

COMPUTER APPLICATIONS IN AGRICULTURAL RESEARCH

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Introduction: Agriculture Research have benefited from incorporation of technological advances primarily developed for other industries. The industrial age brought mechanization and synthesized fertilizers to agriculture. The technology age offered genetic engineering and automation. The information age brings the potential for integrating the technological and industrial advances into sustainable agriculture production system.

The application of the computer in agriculture research originally exploited for the conversion of statistical formula or complex model in digital form for easy and accurate calculation which are found relatively tedious in manual calculation. In the next generation, the same computers have been used to mechanization, automation and to develop decision support system for taking strategic decision on the agricultural production and protection research. Recently remote sensing and geographic information system has played a major and crucial role in agriculture research especially in the field of yield prediction, suitability of soil for particular crop, and site specific resource allocation of agriculture inputs, etc.

Information Systems: Before we can understand information systems, we should ask what is information? and What is a system? The data is nothing but numbers 0 to 9 arranged in some form. But each number in its location elicits thousands of information if you could properly apply your mind as long as we are close to the objective of the research in our mind. Information can be the questions we continuously ask—what, where, when, who, how, how much—and the answers we get. On the other hand the system is how we present these data and information in a systematic manner with the help of computer for further mining of the data to acquire knowledge.

There are many kinds of information technologies, including radars, mobile/telephones, FAX machines, computers, and satellites, to list a few. These technologies contribute to many forms of information systems such as systems for information retrieval and systems that help us solve problems or make decisions. An information retrieval system (IRS) is an environment of people, technologies, and procedures (software) that help find data, information, and knowledge resources that can be located in a particular library or, for that matter, anywhere they exist. Information about available resources is acquired, stored, searched, and retrieved when it is needed.

Data Mining: Data mining is the process of discovering potentially useful, interesting, and previously unknown patterns from a large collection of data. The process is similar to discovering ores buried deep underground and mining them to extract the metal. The term "knowledge discovery" is sometimes used to describe this



process of converting data to information and then to knowledge. The data mining process is interactive and iterative, and it requires an understanding of the decision-maker's intentions and objectives, the nature and scope of the application, as well as the limitations of data mining methods. A variety of software systems are available today that will handle the technical details so that people can focus on making the decisions.

All most all statistical techniques including bioinformatics we are using are just data mining either it may be in the field of agriculture, medicine or engineering.

Bioinformatics: Bioinformatics integrates the advances in the areas of Computer Science, Information Science and Information Technology to solve complex problems in Life and plant Sciences. Biology depended on chemistry to make major strides, and this led to the development of biochemistry. Similarly, the need to explain biological phenomena at the atomic level led to biophysics. The enormous amount of data gathered by biologists—and the need to interpret it—requires tools that are in the realm of computer science. The present role of bioinformatics is to aid agriculture researchers in gathering and processing genomic data to study protein function.

Remote Sensing and Geographic Information System: Remote sensing refers to the process of gathering information about an object, at a distance, without touching the object itself. The most common remote sensing method that comes to most people's minds is the photographic image of an object taken with a camera. Remote Sensing techniques have a unique capability of recording data in visible as well as invisible (i.e. ultraviolet, reflected infrared, thermal infrared and microwave etc.) part of electromagnetic spectrum. Therefore certain phenomenon, which cannot be seen by human eye, can be observed through remote sensing techniques i.e. the trees, which are affected by disease, or insect attack can be detected by remote sensing techniques much before human eyes see them.

Geographical Information System is a computer-based information system that can acquire spatial data from a variety of sources, change the data into useful formats, store the data, and retrieve and manipulate the data for analysis. Today, GIS is a multi-billion dollar industry and has become part of a basic information infrastructure for private enterprises, government agencies, and academic institutions. The majority of the operational GIS are used for thematic mapping, handling spatial queries, and decision-making support.

The application of remote sensing data taken momentum in the field of agriculture and crop studies in India especially crop production forecasting covering both crop inventory and crop yield forecast models, drought assessment, soil mapping and soil degradation, command area monitoring, flood damage assessment, land suitability mapping, insect pest infestation forecasting and widespread availability of satellite signals that allow private use of GPS made it possible for farmers to spatially locate data from precision farming applications. GIS technology is being increasingly employed by agriculture researchers to create resource database and to arrive at appropriate solutions/strategies for sustainable development of agricultural resources.



