Parallel Programming
HW 2 & Xwindow

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Introduction

The X Window System is a windowing system for bitmap displays, common on UNIX-like computer operating systems.

It provides the basic framework for a GUI environment.

How to use?

- **For mac user**
  - Add -Y after ssh command
  - Example: ssh 100062101@140.114.91.170 **-Y**
- **For MobaXterm user**
  - It enables X11 forwarding at default, you don't have to do anything.

Example

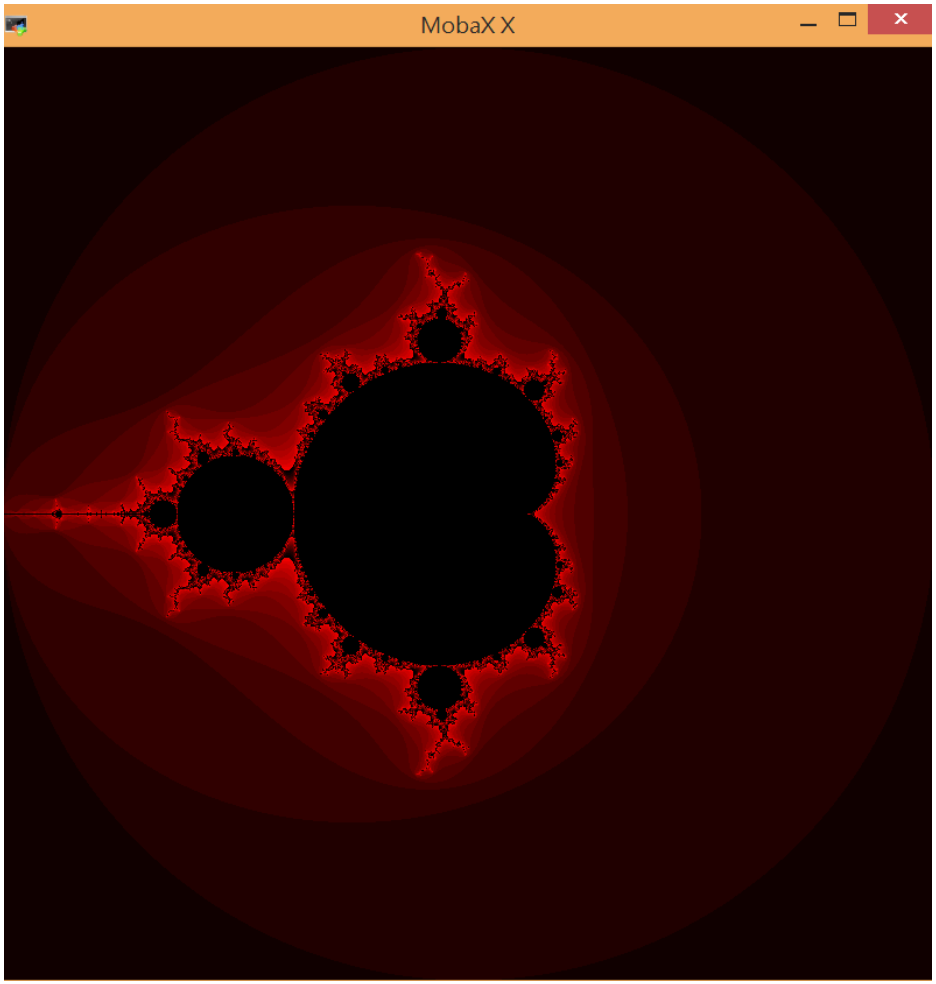
We provide a sequential version of Mandelbrot Set code under /home/pp2016/shared/hw2 for your reference.

Steps

1. ssh to our server
2. $ cp -r /home/pp2016/shared/hw2 $HOME
3. $ cd hw2
   You will be able to see 4 files in hw2 directory:
   - Makefile
   - MS_seq.c
   - job.sh
   - job_hybrid.sh
4. $ make MS_seq
5. $ qsub job.sh //wait until you get the resource
6. $ cd hw2
7. $ ./MS_seq
8. $ exit //after you see the result next page

Result

You should be able to see the graph below after the steps.



Makefile

- We provide a sample makefile for you, and you can also write your own one.

RULE

make -j //If you want to compile all 6 versions

make MS_${API}_${method}

make clean //If you want to clean all the executable files

${API} = MPI, OpenMP, Hybrid

${method} = static, dynamic

Ex: If you want to compile MS_MPI_static.c, just type "make MS_MPI_static"

job.sh

- We provide an **interactive** job.sh for you to **debug** in this assignment, you can type your commands and see the results immediately on standard output or on Xwindow.
- When you want to **debug** your program, please submit your job using the **job.sh** script we provide. (You can submit debug job from **pp01 and pp02** in this assignment!)
- One compute node with 12 cores will be allocated to you when the job is ready.
- You can use for 30 minutes in the node you're provided, if you finish your job earlier than 30 minutes, **type "exit" to release the resource you got**.
- **DO NOT use this job.sh to run your experiments.**
- **DO NOT modify or add any commands into this job.sh!!!**

job_hybrid.sh

- We provide a job script for hybrid version that enables **core binding** to prevent from over-subscription of cores, which will leads to bad performance.
- This script is **not interactive**, modify this job_hybrid script to run your hybrid version experiments.
- You can also modify this script to run other experiments.
- You can submit this job from **pp01** and **pp02**.

Xlib

Xlib is an X Window System protocol client library written in the C programming language.

It contains functions for interacting with an X server.

These functions allow programmers to write programs without knowing the details of the protocol.

Xlib – Basic Datatype

- **Display** – specify the connection to the X server
- **Window** – specify the window
- **GC** – graphic context

Xlib – Basic API

- **XOpenDisplay** – connect to X server
- **XCreateSimpleWindow** – create simple windows
- **XMapWindow** – map windows
- **XCreateGC** – create graphics contexts
- **XSetBackground** – set the background color
- **XFlush** – output buffer or event queue
- **XDrawString** – draw text characters
- **XDrawPoint** – draw points
- **XFillRectangle** – fill rectangles
- **XFillArc** – fill arcs

Mandelbrot Set Code

- You can see how we use these API to draw in the sequential version of Mandelbrot Set code we provided.
- There are some comments in the code to let you better understand the meaning of each part.