Following are some notes aimed at providing a context for the negotiations with EB on the 4th.

- Before information can really become a commodity on a mass consumer level, there are two problems which have to be solved - availability (making it easy for people to retrieve information from wherever it's stored) and accessibility (enabling people to absorb it once they've got it). The intelligent encyclopedia project is aimed at solving both these problems in one comprehensive service. Underlying the project is a plan for constructing the leading information/ knowledge service on a world scale.

- If we pull it off Atari will make mountains of money and become one of the world's major corporations. Even if we fail, which we won't, there will be lots of positive side side effects and byproducts of the effort which will strengthen Atari in numerous ways.

- Taken in its totality this is the most exciting "computer" ever conceived. Once it is announced it will bring respect to Atari and focus attention on the company all around the world.

- Atari is in the best position to succeed in this area. No other company comes close to matching the weave of positive factors represented by Atari's leadership in home entertainment, strong orientation toward the home and market, solid technological base, access to the diverse resources of WCI in many associated areas (notably Cable-TV publishing), and a high caliber research group headed by a scientist capable of inspiring and guiding (at least indirectly) all facets of the creative work necessary to accomplish our goals.

To the man on the street the "information explosion" is something people talk about, but nobody ever seems to do anything about it. Of course, this isn't exactly true. Laboratories around the world are devoted exclusively to information science. A number of relatively useful services have been developed, but they are so expensive or so limited in scope that most people rarely come in contact with them. Computers, which lie at the heart of the solution, are just now starting to appear in homes and offices on a large scale, although the level of technology is still rather primitive. We are at the point now where we can begin to "do something about it," and do it on a grand scale.

What is the "information explosion" besides an overused, trite phrase? From a quantitative point of view, the question seems straightforward. The quantity of what is known is increasing geometrically. But people rarely consider the question of quality. It's not just that information is growing in mass, i.e., that there is more to know, but that most of what people need to know these days tends to be extremely complex, whether it be global politics or astrophysics. The world was a simpler place 200 years ago. Most of the people and things that seemed to make a difference in a person's life existed within a small radius, and one could function fairly effectively within this space armed with a finite set of skills, some major precepts, and a dose of common sense. Not only is there more to learn today, but what is out there to be learned tends to be more abstract and complicated. People are desperate for a way not

only to manage the mass of information and knowledge but for a mechanism to help them absorb it; that is, to learn it.

If you deal only with the question of quantity, you end up with the "computer as a master filing cabinet" -- the computer stores all the information and knowledge and retrieves what you need on demand. This concept is handy (although the filing systems are still fairly primitive), but it only addresses half the problem. To make use of the information, there needs to be a transformation in the learning process. With a body of knowledge that is so much more complex and difficult to grasp, people need to be "smarter." They must absorb larger amounts of more abstract information over wider areas.

The intelligent encyclopedia is a mechanism for dealing with both the quantitative and qualitative aspects of the information explosion. As such it has the potential of becoming one of the ubiquitous tools of the coming "information age". Ubiquitous because it's so damn useful. The intelligent encyclopedia not only gets whatever facts you need with tremendous speed, but also provides the most flexible and powerful learning environment ever conceived. Some of its features include:

-- ULTIMATE FACT REFERENCE TOOL: Questions can be asked in natural language. "Who hit more home runs, Mickey Mantle or Willy Mays?" "What is the third law of thermodynamics?"

-- MULTIMEDIA: Capable of including audio and video of the highest quality, the intelligent encyclopedia presents information and knowledge in the form best suited to the particular subject matter. Text, photos, full-motion video, and sound can each be used to best advantage.

-- CREATIVE TEACHER: Not only will you be able to say, "What is the third law of thermodynamics," but also, "Teach me the third law . . . ," whereupon the IE will launch into a simulation to teach you the basic principles. The system will be intelligent enough not only to answer your questions, but actually to analyze your progress, just like a master teacher, and prescribe alternative learning strategies when necessary.

-- DIVERSE INFORMATION RESOURCES: Links to all electronically stored information and knowledge, including up-to-the-minute news.

-- RESPONSIVE TO THE USER: Tailors responses to the needs, characteristics, skills, and learning style of the user.

