

Question 1 – Parallel Architectures

Explain the difference between the CPU and GPU architecture (10 marks) and describe what types of applications can benefit more from each one of these two systems (5 marks). Which architecture targets the latency and which targets the throughput and why? (10 marks)

(25 marks in total)

Question 2 – Parallel Patterns

Use each digit of your student number as an 8-element input array (pad the missing values with 0s). Perform an averaging operation on the input vector in a local window of size 3 (or range 1). The result should be an average of values at the central position and the immediate neighbours to the left and right. Select and explain a possible solution for handling boundary conditions. Illustrate the processing of individual elements in a graphical form and present the resulting output values. (7 marks)

Which parallel pattern should be used for this problem and why? What is its work and span complexity (10 marks)

What techniques could be used to optimise the actual implementation of the pattern on GPU? (8 marks)

(25 marks in total)

Question 3 – Parallel Algorithms

Describe parallel implementations of binary and p-ary search. (10 marks)

List the advantages and limitations of these two methods. (10 marks)

Compare the step complexity between P-ary and binary search. (5 marks)

(25 marks in total)

Question 4 – Performance

What is the relationship between the speedup and efficiency in the context of parallel computing? (10 marks)

Calculate the total theoretical speedup for a system running a program consisting of serial and parallel parts of the code. Consider two cases where the parallel part is executed on 2 and 20 parallel processors. Assume that the serial part occupies 20% of the entire code. (10 marks) What additional computational costs might be associated with the parallelisation of the task. (5 marks)

(25 marks in total)