical Reasoning and Visualization Option to the UW Registrar for Tri-campus Review

I am returning this proposal for further consideration for the following reasons:

The title seems problematic to me.

- How is this different from mathematics and will students or anyone recognize the difference given the title?
- Will potential students understand the option from the title?
- Will potential employers understand the option from the title on a transcript?
- Will potential graduate programs understand the option from the title on a transcript and will the content of the option lead to graduate studies?

I look forward to further discussion and clarification about this option before we forward.

cc: Susan Jeffords, Bruce Kochis

UW1, Room 260 Box 358520 18115 Campus Way NE Bothell, WA 98011-8246
office 425.352.5220 fax 425.352.5223 www.uwb.edu

Distribution List

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- ☑ Curriculum Development
- ☑ Teaching and Learning Center
- ☑ Writing Center

Refer to Committee

- ☐ Campus Council on Academic Standards and Curriculum
- ☐ Campus Council on Promotion, Tenure and Faculty Affairs
- ☐ Instructional and Research Support Committee
- ☐ _____

Steven Holland — 6/1/11

GFO Vice Chair

Revision Date: April 4, 2008

UNIVERSITY OF WASHINGTON

BOTHELL

Office of the General Faculty Organization

GFO Executive Council Motion:

The General Faculty Organization's Executive Council endorses forwarding the Interdisciplinary Arts and Sciences Program's Mathematical Reasoning and Visualization Option to the UW Registrar for Tri-campus review.

Approved by the Executive Council of the General Faculty Organization on

Date 5/31/11

Chancellor's Approval:

☐ I approve this action.

☒ I do not approve this action (please include an explanation).

See Attached

Signed Kerry Shea

Date 6-2-2011

UNIVERSITY OF WASHINGTON

BOTHELL

Office of the General Faculty Organization

To: Kenyon Chan, Chancellor

From: Steve Holland, Chair, GFO Executive Council SH

Copy: Susan Jeffords, Vice Chancellor for Academic Affairs,
Bruce Kochis, Chair, GFO

RE: GFO Executive Council Endorsement to Forward the Interdisciplinary Arts and Sciences Program's Mathematical Reasoning and Visualization Option to the UW Registrar for Tri-campus Review.

Date: May 31, 2011

On Tuesday, May 31, 2011, the General Faculty Organization's Executive Council endorsed forwarding the Interdisciplinary Arts and Sciences Program's Mathematical Reasoning and Visualization Option to the UW Registrar for Tri-campus Review.

Pursuant to Section 13-23.C of the UWB Handbook, the Executive Council requires your approval of this action. Please indicate your decision on the attached page and return to Barbara Van Sant, GFO Administrative Coordinator. Thank you.

May 31, 2011

Proposal for an Option in Mathematical Reasoning and Visualization Interdisciplinary Arts and Sciences University of Washington Bothell

Overview

A new option for Interdisciplinary Arts and Sciences (IAS) students at the University of Washington Bothell (UWB) is proposed to start in Fall 2012. The option in Mathematical Reasoning and Visualization (MRV) will join existing options in the Interdisciplinary Studies major. In addition to normal graduation requirements for all Interdisciplinary Studies majors, students will complete 40 credits for the MRV option. The current proposal was approved unanimously by the IAS faculty in April 2011 and unanimously by the Executive Committee of the General Faculty Organization in May 2011.

The current Washington State Higher Education Coordinating Board Strategic Master Plan identifies education in mathematics among its priorities, and urges an expansion of degree opportunities. The proposed option also responds to the UWB 21st Century Initiative's commitment to "develop new majors and graduate programs in high-demand fields and foundational studies to serve student, employer and regional needs" and to the IAS priority to "provide students with a transformative education that hones their ability to think critically and creatively, research and communicate effectively, and work and lead collaboratively."

The UWB Mathematics and Quantitative Reasoning Task Force, in its final report of March 24th, 2011 discussed this proposal along with a draft proposal for a Bachelor of Science in Mathematics, which would be offered by the Science and Technology Program:

> ...these degrees, if approved, would:
>
> - add to the already-rich variety of UWB degrees that draw on lower-level mathematics courses. This connects to recommendations for supporting teaching in the CUSP mathematics courses.
> - potentially share some upper-level courses, such as game theory or graph theory. We recommend that faculty curricular decisions be informed by cross-program consultation, and that the campus adopt as a goal the greatest possible sharing of courses.
> - facilitate the offering of courses useful to non-majors.
> - help to build a campus culture in which mathematics is prominently visible, and richly linked to other areas of study. [1]

[1] MQRTF Task Force Report, page 8.

That document further "encourage[s] continued cross-campus coordination of upper-level mathematics and quantitative reasoning."

Title: We have developed this proposal under the title "Mathematical Reasoning and Visualization." We have been asked to consider a shorter title. An alternative title is simply "Mathematics and Visualization."[2]

Background

Mathematics has been part of the IAS curriculum from its beginning and has formed an important part of the campus-level curriculum shared with other programs. Instruction has addressed the applied needs of IAS and other students, especially in statistics, but has also treated mathematics as a subject in its own right, via courses on mathematical aspects of art, game theory, number theory, and other subjects.

In Spring 2006, IAS Senior Lecturer John Rasmussen interviewed 15 regional leaders from for- and non-profit organizations. One of his questions asked "What math/quantitative skills and abilities do you value in entry-level college graduates?" Among the five abilities identified by more than half of the respondents, three

(1) translate real world problems into numbers and formulas
(2) use of statistics
(3) analyze data and present it visually.

inform the currently-proposed degree. Current IAS math courses have also incorporated these ideas into their learning goals, and BIS232: "Visualizing Quantitative Data," was developed as a result of this work.

There are currently three mathematicians on the IAS faculty, and a much larger number of faculty have graduate-level mathematical, statistical, and/or quantitative reasoning training. Several faculty have training as practitioners and scholars visual arts. During the 2009-10 academic year IAS made two hires in Geographic Analysis and Visualization, both of whom bring expertise in mathematical modeling, and interpretation of data, as well as experience in communicating the results of geographical work to local communities. IAS students in a number of degrees have reported that their abilities in communicating data and concepts visually have made a difference in getting employment in such areas as environmental consulting.

