

Ur/Web: A Statically-Typed Language for Building Web Applications from Components

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Emerging Languages Camp 2010

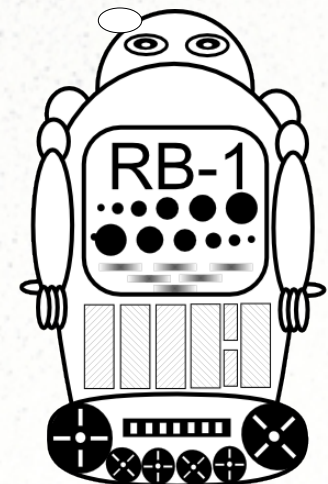
Web Applications: A Steaming Pile of Text

HTML, CSS, JavaScript,
SQL, URLs, JSON, ...



Web App Developer

Strings, strings,
strings, ...

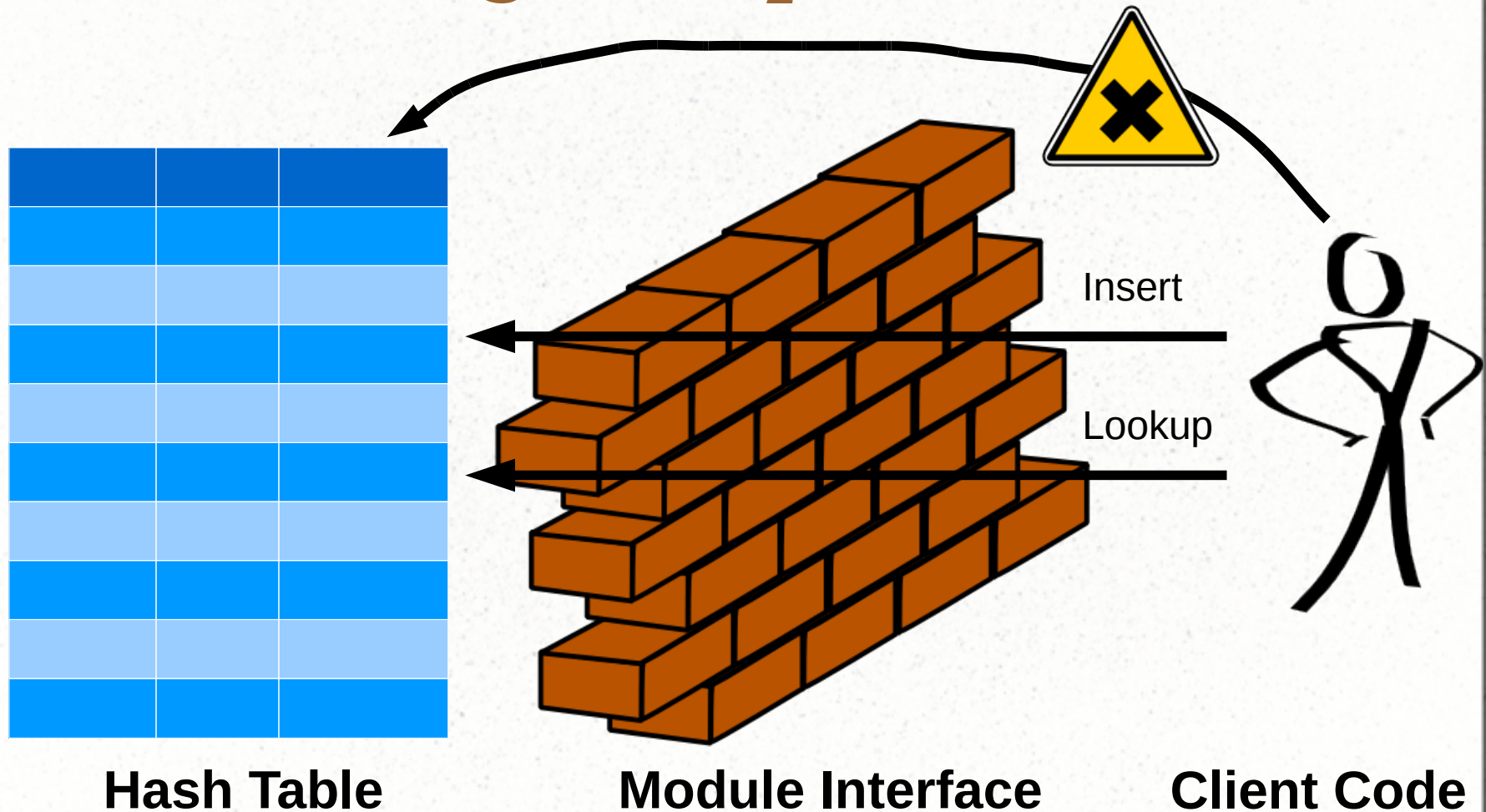


Compiler/Interpreter

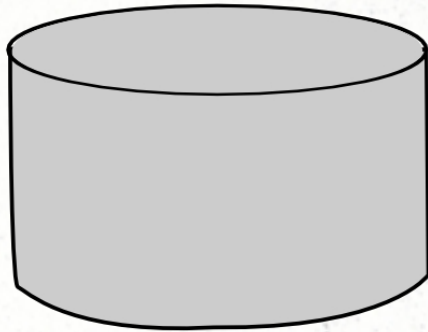
Executive Summary

Ur/Web is a **domain-specific language**
with a **fancy static type system**
with **first-class support** for Web app architecture
including **strong encapsulation**
and **statically-checked metaprogramming**
with **security by construction**

