GPU Architectures and Programming

Assignment- Week 0

TYPE OF QUESTION: Numericals

Number of questions: 2
Total mark: 10 X 2 = 20

QUESTION 1:

Amdahl's law is an expression used to find the maximum expected improvement to an overall system when only part of the system is improved. It is often used in parallel computing to predict the theoretical maximum speedup. Amdahl's law for overall speedup is given by-

$$\text{Overall Speedup} = \frac{\text{Old execution time}}{\text{New execution time}}$$

$$= \frac{1}{\left((1 - \text{Fraction}_{\text{enhanced}}) + \frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}} \right)}$$

90% of a program's execution time occurs inside a loop that can be executed in parallel. The maximum speedup we should expect from a parallel version of the program executing on 32 CPUs will be _____.

Correct Answer: 7.80-7.81

Detailed Solution:

S=1/((1-.9)+(.9/32))=7.80487804878

QUESTION 2:

Estimate the speedup that would be obtained by replacing a CPU having an average CPI (clock cycles per instruction) of 5 with another CPU having an average CPI of 3.5, with the clock period increased from 100ns to 120ns. The speedup will be-

A. 15%
B. 20%
C. 19%
D. 25%

Correct Answer: C. 19%

Detailed Solution:

S=((5X100-3.5X120)/(3.5X120))X100=19%

MCQ Question- Complete the program snippet

Number of questions: 2
Total mark: 5 X 2 = 10

QUESTION 1:

Consider the following incomplete C function which takes as argument an unallocated integer matrix **arr , the integers m and n and dynamically allocates a 2D matrix of size m x n .

```
void allocate(int **arr, int m, int n)
{
        arr = (int **) malloc( (________
*sizeof(int*));
    for(int i=0;i< ________ ; i++)
       arr[i]=(int **)malloc( ______*sizeof(int));
}
```

Complete the blanks from the following options-

A. m, n, n
B. n, m, n
C. m, m, n
D. n, n, m

Correct Answer: C) m, m, n

QUESTION 2:

Consider the following incomplete C function which takes as input two floating point matrices **in**, **out** and integers **nx** and **ny.** The matrix **in** is of dimension **nx** x **ny**. The function transposes the matrix **in** and stores the result in the matrix **out** which is of dimension **ny** x **nx**. Note, both the matrices are treated as one dimensional arrays storing the matrix in row major format.

```
void transpose(int *in, int *out)
{
    for(int ix=0;ix<nx;ix++)
        for(int iy=0;iy<ny;iy++)
            out[_______] = in[______];
}
```

Complete the array access expressions in the above code snippet from the following options-

A. **iy*nx+ix, ix*ny+iy**
B. **iy*ny+iy, ix*nx+ix**
C. **iy*nx+iy, ix*ny+ix**
D. **ix*nx+ix, iy*ny+iy**

Correct Answer: A) iy*nx+ix, ix*ny+iy

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MCQ - Find the result of the program snippet

Number of questions: 2
Total mark: 5 X 2 = 10

QUESTION 1:

In a certain computer, the size of an integer is 4 bytes and each memory address is of 8 bytes. What will be displayed when the following program segment executes?

```
int main()
{
     int a[] = {12, 13, 14, 15, 16};
     printf("size of a: %d, size of a* %d, size of a[0]
     %d\n", sizeof(a), sizeof(*a), sizeof(a[0]));
     return 0;
}
```

A. size of a: 4, size of a* 4, size of a[0] 4
B. size of a: 20, size of a* 4, size of a[0] 4
C. size of a: 20, size of a* 8, size of a[0] 4
D. size of a: 4, size of a* 8, size of a[0] 4

Correct Answer: B) size of a: 20, size of a* 4, size of a[0] 4

QUESTION 2:

```
int main()
{
     int A[6] = {1,2,1,0,3,2};
     int *t = &(A[0]);
     int **it = &t, *w = &(A[1]);
     while ( w < &(A[6]))
     {
          if(*w < *t)
              *it = w;
          w++;
     }
     printf( "%d %d\n", *t, *(*it));
     return 0;
}
```

A. 1 3
B. 1 1
C. 2 3
D. 0 0

Correct Answer: D) 0 0

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Programming Assignment: Implement the following program

Number of questions: 1

Total mark: 60 X 1 = 60

QUESTION 1:

Let us consider the average pooling operation for a 1D array of floating point numbers. Given an input array A of size n and a window of size k, the pooling operation moves the window in strides of k, takes the average of k consecutive numbers in A and populates a reduced array B. For example, if n=6, A = [1.0 2.0 3.0 4.0 5.0 6.0] and k = 3, the pooling operation creates the array B =[2.0 5.0]. PTEL Online Certification Courses Indian Institute of Technology Kharagpur

Refer to the following input output examples.

Input:

5 2
1.0 2.0 3.0 4.0 5.0

Output

1.50 3.50 5.00

The first line of the test case contains the numbers n and k as defined above. The second line contains a space separated list of n numbers which are the values of the array A. The output for the test case is a single line printing the elements of the required array B.

Note, it is not necessary that n is divisible by k. For the given test case, n=5 and k=2. The output array B would have three elements here - the first element being the average of the 1.0 and 2.0, the second element being the average of 3.0 and 4.0. The last element is the average of the remaining elements, which in this case is only 5.0.

**********END**********