Cross-Campus Coordination

The 2011 Mathematics and Quantitative Reasoning Task Force was charged to "identify a short list of degrees or curricula that can be developed in a phased approach over the next five years, with consideration for ways to leverage existing resources and faculty expertise." As noted

[2] Student surveys and discussions with faculty in the field indiate a preference for including reasoning in the title and a preference for "Mathematical" over "Quantitative."

above, the Task Force's report discusses a larger strategy of degree development at UWB which would draw more students through a common set of introductory courses, share upper-level courses, and make courses available to non-majors. The proposed option addresses the Task Force's recommendation of "the greatest possible sharing of courses" in these ways:

- It supports the teaching of BCUSP 124 (first quarter calculus), BIS 231 (linear Algebra), and BIS 315 (statistics), courses with wide demand across the campus.

- It will support the more regular teaching of BIS 232 (Visualizing Quantitative Data) a course of considerable potential interest to a range of non-majors in different programs.

- Following the MQRTF recommendation, it supports a suite of 300- and 400-level electives in mathematics that are of potential interest not only to other mathematics degrees, but to students in a variety of degrees, including:

    - BST 310 Mathematical Game Theory (prerequisite: B CUSP 124)
    - BIS 350 The Concept of Number (no prerequisites)
    - BISMRV 3xx Logic
    - BISMRV 3xx Graph Theory and Social Decision Making
    - BISMRV 3xx Cryptography
    - BISMRV 4xx Mathematical Systems
    - BISMRV 4xx Combinatorics and Discrete Probability

- As the UWB Mathematics and Quantitative Reasoning Task Force report notes, the MRV degree complements a more traditional mathematics degree of the kind contemplated by the Science and Technology program, because courses can be cross-listed, faculty can teach across both degrees, and faculty development and student support can be provided for both. Where integration will be limited will be in courses stressing proof – these will be the special strengths of the S&T degree. However courses in discrete mathematics, courses in the kind of modeling that draws on differential calculus and linear algebra, and a range of applied courses are all potentially shared.

- It would support innovative efforts by the CSS program to offer courses of interest to non-CSS-majors. As noted below, the "mathematical reasoning" bin will be open to a range of courses.

- This degree would provide increased options for students in the Education program who are seeking to fulfill requirements for a Mathematics Endorsement, particularly for primary and middle school. Moreover, at least seven of the IAS courses listed below would meet requirements for a secondary school endorsement in the State of Washington.[3]

[3] For a complete listing of the Secondary Education Mathematical Endorsement requirements, see: http://www.uwb.edu/secondarycertmed/mathendorsement

Coordination and collaboration across campus will require ongoing work, because curricula are evolving. The faculty responsible for this degree will do that in two ways: (1) to the extent possible, interested faculty across the campus will included in the degree's working group, which will mean they are invited to all meetings and are on the e-mail list, and (2) the working group will work with a key contact in each program for regular consultation about curriculum.

As IAS grows, we look forward to supporting the growth of mathematics and quantitative reasoning across the campus and contributing to cross-program initiatives, as well as increasing the opportunities of IAS students to learn mathematics and have their work recognized in the form of degrees. In both its subject matter and opportunities for course cross-listing, this degree option can act as a bridge between our degrees and degrees across campus.

Rationale

A degree in Mathematical Reasoning and Visualization will address State and National needs and student interests in communicating data and concepts.[4] It will build on IAS strengths in quantitative reasoning, logical and critical thinking, data visualization, and geographic visualization. It will support, and develop links to, teaching in Environmental Studies, Environmental Science, Community Psychology, Media and Communication, Policy Studies, Global Studies, Cultural Studies, and Interdisciplinary Arts.

"Mathematical reasoning" refers to abilities to

- Recognize mathematical forms in real-world phenomena: this may include pattern-recognition, the identification of functional forms, and the ability to see common types of model in multiple guises.
- Identify and describe key features of a *problem* mathematically, and use that mathematical description to analyze the problem.
- Construct appropriate models (from a range of choices).
- Generate frameworks of concepts that can be filled with data.
- Gather and interpret data, with attention to units, measurement, and sources of error.
- Use a range of techniques, including diagrams, graphs, tables, formulas, simulations, to understand data, problems, and data-based claims.

As the term is used here, "mathematical reasoning" is broader than the view that mathematics "is about developing rigorous logical proofs about formally defined abstract structures, starting with a set of precisely formulated specific axioms;" like Keith Devlin, we seek a wider range of ways to "do math."[5] The list above draws on Alan Schoenfeld's argument for an inductive, problem-

[4] A recent McKinsey report indicates "The United States alone will need 140,000 to 190,000 more people with "deep analytical" skills, typically experts in statistical methods and data-analysis technologies. Additionally: McKinsey says the nation will also need 1.5 million more data-literate managers, whether retrained or hired. " The full report can be downloaded at: http://www.mckinsey.com/mgi/publications/big_data/index.asp

[5] Keith Devlin, "What does "doing math' mean?" Mathematical Association of America, April 2005.

focused education in mathematics.[6] The inductive focus of this degree also represents a division of labor within UWB: the B.S. in Mathematics currently being developed in the Science and Technology program would proceed along more traditional deductive lines, prioritizing formal proof.

Students trained in mathematical reasoning are not compelled to take at face value the models, formulations, or data-derived arguments they encounter. That is, a student with this background should not merely be competent in quantitative reasoning, but able to think critically about the concepts and choices that underlie the frameworks for the data and mathematical models used to address a question. Students should also be able to bring together quantitative and non-quantitative data to address a question.

"Visualization" refers both to ways that we make questions, phenomena, and arguments clear to ourselves, and to the ways we communicate them to others. While this degree draws on powerful visual traditions and techniques, it does not preclude sound, narrative, or other technologies of communication. This is a rich area, in which work in natural sciences (in particular biology), mapping, social sciences, and arts converge. Some courses of this kind, for example in the Visual Arts in Biology and the mathematics of aesthetics, have already been taught in IAS.

