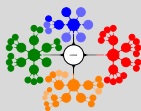# Lecture 1
First Meeting
Lecture Information, Installation of required tools/programs

IKC-MH.57 *Introduction to High Performance and Parallel Computing* at October 13, 2023

<div align="right">

Dr. Cem Özdoğan
Engineering Sciences Department
İzmir Kâtip Çelebi University

</div>

Contents

1 **First Meeting**
   Lecture Information
   Course Overview
   Text Book
   Grading Criteria
   Policies

2 **Installation of Required Tools/Programs**
   Linux System
   Others

First Meeting & Introduction

- IKC-MH.57 Introduction to High Performance and Parallel Computing 2023-2024 Fall
- FRIDAY 16:00-18:00 (T) H1-86
- Instructor: Cem Özdoğan, Engineering Sciences Dept. Faculty of Engineering and Architecture Building, H1-33
- TA: NA
- WEB page: http://cemozdogan.net/
- Announcements: Watch this space for the latest updates.

  ```
  Wednesday, October 9, 2023 In the first lecture, there
  will be first meeting. The lecture notes will be
  published soon, see Course Schedule section.
  ```

- All the lecture notes will be accessible via Tentative Course Schedule & Lecture Notes.
- All the example c-files (for lecturing and hands-on sessions) will be accessible via the link.

Lecture Information I

- Almost all computer systems today are multi-core processors systems. Parallel programming must be used to take benefit of the full performance of such systems.
- Visit https://top500.org/ & https://www.truba.gov.tr/.
- Parallel programming also describes the processes and instructions for dividing a larger problem into smaller steps.
- A practical approach to parallel program design and development will be presented in the course content.
- Awareness of potential design and performance concepts in heterogeneous computer architectures will be gained.
- You will be expected to do significant programming assignments, as well as run programs we supply and analyse the output.
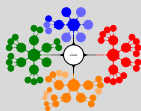
Lecture Information II

- Since we will program in C on a UNIX environment, some experience using C on UNIX will be important.
- In Hands-on sessions, we will concentrate upon the message-passing method of parallel computing and use the standard parallel computing environment called MPI (Message Passing Interface).
- Each student will complete a project based on parallel computing, (distributed computing, cluster computing) for the midterm/final exam.
- Important announcements will be posted to the Announcements section of the web page, so please check this page frequently.
- You are responsible for all such announcements, as well as announcements made in lecture.

Course Overview I

- IKC-MH.57 is intended to provide students an introduction to parallel/distributed computing and practical experiences in writing parallel programs by using C.
- MPI (Message Passing Interface) message passing in distributed memory systems and Open MP (Open Multi-Processing) in multi-core systems will be taught for parallel programming.
    - MPI is the industry standardized parallelization paradigm in high-performance computing and enables programs to be written that run on distributed memory machines.
    - OpenMP is a thread-based approach to parallelize a program over a single shared memory machine.
- An introduction to the basic concepts of hybrid and accelerated paradigms as Cuda (, OpenCL) programming will be given.

Course Overview II

- The course consists of theoretical topics and hands-on practical exercises on parallel programming.
- Upon completion of this course the students will be able to understand/explain/apply;
  - Learn how to work in a scientific computing environment.
  - Gain awareness of Parallel and High Performance Computing concepts for systems with shared/distributed memory.
  - Can write parallel programs both for systems with shared memory using threading (OpenMP) and systems with distributed memory using message passing (MPI).
  - Gains basic knowledge of Cuda OpenCL hybrid and accelerated paradigms.
  - Gains the ability and understanding to develop parallel programs to solve a given big numerical/engineering/ scientific problem.
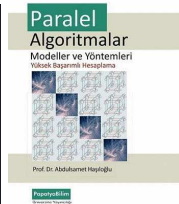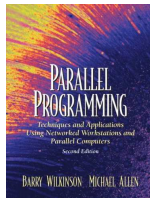
Text Book

- Lecture material will be based on them.
- It is strongly advised that student should read textbooks rather than only content with the lecture material supplied from the lecturer.
- Required: No & Recommended:

- An Introduction to Parallel Programming by Peter Pacheco and Matthew Malensek, Morgan Kaufmann, 2nd edition, 2021, Elsevier.

