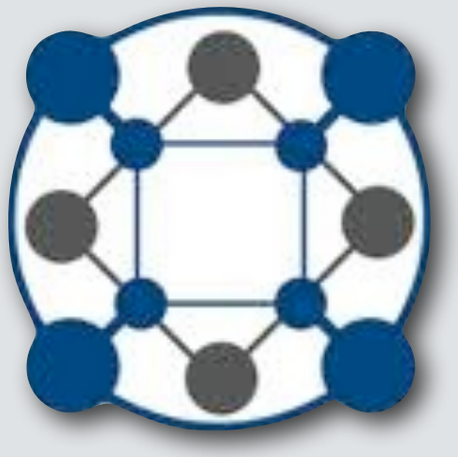
EtherCalc

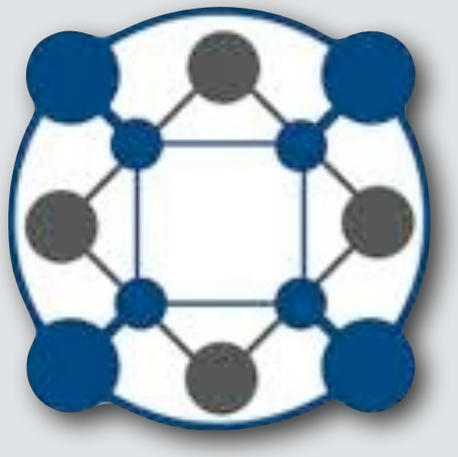
Multiplayer Spreadsheet

ethercalc.tw

Personal Opinions



Personal Opinions



(With Infotisements)

Time Limited

Just Stories

No Coding

Time Limited

Just Ideas

No Coding

ethercalc.org

- `npm install -g ethercalc`
- `ethercalc`

  Please connect to: http://0:8000/

nodejs.org/#download

A.O.S.A., 2011

aosabook.org

aosa.tw

History

VisiCalc, 1979

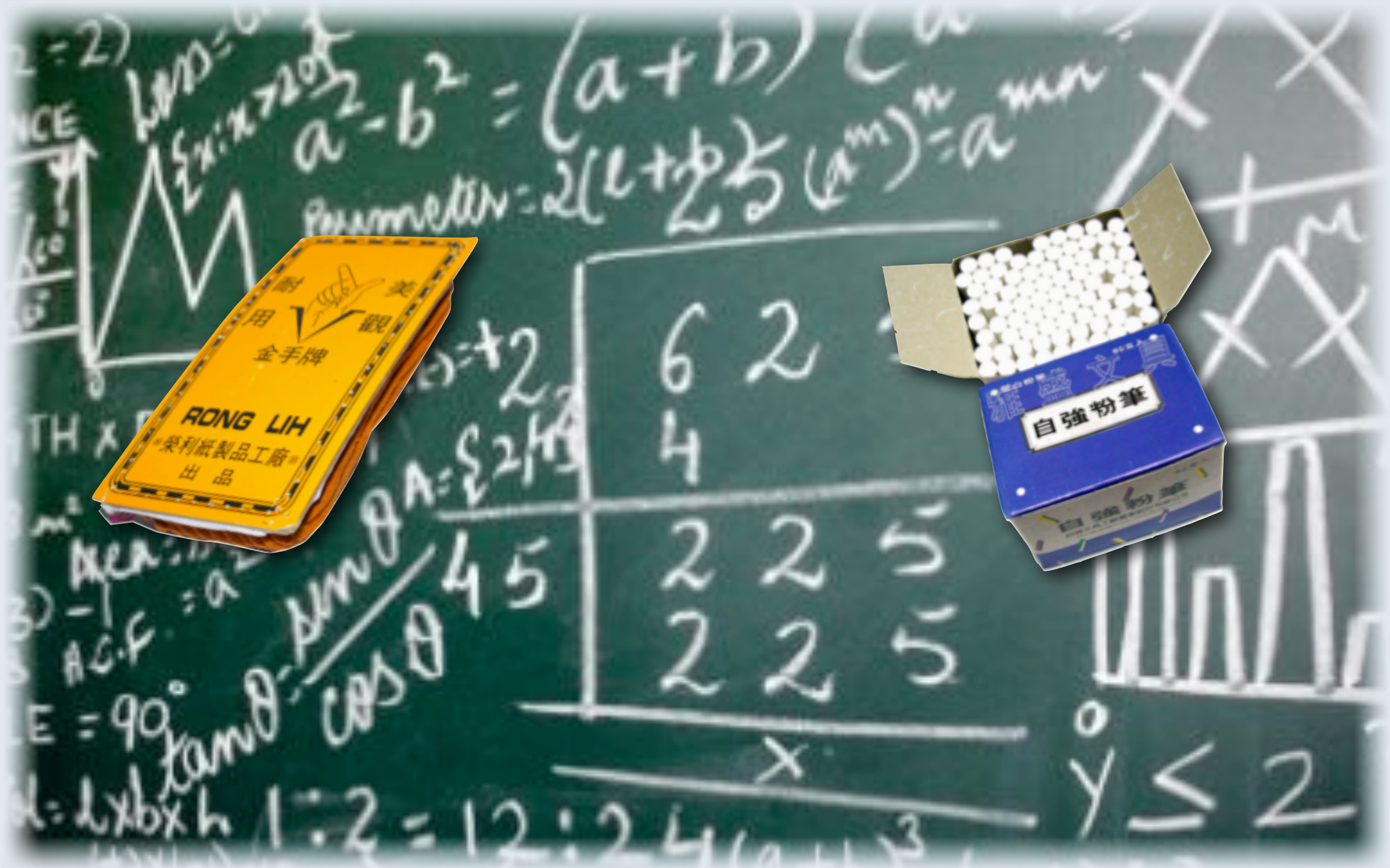
Dan Bricklin

Harvard, 1977

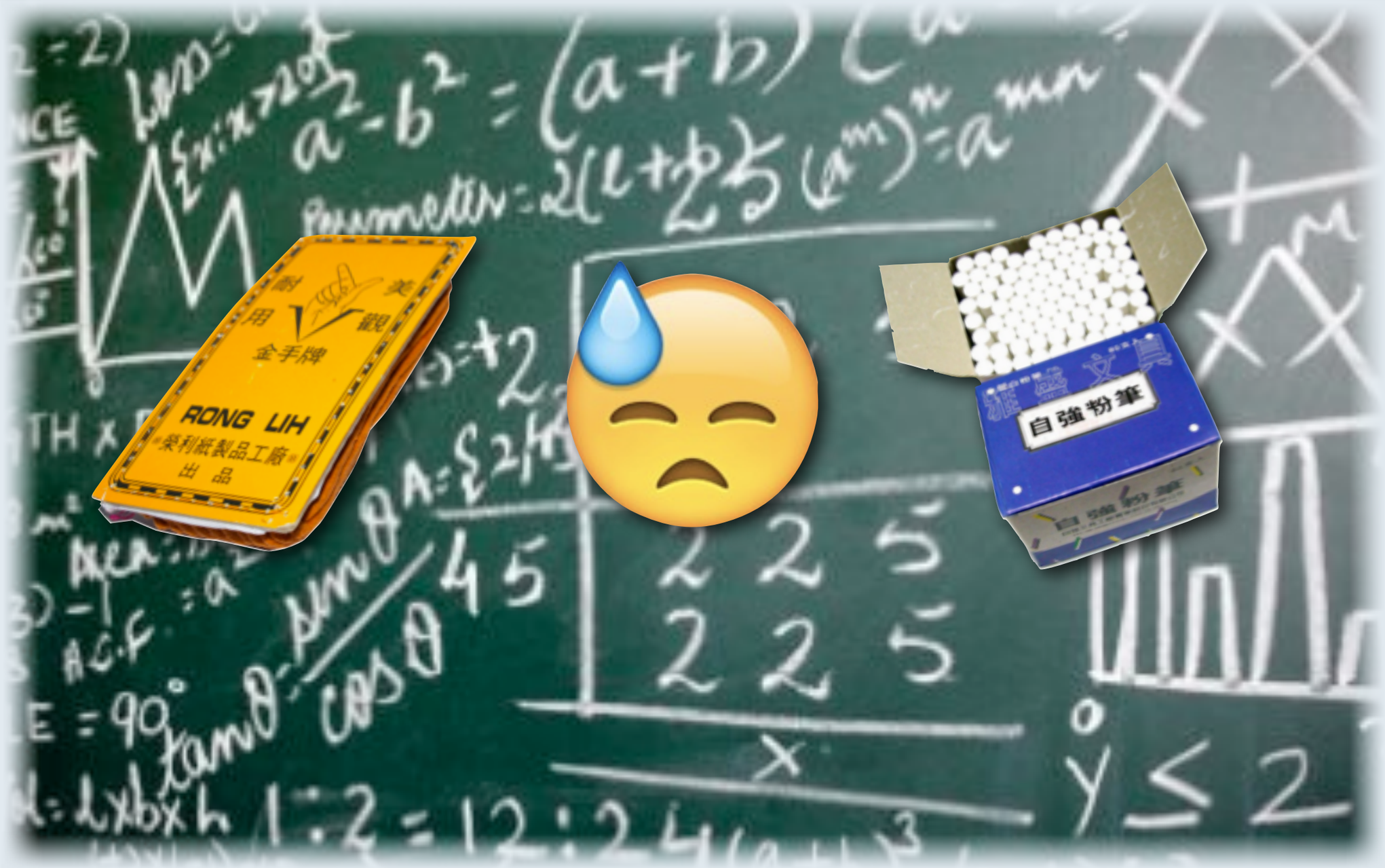
Harvard, 1977

Harvard, 1977

Harvard, 1977



Harvard, 1977



Original Vision

Original Vision

Alto
Workstation

Original Vision

Calculator-Mouse

Alto Workstation

Original Vision

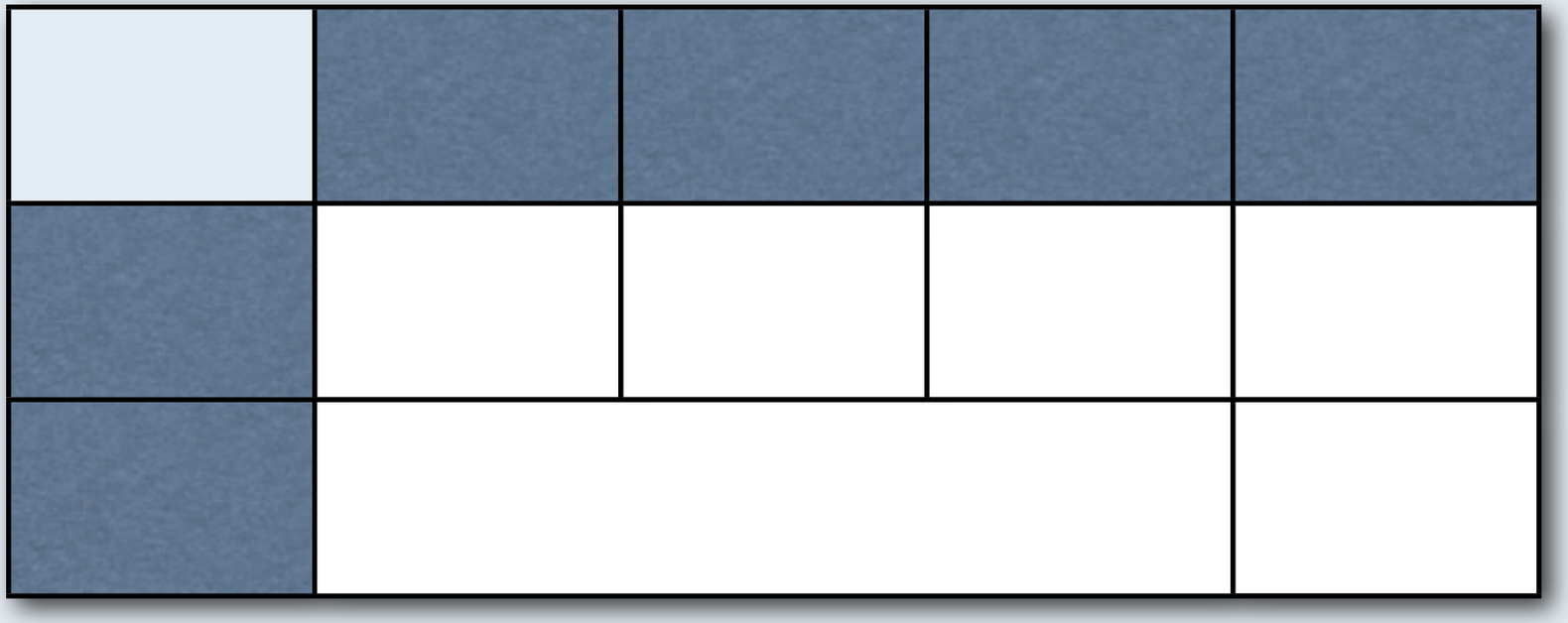
Calculator-Mouse

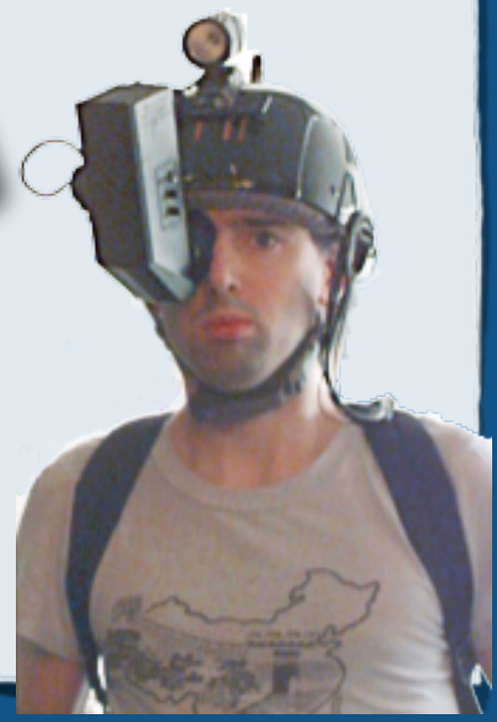
Alto Workstation

Head-mounted Display

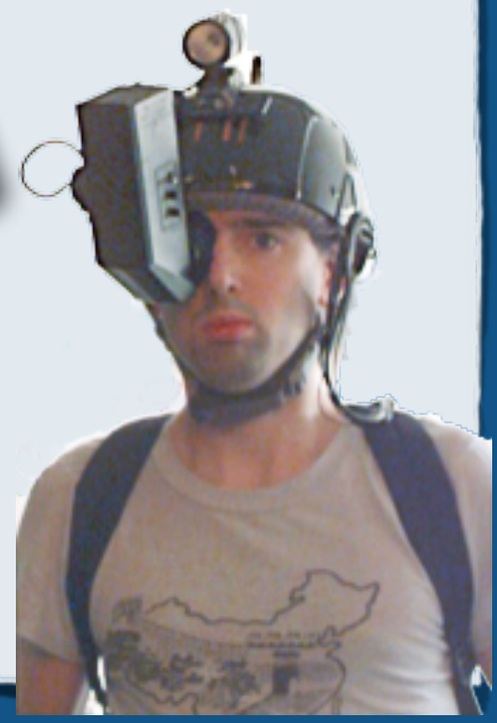
Calcul
Mou

unted
lay

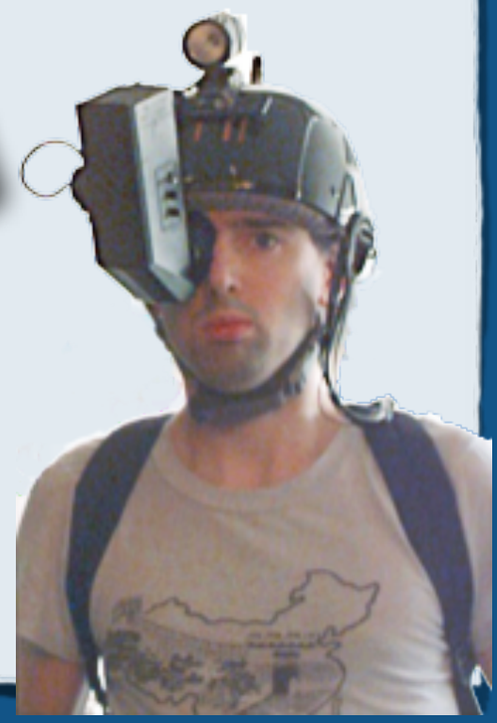




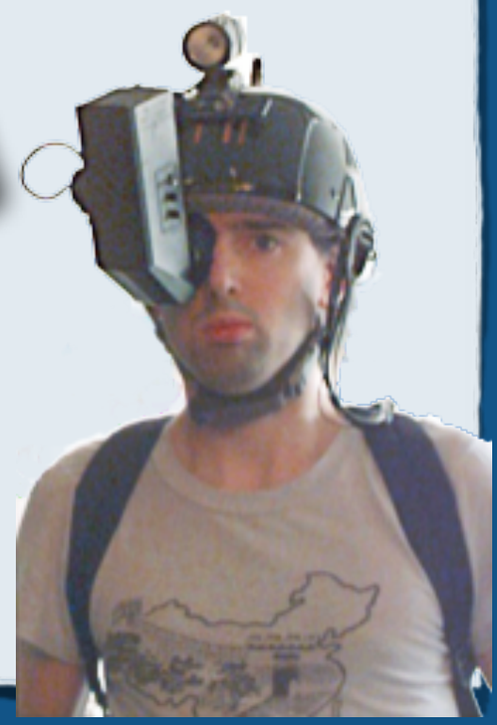
	=SUM( )			**0**



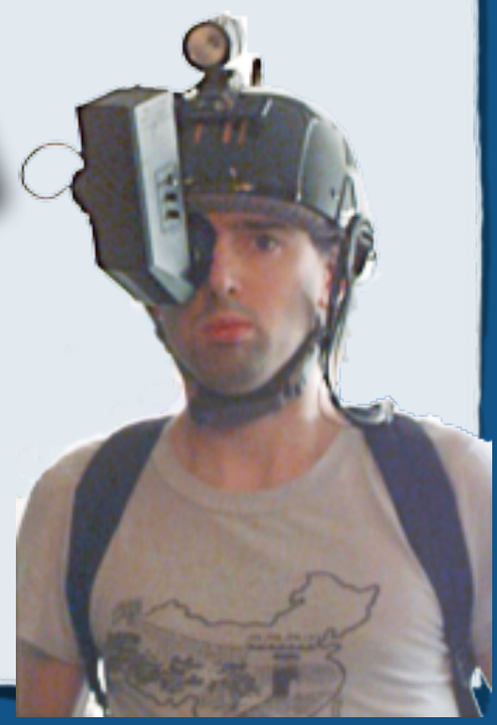
	10			
	=SUM( )			10



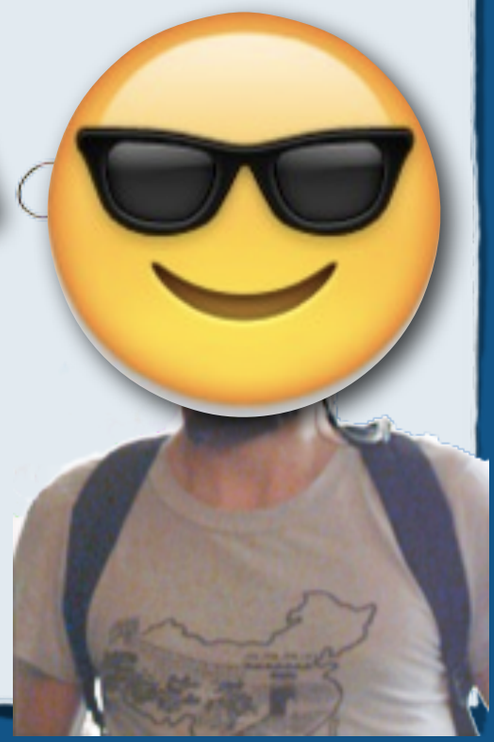
	10	20		
	=SUM( )			30



	10	20	30	
	=SUM( )			60



	10	20	30	
	=SUM( )			60



1977 → 1978

1977 → 1978

1977 → 1978

+

Integer BASIC

1978 → 1979

1978 → 1979

	10	20	30	
	=SUM( )			60

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM( )			60

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

Bob & Dan

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

- **Dan** prototypes in **BASIC**

Bob & Dan

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

- **Dan** prototypes in **BASIC**
- **Bob** codes in **6502 ASM**

Bob & Dan

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

- **Dan** prototypes in **BASIC**
- **Bob** codes in **6502 ASM**
- **700,000** copies in 6 years

Bob & Dan

1978 → 1979

	A	B	C	D
1	10	20	30	
2	=SUM(A1,B1,C1)			60

- **Dan** prototypes in **BASIC**
- **Bob** codes in **6502 ASM**
- **700,000** copies in 6 years
- The first **“Killer App”**