There is already a substantial base of students in several IAS degrees who are taking a required introductory statistics course[7]; a focus in this concentration would let them deepen those skills through advanced courses, explore their theoretical underpinnings, and gain more experience doing research projects that use quantitative methods and communicate their results. Courses in logic, mathematical modeling, and visualization, most of which are already being taught regularly in IAS, would round out this option.

There is also a large base of students who are taking required courses in geographic information science (GISc). At both introductory and advanced levels, students are learning a complete new set of quantitative skills within the fields of spatial analysis and geo-visualization. One of the main skills gained through these courses is the ability to translate geographic problems into mathematical and logical formulations that can be used to model, analyze, and quantify the relationships between geographic features and the environment. In addition, the outcomes of these spatial analyses are represented and visualized as a form of map. Students learn how to create, understand, and interpret geo-visualization where 'numbers' and spatial analyses are embedded in its production.

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[6] Alan H, Schoenfeld, . (1992). Learning to think mathematically: Problem solving, metacognition, and sense-making in mathematics. In D. Grouws (Ed.), Handbook for Research on Mathematics Teaching and Learning (pp. 334-370). New York: MacMillan. Note that aside from the emphasis on the nature of proof, the proposed degree closely tracks the recommendations from the MAA's Committee on the Undergraduate Program in Mathematics (CUPM) can be found at http://www.maa.org/cupm/ The content of this degree is, therefore, more sophisticated than "quantitative reasoning," which is discussed in the MQRTF report as "a 'habit of mind,' competency and comfort in working with numerical data," a capacity that all university graduates should, ideally possess.

[7] For example, the following concentrations require BIS315 (Intro Statistics) for graduation: CP, STS, Env. Science, and SEB.

As IAS increases emphasis on writing and communication, and on completing substantial projects, we are seeing more student research drawing on social and environmental data. In many cases, students collect their own data. The demonstrated capacity to interpret and communicate concepts and information, whether to immediate colleagues or the public at large, will be a compelling skill for a range of employers. IAS students, in particular, have the opportunity to gain experience with a wide range of modes of (interactive) presentation, including photo essays, websites, research papers, and live facilitation. This degree will give students with a strong interest in understanding and communicating complex ideas and dense information an opportunity to develop and showcase those capacities. It will speak to employer interests in students' abilities to communicate ideas to colleagues and the public.

At least a dozen full-time IAS faculty members are potential contributors to a course of study of this kind. Advanced courses in quantitative reasoning would also be attractive to business and science students as well as students in other IAS degrees such as community psychology and policy studies. There are numerous undergraduate and graduate degrees and research centers in quantitative methods and information visualization that we might look to as models.[8] IAS faculty could also contribute significantly to students thinking about knowledge production about and with data, including the ways in which data is created and used.

Developing the above degree would also help IAS meet the growing need for our graduates to achieve competency in quantitative literacy. AAC&U has listed QL has one of its essential learning goals, and there is growing national work that IAS could learn from and contribute to in this area. Throughout IAS, and across the campus, we need to build a culture that sees mathematical methods not as a barrier, or even a hoop to jump through, but a means to insight and better communication. This degree's emphasis on these qualities will serve both its majors and the campus at large.

IAS' annual assessment evaluates student portfolios against criteria for these four goals; those criteria have been revised in 2011 to include mathematical and quantitative skills. This annual assessment encompasses all IAS degrees, but also provides a process that can easily be adapted so that individual degrees can gather evidence about their students' learning.

Learning Objectives

The learning objectives for the Mathematical Reasoning and Visualization degree are aligned with and support the four core IAS learn objectives (critical thinking; interdisciplinary research; writing and presentation; shared leadership and collaboration). Students receiving this degree will:

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[8] For example, see Columbia's MA in Quantitative Methods for the Social Sciences (http://www.columbia.edu/cu/gsas/departments/quantitative-methods-social-sciences/bulletin.html), or the University of New Hampshire's Data Visualization Lab (http://ccom.unh.edu/vislab/index.html)

1. Acquire critical competence in different ways to address real-world problems in mathematical forms (CT).

2. Learn to apply statistical tools and critique their applications, including building and critiquing arguments based on quantitative data. Generate reliable data and evaluate which methods to apply to a given data set (CT; IR).

3. Gain experience creating visual representations of problems and data, and communicate these ideas, results, and analyses in multiple formats (WP).

4. Learn to use mathematical tools across varied disciplinary areas (IR).

5. Learn to work in interdisciplinary teams to communicate and to understand a range of problems that have mathematical underpinnings (IR; SLC; WP).

Curriculum

The curriculum of a new Mathematical Reasoning and Visualization degree option will be structured with courses falling into four categories:

1. Prerequisites: Students will be asked to complete
   - one quarter of calculus
   - one quarter of linear algebra

Students can complete these regularly taught courses at UWB or at another institution. These courses provide underpinnings of the quantitative models and essential mathematical ideas.

2. Required Core Courses: In addition to BIS300 (Introduction to Interdisciplinary Inquiry), which is required of all IAS students, students in this degree would complete

BIS209: Engaging Visual Arts: This course will introduce students to visual form – to the range of possibilities for visual communication, and some part of the history of visual conventions. Viewers encounter visual phenomena having already learned to see and interpret them in particular ways. Arts both draw on those learned ways and, sometimes, change them. The course in visual arts, therefore, provides students a richer understanding of the possibilities in visual communication, and a more sophisticated grasp of visual form as a means to communicate to an audience. It is useful for purposes of this degree to approach visual form and communication *outside* the context of mathematics, in order to isolate the question of visualization.

BIS232: Visualizing Quantitative Data: This course introduces students to the scholarship of data visualization. Through multiple case studies, students learn how numbers become proxies for ideas and what information quantitative modeling can and cannot provide for important decision making. Students learn how to locate

public data sets and create both a technical and creative presentation from these data sets.

BIS315: Understanding Statistics: This course is central to this degree not only for the study of statistical inference, but also because it addresses the fundamental understanding of how data is constructed, and how a given question in the world might be addressed in different ways – different choices of models, different foundational assumptions.

