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The Agent Institute: Develop an Infrastructure for Agent-Based Research and Development for the State of Maine

George Markowsky

Principal Investigator; University of Maine, Orono, markov@maine.edu

James L. Fastook

Co-Principal Investigator; University of Maine, Orono, fastook@maine.edu

Elise Turner

Co-Principal Investigator; University of Maine, Orono

Roy M. Turner

Co-Principal Investigator; University of Maine, Orono, rmt@umcs.maine.edu

Laurence Latour

Co-Principal Investigator; University of Maine, Orono, larry_latour@umit.maine.edu

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Final Report for Period: 09/1999 - 08/2003**Submitted on:** 12/16/2003**Principal Investigator:** Markowsky, George .**Award ID:** 9977780**Organization:** University of Maine**Submitted By:****Title:**

The Agent Institute: Develop an Infrastructure for Agent-Based Research and Development for the State of Maine

Project Participants**Senior Personnel****Name:** Markowsky, George**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Dr. Markowsky lead the effort to establish the Agent Institute by coordinating the search for and hiring of the Executive Director. Dr. Markowsky has also attended the PI meetings held to discuss Agent Institute activities. Dr. Markowsky has attended the two Agent Institute workshops and has presented three talks at these meetings. Dr. Markowsky, working through the Agent Institute, collaborated with the Supercomputing Center at the University of Illinois, Champlain-Urbana relating to Multi-sector Crisis Response Centers.

Name: Fastook, James**Worked for more than 160 Hours:** No**Contribution to Project:**

Dr. Fastook participates in PI meetings for the agent institute and offers comments and suggestions for implementation of different Agent Institute activities.

Name: Turner, Elise**Worked for more than 160 Hours:** No**Contribution to Project:**

Currently working on the sub-committee overseeing conference workshops. Presented at the Orono workshop concerning their labs work on multi-agent control systems.

Name: Turner, Roy**Worked for more than 160 Hours:** No**Contribution to Project:**

Currently serving on the sub-committee overseeing the conference workshops. Presented at the Portland workshop concerning his labs work with multi-agent control systems.

Name: Latour, Laurence**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Dr. Latour has attended the PI meetings for this grant, attended both workshops, is collaborating on a grant submission to NSF through the Agent Institute, and presented at the Portland workshop.

Name: Bickford, Thomas**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Executive Director of the Agent Institute. Coordinates the conferences, handles telephone and email inquiries.

Name: Wagner, Thomas**Worked for more than 160 Hours:** No**Contribution to Project:**

Thomas Wagner has assisted in PI/CI meetings and in presentations given at the Agent Institute Conferences in Portland and Augusta. Dr. Wagner's lab has also sent students to these conferences along with posters presenting work from the MaineSAIL

lab.

Name: Wheeler, Thomas

Worked for more than 160 Hours: No

Contribution to Project:

Served on several grant writing committees focused on the development of local Maine robotics use in the private and educational sector. Also served as a judge for the FIRST LEGO League.

Post-doc

Graduate Student

Name: Hamidova, Sabina

Worked for more than 160 Hours: Yes

Contribution to Project:

Served as the volunteer coordinator for the FIRST LEGO League and in preliminary work for the 1st Maine International Conference on Learning with Technology.

Name: Wang, KeQuang

Worked for more than 160 Hours: Yes

Contribution to Project:

Served as the volunteer coordinator for the FIRST LEGO League, an assistant for the Summer Explorations program, and as an assistant for the 1st Maine International Conference on Learning with Technology

Undergraduate Student

Name: Beane, Glen

Worked for more than 160 Hours: No

Contribution to Project:

Works on the Agent Institute's website.

Name: Chandler, Justin

Worked for more than 160 Hours: No

Contribution to Project:

This student served as the coordinator for volunteers and activities for the FIRST LEGO League competition, held December 9th at the University of Maine. This activity was attended by approximately 90 9-14 year old students, 15 coaches, 200 adult spectators, and 30 volunteers.

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Electrical and Computer Engineering, Dep

The Department of Electrical and Computer Engineering is collaborating with the Agent Institute in a long-range science, mathematics, engineering, and technology grant proposal to develop interest in SMET fields in the K-12 audience. The ECE is taking leadership in the High School student and teacher population and working on activities and curriculum to fulfill the goal of increasing the interest and knowledge base within this population as it regards SMET fields.

The 2002 Summer Explorations program was housed within the ECE department and Rick Eason was one of the faculty responsible for running the program.

College of Education and Human Development

Members of the College of Education and Human Development worked with the Agent Institute in the writing of several grant applications that proposed technology programs within the K-12 community in Maine. Several members of the College also have worked with the Institute in the support of the FIRST LEGO League. During the recent Maine International Conference on Learning with Technology, space was made available within the College for sessions and workshops and several 4 faculty members presented on the issue of technology in the classroom.

The Maine Discovery Museum

The newly opened Maine Discovery Museum in Bangor, Maine is collaborating with the Agent Institute on the NSF SMET Robotics in Informal Science Education program and serves as an outreach program in the dissemination of material for the early-childhood robotics curricula developed by the PAL Research Group (Dr. Latour).

Finance Authority of Maine

FAME has provided financial support for the FIRST LEGO League and is partnering with the Agent Institute in bringing their College Awareness Program to the University at the same time the 2002 FIRST LEGO League championship is held.

