Cross Site Request Forgery

HTML Forms

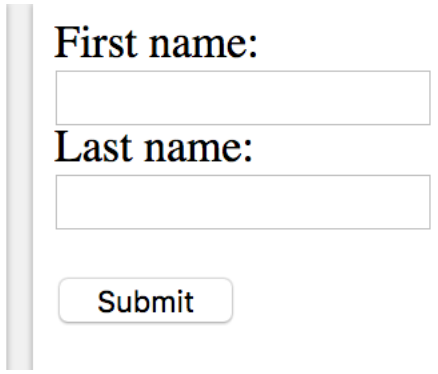
- Allow a user to provide some data which gets sent with an HTTP POST request to a server

```
<form action="bank.com/action.php">

First name:  <input type="text" name="firstname">

Last name:<input type="text" name="lastname">

<input type="submit" value="Submit"></form>
```



When filling in Alice and Smith, and clicking submit, the browser issues

```
HTTP POST request
bank.com/action.php?firstname=Alice&lastname=Smith
```

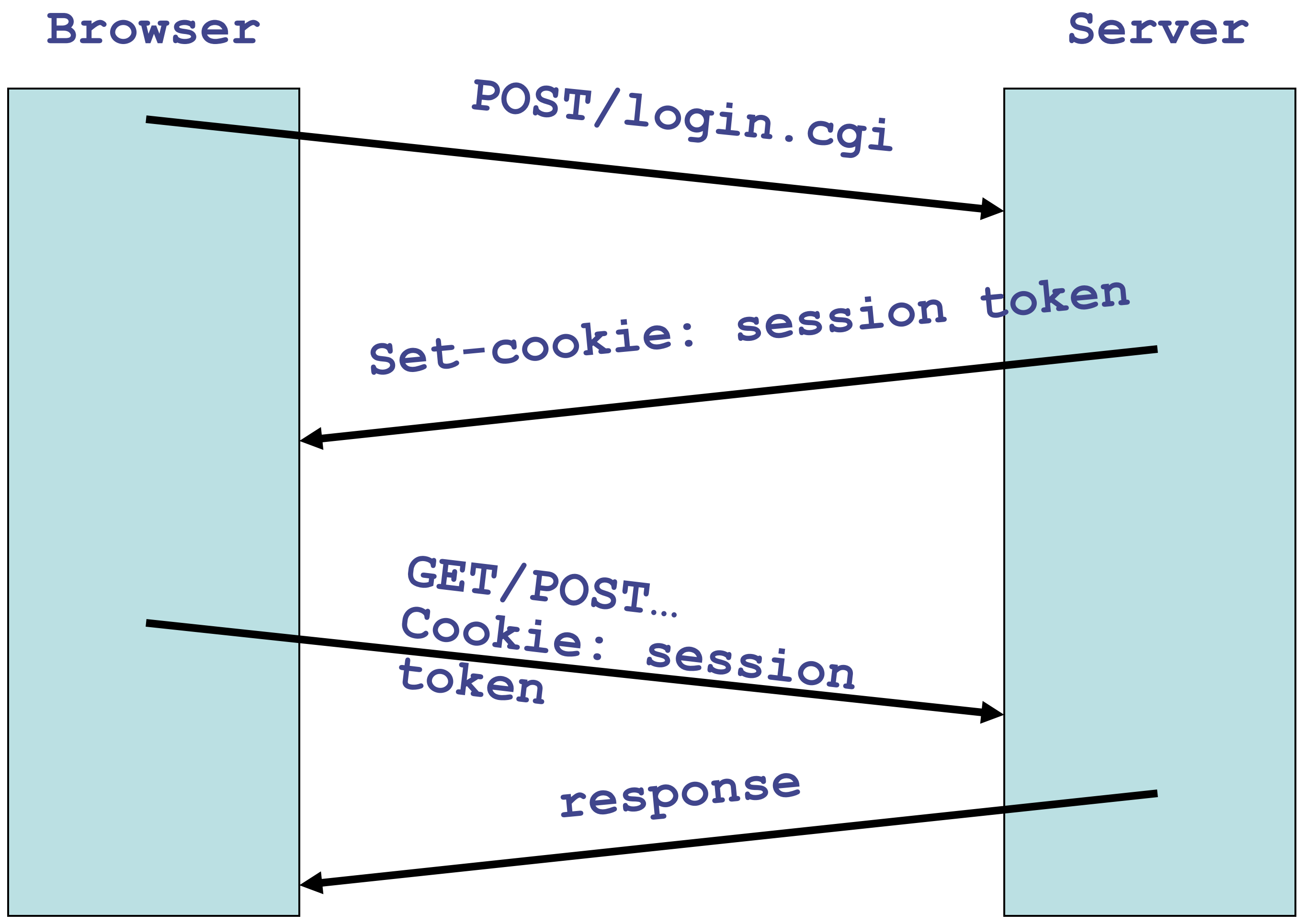
As always, the browser attaches relevant cookies

