

# Exercises on Symbolical Programming

## Dirac-Equation

Write a FORM procedure/program which applies the Dirac equation. Introduce (noncommuting) functions for the spinors and the Dirac matrices. Use the Clifford algebra

$$\gamma_\mu \gamma_\nu + \gamma_\nu \gamma_\mu = 2g_{\mu\nu}$$

to rearrange Dirac chains and apply the Dirac equation

$$\not{p}u(p, m) = +mu(p, m), \quad \not{p}v(p, m) = -mv(p, m),$$

as often as possible. Use the Clifford algebra together with FORM's disorder statement to canonically order the Dirac chains.

## MathLink with LHAPDF

The LHAPDF library, <http://cedar.hepforge.co.uk/LHAPDF>, is *the* one-stop resource for all things hadronic, PDFs,  $\alpha_s(q^2)$ , etc.

Write a program to access the  $\alpha_s(q^2)$  calculation of the LHAPDF library within Mathematica. The routine to compute  $\alpha_s(q^2)$  in LHAPDF is

```
double precision function alphas2(scale)
double precision scale
```