Other Collaborators or Contacts

The Maine Manufacturers Extension Program, The Maine Small Business Development Offices, The Maine Technology Institute, and the University of Maine Corporate Affiliate programs have all proved helpful in contacting groups and companies that would be interested in agent-based technology.

MeSDA, Maine's IT Association (formerly the Maine Software and Developers Association) has worked with the Agent Institute to co-promote activities within the state.

Maine Manufacturing Extension Program. The MEP has worked with the Agent Institute in reaching its clientele with announcements of Agent Institute conferences.

The University of Maine at Orono. The UM Department of Computer Science was the co-host for the Orono - Agent Institute Conference in Orono.

The University of Southern Maine. USM was the host for the Agent Institute Conference in Portland.

The University of Maine at Augusta. UMA was the host for the Agent Institute Conference in Augusta.

The University of Maine at Farmington. The UMF Department of Mathematics and Computer Science was the host for the April 2001 Agent Institute Conference in Farmington.

The University of Maine at Presque Isle. UMPI will be the host for the Northern Maine Agent Institute Conference to be held in May of 2001.

The Maine School for Science and Mathematics. The MSSM has been invited to the Northern Maine Agent Institute conference which will coincide with their May term 'open' program where students work on project related topics rather than classroom activities. It is anticipated that students from the MSSM will provide presentations (poster or oral) at the conference.

The Northern Maine Development Commission and the Loring Development Centre will be cooperating on the Northern Maine Conference to reach out to the area and to encourage attendance by area businesses.

The Eastern Maine Development Commission participated in the first conference at the Agent Institute and presented material on the services provided by the Commission. They have also worked to involve the Agent Institute with participants who have projects that can be benefited by associate or partnership with the Agent Institute.

MAUVCO, The Maine Autonomous Underwater Vehicle Company and Trefoil Corporation have participated in development of grant proposals for remote robotics.

General Electric of Bangor co-hosted the Orono Agent Institute Conference in 2000 and provided a tour of the Bangor bucket (turbine) shop

and the ensuing discussion on possible agent applications.

Foundation for the Inspiration and Recognition of Science and Technology (FIRST) has worked with the Agent Institute on issues of technology education and gender equity within public schools, specifically as it applies to technology.

Activities and Findings

Research and Education Activities:

Project Activities:

What have been your major research and education activities (experiments, observations, simulations, presentations, etc.)?

While the grant funding began in September of 1999, no substantial work was able to begin until the Executive Director was hired as of June 1st, 2000. Difficulties in recruiting and placement of the recruit within the University System slowed the start of the institute significantly. A no-cost extension of the grant will be submitted at an appropriate time to fully utilize the 24 months awarded under the grant. This delay results in this report covering a shortened period of time.

During the academic 2001-2002 year, extensive illness and absence by faculty removed 2 of the AI faculty. The resignation of Tom Wagner with his move to Honeywell has also left a gap in the personnel, a gap that to date has not been filled. A fourth member of the agent-related faculty was on sabbatical for the year, and as such, a majority of the work has focused on the primary focus of the remaining faculty. Professors Latour and Wheeler have been primarily focused on educational uses of agents and as such a great deal of the last year has been spent on this activity.

Recently, both Markowsky and Wheeler have increased their activity within the arena of crisis management and the ability for agents to play an important role within that area. Professor MarieChristine Therrien of the Business School is also now actively involved in crisis management along with Professor Markowsky. It is expected that several grants will be submitted in the near future pertaining to advancing agent applications within this field.

Explanation of activities:

The four main goals of this grant for the first year were as follows:

Goal 1: Contact and bring together those researchers and developers who are already working on agent-related technology or have interest in doing so.

Goal 2: Contact and bring together those who can benefit from agent-based systems.

To accomplish these goals, a website has been constructed with relevant information, informational mailings have gone out to hundreds of companies across Maine, and six Agent Institute Workshops have been planned for the period of September 2000 through June 2001.

The Conferences:

The first workshop was held on September 27th of 2000 in Orono, Maine. Presentations from Elise Turner, Tom Wheeler, George Markowsky, and Tom Bickford discussed the field of agents and gave several examples. Presentations by Jake Ward of the University Industrial Cooperation, Barbara Alexander of the Small Business Development Center; Karen West of the Small Business Innovative Research Program; and John Karp of the Maine Manufacturers Extension Program all discussed the resources available to the people and business' of Maine with regard to funding start-ups, research and development, and growth. Bob Lowe of General Electric's Power Systems gave a presentation about their plant in Bangor, which was then toured to discuss areas where agent-based applications could be used in modernization of the facility. The workshop was attended by approximately 40 people from around the state, including business interests, several colleges and universities, students, and state agencies.

The second workshop was held on November 28th of 2000 in Portland, Maine. The theme for this workshop focused on agent applications. Presentations by University of Maine faculty included Tom Wagner, Roy Turner, Larry Latour, Tom Bickford, and George Markowsky. The keynote speaker was Dick Morley, who spoke about Agents and Complex Systems, particularly with regard to some of his successes over the years using agents to simplify highly complex systems. Mr. Morley is the inventor of the programmable logic controller and has had

significant influence on the computerization of manufacturing automation. George Markowsky presented The IT Industry in Maine a report based on the MESDA (Maine Software and Developer's Association) annual executive summary.