Consider the cookie stores the session token

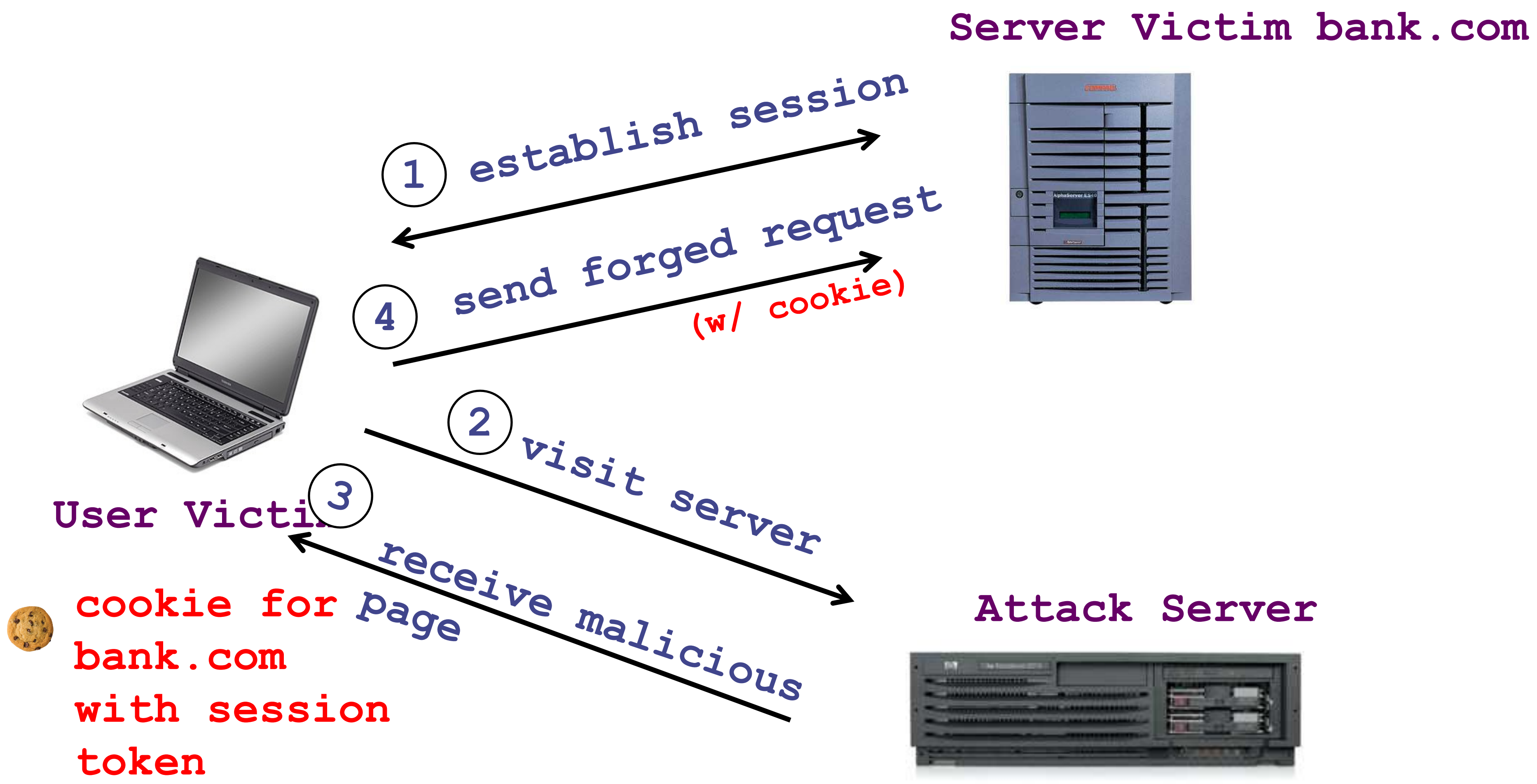
- Server assigns a random session token to each user after they logged in, places it in the cookie
- The server keeps a table of

  [username -> session token], so when it
sees the session token it knows which user
- When the user logs out, the server clears the session token

