APM2164   January/February 2010

COMPUTER ALGEBRA (APPLIED MATHEMATICS 216)

Duration   2 Hours   100 Marks

EXAMINERS
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This paper consists of 3 pages

Answer all the questions

QUESTION 1

State the output that MuPAD would produce from the following inputs If the given statements would not produce output because of a coding error, say so

(a) $\text{int}(x, x = 0\ 1)$,

(b) $\text{solve}(x + y^2 = 0,\ x)$,

(c) $f = x - > x^2$,

   $f(3)$,

(d) ? series

(e) $\text{normal}\left((x + y)^2 / (y + z)\right)$,

(f) $\text{sq} = \text{proc}(n\ \ \text{Type}\ \ \text{PosInt})$

   begin

   $\text{return}\ (n^2)$

   end_proc,

   $\text{sq}(-3)$,

(g) $\text{fe} = (a + x)^2$,

   $\text{coeff}(f, x, 1)$,

(h) $\text{diff}(x^3,\ x,\ y)$,

(i) $\text{limit}(\sin(x) / x, 0)$,

(j) $\text{subs}(x^2 + x,\ x = 2)$,

[20]

QUESTION 2

Given that the following have been defined in a MuPAD session

n positive integer

x array of n identifiers

g $n \times n$ matrix

write a MuPAD procedure called mygam that takes the above as input and outputs $n \times n \times n$ array defined by

$$C_{abc} = \frac{1}{2} \sum_{i=1}^{n} h_{ci} \left(\frac{\partial g_{ai}}{\partial x_b} + \frac{\partial g_{bi}}{\partial x_a} - \frac{\partial g_{ab}}{\partial x_i} \right)$$

where h is the matrix inverse of g [20]

QUESTION 3

(a) Write LaTeX code, in the form of a complete document, for the following

  • The first term is

$$K_{abc} = \frac{1}{2} \sum_{i=1}^{n} h_{ci} \left(\frac{\partial g_{ai}}{\partial x_b} \right),$$

  • where $h = g^{-1}$ (15)

(b) How would you incorporate MuPAD code and output in a LaTeX document   (5)

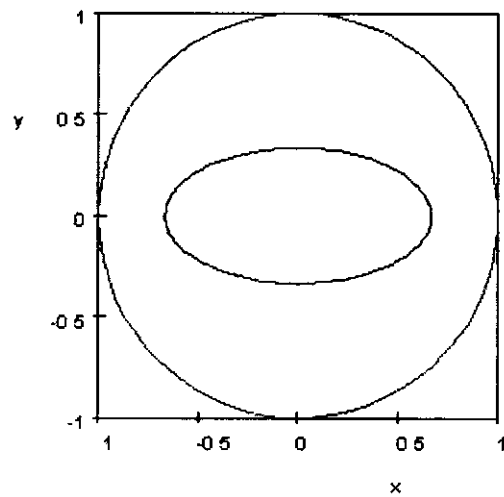   [20]

QUESTION 4

Write a MuPAD procedure, called mydiff(f, x), that does not use the operator D or diff The input parameters are f, which is a polynomial in x, which is an identifier The output should be the first derivative of f with respect to x [Note that degree (p, x) returns the highest power of x in the polynomial p]   [20]

QUESTION 5

Write MuPAD code to produce the diagram shown above The same scale is used on the x- and y-axes, and the objects are drawn inside a box The circle is uniformly colored red, and the ellipse is uniformly coloured blue with parametric definition

$$\left(\frac{2}{3}\cos(u),\ \frac{1}{3}\sin(u)\right)$$

[20]

TOTAL: [100]