CS255 Programming Project 2

Programming Project 2

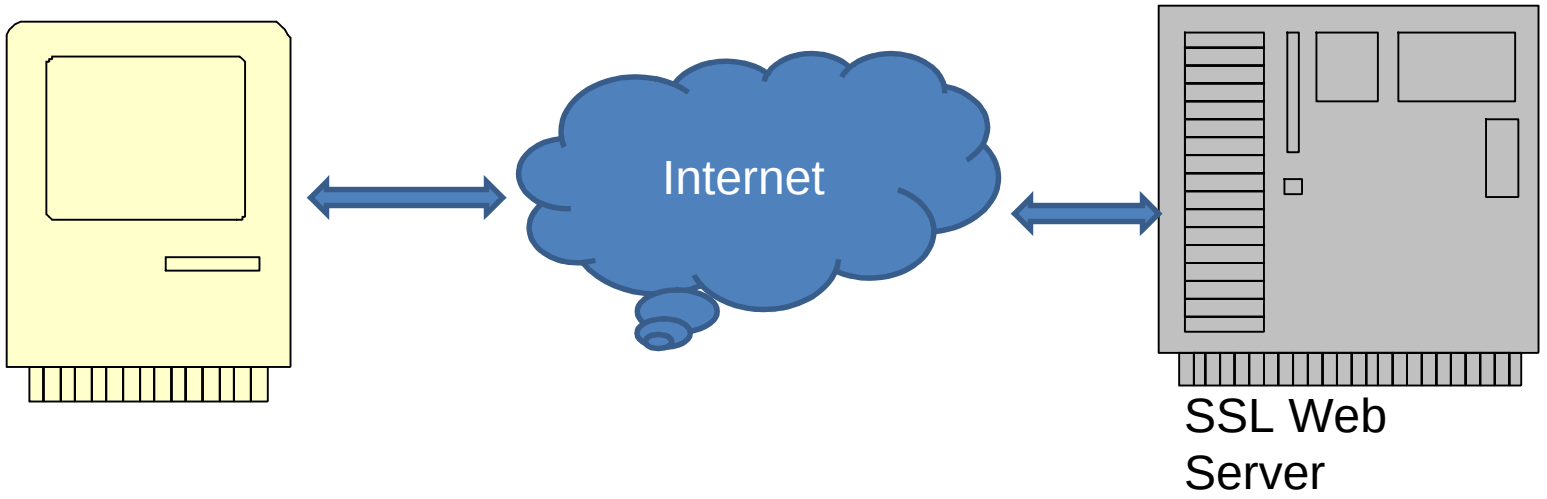
- Due: Wednesday March 14th (11:59pm)
  - Can use extension days
- Can work in pairs
  - One solution per pair
- Test and submit on Leland machines

Overview

- Implement a simple Man In The Middle (MITM) attack on SSL
- Use Java's networking, SSL and Certificate implementations
  - No need for low level packet manipulation
- Also implement a password based authentication system for the MITM server
  - Allows hacker to issue commands to server