Session using cookies



CSRF Attack Basic Picture



What can go bad? URL contains transaction action

Cross Site Request Forgery (CSRF)

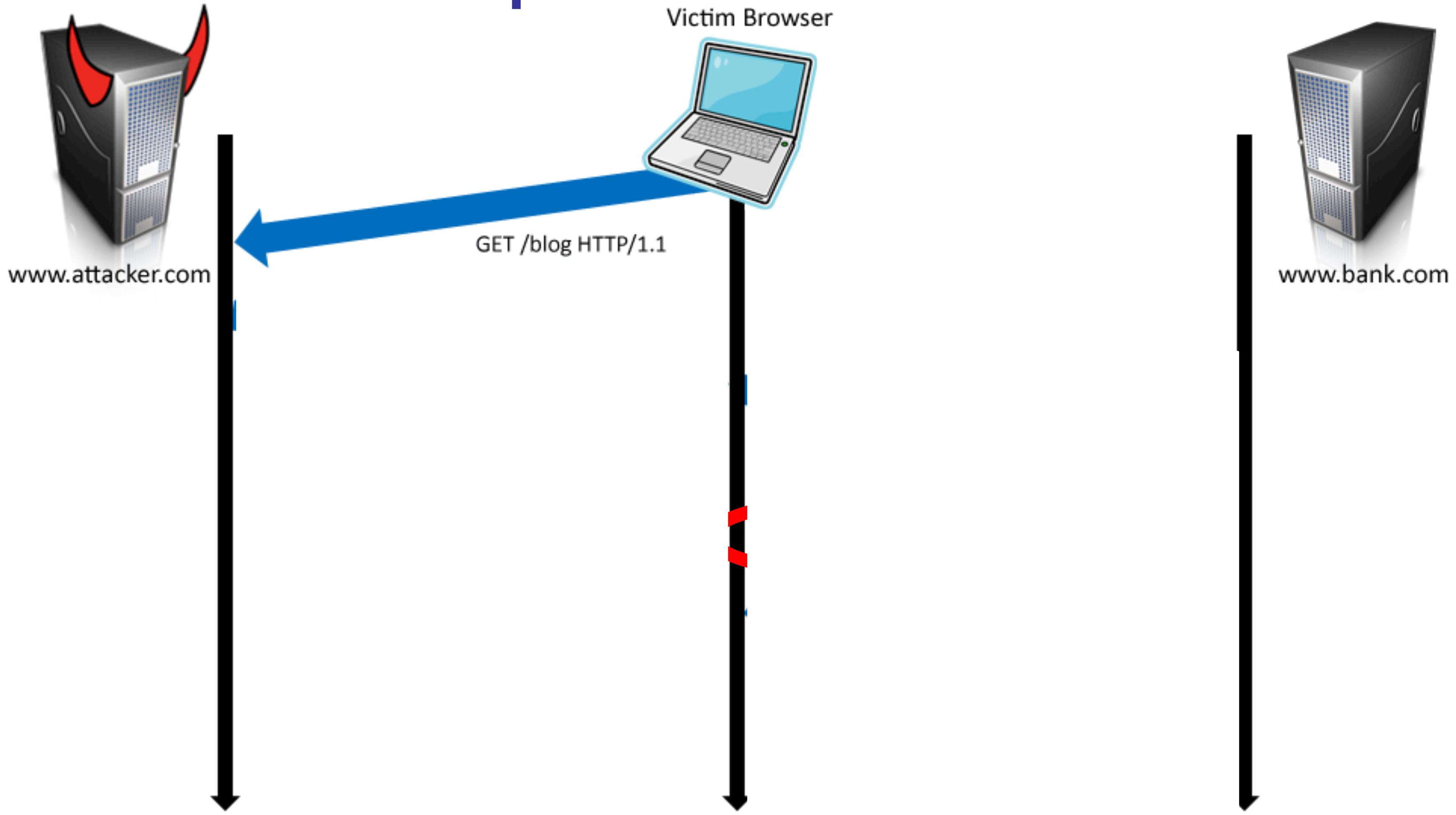
- User logs in to bank.com
  - Session cookie remains in browser state
- User visits malicious site containing:

```
<form  name=F  action=http://bank.com/BillPay.php>
   <input  name=recipient   value=badguy> …
   <script> document.F.submit(); </script>
```

