**Cairo University** **Faculty of Computers and Artificial Intelligence**
Computer Science Department – Software Engineering Undergrad Program

**CS 454: Software Engineering 3, MIDTERM EXAMINATION**

*Instructor: Dr. Soha Makady*

Fall 2020 – CLOSED Book Exam –Total marks: 20 – Duration: 60 mins

This exam comes in **four** pages.

STUDENT NAME _____

STUDENT ID # _____

NOTE: This sheets functions as a **key to the answers not an exact model answer**. Hence, what is written is not a complete unique solution to the exam questions.

**Note: Some questions demand explanations and/or justification. If no explanation and/or justification is provided, that question will receive a zero grade.**

## Question 1 [7 marks]

a) **Give** one concrete example to illustrate the heterogeneity challenge in distributed systems. **[1]**

Any example that illustrates the difference in operating systems, computer architecture, hardware across communicating PCs within a distributed environment would work.

b) **Explain one** difference between the TCP and UDP protocols. For each protocol, **mention** one distributed application where that protocol would be a best fit, and **justify** why the selected protocol would be a best fit for that application. **[2]**

Several differences could be mentioned between TCP and UDP like acknowledge of messages delivery, the order of the packets, the content of the packets. Possible good fit applications for TCP could be Skype audio calls, banking systems. One possible good fit application for UDP could be live Skype video streaming.

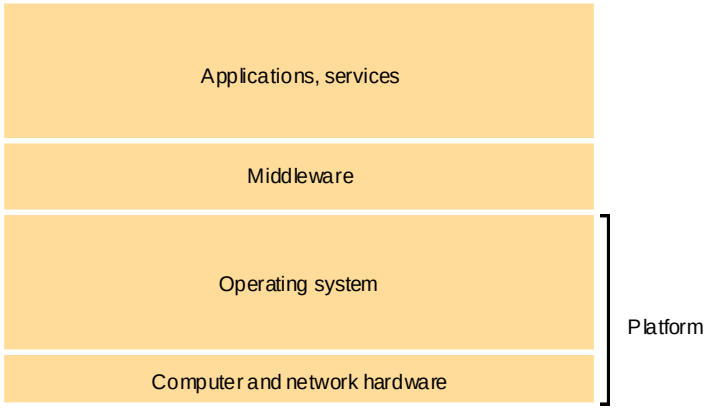
c) What is the difference between **ports** and **sockets**? **[1]**
A socket consist of an IP address for some server and the port number for a specific service on that server.

d) **Explain** three differences between processes and threads. **[3]**
Variance differences exist between processes and threads were mentioned in the course, like:
(i) Threads share the same memory whereas each process has its own memory, hence threads would be able to communicate through shared memory, while processes would need to communicate through message passing.
(ii) Context switching is less complex in threads than processes due to the difference in the amount of state that needs to be saved across different threads/processes.
(iii) Security in processes is better than threads due to the separation of the address space. Furthermore, the operating system is responsible for the synchronization, whereas such activity is done by the developer for threads.

