ATHLONE INSTITUTE OF TECHNOLOGY

SCHOOL OF ENGINEERING

SEMESTER 1 EXAMINATIONS 2014

December Session

BSc (Hons) SOFTWARE DESIGN (GAME DEVELOPMENT)

YEAR 3

GAME THEORY AND MULTICORE 3

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Internal Examiner(s):	**Dr. Mark Daly**

Instructions to candidates:
Read all questions carefully.
All questions carry equal marks.
Answer **Three** out of **Four** questions.

Time Allowed: 2 Hours

No. of pages including cover sheet: 4

Q.1. (a) Define the following:

1. An *n*-person game in extensive form. (3 Marks)
2. A pure strategy. (3 Marks)
3. A saddle point. (3 Marks)

(b) Two Russian guards (A and B) confiscate a black market sport bag and find it contains two dozen packets of cigarettes, a Colt 45 pistol, one bullet, and the rules for Russian Roulette. The Senior officer (A) plays first. Both guards ante a packet of cigarettes. The "game" progresses thus:

1. A can add two packets of cigarettes to the pot and pass the pistol to B or he can add one packet to the pot, spin the pistol's chambers, put the pistol to his head and pull the trigger, and, if his luck is in, hands the gun to B.
2. B has the same option: put two packets in the pot or one in the pot, spin the pistol's chambers, and try his luck.
3. The game is now over with both players splitting the pot, if both are alive, or the survivor taking the whole pot.

Develop this game in extensive form by drawing the game tree, the game matrix, and state the pure strategies for A and B. Identify any saddle points?

(11 Marks)

[20 Marks]

Q.2. (a) For a two person zero-sum game

1. What is a mixed strategy? (2 Marks)
2. What is a *maximin* strategy? (2 Marks)
3. What is a *minimax* strategy. (2 Marks)

(b) How are optimal strategies calculated?

(6 Marks)

(d) Consider the game matrices

$$1.\ \begin{pmatrix} 0 & 3 & 6 & 5 \\ 15 & 10 & 8 & 9 \\ 10 & 15 & 11 & 7 \\ 5 & 9 & 4 & 2 \end{pmatrix} \quad 2.\ \begin{pmatrix} 2 & 4 & 0 & -2 \\ 4 & 8 & 2 & 6 \\ -2 & 0 & 4 & 2 \\ -4 & -2 & -2 & 0 \end{pmatrix}$$

Find any saddle points. If none exist, reduce the games using dominance and, if possible, solve the game.

(8 Marks)

[20 Marks]

Q.3. (a) Use linear programming to find the optimum mix of strategies for a two person zero sum game whose game matrix, A, is given below:

$$A=\begin{pmatrix} 3 & 6 & 1 & 4 \\ 5 & 2 & 4 & 2 \\ 1 & 4 & 3 & 5 \end{pmatrix}$$

(16 Marks)

(b) What is the value of the game for Player 1 in the game represented by A above?

(1 Marks)

(c) In relation to the Simplex Algorithm, what is a basic feasible point (bfp)?

(3 Marks)

[20 Marks]

Q.4. Two n-dimensional vectors $\vec{a},\vec{b}$ are to be summed

$$\vec{c}=\vec{a}+\vec{b} \quad \forall \vec{a},\vec{b},\vec{c}\in \mathbb{R}^n$$

with result stored in $\vec{c}$.

(a) Write the code for

```
__global__ void add (int *a, int *b, int *c );
```

a function that is assigned an index and sums the two vectors' components at this index.

(3 Marks)

(b) In the code given overleaf for *main* explain the following code:

1. `add<<<N,1>>>( dev_a, dev_b, dev_c );`
2. `HANDLE_ERROR( cudaMalloc( (void **)&dev_a, N*sizeof(int) ) );`
3. `HANDLE_ERROR( cudaMemcpy( c, dev_c, N*sizeof(int), cudaMemcpyDeviceToHost ) );`
4. `cudaFree( dev_c );`

(12 Marks)

(c) Explain how the above CUDA GPU implementation of the vector sum differs from standard CPU implementation.

(5 Marks)

[20 Marks]

```
int main( void )
{
	int   a[N],  b[N],  c[N];
	int   *dev_a,  *dev_b,  *dev_c;

	HANDLE_ERROR( cudaMalloc( (void **)&dev_a, N*sizeof(int)  ) );
	HANDLE_ERROR( cudaMalloc( (void **)&dev_b, N*sizeof(int)  ) );
	HANDLE_ERROR( cudaMalloc( (void **)&dev_c, N*sizeof(int)  ) );

	for( int i=0; i<N; i++ )
	{
		a[i] = -i;
		b[i] = i*i;
	}

	HANDLE_ERROR( cudaMemcpy( c, dev_c, N*sizeof( int ),
	                                     cudaMemcpyDeviceToHost ) );

	add<<<N,1>>>( dev_a , dev_b , dev_c );

	for( i=0; i<N; i++ )
	{
		printf( “%d + %d = %d \n”, a[i], b[i], c[i] );
	}

	cudaFree( dev_a );
	cudaFree( dev_b );
	cudaFree( dev_c );

	return 0;
}
```

C/CUDA Code for question 4.