The drawings on the following pages illustrate just how indispensable a tool we envision. Everyone, whether they be a child wondering how birds fly, or an executive trying to understand the intrinsic relationship between interest rates and oil prices, will turn to their intelligent encyclopedia several times a day. It will become an indispensable feature of daily life.

<u>More Than a Souped-Up Version of Existing Encyclopedias</u>

To recognize both the nature and potential of this product, it helps to understand that the work goes far beyond enriching the content of existing encyclopedias. Much more important is the development of an extremely flexible user interface. Our goal

is to enable the user to travel around "knowledgeland" as easily as he drives around town. All options have to be apparent and easily taken advantage of. What we envision is a system that models itself to the user's requirements. If one day you just want straight answers to simple questions, you can get that just by asking your questions. If another day you want to browse a broad domain, the system functions as an intelligent guide, pointing out interesting features along the way. If you want to be serious, the "guide" will be serious; if you're feeling playful, it may assume the persona of your favorite comic. The system "knows" who you are and always tailors its responses to your profile. The important thing here is that once you have that kind of power in the system, you have the potential of creating a major information utility. Because the interface is so powerful, we have the capability to establish links to all electronically stored materials, such that the user can travel from database to database through boundaries that are relatively transparent. Once you have that capability, you have for the first time the basis of an information utility -- one which can do for information and knowledge what the telephone has done for communication.

The Market

When I was consulting for Britannica, I generated figures for them on the potential market for an IE of somewhat narrower scope than what is described here. The major premise

underlying those figures is that the system would be profoundly useful to an almost universal audience. Further, if not unique, the system wouldn't have more than one competitor on a worldwide basis. The system is so expensive to develop and requires a monumental effort by such a talented group of people that more than two parallel efforts would be inconceivable. (The present conception of the IE is at yet another level of complexity. If we get started soon, we can coopt any other efforts, at least at the high end.)

The Britannica figures, which are very conservative, are as follows:

-- By 1990-95 there will be more than 90,000,000 homes in the U. S.

-- If 5% of those homes subscribed to the IE for $10 per month, that would generate revenues of $540 million per year. The $10 figure is analogous to the phone companies' basic charge. For $10 the user gets unlimited usage of the basic system; interconnect charges to other databases result in add-on charges similar to long distance charges with with the phone company.

-- 140,000 schools and libraries could be expected to pay a minimum of $1500 per year each, generating an

additional $210 million. This figure is predicated on the assumption that while small "one-room" school houses might pay only $120 per year, university libraries with hundreds of terminals would run up charges into the tens of thousands of dollars per year.

This brings us to $750 million annual revenues for just the U. S. consumer and educational markets. When you add the international market and figure in the potential for business subscribers, it is clear that the totals become gargantuan very quickly. This can be a multi-billion dollar business.

What makes these figures even more attractive is that once you've put in the front-end money, you have a product/service which continually improves but is never obsolete; again the analogy with the phone system holds. Once it's in place the system is a cash cow which can produce profits at impressive rates year after year, even after allowing for substantial costs for continuous upgrade of the system.

How Do We Get from Here to There?

Getting from where we are today to the IE will require work on three different levels. The first is basic research in varous fields that relate to the IE -- artificial intelligence,

cognitive science and learning theory, display technology, speech recognition and synthesis, man-machine interfaces communications, and networks, to name a few. The second is a major developmental effort to weave together the various strands of the basic research so that we begin to have an understanding of how the conent of the IE should be integrated into a single complex system. Another way to understand this second level is as a research project into the methodology of an intelligent encyclopedia. The third level is the creation of the content itself.

In the main the research will go on anyway, whether the IE as a project exists or not. We have devised a strategy which permits much of the second layer of research and development to take place in the context of development of a number of short term marketable products. From the very beginning our strategy calls for two parallel lines of work: a long term track which consists mainly of basic research, and a short term track which combines research with product development. Neither of these tracks is especially expensive. The first is work that will go on anyway, so theoretically will add no costs. The second, while it may require an investment of $10 - 20 million, spread over several years, promises a significant return on investment. It is the third layer, the creation of the content of the encyclopedia, which gets expensive. However, the strategy allows for a decision point, perhaps three years

down the road, where we could still bail out without losing big bucks if conditions don't look right.

