EtherCalc
Multiplayer Spreadsheet
ethercalc.net
Installation

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

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

ethercalc.org
History
VisiCalc, 1979

Dan Bricklin
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
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

=SUM( )

0
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SUM()</td>
<td>10</td>
</tr>
</tbody>
</table>

The formula is: \( \text{SUM() \text{=SUM( )} 10} \)
<table>
<thead>
<tr>
<th></th>
<th>10</th>
<th>20</th>
<th>=SUM( )</th>
<th>30</th>
</tr>
</thead>
</table>

This image represents a simple table with the formula `=SUM()` applied to the sum of 10 and 20, which equals 30.
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
<td>30</td>
<td>60</td>
</tr>
</tbody>
</table>

=SUM( )
<table>
<thead>
<tr>
<th></th>
<th>10</th>
<th>20</th>
<th>30</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>

=SUM( )
1977 → 1978
1977 → 1978
1977 → 1978

+ Integer BASIC
1978 → 1979
<table>
<thead>
<tr>
<th></th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>→</td>
<td>1979</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

=SUM( )
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=SUM(</td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=SUM(A1,B1,C1)</td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=SUM(A1,B1,C1)</td>
<td></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

1978 → 1979
### 1978 → 1979

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>30</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=SUM(A1,B1,C1)</td>
<td>60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Dan prototypes in BASIC**

![Bob & Dan](image)
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>=SUM(A1,B1,C1)</td>
<td></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

- **Dan** prototypes in **BASIC**
- **Bob** codes in **6502 ASM**
Dan prototypes in BASIC
Bob codes in 6502 ASM
700,000 copies in 6 years
Dan prototypes in BASIC
Bob codes in 6502 ASM
700,000 copies in 6 years
The first “Killer App”
20 years passed
20 years passed
20 years passed
20 years passed
20 years passed
Nothing changed
“Can’t open”
Can’t open

“MøjîbÃké”
“Can’t open”

“MøjîbĀké”

“Virus!”
Wikipedia, 2001
Wikipedia, 2001
Wikipedia, 2001
wikiCalc, 2005
wikiCalc, 2005

✓ Plain text, HTML & Wiki syntax
wikiCalc, 2005

✓ Plain text, HTML & Wiki syntax
✓ References cells on other hosts
wikiCalc, 2005

✓ Plain text, HTML & Wiki syntax
✓ References cells on other hosts
✓ Keeps all operations for auditing
wikiCalc, 2005

✓ Plain text, HTML & Wiki syntax
✓ References cells on other hosts
✓ Keeps all operations for auditing
✓ Revert to any revision
wikiCalc, 2005