3) Students must take 25 credits in the two categories listed below, with a minimum of 10 credits in each category.

Mathematical Reasoning: Students will choose at least two courses that will help them develop the mathematical tools gained in their prerequisite and core courses. This list will evolve as curricula across UWB change; courses in this category explicitly study mathematical principles. That emphasis is manifest in their readings, assignments, and evaluation. This criterion does not exclude courses with substantial application, but a student finishing a course in this category should be able to reflect critically on the mathematical principles learned, in a way that aids their thoughtful application elsewhere.

Visualization Practice and Methods: Students will choose at least two courses that extend their capacities in visualization and communication. "Visualization" may include modeling and tools for examining data sets. It includes interactive and informal modes of presentation and communication, along with polished presentations to specific audiences. Courses in this category develop means of representing, and critically examining data and arguments.

4) Like all IAS students, MRV students will take BIS 499: Portfolio Capstone, and satisfy the IAS "Interdisciplinary Practice and Reflection" requirement. The latter can be satisfied by courses listed as "mathematical reasoning" or "visualization practice." Students can also take an additional course (on top of the 25 credits) to satisfy this requirement.

Category	Credits	Courses
IAS Core	5	Interdisciplinary Inquiry
Degree Core	15	BIS 209 Engaging Visual Arts BIS 232 Visualizing Quantitative Data BIS 315 Understanding Statistics
Mathematical Reasoning	10-15	BCUSP 125/126 Calculus II and III BIS230 Mathematical Thinking for the Liberal Arts BIS302 Issues in Mathematics Across Cultures BIS 329 Topics in Mathematics Across the Curriculum (Topics have included game theory, knot theory, mathematical modeling, symmetry, and cryptography; up to 10 credits) BIS 350 The Concept of Number

		BISMRV 3xx Logic BISMRV 3xx Graph Theory and Social Decision Making BISMRV 3xx Cryptography BISMRV 4xx Mathematical Systems BISMRV 4xx Combinatorics and Discrete Probability STMATH 300 Foundations of Modern Mathematics STMATH 310 Mathematical Game Theory CSS 342 Mathematical Principles of Computing Additional CSS courses *Selected courses from an upcoming formal math degree in S&T may also be available in this option.*
Visualization Practice and Methods	10-15	BIS 2XX: Visual Communication BIS 342: Geographic Information Systems BIS 4XX: Advanced Geographic Information Systems BIS 4XX Geographic Visualization BIS 382 The Visual Art of Biology BIS 434 Psychology and the Visual Arts BIS 447 Topics in Quantitative Inquiry BISMRV 4xx Data Visualization Workshop *Suggestions of other IAS and UWB courses are welcome.*
Additional IAS Coursework	22	This category may including 10 IAS credits in each of the UW areas of knowledge, if not already satisfied.
Portfolio Capstone	3	BIS 499 Portfolio Capstone
General Electives	20	

Note: Within the 90 credits, students must complete 10 credits each in Individual and Society (I&S), Natural World (NW), and Visual, Literary, and Performing Arts (VLPA).

Faculty and Staff

Alex Barchechat: Mathematics

Cinnamon Hillyard: Undergraduate Mathematics Education, Numerical Methods for Partial Differential Equations, Ethnomathematics

Jin-Kyu Jung: Geographic Information Science, Urban Geography

Santiago López: Geography and the Environment

John Rasmussen: Interdisciplinary Mathematics, Finance, Computer Modeling, Mathematical Logic

Additional Faculty

Our ability to staff courses, develop curriculum, and work with students would be greatly enhanced by the addition of colleagues in two areas:

> Statistics and Modeling: A social or natural scientist with experience designing and applying a range of models and statistical techniques
>
> Data Visualization: A scholar with training in both mathematics and visual arts

While not essential to begin the degree, a colleague who could teach logic would help expand options to students in the degree.

Administration and Advising

The MRV option will be housed and administered in IAS under the leadership of the IAS Director and a Curricular Area Working Group charged to oversee MRV. Advising will be done principally by IAS advisors.

Effect on Curriculum

The most significant positive effect of a new MRV option on the rest of the IAS curriculum, apart from the increase in enrollments and economies of scale within IAS and UWB, will be to provide an increased level of proficiency in mathematical reasoning, quantitative literacy, data visualization and communication across the program and campus. We anticipate that this increased quantitative literacy among students will strengthen courses throughout the program and across the campus.

The most significant negative effect will be to draw faculty teaching away from other options in which those faculty members currently teach. This concern is addressed in part by the request for faculty to both develop new courses within the MRV option and to help cover existing courses in other options for which existing faculty will no longer be available.

At the moment, the prerequisites for this degree are being taught on a regular basis, as are BIS 315 and BIS 209. BIS 232 (Visualizing Quantitative Data) is not taught frequently, and would assume a key role in this degree (we may also want to promote it to the 300 level), so that we will at a minimum need to free up faculty time to develop and teach this course. Among the upper-level electives, we offer enough at the moment that a student could fulfill requirements, but choices would not be large. A particular need would be for a regularly-offered logic course.

The equivalent of two additional full-time faculty members will be needed to offer this degree well; at least one of those needs to be a tenure-track hire.

Budgetary Impact

While the degree could be started without additional resources beyond the faculty hires listed above, it will, especially if it is successful in attracting a flow of students, make claims on GIS and statistical software and computing, on the Quantitative Skills Center, and on library databases.

MEMO

To: Bruce Burgett and Susan Jeffords
From: Colin Danby and Cinnamon Hillyard
Re: Option in Interdisciplinary Studies: Mathematical Reasoning and Visualization
Date: September 12, 2011

The proposed Interdisciplinary Studies option in Mathematical Reasoning and Visualization received unanimous support from the IAS faculty and GFO Executive Committee in the first half of 2011. It benefited from an unusual level of cross-program consultation (for an option), including discussion and support within the Mathematics and Quantitative Reasoning Task Force.

