# SIMON FRASER UNIVERSITY

*Office of the Vice-President, Academic*

## MEMORANDUM

**To:**       Senate

**From:**    J.M. Munro, Chair, Senate Committee on Academic Planning

**Subject:**  Institute for Applied Algorithms and Optimization Research

**Date:**     January 18, 1994

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At its meeting on January 12, 1994, the Senate Committee on Academic Planning recommended the establishment of the Institute for Applied Algorithms and Optimization Research.

**Motion:**    "That Senate approve and recommend to the Board of Governors the establishment of the Institute for Applied Algorithms and Optimization Research and the granting of a Charter to the Institute under the terms of Policy R.40.01."

## SIMON FRASER UNIVERSITY
## OFFICE OF THE VICE-PRESIDENT, RESEARCH
## MEMORANDUM

To:   Alison Watt                    From:   Bruce P. Clayman
      Secretary, Senate Committee            John M. Munro
      on Academic Planning (SCAP)

Re:   Institute for Applied Algorithms and    Date:   January 12 1994
      Optimization Research

Attached is a proposal from Dr. Ron Marteniuk, Dean, Faculty of Applied Sciences, to establish an Institute for Applied Algorithms and Optimization Research.

The Governing Committee for Centres and Institutes recommends that the Institute be granted approval by SCAP. Once approved by SCAP, the proposal is to be forwarded to Senate, followed by submission to the Board of Governors.

Governing Committee:

Bruce P. Clayman
Vice-President, Research
(Acting)

John M. Munro
Vice-President, Academic

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**M E M O R A N D U M**

**SIMON FRASER UNIVERSITY**

**FACULTY OF APPLIED SCIENCES**

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**DATE:** December 20, 1993

**TO:** Bruce Clayman, Vice-President Research, and Jock Munro, Vice-President Academic
University's Governing Committee for Centres

**FROM:** Ron Marteniuk, Dean, Faculty of Applied Sciences

**RE:** Proposal to Establish an Institute for Applied Algorithms and Optimization Research

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I am very pleased to submit on behalf of fifteen faculty a proposal for the establishment of an Institute for Applied Algorithms and Optimization Research. I have read the proposal and am in full support of it. In essence, I highly recommend it to you for your approval.

Ron Marteniuk, Dean
Faculty of Applied Sciences

RM/lc

Enclosure

cc: J. Curry, Associate Director, University/Industry Liaison Office
S. Shapiro, Dean, Faculty of Business Administration
C. Irwin, Dean, Faculty of Science
T. Calvert, Director, Research and Computing, Faculty of Applied Sciences
A. Liestman, Director, School of Computing Science
K. Heinrich, Chair, Department of Mathematics and Statistics
Founding Members:
    B. Alspach, Department of Mathematics and Statistics
    B. Bhattacharya, School of Computing Science
    J. Borwein, Department of Mathematics and Statistics
    L. Goddyn, Department of Mathematics and Statistics
    A. Gupta, School of Computing Science
    L. Hafer, School of Computing Science
    K. Heinrich, Department of Mathematics and Statistics
    P. Hell, School of Computing Science and Department of Mathematics and Statistics
    C. Jones, Faculty of Business Administration
    R. Krishnamurti, School of Computing Science
    A.L. Liestman, School of Computing Science
    E. Love, Faculty of Business Administration
    J.G. Peters, School of Computing Science
    T.C. Shermer, School of Computing Science
    A. Warburton, Faculty of Business Administration

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# Simon Fraser University
## MEMORANDUM

**To:** Ron Marteniuk, Dean
Faculty of Applied Sciences

**From:** Art Liestman
School of Computing Science

**Subject:** Institute Proposal

**Date:** December 2, 1993

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Please consider the attached proposal for an "Institute for Applied Algorithms and Optimization Research" as a Schedule A Centre under University policy R 40.01. If additional information is required, please let me know.
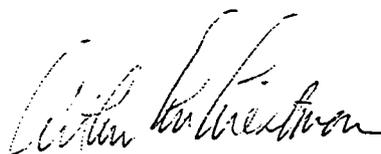
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# Proposal for an Institute for Applied Algorithms and Optimization Research

## Background Information

Much of the basic research within computing science is done by "theorists" who study algorithms and their complexity as well as the mathematics underlying these algorithms. Although much of this work is basic science, the results obtained in this area have extremely important implications to practitioners. Research in theoretical computing science produces results that are both positive and negative. The positive results point the way to efficient solutions of problems while the negative results indicate that problems are difficult/impossible to solve efficiently. In spite of the fact that both types of results have significant implications for industry, these results are largely unknown or misunderstood by practitioners in the field. A primary goal of this proposal is to foster increased awareness of these results by industrial practitioners.

