

NAME : *answers*

The exam is closed book, no notes and no computer.

All your answers to the questions below must be submitted on paper.

Write your name on this sheet and submit it with your answers.

Please do not ask questions during the exam.

1. A company operates a train service between major cities in a country. In setting up the software for posting the train schedules and selling the tickets, there are two possible ways to organize the modules.
 - (a) For each train line between two cities, there is a scheduling and a ticketing department. There are as many modules as there are connections between the cities.
 - (b) There are two modules: scheduling and ticketing. The scheduling module handles all train schedules, while the ticketing module arranges reservations and the selling of the tickets for train seats.

Which of the two designs is best?

Justify your choice by application of the key principles of good modular design.

answer: The second design is best.

- (a) Information hiding: ticketing of customers involves the processing of payments. The dealing of sensitive data such as credit card information is better concentrated in one module, rather than in several modules.
 - (b) High cohesion and low coupling: scheduling trips and selling tickets are two very different operations with little in common, so there is low coupling when those operations are done by different modules, while in the first design those two operations are in every module.
 - (c) Design for change: if inflation drives up ticket prices, the schedules do not change. Changes in schedules does not change the ticketing and reservation operations.
2. What is whitebox static testing? Give an example of such testing.

answer: Whitebox means that we see the source code, while static means that we do inspect the code, but do not execute. Thus, whitebox static testing corresponds to code inspection. For example, we check whether every function is documented.

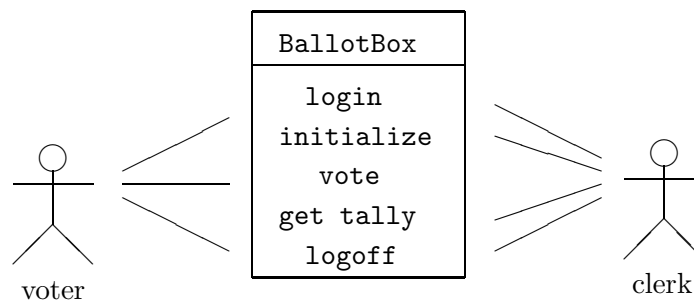
3. Write a function to prompt the user for a natural number in the format `d,ddd` where `d` is a decimal representation of a natural number in the range from 0 to 9, 0 and 9 included. As long as the user fails to enter this amount, the user is asked to retry. The function returns the entered number as an integer.

answer:

```
def prompt():
    """
    Prompts the user for a number in the format d,ddd.
    """
    while True:
        nbr = input('Give a natural number : ')
        try:
            parts = nbr.split(',')
            thousands = int(parts[0])
            assert(thousands >= 0 and thousands <= 9)
            assert(len(parts[1]) == 3)
            hundreds = int(parts[1])
            assert(hundreds >=0 and hundreds <= 999)
            return thousands*1000 + hundreds
        except:
            print('Incorrect format, please try again.')
```

4. Consider the `BallotBox` class which represents the number of votes in favor or against a certain motion. There are two types of users of the `BallotBox`: `Voter` and `Clerk`. Voters vote, after identifying themselves with a login. After voting, a voter logs off. A clerk initializes the `BallotBox` and retrieves the tally of the votes, in favor or against the motion. Draw the use case diagram for the `BallotBox`.

answer:



5. As a sponsor, one can donate funds at the bronze, silver, and gold level. To model certificates to honor the sponsors, define a class `Sponsor`. An object of this class stores the name and the level of the sponsor. The string method of the class provides the certificate, stating that the named sponsor donated at the bronze, silver, or gold level. Write Python code for the constructor and the string method.

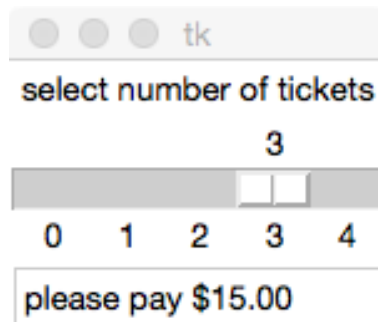
answer:

```
class Sponsor(object):
    """
    Models the level of a sponsor.
    """
    def __init__(self, name, level):
        """
        Defines the name and level of the sponsor.
        """
        self.name = name
        self.level = level

    def __str__(self):
        """
        Returns the certificate.
        """
        result = self.name + ' sponsors at the ' \
            + self.level + ' level.'
        return result
```

6. A bar wants to install a ticket vending machine for alcoholic drinks. A ticket costs \$5 and the machine will dispense at most 4 tickets at a single time. Draw a GUI for such a ticket dispenser. For each widget, write one complete sentence to explain its working.

answer:



There are three widgets:

- The label widget tells the user what to do.
- The scale widget lets the user select the number of tickets.
- The entry widget tells the user the amount to pay.

7. Explain the difference between concurrent and parallel execution. Illustrate with an example.

answer: Concurrent execution is the running of two or more tasks independently from each other. Parallel execution is concurrent and simultaneously, two or more tasks are running at the same time. As an example of a concurrent execution, consider one single processor shared between two processes which each alternately run for a while. On a processor with multiple cores, multiple processes run simultaneously.