PERFECT NUMBER DEMONSTRATION PROGRAM

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1620
Correction

11.0.030
April 7, 1965

Attached are new pages for the flow chart, program listings and program output for this program. The source and object decks have been revised.

1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter or pencil, do not use ink)

Program No._____ Date_____

Program Name:_____

1. Does the abstract adequately describe what the program is and what it does? Yes___ No___
   Comment_____

2. Does the program do what the abstract says? Yes___ No___
   Comment_____

3. Is the Description clear, understandable, and adequate? Yes___ No___
   Comment_____

4. Are the Operating Instructions understandable and in sufficient detail? Yes___ No___
   Comment_____
   Are the Sense Switch options adequately described (if applicable)? Yes___ No___
   Are the mnemonic labels identified or sufficiently understandable? Yes___ No___
   Comment_____

5. Does the source program compile satisfactorily (if applicable)? Yes___ No___
   Comment_____

6. Does the object program run satisfactorily? Yes___ No___
   Comment_____

7. Number of test cases run_____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes___ No___
   Comment_____

8. Does the Program Meet the minimal standards of the 1620 Users Group? Yes___ No___
   Comment_____

9. Were all necessary parts of the program received? Yes___ No___
   Comment_____

10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

Mr. Richard L. Pratt
Data Corporation
7500 Old Xenia Pike
Dayton, Ohio 45432

Your Name _____

Company _____

Address _____

User Group Code_____

THIS REVIEW FORM IS PART OF THE 1620 USER GROUP ORGANIZATION'S PROGRAM REVIEW AND EVALUATION PROCEDURE. NONMEMBERS ARE CORDIALLY INVITED TO PARTICIPATE IN THIS EVALUATION.

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PERFECT NUMBER DEMONSTRATION PROGRAM

John Sawyer, Jr.
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Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for IBM Data Processing Systems. When such an announcement occurs, users should order a complete new program from the Program Information Department.

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DECK KEY

1. Source Deck
2. Object Deck

PROGRAM ABSTRACT

Title: Perfect Number Demonstration Program

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116 Belle Vista Court, N.W.
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Description: Perfect Numbers, by definition, are equal to the sum of their proper divisors. For example, 6 is a perfect number, since 6=1+2+3. Until 1952, only 12 of these numbers were known. After this time computers were used to determine additional perfect numbers.

This program types a brief history of perfect numbers, gives a summary of the method used to determine them, and computes rapidly the first five perfect numbers.

Mathematical Method: If, for an integer n, $2^n - 1$ is a prime number, then $2^{n-1}(2^n - 1)$ is a perfect number. This technique is attributed to Euclid.

The program is written in Fortran with Format, and the object deck is compiled with UTO Fortran.

Equipment Specifications: 20K Memory, 1622 Card Read-Punch.

Time: Five minutes, including loading time.

OPERATING INSTRUCTIONS

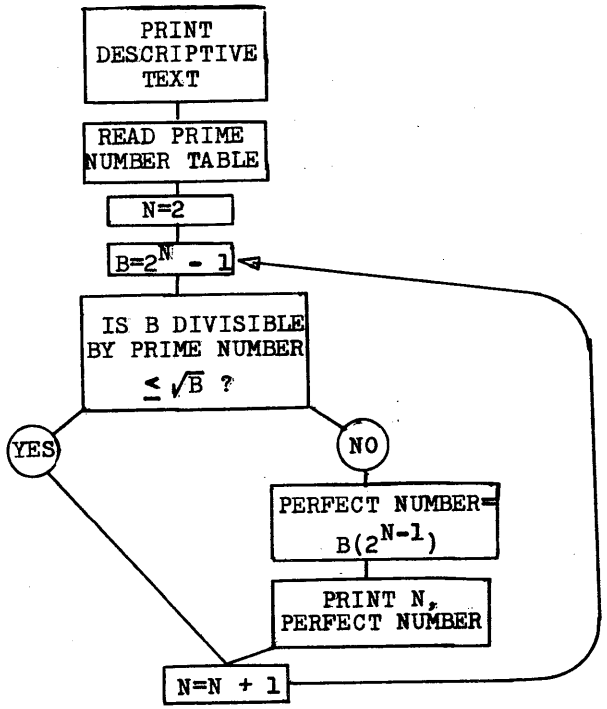
This program is self-explanatory and self-initiating. It is necessary merely to load the program:

1. Clear Storage:
   A. Insert; type 16 00010 00000
   B. Release; start.
   C. Instant stop.
   D. Reset
2. Place object deck in read hopper.
3. Press load button.