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

Sites

./wkcdat/sites/Foo
./wkcdat/sites/Bar
./wkcdat/sites/Baz
wikiCalc.pl

Sites
- ./wkcdat/sites/Foo
- ./wkcdat/sites/Bar
- ./wkcdat/sites/Baz

Pages
- XXX
- YYY
- ZZZ

Cells
A1: 100
wikiCalc.pl

Sites
./wkcdatadata/sites/Foo
./wkcdatadata/sites/Bar
./wkcdatadata/sites/Baz

Pages
XXX
YYY
ZZZ

Cells
A1: 100
A2: =A1*2
wikiCalc.pl

Sites
- ./wkcdada/sites/Foo
- ./wkcdada/sites/Bar
- ./wkcdada/sites/Baz

Pages
- XXX
- YYY
- ZZZ

Cells
- A1: 100
- B1: =XXX!C1
- A2: =A1*2
wikiCalc.pl

Sites
./wkcdatal/sites/Foo
./wkcdatal/sites/Bar
./wkcdatal/sites/Baz

Pages
XXX
YYY
ZZZ

Cells
A1: 100  B1: =XXX!C1
A2: =A1*2
wikiCalc.pl

Sites
- ./wkcdatasites/Foo
- ./wkcdatasites/Bar
- ./wkcdatasites/Baz

Pages
- XXX
- YYY
- ZZZ

Cells
- A1: 100
- A2: =A1*2
- B1: =XXX!C1
- B2: =YYY!D2
wikiCalc.pl

Sites
- ./wkcdatal/sites/Foo
- ./wkcdatal/sites/Bar
- ./wkcdatal/sites/Baz

Pages
- XXX
- YYY
- ZZZ

Cells
- A1: 100
- A2: =A1*2
- B1: =XXX!C1
- B2: =YYY!D2
wikiCalc.pl

Sites
- ./wkcddata/sites/Foo
- ./wkcddata/sites/Bar
- ./wkcddata/sites/Baz

Pages
- XXX
- YYY
- ZZZ

Cells
- A1: 100
- A2: =A1*2
- B1: =XXX!C1
- B2: =YYY!D2

Cross-page Reference
wikiCalc Edit Flow
wikiCalc Edit Flow

A1: 100
A2: =A1*2
wikiCalc Edit Flow

A1: 100
A2: =A1*2
wikiCalc Edit Flow

A1: 100
A2: =A1*2

POST /ajaxsetcell=host:page:A1:300

wikicalc.pl
wikiCalc Edit Flow

A1: 100
A2: =A1*2

POST /ajaxsetcell=host:page:A1:300

200 OK

<?xml version="1.0"?>
<root><![CDATA[
A1:v:300:300:right:1:1::
]]></root>
“Loading...”
“Loading...”

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sample financial calculation in a table with borders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Sales</td>
<td>Loading...</td>
<td>170.5</td>
</tr>
<tr>
<td>D</td>
<td>Cost</td>
<td>124.0</td>
<td>136.4</td>
</tr>
<tr>
<td>E</td>
<td>Profit</td>
<td>31.0</td>
<td>34.1</td>
</tr>
</tbody>
</table>
“Loading…”

“C100k” Problem
“Loading…”

“C100k” Problem
Undo
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

SocialCalc.js

GET

HTTP Server
Architecture

SocialCalc.js

GET

GET ($)

HTTP Server
Architecture

SocialCalc.js

GET

($)

GET

PUT

HTTP Server
Architecture

SocialCalc.js

GET

PUT

HTTP Server

SocialCalc

Class Diagram
Command Pattern
set A1 value n 42
Command Pattern

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

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

- Async recalc loop
- Visible-only redraw
**Command Pattern**

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

```plaintext
set A1 value n 42
set A2 formula A1*2
```
Command Pattern

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

set A1 value n 42
set A2 formula A1*2
Command Pattern

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

```
set A1 value n 42
set A2 formula A1*2
```
“Social” Calc
“Social” Calc
“Social” Calc

Signal, Like, Tag, Share, Embed...
Objects ↔ Relations
Objects ⇔ Relations
Objects ⇔ Relations
Good first

Profits later
Common Public Attribution License
Common Public Attribution License

BSD, MIT
Common Public Attribution License

BSD, MIT

LGPL, MPL
Common Public Attribution License

BSD, MIT

LGPL, MPL

GPL
Common Public Attribution License

BSD, MIT  LGPL, MPL  “ASP loophole”  GPL  ++
Common Public Attribution License

BSD, MIT

LGPL, MPL

"ASP loophole"

GPL

Affero GPL
Common Public Attribution License

BSD, MIT  LGPL, MPL  GPL

“ASP loophole”

CPAL  Afferro GPL
Common Public Attribution License

BSD, MIT

LGPL, MPL

“ASP loophole”

CPAL

Affero GPL

OSI certified
Common Public Attribution License

BSD, MIT

LGPL, MPL

"ASP loophole"

CPAL

Afferro GPL
Common Public Attribution License

BSD, MIT

LGPL, MPL

"ASP loophole"

CPAL

Affero GPL
Sheetnode, 2008

Karim Ratib
Sheetnode, 2008

Views + Fields + CCK

Karim Ratib
Sheetnode, 2008

Views + Fields + CCK

SocialCalc.js

Karim Ratib
Sheetnode, 2008

Karim Ratib

Views + Fields + CCK

SocialCalc.js
OLPC, 2008
OLPC, 2008

Luke Closs & Dan
Mesh P2P
Manusheel Gupta

Vijit Singh

set A1 value n 42

SocialCalcActivity.py

- Gecko/XPCOM
- SocialCalc.js
- XoCom.js
- XoCom.py
set A1 value n 42
Manusheel Gupta