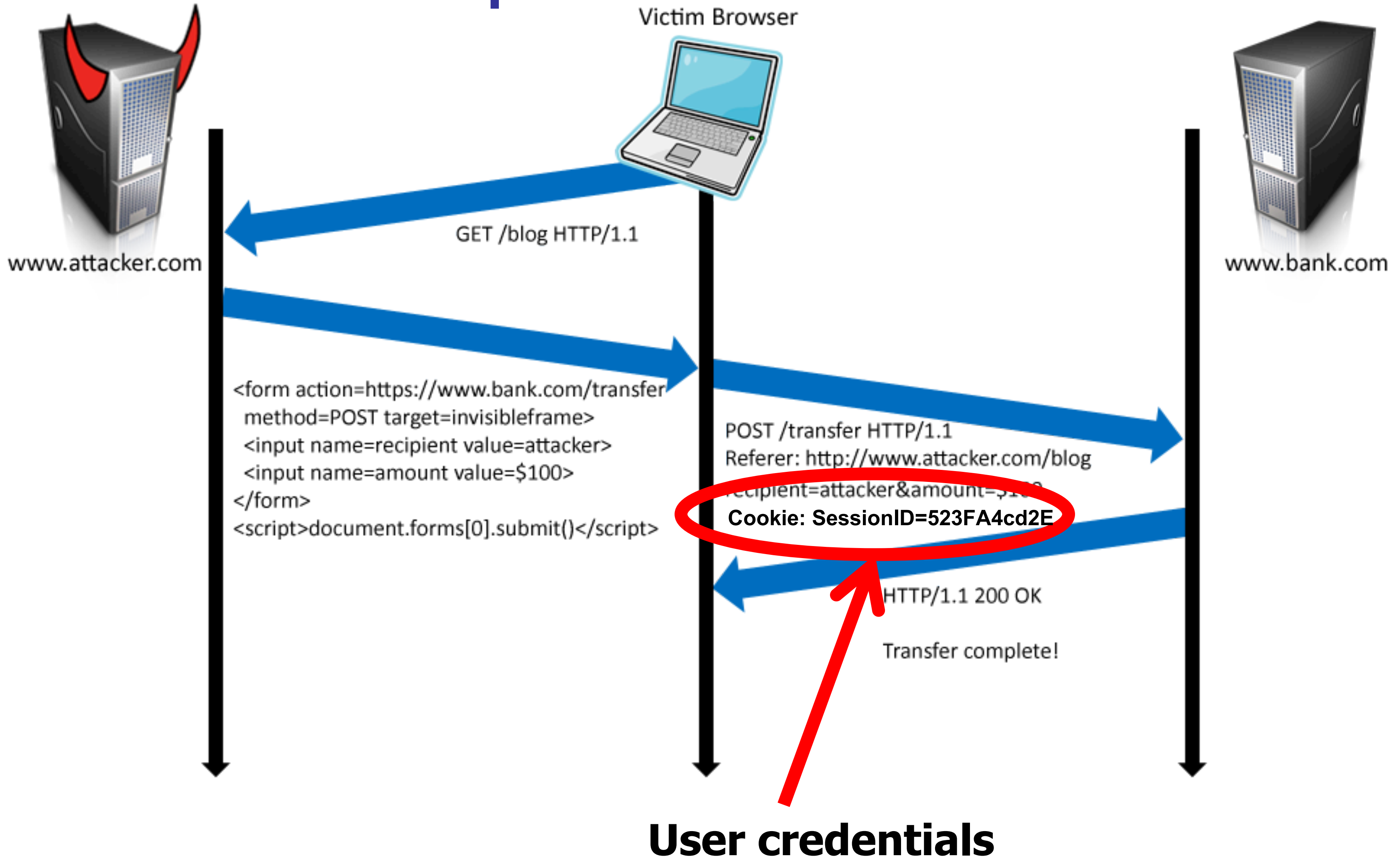
- Browser sends user auth cookie with request
  - Transaction will be fulfilled

- Problem:
  - cookie auth is insufficient when side effects occur

Form post with cookie



Form post with cookie



```
GET /blog HTTP/1.1
```

```
<form action=https://www.bank.com/transfer
  method=POST target=invisibleframe>
  <input name=recipient value=attacker>
  <input name=amount value=$100>
</form>
<script>document.forms[0].submit()</script>
```

```
POST /transfer HTTP/1.1
Referer: http://www.attacker.com/blog
recipient=attacker&amount=$100
Cookie: SessionID=523FA4cd2E
```

```
HTTP/1.1 200 OK

Transfer complete!
```

YouTube 2008 CSRF attack

An attacker could

- add videos to a user's "Favorites,"
- add himself to a user's "Friend" or "Family" list,
- send arbitrary messages on the user's behalf,
- flagged videos as inappropriate,
- automatically shared a video with a user's contacts, subscribed a user to a "channel" (a set of videos published by one person or group), and
- added videos to a user's "QuickList" (a list of videos a user intends to watch at a later point).