No program switches are used.

All output is on the typewriter.

The program ends with STOP 0000.




```
07070 C      PERFECT NUMBER PROGRAM---JOHN SAWYER
07070        PRINT901
07082   901  FORMAT(5X,39HA PERFECT NUMBER IS EQUAL TO THE SUM OF)
07192        PRINT902
07204   902  FORMAT(44HITS PROPER DIVISORS.  FOR EXAMPLE, 6=1+2+3--)
07316        PRINT903
07328   903  FORMAT(29HHENCE, 6 IS A PERFECT NUMBER.)
07410        PRINT904
07422   904  FORMAT(1X)
07446        PRINT905
07458   905  FORMAT(5X,35HPERFECT NUMBERS WERE STUDIED BY THE)
07560        PRINT906
07572   906  FORMAT(41HPYTHAGOREAN SCHOOL AND MUCH MYSTICISM WAS)
07678        PRINT907
07690   907  FORMAT(38HCONNECTED WITH THEM.  AROUND 300 B. C.)
07790        PRINT908
07802   908  FORMAT(39HEUCLID PROVED THE VALIDITY OF A FORMULA)
07904        PRINT909
07916   909  FORMAT(39HFOR FINDING PERFECT NUMBERS.  IT STATES)
08018        PRINT910
08030   910  FORMAT(40HTHAT, FOR ANY POSITIVE INTEGRAL VALUE OF)
08134        PRINT 9111
08146  9111  FORMAT(13X,1HN)
08180        PRINT911
08192   911  FORMAT(36HN FOR WHICH 2  - 1 IS A PRIME NUMBER)
08288        PRINT 9121
08300  9121  FORMAT(16X,3HN-1,2X,1HN)
08354        PRINT912
08366   912  FORMAT(32HTHE EXPRESSION 2   (2  - 1) WILL)
08454        PRINT913
08466   913  FORMAT(20HBE A PERFECT NUMBER.)
08530        PRINT904
08542        PRINT914
08554   914  FORMAT(5X,35HUNTIL 1952 ONLY 12 OF THESE PERFECT)
08656        PRINT915
08668   915  FORMAT(39HNUMBERS WERE KNOWN.  AFTER THAT TIME IT)
08770        PRINT916
08782   916  FORMAT(41HWAS FOUND THAT COMPUTERS COULD BE USED TO)
08888        PRINT917
08900   917  FORMAT(39HGOOD ADVANTAGE IN FINDING MORE OF THESE)
09002        PRINT918
09014   918  FORMAT(8HNUMBERS.)
09054        PRINT904
09066        PRINT919
09078   919  FORMAT(5X,38HUSING THE FORMULA SET FORTH BY EUCLID,)
09186        PRINT920
09198   920  FORMAT(43HTHE 1620 WILL CALCULATE THE FIRST 5 PERFECT)
09308        PRINT921
09320   921  FORMAT(43HNUMBERS AND WILL PRINT THEM, ALONG WITH THE)
09430        PRINT922
09442   922  FORMAT(42HVALUES OF N USED TO PRODUCE THEM.  THIS IS)
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Ø9550       PRINT923
Ø9562   923 FORMAT(42HAN EXAMPLE OF HOW COMPUTERS CAN AID IN THE)
Ø9670       PRINT924
Ø9682   924 FORMAT(26HSTUDY OF PURE MATHEMATICS.)
Ø9758       PRINT9Ø4
Ø9770       PRINT925
Ø9732   925 FORMAT(5X,38H---JOHN SAWYER, STUDENT, DALTON JUNIOR)
Ø9890       PRINT926
Ø9902   926 FORMAT(42HHIGH SCHOOL, WINSTON-SALEM, NORTH CAROLINA)
T0010       PRINT9Ø4
T0022       PRINT 927
T0034   927 FORMAT(6X,14HPERFECT NUMBER,7X,1HN)
T0110       PRINT9Ø4
T0122       DIMENSION A(27)
T0122       N=2
T0146       I=1
T0170       DO 2 K=1,3
T0182       READ1,A(I),A(I+1),A(I+2),A(I+3),A(I+4),A(I+5),A(I+6),A(I+7),A(I+8)
T0518     1 FORMAT (F5.Ø,F5.Ø,F4.Ø,F5.Ø,F5.Ø,F5.Ø,F5.Ø,F5.Ø,F5.Ø)
T0580     2 I=I+9
T0652   1Ø1 B=2.**N-1.
T0700       I=1
T0724     3 DO 4 I=1,27
T0736       Q=B/A(I)
T0796       IF (9999.-Q)5,12,12
T0864    12 IF (Q-A(I)) 14,4,11
T0956    11 L=Q
T0992       C=L
T1028       D=C*A(I)
T1088       IF (B-D)5,8,4
T1156     4 CONTINUE
T1192    14 PNUM=B*2.**(N-1)
T1276       PRINT 1Ø,PNUM,N
T1312    1Ø FORMAT (F2Ø.Ø,5X,I3)
T1346     8 N=N+1
T1382       GO TO 1Ø1
T1398     5 STOP
T1402       END
```