Bob & Dan

1981


IBM


Lotus
1-2-3
Lotus
1-2-3
15


Lotus
1-2-3
Lotus
1-2-3
15


IBM


Lotus
1-2-3
Lotus
1-2-3
15


Lotus


NUMBERS
1
2
3
4
5
6
TOTAL
21
36
54
63
127
158

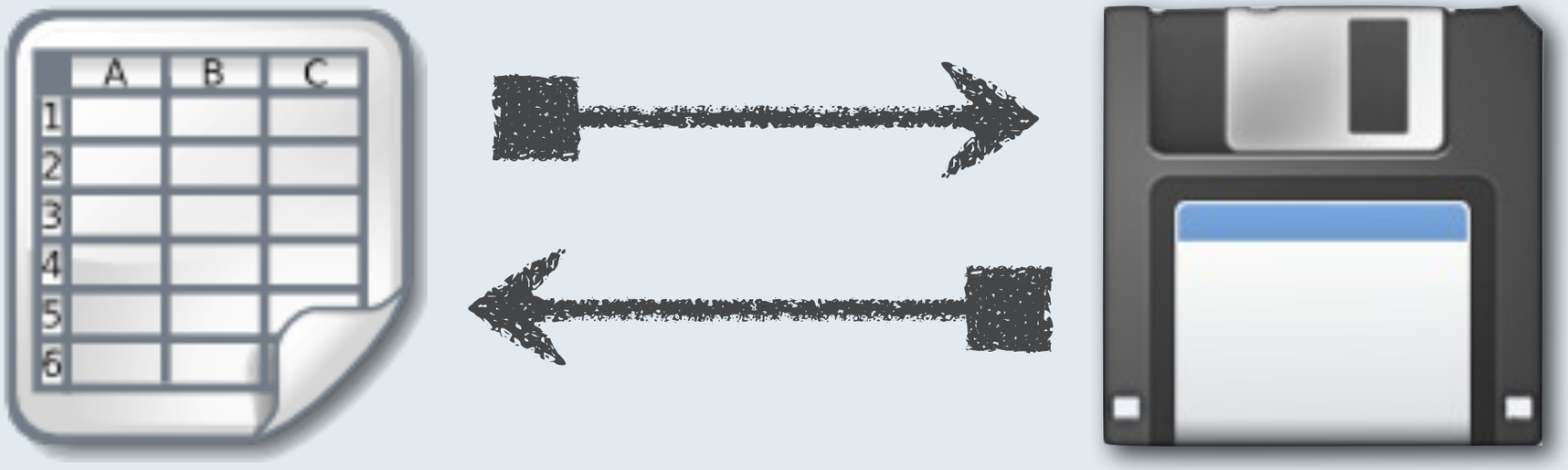

IBM


Lotus
1-2-3
Lotus
1-2-3
15

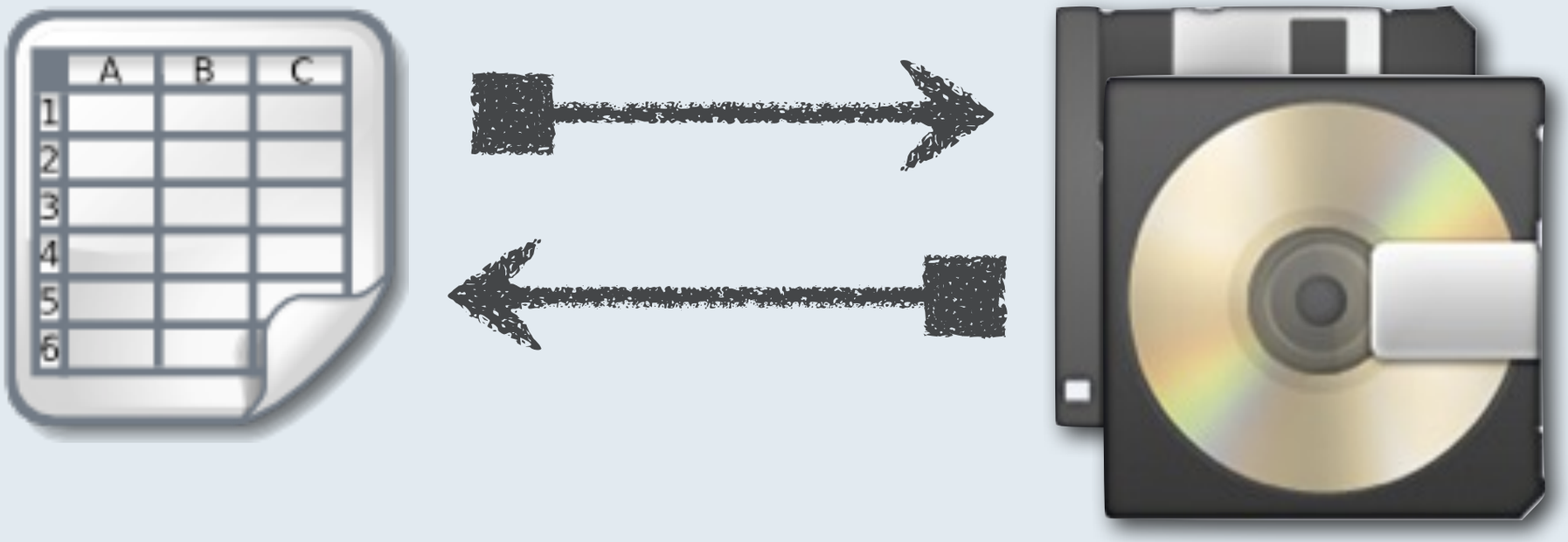

NUMBERS
1
2
3
4
5
6
TOTAL
21
36
54
63
127
158

20 **years** passed

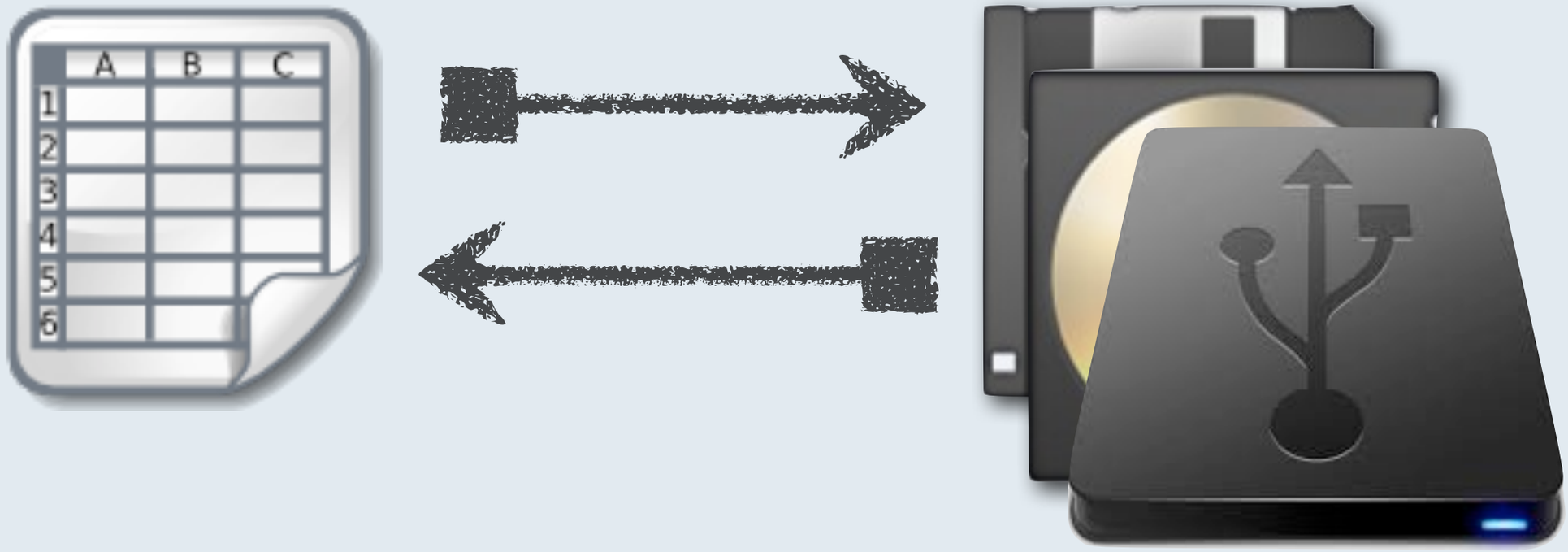
20 years passed



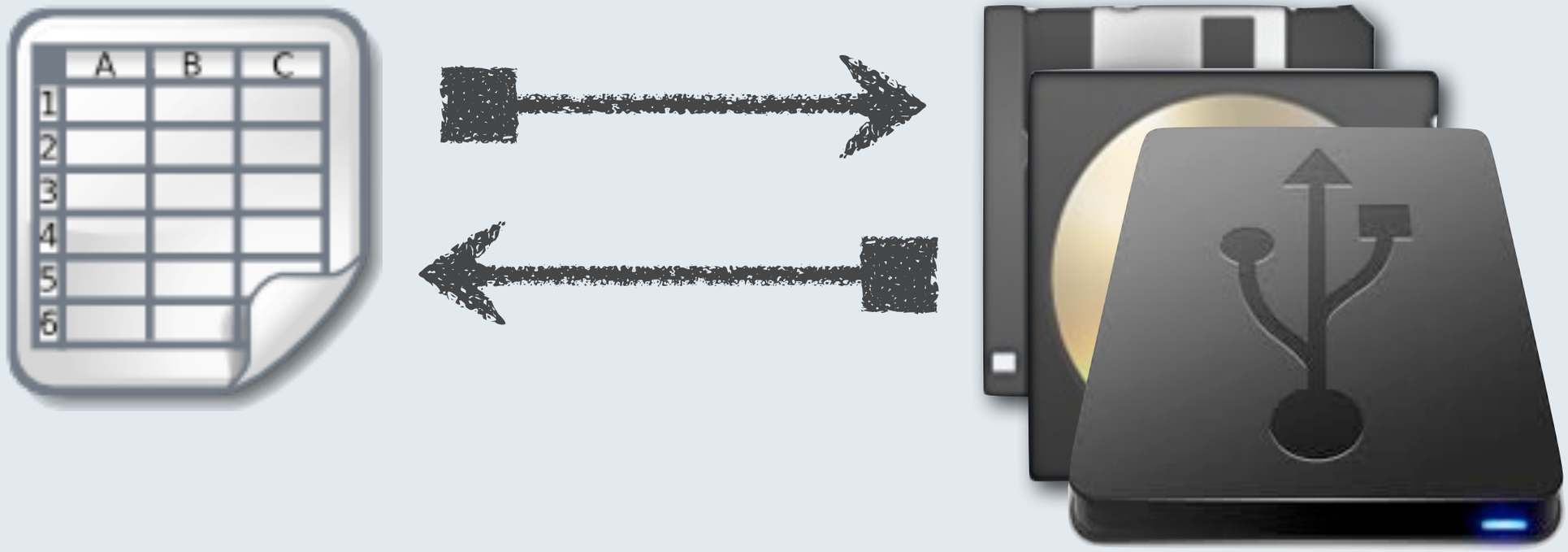
20 years passed



20 **years** passed

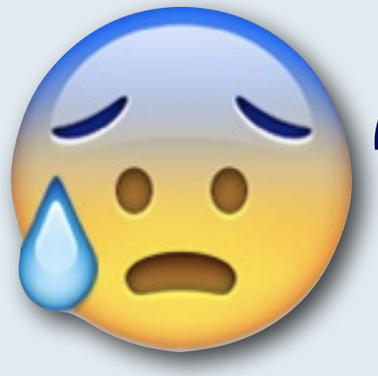


20 years passed

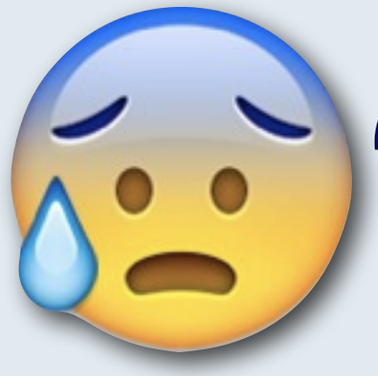


Nothing changed


A
B
C
1
2
3
4
5
6

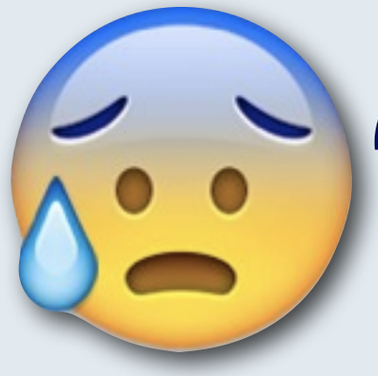


“Can’t open”



“Can’t open”

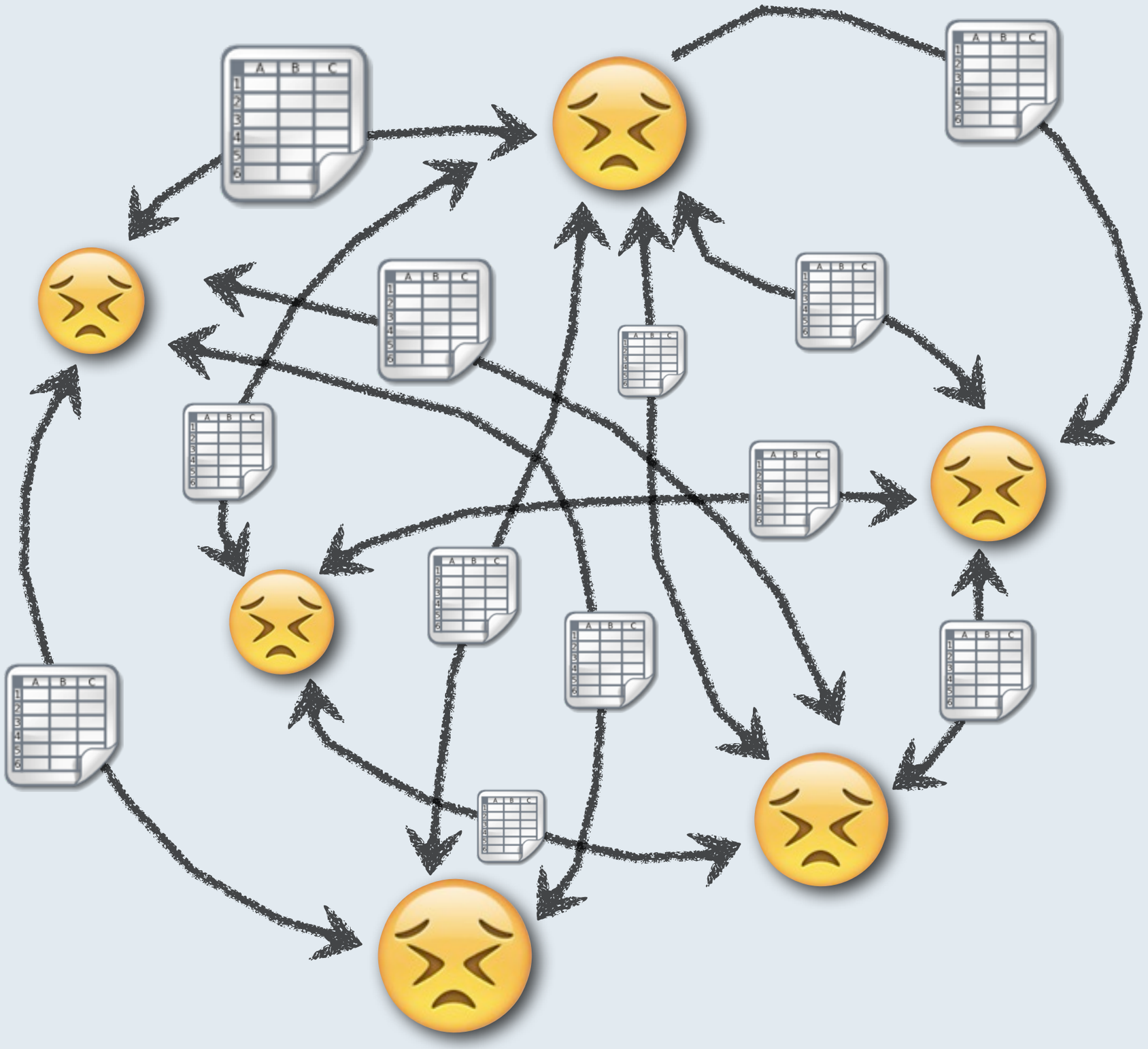
“Garbled”



“Can’t open”

“Garbled”

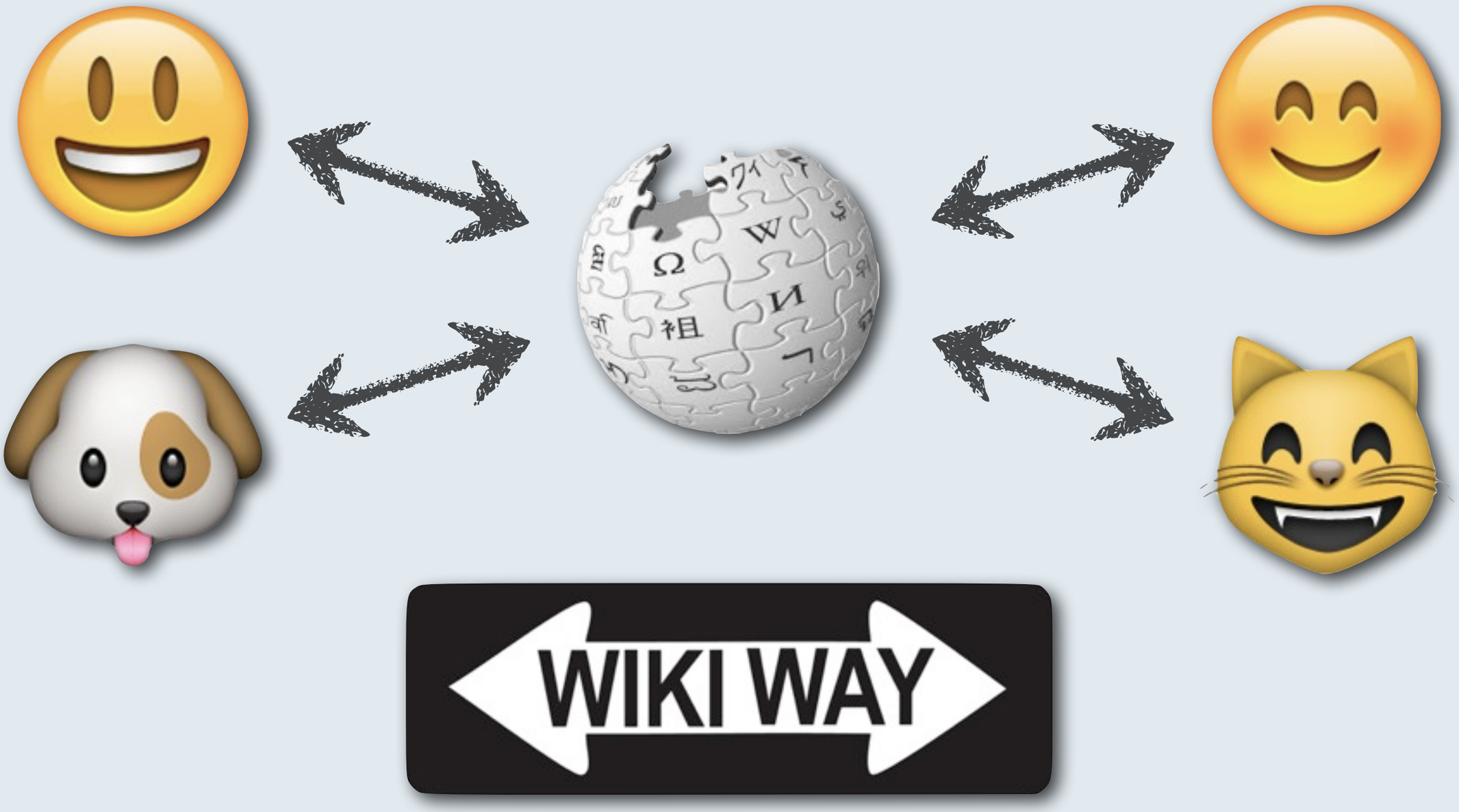
“Virus!”



Wikipedia, 2001

Wikipedia, 2001

Wikipedia, 2001



wikiCalc, 2005

Page | Edit | Format | Publish | Tools | Quit

PAGE SELECTION
This is where you choose which page you want to edit. You can also change which site you are editing. Open a page for editing by pressing the appropriate Edit button. It will be copied from the server and you will be editing that copy. Modified pages may be published (which updates the copy on the server) and editing closed by pressing the appropriate Publish button.

