CS780 Winter 2004: Assignment 1

Web Site: www.student.cs.uwaterloo.ca/~cs780/

Due: end of February.

Task 1: Resultants. In order to compute the `log` terms in the result of integration via the Risch algorithm, including the case of integrating purely rational functions, resultant computations arise (via a Rothstein-Trager theorem).

See section 7.3 of GCL (Geddes, Czapor and Labahn) for the definition of the resultant of two polynomials. A discussion of the application of resultants to solving systems of polynomial equations can be found in section 9.5 of GCL.

Do Chapter 9, Exercise 18, p.425, GCL. Use Maple where appropriate.

Task 2: Integration of rational functions.

(a) Do Chapter 11, Exercise 4, p.508, GCL. In addition to applying Hermite reduction, also apply Algorithm 11.3 to compute the logarithmic part of the integral. Use Maple as a calculator and show the steps of the algorithm.

(b) Do Chapter 11, Exercise 12, p.509, GCL. Apply Algorithm 11.3 to compute the logarithmic part of the integral. Use Maple as a calculator and show the steps of the algorithm.

Task 3: Integration of elementary functions.

(a) Do Chapter 12, Exercise 8, p.570, GCL.

(b) Do Chapter 12, Exercise 9, p.570, GCL.

(c) Do Chapter 12, Exercise 11, p.570, GCL.

Task 4: Preliminaries for a Rothstein/Trager-like theorem for a tan extension.

Note the definition of *tangent* and *arctangent* extensions given in the paragraph preceding the exercises cited below.

The idea here is to have a Risch-like algorithm that works with real trigonometric functions directly, rather then converting to complex exp-log notation. The various trigonometric functions can be expressed in terms of `tan` and `arctan`, thus avoiding the need to introduce complex numbers in the integration algorithm.

The exercises below correspond to results we needed for Rothstein/Trager theorems for both the `log` and `exp` cases, as covered in Chapter 12.

(a) Do Chapter 12, Exercise 16, p.571, GCL.

(b) Do Chapter 12, Exercise 18, p.572, GCL.