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Facebook Hit by Cross-Site Request Forgery Attack

By Sean Michael Kerner | August 20, 2009

Angela Moscaritolo

September 30, 2008

Popular websites fall victim to CSRF exploits

CSRF Defenses

- CSRF token

```
<input type=hidden value=23a3af01b>
```

- Referer Validation

```
Referer: http://www.facebook.com/home.php
```

- Others (e.g., custom HTTP Header) we won’t go into

CSRF token

1. goodsite.com server wants to protect itself from CSRF attacks, so it includes a secret token into the webpage (e.g., in forms as a hidden field)
2. Requests to goodsite.com include the secret
3. goodsite.com server checks that the token embedded in the webpage is the expected one; reject request if not

Can the token be?

- **123456**
- **Dateofbirth**

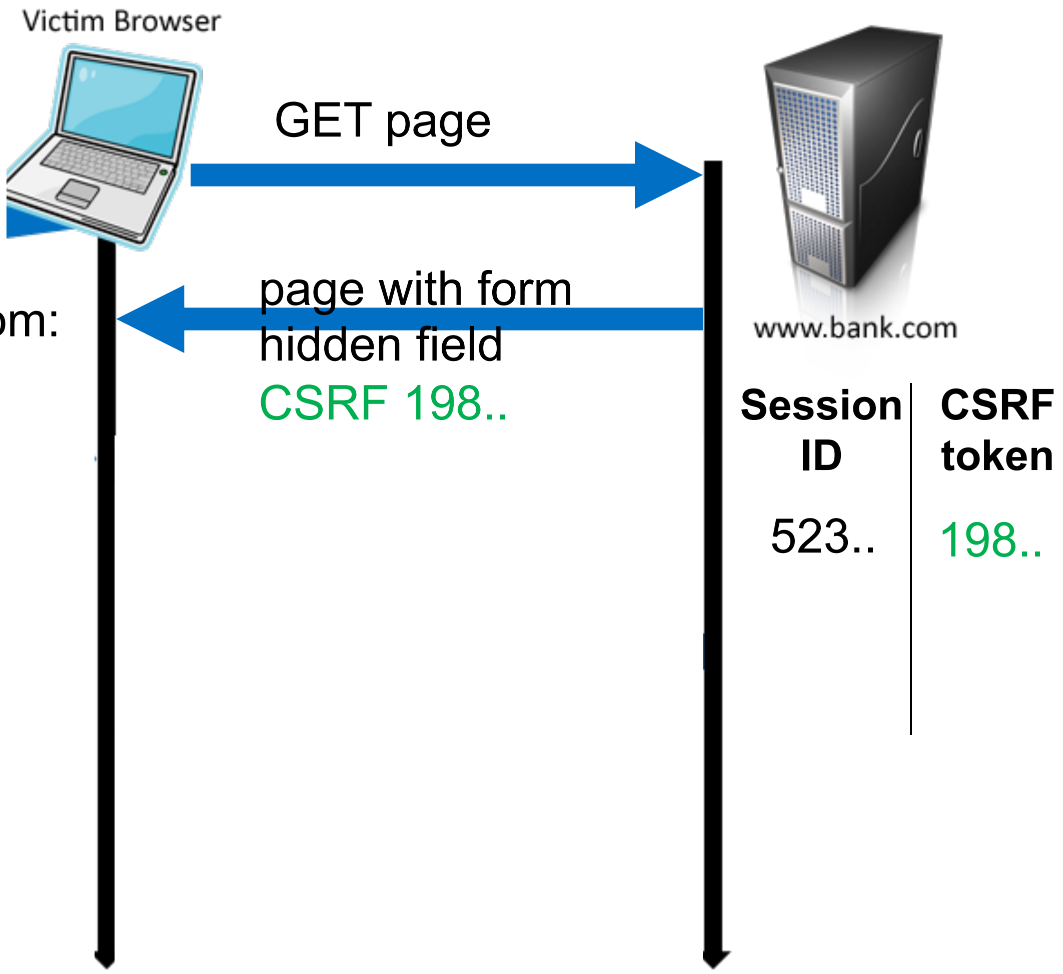
CSRF token must be hard to guess by the attacker