An additional point about the long term track. By formulating and announcing the concept of the IE, we are creating a focus for much of Atari's basic research. A driving function such as this can be very valuable from many perspectives. First, as a motivating force which results in a higher quantity of quality research. Secondly, this magnet will attract people and the product of their research to Atari. An information/knowledge utility -- such as the IE is the dream of thousands of people. When word get out that Atari is working on this project under Alan Kay, everyone doing interesting work in related areas will seek to contribute their work to the effort, bringing Atari a bounty of ideas and talent. The encyclopedia project will allow Atari to benefit directly and indirectly from the efforts of a network of researchers that extends around the world. For many people, scientists and artists, the vision of the IE provides a reason to talk to Atari instead of any of our competetitors.

<u>The Short Term</u>

The short term projects/products are designed to do all of the following:

1. Produce revenues.
2. Extend our understanding of how to do the long term. By doing state-of-the-art work for existing technology, we can push our understanding in several areas, particularly machine/user interface, interactive learning, media selection (when do you use what media?), and simulation design.
3. Establish a presence in the marketplace: with consumers, with the creators of prestigious databases (e.g., The New York Times), and with major cultural institutions (e.g., the Smithsonian, the Library of Congress, etc.) which we will want to involve in the long-term project.

The three principal short-term projects are described below.

Online Encyclopedia

Starting with the existing databases owned by EB, including Encyclopedia Britannica, Compton's Encyclopedia and the Merriam Webster Dictionary, we can put together the premier online encyclopedia within three years. (Note: The term "online

encyclopedia" is used throughout to indicate a short-term product based on existing databases. The term "intelligent encyclopedia (IE) refers to the super-duper information/knowledge utility described earlier which will someday supercede the online encyclopedia.)

Currently, World Book is online with Compuserve, The Academic American Encyclopedia is online with Dow Jones and Lockheed's Dialog System, and the British Everyman Encyclopedia is also on Dialog. These online systems provide access only to entire articles and since the access is by title, you have to know precisely which article you want; there is no facility for browsing. In almost every way these online encyclopedias are worse than their print counterparts; they add no function whatsoever, but have all the added hassle of online communication. They have no illustrations. Encyclopedia Britannica is currently in the NEXIS system. NEXIS is a full-text system which permits searching for information with only a word or a number of words. NEXIS then presents all the articles that mention that word or series of words. This is a great leap beyond the others, but the complexity of searching in NEXIS almost requires the user to be a trained researcher to find what he wants. NEXIS still has no illustrations or browsing capability (and costs $90 an hour to use). None of these online systems attracts a sizeable consumer market. Their value does not balance their costs (either time, inconvenience, or price).

Within three years we could have on the market an online system combining the full-text feature of NEXIS with a fairly powerful interface, permitting the novice user to wander in the database with considerable ease. Our basic standard is that it shouldn't be any harder to find anything than with print versions, and usually, it should be easier. Referral to related subjects should be much better than the existing print version. Not only will it be easier to go from Aardvark to Zebra, but the system can be programmed to point out connections. We would also expect to add, over time, computer graphics, both line drawings and animation, and a number of computer simulation programs on various subjects. If a user is studying electronics in the encyclopedia, for instance, he could elect to run a simulation of an electronic circuit design. An optional videodisc could provide color illustrations, a small number of motion picture sequences, and audio information.

The graphic capabilities of the system should at minimum be up to AT&T's PLP videotex standard. Ideally the system would be designed to work best with an Atari computer, but would be accessible to anyone with a microcomputer -- Apple, IBM, or even a high-quality Videotex terminal.

Communication/Distribution: The question of how to ship the bits to the consumer boils down to cable or telephone. While

cable holds the promise of higher bandwidth, which would permit faster communication of high-quality graphic images, still or motion, it is not likely that for the next five to ten years cable will have anything resembling the extensive network of two-way communication represented by the telephone system. For this reason, AT&T, with its offspring Baby Bell and their various network plans, is the most likely candidate to handle distribution of the online encyclopedia. As a major partner in the venture, AT&T could be expected to provide all the expertise and capital equipment necessary for distribution. [This would be a major contribution to the enterprise.] Good alternatives are not obvious.

Time Frame: Current plans call for the basic design of the system to take two years. An extensive pilot test will allow significant refinement during the third year. The third year would also see the beginning of the marketing push. Since the system's database already exists, we think this is a reasonable timetable.

