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Here are some common socket programming interview questions along with concise, accurate answers to help you prepare:

1. What is socket programming?

Answer: Socket programming is a way of enabling communication between two devices (e.g., client and server) over a network using sockets. A socket is an endpoint for sending or receiving data across a network, typically using protocols like TCP or UDP.

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2. What are the differences between TCP and UDP in socket programming?

Answer:

- **TCP (Transmission Control Protocol):** Connection-oriented, reliable, ensures data delivery in order, slower due to error checking and flow control. Used for applications like HTTP, FTP, and email.

- **UDP (User Datagram Protocol):** Connectionless, unreliable, faster, no guaranteed delivery or order. Used for applications like video streaming, gaming, and DNS.

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3. What are the key steps to create a TCP server in socket programming?(SBL AS RC)

Answer:

1. Create a socket using `socket()`.

2. Bind the socket to an address and port using `bind()`.

3. Listen for incoming connections with `listen()`.

4. Accept connections from clients using `accept()`.

5. Send and receive data using `send()` and `recv()`.

6. Close the socket with `close()`.

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4. How does a TCP client connect to a server?(SC SRC)

Answer:

1. Create a socket using `socket()`.

2. Connect to the server using `connect()`, specifying the server's IP address and port.

3. Send and receive data using `send()` and `recv()`.

4. Close the socket with `close()`.

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5. What is the role of the `bind()` function in socket programming?

Answer: The `bind()` function associates a socket with a specific local address (IP and port). It's typically used on the server side to specify the address and port on which the server will listen for incoming connections.

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6. What is the difference between blocking and non-blocking sockets?

Answer:

- **Blocking Sockets:** Operations like `accept()`, `recv()`, or `connect()` block (wait) until the operation completes. Suitable for simple, sequential programs.

- **Non-Blocking Sockets:** Operations return immediately, allowing the program to continue. Used with mechanisms like `select()`, `poll()`, or async I/O for handling multiple connections.

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7. What is the purpose of the `select()` function in socket programming?

Answer: The `select()` function monitors multiple sockets for events (e.g., ready to read, write, or error) within a specified timeout. It's useful for handling multiple clients in a single-threaded server without blocking on each socket.

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8. What is a socket timeout, and how can you set it?

Answer: A socket timeout is the maximum time a socket operation (e.g., `recv()`) waits before giving up. You can set it using:

- In C: `setsockopt()` with `SO_RCVTIMEO` or `SO_SNDTIMEO`.

- In Python: `socket.settimeout(seconds)` to set a timeout for blocking operations.

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9. What is the difference between `close()` and `shutdown()` in socket programming?

Answer:

- **close():** Terminates the socket, ending all communication and releasing resources.

- **shutdown():** Allows graceful closure by disabling sending (`SHUT_WR`), receiving (`SHUT_RD`), or both (`SHUT_RDWR`), while keeping the socket open for pending operations.

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10. How does a UDP server differ from a TCP server in implementation?

Answer:

- **UDP Server:** Uses a connectionless approach. After creating and binding a socket, it uses `recvfrom()` to receive data and get the client's address, and `sendto()` to send data. No `listen()` or `accept()` is needed.

- **TCP Server:** Connection-oriented, requires `listen()` to queue connections and `accept()` to establish a connection with a client before data exchange.

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11. What is the role of IP addresses and ports in socket programming?

Answer:

- **IP Address:** Identifies the device on the network (e.g., 192.168.1.1).

- **Port:** A number (0-65535) that identifies a specific process or service on the device. Together, they form a unique endpoint for communication.

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12. What are common errors in socket programming, and how do you handle them?

Answer:

- **Connection Refused:** Server not running or wrong IP/port. Check server status and address.

- **Timeout:** Network delay or unresponsive peer. Set timeouts and retry.

- **Broken Pipe:** Client disconnected. Handle by checking return values of `send()`/`recv()`.

- **Address Already in Use:** Port is occupied. Use `setsockopt()` with `SO_REUSEADDR` before binding.

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13. What is the purpose of the `SO_REUSEADDR` socket option?

Answer: The `SO_REUSEADDR` option allows a socket to bind to a port that’s in a TIME_WAIT state, enabling the server to restart quickly without waiting for the port to be released.

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14. How can you handle multiple clients in a socket server?

Answer:

- **Multi-Threading:** Spawn a new thread for each client connection to handle communication.

- **Asynchronous I/O:** Use `select()`, `poll()`, or libraries like `asyncio` (Python) to manage multiple sockets in a single thread.

- **Forking:** Create a new process for each client (less common due to resource use).

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15. What is a "sticky packet" problem in TCP, and how do you solve it?

Answer: In TCP, data is a stream, and multiple messages can be combined ("stuck") into one packet. Solve it by:

- Using fixed-length messages.

- Adding delimiters (e.g., newline) to separate messages.

- Prefixing messages with a length header to indicate message size.

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16. Can you explain the three-way handshake in TCP?

Answer: The three-way handshake establishes a TCP connection:

1. **SYN:** Client sends a SYN (synchronize) packet to the server.

2. **SYN-ACK:** Server responds with a SYN-ACK (synchronize-acknowledge) packet.

3. **ACK:** Client sends an ACK (acknowledge) packet, completing the connection.

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17. What libraries or tools are commonly used for socket programming?

Answer:

- **C:** Standard socket API (e.g., `<sys/socket.h>`).
- **Python:** `socket` module, or higher-level libraries like `socketserver` or `asyncio`.
- **Java:** `java.net.Socket` for clients, `java.net.ServerSocket` for servers.
- **C++:** Boost.Asio for advanced socket programming.

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18. How do you test a socket program?

Answer:

- Use tools like `netcat` (nc) or `telnet` to simulate clients or servers.
- Write unit tests for client and server logic.
- Use packet analyzers like Wireshark to inspect network traffic.
- Test edge cases: disconnections, timeouts, and high load.

These questions cover fundamental concepts, practical implementation, and common challenges. Practice coding simple client-server programs in your preferred language (e.g., Python, C, Java) to solidify your understanding. Good luck with your interview!