Vijit Singh

set A1 value n 42

SocialCalcActivity.py
- Gecko/XPCOM
  - SocialCalc.js
  - XoCom.js
  - XoCom.py

OLPC Mesh
Broadcast

Telepathy
set A1 value n 42
Manusheel Gupta

Vijit Singh

OLPC Mesh
Broadcast

set A1 value n 42

SocialCalcActivity.py

Gecko/XPCOM

SocialCalc.js

XoCom.js

XoCom.py

set A1 value n 42
Great, but...
Great, but...

- Must start at same time
Great, but...

- Must start at same time
- Can’t replay missed logs
Great, but...

- Must start at same time
- Can’t replay missed logs
- Race condition on cells
Great, but...

- Must start at same time
- Can’t replay missed logs
- Race condition on cells
- OLPC-specific transport!
跳格
Multiplayer SocialCalc
二零零九 唐鳳
中英雙字有字版
EV/AnyEvent
Tatsumaki

EV/AnyEvent

@miyagawa
Tatsumaki  EV/AnyEvent

Web::Hippie

@miyagawa  @clkao
Tatsumaki

Web::Hippie

EV/AnyEvent

@miyagawa  @clkao  @stash

Feersum
WebSocket Channels

multiserver.pl

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

SpreadsheetControl

ScheduleSheetCommand
  set A1 value n 2046

RenderSheet

multiserver.pl

Web::Hippie
Plack
Feersum
EV/libev

Send
WebSocket Channels

- multiserver.pl
  - Web::Hippie
  - Plack
  - Feersum
  - EV/libev

- Send

- Relay

- ScheduleScheetCommand
  - set A1 value n 2046

- RenderSheet
  - A
  - 1
  - 2046
WebSocket Channels

SpreadsheetControl

ScheduleSheetCommand
  set A1 value n 2046

RenderSheet

multiserver.pl

Web::Hippie

Plack

Feersum

EV/libev

Relay

ScheduleSheetCommand
  set A1 value n 2046
  (isRemote = true)

RenderSheet

Send
New Features
New Features

✓ Logs retrieved on join
New Features

✓ Logs retrieved on join
✓ Reconnection recovery
New Features

✓ Logs retrieved on join
✓ Reconnection recovery
✓ Peer cursors are visible
New Features

✓ Logs retrieved on join
✓ Reconnection recovery
✓ Peer cursors are visible
✓ Cross-browser support!
New Features

✓ Logs retrieved on join
✓ Reconnection recovery
✓ Peer cursors are visible
✓ Cross-browser support!
Much better, but...
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?
- What if everyone leaves?
- Who would keep the logs?
- 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??
“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.”
“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.”
“Because, as we all know, worse is better, so the worst scripting language is doomed to become the best.”
“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.”
JS: Only The Good Parts

Jeremy Ashkenas
JS: Only The Good Parts

cs = (js) => js / 2
JS: Only The Good Parts

cs = (js) => js/2
**JS**: Only The Good Parts

\[ \text{cs} = (\text{js}) \Rightarrow \text{js}/2 \]

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

Jeremy Ashkenas
\{x, y\} = \texttt{@offset}
\{x, y\} = \_\text{offset}

var \_\text{ref} = this.offset;
\{x, y\} = @offset

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

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

```javascript
var _ref = this.offset;
var x = _ref.x;
var y = _ref.y;
```
Wen-Tien Chang @ihower

原來 JavaScript 也可以搞 Function Composition
seanhess.github.com/2012/02/20/function-composition/

