I. Research Areas: Artificial Intelligence/Cognitive Science Software Engineering
Computer Science Education/Complex Systems Failures

II. Sub-Specialties: Knowledge Representation; Problem Solving; Computer Chess,
Educational Software/Intelligent Tutoring Systems,
Classification of Errors (medical systems, programmers, chess)
Outcomes Assessment in Computer Science Education

My research interests are focused in three areas: **intelligent tutoring systems (ITS), experimental cognitive science/computer chess, and technological mishaps**. These domains involve more specific issues in a number of areas including problem solving, knowledge-based systems, human-computer interaction, expert systems, natural language processing and the management of interdisciplinary teams. **During the past three years I have recognized that a unifying theme which ties all my research interests together is the testing of performance, evaluation of existing, missing and essential knowledge for competence, and suggested remedies. In other words, how to identify and prevent ERROR(s) --- their origins and sources.**

Intelligent tutoring systems (ITS) is a broad domain with the general goal of improving education. It embraces a number of different disciplines including computer science, education, psychology, and beyond. C*oncept mapping*, an educational technique, forms the basis of my research approach. Using this technique, I have developed knowledge bases for AIDS as well five other STD's. Our team has transformed these specialized knowledge areas into *SmartBooks*, a multimedia format we developed in hypercard on Macintosh computers. Other research work in this area explores a number of different AI aspects of the system to interrogate the knowledge base via the expert module, the student modeller and the tutoring module.

I developed a "Rules of the Road" SmartBook for ocean navigation of the seas was developed in 1995-96 with cadets at the U.S. Coast Guard Academy. A number of cadets used this SmartBook in preparation for exams in their navigation course. At Brooklyn College the concept of SmartBooks is being developed as a generic methodology, "SmartTutor", which aims to provide tutoring support for CIS 1.5, the introductory programming course. The aim of SmartTutor is to capture the essence of the subject matter presented by instructors and peer tutors while providing multimedia, anonymous, interactive support. Working with Professor Paula Whitlock and Dr. Myra Kogen (Director of the Learning Center) since June, 2001, we have applied the same technique to some of the more advanced subject matter towards a working online system. I have supervised a number of CIS 60.1 senior projects by students who have contributed to this project. Examples of topic areas for which instructional material has been developed to date include control structures, functions, recursion, and arrays. Papers addressing this area of research include: SmartBooks: A generic methodology to facilitate delivery of post-secondary information (Kopec, 2001) and Kopec, Whitlock, and Kogen, (2002).

I have also worked in a number of different research areas in **experimental cognitive science** using **computer chess** as an application domain, both as an academic researcher and as a consultant. My interest has always been focused on the knowledge-based approach as an essential element for successful problem solving in chess as opposed to brute force methods. The Bratko-Kopec Test, a set of 24 positions which has been used by computer chess researchers around the world to evaluate the strength of their programs,

exemplifies the validity of this approach. As the time when computer chess programs will supersede even the best human players draws near, my publications (Dallas, 2001) and ***Test, Evaluate and Improve Your Chess***: ***a knowledge-based approach*** (with Hal Terrie , 2nd edition, **in Press,** USCF Press) based on a taxonomy of 181 test positions (comprising seven tests) highlights the significance of the knowledge-based approach.. It demonstrates that there is still a knowledge-based problem space in chess which will remain beyond the realm of the best computer programs for many years.

Computers affect nearly every aspect of human life. Their use in **complex systems** and the real possibility of disastrous accidents (especially where human error may be involved) must be addressed. In 1982, I co-authored a report with Professor Donald Michie, (former Chief Scientist and founder of the Turing Institute in Glasgow, Scotland) for the Commission of the European Communities entitled: ***Mismatch Between Machine Representations and Human Concepts: dangers and remedies***. The various forms of computer malfunction and accidents involving computers and complex systems are considered in two papers: **(1)** ***Technology Transfer Crises in the 1980s: mishaps at the human interface;*** **(2)** ***Societal and Technological Problems of Computers (with Q. Jiang, 1992).*** Presently, this is my area of primary area of research interest integrated with specific investigations into medical errors and medical information systems **(Kopec, Kabir, Reinharth, Rothschild, and Castiglione, 2002, in Press)**, and intermediate student programmer errors (Kopec and Minzer, 2002). The extension and re-shaping of my student Adeleye Okeowo's Master Thesis into a book to be entitled ***Software Development Methodologies: a comparative case study*** is a longer term project.