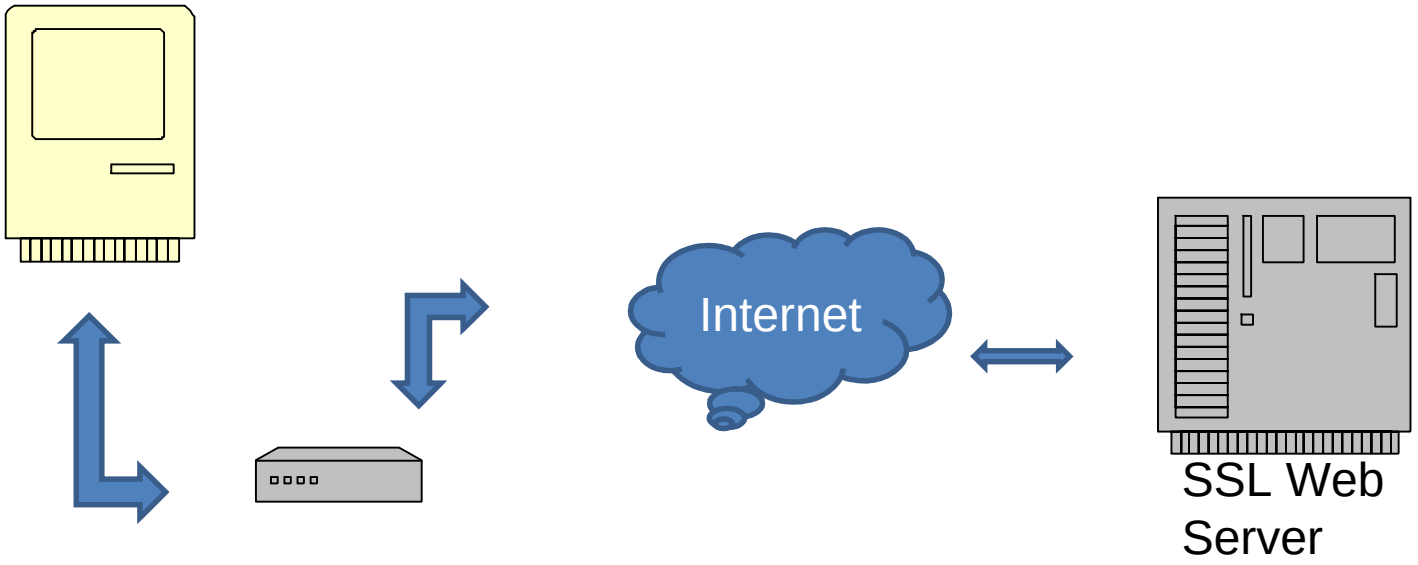
Overview

- Normal SSL
  - SSL encrypted data routed like normal TCP/IP data over the internet



Proxy Server

- Browser connects to proxy
- Proxy connects to web server and forwards between the two



Man in the Middle

- Instead of forwarding encrypted data between the two hosts, our proxy will set up two DIFFERENT SSL connections between the two.
- Proxy<->Remote Server
  - Sets up a normal SSL client connection to requested remote site
- Proxy<->Browser
  - Sets up a SSL server connection to the browser, using its own certificate, generated as a copy of the remote host's cert
- If the browser accepts this fake cert, the proxy has access to the data in the clear!

What is provided?

- Basic Proxy Server setup
  - Parses CONNECT request and sets up a connection between client and remote server
- Basic Admin Server/Client
  - Server listens for connections on a PLAIN socket and parses out username/password/command that the client sends

Security Features

- Secure connection between admin client and proxy server using SSL
- Password based authentication for client
  - Secure storage of password file
  - Passwords stored hashed using public and private salt
- Extra Credit: Challenge / Response authentication
  - This is IN ADDITION TO password authentication

Proxy Server

- Already listens for the browser CONNECT request and sets up the needed SSL connections
- You need to
  - Understand the connections being made
  - Obtain the remote server cert from the remote SSL conn
  - Copy the relevant fields and sign the forged cert using your CA cert (from your keystore) (use IAIK)
  - Modify the code creating the client SSL conn to use the newly forged cert

Signing Certificate

- Build a self signed cert for the proxy server using keytool
  - `keytool –genkey –keyalg RSA`
  - Store this in a JKS keystore for use by your proxy server
  - Use it for signing your programmatically generated certs
  - You pretend to be a CA e.g. Verisign
- Submit a keystore with your project

Generating Certs “On the Fly”

- Not easy to generate certs programmatically using standard Java libs
- Use the IAIK-JCE library
  - iaik.x509.X509Certificate

iaik.x509.X509Certificate

- To convert from a java cert:
  - new X509Certficate(javaCert.getEncoded());
- Signing
  - cert.sign(AlgorithmID.sha256withRSAEncryption, issuerPk);
- See iaik.asn1.structures.Name
  - For extracting info (e.g. common name) from the cert's DN (cert.getSubjectDN())