In response to questions raised at the UWB administrative level, we consulted over the summer with a range of people on the degree's name, scope, application, and design.

Cecilia Aragon, Associate Professor, Human Centered Design and Engineering, UW Seattle
Scott Barker, Informatics Program Chair, Information School, UW Seattle
Rebecca Hartzler, Senior Associate, The Carnegie Foundation for the Advancement of Teaching
Jeremy Klein, Visual Data Specialist, Google
Nathan Kutz, Chair, Applied Mathematics, UW Seattle
Joel Levine, Chair, Mathematical Social Sciences, Dartmouth College
Jock Mackinlay, Director, Visual Analysis, Tableau
Maura Mast, Assoc Vice-Provost for Undergraduate Studies and Professor of Mathematics, University of Massachusetts Boston

Visualization and data analysis are growing rapidly. Nathan Kutz reported burgeoning enrollment over the last three years for his graduate course in data analysis, AMATH 582, and plans to offer an undergraduate version this academic year (which would require one quarter of calculus and statistics, in alignment with our proposed curriculum). Cecilia Aragon, a scholar of scientific visualization, is a new hire this Fall who will offer the undergraduate course in visualization that she previously taught at UC Berkeley. Scott Barker wrote that "We also are expanding in this area in the future."

Kutz reported surging employer interest in students with analysis and visualization skills. Google, which is expanding its presence in the area, is a major user of these skills, and Tableau is a growing producer of data visualization software. Jeremy Klein wrote: "I love the idea, and I think that the concept is spot on. There's a lot of potential available." In recent months there has been a wave of media accounts of the "data tsunami" and difficulties that a range of organizations have in dealing with the much greater volumes of data that are now available.

But on the Seattle campus and at most universities, this area is a curricular orphan. Visualization is taught in computing programs, information schools, and business curricula, but typically as an elective. Interdisciplinary links to the psychology of perception have formed at the scholarly level, but the obvious connections that IAS can support to arts and digital humanities are still thin, a reflection, perhaps, of the academic milieux in which the field has so far developed.

We encountered no reservations among our academic colleagues about the degree's name, even when we pressed the question. Nor did we hear concern that the curriculum was light on mathematics. In fact it is clear, from online syllabi, that we require more mathematical background than is requisite for many analysis and visualization courses.

While we discovered no other degree quite like this, we were surprised by how easy it was to explain. Joel Levine, who has guided Dartmouth's Mathematical Social Sciences Department for three decades, wrote that "I don't know of any such program other than the obvious, Dartmouth and Northwestern," a reference to Northwestern's rather more highly structured Mathematical Methods in the Social Sciences program. Levine commented on the proposal that

> It integrates various disciplines where most interdisciplinary programs settle for representation by various disciplines, lacking the courage to propose that they merge - at least in the minds of the students. ... Oddly, faculty can get away with this representation without integration' while students and people who are actually trying to use these skills cannot. The latter are responsible for complete projects.
>
> ... For the practical value of the degree itself -- it is every bit the goldmine you suggest. ... When the math component is serious, as yours appears to be (not just a "taste," but the real thing) it gives the students credibility. The fact that few employers have ever heard of "Math Social Science" means that our students' applications get read, not

pigeon-holed. Alums have gone to just about everything imaginable and unpredictable -- medicine, law, public health, business, venture cap / investment banking, art (curator), military intelligence, symphony (management), Congressional staff, polling, and a broad range of Ph.D's and Prof's ... not to leave out one circus acrobat (a brilliant guy who is also a gymnast, loves kids, and now teaches/runs math programs in Phoenix public schools.). ...

Should there be any doubt, your proposal is leading edge (cliché) professionally and scientifically as well as pedagogically and practically. With computers we can now do simple analyses (conceptually simple) that were intractable by hand. Paradoxically, the computer allows us to go back to scientific basics where much of the routine and elegance of mathematical statistics was a necessary diversion, necessary in a world of hand computation, but no longer. The operating definition of "scientific" in the social and policy sciences has been "that which classical statistics allows us to analyze," with the anachronistic caveat "... analyze by hand". As we expand (and simplify) what we can analyze, the boundaries of the 20th century disciplines will move.

This last point was echoed by Kutz, and others: software tools (such as Tableau) now allow students to move quickly to challenging work. Part of our job is providing conceptual rigor so students understand what they are doing, and the software allows us to move more rapidly to the point that we can pose those questions.

Our experience and capacity supporting internships should be especially helpful. Students who have data analysis and visualization capacities should have little difficulty finding internship perches in a range of nonprofits (where we have a particular advantage) and businesses. Klein suggested Math 381 at UW Seattle as a model. Tableau is open to internships, and we would be in a good position to develop links with Google.

These meetings helped us appreciate the degree's resonance with the IAS learning objective of Shared Leadership and Collaboration (Aragon studies this in groups of scientists). How do members of a group make their ongoing work visible to others, and explain it as part of the collaborative process, rather than just throwing together elements of a project at the last minute? Finally, as IAS deepens the pedagogy of the portfolio, we are helping students examine, explain, and document the communicative success of their work. The portfolio becomes not just a sheaf of old college papers, but a narrative of learning to engage different audiences in different ways. The inherently public qualities of visualization should be well supported by the portfolio, which will in

turn support graduates' abilities to communicate what they have learned to employers and professional schools.

A word more on the name: as noted above, we encountered no doubts among our colleagues. Aragon, a visualization scholar, discussed it at with great care and suggested (a) that the alternative "Mathematics and Visualization" was not a good idea because it was prone to misinterpretation as a standard math degree and (b) that there is a distinction among visualization scholars between the areas of "scientific visualization" and "data visualization," and that we might note in our supporting literature that our teaching is mainly in the latter area - but she had no difficulty with "Mathematical Reasoning and Visualization" as a title.

We were delighted that Levine recognized this degree as a peer of the math and social science degrees at Dartmouth and Northwestern, while also noting that our degree appropriately exceeded the boundaries of the social sciences.

