UNIVERSITY OF BOLTON

SCHOOL OF BUSINESS AND CREATIVE TECHNOLOGIES

GAMES PATHWAYS

SEMESTER 2 EXAMINATIONS 2009/2010

ADVANCED GAME TECHNOLOGY

MODULE NO: CGD3002

Date: **Friday 4 June 2010**

Time: 10.00 am - 12.00 pm

INSTRUCTIONS TO CANDIDATES:

There are EIGHT questions on this paper.

Answer THREE questions, ONE FROM EACH SECTION.

All questions carry equal marks.

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SECTION A – OPTIMIZATION, MULTIPROCESSING AND NETWORKING

Question 1

(a) Explain the term *strength-reduction* and give two examples of how you would apply strength reduction. Give any assumptions.

[7 marks]

(b) The following loop can be trivially unrolled:

```
for(i=1; i < 5; i++) {
   array[i] = i;
}
```

Write out an unrolled version of this loop and explain any factors that may affect the efficiency of loop-unrolling generally.

[8 marks]

(c) Explain the process of profile guided optimization and any benefits that are likely to accrue from using it.

[10 marks]

Question 2

(a) Define the characteristics (ie the methods and/or attributes) of a minimal UDP-based class for programming network-enabled games.

[9 marks]

(c) Discuss the concept of *dead-reckoning* in the context of networked video games and show a sample implementation (in pseudo-code if you wish) of the technique (you should provide code for both sender and receiver).

[16 marks]

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Question 3

(a) There follows a section of code which produces a very crude estimate of pi. Show how OpenMP can be used to improve the performance of this code segment and explain the reasons for any alterations you make.

```
int main() {
      long long i;
      double rx, ry;
      double inside = 0.0;
      double myPI;
      double dist;
      int start = GetTickCount();

      srand(17);
      for(i=0; i < ITERATIONS; i++) {
            rx = (((double) rand() / (double) RAND_MAX) * RMAX + RMIN);
            ry = (((double) rand() / (double) RAND_MAX) * RMAX + RMIN);

            dist = (rx-CENTREX)*(rx-CENTREX) + (ry-CENTREY)*(ry-CENTREY);
            if(dist <= 1.0) inside = inside + 1.0;
      }
      myPI = 4 * (inside / (double)ITERATIONS);

      int end = GetTickCount();

      printf("\n\nMy estimate of PI is: %1.25f\n", myPI);
      printf("Time = %d.%d\n", (end-start)/1000, (end-start)%1000);
}
```

[7 marks]

(b) Explain the different approaches you might take to parallelizing a section of code which is destined to run on the Microsoft Xbox360 or the Sony PS3.

[10 marks]

(c) Suppose you have a program which is currently run on a single-core CPU. 60% of the program could be parallelized leaving 40% of the program which must run serially. You now have a six-core, symmetric CPU on which to run the program. Explaining any assumptions you make, use Amdahl's Law to determine the likely improvement in speed.

[8 marks]

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SECTION B – 3D GRAPHICS, RENDERING AND LIGHTING

Question 4

a) What is a deferred rendering pipeline and how does it differ from a forward rendering pipeline?

(8 marks)

b) Draw a diagram of the typical 3d pipeline. Demonstrate where in the pipeline, vertex, geometry and pixel shaders are used.

(7 marks)

c) Newer rendering hardware includes hardware for “tessellation”. Explain how this hardware functions, why it is desirable and describe two example scenarios where hardware tessellation is desirable.

(10 marks)

Question 5

a) What is the difference between a message system (such as that demonstrated in Buckland’s AI code, although he calls it a telegram system) and a signal/slot system?

(7 marks)

b) List four software engineering patterns typically used in a game engine, giving an example of their use.

(8 marks)

c) Describe four methods you can use to protect yourself from pointer handling errors, giving examples of their use.

(10 marks)

Question 6

You are asked by your lead programmer to prepare a short briefing document for management laying out the options for appropriately lighting a typical American city street (such as you might see in New York). The game this is intended for is a big budget console game and the visuals are expected to be leading edge. Write this short document, being sure to discuss the benefits and any drawbacks of each solution you identify.

(25 marks)

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SECTION C – ARTIFICIAL INTELLIGENCE

Question 7

a) Briefly describe, with reasons, at least two situations in which a game agent should possess short term memory in order to be able to display realistic behaviour.

[5 marks]

b) Outline fully a design that is capable of providing short term memory for game agents. Description of your design may include prose but should be primarily based on appropriate notations such as UML diagrams for structure and behaviour, etc, and pseudocode (or code) for the detailed logic of essential functions.

[20 marks]

Note: minor syntax errors in code will not be penalised as long as the meaning is clear

Question 8

a) Assume that the decision-making module of a game agent is to be implemented in fuzzy logic. The agent can display sentiment towards its enemy ranging from indifference to hatred. The agent has available three weapons, namely shotgun, machete and rocket launcher. The shotgun has poor accuracy at great distance whereas rockets aimed close to the agent not only kill the enemy but also cause damage to the agent.

Design a fuzzy decision system that selects the appropriate weapon for attacking the enemy in a given scenario. Use appropriate diagrams and tables to explain and illustrate your answer.

[12 marks]

b) Construct a set of inference diagrams to show how a particular pair of values of linguistic variable would be evaluated through the fuzzy decision system to produce a crisp output. Your answer should demonstrate how you would fuzzify the inputs, perform rule evaluation and consequent aggregation and how you could determine the output.

[7 marks]

c) Discuss why fuzzy logic is useful and hence argue the case as to whether or not fuzzy logic is logic that is fuzzy.

(6 marks)

END OF QUESTIONS