Web Application Security

Lecture 3

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Web Application Security

- 19/11: Historical introduction to technologies and vulnerabilities that accompany them
- 26/11: Defenses XSS and DOM-XSS: sanitizers, Content Security Policy
- 10/12: Same Origin Policy
- 17/12: JavaScript vulnerabilities and defences
- 07/01: Pysa or/and Trusted Types
- 14/01: Mandatory workshop (15'+5'): 9-12h30
- 21/01 or 28/01: examen (9h -12h30), required: mandatory TP exercises

Same Origin Policy (high level)

Implemented in the browsers :

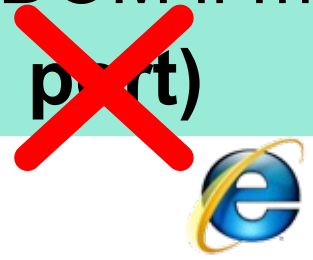
Full access to same origin resources

Isolation from different origin resources

Same origin policy: "high level"

Same Origin Policy (SOP) for DOM:

- Origin A can access origin B's DOM if match on **(scheme, domain, port)**



Same Original Policy (SOP) for cookies:

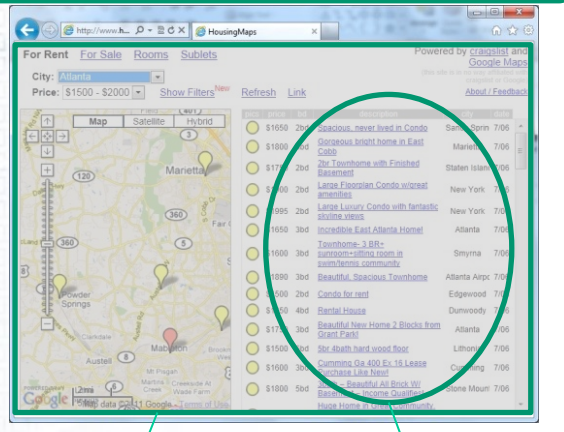
- Generally speaking, based on: **([scheme], domain, *path*)**

optional

to read: On the Incoherencies in Web Browser Access Control Policies, Singh et al, IEEE S&P 2010