Managing Certs and SSL Sockets

- Use the KeyStore class for
  - Loading certs from file (e.g. your CA cert)
  - Storing programmatically generated certs
- Use SSLContext class for setting up certs to be used with an SSLServerSocket
  - Create a cert
  - Load into new KeyStore
  - Init a KeyFactoryManager with new KeyStore
  - Init SSLContext with new KeyFactoryManager and provided “TrustEveryone” TrustManager
- Use SSLContext for creating SSLSocketFactories

Admin Server

- Already listens for client connections and parses the data sent, using plain sockets
- You need to
  - Modify the code to use SSL sockets (see the proxy server code for examples)
  - Implement authentication for the transmitted username and password
  - Implement the required admin commands
    - Shutdown – the proxy server to stops accepting connections and exit
    - Stats – the proxy server returns a summary of the number of connections it has processed. Add code to record these

Password Authentication

- Proxy server listens for SSL connections from admin client too
- On connection client transmits a username and password
- Server verifies these from its local password file, and executes command if the client is authenticated

Password File

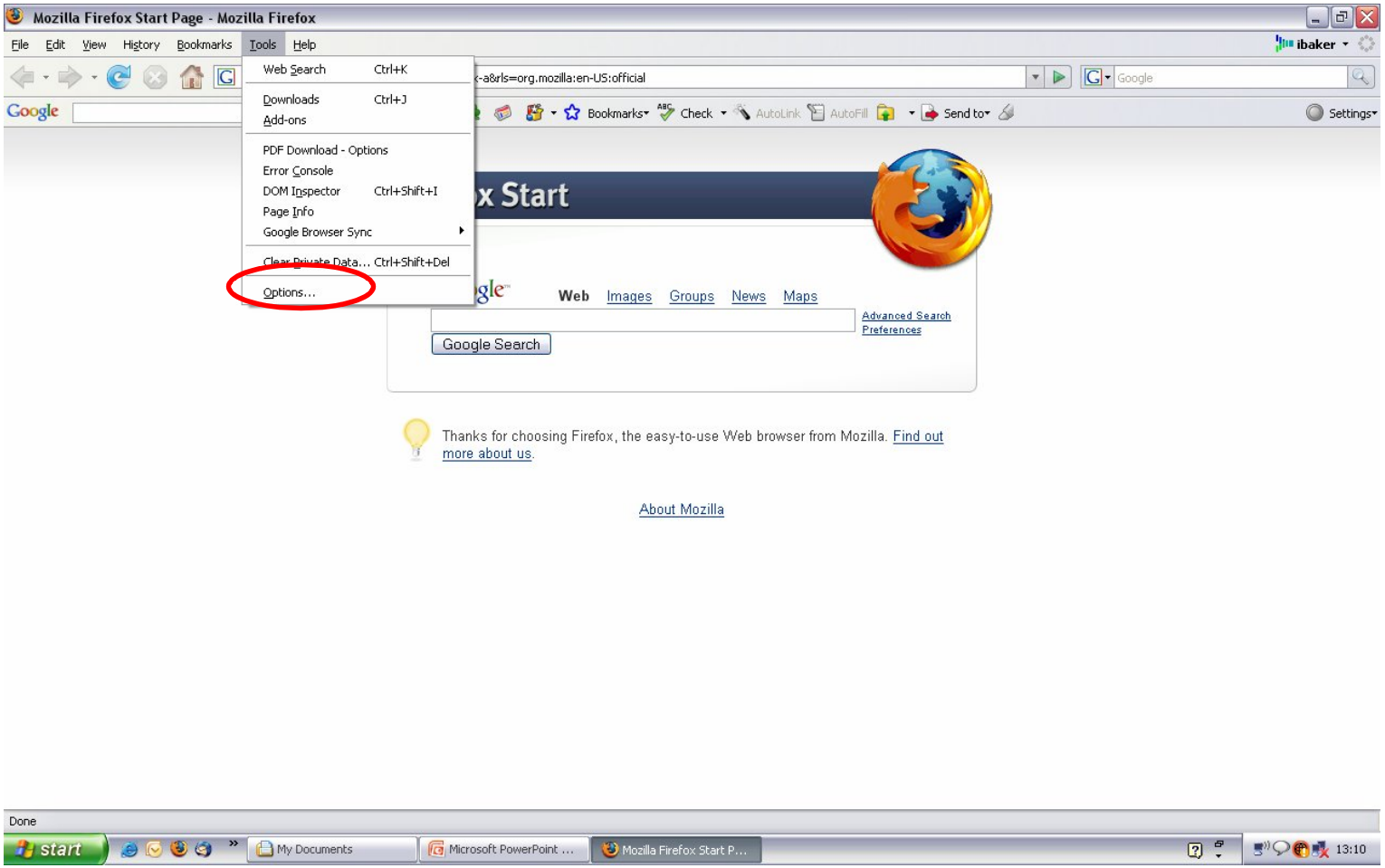
- Need to store a file containing usernames, salts, and hashed passwords
  - Use BOTH public and secret salts (AKA pepper)
- Should be stored encrypted/MACed
  - Similar to how keyfile is stored in project 1
  - Can use built in CTR mode