How the token is used

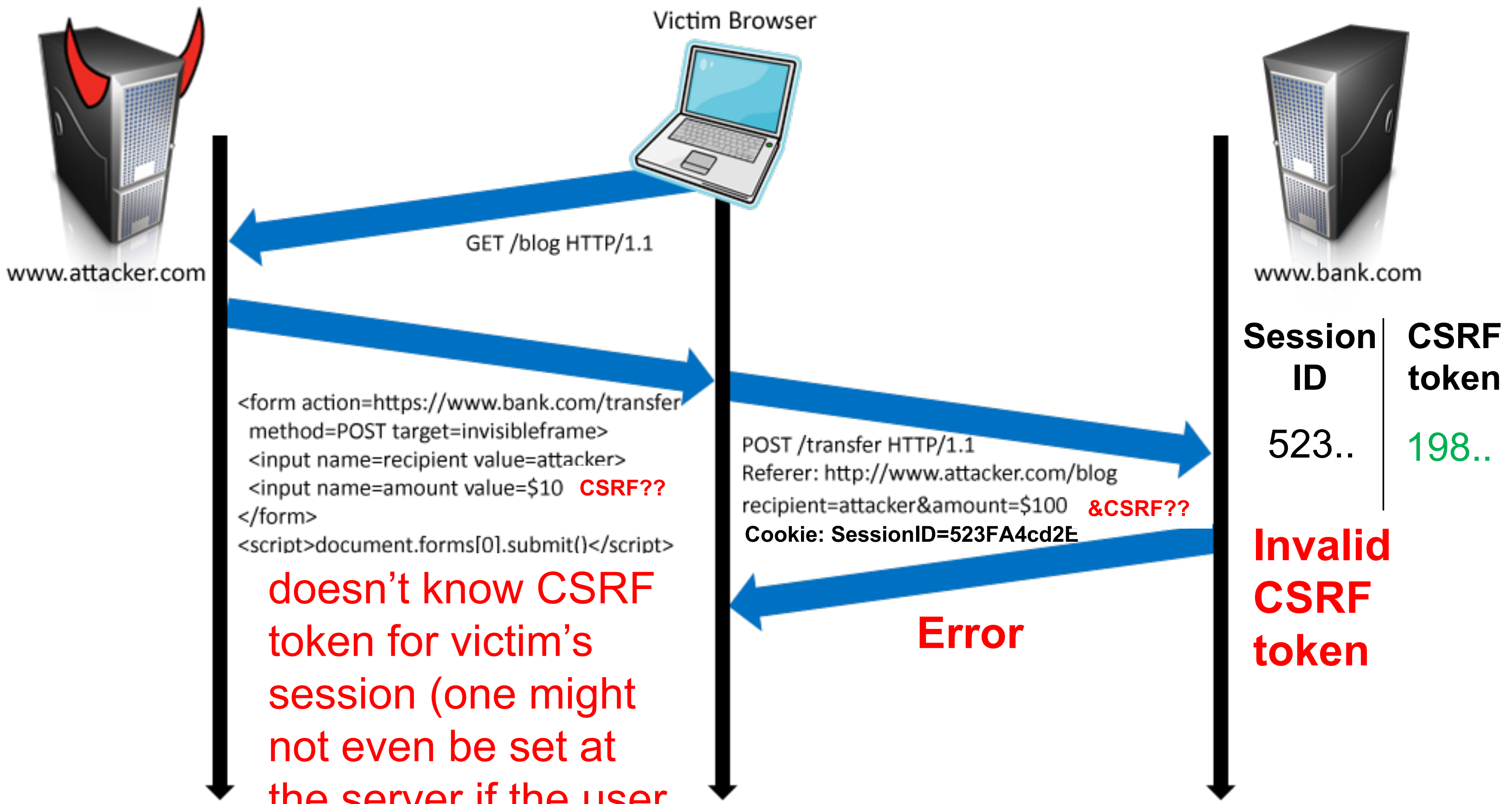
- The server stores state that binds the user's CSRF token to the user's session token
- Embeds a fresh CSRF token in every form
- On every request the server validates that the supplied CSRF token is associated with the user's session token
- Disadvantage is that the server needs to maintain a large state table to validate the tokens.

