A Fast Exponential Calculation for the IBM 370-195 at the Oak Ridge Gaseous Diffusion Plant

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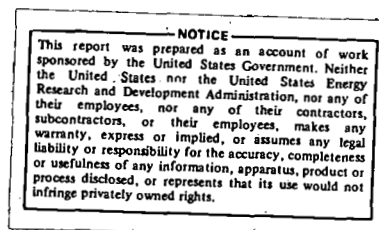
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ABSTRACT

The time spent for computing an exponential for the IBM 370-195
at the Oak Ridge Gaseous Diffusion Plant is about 25 times slower than
that spent by the CDC-7600 CTR computer at Livermore. We propose a
scheme which does not involve a function call, is 15 times faster than
the IBM 370-195 scheme, and is useful when the exponential is called
many times.

We propose here a scheme — which is 15 times faster than that presently used, does not involve a function call, and proves useful when the exponential is computed many times — for computing an exponential for the IBM 370-195 at the Oak Ridge Gaseous Diffusion Plant.

First a table of 341 values is computed (once for the entire program) using the standard IBM function calls in the main program:

```
COMMON/EXPCOM/EXX(341)
IEXP = - 171
DO 1 I = 1, 341
IEXP = IEXP + 1
XEXP = IEXP
EXX(I) = EXP(XEXP)
1    CONTINUE;
```

in the subroutine where the exponential is called repeatedly. A Taylor's series expansion about the near integer is performed:

$$e^x = e^a \left\{ 1 + (x - a) + \frac{(x - a)^2}{2!} + \frac{(x - a)^3}{3!} + \dots \right\} \quad .$$

Specifically, the following will suffice in IBM single precision:

```
COMMON/EXPCOM/EXX(341)
```

$$PEX(Z) = (1 + Z(1 + \frac{Z}{2}(1 + \frac{Z}{3}(1 + \frac{Z}{4}(1 + \frac{Z}{5}(1 + \frac{Z}{6}(1 + \frac{Z}{7}(1 + \frac{Z}{8}))))))))$$

```
U = ARGEXP + .500001
IF (ARGEXP < 0) U = ARGEXP - .500001
IU = U
LUP = IU + 171
IF (LUP < 0) GO TO 2
```

```
        IF (LUP > 341) STOP

        XU = IU

        XNA = ARGEXP - XU

        EXPP = EXX(LUP)*PEX(XNA)

3       CONTINUE

2       EXPP = 0

        GO TO 3.
```

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