

CASOS Ph.D. in Heinz

By CASOS advisory board

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Background

The challenges of educating scientists, mathematicians, and engineers for the 21st century mandate a new paradigm for training graduate students. To meet the need for a cadre of broadly prepared Ph.D.s with multidisciplinary backgrounds and the technical, professional, and personal skills essential to addressing the varied career demands of the future, the National Science Foundation (NSF) announces an agency-wide, multidisciplinary, graduate training program. The goal of the Integrative Graduate Education and Research Training (IGERT) Program is to enable the development of innovative, research-based, graduate education and training activities that will produce a diverse group of new scientists and engineers well-prepared for a broad spectrum of career opportunities in industry, government and academe.

Such programs should be distinct from existing graduate programs. This program will have approximately 50 students associated with it over 6 years, or roughly 8-10 a year. This includes both fellows and associates. Graduate students in the program are composed of fellows and associates. There is no difference in the curriculum that they follow. Fellows are US citizens, permanent residents, or those with permanent green cards who receive funding, in part, from the IGERT. Associates are non US citizens.

In the past decade the computational social sciences (e.g., computational organization theory) and the social computer sciences (e.g., multi-agent systems) have emerged. This has resulted in a unified perspective on groups, organizations, institutions and societies as intelligent adaptive agents composed of networks of socially-embedded, intelligent and adaptive agents that can be reasoned about, and supported by, computationally and socially sophisticated models and agents. We will prepare students for this field by teaching them how to use computers to understand the complexities of human behavior and how to use knowledge of humans as social actors to improve computational agents. Program features include: integrated social and computer science curriculum; studio courses emphasizing real-world corporate concerns, model design, implementation and validation; mentoring program; research practicum, proposal competition; distance learning; and integrated summer workshop and conference. Classes and research will take place in the “classroom/office of the future” — a distributed intelligent space where people have ubiquitous access to and can provide/receive information wherever, whenever and to/from whomever they want in an unbounded network of agents (human, webbots, robots, corporations, etc.); thus, reducing classroom/research barriers, enabling real-time computational analysis, data collection, and model validation, and increasing interaction with faculty and students at other institutions.

At CMU, in 1997, the CASOS faculty began to plan and develop a program in computational analysis of social and organizational systems. They pursued an NSF igert award, which they received, for this innovative program. The CASOS faculty are drawn from across the university, the University of Pittsburgh, Stanford, Duke, and the University of Michigan. This innovative

education and research program is a joint venture between Heinz, SDS, and ICES. Students from throughout the university are eligible.

Goal

Integrated graduate education and research in computational social and organizational science. Development and institutionalization of an innovative graduate education program that creates a seamless interface between education and research, classroom and research experience, for students in the computational social and organizational science area. Development and institutionalization of a university+ graduate experience. Students receive foundational training in organization theory, social networks, and computer science / computer engineering. Students do research on substantive and technical problems in the network, organization, policy, information science, artificial intelligence, and machine learning fields. Students gain experience in the practical side of being an academic: teaching, writing grant proposals, reviewing papers, working with industry. Students are active participants in on-going seminars, conferences, and the summer institute associated with CASOS.

Initial Advisors

The student's initial committee will include two CASOS faculty. Typically, faculty will be drawn from multiple departments.

Core Courses

To achieve a coherent and unified multi-disciplinary basis, all students will be required to take a set of core courses. All students in the CASOS program, regardless of background or department, must take the following core courses:

17-752 Organizational Theory

90-904 Social Network Analysis and Methods

17-750 Computational Analysis of Societies, Organizations, and Policy

Multi-agent Systems or Distributed Artificial Intelligence (number and title to be determined)

All students in the CASOS program, regardless of background or department, must take every year, the practicum. The purpose of this practicum is to provide direct guidance to students on the ethical conduct of research and practical experience in how to conduct science. The practicum varies in format from year to year and each term the students should consult with Prof. Carley to determine the form for that year.

All students in the CASOS program, regardless of background or department, must take a course in ethics or to demonstrate through a set of courses, seminars, etc. that they have spend the equivalent time on issues of ethics.

All students in the CASOS program in Heinz are encouraged to take the Heinz Seminar during their first year at CMU.

Constrained Electives

All students in the CASOS program, regardless of background or department, must take an additional 6 Ph.D. level courses, roughly balancing methods and substantive concerns. Students without a strong programming background must take C++ and possibly JAVA. New courses are added to this year as they are developed. There may also be additional courses at the University of Pittsburgh. The program will maintain a list of Ph.D. courses that are acceptable and the oversight committee will review requests to add new courses to this list on a regular basis.