Everyone we talked to recognized the deep connection between visualization, and the rigorous reasoning plus focused creativity that mathematics enables. On its own, "visualization" (or "data visualization") represents a course or two. Nor are we proposing a conventional statistics degree. Mackinlay told us that business terms such as "data analytics" did not capture the full interdisciplinary aspects of the degree or field of study.

Given that we have circled back repeatedly to MRV as the name for the degree, and that no obvious alternative has emerged, we propose to begin with it. When we consider transitioning the option to a major in a few years we will have an opportunity to revisit the name in light of our experience with students and the shifting academic landscape.

Bothell: Option in Mathematical Reasoning and Visualization within the Bachelor of Arts degree in Interdisciplinary Studies (BIS-20110601)

uwcr
uwcr
Board owner

Please review the attached 1503 pdf requesting to establish an option in Mathematical Reasoning and Visualization within the Bachelor of Arts degree in Interdisciplinary Studies at the Bothell campus and post comments by 5:00 pm on Friday, December 9th.

If you have any problems viewing the attachment, please contact the University Curriculum Office at uwcr@uw.edu.

Attachments:

- BIS-20110601.pdf13.3MDownloadView

shawniep
SHAWN E. PARNELL

I am not really a fan of the term "visualization". It seems unclear and makes the title seem like it is a totally watered down version of mathematics. Mathematical Reasoning and Applications would be my suggestion.

pickle5
MATTHEW CONROY

The 1503 does a good job of explaining the use of the term visualization; I think the title is fine. Perhaps "Mathematical Reasoning and Data Visualization" would be more acceptable to some, though it may be too narrow.

However, "Mathematical Reasoning and Applications" is a poor choice, as the range of applications of mathematics goes far beyond what this program is proposing and largely misses the point of the significant visualization component.

cheers,

Matt Conroy
Department of Mathematics
UW Seattle

jpalmier
JOHN PALMIERI

I actually find the other half of the title, "Mathematical Reasoning," a little bit problematic. The proposal says

As the term is used here, "mathematical reasoning" is broader than the view that mathematics "is about developing rigorous logical proofs ..."

I would say that as the term is used in the proposal, "mathematical reasoning" is *complementary* to the view that mathematics is about proofs: proofs and the surrounding concepts and language don't seem to be part of this proposal, or at least part of its definition of mathematical reasoning (see p. 11 in the PDF file, p. 4 of the actual proposal). I disagree with that usage: "mathematical reasoning" should certainly include proofs and mathematical logic.

This issue isn't enough for me to object to the proposal, but it would be nice if it could be addressed. Maybe "Mathematical problem-solving and visualization" would work better? "Mathematical modeling and visualization"?

John Palmieri
Department of Mathematics
UW Seattle

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pickle5
MATTHEW CONROY

It appears, if I'm reading the proposal correctly, that students could satisfy the "mathematical reasoning" component by taking Calc I, II, and III and linear algebra. If so, I don't think that would prepare the students to reason mathematically in the sense that the proposal indicates with the bullet points on page 4 of the proposal (page 11 of the pdf).

Perhaps renaming it "Mathematics and Visualization" or "Mathematical Visualization" would avoid the issue of what kind of mathematical reasoning is intended.

Matt Conroy
Department of Mathematics
UW Seattle

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johnmlee
JOHN M LEE

I have serious problems with using the term "Mathematical Reasoning" in the title of this degree. To mathematicians, the term "mathematical reasoning" has a very specific meaning -- starting with precise definitions and assumptions, and using rigorous arguments to derive logically sound conclusions. (I'm currently teaching Math 300, "Introduction to Mathematical Reasoning," whose syllabus is all about learning to read and write proofs.)

There are a few courses in the proposal that might fit under the title "Mathematical Reasoning" (e.g., The Concept of Number,

Logic, Mathematical Systems, Foundations of Modern Mathematics); but they're not required, and a lot of what the proposal's authors are referring to would be better described as "quantitative reasoning" or "statistical reasoning." In particular, it appears that students can get this degree with three quarters of calculus and a quarter of linear algebra, and no other mathematics courses, which means they might not have received even a basic introduction to the way mathematicians actually reason.

A title like "Quantitative Reasoning and Data Visualization" would be much more accurate.

John M. Lee
Professor of Mathematics
UW Seattle

burdzy
KRZYSZTOF BURDZY

I totally agree with John Palmieri and John Lee.
"Mathematical resoning" is a blatant misnomer.
It promises something to students that they will not get.

Krzysztof Burdzy
Department of Mathematics
UW Seattle

folland
GERALD B. FOLLAND

Yes, "Mathematical Reasoning" is misleading. The description of "mathematical reasoning" in the form 1503 is what I would call "mathematical modeling," which is rather different. The title may also suggest, incorrectly, that this program has something to do with the sophisticated mathematics that goes into computer graphics and related technologies. The broader labels "quantitative reasoning" or "quantitative studies" would be better.

Gerald Folland
Professor of Mathematics, UWS

montiii
WILLIAM M MCGOVERN

I agree with Jack Lee's comments: I too have serious concerns about this proposal and the low level of rigor that it would require to give a degree with mathematical reasoning in the title. The programs that we offer at the Seattle campus offer much more exposure to proofs and provide much more of the content that would be suggested by the title of this proposal. If this is offered, I would want the wording changed to something that I could view as more honest about the actual content. All

of the courses proposed would be at the 300 level or below on the Seattle campus, nor is any course proposed that would correspond to our Math 300, which specifically trains students in mathematical reasoning.

littig
PETER J. LITTIG

I think the proposal has several strengths. What the proposed option does best is couple quantitative and statistical reasoning with data visualization techniques to address real-world problems in a wide range of domains (e.g., politics, voting, social science, economics and social justice, art, etc.) These applications are not central to any other degree program I know of in the UW system. The proposed option is a nice step in addressing this curricular gap.

It seems both natural and advantageous, then, to capture this unique "brand" in the option's title. "Quantitative Reasoning and Data Visualization" would do this nicely (though verbosely). "Quantitative Studies" is shorter (though less descriptive) and could also work. And, of course, neither of these possibilities suggest that students would *not* engage in mathematical reasoning.