Pages You Can Edit On Site: Site setup by Demonstration Setup (demosite)
Your author name is: demoauthor

(•) Edit Buttons ( ) View On Web Buttons ( ) Delete and Abandon Edit Buttons

	FILENAME	FULL NAME	EDIT STATUS	PUBLISH STATUS
Edit Publish	**ax.html**	**axax**	***Currently being edited*** Last modified: Apr 24, 2011 07:10:48	*[Not Published]*
Edit	demopage1.html	**wikiCalc Demonstration Page**	***Open for editing*** Not modified	*[Not Publis*
Edit Publish	fll.html	**bar**	***Open for editing*** Last modified: Apr 24, 2011 07:10:48	*[Not Publis*

wikiCalc, 2005

✓ Plain text, HTML & Wiki syntax

wikiCalc, 2005

- ✓ Plain text, HTML & Wiki syntax
- ✓ References cells on other servers

wikiCalc, 2005

- ✓ Plain text, HTML & Wiki syntax
- ✓ References cells on other servers
- ✓ Keeps all operations for auditing

wikiCalc, 2005

- ✓ Plain text, HTML & Wiki syntax
- ✓ References cells on other servers
- ✓ Keeps all operations for auditing
- ✓ Revert to any revision

wikiCalc, 2005

- ✓ Plain text, HTML & Wiki syntax
- ✓ References cells on other servers
- ✓ Keeps all operations for auditing
- ✓ Revert to any revision
- ✓ Open Source! (GPLv2)

wikiCalc.pl

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

ZZZ

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

ZZZ

Cells

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

ZZZ

Cells

A1: 100

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

ZZZ

Cells

A1: 100
A2: =A1*2

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

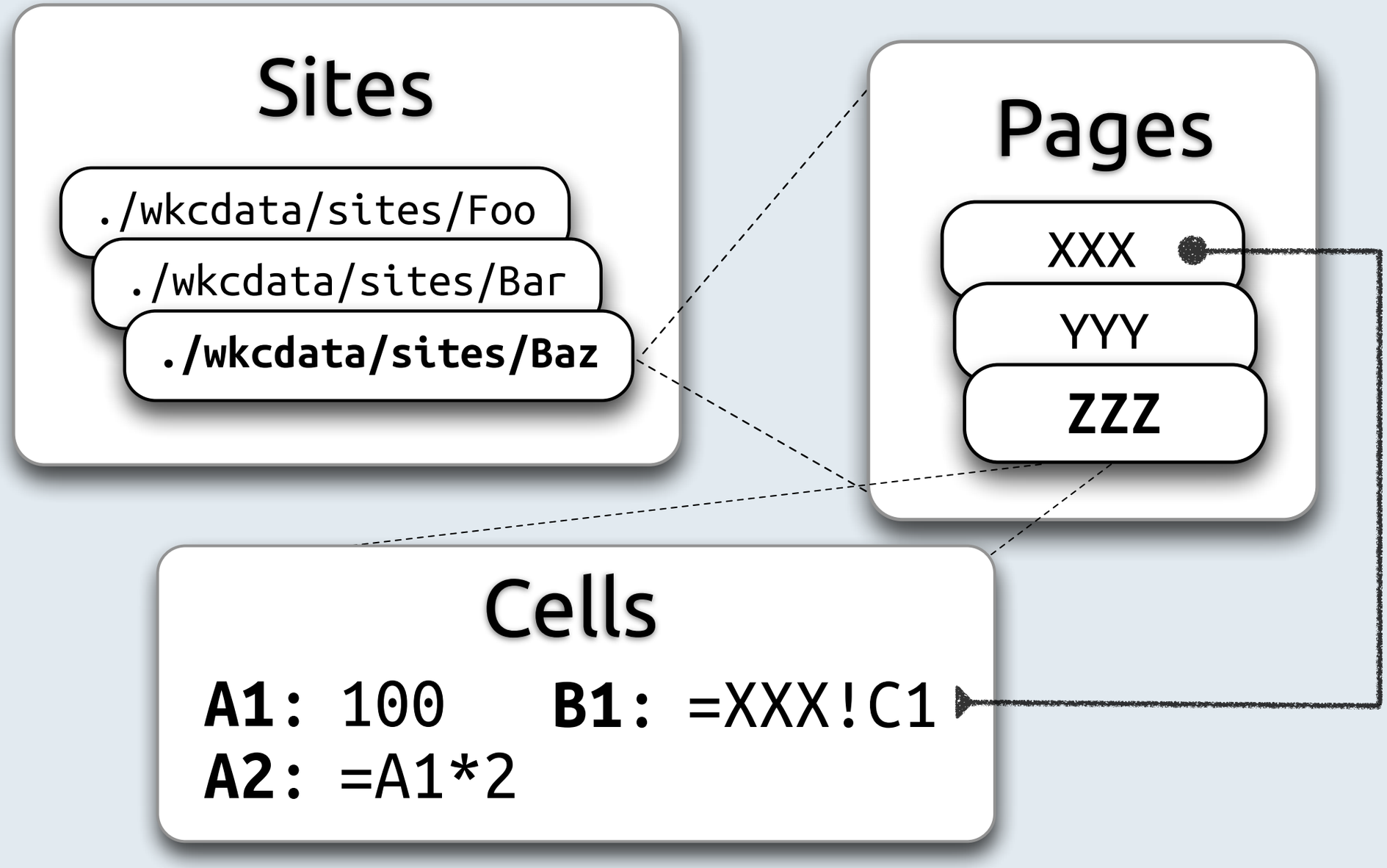
ZZZ

Cells

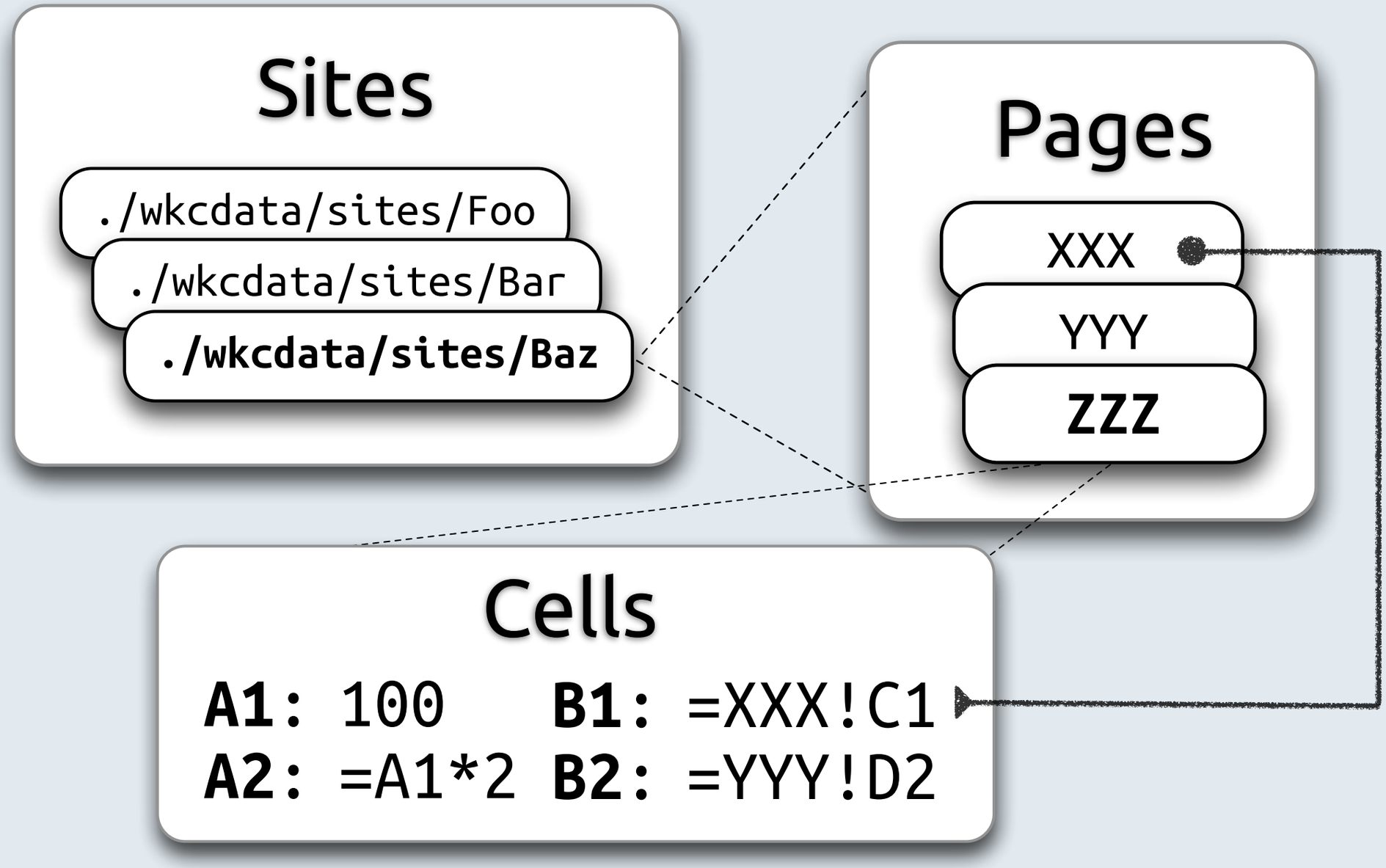
A1: 100 **B1**: =XXX!C1

A2: =A1*2

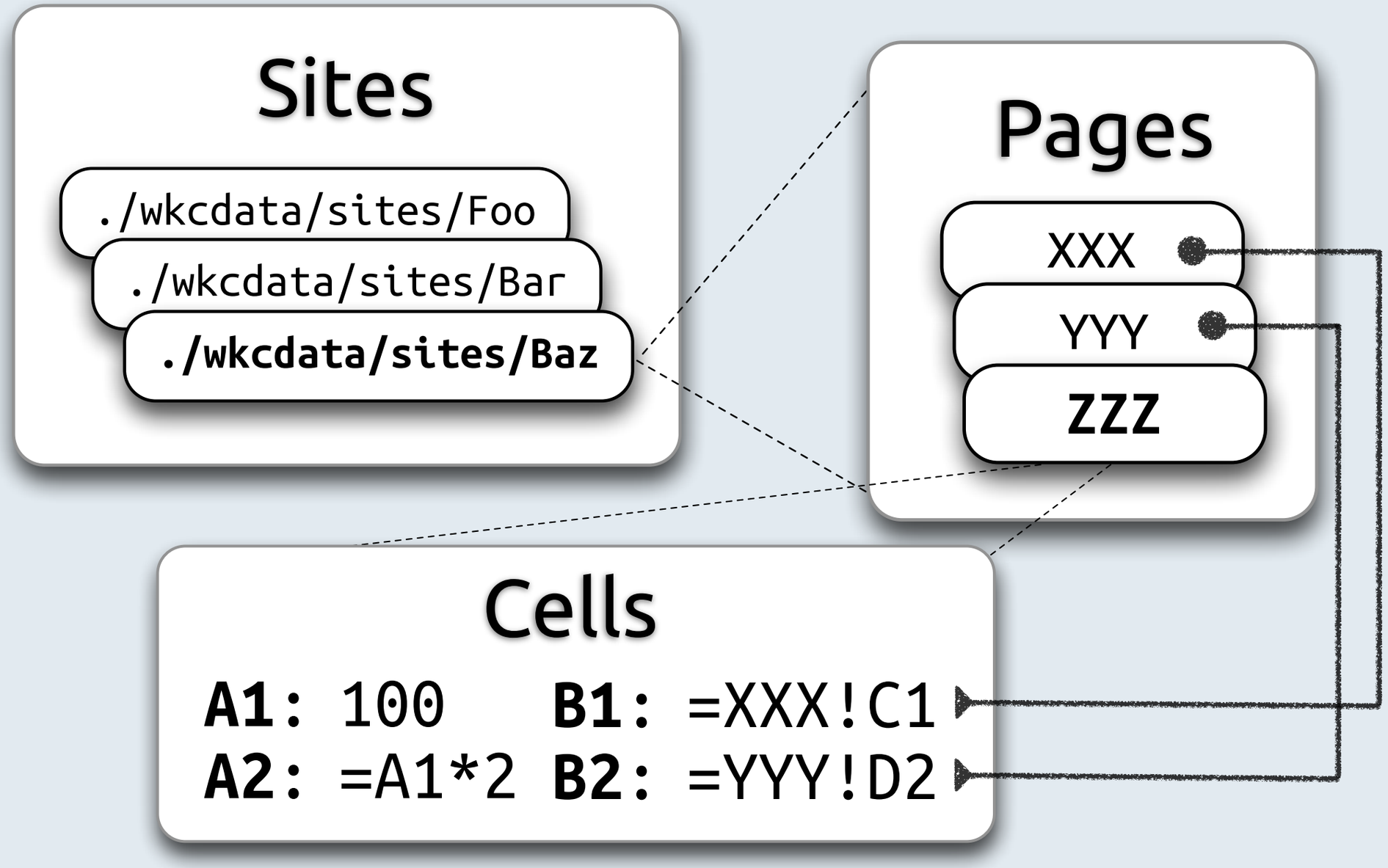
wikiCalc.pl


Sites
./wkcdata/sites/Foo
./wkcdata/sites/Bar
./wkcdata/sites/Baz
Pages
XXX
YYY
ZZZ
Cells
A1: 100
B1: =XXX!C1
A2: =A1*2

wikiCalc.pl


Sites
./wkcdata/sites/Foo
./wkcdata/sites/Bar
./wkcdata/sites/Baz
Pages
XXX
YYY
ZZZ
Cells
A1: 100
B1: =XXX!C1
A2: =A1*2
B2: =YYY!D2

wikiCalc.pl


Sites
./wkcdata/sites/Foo
./wkcdata/sites/Bar
./wkcdata/sites/Baz
Pages
XXX
YYY
ZZZ
Cells
A1: 100
A2: =A1*2
B1: =XXX!C1
B2: =YYY!D2

wikiCalc.pl

Sites

./wkcdata/sites/Foo

./wkcdata/sites/Bar

./wkcdata/sites/Baz

Pages

XXX

YYY

ZZZ

Cells

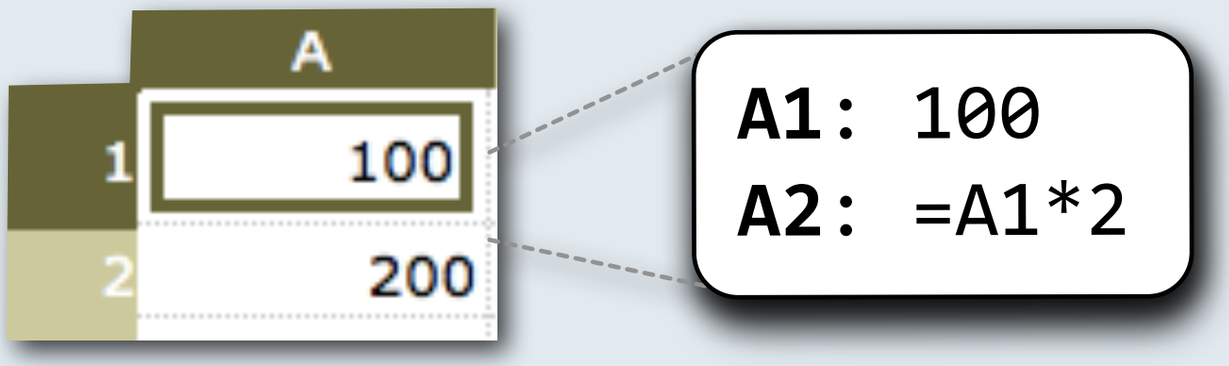
A1: 100 **B1**: =XXX!C1

A2: =A1*2 **B2**: =YYY!D2

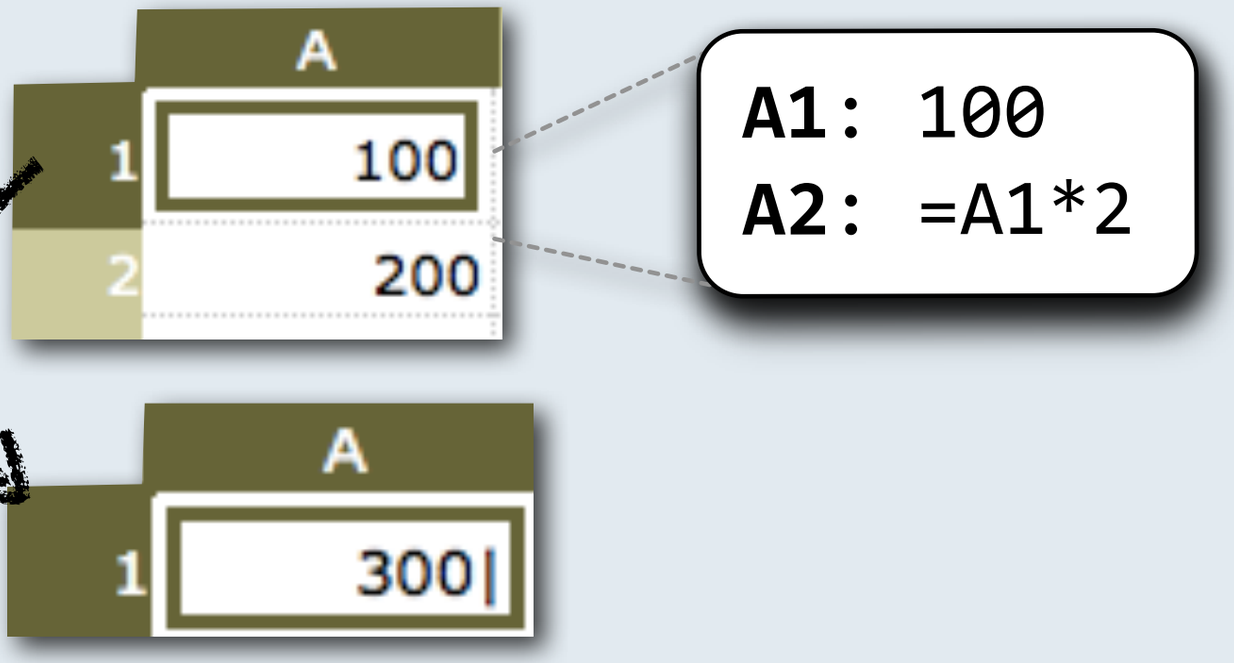
Cross-page Reference

wikiCalc Edit Flow

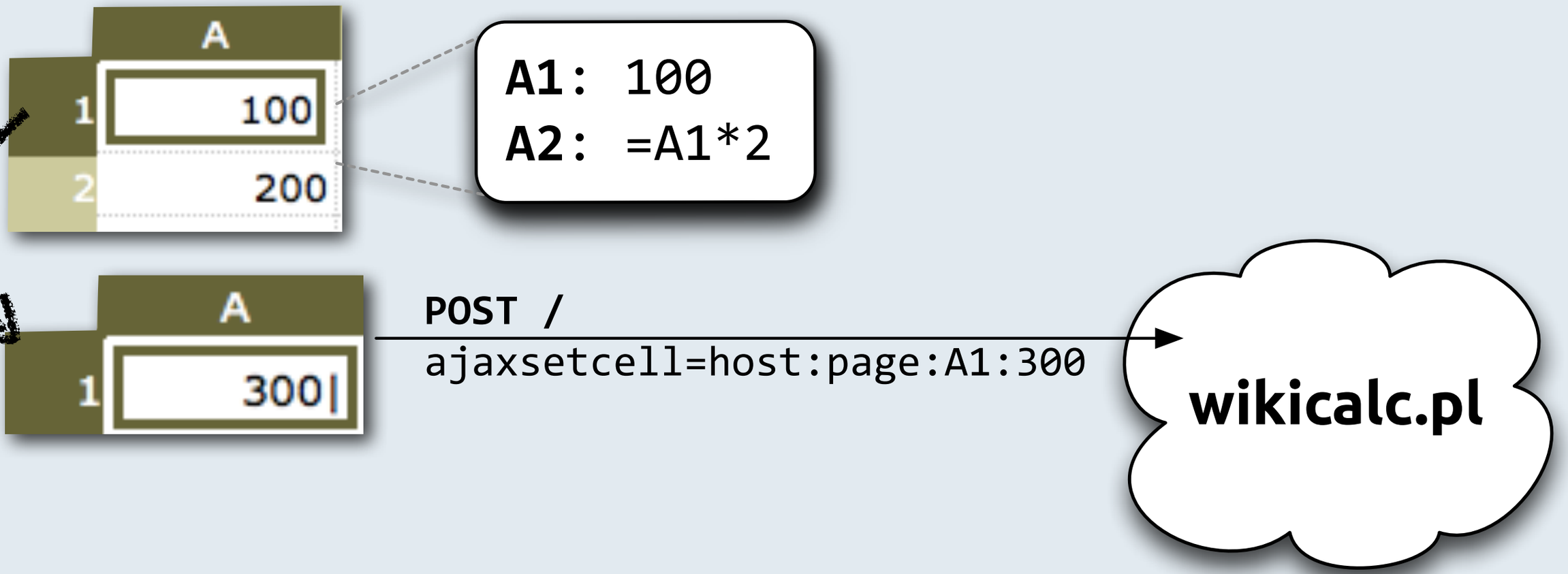
wikiCalc Edit Flow



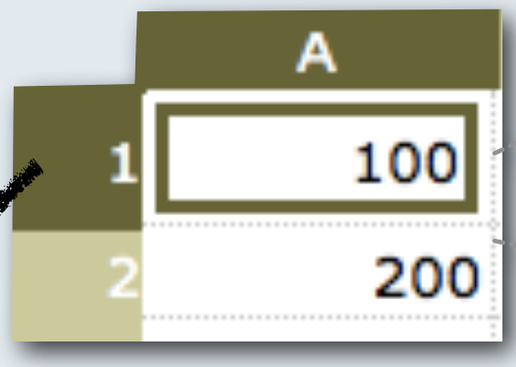
wikiCalc Edit Flow



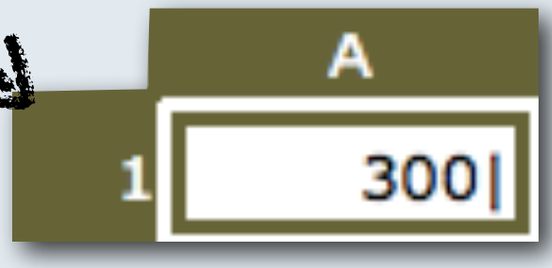
wikiCalc Edit Flow



wikiCalc Edit Flow

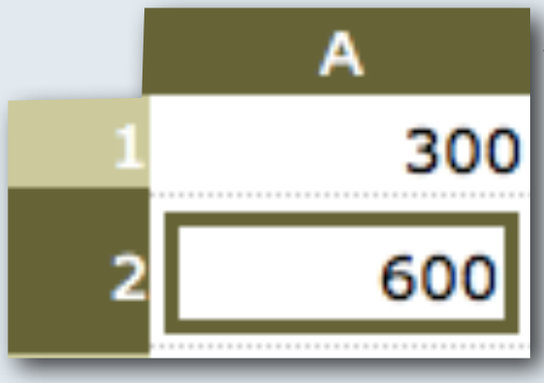



```
A1: 100
A2: =A1*2
```




```
POST /
ajaxsetcell=host:page:A1:300
```

wikicalc.pl




```
200 OK
<?xml version="1.0"?>
<root><![CDATA[
A1:v:300:300:right:1:1::
A2:f:600:A1*2:right:1:1::
]]></root>
```

“Loading…”

“Loading...”