Three presenters were also invited to present with regards to commercial agent-applications. These included Dr. Randolph Jones of Colby College and Soar Technology who presented Intelligent Agents for Training Simulations. Dr. Goutam Satapathy from Intelligent Automation, Inc., who presented Agent Infrastructure and Development Tools. And Richard Anderson from Computer Associates presented Enterprise Management Agents using Neural Network Technology 'Neugents'.

The Portland conference was attended by approximately 35 people and was held on the University of Southern Maine campus. George Markowsky and Tom Bickford met with three faculty members of the USM computer science department and are looking forward to using them as a resource in the future. Post event meetings were also held with two different software development companies in the area who both have projects they would like to collaborate on with the University.

The third workshop took place on March 5th of 2001 in Augusta, Maine. The Augusta workshop included opening remarks about the educational and technology environment in the federal government by Congressman John Baldacci. Our keynote speaker was Les Gasser from the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign. Dr. Gasser gave an excellent overview of agents. Additional speakers included Dr. George Markowsky on agents in crisis response management, Dr. Amy Baylor from Florida State University on cognitive issues with agents in education, Dr. Ali Jafari from Indiana University Purdue University Indianapolis on Intelligent Learning Environments, and Dr. Larry Latour on the Programming and Alternative Learning Group (PAL) at the University of Maine. Dr. Tom Wagner and Tom Bickford were scheduled to speak, however, a blizzard on the day of the conference forced the conference to be truncated by several hours and these two speakers were dropped to allow presenters and attendees to leave.

The Augusta conference offered 0.8 continuing education credits and 63 people registered for the conference. Of these, 45 showed up and an additional 5 walk-ins came for a total of 50 attendees.

On April 25th, 2001 the Agent Institute sponsored a conference at the University of Maine in Farmington entitled 'Computer Agents'. As with all conferences both the college and general public were invited. Tom Bickford, George Markowsky, Larry Latour, Elise Turner and Tom Wheeler all gave presentations and a time for discussion was provided. This conference was the lightest in attendance with only 13 people.

On June 6th, 2001 the Agent Institute sponsored a conference at the University of Maine in Presque Isle entitled 'Computer Agents and Related Topics'. At this conference a close collaboration was established with UMPI and the Maine Small Business Development Center for the area. Bickford, Markowsky, Haptom Resson, Cristian Domnisoru, Steve Cousins, Larry Latour, and Roy Turner all presented and the conference enjoyed a very healthy attendance of 46 people. The presentations were as follows:

- The Agent Institute and Agents in General (Bickford)
- Overview of the UMaine Computer Science Department and Research (Markowsky)
- Computational Intelligence and its Application (Resson)
- DNA base calling (making sense of the vast information available) (Domnisoru)
- Beowulf Cluster (Super computing without the super computer) (Cousins)
- StarLOGO, a Microworld Construction Tool (Latour)
- Artificial Intelligence and Agents (Turner)

Following the program, there was a social networking program at a local IT company ATX Forms, sponsored by ATX and MeSDA (Maine's IT Association, formerly the Maine Software and Developers Association).

The conference scheduled for Machias in the fall of 2001 was cancelled as we had not found a partner for the conference and we believed we had amply covered the geographical area of the state with the 5 conferences already held.

The Agent Institute Website:

The website has been active since August of 2000 and contains information about agents, events, links, and contact information. The institute's goal is to also include external conference, call for papers, and position listings within the website. Since a counter was added in 10/25/2000 over 2200 people have visited the site (March 2001). By 8/2002 this number exceeds 11,000 visits.

The Agent Institute Office:

With the arrival of the Executive Director, preparations for a formal office began. Two rooms in the East Annex at the University of Maine were turned over to the Institute and work was immediately begun to have the rooms renovated to meet minimum requirements. The College of Liberal Arts and Sciences was kind enough to have the rooms painted, carpeted, a new door installed, and new locks for the exterior doors. Renovations were complete, new furniture installed, and the office was operational in the first weeks of August 2000. This coincided with the arrival of the new administrative assistant for the executive director.

The fall of 2001 saw the addition of a graduate student to assist with the FIRST LEGO League and other projects. The student was a second year master's candidate in the MBA program at the University. When this student graduated in May of 2002, they were replaced by a new second year master's candidate from the same program.

Goal 3: Identify several promising agent-based systems projects for collaborative research and development by subsets of the state's R&D community.

Four potential projects have been identified and are being coordinated through the Agent Institute with regards to the development and implementation of agent based technologies. Two are mentioned above and are developer driven, the third is manufacturer driven. More will be reported as these move along.

Three of these contacts have been the result of companies and developers who attend the workshops. We expect more as we hold the remaining three workshops. The final contact was made through the Eastern Maine Development Commission.

In 2001 the Agent Institute lead a collaborative that included the Departments of Computer Science, Electrical and Computer Engineering, the College of Education and Human Development, and the Maine Discovery Museum in the research and writing of a robotics in education grant. The grant proposal (NSF 0125655) was in response to NSF 01-60 and was not funded. This grant would have developed and researched the use of robotics (agents) within the middle level and high school curricula.

In 2002 the Agent Institute lead a collaborative that included the Department of Computer Science, the Maine Discovery Museum, and Trefoil corporation in developing a large scale remote robotics facility for use in both education and research. The grant proposal (NSF 0223176) was in response to NSF 01-060 and was not funded. This grant would have developed and researched the use of remote technologies in the control of physical agents within a variety of environments. The collaborative is currently working to find alternative funding, and/or resubmitting this proposal.