Regular use

cookie for bank.com:
SessionID =
523FA4cd2E



Attack attempt



```
<form action=https://www.bank.com/transfer
  method=POST target=invisibleframe>
  <input name=recipient value=attacker>
  <input name=amount value=$10   CSRF??
</form>
<script>document.forms[0].submit()</script>
```

```
POST /transfer HTTP/1.1
Referer: http://www.attacker.com/blog
recipient=attacker&amount=$100   &CSRF??
Cookie: SessionID=523FA4cd2E
```

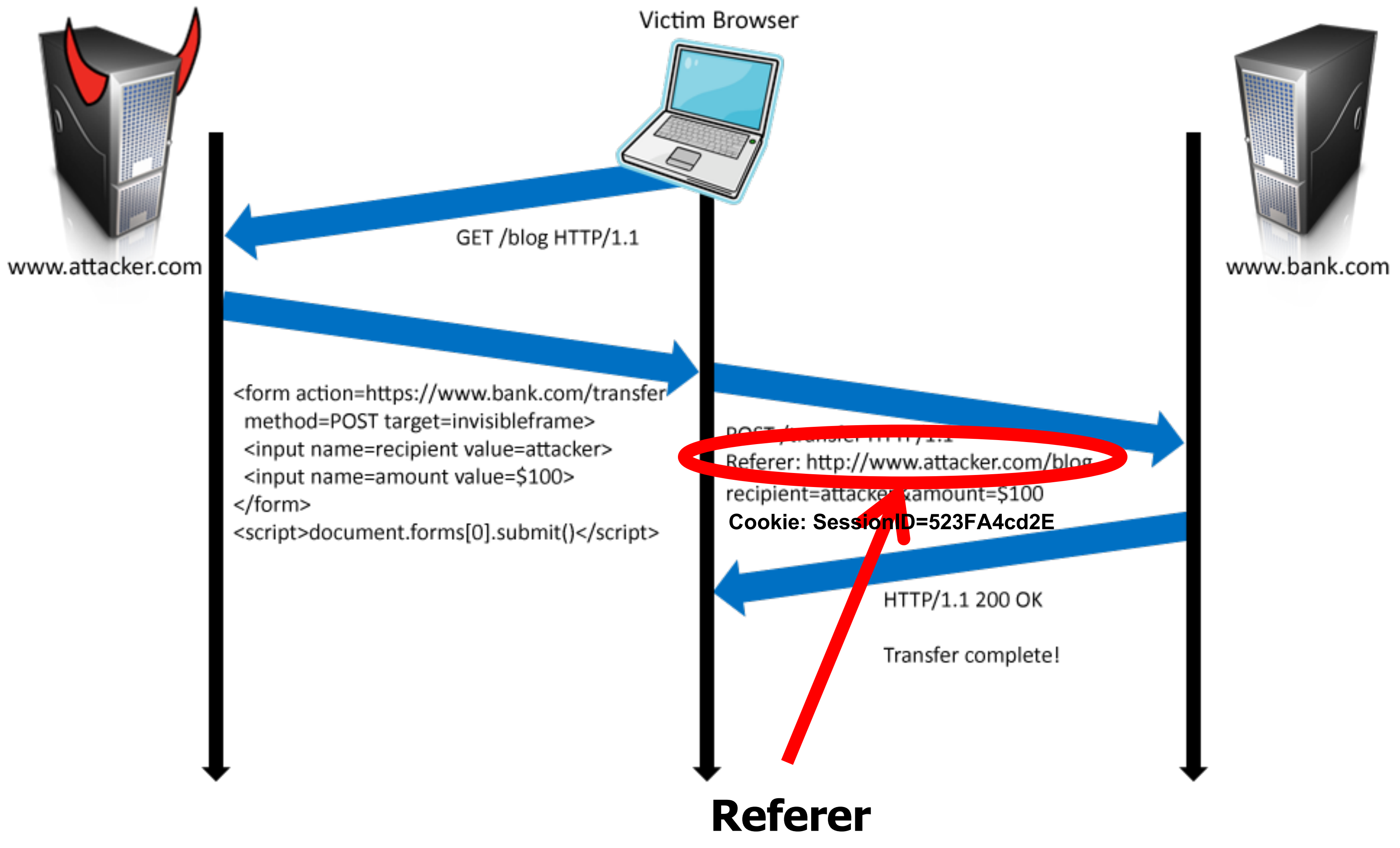
Session ID	CSRF token
523..	198..

doesn't know CSRF token for victim's session (one might not even be set at the server if the user did not request the form recently)

Other CRSF protection: Referer Validation

- When the browser issues an HTTP request, it includes a referer header that indicates which URL initiated the request
- This information in the Referer header could be used to distinguish between same site request and cross site request