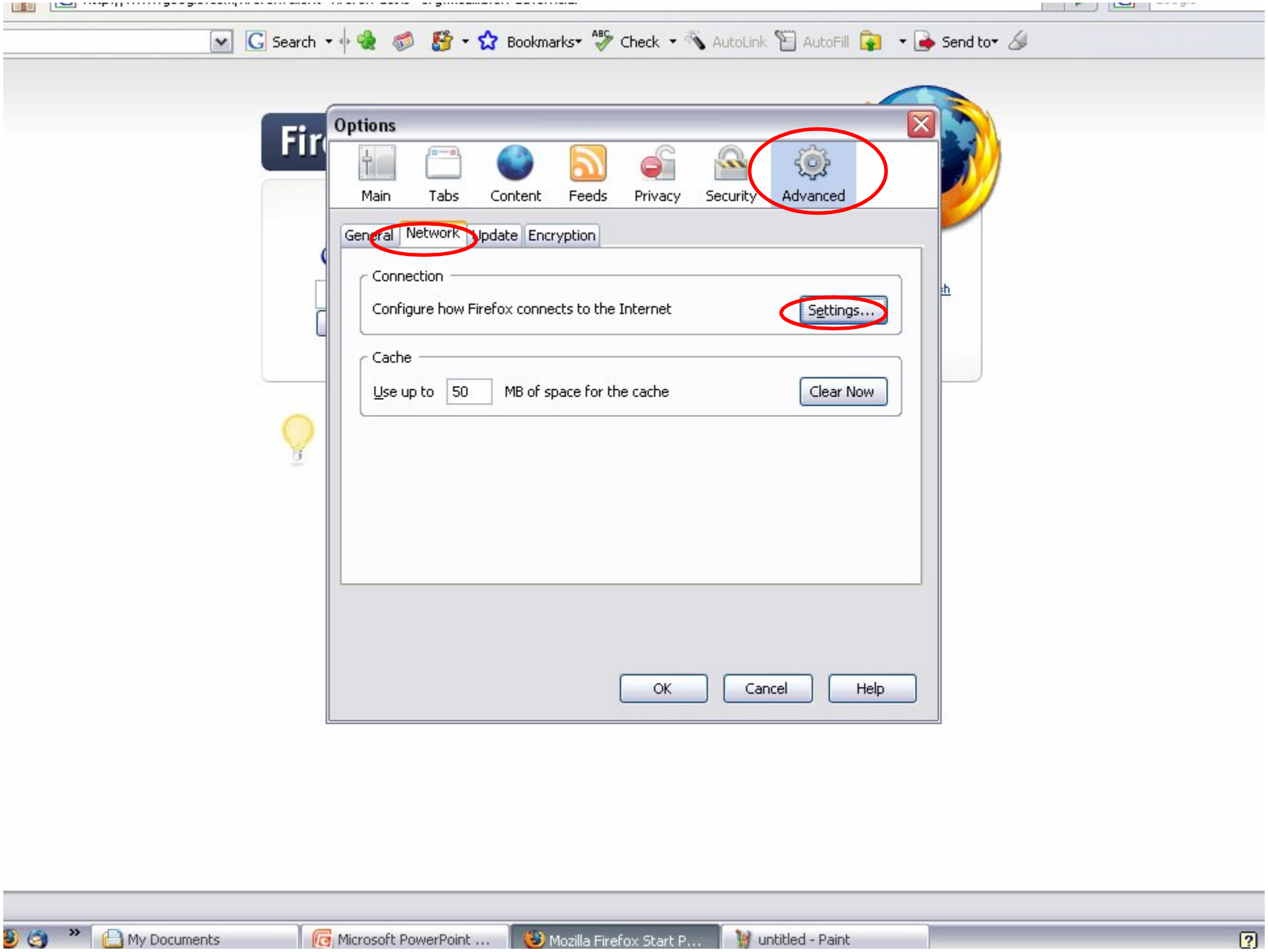
Username	Salt	Password
ibaker	S	H(Pwd||S||P)
singuva	…	…
dabo		
…		