Same Origin Policy for DOM

Using `<script>` tag

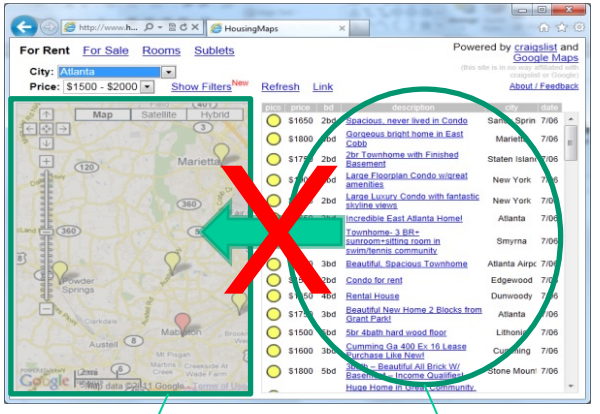


Google Maps Gadget

Integrator's Housing Data

- Full sharing (JS Env.)
- Running as integrator
- Gadget trusted

Using `<iframe>` frame



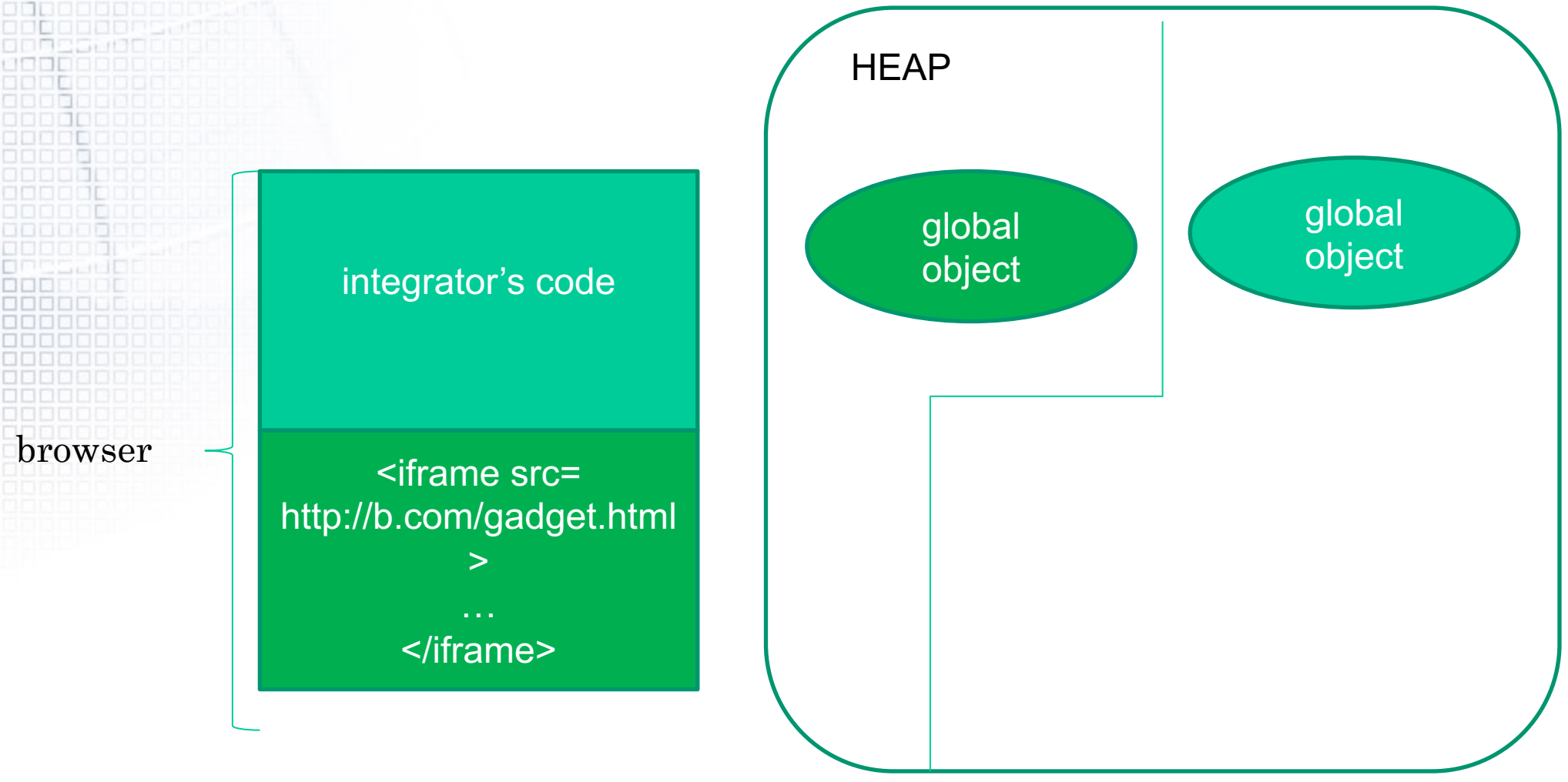
Google Maps Gadget

Integrator's Housing Data

- Full isolation (by SOP)
- Running as gadget
- Limited sharing
  - Frame identifier
  - PostMessage

The same origin policy (SOP)

- The <iframe> tag: Javascript memory



Frame isolation

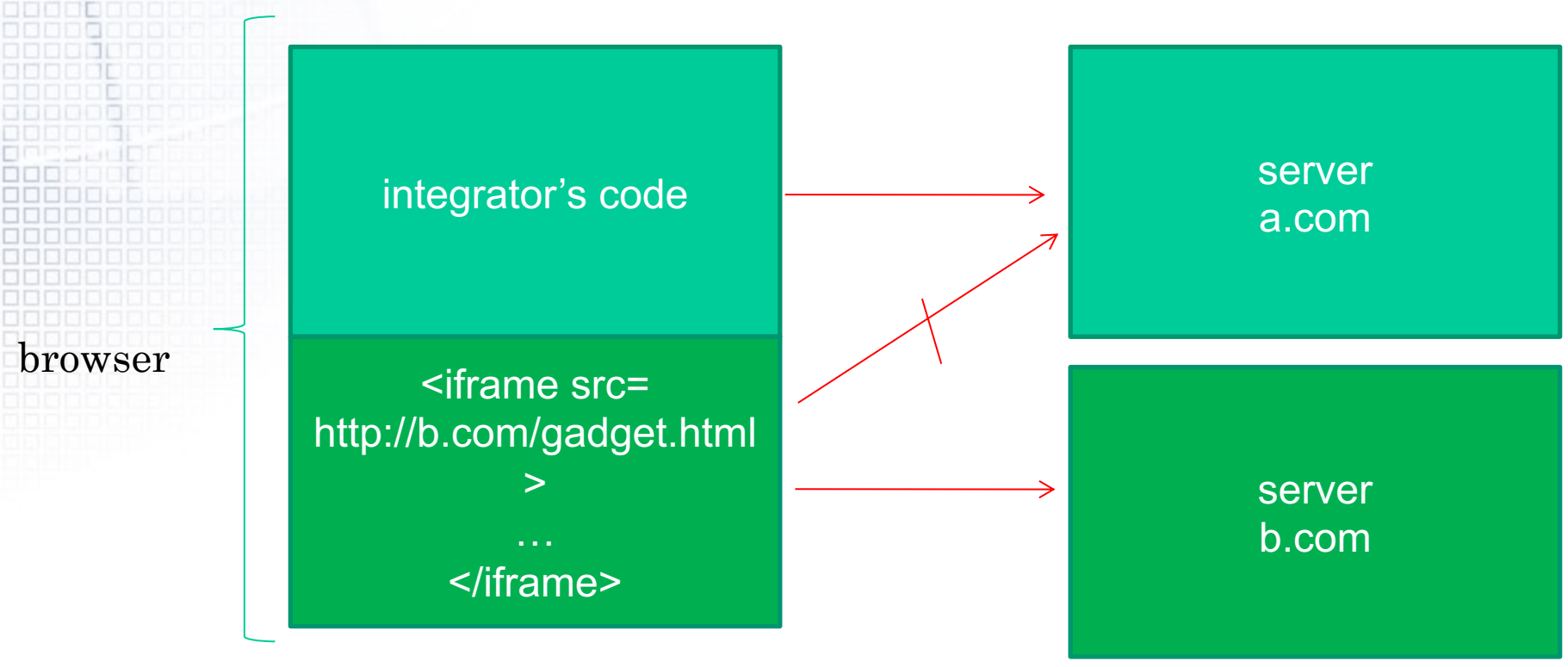
- Other origin frames have isolated DOM resources:
- Example (works in Chrome):

```
<!-- This is allowed -->
<iframe src="SameDomainPage.html"> </iframe>
alert(frames[0].contentDocument.body); //works fine
<!-- This is **NOT** allowed -->
<iframe src="http://google.com"> </iframe>
alert(frames[1].contentDocument.body); //throws error
```