In 2001 Tom Bickford sat on the committee developing the specifications for the new Beowulf supercomputing cluster at the Target Technology Center in Orono. This is a joint UMaine, Sensor Technology, and DOD project that has now completed phase I implementation and is the 501st fastest computer in the world. Its primary research goal is to investigate the scalability of the Beowulf cluster concept and is currently at 208 processors and is expected to exceed 400 by the middle of 2003. The management group is also looking at possible agent monitoring for both efficiency and environmental assessment.

In 2002 Tom Bickford sat on the committee developing a gender equity proposal to NSF in order to facilitate moving engineering, physical science, and computer science to the next phase of gender equity; that of breaking the concept that we are done with the gender issue.

Goal 4: Begin to educate the public and state government about the benefits of agent-based systems to the state of Maine.

We consider there to be a number of educational audiences to whom we are targeting different programs.

August 2002: The Agent Institute collaborated with The Learning Barn, The Papert Institute, The University of Maine, CBE Services, Inc., and EchoVision and served as the Conference Coordinator for the First Maine International Conference on Learning with Technology. This conference was a 4 day conference and was supported by over 25 companies and groups around Maine. The Institute served as the focal center for developing the program, disseminating the announcements, collecting registrations, and coordinating the workshops and sessions. In all there were 45 plenary or concurrent sessions, 10 of which were agent/robotics based sessions and 10 of which were from other countries. Of the 3 two-day workshops, 2 involved agent/robotic topics as their primary theme.

The conference workshops were attended by 45 people and the two days of the main conference were attended by 188 people (66% from Maine, 34% from away). The attendees were from 17 states and 7 different countries and served as a stepping stone for the Maine Learning and Technology Initiative (the Laptop Initiative). The event was extremely well received and had newspaper, radio, and television press coverage. The conference attendance fees and sponsorships covered all expenses except personnel.

K-8 Grade Children: This population is being targeted with the promotion of the FIRST LEGO League competitions and team formations that result from participation. On December 9th of 2000 the first such competition was held at the University of Maine, sponsored by the Agent Institute, and attended by 90 students, 15 coaches, 200 adults and 30 volunteers. Teams ranged from around Maine, but also included 2 teams from Massachusetts, 1 team from Vermont, and 1 team from Ontario, Canada. This program uses agents in the form of programmable robots built entirely from LEGO parts and the LEGO MindStorms kit. Children must program, build, and test the robot. It includes simple feedback sensors and output devices to drive motors. The next competition for this age group will be in December of 2001 when we expect at least twice

the number of participants and visitors.

December 2001: On December 6th the second such competition was held at the University of Maine, sponsored by the Agent Institute, and attended by 250 students, ~40 coaches, 500 adults and 50 volunteers. Teams ranged from around Maine, but also included several teams from Massachusetts and New Hampshire. The next competition for this age group will be in December of 2002 when we expect 60 teams, 500 students, coaches, volunteers, and approximately 1000 spectators. Sponsorship for this activity has been increasing yearly but is still not self supporting.

Other activities include working with the new Maine Discovery Museum in Bangor to develop Informal Science Education opportunities for teachers, parents, and children using computers, robotics, and ICAI (intelligent computer aided instruction). Summer camps and after school programs are being planned through collaboration with the Department of Computer Science, the Housing Foundation (Orono) and the College of Education, all to promote SMET activities.

In July of 2002, the Agent Institute provided administrative support for the Summer Explorations camp which was attended by 30 middle school students. The program involved puzzle solving, robotics (MindStorms), journaling and individual website development. The camp served as a pilot for future years.

9-12 Grade Children:

2000-01: This population is being targeted with several programs that are in the development phase. One program is being collaborated on with the Department of Electrical and Computer Engineering and is based on teacher education programs that train teachers how to incorporate more SMET technology, particularly robotics, into their curriculum. We are also working on the development of a high school age robotics competition that will be similar but age appropriate as that of the K-8 Children.

For the 2002 year, the Agent Institute had looked to participate with the Maine Principal's Association in the Maine Science Fair program (MSF). The MSF is a well established science fair in Maine for the high school level. Unfortunately it specifically EXCLUDES any evaluation of work done with computers. Students may use computers, for example to display information, or run programs, but they will not be evaluated on any programming, or hardware/software work they perform. The Agent Institute and the Department of Computer Science would obviously like this to change and as such a possible collaboration with the MSF was investigated. By the time appropriate contacts with the MPA had been established, it was too late for the 2002 spring program.

For the 2003 season, the Institute is looking to specifically look at developing an independent high-school level robotic/programming competition that mimics the FIRST LEGO League, but more age appropriate, to be run in the spring of 2003. This is in part due to the demand we have received from parents and teachers to establish some program for this age group.

General population: The Agent Institute submits, through the University, press releases about all of its activities and has had its activities featured in several of the state newspapers, and the Executive Director has been featured in news spots on two different TV stations in Maine.

Legislature: Our Augusta workshop at the capital of Maine was geared to include legislators from Maine and all legislators were invited to attend. Unfortunately, of the 8 registered legislators only two attended. The schedules for the senate and house are not available or set until the beginning of each month and for purposes of scheduling we were unable to wait until the beginning of March to set the conference date. This resulted in many committee meetings occurring on the date of the conference and the resulting blizzard on the conference day probably added to the small attendance by this group.

