

DESIGNING SOFTWARE TO BE USED UP
and Protecting It from Pirates

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INTRODUCTION

Software products by their very nature are designed to be used forever. However, there are some real advantages in purposefully designing them to be "used up." These advantages accrue to both the software vendor and the customer and pertain to product marketing, pricing, support, and protection from software piracy. What is being proposed here is "exhaustible software" versus the normal inexhaustible variety.

AN EXAMPLE

An example of exhaustible software is a product called the COMPUTERIZED GRADEBOOK. It was recently implemented by this author on an IBM Personal Computer, in part, to develop and demonstrate the concept of exhaustible software. Basically, this product allows a teacher to utilize a computer to record student grades, analyze them, and compute averages and final letter grades. In this respect, it is not unlike similar products on the market. But while the other products allow a teacher to use them semester after semester, in perpetuum, the COMPUTERIZED GRADEBOOK is designed to be just like a conventional gradebook. It has space for just ten classes, and when this "space" is used up, another gradebook must be purchased.

ADVANTAGES

What advantage is this for the teacher? The main advantage comes in price. While other software packages having comparable capabilities might cost between fifty and one hundred dollars, the COMPUTERIZED GRADEBOOK could be purchased for perhaps \$12.95. This means that initially the teacher does not have to make a large investment in order to try out the product, and the teacher retains the flexibility to discontinue using it at any time without suffering a large monetary loss, i.e. "pay as you go". Another advantage is that the teacher will receive any new features and bug fixes whenever a new gradebook is purchased.

To the COMPUTERIZED GRADEBOOK vendor, the exhaustible nature of the product means that multiple copies can be sold to one customer, thus justifying the low price. Also, since customers are repurchasing the product when their old one is used up, new versions of the product are gradually disseminated to current customers so that support of older versions is gradually phased out. The lower price for the product makes it very competitive, especially in attracting new

customers. Also, its low price and exhaustibility make the product more like traditional gradebooks and thus more suitable for distribution through traditional, and perhaps less threatening, outlets such as stationary stores and bookstores, instead of computer and software stores. Finally, the COMPUTERIZED GRADEBOOK's low price means that extensive efforts to pirate the software will not be worthwhile.

SOFTWARE PROTECTION

But are extensive efforts really required to copy the software? The COMPUTERIZED GRADEBOOK resides on a single diskette. The diskette can be readily copied using standard PC-DOS commands. This is necessary to permit any number of legitimate backup copies to be made. But the programs and data on the COMPUTERIZED GRADEBOOK diskette are inseparable. This means that if someone attempts to illegally copy a partially used COMPUTERIZED GRADEBOOK diskette, they will get a used gradebook which includes someone else's classes, students, and grades. And they will not be able to erase this information because of the operational restrictions built into the software that make it exhaustible.

So why doesn't a teacher just make multiple copies of an unused, or blank, COMPUTERIZED GRADEBOOK? Implemented as part of the COMPUTERIZED GRADEBOOK is a software-based software authorization system, which is referred to in the product documentation as a "customer validation procedure". Its purpose is to ensure that everyone using the product is a legitimate customer. The customer validation procedure thereby supports the concept of exhaustible software by ensuring the viability of a low product price. At the same time, it depends on the exhaustive nature of the software for its integrity.

Customer validation is requested by the COMPUTERIZED GRADEBOOK whenever the teacher has used the product a certain number of times after first entering grades for a new class. The number of uses permitted before validation is set so that the teacher has the opportunity to also begin entering grades for other classes. (Once grades are entered for a class, the class cannot be removed from the gradebook.)

Customer validation essentially involves the teacher obtaining a password from the vendor and entering it in order to continue using the gradebook. The password is based on twelve digits which are displayed on the gradebook cover at the time customer validation is requested. (The gradebook cover is always the first screen displayed whenever the gradebook is used. See Figure 1.) The teacher records the twelve digits on a postcard and drops it in the mail. A CUSTOMER VALIDATION postcard is included for this purpose in the original product package. (See Figure 2.) In a few days, the teacher receives the password in the mail along with a new CUSTOMER VALIDATION postcard.

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Version 1.0                                030226-05-0138
o
      C O M P U T E R I Z E D
      G R A D E B O O K

o
      Instructor: John Q. Doe      <
      Term: Spring < Year: 1985<

Notes:                                     <

      ** Password:      < **
      In order to validate your use of this gradebook, you will be expected to
      give a password before using it one of the next 5 times.
o      To obtain this password, record the 12 digits shown in the top righthand
      corner. Then complete and mail the postcard provided with your COMPUTERIZED
      GRADEBOOK or call 999-999-9999 any weekday from 8 AM to 5 PM, PST.
-----
Type space (i.e. press space bar or RETURN key) for Main Menu.