Example sop.html

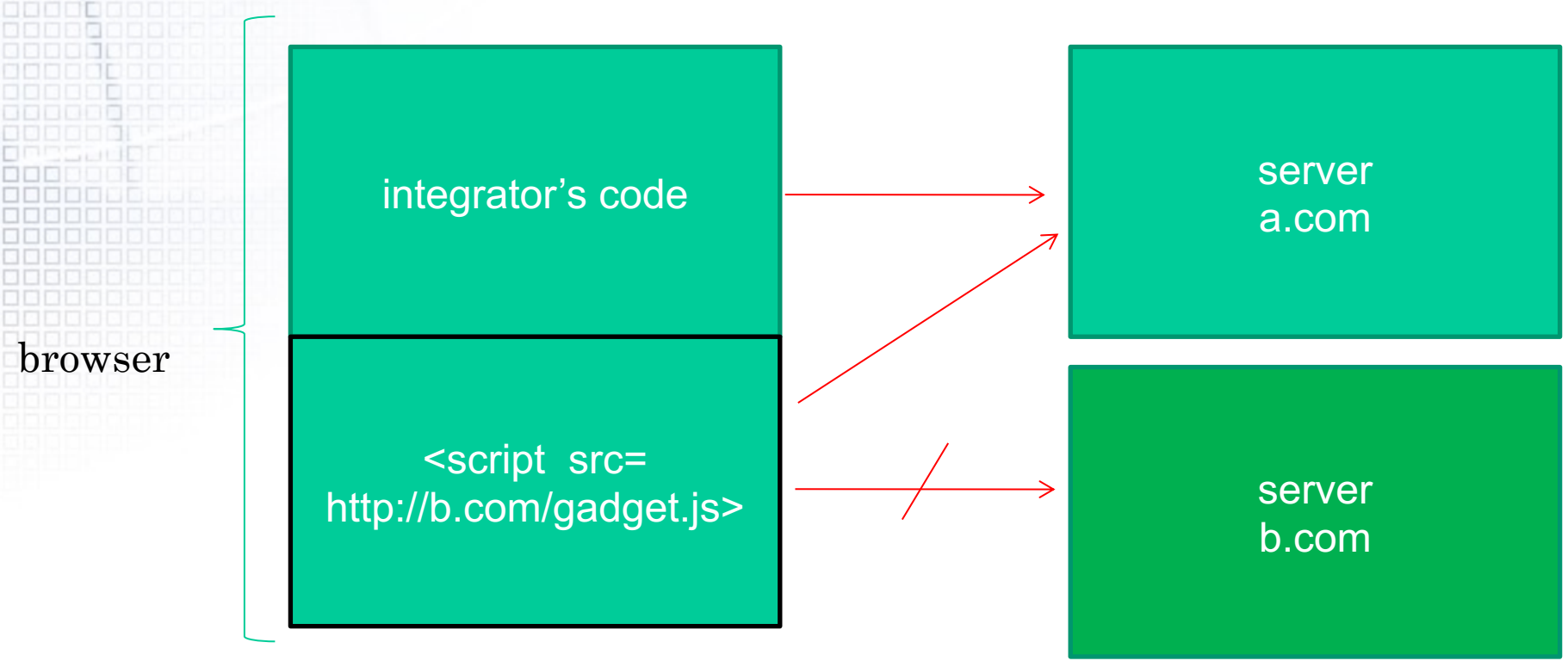
The same origin policy (SOP)

- The <iframe> tag: code treated as external code (different origin). The cross domain request is forbidden only before HTML5 (CORS)