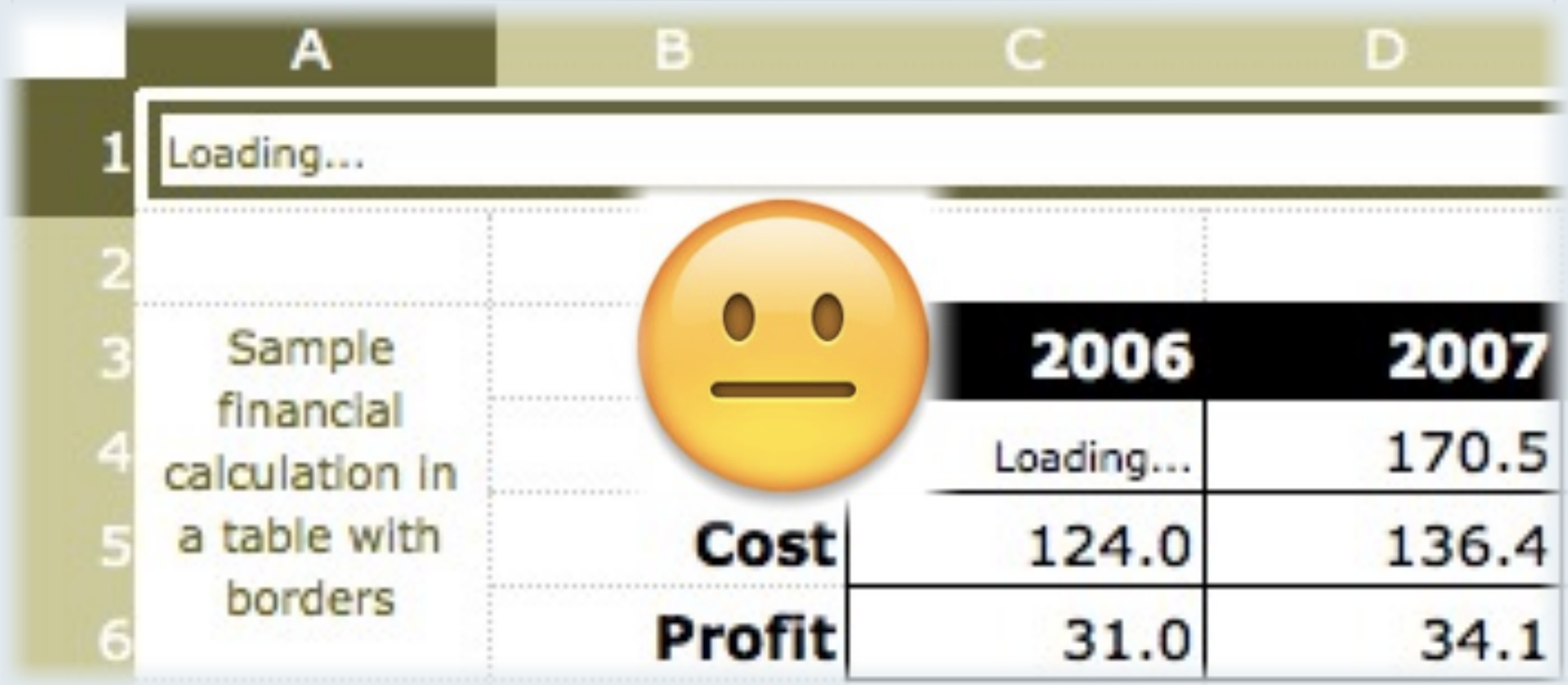
	A	B	C	D
1	Loading...			
2				
3	Sample financial calculation in a table with borders	**Year**	**2006**	**2007**
4		**Sales**	Loading...	170.5
5		**Cost**	124.0	136.4
6		**Profit**	31.0	34.1

“Loading…”

	A	B	C	D
1	Loading...			
2				
3	Sample financial calculation in a table with borders	**Year**	**2006**	**2007**
4		**Sales**	Loading...	170.5
5		**Cost**	124.0	136.4
6		**Profit**	31.0	34.1

“**C100k**” Problem

“Loading…”



“**C100k**” Problem

Undo

Undo

Redo

SocialCalc, 2006

Dan Bricklin

Ross Mayfield

Design Goals

Design Goals

- Rewrite calc engine in JS

Design Goals

- Rewrite calc engine in JS
- Real-time responsive editor

Design Goals

- Rewrite calc engine in JS
- Real-time responsive editor
- Supports 100,000+ cells

Design Goals

- Rewrite calc engine in JS
- Real-time responsive editor
- Supports 100,000+ cells
- Works on all browsers (IE6+)

Design Goals

- Rewrite calc engine in JS
- Real-time responsive editor
- Supports 100,000+ cells
- Works on all browsers (IE6+)
- Client-side log & undo/redo

Architecture

Architecture

SocialCalc.js

HTTP Server

Architecture

SocialCalc.js

GET

HTTP Server

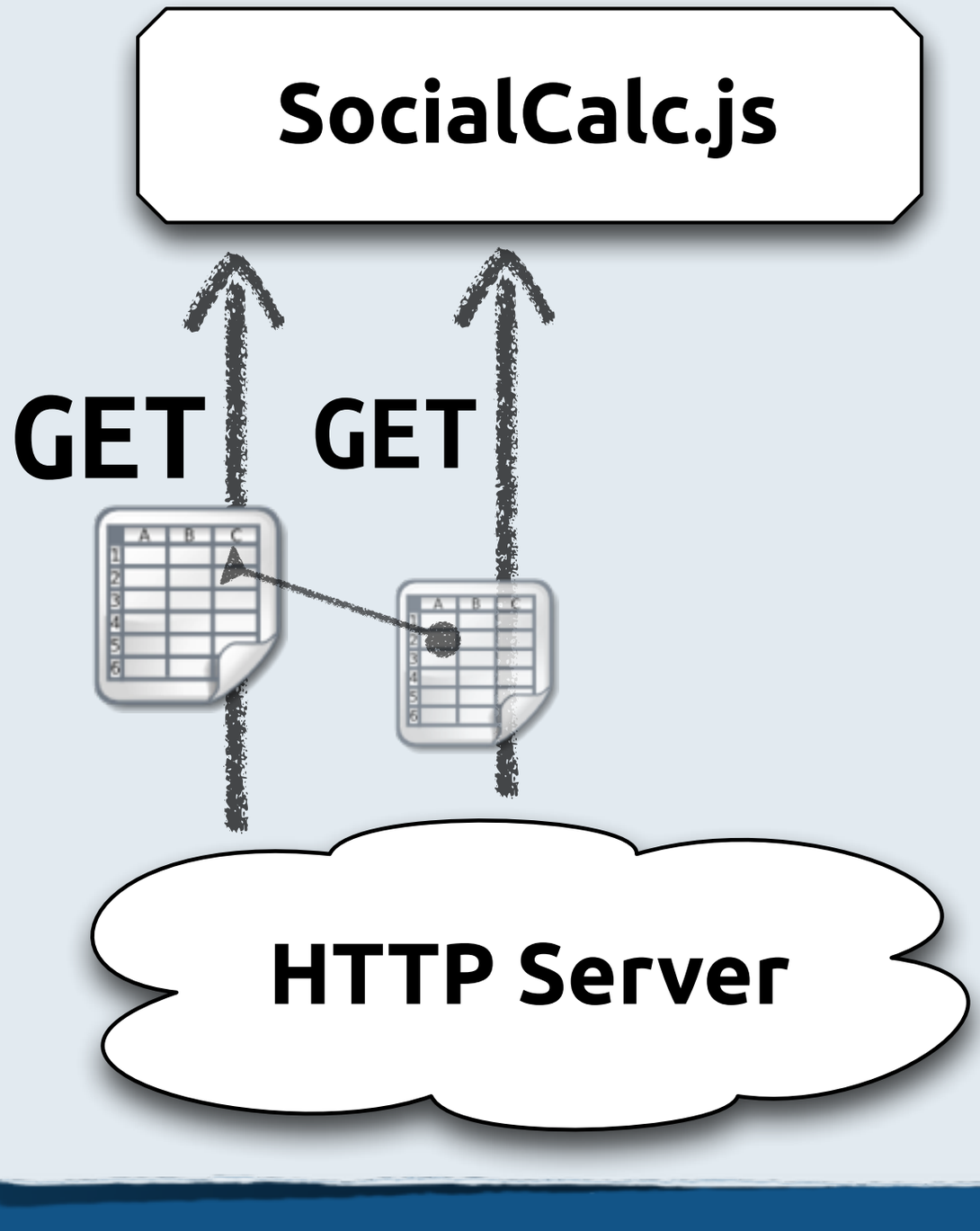
Architecture

SocialCalc.js

GET

HTTP Server

Architecture



Architecture

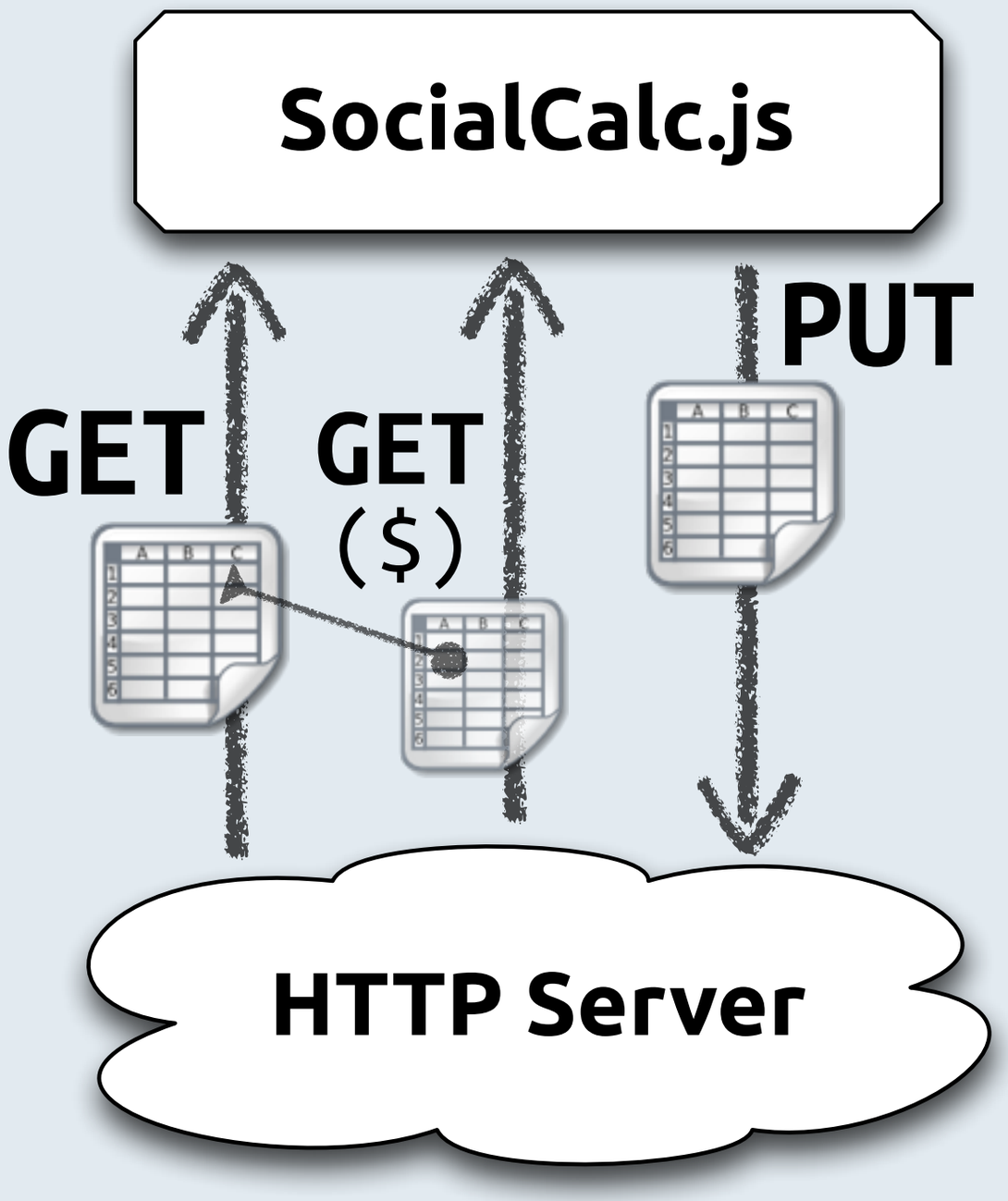
SocialCalc.js

GET

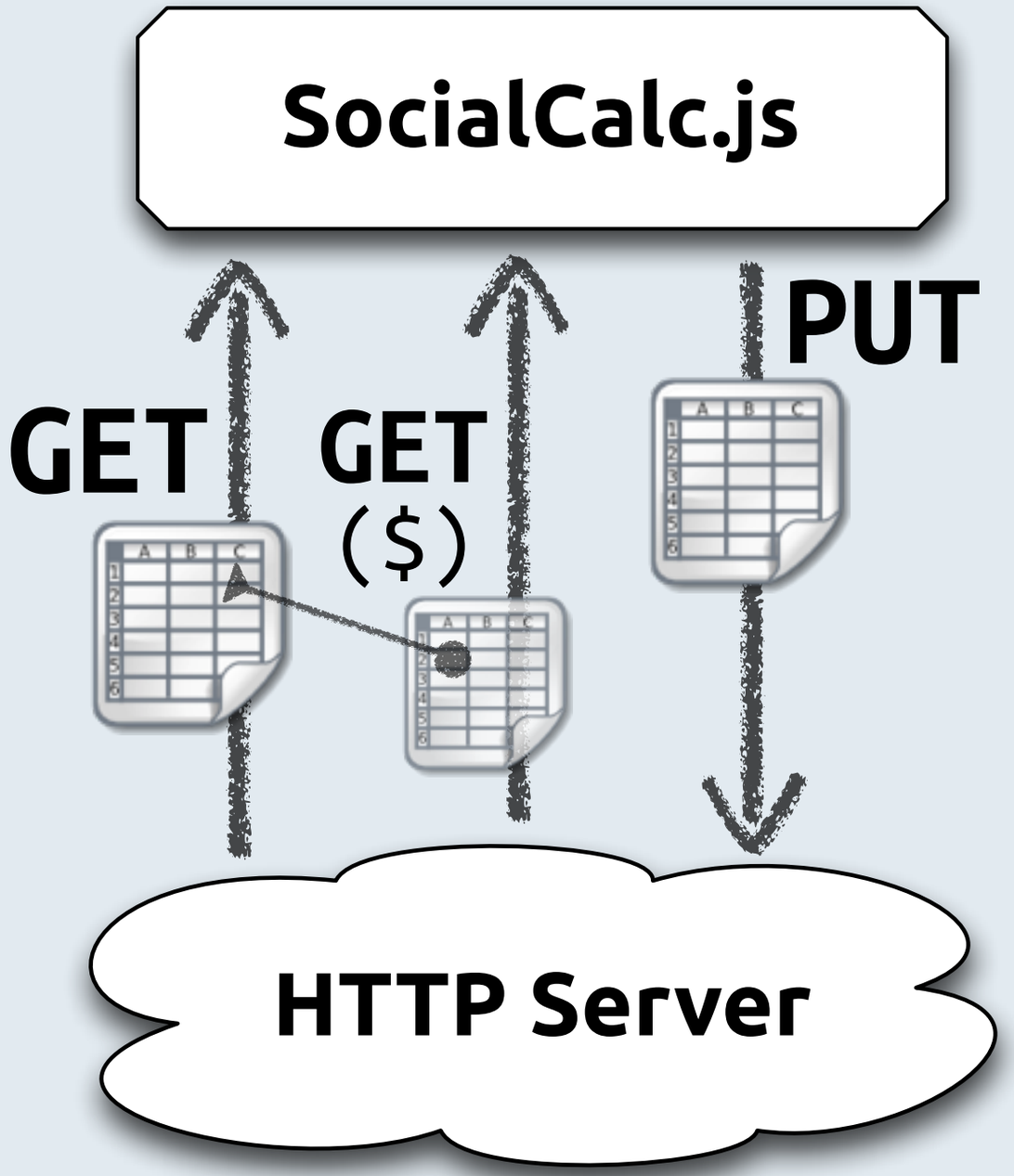
GET ($)

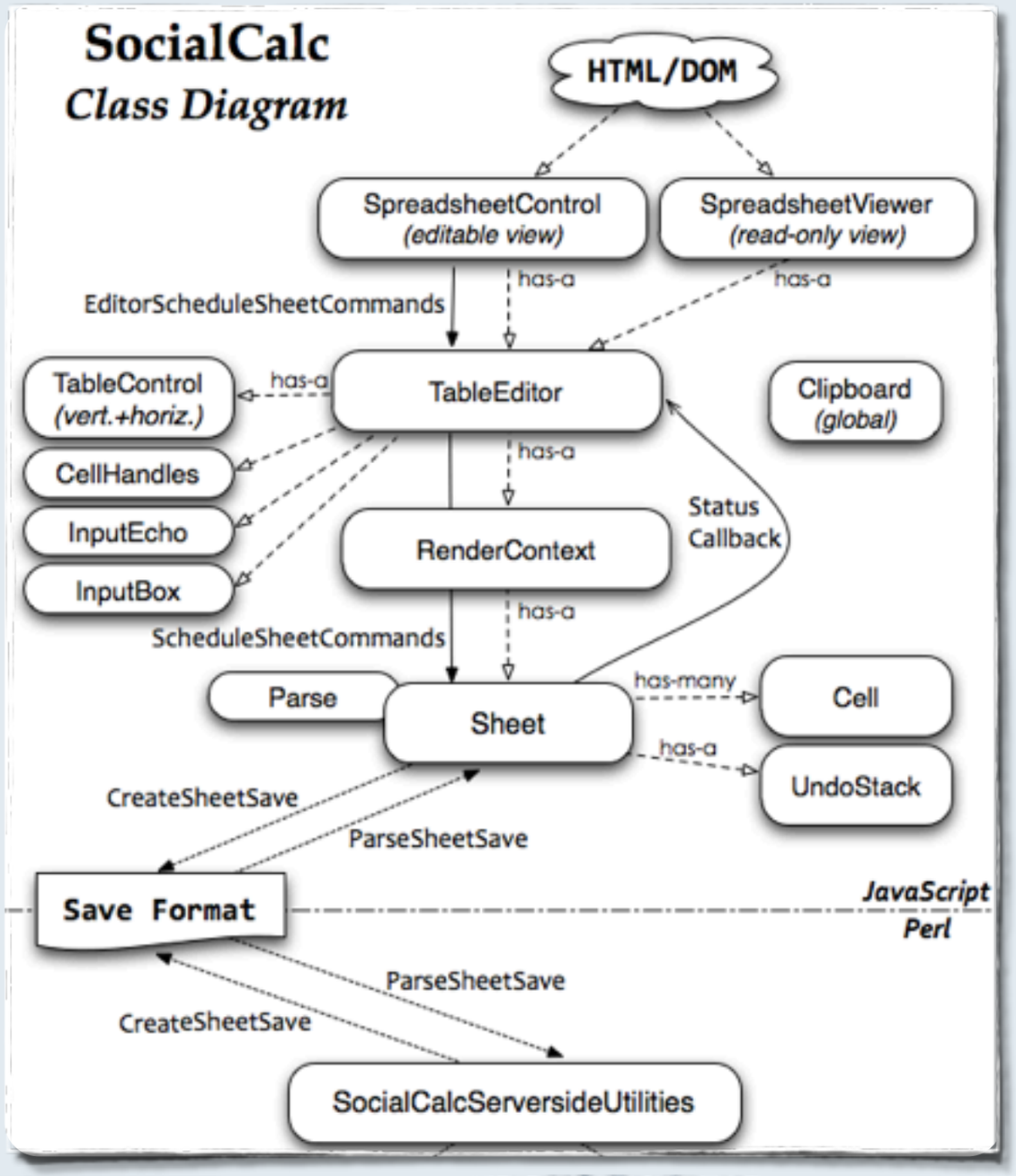
HTTP Server

Architecture



Architecture





Command Pattern

Command Pattern

```
set A1 value n 42
```

Command Pattern

```
set A1 value n 42
set A2 formula A1*2
```

Command Pattern

```
set A1 value n 42
set A2 formula A1*2
merge A1:B2
cut A3
paste A4
sort A1:B9 A up B down
set sheet defaultcolor blue
...
```

Command Pattern

```
set A1 value n 42
set A2 formula A1*2
```

- Async recalc loop

Command Pattern

```
set A1 value n 42
set A2 formula A1*2
```

- Async recalc loop
- Visible-only redraw

Command Pattern

```
set A1 value n 42
set A2 formula A1*2
```

- Async recalc loop
- Visible-only redraw
- Unlimited undo/redo

Command Pattern

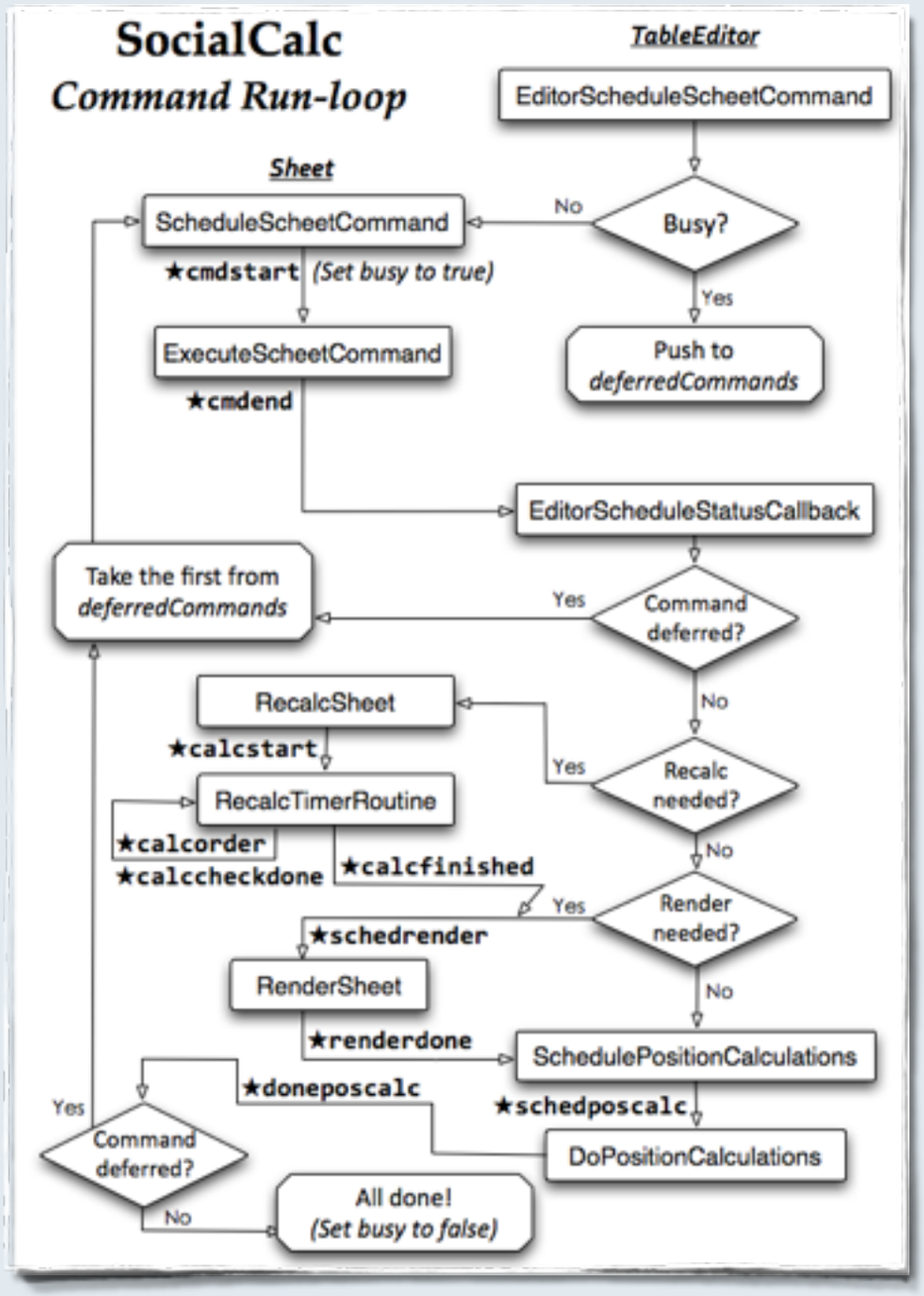
```
set A1 value n 42
set A2 formula A1*2
```

