REDUCE to LaTeX Interface

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REDUCE [HE 87] is a system for carrying out algebraic operations accurately, no matter how complicated the expressions become. It can manipulate polynomials in a variety of forms, expanding them, breaking them into factors, and extracting various parts of them as required. REDUCE can also do differentiation and integration. Other built-in features are arrays, procedures and operators, specific routines for high energy physics calculations, files to eliminate repetitious typing and for saving results.

To put the expressions computed by REDUCE into a publication requires often tedious and error prone typing. To facilitate this work we developed an interface from REDUCE to the LaTeX document preparation system [LL 86]. LaTeX is some kind of generalized markup language for the TeX system for mathematical typesetting [DK 84].

The REDUCE to LaTeX interface can simply be invoked by a TSO command procedure at GSI. The formating is performed by the REDUCE function 'TEXWRITE'. TEXWRITE is declared as algebraic operator and takes an expression as one and only input. TEXWRITE opens the file TEXOUT and sends LaTeX formating sequences to this file. The 'begin and 'end tokens are optional, you can also generate the document environement by writing the appropriate strings with TEXWRITE.

Input to REDUCE:

```
q:=3*p;  % reduce statements.
         % begin latex document environment.
texwrite 'begin;
texwrite " some other text \\
           including \LaTeX -commands ";
a:=(q+d)**3;  % further reduce statements.
         % expression to be formated.
texwrite (a+34*(b**3-c)**4);
         % end latex document environement.
texwrite 'end;
bye;     % leave reduce.
```

Output generated by LaTeX:

some other text
including LaTeX-commands

$$34\ B^{12} - 136\ C\ B^9 + 204\ C^2\ B^6 - 136\ C^3\ B^3 + 34\ C^4 + D^3 + 9\ P\ D^2 + 27\ P^2\ D + 27\ P^3$$

In contrast the original REDUCE output would look like:

```
34*B**12-136*C*B**9+204*C**2*B**6-136*C**3*B**3+
34*C**4+D**3+9*P*D**2+27*P**2*D+27*P**3
```

A list of examples demonstrating both the REDUCE integrator and LaTeX documentation facilities follows. All integrals are to be taken with respect to the variable X.
The integral of

$$\frac{X^3 + 3\ X^2 + 3\ X + 1}{X^4 - 4\ X^3 + 6\ X^2 - 4\ X + 1}$$

is

$$\frac{(3\ X^3 - 9\ X^2 + 9\ X - 3)\ \mathrm{LOG}(X - 1) - 6\ X^3 - 2}{3\ X^3 - 9\ X^2 + 9\ X - 3}$$

(computed in 43 milliseconds).
The integral of

$$\mathrm{SIN}(\mathrm{LOG}(X))$$

is

$$\frac{-X\ \mathrm{COS}(\mathrm{LOG}(X)) + X\ \mathrm{SIN}(\mathrm{LOG}(X))}{2}$$

(computed in 37 milliseconds).
The integral of

$$\frac{\mathrm{LOG}(X)^P}{X}$$

is

$$\frac{\mathrm{LOG}(X)\ \mathrm{LOG}(X)^P}{P + 1}$$

(computed in 43 milliseconds).
The integral of

$$X^2\ \mathrm{LOG}(A^2 + X^2)$$

is

$$\frac{3\ X^3\ \mathrm{LOG}(A^2 + X^2) - 6\ A^3\ \mathrm{ATAN}(\frac{X}{A}) + 6\ X\ A^2 - 2\ X^3}{9}$$

(computed in 80 milliseconds).
The integral of

$$\frac{1}{B\ E^{M \cdot X} + A}$$

is

$$\frac{-\mathrm{LOG}(E^{M \cdot X} B + A) + X\ M}{M\ A}$$

(computed in 85 milliseconds).
The integral of

$$\frac{X^2}{\beta\ X + \alpha}$$

is

$$\frac{2\ \alpha^2\ \mathrm{LOG}(X \cdot \beta + \alpha) + \beta^2\ X^2 - 2\ \alpha\ \beta\ X}{2\ \beta^3}$$

(computed in 41 milliseconds).

References

[HE 87] A. C. Hearn. *REDUCE 3 - Users Manual.* The Rand Corporation, Santa Monica, 1987.

[DK 84] D. E. Knuth. *The TeXbook.* A. Reading, Massachusetts: Addison Wesly 1984.

[LL 86] L. Lamport. LaTeX. *A Document Preparation System.* A. Reading, Massachusetts: Addison Wesly 1986.