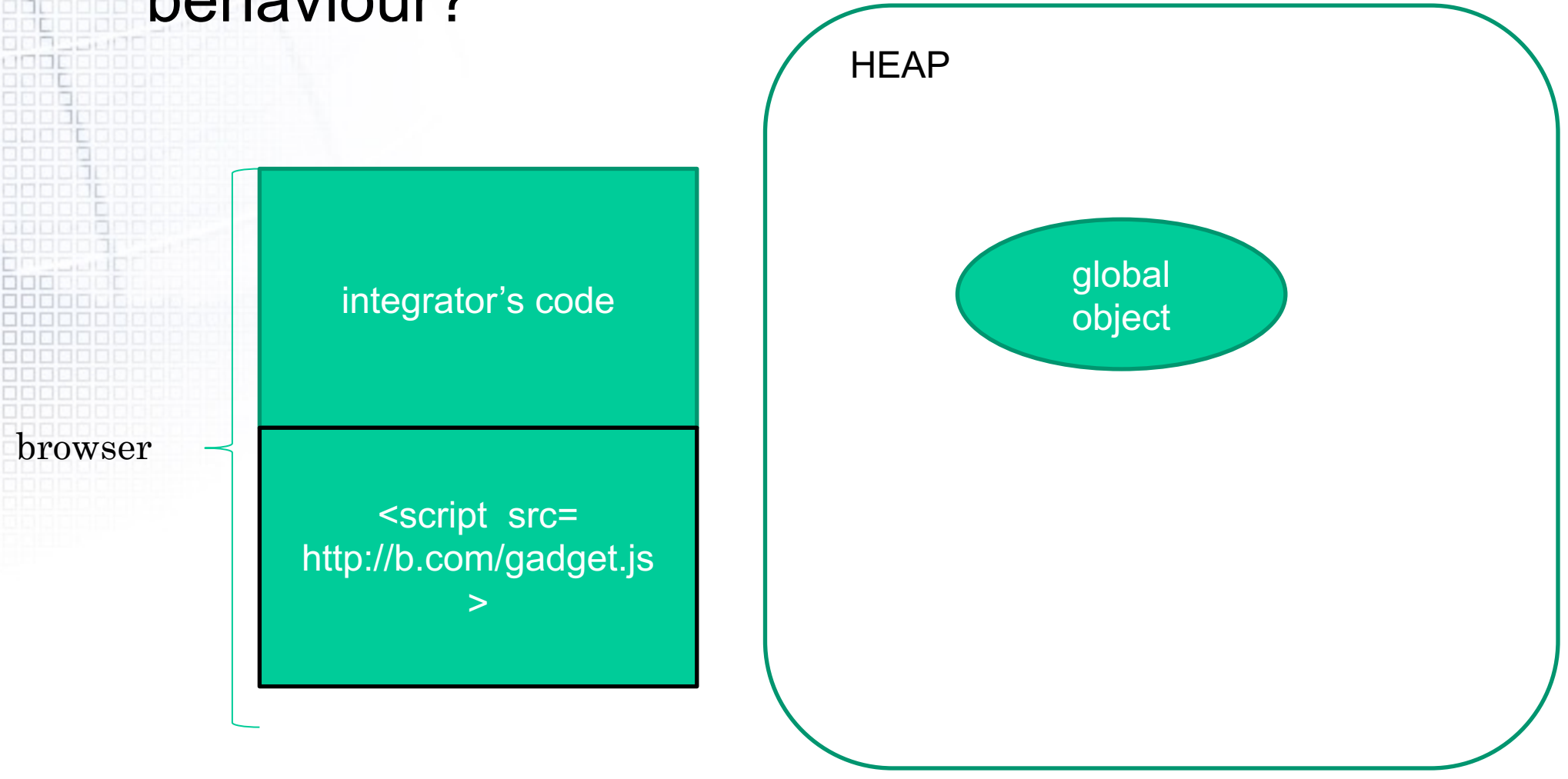
The same origin policy (SOP)

- The <script> tag permits to treat code as code from the same origin. The cross domain request is forbidden only before HTML5 (CORS)



The same origin policy (SOP)

- The <script> tag: what about Javascript behaviour?



SOP Example

Can the iframe see it's parent secret?

```
<div id=secret> The secret is 42 </div>
<iframe
src="http://subdomain.host.com/subdomainpage2.ht
ml">
</iframe>
```

SOP Incoherences

Can the iframe see its parent secret?

```
<div id=secret> The secret is 42 </div>
<iframe
src="http://subdomain.host.com/subdomainpage2.ht
ml">
</iframe>
```

And if we change document.domain?

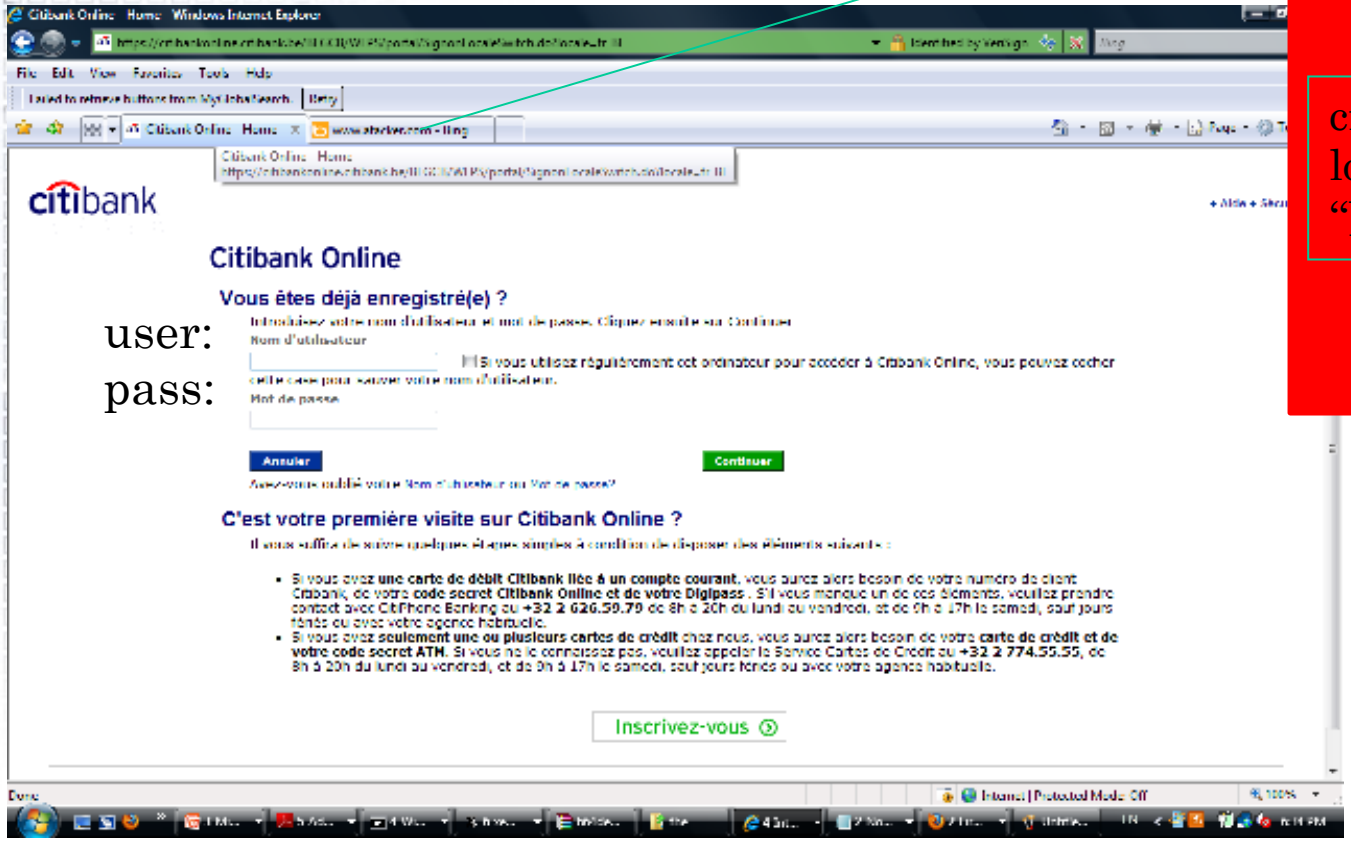
Security problems with SOP due to Frame Communication

