

CS 490-004 Network Programming
Fall 2026

Quiz #4 on September 22, 2026 (**SUGGESTED SOLUTIONS**)

Your Last Three Digits: _____
(please do NOT write all of your student ID or your name)

Grade: _____

- (1) What are the four generations of “network application architectures”? When was each of the four network application architectures introduced?

~ 1980’s	“dumb terminals” for “mainframe” (thin-client)
early1990’s ~ mid 1990’s	client/server model (fat client)
mid1990’s ~ early 2000’s	HTML client for web applications
mid 2000’s ~	rich clients

- (2) What is “the thin-client architecture” (one definition)?

A mode of network applications that assumes most of their application processing occur at a central server.

(3) What types of “thin client” products are popularly used today? Mention four of them.

The following are the four suggested examples:

- (a) POS (Point-of-Sale) applications – those we see in grocery stores and gas-pumps at gas-stations
- (b) Remote-Desktops (e.g., Windows Remote Desktop)
- (c) Cloud-based applications
- (d) UNIX telnet (network applications that execute at the server-side using telnet)

Note 1: there can be other possible advantages.

Note 2: Graphic-based games (video games) should not be implemented as a thin-client application. If a graphic-based network application is implemented as a thin-client model, a server has to prepare graphics for each participating user, which takes huge amount of processing power and the network transmission bandwidth (graphic images need to be transmitted from a server to each of the participating users).

Note 3: GPS is a fat-client network application (each smartphone calculates the current location using the signals from multiple GPS-satellites, while GPS satellites do not calculate the location of each terminal device – GPS satellites just broadcast their beacon signals).

(4) What are the primary advantages in using “dumb thin client (a.k.a., “zero thin-client”)”? Mention at least three.

The following three are those discussed in the classroom:

- Each client-side hardware is not expensive. This means that “dumb thin client” is a good network application model that supports a large number of users with the minimum cost.
- The client-side terminal devices do not have much hardware components. Thus, it is easy for a system administrator to manage/maintain a large number of terminal devices.
- Since each client-side terminal holds/keeps data (all data being processed by users is stored at a server), a higher level of security (information security) is possible.

Note: there are other advantages.

- (5) Is there any advantage of “fat client system (one where the server side does not have either programs or data)” compared to “thin client systems”? If any, what is (are) it (they)?

Those we discussed in the classroom are:

- Graphic-heavy applications should be “fat-client” (client-side should take care of graphics). It is because rendering especially high-resolution graphic images is a very expensive task. If the server-side takes care of generating graphics for each user, a server can easily be overloaded (a performance bottleneck).
- Any network application that requires high response rate (i.e., short response time), such as an on-line shooting games, should be “fat client”. If a client makes a request to a server, server performs the requested task and send only a result a large volume of results should be sent back from a server to a client, network delay will prevent high response rate.

Note: security is poor for network applications based on fat-client model. It is because each terminal host computer (i.e., “client host computer”) under fat-client model has many software components, each of which can be a target of security attacks. That way, each client host computer under fat-client model has wider attack surface than thin-client model (e.g., there is almost no attack target at each client under “dumb thin-client model”).