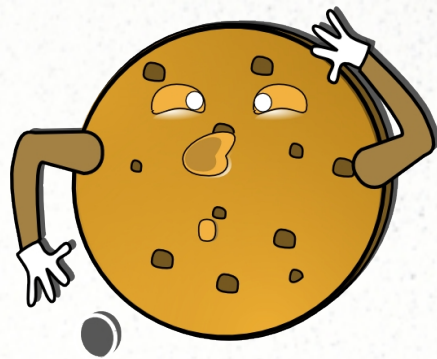
Strong Encapsulation



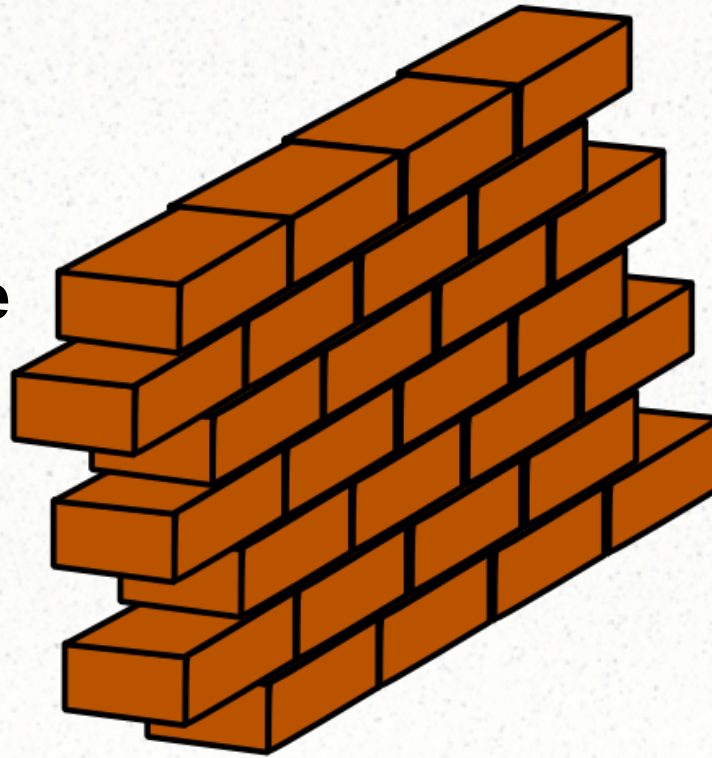
Web 1.0 Encapsulation



Users Database Table



Login Cookie



Module Interface

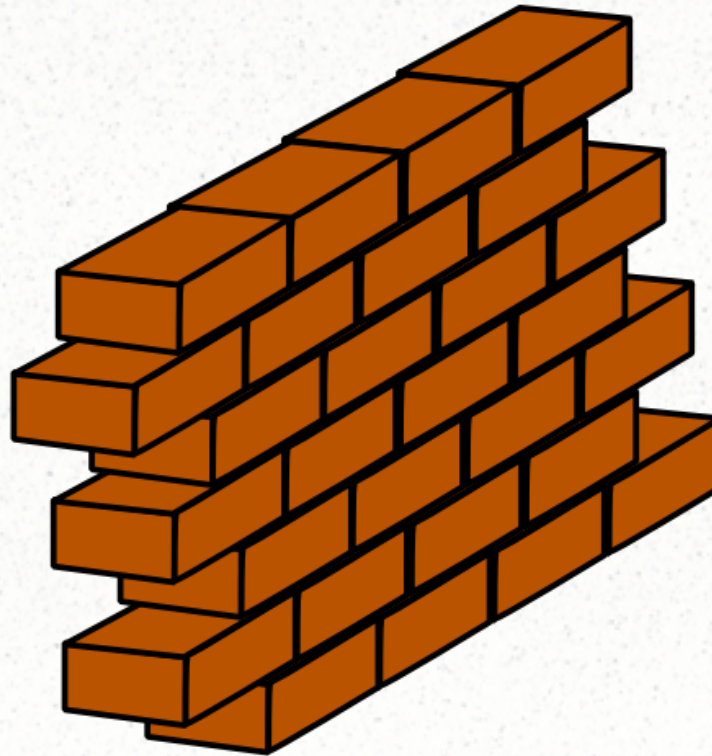


Client Code

Web 2.0 Encapsulation



**Subtree of
Dynamic Page
Structure**



Module Interface



Client Code

Automatic Admin Interface

Id	A	B	C	D

SQL Table Schema

Metaprogram

Crud1

ID	A	B	C	D	
115	2	1	65	True	[Update] [Delete]
123	10	1000	100	True	[Update] [Delete]

A:

B:

C:

D:

In-Browser Spreadsheet

No sort		Id	A	B	C	D	E	F	2A	Link
Update	Delete	138	1	4	False	default		NULL	2	Go
Update	Delete	137	0		True	default		NULL	0	Go
Save	Cancel	136	56	qqq	<input checked="" type="checkbox"/>	default ▾		NULL ▾
Update	Delete	135	0		False	further		NULL	0	Go
Update	Delete	134	7657		True	default		NULL	15314	Go
Update	Delete	140	0	141	False	other		NULL	0	Go