Frame isolation

- Other frames cannot access resources from other origins

- Browsers implement a navigation policy that is allowed (changing .location attribute of frame)
  - permissive policy: Guninski attack on CitiBank
  - window policy: gadget hijacking attacks (igoogle+hotmail)

Guninski attack (permissive policy, 1999)



Other browser window/tab location = attacker

citibankWindow.frames[0].location = "https://attacker.com/login"

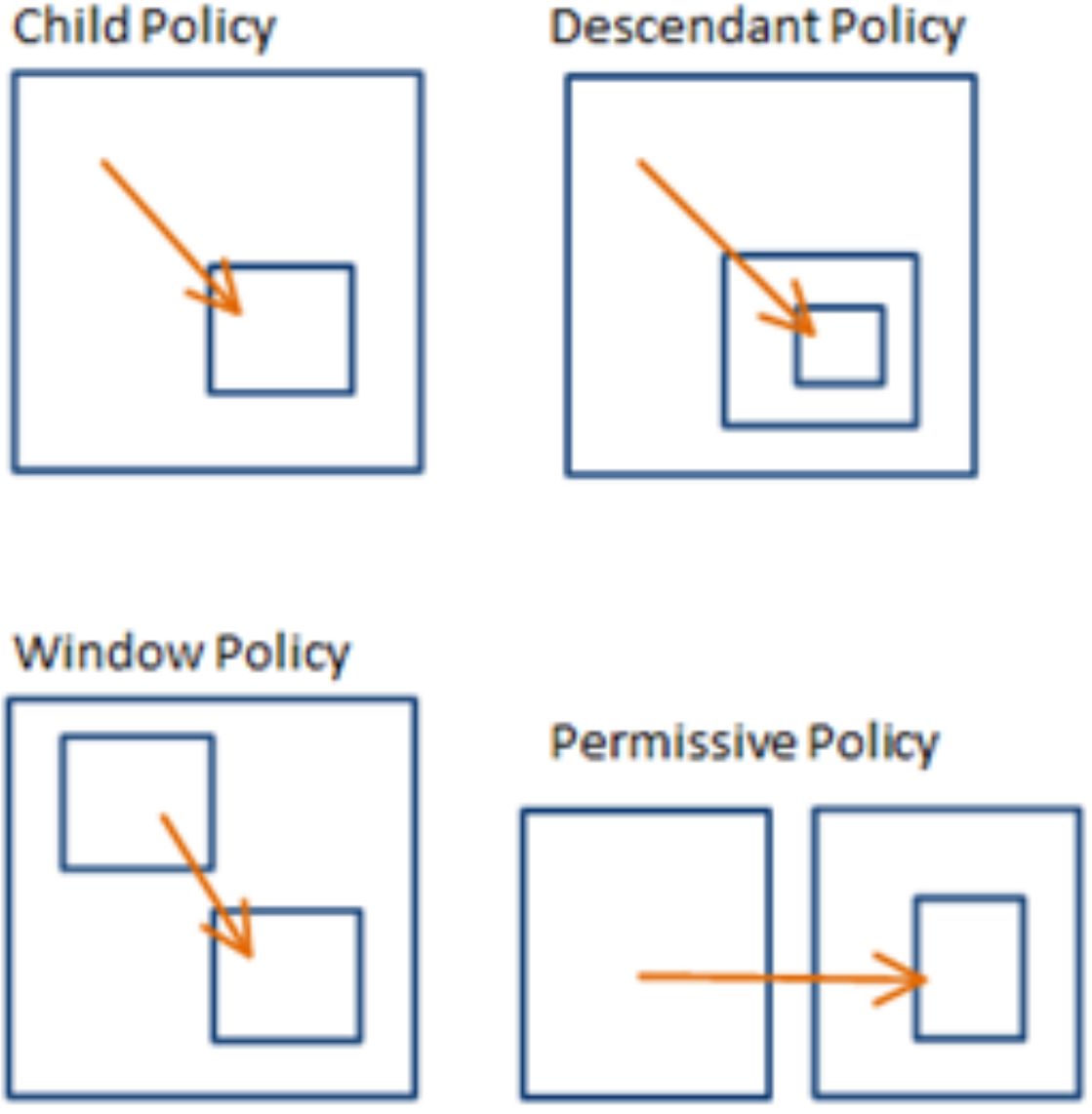
SOP applies but attacker can navigate the login frame and replace it with its own code !

