RANDOMTOOLS: An Apple Pascal unit useful in randomization

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Almost all research in the behavioral sciences requires that the ordering of the presentation of conditions be suitably randomized. The process of developing a random ordering is tedious; computer assistance is available and frequently used. Most computer languages have a built-in procedure or command for generating pseudorandom orderings. In addition, the algorithms for producing pseudorandom orderings are becoming better known (Knuth, 1969; Sander-Cederlof, 1984a), as are methods of testing the adequacy of specific implementations of algorithms (Rasmussen, 1984; Sander-Cederlof, 1984b).

Simply having a "random number" generator availa-

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ble on a computer still leaves large sections of program code to be written for each application program. The UCSD Pascal unit described here makes two procedure calls available to an applications program: *Randomorder* and *Reorder*. These calls greatly reduce the coding overhead for providing random orderings of sequences. *Randomorder* produces a linked list of pseudorandomly ordered integers (1 to n). *Randomorder* also returns a heap pointer so that the memory locations used in the list can be released when no longer needed. The second procedure, *Reorder*, randomizes a linked list of integers provided by the calling program. When *Reorder* returns control to the calling program, the heap has been restored to its state at the time of the procedure call.

RANDOMTOOLS includes utility procedures making the creation, use, and maintenance of linked lists simple for those unfamiliar with this data structure. Heap management is left to the calling program. Table 1 contains a Pascal program that illustrates the use of RANDOMTOOLS by creating and then listing a random ordering of integers.

RANDOMTOOLS does not use any other UCSD units.

Table 1
Example Program Using RANDOMTOOLS

```
PROGRAM Demo;
Uses Randomtools;
VAR
    HEAP      : HeapPointer    { These three variables are }
    ROOT      : Element        { of types which are declared }
    PTR       : ElementPointer { in the unit RANDOMTOOLS }
    INT       : integer;
Begin { Demo }
{ Provide the values in the "seed" for the pseudorandom
generator. This replaces the RANDOMIZE procedure.
Any 4 numbers between 0 and 255 can be used as a particular
seed. }
    SEED[1] := 99;
    SEED[2] := 153;
    SEED[3] := 0;
    SEED[4] := 213;

{ So later we can reuse the memory locations used in the list }
    MARK (HEAP);
{ Initializes the root node of the list }
    BEGINLIST (ROOT);
{ Creates list of 5 items containing even integer 2..10 }
```

```

FOR INT := 1 TO 5 DO ADDELEMENT(INT * 2, ROOT);
{ reorders the list }
REORDER(ROOT);

{ NEXTITEM is a boolean function which returns the next integer
and TRUE if the end of the list has not yet been reached. It
returns false when the end of the list has been reached and
the value of -MAXINT for the next integer.
Before NEXTITEM can be used the pointer variable has to be
set at the beginning of the list by using the provided
function, FRONT.}

PTR := FRONT(ROOT);
WHILE NEXTITEM(ROOT,PTR,INT) DO WRITELN(INT);
{ Make the memory locations used in the list available for
other uses--not necessary at the end of a program. }

RELEASE(HEAP);
End. { DEMO }

```

A pseudorandom generator coded in Pascal (Sands, 1984) is included. The generator is easily reseeded (see Table 1). Any other pseudorandom generator can be substituted for the one provided without changing either the basic algorithm or the data structures.

Program Requirements. The program is written in Apple Pascal v1.1 and has been used on both an Apple II+ (with 16K memory card) and an Apple IIe.

Program Availability. The source code for the RANDOMTOOLS unit is available free of charge from the author. The source and object code of RANDOMTOOLS, as well as of several short demonstration programs, is available from the author on 5¼-in. diskette. Please accompany diskette requests with a \$5.00 check payable to the author.

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