- Async recalc loop
- Visible-only redraw
- Unlimited undo/redo
- UI stays responsive

Command Pattern

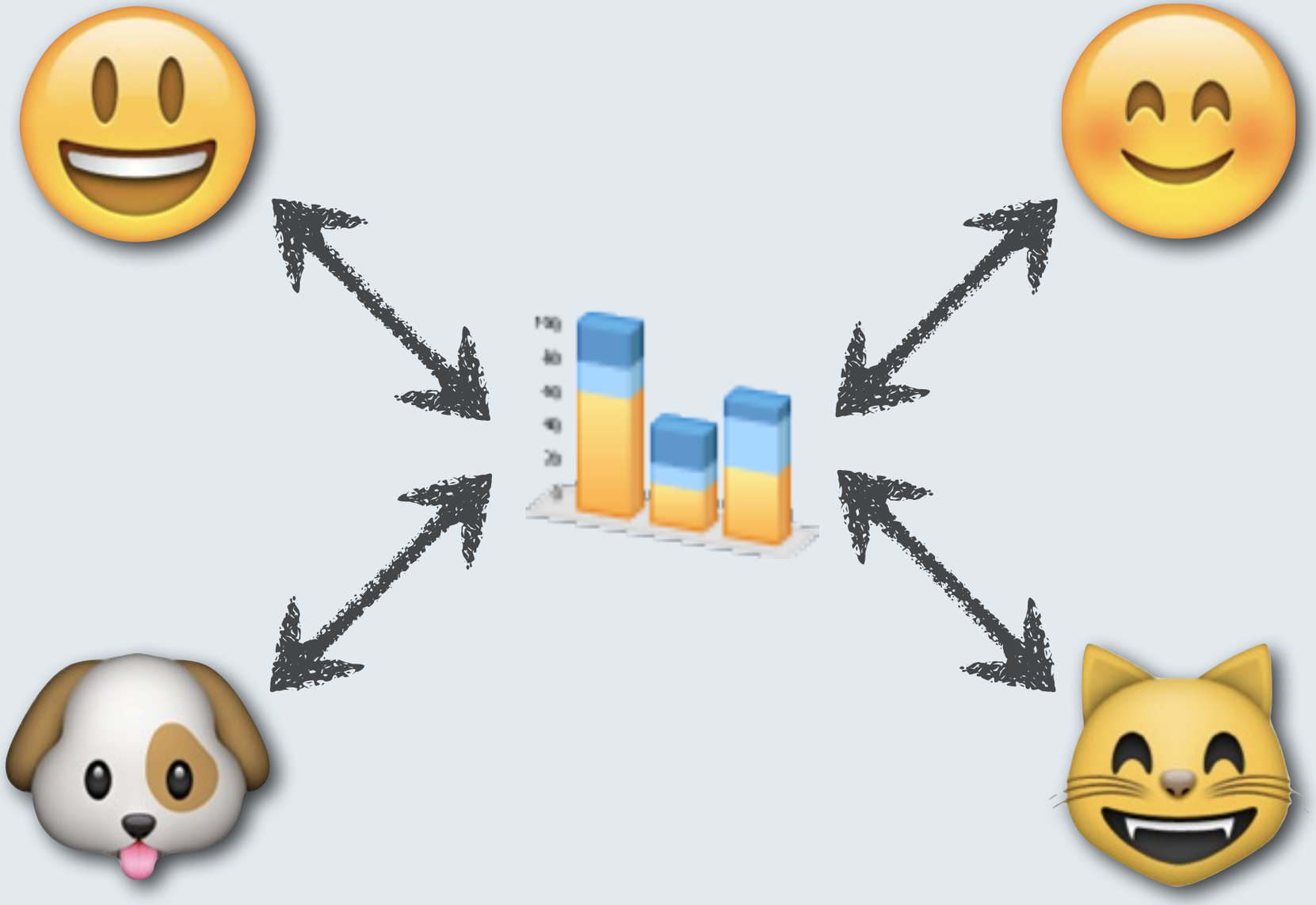
```
set A1 value n 42
set A2 formula A1*2
```

- Async recalc loop
- Visible-only redraw
- Unlimited undo/redo
- UI stays responsive

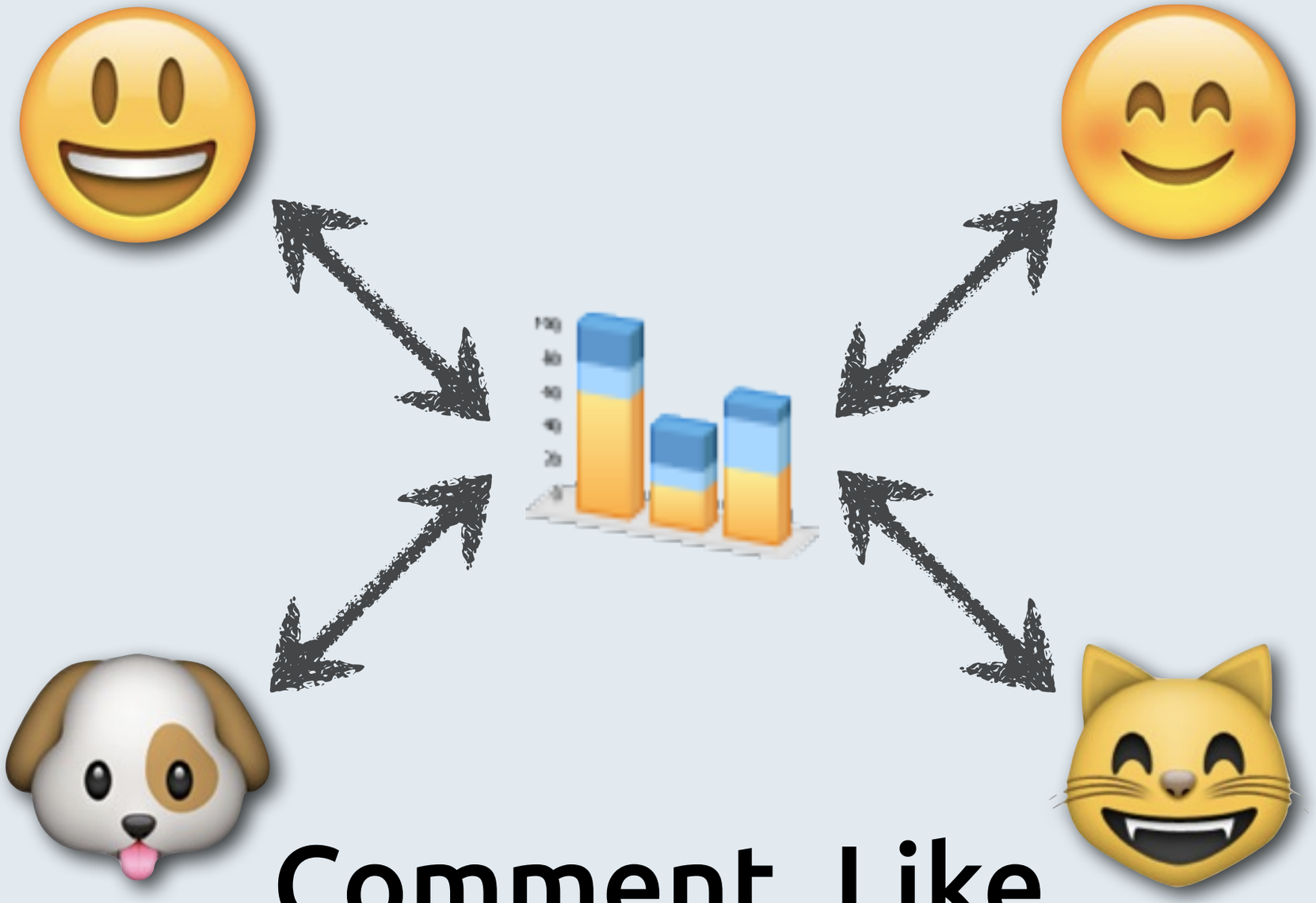


“Social”Calc

“Social”Calc

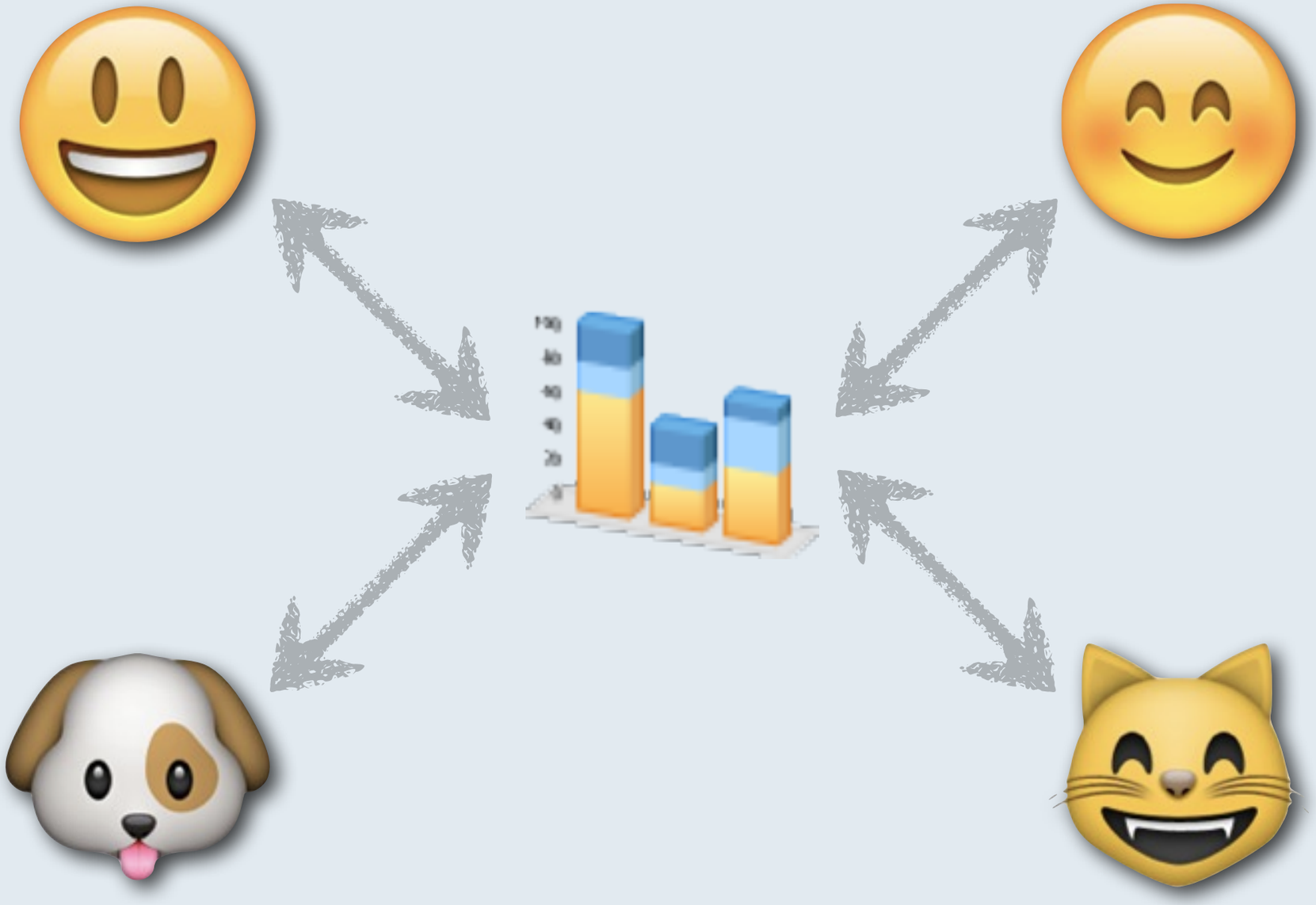


“Social”Calc

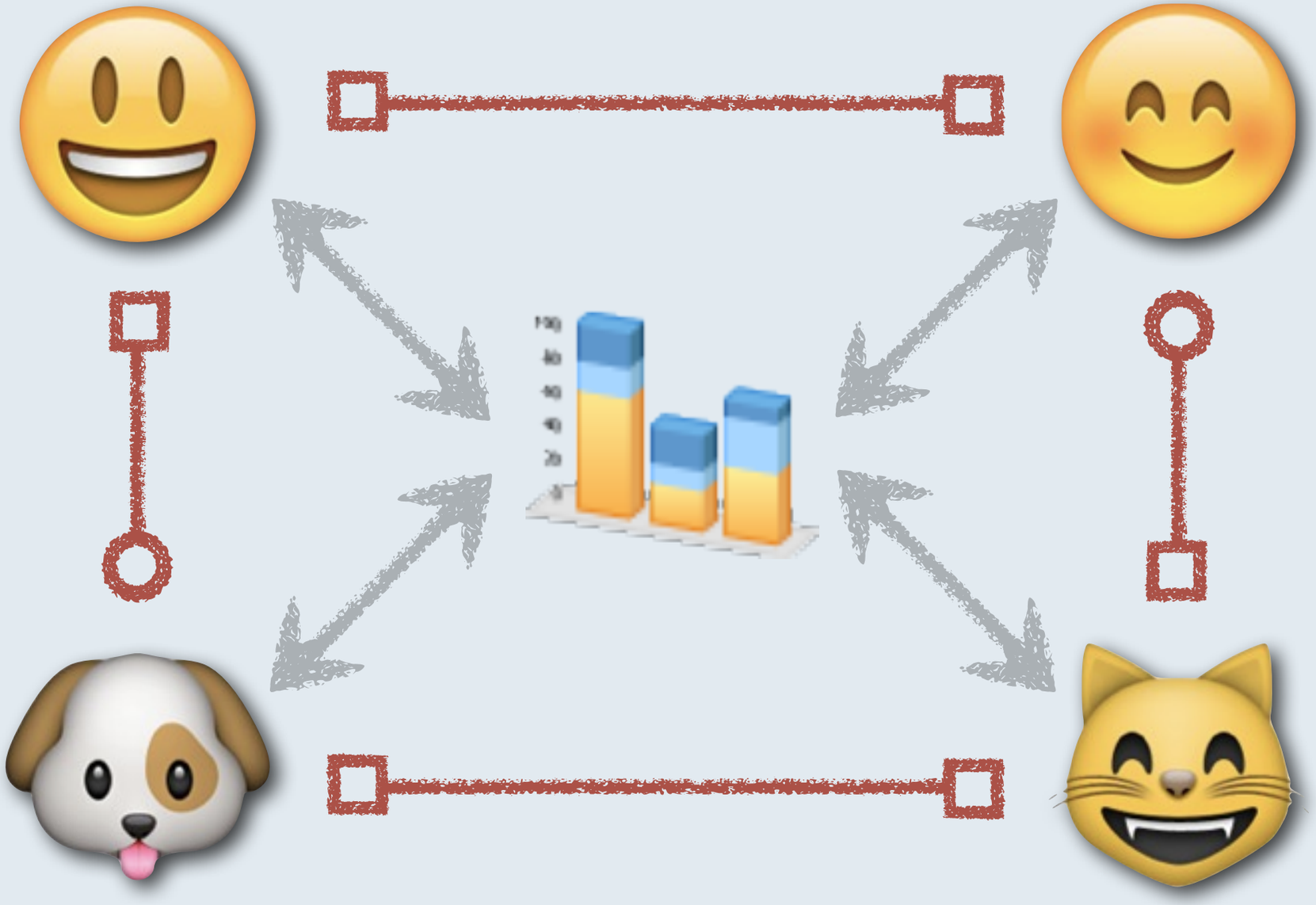


Comment, Like,
Tag, Share, Embed...

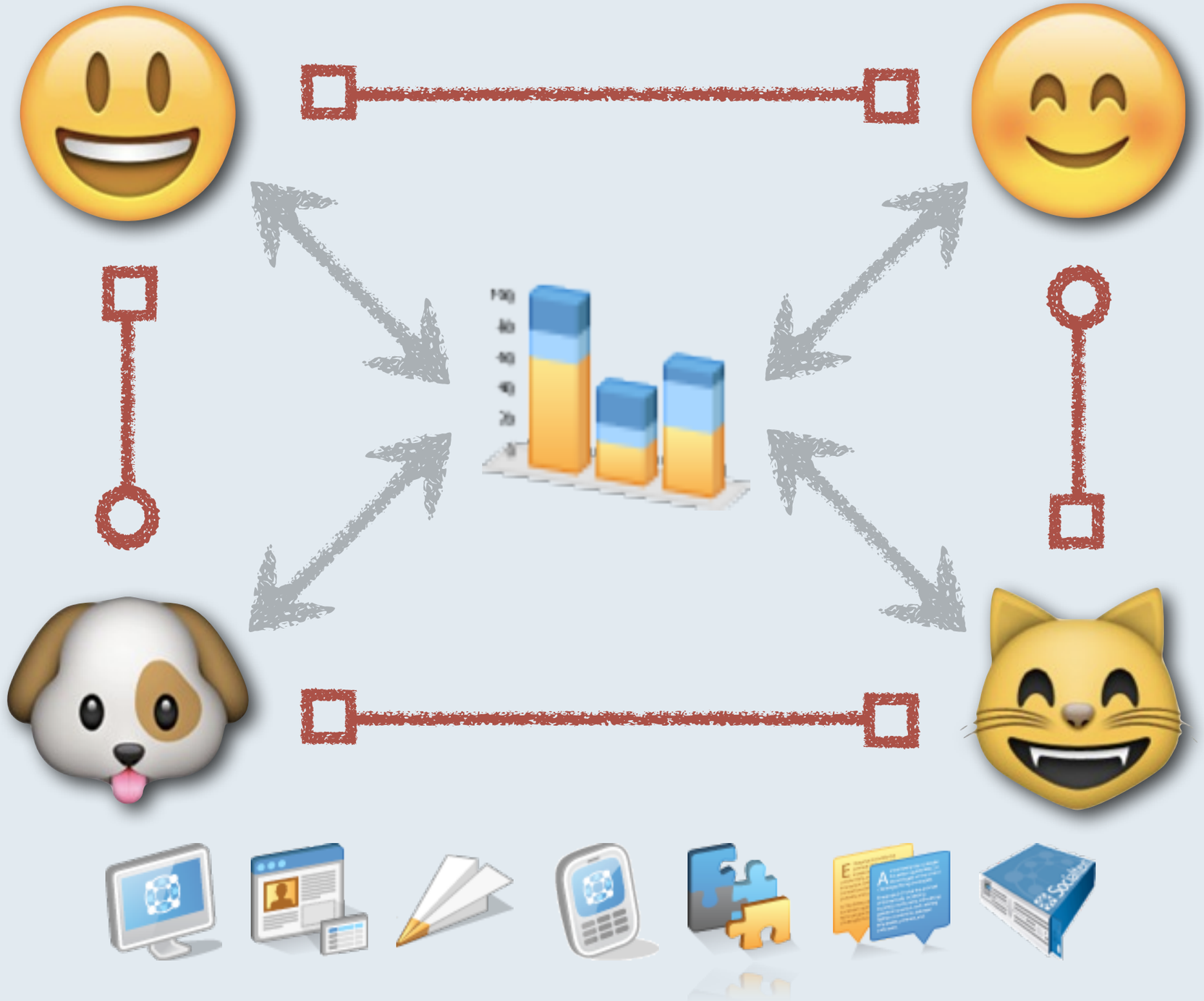
Objects ⇔ Relations

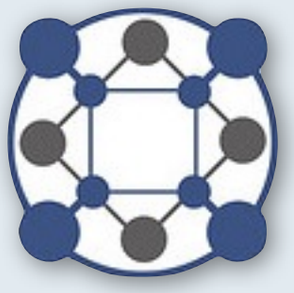


Objects ⇔ Relations



Objects ⇔ Relations





Socialtext Open

Socialtext Open

Good first

Profits later

Common **P**ublic **A**ttribution **L**icense

Common Public Attribution License

ⓐ

BSD, MIT

Common **P**ublic **A**ttribution **L**icense

BSD, MIT

LGPL, MPL

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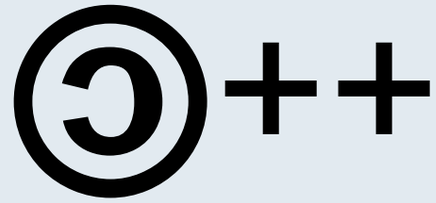

GPL

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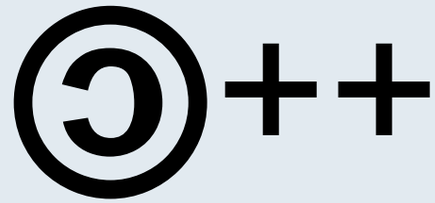
BSD, MIT

LGPL, MPL



GPL

"ASP loophole"

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"ASP loophole"

↓

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GPL

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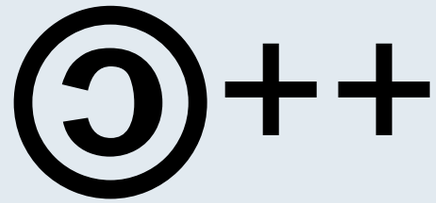
LGPL, MPL



GPL

"ASP loophole"

CPAL

Affero GPL

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"ASP loophole"

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CPAL

Affero GPL

OSI certified

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ⓐ

BSD, MIT

©

LGPL, MPL

©++

GPL

"ASP loophole"