DATA CARDS (PRIME NUMBER TABLE)

```
  2    3    5    7   11   13   17   19   23   ØØ1*
 29   31   37   41   43   47   53   59   61   ØØ2*
 67   71   73   79   83   89   97  1Ø1  1Ø3   ØØ3*
```


PROGRAM OUTPUT

A PERFECT NUMBER IS EQUAL TO THE SUM OF ITS PROPER DIVISORS. FOR EXAMPLE, 6=1+2+3--HENCE, 6 IS A PERFECT NUMBER.

PERFECT NUMBERS WERE STUDIED BY THE PYTHAGOREAN SCHOOL AND MUCH MYSTICISM WAS CONNECTED WITH THEM. AROUND 3ØØ B. C. EUCLID PROVED THE VALIDITY OF A FORMULA FOR FINDING PERFECT NUMBERS. IT STATES THAT, FOR ANY POSITIVE INTEGRAL VALUE OF N FOR WHICH $2^N - 1$ IS A PRIME NUMBER THE EXPRESSION $2^{N-1}(2^N - 1)$ WILL BE A PERFECT NUMBER.

UNTIL 1952 ONLY 12 OF THESE PERFECT NUMBERS WERE KNOWN. AFTER THAT TIME IT WAS FOUND THAT COMPUTERS COULD BE USED TO GOOD ADVANTAGE IN FINDING MORE OF THESE NUMBERS.

USING THE FORMULA SET FORTH BY EUCLID, THE 162Ø WILL CALCULATE THE FIRST 5 PERFECT NUMBERS AND WILL PRINT THEM, ALONG WITH THE VALUES OF N USED TO PRODUCE THEM. THIS IS AN EXAMPLE OF HOW COMPUTERS CAN AID IN THE STUDY OF PURE MATHEMATICS.