What Does the Consumer Pay For: The context of the service will determine how the consumer pays for it. If the online encyclopedia is a standalone service, the consumer would probably be billed at a set amount per month for unlimited access. On the other hand, if the encyclopedia is one of the anchors in a broader home information/entertainment service which might include games, electronic mail, etc., charges might

conceivably be use sensitive.

We should consider designing an add-on attachment which would turn the VCS into a low-cost videotex terminal that, among other things, could access the online encyclopedia.

Videodiscs

The online encyclopedia is the arena in which we will be studying many of the questions relating to how people use online information systems. The videodisc project will be the main avenue for investigating what interactive video is all about. We know that full motion video interactive video will be an important component of the IE, but little is known about how to use this tool effectively. It is proposed that we produce a continuing series of videodiscs bearing the Atari/EB name on a wide range of topics -- e.g., space exploration, ocean life, sports history, how to speak French, a reading program for kids, a guide to music appreciation, etc. With each program we will be exploring better ways to use visual images to communicate. Games will be an integral part of many of the programs as we strive to tear down the walls between education and entertainment.

Even though the player population will be large enough to make this a profitable undertaking, we would plan to increase revenues by issuing the same materials in various formats. For example, each program will be designed so that it is most powerful, fun, instructive, etc. when driven by a microcomputer. However, since the number of people who will have both Ataris and videodisc players will be relatively small by that time, we will plan to release the programs in two additional formats -- as stand-alone programs to be played on standard videodisc players, and as linear programs suitable for broadcast. [A note on "standard videodisc player." By 1984 it is likely that all three videodisc formats -- laser, RCA, and VHD -- will be able to do most of the same things. All will support freeze frame and random access, and can interface with and be driven by a computer. We won't have to worry about who is winning the videodisc hardware wars since our programs will be released on all three systems.]

Several reasons compel us to begin this work now rather than later. Because of the slow take-off in the consumer market, few companies have invested in original material for videodisc. However, the technology has definitely captured the imagination of a number of highly creative people who have been dreaming up exciting applications and are champing at the bit. The videodisc player base is about to reach critical mass, and it won't be long before some major company makes a major videodisc effort. If we begin now, we can have our pick of the most

interesting projects, before people start committing elsewhere. Given the newness of the medium the importance of working with the best creative minds should not be underestimated. Second, is that Atari/EB can still establish strong connections to several major institutions -- the Smithsonian, the Library of Congress, the Metropolitan Museum of Art -- whose holdings constitute a resource rich beyond dreams, just waiting for the proper medium to exploit them. In the course of my work for EB I discussed the possibility of doing discs with representatives of several of these institutions and received an enthusiastic response from them -- extremely enthusiastic. Last and most important, good footage which we might want to include as part of the system at a future time should be optioned now. The amount of great footage that exists is finite, and the longer we wait, the less will be available and the higher the price tag it will carry. The recent PBS program "Life on Earth," for example (25% financed by WCI), was widely regarded as one of the most beautifully photographed films on biology/evolution ever produced. An excellent disc could be based on it, and later the footage could be incorporated into the IE itself. It would be a shame to see someone else get it.

There are two ways we can go with the videodisc series. Pay for it all ourselves, or have Atari/EB produce the discs as part of a joint venture either with one of the videodisc hardware manufacturers (RCA, Matsushita, Pioneer, etc.) or with a major broadcaster (ABC, PBS, CBS, etc.). The Atari/EB name

will draw many partners who would like to use our name and expertise to enter the videodisc market.

Microcomputer Software

The microcomputer software project will focus on several basic research questions, particularly simulation design. Results will influence future stand-alone and network software products, plowing the benefits of research directly back into our ongoing business. These products can become models for future generations of Atari software. But the lasting value of the microcomputer project lies in the contribution to the intelligent encyclopedia itself. The project will be designed to answer fundamental questions in generalizable ways, and will provide additional feedback from consumers on an ongoing basis to the ultimate design of the intelligent encyclopedia.

The goal of the microcomputer project is to produce a series of at least five exemplary products over a two-year period. We envision stand-alone versions of each product that will run on a variety of target microcomputers, as well as a version of each to run on the online encyclopedia network. In this way, we can maximize revenues by quadrupling the number of units sold. More importantly, we will be forced to design product concepts that move smoothly through different technologies. This will give our products evolutionary potential as well as

wide exposure.