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Figure 1. Gradebook cover screen with message requesting customer validation.

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      C U S T O M E R   V A L I D A T I O N

Enter 12 digit number:

      _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
      (See page 4A in User's Guide.)

Customer Validation Password: _ _ _ _ _ _ _ _ _ _
                              (Leave blank.)

FROM: [-----]
      [-----]
      [-----]
      [-----]

Enter your return address above.

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Figure 2. Postcard for customer validation.

In the interim, the teacher is allowed to continue to use the gradebook (up to five times after validation is requested.) A telephone number is also provided by the vendor to enable the teacher to call for the password.

The twelve digits shown on the screen and recorded on the postcard are unique to each gradebook and the prior use made of the gradebook. The first six digits is the gradebook ID which is unique to each COMPUTERIZED GRADEBOOK product sold. The next two digits is the number of classes currently recorded in the teacher's gradebook. The last four digits represent a number which characterizes how the gradebook has been used up to this time by the teacher.

Upon receiving the postcard, what does the vendor do to validate that the user is a legitimate customer, and how is the correct password determined? First, the vendor checks a journal of all issued gradebook IDs to ensure that the ID is valid and that the gradebook has not already been validated with a class count greater than or equal to the class count appearing on the postcard. If not, then the last six digits are written in the journal to record validation, and a password is computed based on the twelve digits. (Obviously, this effort on part of the vendor can easily be computerized.) The vendor then writes the password on the postcard and mails it in a windowed envelope which displays the customer's return address.

GENERAL TECHNIQUES

Given below is a summary of the general techniques which can be used to create exhaustible software and to protect it. Again, the COMPUTERIZED GRADEBOOK will be used to illustrate these techniques.

1. Limitations are placed on certain parameters of the application in order to limit the use of the software. In the COMPUTERIZED GRADEBOOK, the number of classes which can be recorded in the gradebook is limited to ten.
2. Restrictions are placed on certain operations in order to limit reuse of the software. In the COMPUTERIZED GRADEBOOK, a single gradebook exists from the outset which can never be destroyed and recreated. The instructor's name on the gradebook cover, once entered and verified, cannot be changed. Also, two restrictions apply once grades have been entered for a class. The class cannot be deleted, and number of student additions and deletions allowed is limited.
3. A software authorization system which is based on the exhaustibility of the product is included to ensure the viability of a low product price. The "customer validation procedure" for the COMPUTERIZED GRADEBOOK has already been discussed, largely from the viewpoint of the customer and vendor. The general techniques for its implementation will be given shortly.

4. Data which controls product use and software authorization is placed in a control file and protected by encryption and/or scrambling. All programs are made dependent on a valid control file for their operation. In the COMPUTERIZED GRADEBOOK, a gradebook ID, class counter, usage counter, update level indicator, file format level indicator, and various other items are stored in a control file record in undocumented sequence and data item format. The record is partially scrambled and fully encrypted on disk.
5. Only program object code is distributed.

The general techniques that can be used to implement the software authorization system are listed below.

1. Each product distributed is assigned a unique numeric ID which is included as part of the control data at the time the product diskette (or tape) is made. This is the gradebook ID for the COMPUTERIZED GRADEBOOK.
2. At appropriate times in the useful life of the product, customer validation is requested, i.e. a password must be entered in order to continue to use the product. Obviously, customer validation must not be requested too often, but must be requested often enough to give it credibility. Its occurrence could be random within certain constraints.

Customer validation is requested only after some incremental use of a significant nature has been made of the product which cannot be undone. This incremental use should be recorded by some numeric code. In the COMPUTERIZED GRADEBOOK, this "incremental use" is the first-time entering of grades for a class. However, a number of additional uses (i.e. program executions) is allowed before validation is requested in order to give the teacher an opportunity to enter grades for the first time in other classes. This delay minimizes the number of customer validations requested over the life of the gradebook.

Before validation is requested, enough use must have been made of the product in order to "measure" some aspect of this use which most likely is different for different users. This particular aspect of use is reflected by some numeric code and its nature should remain undocumented (as is the case with the COMPUTERIZED GRADEBOOK). In the COMPUTERIZED GRADEBOOK, an example of an aspect of use which could have been measured (but was not) is the total number of grades in the gradebook.

3. At the time validation is requested, a numeric code is displayed which contains three components: 1) the product ID, 2) the code which measures the incremental

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