2001-02: We continue to keep the legislature apprised of the Agent Institute activities and invite local legislators to any meeting/events that are sponsored. At the 2001 FLL tournament, Representative Tom Sawyer served as a judge. At the 2002 LLPI Conference all legislators were invited although the only one who attended (albeit via teleconference) was Governor Angus King for a special session.

Industry and Research: Included in each of the workshops around the state are informational/tutorial sections allowing a general education of the commercial sector to the field of agent-based technology?

2001-02: The Agent Institute has worked strenuously to involve the state's commercial sector in the ongoing programs that are sponsored by the Institute. We have worked with the Development Corporations of Eastern and Northern Maine, with the Maine Manufacturer's Extension Program, The Maine Math and Science Alliance, the Finance Authority of Maine, The University System, The Governor's office, Apple Computer, and The Maine Technology Institute all in an effort to seed further work.

Findings:

Project Findings:**2000-2001:**

Given that the Agent Institute has been operating actively for only 8 months, there is little to report in terms of changes in the use of agents within the state of Maine. The figures on attendance have been listed above.

One main finding is the lack of knowledge on what agents are and how they have been incorporated into the existing infrastructure of e-commerce, the Internet, and control systems. Even facilities that now utilize agent technology may not understand what it is, or what its abilities/limitations may be.

A second finding is a general enthusiasm for the field once people become familiar with agents and agent-based technology. At our three meetings discussions have always come up regarding how a particular problem could be solved using one form of agent or another. It is from these discussions that we find groups that are willing to collaborate in developing future applications.

2001-02:

The two largest successes for the Agent Institute for the year have been the expansion of the FIRST LEGO League within the state, growing by 280% while actually reducing the cost to operate the program. This program has students and teachers constructing and programming age-appropriate agents, completing missions, and demonstrating their knowledge of engineering and programming at a state-level tournament.

The second major success for the Institute was the coordination and hosting of the 1st Maine International Conference on Learning with Technology. Maine suffers from a dichotomy that includes a successful K-12 program and an unsuccessful environment for promoting/recruiting these rising students to enter college, particularly in the areas of science, mathematics, engineering, and technology. This conference is one step to educating teachers, and the general public on the importance that technology must play in our education environment. Speakers were recruited from around the state, the country, and the world, all without honoraria, to talk about what has worked successfully, what has not, and to help teachers find a focus for themselves and their students using the technology currently available. While this was not strictly a part of the Maine Learning and Technology Initiative (Maine Laptop Program) it was coordinated with the Maine State Department of Education.

The conference included two days of preconference workshops, included two-day workshops on 'Using Robotics in the Middle School' lead by Tom Bickford, and 'Programming and Adaptive Learning' lead by Larry Latour. In all the workshops were attended by 53 people and the two days of the main conference by 188 people.

The Agent Institute has not performed evaluations on the effect of these programs to date but has begun working with FIRST to begin the task of assessing the effectiveness of the FIRST LEGO League on science and math scores for the target population.

With the implementation of the high school level program there will exist a 9 grade span of activities that bring agents, engineering, computer science, and robotics to the schools of Maine. It is our expectation to track these students as they graduate from high school and see if this program has an effect on college entrance and major selection.

Training and Development:

No direct training and development activities FOR THE INVESTIGATORS has occurred through the Agent Institute to date, with the exception of those investigators attending the Agent Institute workshops and their exposure to other researchers and developers who presented.

For those attending the workshops the attendees learned about the types and uses of different agents, what research is being conducted in Maine on agent-based technology, and detailed examples of how agents can be employed in the commercial/industrial sector.

For elementary and middle school students, their teachers/coaches and parents, we have provided the forum for learning about computers, mathematics, engineering, physics, and programming. All of these topics are integrated into a program that allows these students to build working agents with real-life (simulated) goals. Training was provided for this through the commercial product available from LEGO, as well as extra written material from the FIRST Foundation in New Hampshire and the Agent Institute in Maine.

Outreach Activities:

The majority of year one goals for the Agent Institute are in the form of Outreach Projects, and these have been elaborated on in the activity sections of this report. These outreach activities include the workshops, the FIRST LEGO League sponsorship, and other educational projects currently underway.

2001-2002: Outreach has continued within the University as the Agent Institute participates with more colleges and departments at the Orono campus, as well as with campuses across the state. The Institute has also greatly increased its outreach within the educational sector, both locally within Maine, but also to school boards across the country. In 2002 alone, more than 12,000 informational brochures or packets were sent out to provide information or invitations on the use of technology within education and the benefits of such use.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):

www.agent.maine.edu

Description:

This website is designed to provide information about the Agent Institute, the activities of the Agent Institute, and to disseminate general information about agent-technology. This site has been initiated at the end of October, 2000 and had received 2200 visits by March of 2001. By August of 2002 this number exceeded 12,000.

Other Specific Products

Contributions

Contributions within Discipline:

The principals within the Agent Institute continue to perform research on agent-based topics. These activities, while agent in nature do not reflect the nature of the Agent Institute grant as their research was not a product of the Institute.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

The Agent Institute has contributed to the furthering of SMET education and informal science education within Maine by playing a leadership role in developing a collaboration between several campus departments and schools and several local science centers. The Executive Director is also active with two other projects at the University of Maine, the Maine Mathematics and Science Teacher Effectiveness Collaboration, and the Center for Science and Mathematics Educational Research.