CPAL

Affero GPL

OSI certified

Sheetnode, 2008

Karim Ratib

Sheetnode, 2008

Views + Fields + CCK

Karim Ratib

Sheetnode, 2008

Karim Ratib

Views + Fields + CCK

SocialCalc.js

Sheetnode, 2008

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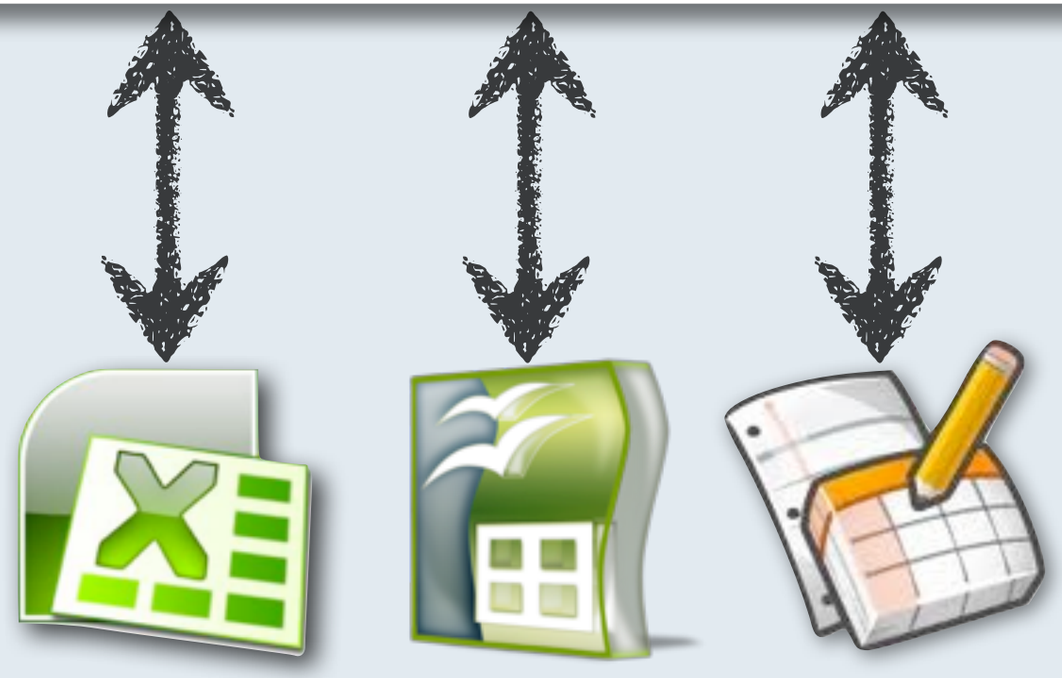
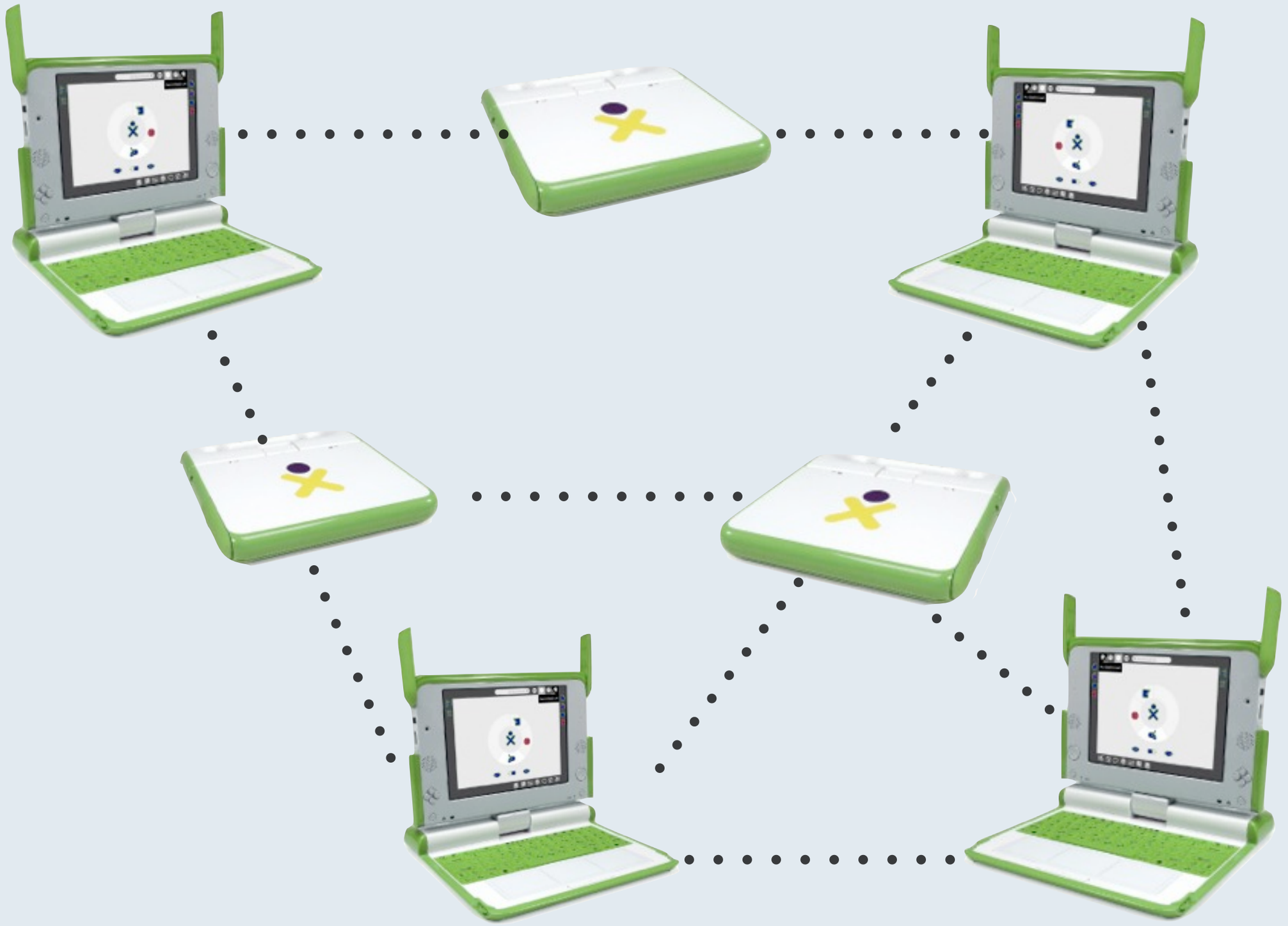


OLPC, 2008

OLPC, 2008

Luke Closs & Dan



Mesh P2P

SEETA

SEETA

Manusheel Gupta

Vijit Singh

SEETA

Manusheel Gupta

Vijit Singh

SocialCalcActivity.py

Gecko/XPCOM

SocialCalc.js

XoCom.js

XoCom.py

SEETA

Manusheel Gupta

Vijit Singh

`set A1 value n 42`

SocialCalcActivity.py

Gecko/XPCOM

SocialCalc.js

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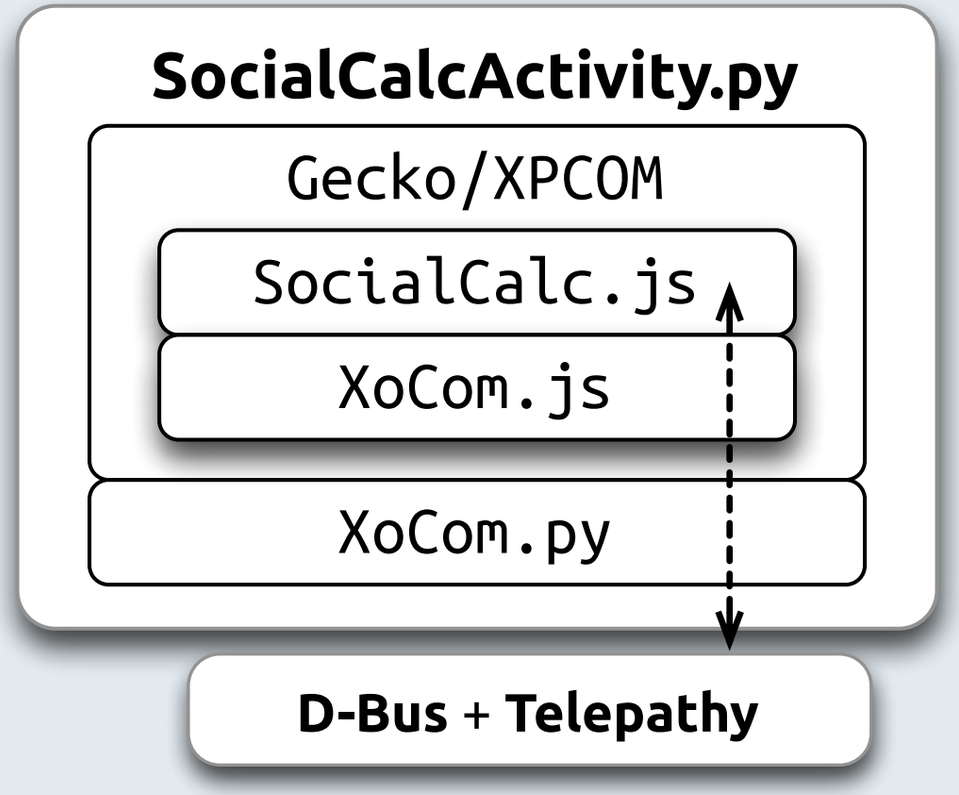
SEETA

Manusheel Gupta

`set A1 value n 42`



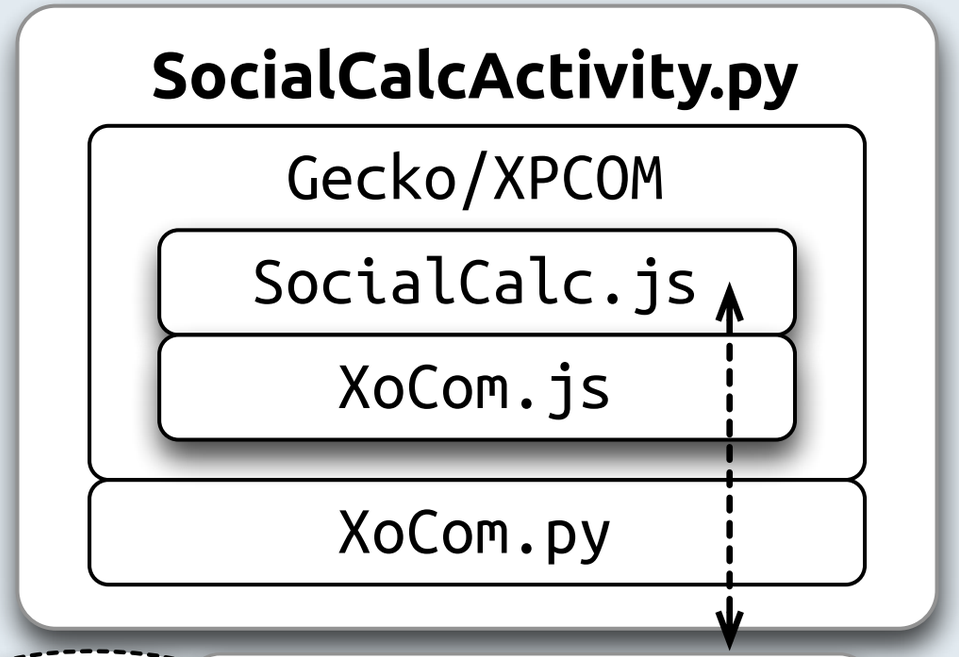
Vijit Singh

SEETA

Manusheel Gupta

Vijit Singh

`set A1 value n 42`



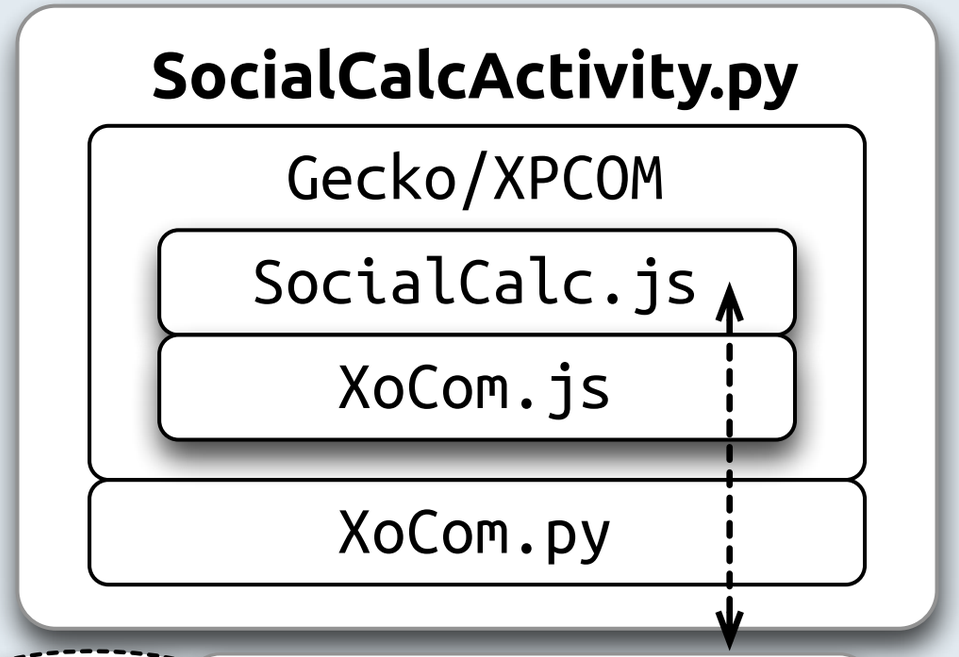
OLPC Mesh Broadcast

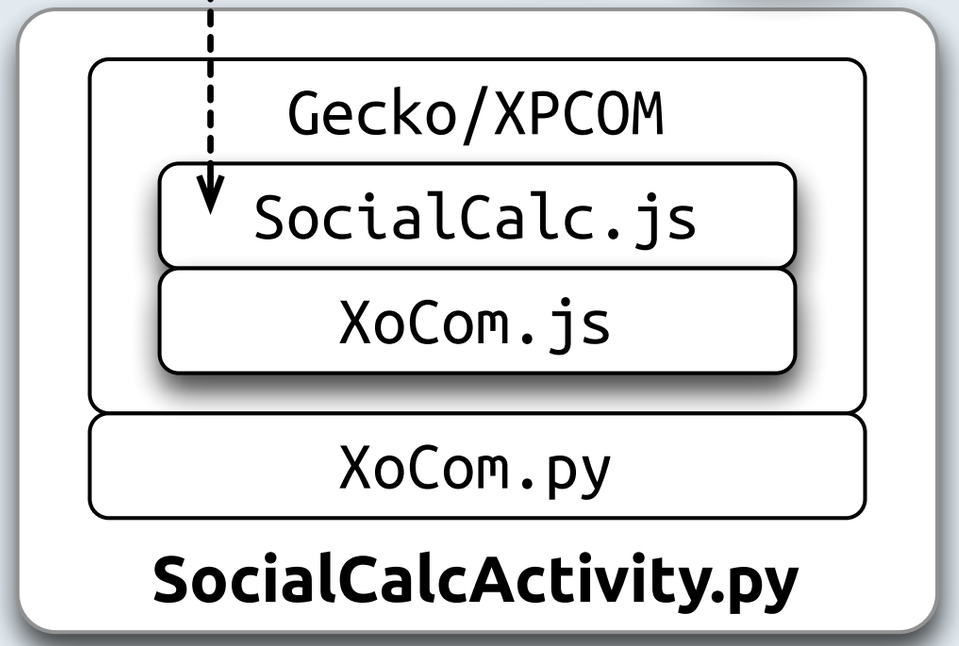
SEETA

Manusheel Gupta

Vijit Singh

`set A1 value n 42`



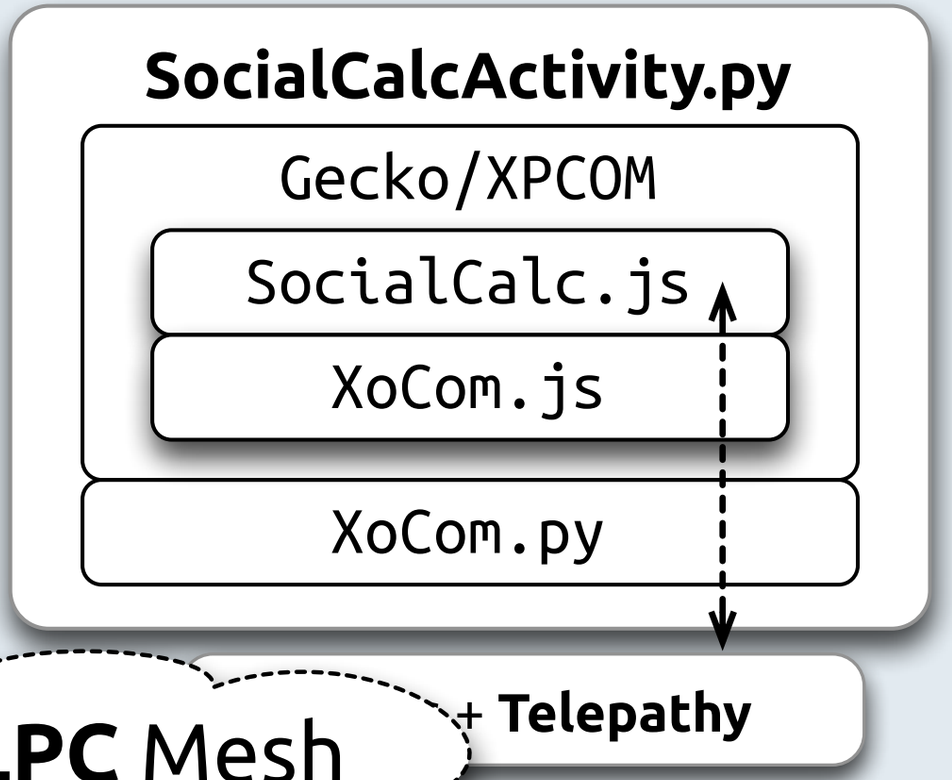


SEETA

Manusheel Gupta

`set A1 value n 42`

Vijit Singh



`set A1 value n 42`

Great, but...

Great, but...

- Must log on same time

Great, but…

- Must log on same time
- Can’t replay missed logs

Great, but...

- Must log on same time
- Can’t replay missed logs
- Race condition on cells

Great, but...

- Must log on same time
- Can’t replay missed logs
- Race condition on cells
- OLPC-specific code!