Password File Utility

- You need to add a utility for creating these password files
- Simple method:
  - Make a class to take a file with a list of usernames and passwords and convert it to a password file

Configuring Mozilla

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Configure how Firefox connects to the Internet
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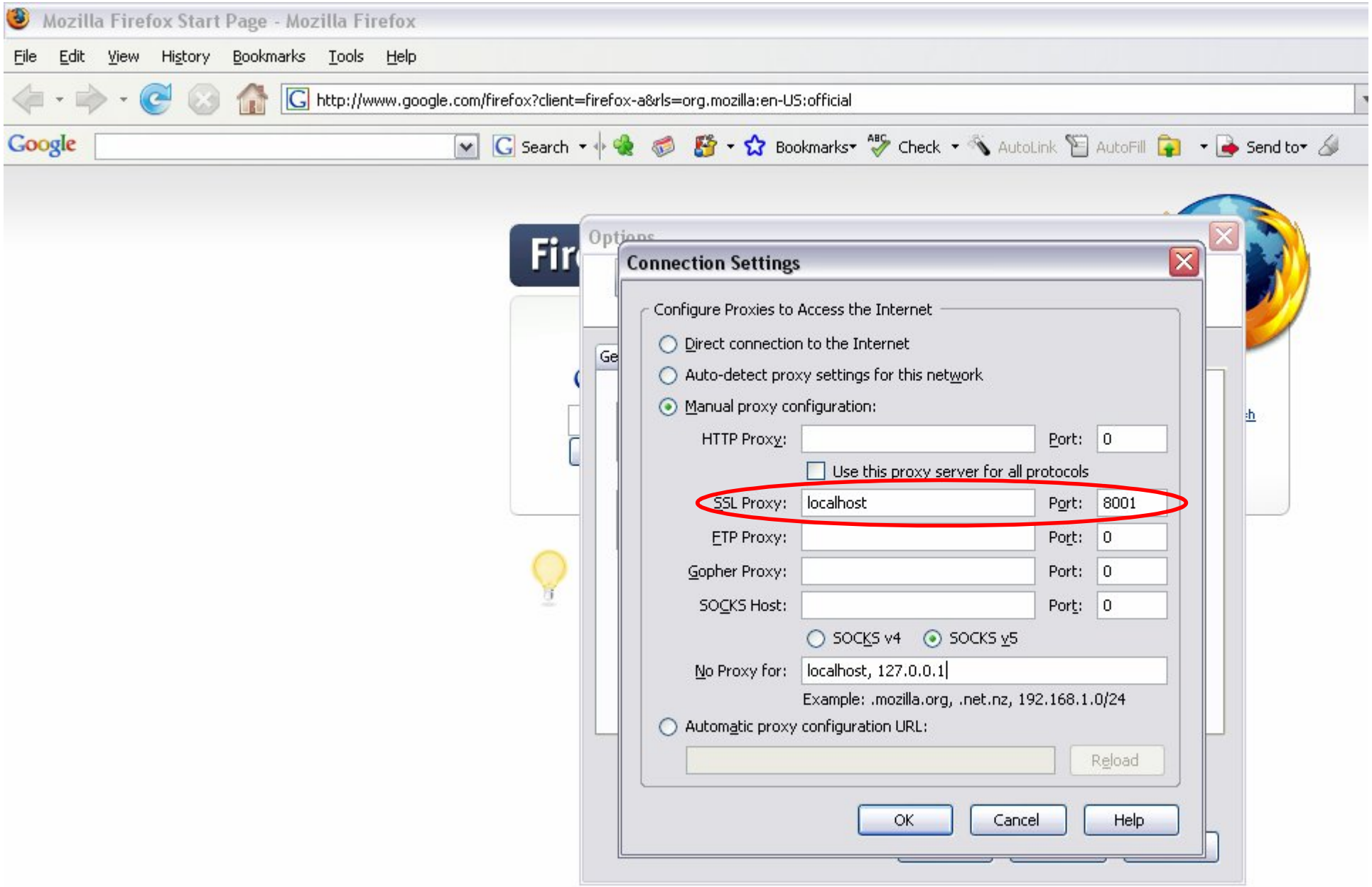
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File Edit View History Bookmarks Tools Help
http://www.google.com/firefox?client=firefox-a&rls=org.mozilla:en-US:official
Google
Search
Bookmarks
Check
AutoLink
AutoFill
Send to
Options
Connection Settings
Configure Proxies to Access the Internet
Direct connection to the Internet
Auto-detect proxy settings for this network
Manual proxy configuration:
HTTP Proxy:
Port: 0
Use this proxy server for all protocols
SSL Proxy: localhost
Port: 8001
FTP Proxy:
Port: 0
Gopher Proxy:
Port: 0
SOCKS Host:
Port: 0
SOCKS v4
SOCKS v5
No Proxy for: localhost, 127.0.0.1
Example: .mozilla.org, .net.nz, 192.168.1.0/24
Automatic proxy configuration URL:
Reload
OK
Cancel
Help

Possible Problems

- You should be able to start up the proxy server and connect to it “out of the box”
- If you are having problems
  - Is someone else using the port? (default 8001)
    - Try a different port on the command line
  - Firewall problems?
    - Try opening the needed ports 8001/8002 (or whatever)
  - Try running your browser on the same machine and setting the proxy as localhost
  - We can’t debug your local network setup

Grading

- Security comes first
  - Design choices
  - Correctness of the implementation
- Did you implement all required parts?
- Secondary
  - Cosmetics
  - Coding style
  - Efficiency

Submitting

- README file
  - Names, student IDs
  - Describe your design choices
  - How to run your system (e.g. create passwords)
  - Answer to discussion question
- Your sources
- A sample of data recorded from your proxy
- Use `/usr/class/cs255/bin/submit` from a Leland machine

Stuck?

- Use the newsgroup (su.class.cs255)
  - Best way to have your questions answered quickly
- TAs cannot:
  - Debug your code
  - Troubleshoot your local Java installation
  - Troubleshoot your local network