Frame isolation

- Other frames cannot access resources from other origins

- Browsers implement a navigation policy that is allowed (changing .location attribute of frame)
  - permissive policy: Guninski attack on CitiBank
  - window policy: gadget hijacking attacks (igoogle+hotmail)
  - descendant policy
  - child policy

Navigation policies



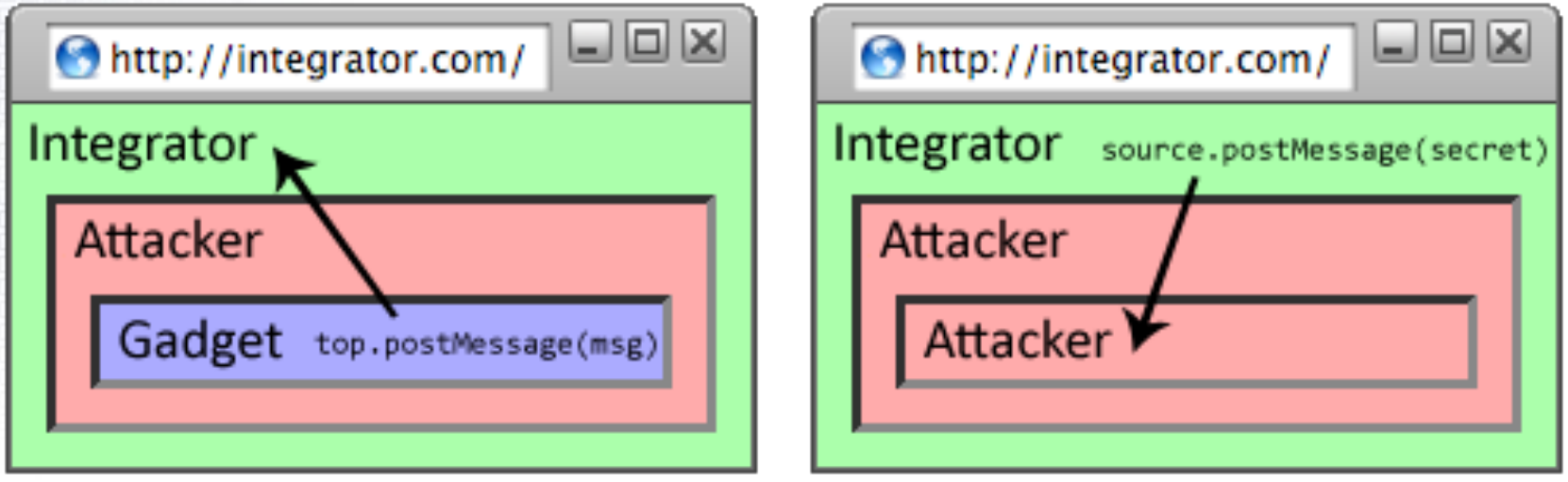
Fragment Identifier Messaging

- Send information by navigating a frame
  - http://gadget.com/**#hello**
- Navigating to fragment doesn't reload frame
  - No network traffic, but frame can read its fragment
- Not a secure channel
  - Confidentiality ✓
  - Integrity ✓
  - Authentication ✗

HTML 5

- Cross-origin client side communications
- Postmessage channel between frames
- Child policy

Reply Attack



Example of PostMessage

'http://destination.com

```
window.addEventListener('message',function(event){
    if(event.origin !== 'http://originExpected.com')
    {return;}
    {console.log('received response: ',event.data);
    event.source.postMessage('received',event.origin
});
```

frame at 'http://originExpected.com

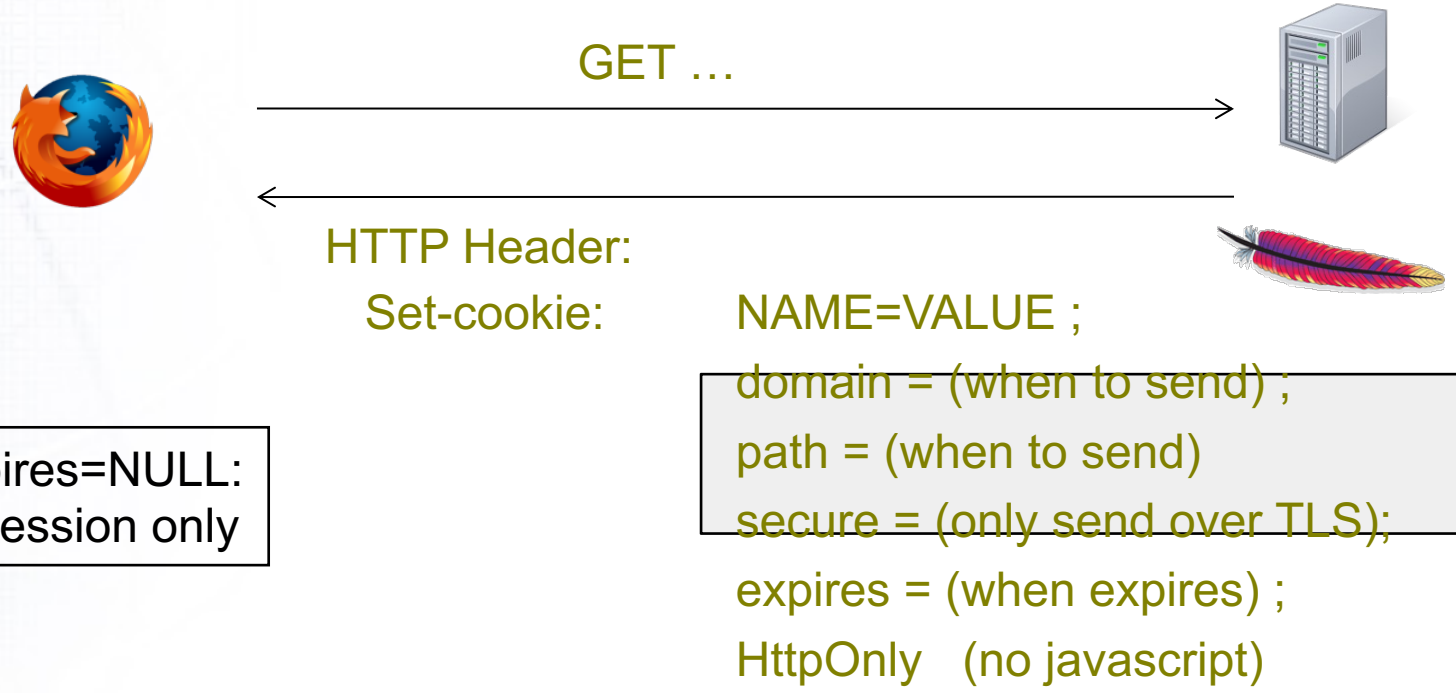
```
var domain = 'http://destination.com';
var iframe =
document.getElementById('myIFrame').contentWindow;
var message = 'Hello!';
iframe.postMessage(message,domain);
```

