COMPUTER SCIENCE TRIPOS Part IA – 2014 – Paper 1

5   Numerical Methods (DJG)

(*a*) Floating point representation:

    (*i*)   If a single-precision floating point number is added to a double-precision floating point number, what can we say about the expected and worst-case representation errors in the result?   [2 marks]

(*b*) Floating point rounding:

    (*i*)   Would a *round-to-odd* rule introduce a different amount of bias compared with the normally used *round-to-even* rule?   [2 marks]

    (*ii*) What is it about counting in base 10 that causes bias in the standard approach used when rounding to a given number of significant figures? Explain whether a similar rule for numbers expressed in base 4 would introduce a bias.   [4 marks]

(*c*) Matrix multiplication conditioning:

    (*i*)   When a pair of matrices of dimension $N \times N$ are multiplied, what is the expected and worst case representation error in the result?   [2 marks]

    (*ii*) Before using Gaussian Elimination to achieve triangle form when solving a system of simultaneous equations, what step or steps can be taken to ensure numerical stability?   [4 marks]

    (*iii*) What is meant by backwards stability regarding a numerical method?
                                                                          [2 marks]

    (*iv*) What role can partial derivatives play in examining the stability of a computation compared with using a *condition number*?   [4 marks]