Final: Scheduled for *June 11th, 8:30-10:20AM*

- Start thinking about review
- Next week’s section will be Final review

Project 3 Proxy: Due *June 3rd*

Homework 5: Due *June 1st*
Fair Game for the Final

- 5 layers we’ve covered, but a heavy focus on Application, Link and Physical Layers
- Security
- Cloud computing networks (tentative)

Internet protocol stack

- **application**: supporting network applications
  - ftp, smtp, http
- **transport**: host-host data transfer
  - tcp, udp
- **network**: routing of datagrams from source to destination
  - ip, routing protocols
- **link**: data transfer between neighboring network elements
  - ppp, ethernet
- **physical**: bits “on the wire”
MACA

- Protocol rules:
  1. A sender node transmits a RTS (Request-To-Send, with frame length)
  2. The receiver replies with a CTS (Clear-To-Send, with frame length)
  3. Sender transmits the frame while nodes hearing the CTS stay silent
     - Collisions on the RTS/CTS are still possible, but less likely
## Security - Symmetric vs. Asymmetric Encryption

<table>
<thead>
<tr>
<th>Key Distribution</th>
<th>Symmetric (Shared Key)</th>
<th>Asymmetric (Public Key)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>need to share secret key to both parties securely</td>
<td>Easier - each user publishes their own public key</td>
</tr>
<tr>
<td>Fast</td>
<td>only need to reverse the encryption with the same key</td>
<td>Slow - need to run RSA decryption, very expensive</td>
</tr>
<tr>
<td>Runtime Performance</td>
<td>Fast - only need to reverse the encryption with the same key</td>
<td>Slow - need to run RSA decryption, very expensive</td>
</tr>
</tbody>
</table>
Quiz Review
Project 3 - HTTP Proxy

Tips and Common Errors
Forwarding Data with Byte Buffers (Java)

Where is the issue?
Writes entire buffer to output, even if read(buf) only read 1 byte!

Now, only writes the bytes that were read into buf. Nice!
General Proxy Multithreading Structure

Proxy Main

Connection Thread

Connection Thread

Connection Thread

....

Client to Server Reader

Server to Client Reader

Both of these readers are for CONNECT requests only
Additional Things to Lookout For

- Make sure you are **not** modifying the headers beyond what the spec requires
  - Even reordering may result in a rejected packet
- Double carriage return ("\r\n\r\n") after sending HTTP 200 OK on Connect
- Parsing headers but not sending headers (or sending headers too many times)
- Closing sockets prematurely

- **Testing**: try loading popular HTTPS websites concurrently and ensure the proxy can do so at a reasonable speed.
Project 3 - HTTP Proxy Port Demo