```
> restart;
  Physics:-Version( );                    # verify the date: November 19
   interface(typesetting = extended);    # equivalent to Physics:-Setup(mathematicalnotation = true)
```

"/Users/ecterrab/Maple/lib/Physics.mla", *2013, November 19, 5:25 hours*

$$\textit{extended} \tag{1}$$

You compute with inert functions by taking their properties into account but not executing the functions themselves. This is a concept useful in different contexts, giving an extra level of control over the operations being performed. Inert functions exist in the Maple language since its beginning. In the past, however, only a few of them existed: Int, Diff, Product, Sum, they were all represented by names corresponding to the inert functions but starting with a Capital letter (so Int as the inert version of int).

Some releases ago, a new convention got adopted that permited generalize the concept to all the mathematical functions of the language: everything starting with % is inert, so %int, %diff, %exp, even %factor, %expand, are considered 'inert'. The value command handles all these function calls, so for instance value(%exp(0)) returns exp(0), which in turn evaluates to 1; likely for names, not functions, value(%gamma) becomes gamma, etc.

All the kernel commands know about inert functions, so series, evalf, diff, expand, etc. can operate over %foo(x) using the existing knowelge for corresponding active function foo(x). The library knows about these inert functions in various places too, mostly in simplify, in some other places too. It is work in progress, inert functions are relevat words of the mathematical language, that permit expressing concepts, and as such they are in use already, frequently, both interactively and within the Maple library. Some packages, like Physics, advertise the use of inert forms of all of its commands in its help pages.

All these inert functions, however, never had appropriate typesetting, making the computational experience with them poor, and when attempting to use `print/%foo` routines to produce the right display, then copy and paste didn't work anymore.

So this is about having all of copy, paste and the correct math display for the inert versions of *all mathematical functions of the Maple language* as well as for generic *unknown functions*, as in:

```
> %exp(x)
```

$$e^{x} \tag{2}$$

```
> %f(x)
```

$$f(x) \tag{3}$$

Before this change, these two, as well as all other ones, were all displayed as

```
> convert(%exp, `local`)(x)
```

$$\%exp(x) \tag{4}$$

```
> convert(%f, `local`)(x)
```

$$\%f(x) \tag{5}$$

Only the active functions get executed when invoked, not the inert ones

```
> z + Pi/2
```

$$z + \frac{\pi}{2} \tag{6}$$

> (%sin = sin)((6));

$$\sin\left(z + \frac{\pi}{2}\right) = \cos(z) \quad \textbf{(7)}$$

The system knows about their properties regardless of executing them

> diff((7), z)

$$-\sin(z) = -\sin(z) \quad \textbf{(8)}$$

> %sin(exp(%ln(x)))

$$\sin\left(e^{\ln(x)}\right) \quad \textbf{(9)}$$

> diff((9), x)

$$\frac{\cos\left(e^{\ln(x)}\right) e^{\ln(x)}}{x} \quad \textbf{(10)}$$

> value((10))

$$\cos(x) \quad \textbf{(11)}$$

> %BesselJ(n, z);

$$J_n(z) \quad \textbf{(12)}$$

> (12) = MathematicalFunctions:-Series((12), z)

$$J_n(z) = \left(z^n \left(\frac{1}{2^n\,\Gamma(1+n)} - \frac{1}{4}\,\frac{1}{2^n\,\Gamma(n+2)}\,z^2 + \frac{1}{32}\,\frac{1}{2^n\,\Gamma(3+n)}\,z^4 + O\left(z^6\right)\right), \mathrm{And}(n{::}\mathbf{Not}\ negint)\right) \quad \textbf{(13)}$$

For illustration purposes, this is the inert display of all the functions of the mathematical language: you get them with syntax using *map2*(*FunctionAdvisor*, *syntax*, *FunctionAdvisor*(*known*, *quiet*)). So,

> nprintf("%%%A", BesselJ)

$$\%BesselJ \quad \textbf{(14)}$$

> map(u → subsop(0 = nprintf("%%%A", op(0, u)), u), map2(FunctionAdvisor, syntax, FunctionAdvisor(known, quiet)))

$$\left[Ai^{(n)}(z), Bi^{(n)}(z), \boldsymbol{J}_a(z), BellB(n,z), I_a(z), J_a(z), K_a(z), Y_a(z), B(x,y), T_a(z), U_a(z), \mathrm{Chi}(z), \mathrm{Ci}(z), F_a(b,z), \mathrm{D}_a(z), U(a,z), V(a,z), \delta^{(n)}(x), \mathrm{Ei}_a(z), \boldsymbol{E}'(k), \boldsymbol{K}'(k), \Pi'(\nu, k), E(z,k), F(z,k), \boldsymbol{K}(k), k(q), q(k), \Pi(z,\nu,k), C(z), S(z), f(z), g(z), \Gamma(a,z), \mathrm{GaussAGM}(x,y), C_a^{(b)}(z), H_a^{(1)}(z), H_a^{(2)}(z), \theta(z), H_a(z), HB(\alpha,\beta,\gamma,\delta,z), HB'(\alpha,\beta,\gamma,\delta,z), HC(\alpha,\beta,\gamma,\delta,\eta,z), HC'(\alpha,\beta,\gamma,\delta,\eta,z), HD(\alpha,\beta,\gamma,\delta,z), HD'(\alpha,\beta,\gamma,\delta,z), HG(a,q,\alpha,\beta,\gamma,\delta,z), HG'(a,q,\alpha,\beta,\gamma,\delta,z), HT(\alpha,\beta,\gamma,z), HT'(\alpha,\beta,\gamma,z), \right. \quad \textbf{(15)}$$