Having said that, I agree with UWB Chancellor Chan and UWS Mathematics Professors Palmieri, Lee, Burdzy, Folland, and McGovern: the currently proposed title is problematic. It is misleading (as discussed by Palmieri and Folland) and--perhaps more to the point--it misses the opportunity to stake its claim as a unique and innovative degree option.

Sincerely,

Peter Littig
Assistant Professor of Mathematics
Science and Technology Program
University of Washington Bothell

jmarms
JUDITH M ARMS

Professor Littig has summed the situation up well, but let me reiterate for emphasis.

- The proposed program would offer many different students a stronger background in quantitative reasoning. I'm particularly interested in the opportunities for current or future K12 teachers to strengthen their skills in this area.

- The proposed title is misleading. The phrase "mathematical reasoning" should be included in the title ONLY if several upper level math courses are required, and that would significantly

change the program. With the currently proposed requirements, the title should be something like what Professor Littig suggests, "Quantitative Reasoning and Data Visualization" or "Quantitative Studies" for short. It would be nice to get statistics into the title, as the statistics requirements are one of the strengths of the proposal. "Visual representation of Data, Statistics, and Mathematical Models" is probably too long, but captures more aspects of the program.

Judith Arms
Associate Professor of Mathematics
UW Seattle

27 January 2012

From: Bruce Burgett, Director, Interdisciplinary Arts and Sciences, UW Bothell

To: Steve Holland and Pamela Joseph, GFO Chair and Vice Chair, UW Bothell

RE: Response to Tri-campus Review of Mathematical Reasoning and Visualization Proposal

Interdisciplinary Arts and Sciences (IAS) at UW Bothell has proposed a new option in Mathematical Reasoning and Visualization under the existing B.A. in Interdisciplinary Studies. In the approval process, the proposal received the unanimous backing of the IAS faculty and the Executive Committee of the UW Bothell General Faculty Organization (GFO). During the tricampus review period, the proposal received several comments from the Math Department at UW Seattle, all of which expressed concerns about the use of the phrase "mathematical reasoning" in the title of the degree. We are pleased to note that no other concerns were raised about the curriculum itself and, indeed, most of the comments were very positive in terms of the content of the degree. This memo addresses the concerns about the title of the degree.

We should begin with a note on process and sequence. In late spring 2011, UW Bothell Chancellor Kenyon Chan and Vice Chancellor for Academic Affairs Susan Jeffords expressed concerns about the marketability of the title of the degree. In response, IAS faculty members Cinnamon Hillyard and Colin Danby undertook a process of consultation with UW colleagues and others nationally who have experience with interdisciplinary mathematics education, including those with expertise in the emerging field of data visualization. They wrote a memo summarizing their findings (see below), with the result that Chancellor Chan forwarded the proposal to Seattle with no further revisions. We regret the clerical mix-up which resulted in Chancellor Chan's spring memo being attached to the proposal, without any word on our subsequent work and conversations with UW Bothell administration.

We have discussed the comments made by colleagues in the mathematics department and followed up with Selim Tuncel, chair of the department, for further clarification. He writes on January 24th that he has "discussed this with our department's Executive Committee," which takes the view that

> There is general agreement among mathematicians on what "mathematical reasoning" means, and we do not believe that it would be accurate to use this term in describing the proposed degree program.
>
> There are a number of activities and mental capacities associated with doing mathematics (as indicated by the articles by Devlin and Schoenfeld, for example). Some of these are shared with the sciences and other academic disciplines. What makes mathematics unique and gives it its power is its use of proof to establish absolute truth. You cannot have "mathematical reasoning" without proof. The proposed degree program covers some of the steps associated with mathematical investigation. However, without substantially covering the essential ingredient associated with mathematical reasoning, namely the concept of proof, it would not be accurate to use "mathematical reasoning" in the title.
>
> We have two suggestions for title of the proposed degree program: "Mathematical Modeling and Visualization", and "Mathematical Visualization".

This very usefully narrows the question before us: can the term "reasoning" legitimately follow the word "mathematical" in the title of a degree option, if we do not offer the same coverage of proof as a standard mathematics baccalaureate degree? Here is why we think the answer is yes.

It is worth, first, reaffirming that we are not aiming to imitate a standard mathematics baccalaureate degree: this degree was fleshed out, a year ago, in the context of the UW Bothell-wide Mathematics and Quantitative Reasoning Task Force, which endorsed it under its current name, as part of a larger menu of baccalaureate offerings on the UW Bothell campus. That task force simultaneously endorsed the development of B.S. in Mathematics in the Science and Technology Program. We look forward to the offering of that degree as a key component of this campus' growth. We will clarify to our students that the proposed B.A. in Interdisciplinary Studies with an option in Mathematical Reasoning and Visualization is not equivalent to a traditional baccalaureate Mathematics degree, and counsel those students interested in pursuing a Mathematics Ph.D. to take the Mathematics B.S. offered by the Science and Technology program. We are gratified that our colleagues in the mathematics department recognize that we have developed a distinct degree.

Why, then, are we committed to the term "reasoning"? Or proposal fleshes it out this way:

- Recognize mathematical forms in real-world phenomena: this may include pattern-recognition, the identification of functional forms, and the ability to see common types of model in multiple guises.

- Identify and describe key features of a *problem* mathematically, and use that mathematical description to analyze the problem.
- Construct appropriate models (from a range of choices).
- Generate frameworks of concepts that can be filled with data.
- Gather and interpret data, with attention to units, measurement, and sources of error.
- Use a range of techniques, including diagrams, graphs, tables, formulas, and simulations, to understand data, problems, and data-based claims.

(We should add, in response to Matthew Conroy's questions, that we are not depending on "Calc I, II, and III and linear algebra" to achieve these goals. BIS 232 and 315 contribute strongly (315's learning objectives map to most of the elements in the description of mathematical reasoning), and the ten credits in Visualization Practice and Methods are essential to consolidating students' learning.)

Perhaps it would be useful to expand on this list, with a few more words on how and why reasoning matters to student learning in this degree.

