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• Quiz 4 (SQL) released on Tuesday 4/28 is due Thursday 4/30 @ 11:59pm
Distributed Computing
Distributed Computing

A distributed computing application consists of multiple programs running on multiple computers that together coordinate to perform some task.
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Distributed computing for large-scale data processing:
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Distributed computing for large-scale data processing:
• Databases respond to queries over a network.
• Data sets can be partitioned across multiple machines (next lecture).
Network Messages
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Computers communicate via messages: sequences of bytes transmitted over a network.
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• For example, bits at fixed positions may have fixed meanings.
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• Protocols are designed to be implemented by many different programming languages on many different types of machines.
Internet Protocol
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<td></td>
<td></td>
</tr>
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http://en.wikipedia.org/wiki/IPv4
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<th>Where to send error reports</th>
<th>Where to send the packet</th>
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<td>E.g., 192.168.1.1</td>
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Ipv4 Header Format

- The packet knows its size
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Max length: 216 = 65,536
E.g., 192.168.1.1

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Packets can’t survive forever

The packet knows its size

Where to send error reports

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Decremented on forwarding

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Packets are forwarded toward their destination on a best effort basis. Programs that use IP typically need a policy for handling lost packets.
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The socket module in Python implements the TCP.
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Message Sequence of a TCP Connection
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Computer A
Message Sequence of a TCP Connection

Computer A

Computer B
Message Sequence of a TCP Connection

Computer A \rightarrow \text{Synchronization request} \rightarrow \text{Computer B}
Message Sequence of a TCP Connection

Computer A

Synchronization request

Computer B

Acknowledgement & synchronization request
Message Sequence of a TCP Connection

Computer A

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Acknowledgement & synchronization request

Acknowledgement

Computer B
Message Sequence of a TCP Connection

Computer A

Synchronization request

Acknowledgement & synchronization request

Computer B

Acknowledgement
Message Sequence of a TCP Connection

- **Computer A**: Establishes packet numbering system
- **Computer B**:
  - Synchronization request
  - Acknowledgement & synchronization request
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Message Sequence of a TCP Connection

Computer A
- Establishes packet numbering system
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- Acknowledgement & synchronization request
- Acknowledgement
- Data message from A to B
- Acknowledgement
- Data message from B to A
- Acknowledgement

Computer B
Message Sequence of a TCP Connection

Computer A

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• Internet file and resource transfer: HTTP, FTP, email, etc.
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