- Paralel Algoritmalar: Modeller ve Yöntemler (Yüksek Başarımlı Hesaplama) by Abdulsamet Haşıloğlu, 2020, Papatya Bilim.

- Parallel Programming: Techniques and Application Using Networked Workstations and Parallel Computers by Barry Wilkinson and Michael Allen, 2nd edition, 2005, Pearson.
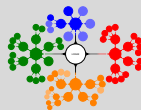
First Meeting

Dr. Cem Özdoğan

First Meeting
Lecture Information
Course Overview
Text Book
Grading Criteria
Policies
Installation of Required Tools/Programs
Linux System
Others

Online Resources

The following (some) resources are available online.

- https://www.cs.purdue.edu/homes/ayg/book/Slides/
- https://sites.cs.ucsb.edu/ tyang/class/240a17/
- https://hpc-tutorials.llnl.gov/

Grading Criteria

- Midterms & Final Exams: There will be one take-home midterm and one take-home final exam, will count 40% each and 60% of your grade, respectively.
- Homeworks/Assignments (or Term Project): ??
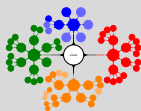
Policies

- Attendance is not compulsory (30%), but you are responsible for everything said in class.

- Academic Regulations:
  Derslere devam zorunluluğu ve denetlenmesi MADDE 18 - (1) Öğrencilerin derslere, uygulamalara, sınavlara ve diğer çalışmalara devamı zorunludur. Teorik derslerin % 30'undan, uygulamaların % 20'sinden fazlasına devam etmeyen ve uygulamalarda başarılı olamayan öğrenci, o dersin yarıyıl/yılsonu ya da varsa bütünleme sınavına alınmaz. Tekrarlanan derslerde önceki dönemde devam şartı yerine getirilmiş ise derslerde devam şartı aranıp aranmayacağı ilgili birim tarafından hazırlanarak Senato onayına sunulan usul ve esaslar ile belirlenir.

- You can use ideas from the literature (with proper citation).

- The code you submit must be written completely by you. You can use anything from the textbook/notes.

- I encourage you to ask questions in class. You are supposed to ask questions. Don't guess, ask a question!

1.11
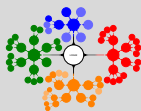
Linux System under VirtualBox

- Assuming you are using Windows OS.
- Download & Install VirtualBox-7.0.10-158379-Win.exe
- Download & Install kubuntu-22.04.3-desktop-amd64.iso under VirtualBox
- Post-Installation Steps of Kubuntu
  - ping google.com
  - # Setup "Display Configuration" for resolution
  - cat /proc/cpuinfo
  - sudo apt-get install libopenmpi-dev openmpi-bin libomp-dev
  - # End of Post-Installation Steps of Kubuntu
  - mpicc -o mpi_helloWorld mpi_helloWorld.c
  - ./mpi_helloWorld
  - mpirun -np 2 mpi_helloWorld
  - mpirun --machinefile mf.txt -np 3 mpi_helloWorld
  - gcc -o omp_helloWorld -fopenmp omp_helloWorld.c
  - export OMP_NUM_THREADS=3
  - ./omp_helloWorld
  - export OMP_NUM_THREADS=8
  - ./omp_helloWorld
  - cuda_helloWorld.cu later!
  - sudo apt-get update # Regular Updates
  - sudo apt-get upgrade # Regular Upgrades

Others
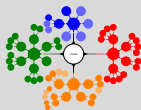
- See video for Installation of Kubuntu & Parallel Tools under VirtualBox.
- In take-home exams:
  - Prepare your report/codes.
  - Copy your files into a directory named as your ID.
  - Upload/send a single file by compressing this directory.
- Check the web page: IKC-MH.57 2023-2024 Fall frequently.