1. We place considerable emphasis on *inductive* reasoning – starting with evidence, patterns, phenomena already visible in the world. "Visualization" asks what we can see and how we make sense of it. While we by no means *exclude* proof and rigorous deductivism from a broader understanding of mathematical reasoning, we want to clearly distinguish this offering from the more traditionally-conceived mathematics B.S.
2. The degree is centrally concerned with validity of inference. How can visualization be a tool of thinking and communicating arguments and understanding evidence? There is also an ethical imperative that visualization not be used merely to embellish, much less to distract or deceive. What is being communicated with a visual representation, what excluded, what entailed? Students will be working in contexts – for example, the presentation of data on an environmental question to the public – in which the full apparatuses of formal *deductive* logic are unavailable as a guide. (This approach to the use of mathematics is routine in the social and indeed natural sciences, in situations where we have mathematical structure to work with, but cannot work everything out from axioms.)

3. The degree is concerned with the internal properties of systems (e.g. accounting frameworks) which generate powerful and representable concepts.

4. Visualization is the key to this degree, and fleshes out its inductive emphasis. It concerns recognizing, understanding, working with, and communicating mathematical structure. (The proposed degree is broader than "modeling" given its concern with data, communication, and the visual.) In consultations with a range of colleagues in Seattle and elsewhere over the summer, we found universal understanding of the deep connection between visualization, and the rigorous reasoning plus focused creativity that mathematics enables. Courses in visualization and data analysis are growing in popularity, and typically require *less* by way of mathematics prerequisites than the proposed MRV degree: we are therefore confident that we can offer a rigorous degree in this area.

"Reasoning," therefore, names the degree's central emphasis on logical connection and rigor, and the essential ties, ethical, practical, and creative, *between* visualization and reasoning. The term is central to conveying what this degree does.

We agree that within the Mathematics Department, the phrase "mathematical reasoning" has a much more restricted and technical use. We submit, however, that this fact should not foreclose the offering of an option whose title includes these words under our B.A. in Interdisciplinary Studies. Among the degrees and options offered at University of Washington campuses are a number of terms – history, society, science, justice, culture – which turn up in multiple degree names and which have different entailments in different disciplinary contexts. "Mathematical Reasoning and Visualization" is the result of consultation with our UWB colleagues, with our students, and with a wide range of colleagues in the UW system and beyond. It names an emerging interdisciplinary area of study which draws our experience teaching mathematics in an interdisciplinary setting, our wide range of expertise in the use of mathematics in the social and natural sciences, and capacities in the visual arts.

UNIVERSITY of WASHINGTON | BOTHELL

Office of the General Faculty Organization

To: Faculty Council on Tri-Campus Policy

From: Pamela Joseph, Chair, Executive Council of the General Faculty Organization, University of Washington Bothell

Date: February 24, 2012

Re: Executive Council Approval of Mathematical Thinking and Visualization

The Executive Council (EC) of the General Faculty Organization of University of Washington Bothell reviewed the responses from the tri-campus review of the proposal for the Mathematical Thinking and Visualization at its February 7, 2012 meeting. The EC has determined that the proposing faculty in the Interdisciplinary Arts and Sciences Program have duly considered and responded to the comments posted by faculty from across the three campuses during the tri-campus review period. The EC furthermore voted to approve the Mathematical Thinking and Visualization proposal.

Please let me know if you need any additional information.

UNIVERSITY CAMPUSES UNDERGRADUATE PROGRAM REVIEW PROCEDURES**

CHECKLIST

Title of Proposal: Mathematical Thinking and Visualization option within the Bachelor of Arts degree in Interdisciplinary Studies

Proposed by (unit name): Interdisciplinary Arts and Sciences

Originating Campus:

___UW, Seattle

_x_UW, Bothell

___UW, Tacoma

I. **Phase I. Developed Proposal Review** (to be completed by Originating Campus' Academic Program Review body)

A. Review Completed by: (list name of program review body)

Chaired by:

10/17/11 Date proposal received by originating campus's review body

11/08/11 Date proposal sent to University Registrar

11/08/11 Date proposal posted & email sent to standard notification list

03/26/12 Date of originating campus's curriculum body approval
(Note: this date must be 15 business days or more following date of posting)

B. ___10_ Number of comments received. Attach the comments and a summary of the consideration and responses thereof : (1-2 paragraphs)

II. **Phase II. Final Proposal Review** (to be completed by FCTCP)

A. Review Completed by:
_X_ FCTCP subcommittee
___ FCTCP full council
Chaired by: William Erdly

3/29/12 Date request for review received from University Registrar
5/25/12 Date of FCTCP report

B. Review (attached)

YES NO
_X_ ___ Was notice of proposal posted on UW Website for 15 business days?
_X_ ___ Was notice of proposal sent to standard mailing list 15 business days in advance of academic program review?
_X_ ___ Were comments received by academic program review body?
_X_ ___ Was response to comments appropriate? (explain, if necessary) **See Note 1 below.**
___ _X_ Was final proposal reviewed by FCTCP within 14 days of receipt? **See Note 2 below.**
_X_ ___ Was there adherence to the University Campuses Undergraduate Program Review Process? (explain, if necessary)

This was a complex review as there were many comments related to the initial use of the term "Reasoning" in the degree option title as well as an initial concern by the UWB Chancellor related to the term "Visualization." The originating department responded and maintained that "reasoning" was appropriate. It was then changed to "Thinking." FCTCP did not receive the comment response information related to the various name changes – and was concerned regarding process related to the final change to "Mathematical Thinking and Visualization." A meeting between the Chair of FCTCP and the Program Director of the sponsoring program verified that all processes were followed and that faculty support was received related to the final name change. The FCTCP review process required additional time related to obtaining all necessary response documentation, and scheduling of meetings with various process representatives.

C. Recommendation

_X_ Forward for final approval
___ Forward to Provost because of University issues (Explain)
___ Return to campus council because of insufficient review (Explain).

**Endorsed by Faculty Senate Executive Committee, 1/10/05, modified 1/31/06; These procedures apply to new undergraduate degrees, majors, minors (and certificates) and substantive changes to same