3-4 additional courses in societies and organizations, at least two of which must be non-methods courses. One such course can be a statistics course.	2-3 additional courses in computational and mathematical analysis and the technical side of information systems. Students must learn a programming language. A programming course can count as one of these courses.
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90-903 Social Network Theory	C++
88-745 / 18-880 / 95-751	AI Core
Org. Management and Info. Security	
Social Theory (Pitt)	Software Engineering
47-946 Groups, Technology & Org. Effectiveness	Hierarchical Methods for Simulation
47-946 Organizational Learning	Information Systems
47-908 Research Methods in Behavioral Sciences	15-750 Algorithms
90-796 Human Resources Policy and Planning	Graph theory
90-917 Organizations Theory	15-681 Machine Learning
90-742 Electronic Commerce	15-882 Introduction to Artificial Neural Networks
90-768 Telecommunications Management	15-802/10-602 Statistical Approaches to Learning and Discovery
90-769 Game Theory	21-690 Methods of Optimization
47-904 Current Debates in Organizational Theory	85-717 Cognitive Modeling and Intelligent Tutoring Systems
88-756 Communication in Groups and Organizations	
88-770 Computer Supported Collaborative Work	
36-749 Experimental Design for Behavioral and Social Science	
88-341 Organizational Communication	36-711 Statistical Computing
85-711 Cognitive Processes and Problem Solving	C++
90-753 Population and Public Policy	Software Engineering
90-905 Statistical Theory for Social & Policy Analysis	
85-713 Information Processing of Psychology and Artificial Intelligence	85-713 Information Processing of Psychology and Artificial Intelligence
Project Course in Computational Analysis (new course)	Project Course in Computational Analysis (new course)
Complex Adaptive Systems	Complex Adaptive Systems

On demand reading courses/ independent studies in Mathematical Sociology, Computational Sociology, Advances Network Analysis and Computational Economics.

Potential new courses:

Models and Measures of Org. for Consultants, Inter-organizational Relations, Project course in computational analysis

Milestones

10 courses by end of year 4.

Research papers:

All CASOS students in Heinz will fulfill the Heinz two paper research requirement. There will be the following modification. One of those papers will be in the area of computational social and organizational science employing, testing, validating, or designing such a model. The other these papers will employ social network techniques. This distinction provides breadth and allows the students to meet the Heinz breadth requirement. Students will be encouraged by their committee to submit this paper for presentation at national and international conferences. The committee will work with the student, to eventually generate publishable paper. In general the papers will be under review by year 4. The student's committee will contain at least three faculty such that at least two of them are from CASOS. Typically faculty will be drawn from multiple departments. Note, these papers might become chapters in the student's thesis.

Internships:

All CASOS students in Heinz are eligible for internships after 1.5 years. These internships are from 3 to 7 months. A set of companies, including those on the CASOS advisory board, have agreed to host interns. The internship must be approved by the CASOS advisory committee. If a student takes an internship during the academic year, the student's "clock" stops while they are on the internship.

Ph.D. proposal and thesis.

All CASOS students in Heinz are to do a Ph.D. thesis. In addition to following the standard Heinz proposal and defense procedures, all students are to submit their thesis proposal to the CASOS proposal competition. In addition, CASOS faculty will work with the student to make this proposal sufficiently grounded that it can be submitted to a funding source such as a Foundation, the National Science Foundation. The student's committee will contain at least three faculty such that at least two of them are affiliated with CASOS. Typically such faculty will be drawn from multiple departments – one more on the computational side and one more on the social theory or network side.

TAs and teaching.

All CASOS students are required to TA at least one CASOS related course at some point in their graduate years. Additionally, during their 4th or 5th years students should teach (actually lecture)

a CASOS related course with CASOS faculty supervision. CASOS students will also TA and run lab sessions in the CASOS summer institute.

Other activities:

Students are expected to take part in the CASOS seminar and either the social network or groups and organization seminar. Students are expected to attend, and then TA, the CASOS summer institute. Students are expected to attend, take part in, and help with the CASOS conference. Students will attend, take part in, help organize the CASOS summer institute and conference.

Timing:

Timing follows the standard Heinz timing with these exceptions:

If the student takes an internship this “stops the clock” in terms of paper, course, qualifier, and proposal timing.

Courses are spread out over 4 years to enable students to engage 25% to 50% in research.

Students are encouraged to take independent studies. Independent studies count toward the 10 course requirement and can be used as constrained electives.

Expected time to degree is 6 years because this is an inter-disciplinary program where the students gain expertise both in computational/information science and social/organizational science. This is typical of all IGERT programs throughout the nation.

Approval Process:

For each milestone, the various committees must be approved by the CASOS oversight committee. Petitions for changing one of the two required papers, thesis proposal, etc. must be approved by the CASOS oversight committee. Internships must be approved by the CASOS oversight committee.

Typical Curriculum for Ph.D. in CASOS in Heinz

<i>Year</i>	<i>Fall</i>	<i>Spring</i>	<i>Summer</i>
1	Organizational Theory	Distributed and Agent Based Systems / Multi-agent System	Summer Institute
1	Heinz seminar	Heinz seminar	Conference
1	Constrained Elective (e.g., Res Methods)	Constrained Elective (e.g., Organizational Learning)	Research
1	Computational Analysis of Social and Organizational Systems	Social Network Methods	Research
1	Practicum	Practicum	Practicum
2	Constrained Elective (e.g., Social Network Theory)	Constrained Elective (e.g., Microeconomics)	Summer Institute
2	Constrained Elective (e.g., Machine Learning)	Constrained Elective (e.g., experimental design)	Conference

2	Research	Research	Research
2	Research	Research	Research
2	Practicum	Practicum	Practicum
3	Constrained Elective (e.g., Algorithms)	Additional Courses if remedial needed in year 1	Internship
		Internship might start here	
3		Ethical Practice	
3	Research - 50%	Research - 50%	Conference
3	Practicum	Practicum	Practicum
4	Internship might continue here		Summer Institute
4	TA Course in organizations, social networks or computer science		Conference
4	Research - 50%	Research - 75%	
4	Practicum	Practicum	Practicum
5-6		Teach Course	Summer Institute
5-6	Research - 75%	Research - 50%	Conference
5-6	Practicum	Practicum	Practicum