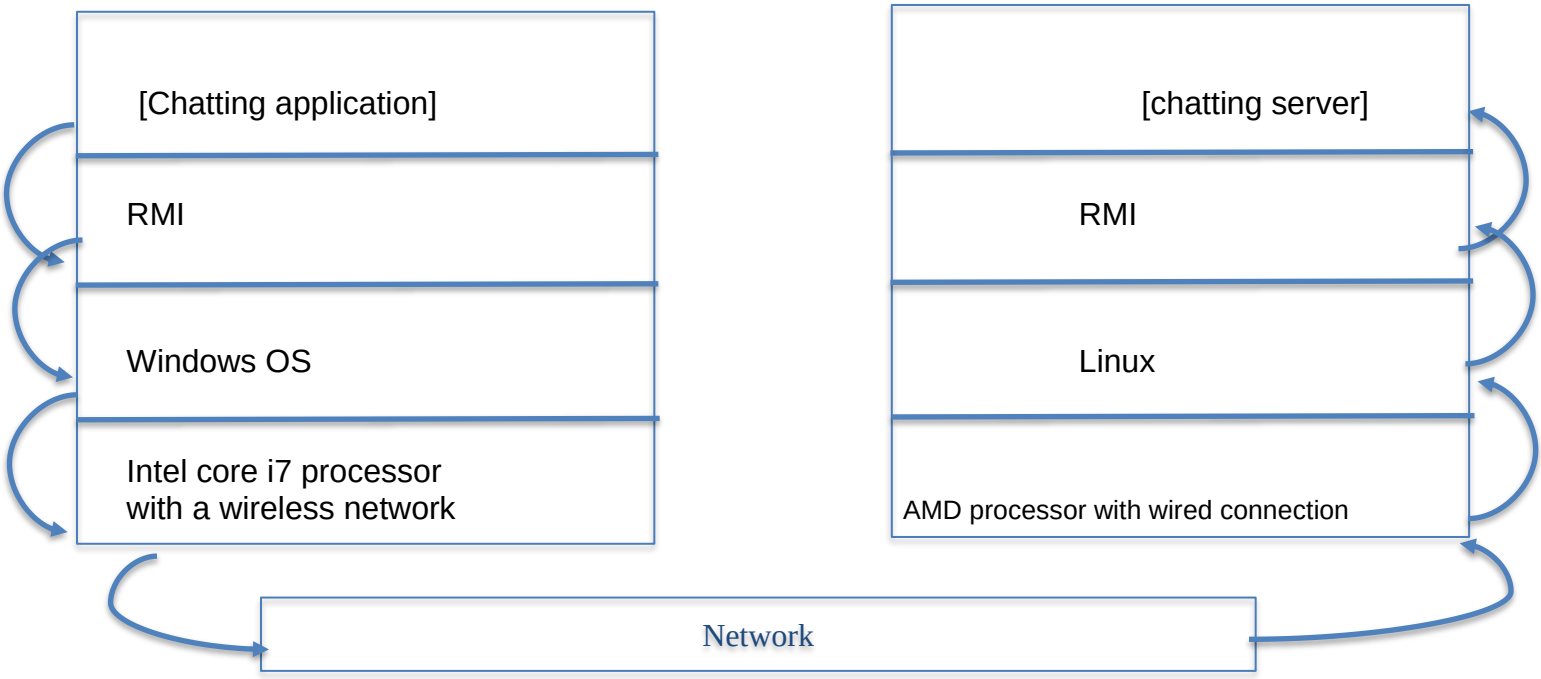
**Question 2 [5 marks]**

Use the layers and terms present within the following figure to illustrate the communication within a client-server architecture. One client is a Windows laptop with an Intel core i7 processor that uses a wireless internet connection, whereas the server is a Linux desktop with an AMD processor.

Use the below diagram to **sketch your own diagram. Your own diagram should illustrate:** (i) the details of the involved elements within the communication, (ii) how the communication is done, and (iii) the name of the used middleware. **Make any additional needed assumptions.**

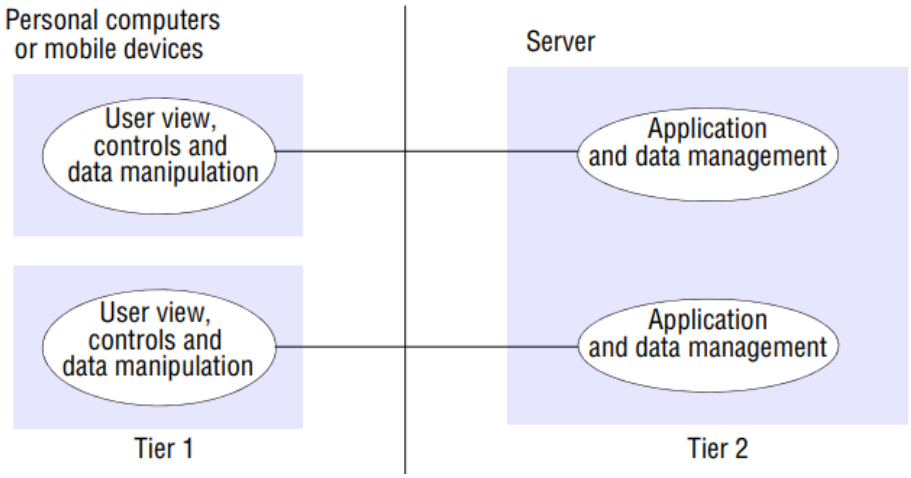



The diagram/supporting text should illustrate that the communication is done through the layers starting from the application that issues a request, and how the request goes through the middleware layer, to the operating system layer, to the computer and network hardware layer, then through the physical network. On the server side, the data would be received through the computer and hardware layer, up to the above layers in details.