In 2000 and 2001 The Agent Institute has worked with schools across the state of Maine in the use of computers and robotics in the middle school classroom and afterschool programs. This work is expected to continue and to broaden to cover the high school grades as well.

In 2002 The Agent Institute worked with the Maine Department of Education, the Governor's Office, the Colleges of Liberal Arts and Sciences, Engineering, and Education and Human Development in the organization and operation of the 1st Maine International Conference on Learning with Technology. This conference served as the first such conference specifically looking at the issues of educational transformation under the upcoming Maine Learning and Technology Initiative (Laptops).

Contributions Beyond Science and Engineering:

The Agent Institute has worked with schools, school departments, colleges, the Maine Department of Education, and Maine Foundations to develop an active strategy for the promotion of interest and activity within the SMET areas in Maine schools. This is seen as a key for the transformation of Maine's current economy into an economy with a significant technology component, something that has been started at higher levels, but the Institute has been working to promote this development down into the elementary, middle, and high schools of the state.

Categories for which nothing is reported:

Any Journal

Any Book

Any Product

Contributions: To Any Other Disciplines

Contributions: To Any Human Resource Development

Final Report:

Project Activities for the Agent Institute:

The Agent Institute was formed in 1999 with the award from NSF of a grant to cover the following four overall goals:

1. Contact and bring together those researchers and developers who are already working on agent-related technology or have interest in doing so;
2. Contact and bring together those who can benefit from agent-based systems;
3. Identify several promising agent-based systems projects for collaborative research and development by subsets of the state's R&D community; and
4. Begin to educate the public and state government about the benefits of agent-based systems to the state of Maine.

During the academic 2001-2003 years, continued illness and absence by faculty removed 2 of the AI faculty. The inability to fill vacant faculty/research positions continues to be a problem within the University and to date remains unfilled. As such, a majority of the work has focused on the primary work of the remaining faculty. Professors Latour and Wheeler have been primarily focused on educational uses of agents and as such a great deal of the last year has been spent on this activity.

Recently, both Markowsky and Wheeler have increased their activity within the arena of crisis management and the ability for agents to play an important role within that area. Professor MarieChristine Therrien of the Business School is also now actively involved in crisis management along with Professor Markowsky. It is expected that the Agent Institute will continue work in this area as well.

Goal 1: Contact and bring together those researchers and developers who are already working on agent-related technology or have interest in doing so;

Goal 2: Contact and bring together those who can benefit from agent-based systems.

The Conferences:

September 27th of 2000 in Orono, Maine

Presentations from Elise Turner, Tom Wheeler, George Markowsky, and Tom Bickford discussed the field of agents and gave several examples. Presentations by Jake Ward of the University Industrial Cooperation, Barbara Alexander of the Small Business Development Center; Karen West of the Small Business Innovative Research Program; and John Karp of the Maine Manufacturers Extension Program all discussed the resources available to the people and business' of Maine with regard to funding start-ups, research and development, and growth. Bob Lowe of General Electric's Power Systems gave a presentation about their plant in Bangor, which was then toured to discuss areas where agent-based applications could be used in modernization of the facility. The workshop was attended by approximately 40 people from around the state, including business interests, several colleges and universities, students, and state agencies.

November 28th of 2000 in Portland, Maine

The theme for this workshop focused on agent applications. Presentations by University of Maine faculty included Tom Wagner, Roy Turner, Larry Latour, Tom Bickford, and George Markowsky. The keynote speaker was Dick Morley, who spoke about Agents and Complex Systems, particularly with regard to some of his successes over the years using agents to simplify highly complex systems. Mr. Morley is the inventor of the programmable logic controller and has had significant influence on the computerization of manufacturing automation. George Markowsky presented The IT Industry in Maine a report based on the MESDA (Maine Software and Developer's Association) annual executive summary. Three presenters were also invited to present with regards to commercial agent-applications. These included Dr. Randolph Jones of Colby College and Soar Technology who presented Intelligent Agents for Training Simulations. Dr. Goutam Satapathy from Intelligent Automation, Inc., who presented Agent Infrastructure and Development Tools. And Richard Anderson from Computer Associates presented Enterprise Management Agents using Neural Network Technology 'Neugents'.

The Portland conference was attended by approximately 35 people and was held on the University of Southern Maine campus. George Markowsky and Tom Bickford met with three faculty members of the USM computer science department and are looking forward to using them as a resource in the future. Post event meetings were also held with two different software development companies in the area who both have projects they would like to collaborate on with the University. Meetings are schedule with faculty and these developers in January of 2001.

March 5th of 2001 in Augusta, Maine

The Augusta workshop included opening remarks about the educational and technology environment in the federal government by Congressman John Baldacci. Our keynote speaker

was Les Gasser from the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign. Dr. Gasser gave an excellent overview of agents. Additional speakers included Dr. George Markowsky on agents in crisis response management, Dr. Amy Baylor from Florida State University on cognitive issues with agents in education, Dr. Ali Jafari from Indiana University Purdue University Indianapolis on Intelligent Learning Environments, and Dr. Larry Latour on the Programming and Alternative Learning Group (PAL) at the University of Maine. Dr. Tom Wagner and Tom Bickford were scheduled to speak, however, a blizzard on the day of the conference forced the conference to be truncated by several hours and these two speakers were dropped to allow presenters and attendees to leave.