Security considerations postmessage

- Do not configure target origin (recipient) to “*”
- Sensitive data can be leaked to unknown widgets
- Always check for sender’s origin
- Always validate data before use
- Do not consume data directly with eval() or innerHTML

SAME ORIGIN POLICY FOR COOKIES

Setting/deleting cookies by server



- Delete cookie by setting “expires” to date in past
- Default scope is domain and path of setting URL

SameSite:

it restricts when browser sends the cookies

Attribute	When cookie fires	Default mode
SameSite=Strict	Domain in URL bar equals the cookie's domain (first-party) AND the link isn't coming from a third-party	n/a
SameSite=Lax	Domain in URL bar equals the cookie's domain (first-party)	New default if SameSite is not set
'SameSite=None'	No domain limitations and third-party cookies can fire	Previous default; now needs to specify 'None; Secure' for Chrome 80

https://portswigger.net/web-security/csrf/bypassing-samesite-restrictions#:~:text=SameSite%20is%20a%20browser%20security,leaks%2C%20and%20some%20CORS%20exploits.

Who can set a cookie?

domain: any domain-suffix of URL-hostname, except TLD

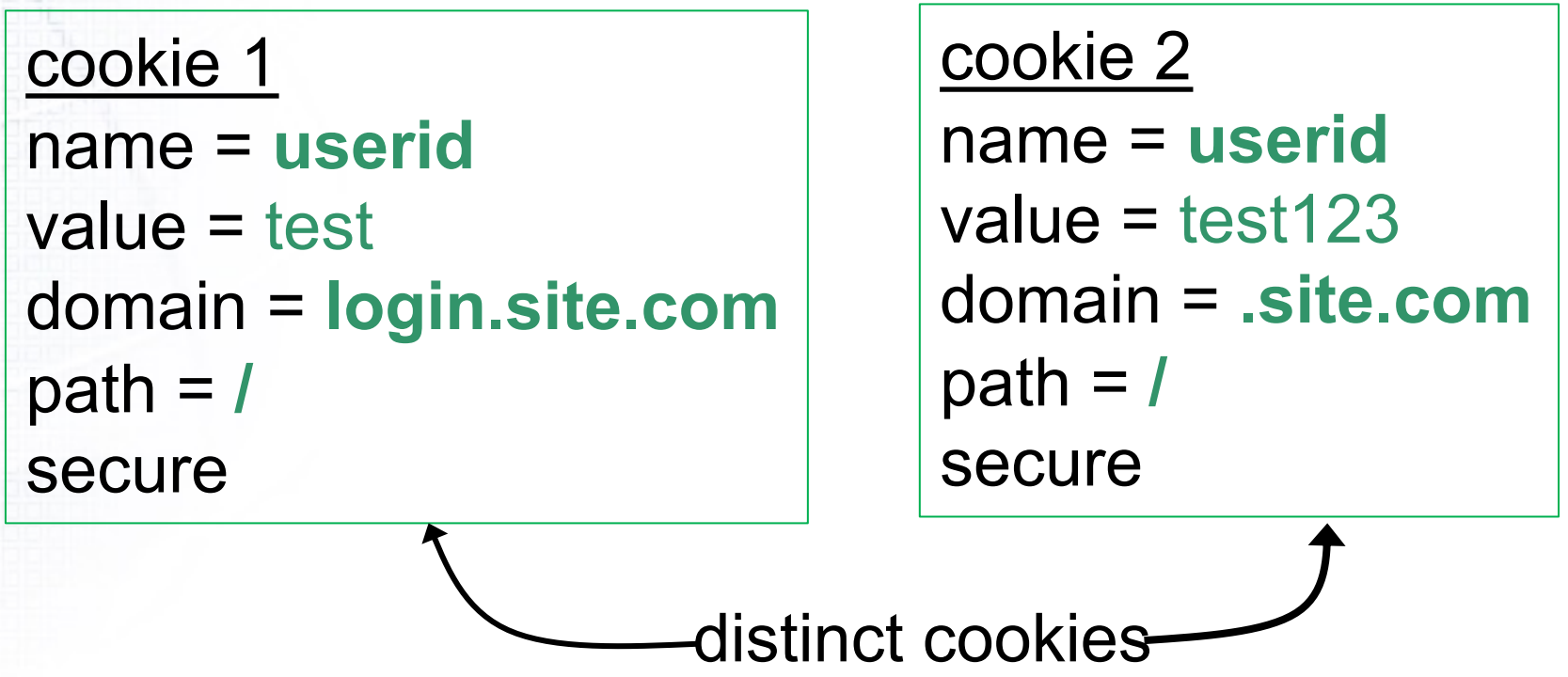
example: host = “login.site.com”