**Question 3 [3 marks]**

Consider the below figure that illustrates a two-tiered architecture.




a) **Explain** one advantage of that architecture, and how that architecture enables such an advantage. **[1]**

Reduced latency as the application logic layer and the data logic layer are both hosted on the same tier, hence they would not be communicating over a network.

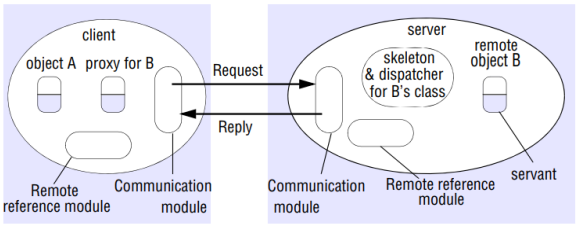
b) Consider some online shopping application. **Explain in details** what would be present in each tier for that application. **[2]**

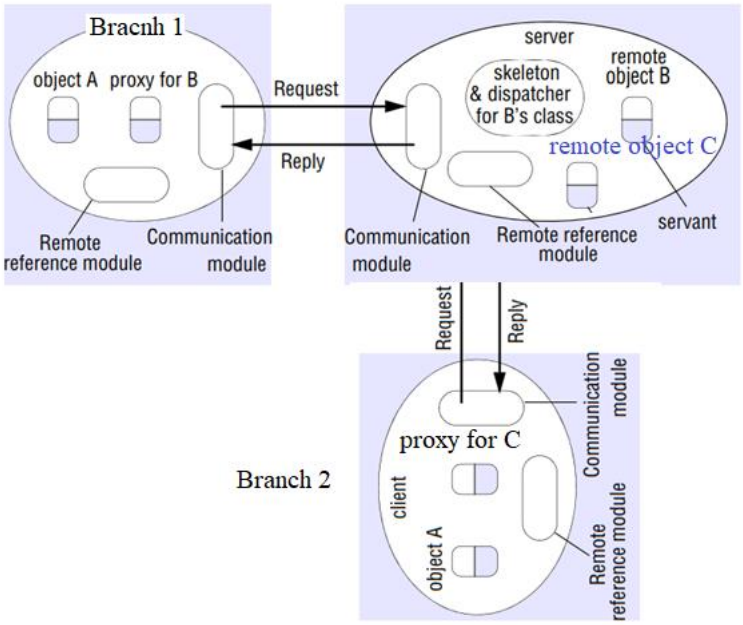
Tier 1 has the user interface forms for the shopping application, whereas tier 2 two would hold the application logic (e.g., validating the presence of requested items in the inventory), and the data logic (the database the serves the shopping application).

**Question 4 [5 marks]**

Consider the following diagram for the RMI architecture. Use that diagram to: (i) **sketch** a diagram that shows an RMI communication within a banking system and (ii) **explain** your sketched diagram. That RMI communication is utilized in **two different bank branches** that communicate with **one centralized server**. Branch A has one customer who would like to make a withdrawal operation, with a specific amount of money, on some remote bank account. Branch B customer would like to make a deposit operation, with a specific amount of money, one another remote bank account.

Your **diagram/explanation** should utilize the below figure notations, and clarify: (i) the whole architecture involving the two branches and the server, (ii) the role and content of the "proxy for B" and "remote object B" for all communicating parties, (iii) the role and content of the remote object table for all communicating parties, and (iv) how the marshalling/unmarshalling is done. Make any additional needed assumptions.






The *remote object table* records the correspondence between the local objects in each process and the remote objects.
For branch 1, the content of that table would be

| Object | ID |
|---|---|
| Proxy A | 1 |

For branch 2, the content of that table would be

| Object | ID |
|---|---|
| Proxy C | 2 |

For the server, the content of that table would be

| Object | ID |
|---|---|
| Remote A | 1 |
| Remote C | 2 |

**End of Exam**