Refer header



```
GET /blog HTTP/1.1
```

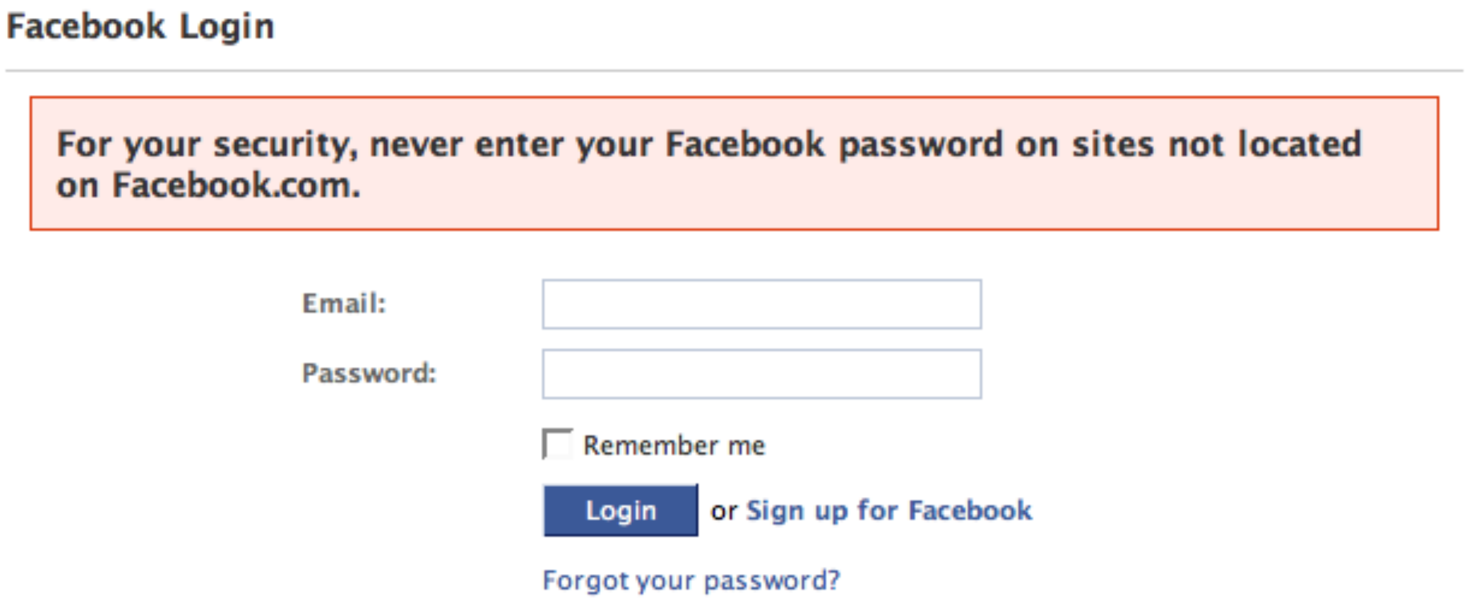
```
<form action=https://www.bank.com/transfer
  method=POST target=invisibleframe>
  <input name=recipient value=attacker>
  <input name=amount value=$100>
</form>
<script>document.forms[0].submit()</script>
```

```
POST /transfer HTTP/1.1
Referer: http://www.attacker.com/blog
recipient=attacker&amount=$100
Cookie: SessionID=523FA4cd2E
```

```
HTTP/1.1 200 OK

Transfer complete!
```

Referer Validation



Facebook Login

For your security, never enter your Facebook password on sites not located on Facebook.com.

Referer Validation Defense

- HTTP Referer header
  - Referer: http://www.facebook.com/ ✓
  - Referer: http://www.attacker.com/evil.html ✗
  - Referer: [empty] ?
    - Strict policy disallows (secure, less usable)
    - Lenient policy allows (less secure, more usable)

Privacy Issues with Referer header

- The referer contains sensitive information that impinges on the privacy
- The referer header reveals contents of the search query that lead to visit a website.
- Some organizations are concerned that confidential information about their corporate intranet might leak to external websites via Referer header

Referer Privacy Problems

- Referer may leak privacy-sensitive information

```
http://intranet.corp.apple.com/
projects/iphone/competitors.html
```

- Common sources of blocking:
  - Network stripping by the organization
  - Network stripping by local machine
  - Stripped by browser for HTTPS -> HTTP transitions
  - User preference in browser

Summary: CSRF

- CSRF attacks execute request on benign site because cookie is sent automatically
- Defenses for CSRF:
  - embed unpredictable token and check it later
  - check referer header in addition as defense in depth