Quiz 2: Lectures 5 to 7

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Instructions:

- Answer on a separate page.
- Make sure that your student number is on all your answer pages.
- There are 3 questions, each divided into sub-questions. Answer all questions.
- Total time: 45 minutes.
- Total marks: 40.

Question 1: Processor Architectures [15 Total]

#1 List Flynn's four architectural models for parallel computers. **[4]**

#2 Explain what is meant by cores operating in lockstep. **[2]**

#3 In which of the models mentioned in (#1) above do all processing units operate in lockstep? **[1]**

#4 Give an example of a processing platform that operates in lockstep. **[1]**

#5 In which of the models mentioned in (#1) above does the classic Von Neumann architecture fall? **[1]**

#6 Draw a block diagram of a classic Von Neumann processor architecture. Give a brief description of the function of each block. **[6]**

#7 **Bonus marks:** How does the Harvard processor architecture differ from the Von Neumann architecture? Name an advantage of each. **[3]**

Question 2: Parallel Computing Design **[15 Total]**

#1 Explain the concepts of latency, bandwidth and throughput. Make reference to how these concepts could be applied to ‘memory’ and ‘processing’. **[5]**

#2 Explain the difference between functional and domain decomposition of tasks. **[4]**

#3 Categorise the following examples into ”Course Grained”, ”Fine Grained” or ”Embarrassingly Parallel”. Explain your choice in each case. **[6]**

- Convert an image from colour to grey-scale.
- Apply a 5×5 pixel Gaussian filter to a $1\,024 \times 1\,024$ picture.
- Finite element simulation of a mechanical structure.

Question 3: OpenGL **[10 Total]**

#1 With the aid of diagrams, briefly explain the graphics pipeline employed in the modern OpenGL programming model. **[5]**

#2 What does the CPU side of a modern OpenGL application need to do in order to obtain an image on the screen? **[5]**