The Augusta conference offered 0.8 continuing education credits and 63 people registered for the conference. Of these, 45 showed up and an additional 5 walk-ins came for a total of 50 attendees. Given the blizzard on the day of the conference we considered this conference to be well attended.

April 25th of 2001 in Farmington, Maine

The Farmington conference was entitled “Computer Agents”. As with all conferences both the college and general public were invited. Tom Bickford, George Markowsky, Larry Latour, Elise Turner and Tom Wheeler all gave presentations and a time for discussion was provided. This conference was the lightest in attendance with only 13 people.

June 6th of 2001 in Presque Isle, Maine

The Presque Isle conference was entitled “Computer Agents and Related Topics”. At this conference a close collaboration was established with UMPI and the Maine Small Business Development Center for the area. Bickford, Markowsky, Haptom Resson, Cristian Domnisoru, Steve Cousins, Larry Latour, and Roy Turner all presented and the conference enjoyed a very healthy attendance of 46 people. The presentations were as follows:

- The Agent Institute and Agents in General (Bickford)
- Overview of the UMaine Computer Science Department and Research (Markowsky)
- Computational Intelligence and its Application (Resson)
- DNA base calling (making sense of the vast information available) (Domnisoru)
- Beowulf Cluster (Super computing without the super computer) (Cousins)
- StarLOGO, a Microworld Construction Tool (Latour)
- Artificial Intelligence and Agents (Turner)

Following the program, there was a social networking program at a local IT company ATX Forms, sponsored by ATX and MeSDA (Maine’s IT Association, formerly the Maine Software and Developers Association).

The conference scheduled for Machias in the fall of 2001 was cancelled as we had not found a partner for the conference and we believed we had amply covered the geographical area of the state with the 5 conferences already held.

February 12th of 2003 in Orono, Maine

The Agent Institute and the Department of Computer Science hosted the Atlantic Region IBET (Integrated Border Enforcement Team) Communications Working Group Meeting. This meeting

was a collaborative gathering of members from the Royal Canadian Mounted Police, the Canadian Customs & Revenue Agency, the U.S. Border Patrol, the Maine State Police, the Maine Emergency Management Agency, the Special Services for the Maine State Police, the U.S. Customs Agency, JPS Communications, M/A-COM, Brown Consultants, and the University of Maine. Discussions were primarily on the use of technology to improve cross agency and cross border communications.

The Grants:

Grants submitted during the course of the Agent Institute grant were as follows:

1. Robotics in Informal Science Education (NSF 01-060, proposed for 2001-03, \$598,846 not funded)
2. Robotics Lab (NSF 01-100, proposed for 2002-03, \$61,648 not funded)
3. Remote Robotics Lab (NSF 02-038, proposed for 2003-05, \$461,679 not funded)
4. Multi-Sector Crisis Management Research Center (Through the University of Illinois – Chicago, Proposed for 2001-03, \$434,597, not funded)
5. A Balancing Act Between Trade Mobility and Safety Control (NSF 02-168, proposed for 2003-06, \$1,952,380 not funded)
6. Maine Experimental Wireless Research and Education Network (NSF 2003-2006, \$1,057,459, not funded)
7. Maine Technology Intensive Mathematics Education Project (TIME) (NSF 2003-2007, \$2,182,000, not funded)
8. Optimal Security for Power Grids (NSF 2003-2006, \$348,755, not funded as is, asked to resubmit with modifications)
9. Operation Safe Commerce (Transportation Security Commission via Port of NY/NJ and Seattle/Tacoma, \$3,400,000 awarded 2003 to Systems Planning Corporation, with Trefoil Corporation and UMaine as subcontractors)
10. Anywhere, Anytime, Any Size, Any Signal: Scalable, Remote Information Sensing and Communication Systems Workshop – NSF grant, funded for \$50,000 in 2002.
11. Exploratory Grant with Honeywell Corporation for implementing agent systems on Beowulf Clusters, \$35,000, January 2003.

Goal 3: Identify several promising agent-based projects for collaborative research and development by subsets of the state's R&D community.

In 2001 the Agent Institute lead a collaborative that included the Department's of Computer Science, Electrical and Computer Engineering, the College of Education and Human Development, and the Maine Discovery Museum in the research and writing of a robotics in education grant. The grant proposal (NSF 0125655) was in response to NSF 01-60 and was not funded. This grant would have developed and researched the use of robotics (agents) within the middle level and high school curricula.

In 2002 the Agent Institute lead a collaborative that included the Department of Computer Science, the Maine Discovery Museum, and Trefoil corporation in developing a large scale remote robotics facility for use in both education and research. The grant proposal (NSF 0223176) was in response to NSF 01-060 and was not funded. This grant would have developed and researched the use of remote technologies in the control of physical agents within a variety of environments. The collaborative is currently working to find alternative funding, and/or resubmitting this proposal.

In 2001 Tom Bickford sat on the committee developing the specifications for the new Beowulf supercomputing cluster at the Target Technology Center in Orono. This is a joint UMaine, Sensor Technology, and DOD project that has now been implemented and is the 501st fastest computer in the world. Its primary research goal is to investigate the scalability of the Beowulf cluster concept and is currently at 208 processors and is expected to exceed 400 by the middle of 2003. The cluster was listed as the 336th fastest computer in the world in November of 2002.

In 2002 Tom Bickford sat on the committee developing a gender equity proposal to NSF in order to facilitate moving engineering, physical science, and computer science to the next phase of gender equity; that of breaking the concept that we are done with the gender issue.

