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Introduction to Algorithmic Differentiation

Wintersemester 2004/05

Practice Exercise 1

To be finished by October 27, 2004

Exercise 1.1 Consider the mapping from the Cartesian coordinates (x_1, x_2, x_3) to the corresponding spherical polar coordinates (r, ϕ, θ). Write a suitable evaluation trace and draw the corresponding computational graph.

Exercise 1.2 Consider the following evaluation procedure.

$$
\begin{aligned}
v_1 &= c_{10} * v_0 \\
v_2 &= c_{21} * v_1 \\
v_3 &= c_{30} * v_0 \\
v_4 &= c_{43} * v_3 \\
v_5 &= c_{52} * v_2 + c_{54} * v_4
\end{aligned}
$$

Draw the computational graph and find a forward compatible allocation function

$$ f : [v_0, v_1, v_2, v_3, v_4, v_5] \mapsto [0, 1, 2] $$

Show that it is an allocation that is also reverse compatible and hence two-way compatible.

Exercise 1.3 Write a program in C/C++/Fortran/Java to evaluate the Jacobian matrix of the map from Cartesian coordinates to the spherical polar coordinates using the forward mode and the evaluation trace in Exercise 1.1 at the Cartesian point (2.5, -1.75, -0.05).