Because the research goals of the project will necessitate close, ongoing involvement with the software developers, and because there will be times when answering research questions will take precedence over product schedules, development of this particular line of software must be driven by Corporate Research. Such a development scheme will also allow Research to directly evaluate, teach, and recruit development resources for the long haul. Once the products are complete, they can be funnelled into HCD for manufacturing and distribution. In this way, research goals can be met, and HCD can beef up its product line and realize handsome profits with no impact on its software development or product management resources.

Are We Aiming Only at the Atari Installed Base? (or Let's Get as Much Mileage out of EB as We Can)

It may be adviseable both to publish the videodiscs and microcomputer software under a separate label and to market these short-term products to run on several of our competitors' machines. Published under the prestigious Atari-EB label, these products will enable us to establish the class act in knowledge-related software. Marketing the products in the Atari-EB name will create visibility for the long-term association and will provide another class of products for

retailers, commanding additional shelf space. A high-quality image in product packaging should enhance revenues: greater perceived value will support higher retail prices. Tying the packaging of the microcomputer and videodisc products together should create even greater benefits at retail, including enhanced scope, variety, and retail presence. We can protect our own hardware business by giving the Atari versions a six-month head start in the marketplace.

The products can also be sold by EB through its direct sales force, singly or in series (presumably the actual Atari-EB line will consist of more than the titles being done as part of the IE project). EB distribution will also bolster penetration in the school market. Combining Atari and EB distribution channels, as well as offering products for different machines, can be expected to increase unit sales by several multiples.

A Few Points about Encyclopedia Britannica

As a 213-year-old company, one of the oldest English language publishing companies, EB is as solid as they come. By doing what they do best, selling encyclopedias by direct sales methods, they have weathered storm after storm successfully. Their unbending reliance on the foundation of their name and charter accounts for this stability. But they recognize that the advent of electronic media has put them up against a dilemma that they can't just tough their through. For years now companies and individuals have come to EB with one scheme

after another, each suggesting ways to exploit the Britannica name and database in the "new technologies" area. EB has successfully resisted all comers to date, mainly due to the current management's overly cautious nature. However, feeding that paralysis is a sharp fear of doing anything which might jeopardize their bread and butter -- the sales of print encyclopedia. They are in the difficult position of wanting/needing to advance while they guard both their rear and their supply lines all at the same time. Atari represents a TOTAL solution to them. There are the obvious benefits to be gained by association with Atari's image, as well as the depth represented by Atari's commitment to long-term research. They are very impressed by Alan Kay, in whom they see the breadth of vision that is necessary to transform the very concept of the encyclopedia. EB is particularly comfortable with Atari's orientation toward the home which parallels their own orientation very closely. The whole WB confusion difinitely caused EB to grasp at a much dedeper level exactly how much they wanted to work with Atari. Their fear that we could still go with WB undoubtedly provides us with a certain amount of leverage.

The depth of EB's interest in working with Atari is indicated by their increasing willingness to invest ever greater amounts of their own money. According to the last figures suggested by Van Doren, and later confirmed to him by Swanson, EB might be willing to invest as much as $3 - 5 million per year (constant

dollars) over the long haul.

International Connections and International Editions

As I have mentioned in several other memos, EB is highly regarded around the world. Wholly owned subsidiaries in Japan, Australia, Canada, Western Europe, Britain, Phillipines and Korea sell more than 50,000 sets of EB. Plus EB is involved in numerous joint ventures which publish encyclopedias in many of the major languages of the world - The French Encyclopedia Universalis (20,000 sets); the Barsa Spanish and Portuguese encyclopedias (60,000); and the Italian Il Modulo (12,000). Under and exclusive agreement with the Chinese government a major Chinese encyclopedia based on the Micropedia is currently under development. The prestige connected with the Atari/EB name should allow us to establish significant penetration in foreign markets for the videodiscs and microcomputer software lines. With EB's help deals could be struck in many countries to adapt the IE for use in that country. The international market for the IE should be immense, especially if we can make deals to get it adapted for several key countries.