The members of the proposed Institute are faculty members from SFU's School of Computing Science, School of Business Administration, and Department of Mathematics and Statistics. Their research interests span a broad range of topics. The major areas of investigation at this time include optimization, operations research, computational geometry, parallel algorithms, distributed algorithms, scheduling, design theory, integer programming, and graph algorithms. Some of the current projects have application in the areas of scheduling of industrial processes, geographical information systems, communication networks, robot motion planning, and VLSI layout.

One particular subgroup, the *Optimization Group*, was recently formed to focus on the development of algorithms for optimization problems. The interests of this subgroup have converged on the solution of resource constrained scheduling problems and their applications to industrial environments. This group has obtained a fellowship from the B.C. Advanced Systems Institute to support research in this area. We believe that this indicates that there is a need for this type of technology transfer in British Columbia. The Institute of Applied Algorithms and Optimization Research is intended to meet these needs and to provide British Columbia and Canada with a strong center of research and technology transfer in this strategically important area.

The Institute is intended to stimulate, encourage, and enhance research and technology transfer in the areas of Applied Algorithms and Optimization by providing a focus and

resource base for collaborative and multidisciplinary research. The Institute will be a Schedule A Centre with an Administrative Officer, an elected Director, and an Advisory Board as discussed in more detail below.

An important objective of the Institute is to expand and promote applied algorithms and optimization technology through collaboration with others. Institute members work with other academic researchers and graduate students to create new technology. The Institute will seek methods to foster two-way communication between Institute members and industry thereby transferring academic knowledge to industry and bringing practical problems into the academic realm. Simon Fraser University has expertise in the area of Applied Algorithms and Optimization that is unique in British Columbia and rare in Canada. This institute should provide a vehicle for disseminating known results and stimulating new work on relevant problems.

## The Market

The Institute for Applied Algorithms and Optimization Research will fill an important need for business in British Columbia; our greatest challenge lies in making industry cognizant of that need. Theoretical computer scientists and Applied Mathematicians *do* work on the solutions of problems encountered every day in industry. However, as academics, we tend to work on abstract versions of these problems stated in general terms.

Consider the problems of scheduling a fleet of trucks to service a set of customers distributed over the lower mainland; designing digital hardware to implement a particular algorithm; scheduling required maintenance for a fleet of airplanes. Superficially, these might seem very different problems. In fact, they are all resource-constrained scheduling problems, and algorithms developed for one problem often contain techniques applicable to the others. The difficulty is in recognizing the resemblance and having the skill to adapt an algorithm from one domain to the specific requirements of another. It is here that collaboration between an expert for the specific problem and an expert in algorithm design and application can be very fruitful.

Consider the problem of balancing the time required for each assembly path in a complicated assembly line. An efficient algorithm to calculate the optimal answer for some cases can be found in "A Polynomial Algorithm for Balancing Acyclic Data Flow Graphs", in the November 1992 issue of IEEE Computer, but that isn't immediately apparent from either the title or the journal in which it appears.

An interface between the theorist and the practitioner is necessary in order to identify and perhaps translate relevant theories that may help solve the real problem. The Institute, hopefully, will serve to fill this role. The proposed Institute would be a cooperative effort to establish where a specific industrial problem fits in the somewhat abstract classification that orders the world of algorithm design, and then to identify, modify, or invent algorithms that can solve the problem. The collaboration enables the problem expert and the algorithms expert to surmount the barriers of specialist jargon, each providing the skill required to interpret their discipline to the other.

Within the Optimization group, we have focussed on solutions to resource-constrained scheduling problems that use both exact and heuristic algorithms to provide efficiency and flexibility. Exact algorithms provide optimal or near-optimal answers for the purpose of planning, where a running time of a few hours to as much as a few days is acceptable to

obtain an answer that makes the best use of available resources. Heuristic algorithms can provide reasonably good answers quickly, so that the optimal answer can be adapted to the inevitable but unpredictable events that were not included in the ideal plan (such as machinery breakdown or employee illness).

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## Objectives of the Institute

Consistent with the goals and objectives of Simon Fraser University, the particular objectives of the Institute are as follows:

1. To stimulate, encourage, and enhance applied algorithms and optimization research and development, by providing a focus and resource base for such collaborative research.

2. To encourage research collaborations within the Institute and with other researchers across Canada and around the world.

3. To promote the development of highly trained personnel with expertise in applied algorithms and optimization through the undergraduate and graduate programs of the participating units and through student involvement with Institute projects.

4. To promote the dissemination of knowledge in the broader community through short courses and seminars in cooperation with Continuing Education and through the provision of consulting services.

