# Birla Institute of Technology & Science, Pilani
Pilani Campus

**II SEMESTER 2020-2021**
**Assignment-2**

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| **Course No.:** | **CS F422** | **Course Title:** | **Parallel Computing** |
| **Deadline:** | **23rd April 2021 (As per Canvas)** | **Maximum Marks:** | **60M (15%)** |

**Note:**
- Maximum of three students per group.

**P1.** Consider a text file (of atleast 10 MB in size) to be encoded using Huffman codes. Now consider parallel algorithms for encoding a given text file and decoding a given encoded file respectively.

(a) Using Pthreads on shared address space platform, devise and implement algorithms for encoding and decoding.
(b) Estimate the fraction of code executing sequentially using multiple experiments.
(c) Given input size n and processers p, derive asymptotic expressions for time complexity, speed up, efficiency, cost and iso efficiency function.
(d) Estimate the maximum number of processors that can be used to solve this problem cost-optimally.

Deliverables:

- Design Document (.pdf) explaining your design. Must contain answers for (b), (c), (d)
- Source code for a: encode_parallel.c, decode_parallel.c

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**P2.** Many parallelizations of Quicksort are available such as Hyperquicksort (10.5.2 from Quinns' reference book), Parallel Sorting by Regular Sampling (PSRS) (10.5.3) etc. In this problem you are required to implement Hyperquicksort on OpenMP platform.

(a) Using OpenMP devise and implement Hyperquicksort algorithm.
(b) Estimate the serial fraction.
(c) Measure speedup, and efficiency for input size n and processers p where n varies logarithmically and p ranges as per your configuration. Compare the speedup with result given by Amdahl's law.
(d) Derive asymptotic expressions for iso efficiency function.
(e) Estimate the maximum number of processors that can be used to solve this problem cost-optimally.

Deliverables:

- Design Document (.pdf) with explanation for the code. Must contain answers for (b), (c), (d), (e)
- Source code for a: hyperquicksort_openmp.c

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**P3.** Consider the problem of computing prefix sums (scan operation) on a list of elements in a vector. The operator applied can be summation, subtraction, minimum, or maximum.

(a) Using CUDA, implement scan operation on a vector of elements with a given operator.
(b) Estimate the serial fraction.
(c) Measure speedup, and efficiency for input size n and processers p where n varies logarithmically and p ranges as per your configuration. Compare the speedup with result given by Amdahl's law.
(d) Derive asymptotic expressions for iso efficiency function.
(e) Estimate the maximum number of processors that can be used to solve this problem cost-optimally.

Deliverables:

- Design Document (.pdf) with explanation for the code. Must contain answers for (b), (c), (d), (e)
- Source code for a: scan_CUDA.c

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