The application of remote sensing and GIS techniques in the management of agricultural resources are increasing rapidly due to improvement in space borne remote sensing satellites in terms of spatial, spectral, temporal and radiometric resolutions.

Other analytical functions of GIS include buffer zones, neighborhood characterization, and connectivity measurement. A particular feature of GIS is the ability to calculate more realistic distance measures among objects based on actual geometry, travel time, and cost, rather than straight-line distance. The trend in developing GIS analytical functions is to better integrate GIS with other software in statistical analysis, operations research, and artificial intelligence (AI) tools. Looking into the future, geographical information systems will likely become more user-friendly. With the development of web-based GIS, there is an evolution from single-user systems to more open, multiple-user systems.

Precision agriculture: Precision Agriculture is conceptualized by a system approach to re-organize the total system of agriculture towards a low-input, high-efficiency, sustainable agriculture. This new approach mainly benefits from the emergence and convergence of several technologies, including the Global Positioning System (GPS), geographic information system (GIS), miniaturized computer components, automatic control, in-field and remote sensing, mobile computing, advanced information processing, and telecommunications. Agricultural research is now capable of gathering more comprehensive data on production variability in both space and time. The desire to respond to such variability on a fine-scale has become the goal of Precision Agriculture

Expert Systems: An expert system is a specific kind of information system in which computer software serves the same function expected of an expert. The computer, programmed to mimic the thought processes of experts, provides the decision-maker with suggestions as to the best choice of action for a particular problem situation. The hope is that we can design computers (information systems) that extend our ability to think, learn, and act as an expert. Expert systems allow users to influence the knowledge of experts without requiring their presence. Expert systems are useful in any field especially in agriculture where experts are rare, expensive, or inaccessible.

The knowledge base is the core component of any expert system since it contains the knowledge acquired from an expert in the field and from published literature. Typically, a knowledge engineer is responsible for working with an expert to build the knowledge base for the system. The knowledge engineer must perform a detailed analysis of the inference process and develop the prototype knowledge base. The tasks involved in developing any knowledge base include knowledge acquisition, knowledge representation, knowledge programming, and knowledge refinement.

Decision Support Systems: Computer systems that provide users with support to analyze complex information and help to make decisions are called decision support systems (DSSs). Decision support systems are information systems with a specific function to help people with the problem solving – to some extent and decision-



making process. DSS consists of a collection of people, procedures, software, and databases with a purpose. The computer is the primary technology in such systems.

Decision support systems are an advancement of management information systems, generally help human beings solve complex problems, and provide data that can lead to non-predetermined solutions that are beyond the limitations of expert systems. Decision support systems may work actively or in a passive mode. Passive systems are mostly used by decision makers or supervisors or physicians for reference purposes, while active systems give advice in certain situations, such as alerting technical personnel when a parameter being monitored exceeds its designated threshold value.

The Internet : Use of Internet has given the globe a shrinking effect. Every kind of information is only a few clicks away. In today's world of competition – “information” is the key word to success. Availability of right information at the right time can make all the difference. Today relevant information outweighs the price of gold. The graphical user interface has simplified one of the most complex issues in the world. The time has come to exploit this medium to the best-suited interests in the other fields of life such as agriculture.

As this technology evolved and access expanded to business, industry, research, education, and personal users, the Internet and the World Wide Web (WWW) were born. They have changed the way we work, learn, and stay in touch with others. We can send and receive letters electronically and instantly; articles, books and journals are accessed instantly on your table without wasting time and money; we can purchase almost anything without physically traveling to a store; and we can quickly locate products and services via the Internet that may not be available in our own geographic neighborhoods. We can even build businesses and create networks of coworkers and customers without the need for office space and daily commuting.

Computer based information systems have changed the way we do research. They have enhanced our ability to identify and solve problems and to perform tasks that are beyond our physical ability. Information system technology, bioinformatics, and nanotechnology no doubt will continue to provide new horizons to us in the years to come.