The Homeland Security Lab, directed by George Markowsky, is pushing agents as key components in homeland security applications. One concrete result was the winning of a small (\$35,000) exploratory research grant from the Honeywell Corporation. This project involves working with agent researchers at Honeywell and the University of Massachusetts to implement multi-agent systems on Beowulf clusters. We expect this first project to lead to additional agent-based research and to a more substantial grant application.

Work has begun on using neural nets for such tasks as license plate identification. This work is being done with the Computer Information Division of The Ternopil Academy of the National Economy in Ukraine. A paper on this subject, *Smart Vehicle Screening System Using Artificial Intelligence Methods*, was presented at the May 2003, IEEE Cambridge Conference on Homeland Security.

In addition, a paper entitled *Remote Sensing of Vegetation Using Modular Neural Networks* on the analysis of satellite imaging to detect biological attacks has been presented at The Third International Conference on Neural Networks and Artificial Intelligence held in Minsk, Belarus

in November 2003. This paper was prepared in conjunction with the Ukrainian Space Agency, and the work is being further developed for presentation in the United States.

In November 2003, the Civilian R&D Foundation (CRDF) awarded Trefoil Corporation a \$20,000 grant to develop software for designing sensor systems working with the Ternopil Academy.

A project entitled, *Web Neighborhood Watch*, and a paper describing this project was presented at the May 2003 IEEE meeting on Homeland Security.

Goal 4: Continue to educate the public and state government about the benefits of agent-based systems to the state of Maine.

We consider there to be a number of educational audiences to whom we are targeting different programs.

August 2002: The Agent Institute collaborated with The Learning Barn, The Papert Institute, The University of Maine, CBE Services, Inc., and EchoVision and served as the Conference Coordinator for the First Maine International Conference on Learning with Technology. This conference was a 4 day conference and was supported by over 25 companies and groups around Maine. The Institute served as the focal center for developing the program, disseminating the announcements, collecting registrations, and coordinating the workshops and sessions. In all there were 45 plenary or concurrent sessions, 10 of which were agent/robotics based sessions and 10 of which were from other countries. Keynote speakers included Seymour Papert, Alan Kay, David Loader (Australia), Clotilde Fonseca (Costa Rica) and Maine Governor Angus King (via teleconference) to mention a few. Of the 3 two-day workshops, 2 involved agent/robotic topics as their primary theme.

The pre-conference workshops were attended by 45 people and the two main days of the conference were attended by 186 people (66% from Maine, 34% from away). The attendees were from 17 states and 7 different countries and served as a stepping stone for the Maine Learning and Technology Initiative (the Laptop Initiative). The event was extremely well received and had newspaper, radio, and television press coverage. The conference attendance fees and sponsorships covered all expenses except personnel.

August, 2003: Second Annual Maine International Conference on Learning with Technology; hosted by the Agent Institute, the Department of Computer Science, and the Learning Barn at the University of Maine's Business Center. The conference included 2 days of pre-conference workshops, and 3 days of plenary and breakout sessions. Keynote speakers included Seymour Papert, Elliot Soloway, David Brown (U.S. Department of Education), and Bette Manchester (Maine Department of Education) to name a few.
Conference website: www.agent.maine.edu/LLPI

K-8 Grade Children: This population is being targeted with the promotion of the FIRST LEGO League program and team formation that result from participation. This program uses agents in

the form of programmable robots built entirely from LEGO parts and the LEGO MindStorms kit. Children must program, build, and test the robot. It includes simple feedback sensors and output devices to drive motors. The children must also present a research project on how robots could assist in the year's topic. 8th graders who first attended in 2000 are now juniors in high school and it is our goal to provide a longevity for this program, and to continue it through the high school years so students will remain interested in the computer, engineering, and programming fields.

- 2000 10 Maine Teams (13 total, including MA, VT, Canada)
- 2001 20 Maine Teams (26 total, including MA, NH)
- 2002 36 Maine Teams (no out-of-state)
- 2003 54 Maine Teams (no out-of-state) over 1200 people attended the 1 day event

Starting in 2002, the Agent Institute ran summer camps geared specifically at computers, programming, robotics, and mathematics. This is expected to continue with the goal of being fully self-sufficient.

- 2002 30 children 1 week of summer camp
- 2003 105 children 4 weeks of summer camp

9-12 Grade Children: The Agent Institute is still seeking a suitable program for the high school population and will continue to seek such a program and funding to support it within the state of Maine.

General population: The Agent Institute submits, through the University, press releases about all of its activities and has had its activities featured in several of the state newspapers, and the Executive Director has been featured in news spots on both TV and radio stations in Maine.

Legislature: We continue to keep the legislature apprised of the Agent Institute activities and invite local legislators to any meeting/events that are sponsored.

Industry and Research: The Agent Institute has worked strenuously to involve the state's commercial sector in the ongoing programs that are sponsored by the Institute. We have worked with the Development Corporations of Eastern and Northern Maine, with the Maine Manufacturer's Extension Program, The Maine Math and Science Alliance, the Finance Authority of Maine, The University System, The Governor's office, Apple Computer, and The Maine Technology Institute all in an effort to seed further work.

The Agent Institute Website: The website has been active since August of 2000 and contains information about agents, events, links, and contact information. The institute's goal is to also include external conference, call for papers, and position listings within the website. Since a counter was added in 10/25/2000 over 16,000 people have visited the site.