---JOHN SAWYER, STUDENT, DALTON JUNIOR HIGH SCHOOL, WINSTON-SALEM, NORTH CAROLINA

```
      PERFECT NUMBER        N

                  6.        2
                 28.        3
                496.        5
               8128.        7
           33550336.       13
STOP ØØØØ
```

DATA CARDS (PRIME NUMBER TABLE) 4

```
   2    3    5    7   11   13   17   19   23                    001
  29   31   37   41   43   47   53   59   61                    002
  67   71   73   79   83   89   97  101  103                    003
 107  109  113  127  131  137  139  149  151                    004
 157  163  167  173  179  182  191  193  197                    005
 199  211  223  227  229  233  239  241  251                    006
 257  263  269  271  277  281  283  293  307                    007
 311  313  317  331  337  347  349  353  359                    008
 367  373  379  383  389  397  401  409  419                    009
 421  431  433  439  443  449  457  461  463                    010
 467  479  487  491  499  503  509  521  523                    011
 541  547  557  563  569  571  577  587  593                    012
 599  601  607  613  617  619  631  641  643                    013
 647  653  659  661  673  677  683  691  701                    014
 709  719  727  733  739  743  751  757  761                    015
 769  773  787  797  809  811  821  823  827                    016
 829  839  853  857  859  863  877  881  883                    017
 887  907  911  919  929  937  941  947  953                    018
 967  971  977  983  991  997 1009 1013 1019                    019
1021 1031 1033 1039 1049 1051 1061 1063 1069                    020
1087 1091 1093 1097 1103 1109 1117 1123 1129                    021
1151 1153 1163 1171 1181 1187 1193 1201 1213                    022
1217 1223 1229 1231 1237 1249 1259 1277 1279                    023
1283 1289 1291 1297 1301 1303 1307 1319 1321                    024
1327 1361 1367 1373 1381 1399 1409 1423 1427                    025
1429 1433 1439 1447 1451 1453 1459 1471 1481                    026
1483 1487 1489 1493 1499 1511 1523 1531 1543                    027
1549 1553 1559 1567 1571 1579 1583 1592 1601                    028
1607 1609 1613 1619 1621 1627 1637 1657 1663                    029
1667 1669 1693 1697 1699 1709 1721 1723 1733                    030
1741 1747 1753 1759 1777 1783 1787 1789 1801                    031
1811 1823 1831 1847 1861 1867 1871 1873 1877                    032
1879 1889 1901 1907 1913 1931 1933 1949 1951                    033
1973 1979 1987 1991 1993 1997 1999 2003 2011                    034
2017 2027 2029 2039 2053 2063 2069 2081    0                    035
```


PROGRAM OUTPUT 5

A PERFECT NUMBER IS EQUAL TO THE SUM OF ITS PROPER DIVISORS. FOR EXAMPLE, 6=1+2+3--HENCE, 6 IS A PERFECT NUMBER.

PERFECT NUMBERS WERE STUDIED BY THE PYTHAGOREAN SCHOOL AND MUCH MYSTICISM WAS CONNECTED WITH THEM. AROUND 300 B. C. EUCLID PROVED THE VALIDITY OF A FORMULA FOR FINDING PERFECT NUMBERS. IT STATES THAT, FOR ANY POSITIVE INTEGRAL VALUE OF N FOR WHICH (2**N)-1 IS A PRIME NUMBER, THE EXPRESSION (2**(N-1))*((2**N)-1) WILL BE A PERFECT NUMBER.

UNTIL 1952 ONLY 12 OF THESE PERFECT NUMBERS WERE KNOWN. AFTER THAT TIME IT WAS FOUND THAT COMPUTERS COULD BE USED TO GOOD ADVANTAGE IN FINDING MORE OF THESE NUMBERS.

USING THE FORMULA SET FORTH BY EUCLID, THE 1620 WILL CALCULATE THE FIRST 5 PERFECT NUMBERS AND WILL PRINT THEM, ALONG WITH THE VALUE OF N USED TO PRODUCE THEM. THIS IS AN EXAMPLE OF HOW COMPUTERS CAN AID IN THE STUDY OF PURE MATHEMATICS.

---JOHN SAWYER, STUDENT, DALTON JUNIOR HIGH SCHOOL, WINSTON-SALEM, NORTH CAROLINA

```
     PERFECT NUMBER        N

                 6.        2
                28.        3
               496.        5
              8128.        7
          33550336.       13
STOP 0000
```