allowed domains	disallowed domains
login.site.com	**user.site.com**
.site.com	**othersite.com**
	.com

⇒ **login.site.com** can set cookies for all of **.site.com** but not for another site or TLD

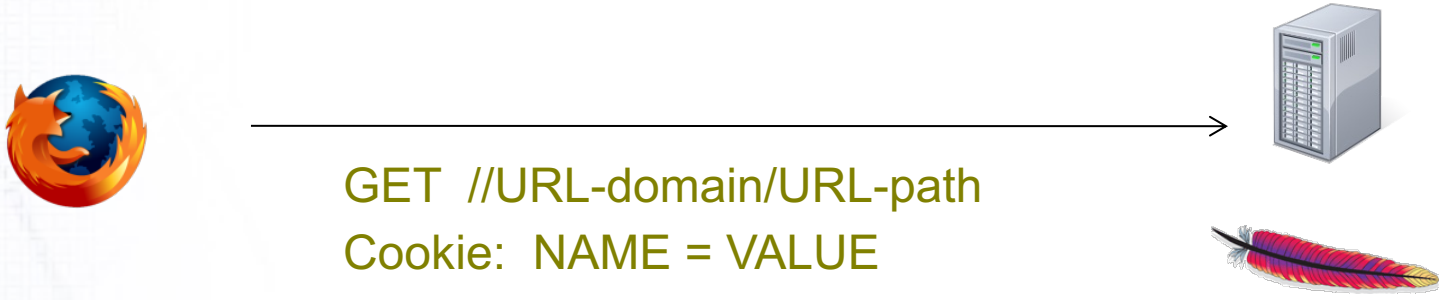
path: can be set to anything

Cookies are identified by (name,domain,path)



- Both cookies stored in browser's cookie jar;
  both are in scope of **login.site.com**

Who can read a cookie?



Browser sends all cookies in URL scope (according to SameSite):

- cookie-domain is domain-suffix of URL-domain, and
- cookie-path is prefix of URL-path, and
- [protocol=HTTPS if cookie is “secure”]

Examples

both set by **login.site.com**

cookie 1	cookie 2
name = **userid**	name = **userid**
value = u1	value = u2
domain = **login.site.com**	domain = **.site.com**
path = **/**	path = **/**
secure	non-secure

If I type the following URL in my browser, which cookie will the browser send?

http://checkout.site.com/	cookie: userid=u2
http://login.site.com/	cookie: userid=u2
https://login.site.com/	**cookie: userid=u1; userid=u2**

(arbitrary order)

Client side read/write: document.cookie

Let's see cookies in browser!

- Setting a cookie in Javascript:

  document.cookie = "name=value; expires=…; "

- Reading a cookie: alert(document.cookie)

  prints string containing all cookies available for document (based on [protocol], domain, path)

Example sop3.php

- Deleting a cookie:

  document.cookie = "name=; expires= Thu, 01-Jan-70"

When a server sees a cookies it

- Does not see cookie attributes (e.g. secure)
- Does not see which domain set the cookie

Server only sees: **Cookie: NAME=VALUE**

This server blindness carries some problems

Example : server does not see which domain set the cookie

- Alice logs in at **login.site.com**

  login.site.com sets session-id cookie for **.site.com**

- Alice visits **evil.site.com**

  overwrites .site.com session-id cookie with session-id of user “badguy”

- Alice visits **homework.site.com** to submit homework.

  homework.site.com thinks it is talking to “badguy”

Interaction with the DOM SOP

Cookie SOP: path separation

x.com/A does not see cookies of x.com/B

Not a security measure:

DOM SOP: x.com/A has access to DOM of x.com/B

```
<iframe src="x.com/B"></iframe>
alert(frames[0].document.cookie);
```

Path separation is done for efficiency not security:

x.com/A is only sent the cookies it needs

TP

1) Look at the code of integrator.html and write code for evilGadget.js in such a way that evilGadget.js will send the secret to evil.com. Rewrite integrator.html so the same origin policy will protect the secret.
2) Look at the sop2.html. From subdomain2.html try to read the secret from the integrator, what happens according to SOP? How do you read the secret by using document.domain?

TP cont.

3. Write two different services from the same server that set a cookie. On the client side include a gadget and try the following things:

- let the gadget delete the cookie via JavaScript
- can the second service delete the cookie of the first? Justify why.
- let the gadget send the cookie to another server (you can use a different port to simulate this)
- Does the previous item work if the gadget is inside a frame?
- and if the gadget is inside a script and the cookie is initially set as httpOnly?
- and if the gadget is inside a script and the cookie is initially set as secure?

Justify all your answers with code and explanations.

4. Implement a CSRF attack and explain then demonstrate what kind of SameSite cookie can mitigate this attack.