2002 Paper 3 Question 7

Numerical Analysis I

(*a*) Consider a version of the Brown model in which the significand of a floating-point number is represented as $d_0.d_1d_2\ldots d_{p-1}$. Explain the parameters β, p, $e_{\max}$, $e_{\min}$ of the model. [3 marks]

(*b*) Describe the layout of bits in IEEE single precision and give the values of the above four parameters. [5 marks]

(*c*) IBM System/370 single precision uses the same total number of bits, and a similar method for storing negative exponents. However, there are 7 bits for the exponent, and all bit patterns represent numbers. Given $\beta = 16$, deduce the values of the remaining three parameters for this floating-point implementation. [5 marks]

(*d*) If $\beta = 10, p = 3$ how should 6.789, 6.785, 6.755 be rounded using the "round to even" method? [3 marks]

(*e*) Now consider $\beta = 2$, $p = 8$ on a machine with just one guard digit. How should the following be rounded using "round to even"?

$$0\,1\,1\,0\,1\,0\,1\,1\,0$$
$$1\,0\,1\,1\,1\,0\,1\,0\,1$$
$$1\,1\,0\,1\,0\,0\,0\,1\,1$$
$$0\,1\,1\,1\,1\,1\,1\,1\,1$$

[4 marks]