Complex Projects Require Complex Structures

Although probably not true in all cases, nor a goal to shoot for, this phrase will inevitably apply to the encyclopedia project. However, EB's willingness to invest large sums of their own money simplifies matters since it is now reasonable to propose a joint venture to produce both long and short term

products. It is assumed from the beginning that the joint venture with EB must bring in other partners for limited or general purposes. For example the Atari/EB venture could bring in AT&T to play a role only on the online encyclopedia, or to be a more general partner. This principal applies also to other organizations which bring something necessary and unique to the party such as The New York Times, CBS, or Time-Life. Calculating investment will be complicated since part of everyone's contribution will be "in kind" -EB providing its database, (eg.)AT&T its communication network, and Atari its research capability. Presumably EB's share in the venture might change over time. For example they may own a bigger piece of the venture during the short-term when their investment represents a bigger percentage of the whole, than over the long-term when even the (for them) sizeable sums they are willing to invest are dwarfed by the development and capital costs. Van Doren and I have discussed this in the past, and he sees no particular problem from EB's point of view; they understand that in the electronic environment they must settle for being smaller fish in a larger pond.

During the first several years, Atari should be able to charge a significant portion of its contribution to the venture to the research budget; that is with funds that would be spent anyway - venture or no.

Structure For Carrying Out Work

For purposes of discussion I want to distinguish three main areas of work - basic research, development of product (creation of content), marketing and distribution (including communications). During the first few years all basic research will be conducted by Atari research. In terms of product development, the design of the interface for the online encyclopedia, the creation of graphics and computer simulations for the online encyclopedia, the production of videodiscs and microcomputer software, EB will be primarily a silent partner, providing mainly money. EB will want to exercise some editorial rights, at least to pass on the content, but this should not be a problem, in fact it will lend an air of credibility. Additionally EB should be relied upon to use their good offices in appropriate situations, eg. helping us to work out an arrangement with the Smithsonian for a videodisc project. Atari, of course, doesn"t have all the necessary people in house to develop all the videodiscs programs, software etc. Many of these programs will actually be produced by independent contractors under our direct supervision. (The potential Atari/EB Bank Street deal referred to in an earlier memo is an example of how this might work.)

Distribution of the short term online encyclopedia would be handled by whatever company is brought in to handle that end of things (AT&T or whomever). Marketing and other distribution questions will have to be handled by the joint venture itself.

However, especially in the first few years, the joint venture will look very much like an Atari subsidiary, much the way the camps look like a sole Atari project to a visitor from the outside.

Within Atari we need to form a cross-divisional project or mini-division which will oversee all aspects. Within that matrix, Atari research must be relied on to oversee the initial short-term product development. Given that a key reason for the short-term products is their role in understanding how to do the intelligent encyclopedia itself, it's crucial that the development of these short-term - the online encyclopedia, videodiscs and special line of Atari/EB software - take place in the context of the long-term goal. Developing them out of this context threatens to dilute their value. The reason for suggesting this is not that Atari Research can necessarily do a better job of product development, but that with a project as complex as the intelligent encyclopedia, the parts must contribute to the whole in a way that maintains the integrity of the whole structure. We can structure the short-term product development within Atari Research so that it doesn't disrupt, and in fact contributes to the long range research efforts.

<u>The Atari Institute for the Art and Science of Knowledge</u>

Given that the IE requires a thorough rethinking of how knowledge is represented and transmitted, the content of the IE

will have to be created largely from scratch. We can't just take text from books, movie footage from over here and some photos from over there and transport them as is into the IE. A thoroughly interactive learning environment such as the IE will require a fresh approach. Creating the content of this encyclopedia will be an intellectural and artistic task of mammoth proportions. Because of this, we suggest that two or three years into the project we create something like the Atari Institute for the Art and Science of Knowledge. Located at a major university in a stimulating metropolitan area (Harvard, Columbia etc.), this institute would have two main tasks. One is the theoretical task of deciding how each subject area will be treated. The second is the practical task of assigning people (from around the world) to actually create the content, and then assembling and editing the parts into a coherent whole. In the main this second task requires two types of people to work together. One group, subject area experts, understand the message. The other group, media experts and artists, understand how to communicate ideas. In the main, the content of the encyclopedia will be created by teams of people representing these two aspects. Locating at a major university in a big city gives us the best bet of assembling the array of talent needed. We could set up an institute like this from scratch perhaps, but it would be prohibitively expensive. Connected to a university we would have access to its resources, professors and graduate students (a great source of inexpensive, highly motivated labor), libraries, and the general richness of the intellectual environment.