$\mathrm{Hypergeom}([a, b], [c], z), \Im(z), am^{-1}(\phi|k), cd^{-1}(z|k), cn^{-1}(z|k), cs^{-1}(z|k), dc^{-1}(z|k), dn^{-1}(z|k), ds^{-1}(z|k), nc^{-1}(z|k), nd^{-1}(z|k), ns^{-1}(z|k), sc^{-1}(z|k), sd^{-1}(z|k), sn^{-1}(z|k), am(z|k), cd(z|k), cn(z|k), cs(z|k), dc(z|k), dn(z|k), ds(z|k), nc(z|k), nd(z|k), ns(z|k), P_a^{(b, c)}(z), sc(z|k), sd(z|k), sn(z|k), \vartheta_1(z, q), \vartheta_2(z, q), \vartheta_3(z, q), \vartheta_4(z, q), Z(z, k), bei_a(z), ber_a(z), hei_a(z), her_a(z), kei_a(z), ker_a(z), M(a, b, z), U(a, b, z), L_a^{(b)}(z), W(a, z), P_a^b(z), Q_a^b(z), \Phi(a, b, z), \mathrm{Li}(z), s_{a, b}^{(+)}(z), s_{a, b}^{(-)}(z), a_a(z), b_a(z), C(a, b, z), ce_a(b, z), ce_a{}'(b, z), C'(a, b, z), \mathrm{MathieuExponent}(a, z), \mathrm{MathieuFloquet}(a, b, z), \mathrm{MathieuFloquetPrime}(a, b, z), S(a, b, z), se_a(b, z), se_a{}'(b, z), S'(a, b, z), G_{2, 2}^{1, 1}\left(z \middle| \begin{matrix} a, b \\ c, d \end{matrix}\right), \Psi^{(n)}(z), \Re(z), \mathrm{Shi}(z), \mathrm{Si}(z), Y_\lambda^\mu(\theta, \phi), \mathrm{Ssi}(z), Stirling1(m, n), Stirling2(m, n), \boldsymbol{H}_a(z), \boldsymbol{L}_a(z), \boldsymbol{E}_a(z), \wp(z; a, b), \wp'(z; a, b), \sigma(z; a, b), \zeta(z; a, b), M_{a, b}(z), W_{a, b}(z), \omega(z), \zeta^{(n)}(z, v), \mathrm{abs}(a, z), \arccos(z), \mathrm{arccosh}(z), \mathrm{arccot}(z), \mathrm{arccoth}(z), \mathrm{arccsc}(z), \mathrm{arccsch}(z), \mathrm{arcsec}(z), \mathrm{arcsech}(z), \arcsin(z), \mathrm{arcsinh}(z), \arctan(y, x), \mathrm{arctanh}(z), arg(z), B_n(z), \binom{a}{z}, \cos(z), \cosh(z), \cot(z), \coth(z), \csc(z), \mathrm{csch}(z), \mathrm{csgn}(a, b, z), \mathrm{dawson}(z), \mathrm{dilog}(z), n!!, \mathrm{erf}(z), \mathrm{erfc}(n, z), \mathrm{erfi}(z), E_n(z), \mathrm{e}^z, z!, H_a(z), {}_2F_1(a, b; c; z), \ln(z), ln\Gamma(z), \log(z), (z)_n, \mathrm{Li}_a(z), \sec(z), \mathrm{sech}(z), \mathrm{signum}(a, b, z), \sin(z), \sinh(z), \tan(z), \tanh(z), unwindK(z)]$

The above is standard mathematical textbook-notation for the corresponding active mathematical functions -- the display of the inert ones above has the relevant parts of the typesetting displayed in grey as usual in Maple. As said, series, diff, evalf, expand, and various other commands know how to compute with these inert functions without executing the function itself, just because they know how to operate in the active function.

Regarding copy and paste: mark any of the inert functions in the displayed output above, say MeijerG, that is, $G_{2, 2}^{1, 1}\left(z \middle| \begin{matrix} a, b \\ c, d \end{matrix}\right)$, then paste: **%MeijerG([[a], [b]], [[c], [d]], z)**. So the correct contents is behind this display and pasted as expected. The approach also works with generic unknown functions, say

> $G(x, y, z)$

$$G(x, y, z) \tag{16}$$

> $subs(G = \%G, \mathbf{(16)})$

$$G(x, y, z) \quad \mathbf{(17)}$$

> $value(\mathbf{(17)})$

$$G(x, y, z) \quad \mathbf{(18)}$$

>