

1. (50 points) Calculator GUI Design

Design a class **Calculator** that extends class **JFrame**, and implement the following functions:

- 1) Implement a basic graphical user interface using Java Swing. A calculator GUI example is shown in Fig. 1;
- 2) Implement basic arithmetical operations, including *add*, *subtract*, *multiply* and *divide* operations.



Fig. 1: Example of calculator GUI design

2. (50 Points) A Simple Chatting Socket Program

Refer to the programs Socket Client and Socket Server for chatting that you learned in the class (slide 19-20). Write a program using Java Thread to make multiple clients communicate with each other. The task of the socket server is to listen the messages received from the clients and forward the messages to all the other clients, and the socket clients also need to listen the messages received from the socket server. A running example is shown in Fig. 2(a) and Fig. 2(b).

```
Server->java Server
Initializing Port...
Listening...
Connect to client!
Connect to client!
```

Fig. 2 (a): Chatting example of server.

Client->java Client	Client->java Client
->Receive: Hi!	->Hi
->Hi!	->Receive: Hi!
->Receive: What's your name?	->What's your name?
->I am client 1.	->Receive: I am client 1.
->And you?	->Receive: And you?
->Receive: I am client 2.	->I am client 2.

Fig. 2 (b): Chatting example of client 1 and client 2.

Bonus Question (20 Points): (You can choose one of the two questions)

1. GUI for Chess Game

You are required to design and implement a GUI for Chessboard. The GUI function can be designed referring to the chessboard UI in command line in Exercise 3. In this exercise, all the pieces can only be moved by the mouse instead of the keyboard in the previous exercise.

2. The Traffic Light

As shown in Fig. 3, write a program to implement the GUI of the traffic light. When the user selects the color below the traffic light, the corresponding color light above will be filled automatically (i.e., turn on). The red light will be automatically lit at the beginning.

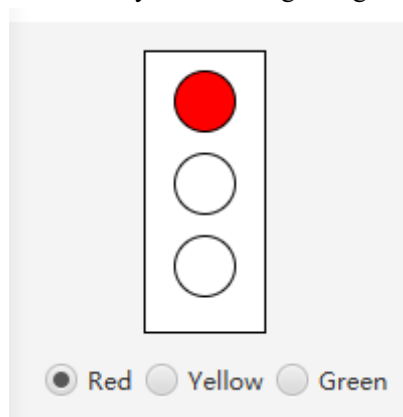


Fig. 3: Example of the traffic light