# 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
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

唐鳳 @audreyt
@ihower (Function::° = (fun) -> (arg) => @ fun arg); (f = (x) -> x * 2); (g = (x) -> x * 3); h = f .° g; console.log h 10 # 60 #coffeescript
Function::\circ = (\text{fun}) \rightarrow
Function:\ ^{\circ} = \ (\text{fun}) \rightarrow \ (\text{arg}) \Rightarrow \ @ \ \text{fun} \ \text{arg}
Function: \( \circ \ = (\text{fun}) \rightarrow (\text{arg}) \rightarrow \text{fun \ arg} \)

\[ f \ = (x) \rightarrow x \ast 2 \]
Function::° = (fun) -> (arg) => @ fun arg

f = (x) => x * 2

g = (x) => x * 3
Function: \( \circ \) = (fun) -> (arg) => @ fun arg

\[
\begin{align*}
  f &= (x) \Rightarrow x \times 2 \\
  g &= (x) \Rightarrow x \times 3 \\
  h &= f \circ g
\end{align*}
\]
Function:: = (fun) -> (arg) => @ fun arg

f = (x) => x * 2

g = (x) => x * 3

h = f . g

h 100 # 600
Function::\circ = (\text{fun}) \rightarrow (\text{arg}) => \text{fun arg}

\text{f} = (x) => x * 2
\text{g} = (x) => x * 3
\text{h} = \text{f} \circ \text{g}

\text{h 100} # 600
Zappa: Lazy Node.js

zappajs.org
Zappa: Lazy Node.js

Maurice Machado

zappajs.org
Zappa: Lazy Node.js

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

Maurice Machado

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 {
  wiki: "Wiki to HTML"
  html: "HTML to Wiki"
}
  form method: 'post', =>
    p => textarea {name}
    p => input {type: 'submit', value}
@post '/': ->
  if @data.wiki?
    @send w2h @data.wiki
  else if @data.html?
    @send h2w @data.html
  else redirect '/'

form method: 'post', =>
  p => textarea {name}
  p => input {type: 'submit', value}
COSCUP, 2011
COSCUP, 2011

Multiplying Opportunities for your Apps
COSCUP, 2011

hack hack hack hack ...
COSCUP, 2011

EtherCalc

EtherCalc is a web spreadsheet. Your data is saved on the web, and people can edit the same document at the same time. Everybody’s changes are instantly reflected on all screens.

Work together on inventories, survey forms, list management, brainstorming sessions and more!

Create Spreadsheet

No sign-up, start writing instantly

Tip: You can create a pad with any web address you like -- just type it after the “/” in the domain name.
EtherCalc Edit Flow
EtherCalc Edit Flow

main.coffee

sc.coffee
SocialCalc.js

db.coffee
redis.js

Socket.io
Express
Node.js
EV/libuv

Zappa
EtherCalc Edit Flow

main.coffee

sc.coffee
SocialCalc.js

db.coffee
redis.js

Socket.io
Express
Node.js
EV/libuv

Zappa

Redis (optional)
EtherCalc Edit Flow

**main.coffee**

- **sc.coffee**
  - SocialCalc.js

- **db.coffee**
  - redis.js
  - Zappa
  - Socket.io
  - Express
  - Node.js
  - EV/libuv

**player.coffee**

- SocialCalc.js

**Redis**

(optional)

- MULTI
- GET snapshot
- LRANGE log
- EXEC
- RPUSH log cmd
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

RPUSH log cmd

Redis
(optional)
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

log: Foo, snapshot, log

execute: set A1 formula Bar!B2

ask.recalc: Bar

ask.log: Foo
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
  - stackato.yml
  - app.js
- dotCloud
  - dotcloud.yml
  - server.js
- JoyentCloud
  - server.js
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

- Export/Import
TODO, 2012

- Export/Import
- Chat & Presence
TODO, 2012

- Export/Import
- Chat & Presence
- Socialtext Integration
TODO, 2012

- Export/Import
- Chat & Presence
- Socialtext Integration
- Drupal Integration
Todo, 2012

- Export/Import
- Chat & Presence
- Socialtext Integration
- Drupal Integration
- Forks welcome!
Thank you!

EtherCalc
Multiplayer Spreadsheet
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