YAPC::Tiny, 2009

EV/AnyEvent

Tatsumaki

EV/AnyEvent

@miyagawa

Tatsumaki

EV/AnyEvent

Web::Hippie

@miyagawa

@clkao

Tatsumaki

@miyagawa

EV/AnyEvent

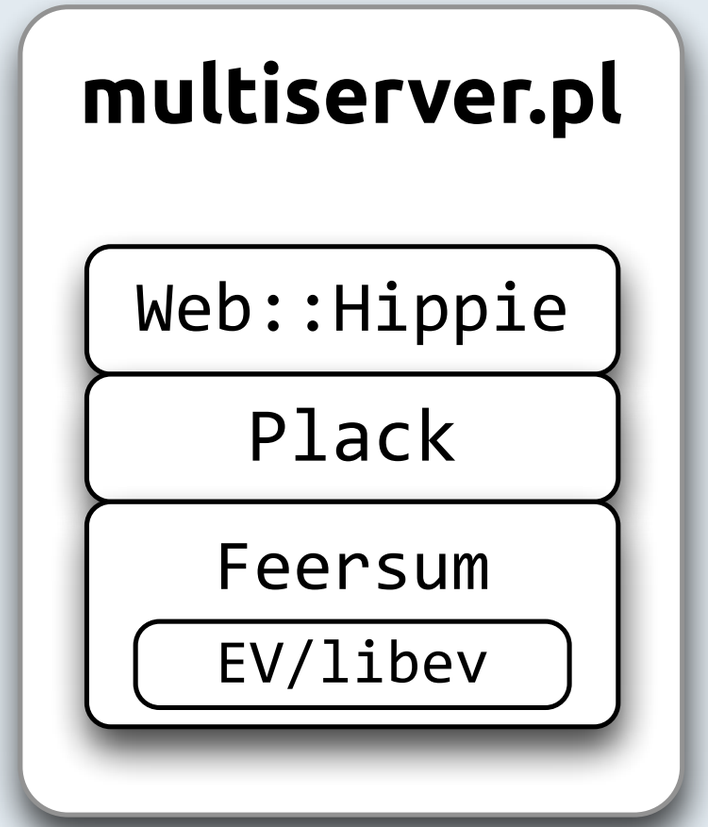
Web::Hippie

@clkao

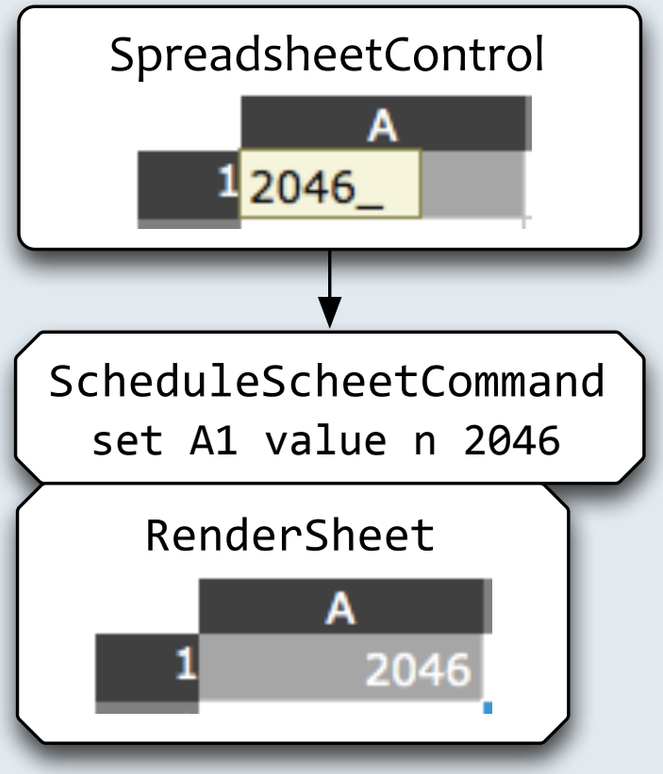
Feersum

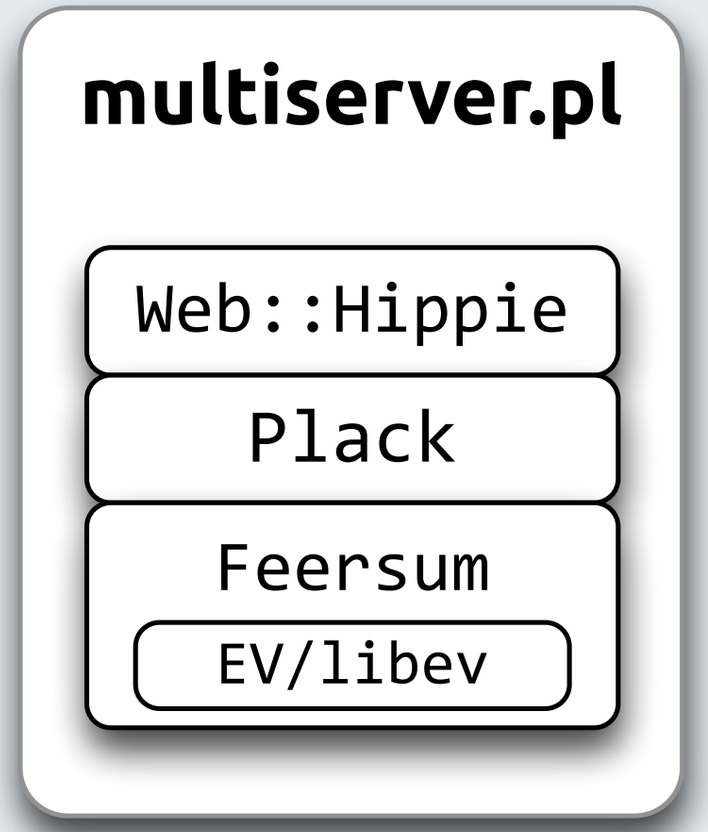
@stash

WebSocket Channels



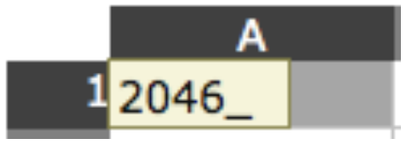
WebSocket Channels





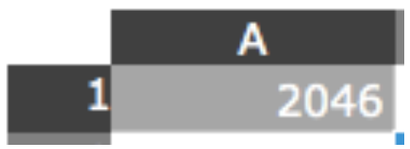
WebSocket Channels

SpreadsheetControl



ScheduleScheetCommand
set A1 value n 2046

RenderSheet



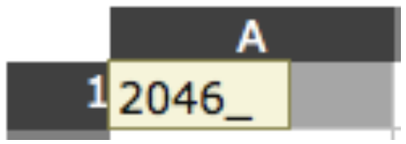
Send

multiserver.pl

- Web::Hippie
- Plack
- Feersum
  - EV/libev

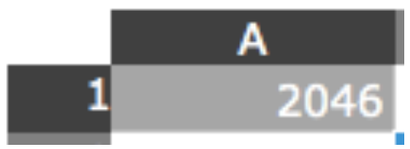
WebSocket Channels

SpreadsheetControl



ScheduleScheetCommand
set A1 value n 2046

RenderSheet



Send

multiserver.pl

Web::Hippie

Plack

Feersum

EV/libev

Relay

WebSocket Channels

SpreadsheetControl

	A
1	2046_

ScheduleScheetCommand
set A1 value n 2046

RenderSheet

	A
1	2046

Send

multiserver.pl

Web::Hippie

Plack

Feersum

EV/libev

Relay

ScheduleScheetCommand
set A1 value n 2046
(isRemote = true)

RenderSheet

	A
1	2046

New Features

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- ✓ Fetch logs on join

New Features

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- ✓ Reconnection recovery

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- ✓ Show peer cursors

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- ✓ Reconnection recovery
- ✓ Show peer cursors
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Much better, but...

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- Which peer's log to take?

Much better, but...

- Which peer's log to take?

- What if everyone leaves?

Much better, but...

- Which peer's log to take?
- What if everyone leaves?
- Who would keep the logs?

Much better, but...

- Which peer's log to take?
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- Replay 1,000+ commands?

Much better, but...

- Which peer's log to take?
- What if everyone leaves?
- Who would keep the logs?
- Replay 1,000+ commands?

Undo

Undo

Redo?

YAPC::NA, 2006

YAPC::NA, 2006

"I think, but I cannot prove, that by the next year **JavaScript 2.0** will **bootstrap** itself, complete self hosting, **compile back** to JavaScript, and **replace Ruby** as the Next Big Thing in all environments."

YAPC::NA, 2006

YAPC::NA, 2006

"**JavaScript** will become the **common backend** for all dynamic languages, and so you can write **Perl** to run in the **browser**, on the **server**, and inside **databases**, all with the same set of development tools."

YAPC::NA, 2006

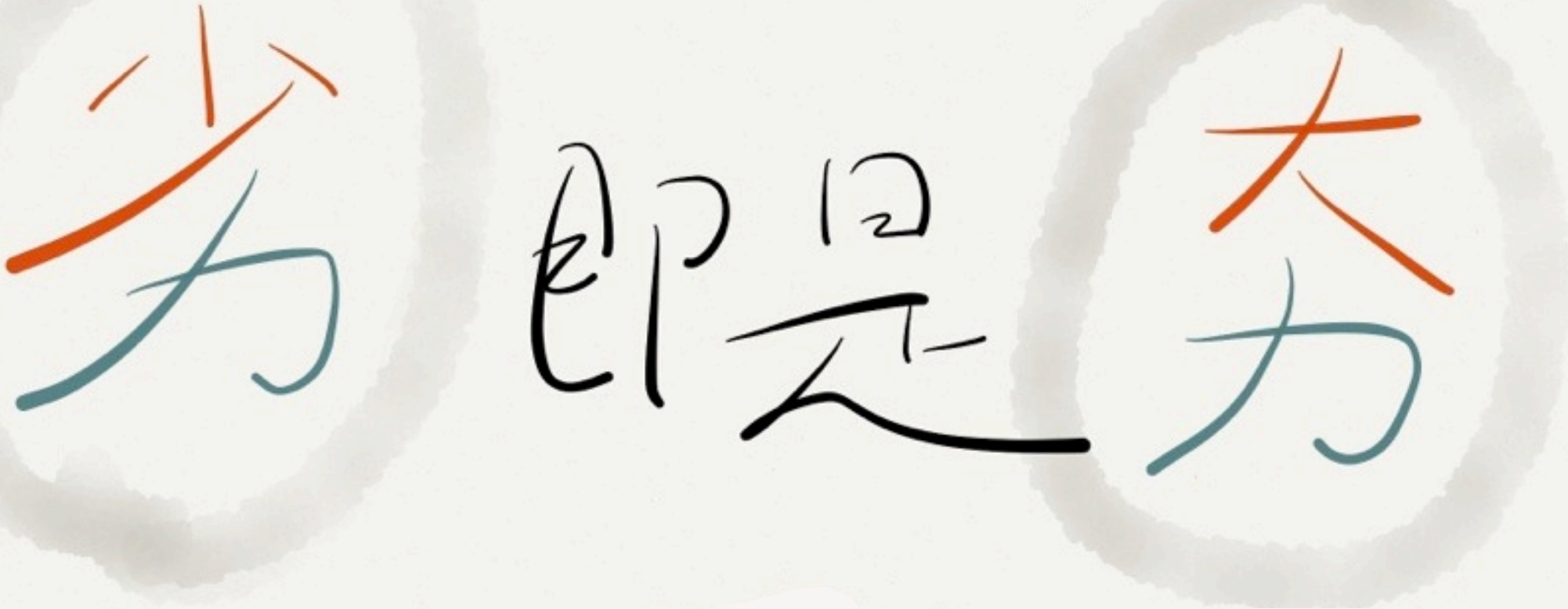
YAPC::NA, 2006

"Because, as we all know, **worse is better**, so the ***worst*** scripting language is doomed to become the ***best***."

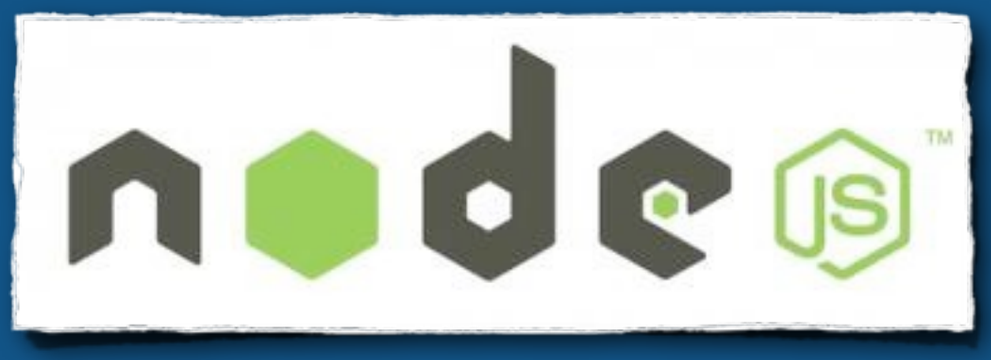
YAPC::NA, 2006

"Because, as we all know, **worse is better**, so the ***worst*** scripting language is doomed to become the ***best***."

劣＝夯



少 即是 大



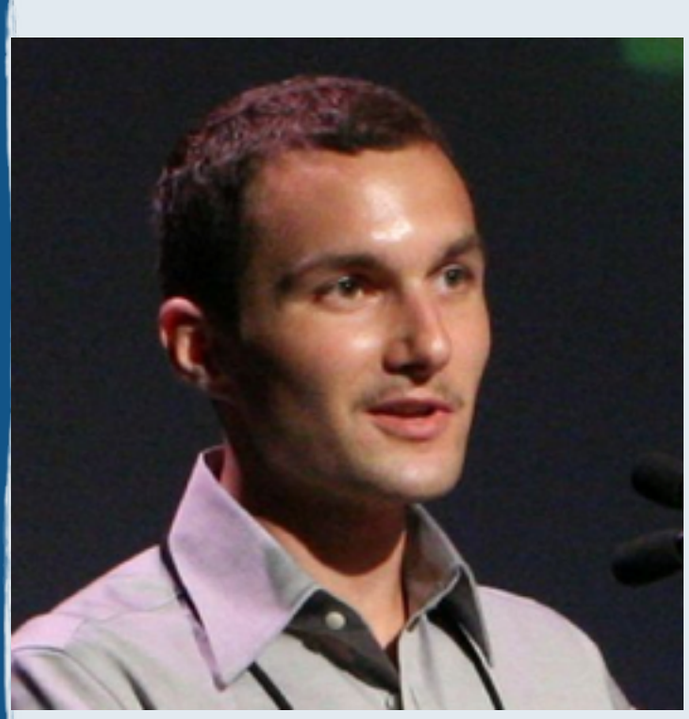
node.js™

CoffeeScript

JavaScript: Good Part Only

CoffeeScript: Half the Noise

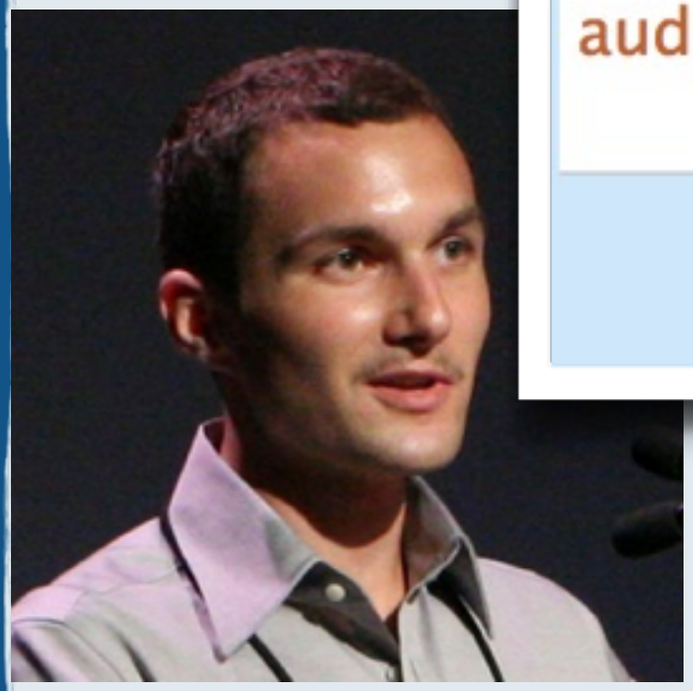
```
cs = (js) => js/2
```



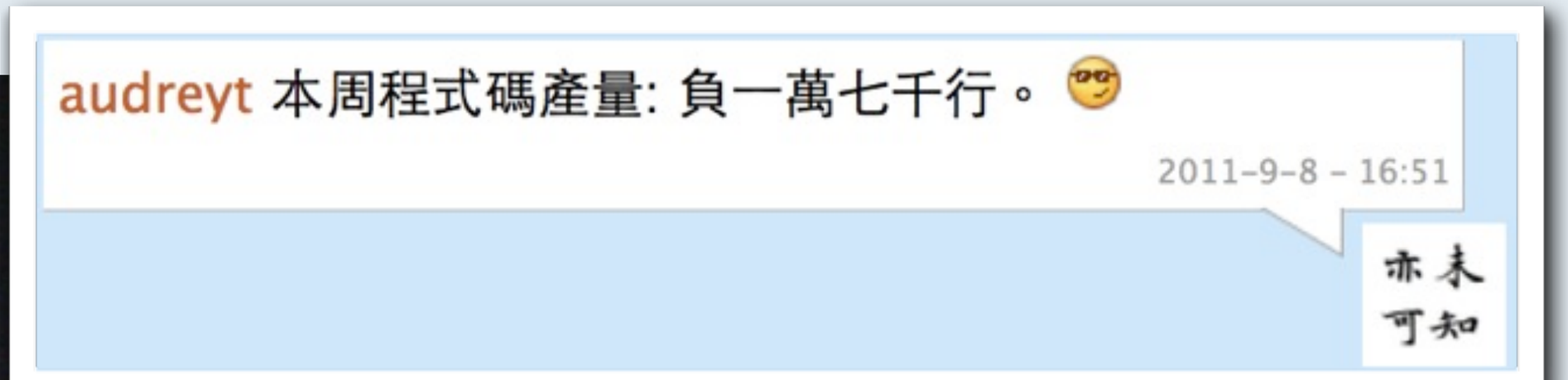
Jeremy Ashkenas

CoffeeScript: Half the Noise

cs = (js) => js/2

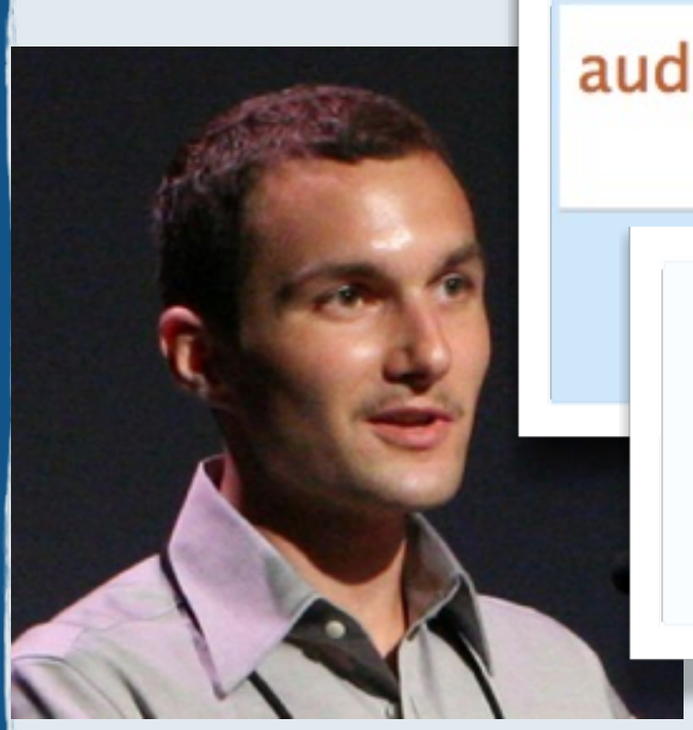


Jeremy Ashkenas



CoffeeScript: Half the Noise

cs = (js) => js/2



Jeremy Ashkenas

audreyt 本周程式碼產量: 負一萬七千行。

2011-9-8 - 16:51

"Original **JavaScript: 22k** LOC.
Ported to **CoffeeScript: 5k** LOC.
{async, jsdom, zappa, optimist etc}++"


```
{x,y} = @offset
```

CoffeeScript

```
{x,y} = @offset
```

```
var _ref = this.offset;
```

CoffeeScript

```
{x,y} = @offset
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```
var _ref = this.offset;
var x = _ref.x;
```

CoffeeScript

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{x,y} = @offset
```

```
var _ref = this.offset;
var x = _ref.x;
var y = _ref.y;
```

CoffeeScript

```
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```

```
var _ref = this.offset;
var x = _ref.x;
var y = _ref.y;
```

js2coffee.org

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition
seanhess.github.com/2012/02/20/fun... # 不過還是 Haskell 用起這招最漂亮，一個 . 就是 compose 運算子 XD

Wen-Tien Chang @ihower 4月12日

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seanhess.github.com/2012/02/20/fun... # 不過還是 Haskell 用起這招最漂亮，一個 . 就是 compose 運算子 XD

唐鳳 @audreyt

@ihower (Function::º = (fun) -> (arg) => @ fun arg); (f = (x) -> x * 2); (g = (x) -> x * 3); h = f .º g; console.log h 10 # 60 #coffeescript

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition

```
Function::° = (fun) ->
```

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition

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```

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition

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Function::° = (fun) ->
  (arg) => @ fun arg

f = (x) => x * 2
```

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition

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Function::° = (fun) ->
  (arg) => @ fun arg

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Wen-Tien Chang @ihower 4月12日

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Wen-Tien Chang @ihower 4月12日

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h 100 # 600
```

Wen-Tien Chang @ihower 4月12日

原來 JavaScript 也可以搞 Function Composition

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h = f .° g

h 100 # 600
```

Zappa: Lazy Node.js

zappajs.org

Zappa: Lazy Node.js

Maurice Machado

zappajs.org

Zappa: Lazy Node.js

Maurice Machado

"**If** you can describe it in **495** characters, **why on earth** should it take **879**?"

zappajs.org

```
require('zappa') ->
  @view layout: ->
    html => body => @body

  @get '/': -> @render 'index'

  @view index: -> for name, value of {
    wiki: "Wiki to HTML"
    html: "HTML to Wiki"
  }
    form method: 'post', =>
      p => textarea {name}
      p => input {type: 'submit', value}
```

```
require('zappa') ->
  @view layout: ->
    html => body => @body

  @get '/': -> @render 'index'

  @view index: -> for name, value of {
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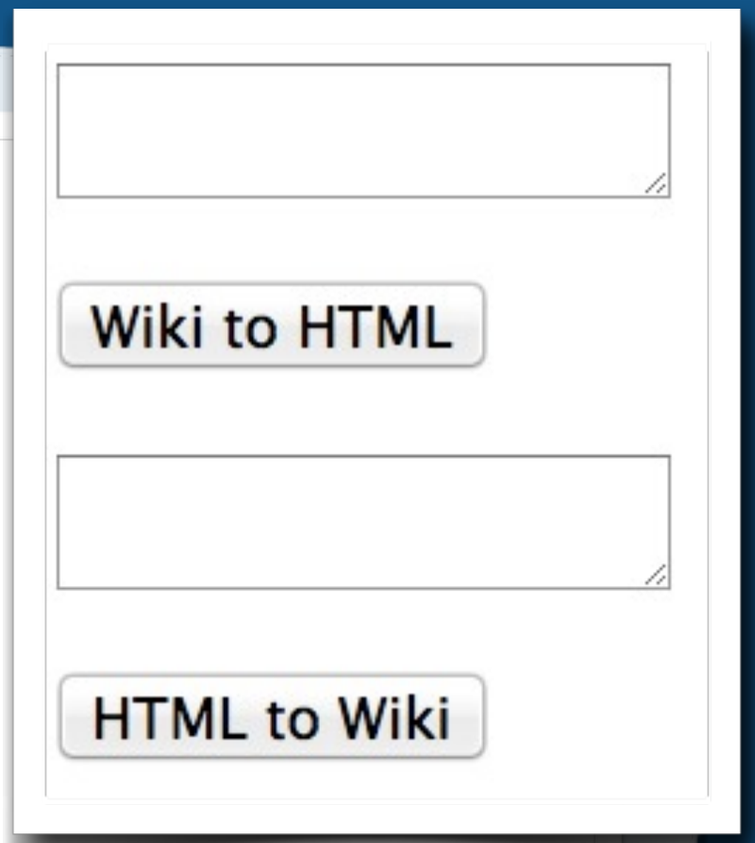
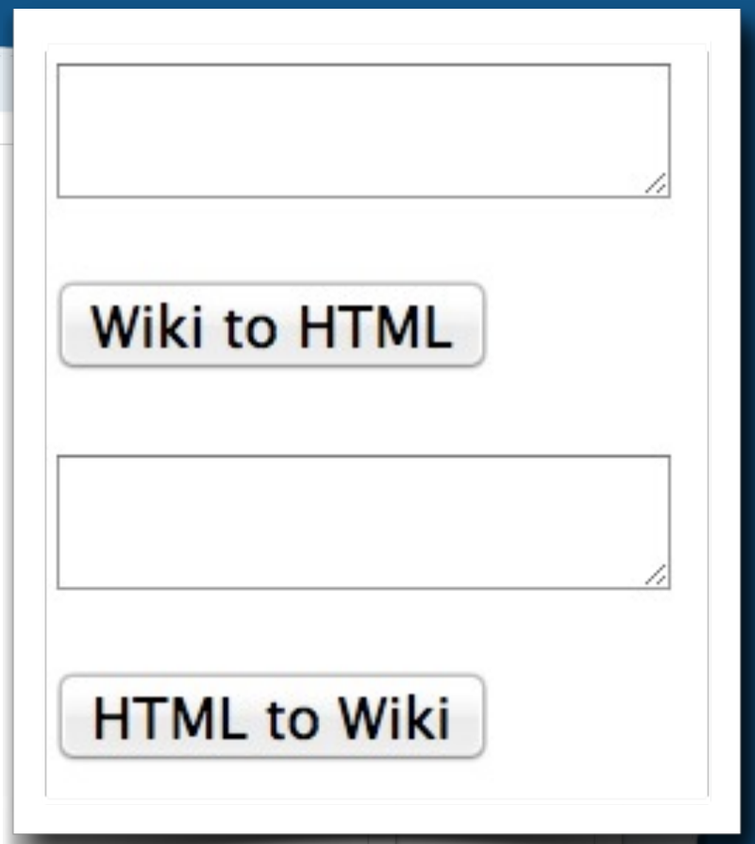


```
@post '/': ->
  if @data.wiki?
    @send w2h @data.wiki
  else if @data.html?
    @send h2w @data.html
  else redirect '/'
```




```
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    p => textarea {name}
    p => input {type: 'submit', value}
```