5. To provide an appropriate computing environment for pursuing research and technology transfer in this area.

6. To provide a vehicle for technology transfer from the university-based researchers of the Institute to industry.

7. To provide mechanisms for industrial problems to be communicated to the researchers of the Institute.

8. To foster closer ties with industry.

## Organizational Structure of the Institute

The Institute will be a Schedule A Centre as described in R 40.01.

*Administrative Officer:* The Administrative Officer will be the Dean of Applied Sciences.

*Director:* The Director of the Institute will be a member of the Institute and an employee of Simon Fraser University. Each candidate for the position of Director must be nominated

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by a member of the Institute. Following an election, the successful candidate's name is then recommended to the Dean of Applied Sciences for appointment.

The term of the Director will be for three years, renewable.

The Director approves all contracts to be undertaken in the name of the Institute, in conjunction with the Administrative Officer.

The Director shall submit an annual report on all Institute activities, and a financial statement showing all revenues and expenditures; for the twelve months ending March 31 of each year, no later than June 30 of each year.

The Director will call meetings of the membership to discuss policy and direction of the Institute and any other concerns of general import. Such meetings will be called at least twice a year.

The Director will call meetings of the Advisory Board periodically.

*Membership*: Membership shall be by application to the Director, and a two-thirds majority vote of the membership, subject to appeal (for Simon Fraser University personnel only) to the Administrative Officer, whose decision shall be final.

Candidates for membership should have been involved in ongoing active collaboration with Institute members prior to application for membership.

Membership shall be for a three year term, renewable at the discretion of the Director.

Any member may withdraw from the Institute by delivering a written letter of resignation to the Director of the Institute.

*Associate Membership*: Associate membership shall be by application to the Director, and a simple majority vote of the membership.

Candidates for associate membership should have been involved in ongoing active collaboration with Institute members prior to application for associate membership.

Associate membership shall be for a three year term, renewable at the discretion of the Director.

Any associate member may withdraw from the Institute by delivering a written letter of resignation to the Director of the Institute.

*Advisory Board*: An Advisory Board representing a cross section of academic and industry personnel plus representation from the university administration and government, will be

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assembled to provide guidance to the Institute.

The primary task of the Advisory Board is to help the Institute evolve to best serve the changing needs of the academic and industrial communities.

All Advisory Board meetings are open, and Institute members are encouraged to attend.

Advisory Board membership shall consist of the Administrative Officer, the Director of the Institute, two corporate members, two external researchers, and such others as may be deemed capable of making an exceptional contribution to the activities of the Board.

Invitations for membership are issued at the sole discretion of the Director of the Institute, except for the Administrative Officer and the Director.

Membership is for a three (3) year renewable term, except for the designated personnel.

The Advisory Board bears no legal responsibility for the actions of the Institute, and exercises no direct control over the actions of the Director, Institute members, or staff.

## Institute Membership

The initial members of the Institute are listed below:

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| Brian Alspach | Department of Mathematics and Statistics |
| Binay Bhattacharya | School of Computing Science |
| Jonathan Borwein | Department of Mathematics and Statistics |
| Luis Goddyn | Department of Mathematics and Statistics |
| Arvind Gupta | School of Computing Science |
| Louis Hafer | School of Computing Science |
| Katherine Heinrich | Department of Mathematics and Statistics |
| Pavol Hell | School of Computing Science and |
| | Department of Mathematics and Statistics |
| Chris Jones | School of Business Administration |
| Ramesh Krishnamurti | School of Computing Science |
| Arthur L. Liestman | School of Computing Science |
| Ernie Love | School of Business Administration |
| Joseph G. Peters | School of Computing Science |
| Thomas C. Shermer | School of Computing Science |
| Art Warburton | School of Business Administration |

## Institute Affiliations

Since collaboration is a primary goal of the Institute, affiliations with other institutions will be sought, where such affiliation brings contact with exceptional research. This particularly holds true outside North America, where frequent casual contact is less likely.

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## Budget of the Institute

The Institute requires an initial budget only for publicity costs, since research activities utilize existing facilities, personnel, and funding. However, as the Institute grows, several objectives require funding over and above existing levels. These include exchange of personnel with other institutions, possible establishment of a research chair for the Director, maintenance of equipment, and purchase of new capital equipment.

Start-up funding from the Faculty of Applied Sciences will be sought to cover the initial costs associated with organizing the Institute. All subsequent funding for the Institute, which is incremental to existing levels of support, should come from sources outside Simon Fraser University, excepting the normal internal applications for funding to which all personnel, groups of personnel, and institutes are entitled to apply.

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