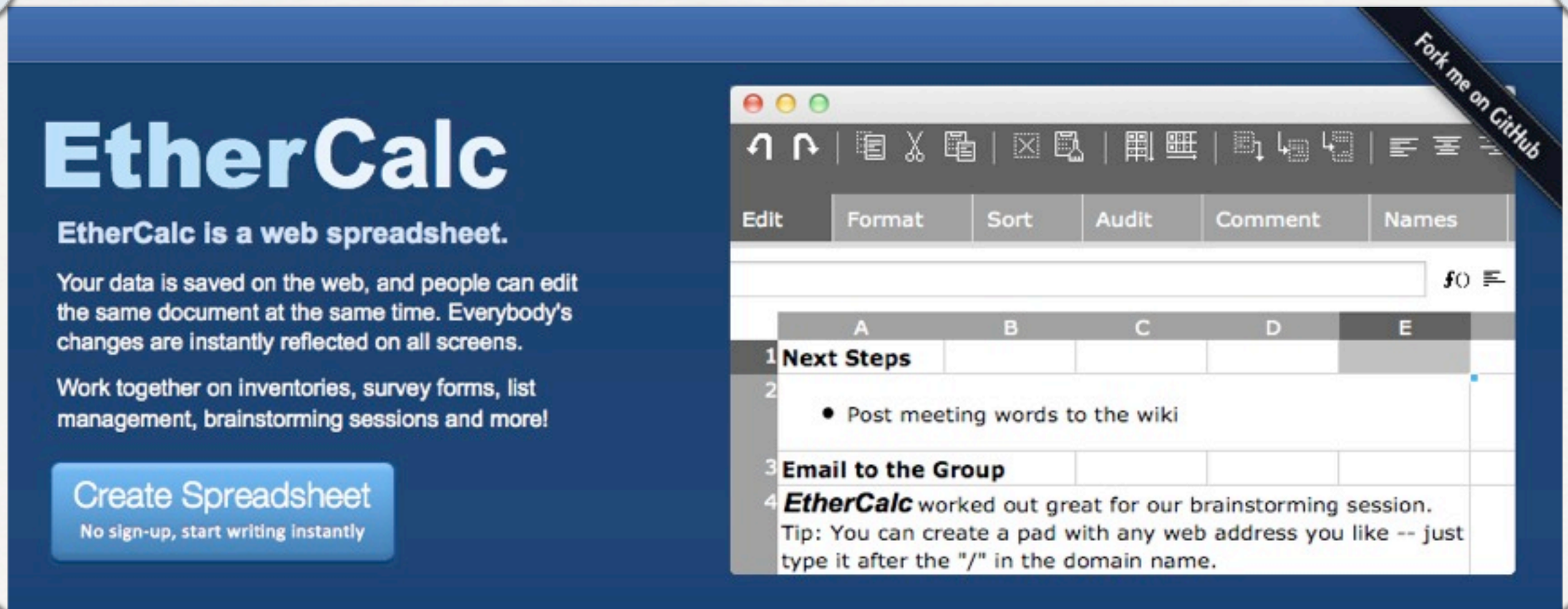
COSCUP, 2011

COSCUP, 2011

COSCUP, 2011

hack hack hack ...

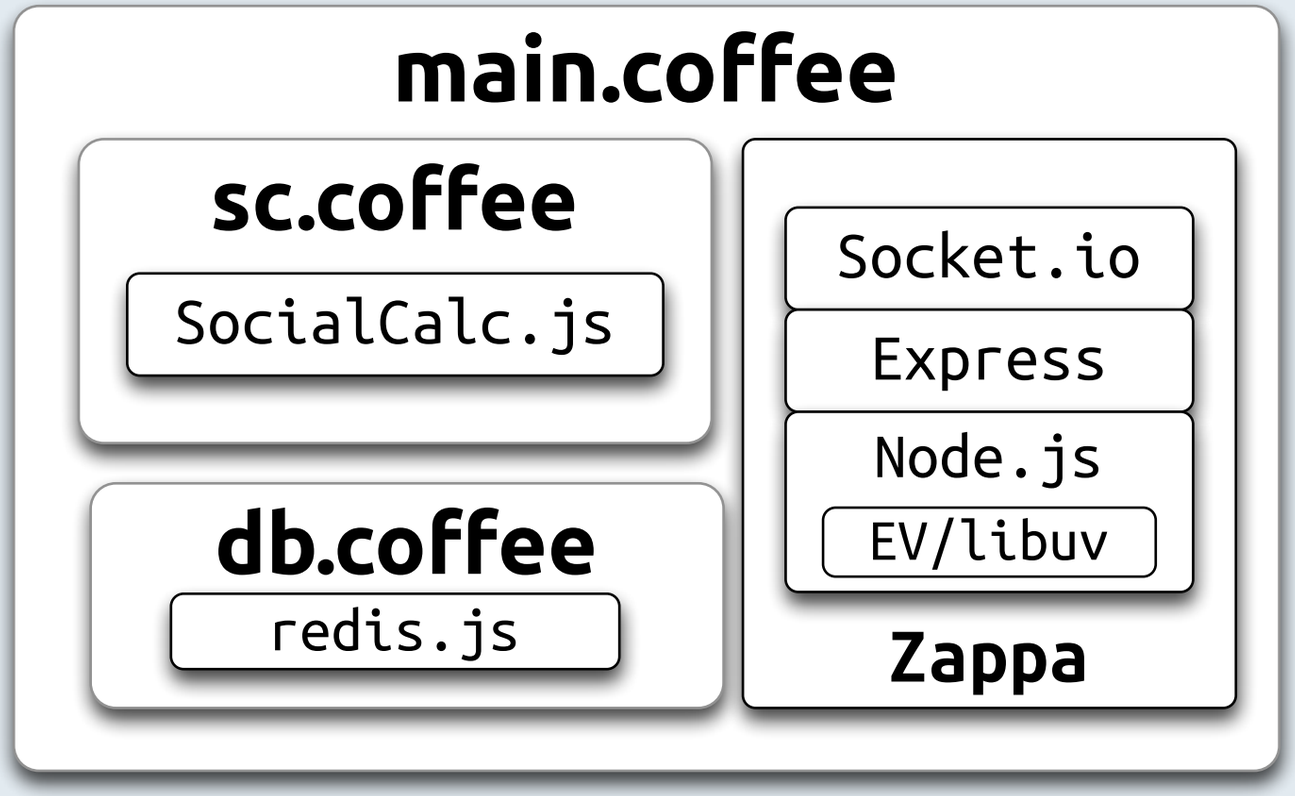
COSCUP, 2011



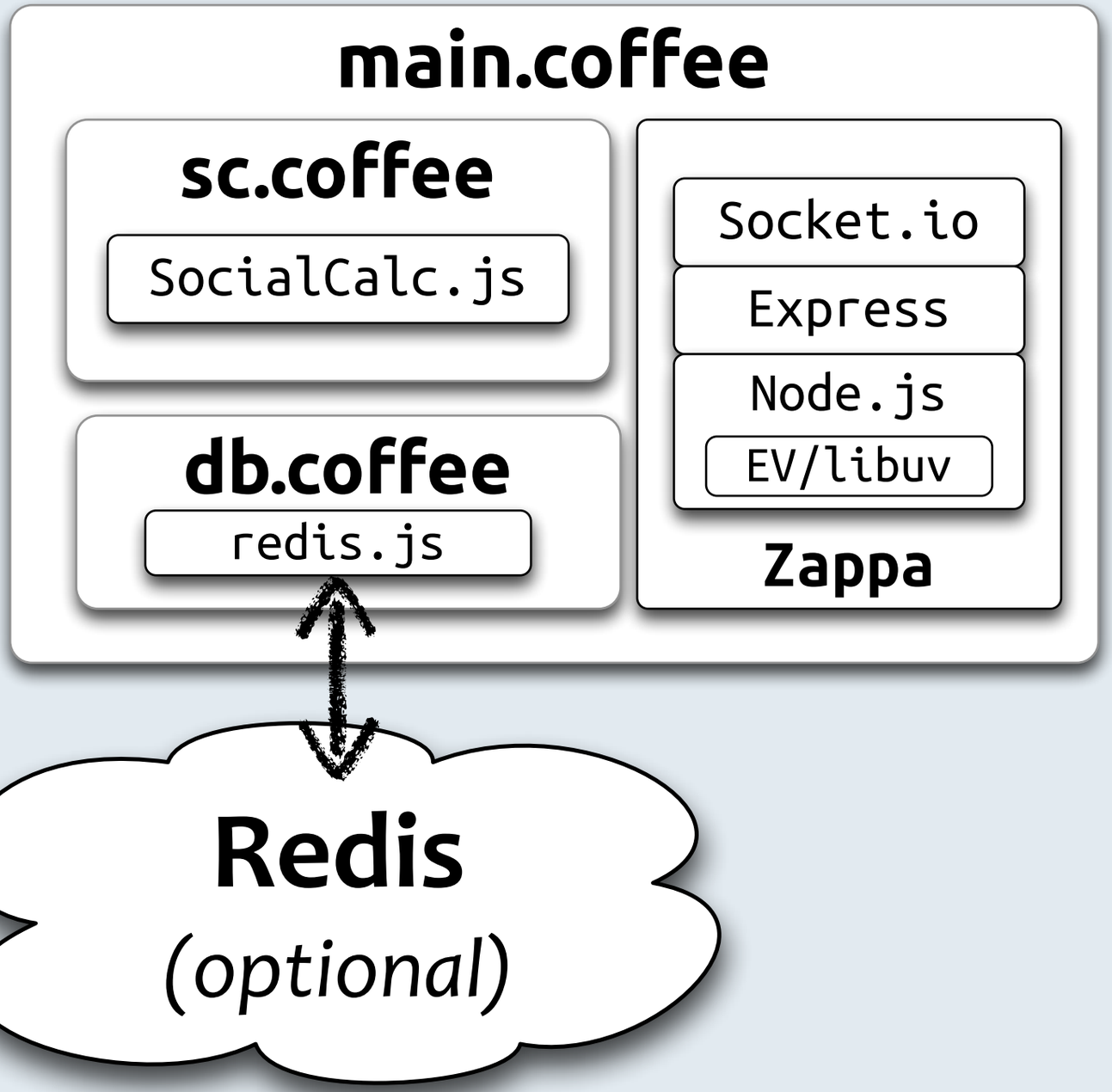
hack hack hack ...

EtherCalc Edit Flow

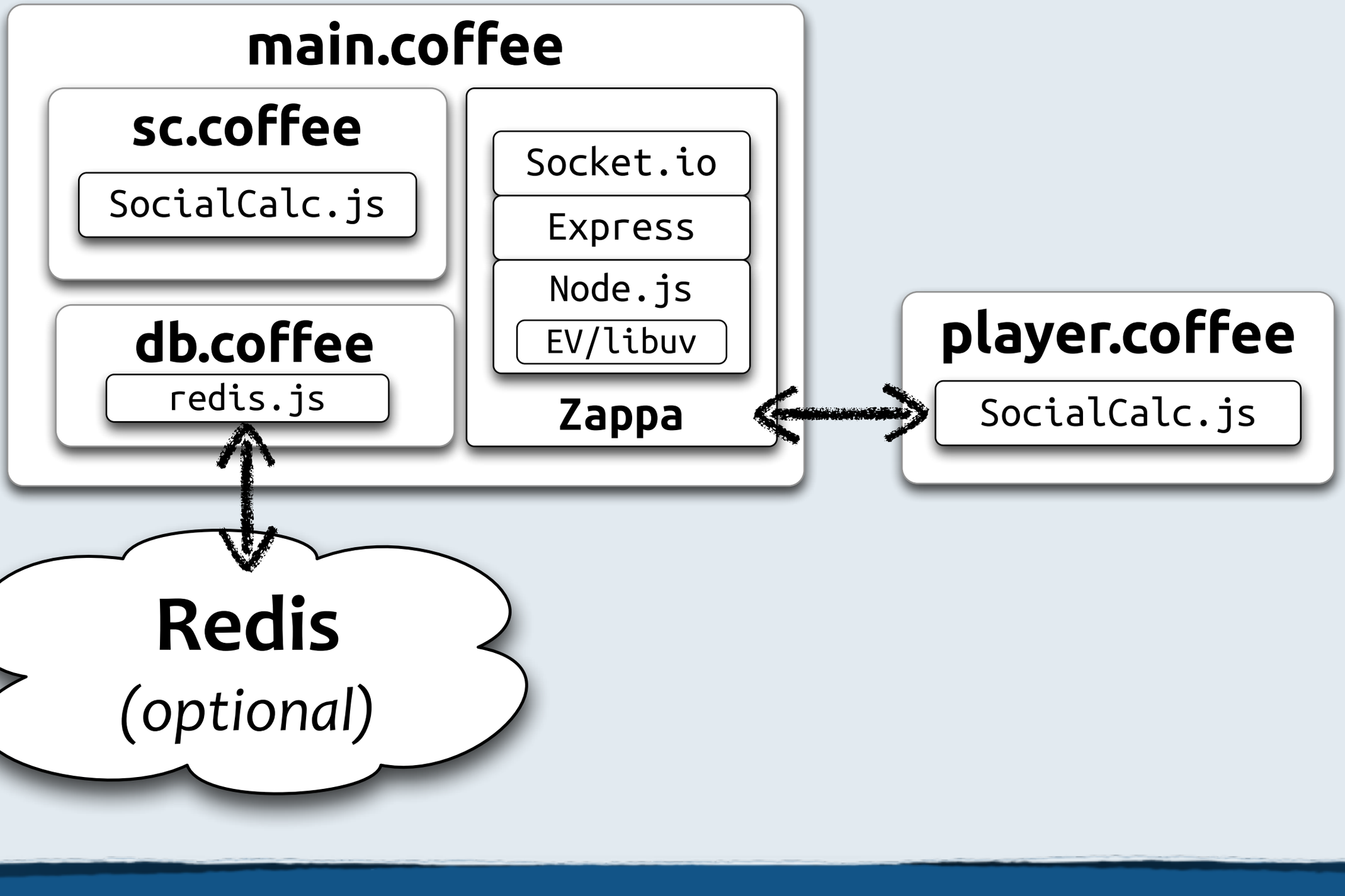
EtherCalc Edit Flow



EtherCalc Edit Flow



EtherCalc Edit Flow



EtherCalc Edit Flow

main.coffee

sc.coffee

SocialCalc.js

db.coffee

redis.js

Socket.io

Express

Node.js

EV/libuv

Zappa

```
MULTI
  GET snapshot
  LRANGE log
EXEC
```

player.coffee

SocialCalc.js

Redis

(optional)

EtherCalc Edit Flow

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db.coffee

redis.js

Socket.io

Express

Node.js

EV/libuv

Zappa

MULTI
  GET snapshot
  LRANGE log
EXEC

player.coffee

SocialCalc.js

RPUSH log *cmd*

Redis
(optional)

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(optional)

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RPUSH log ***cmd***

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(optional)

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   GET snapshot
   LRANGE log
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RPUSH log ***cmd***

EtherCalc Edit Flow

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sc.coffee

SocialCalc.js

db.coffee

redis.js

Socket.io

Express

Node.js

EV/libuv

Zappa

Redis

(optional)

```
MULTI
  GET snapshot
  LRANGE log
EXEC
```

player.coffee

SocialCalc.js

```
MULTI
  DEL log
  SET snapshot snapshot
EXEC
```

Recalc Subscription

Recalc Subscription

Recalc Subscription

Recalc Subscription

ask.log: Foo

Recalc Subscription

ask.log: Foo

log: Foo,*snapshot*,*log*

Recalc Subscription

ask.log: Foo

log: Foo,*snapshot*,*log*

execute: set A1
formula **Bar**!B2

Recalc Subscription

ask.log: Foo

log: Foo,*snapshot*,*log*

execute: set A1
formula **Bar**!B2

ask.recalc: Bar

Recalc Subscription

ask.log: Foo

log: Foo,*snapshot*,*log*

execute: set A1
formula **Bar**!B2

ask.recalc: Bar

recalc: Bar,*snapshot*

Recalc Subscription

ask.log: Foo

log: Foo,*snapshot*,*log*

execute: set A1
formula **Bar**!B2

ask.recalc: Bar

recalc: Bar,*snapshot*

recalc: Bar,*snapshot*

PaaS Deployment

PaaS Deployment

`stackato.yml`
`app.js`

PaaS Deployment

stackato.yml
app.js

dotcloud.yml
server.js

PaaS Deployment

stackato.yml
app.js

dotcloud.yml
server.js

server.js

REST Interface

REST Interface

GET */_/page*
PUT */_/page*

REST Interface

GET */_/page*

PUT */_/page*

POST */_/page*

```
{command:[…]}
```

REST Interface

GET */_/page*
PUT */_/page*

POST */_/page*
{command:[…]}

GET */_/page*/cells/**A1**
PUT */_/page*/cells/**A1**
GET */_/page*/names/***range***

TODO, 2012

TODO, 2012

- Chat & EtherPad Lite

TODO, 2012

- Chat & EtherPad Lite
- Export/Import, Charts

TODO, 2012

- Chat & EtherPad Lite
- Export/Import, Charts
- Drupal Integration

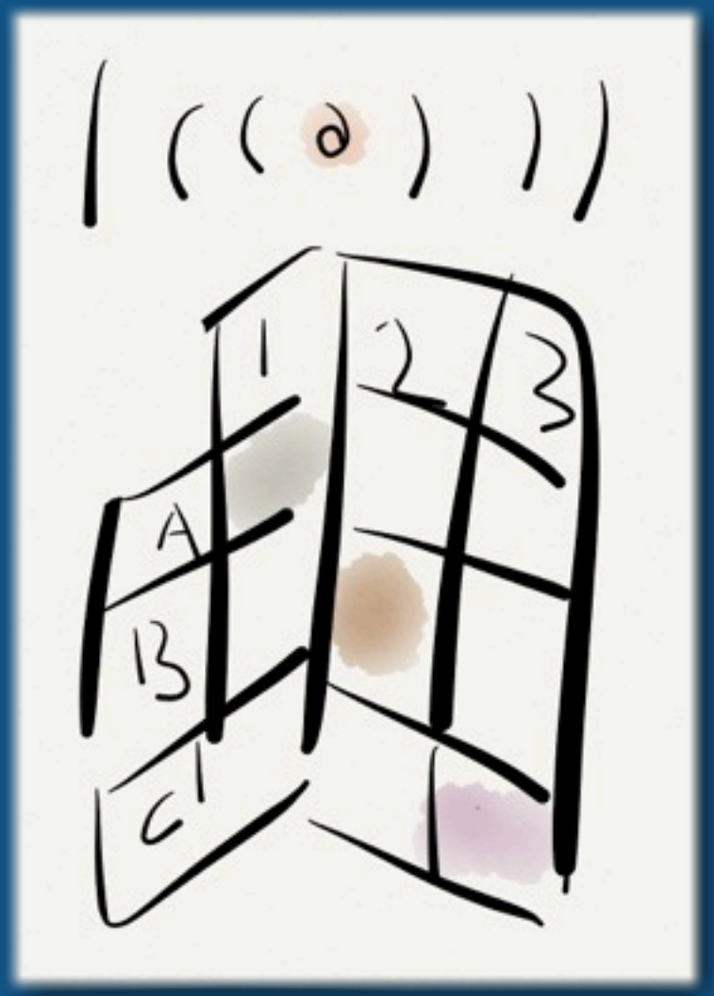
TODO, 2012

- Chat & EtherPad Lite
- Export/Import, Charts
- Drupal Integration
- Socialtext Integration

TODO, 2012

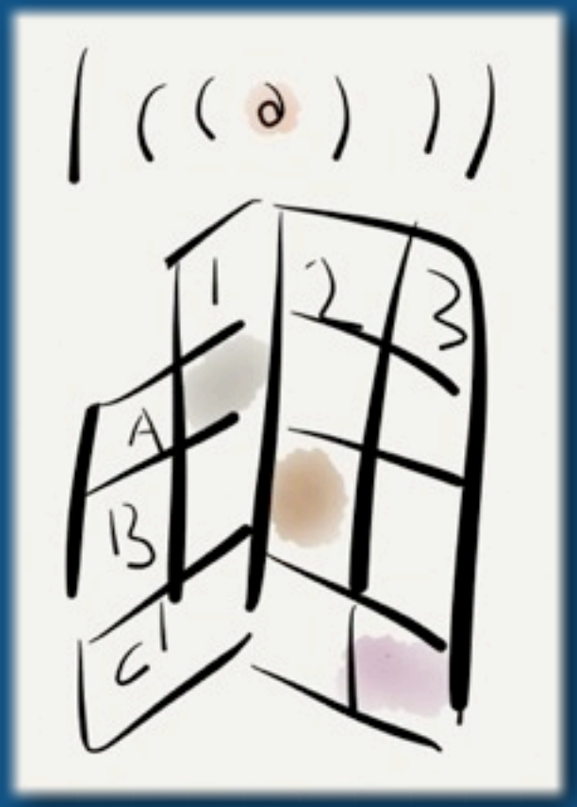
- Chat & EtherPad Lite
- Export/Import, Charts
- Drupal Integration
- Socialtext Integration
- ***Forks welcome!***

Thank you!



EtherCalc

Multiplayer Spreadsheet



EtherCalc

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