Update	Delete	157	0		False	default		NULL	0	Go
Aggregates			7715		False					
Filters										

Pages: 1 | 2

New row

Refresh

Metaprogramming in a Nutshell

Compile-time Programming Language

(AKA, type system)

(not Turing complete, but includes basic lambda calculus)

Crucial feature: type-level records!

Included in

Run-time Programming Language

(Turing complete)

Key Property 1:

These types are expressive enough to guarantee absence of code injection, abstraction violation, etc..

Key Property 2:

Effective static checking that the metaprogram really has the claimed type

Metadata
controlling
code
generation
options

Metaprogram

Sub-Web

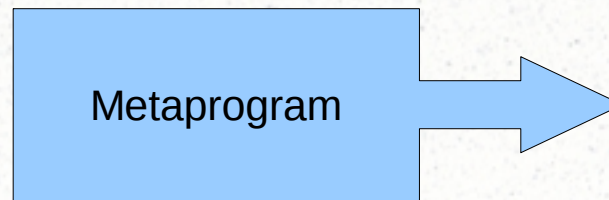
Metadata's
type

Type-level program

Sub-Web's
type

An Example Application

Id	A	B	C	D



Crud1

ID	A	B	C	D	
115	2	1	65	True	[Update] [Delete]
123	10	1000	100	True	[Update] [Delete]

A:

B:

C:

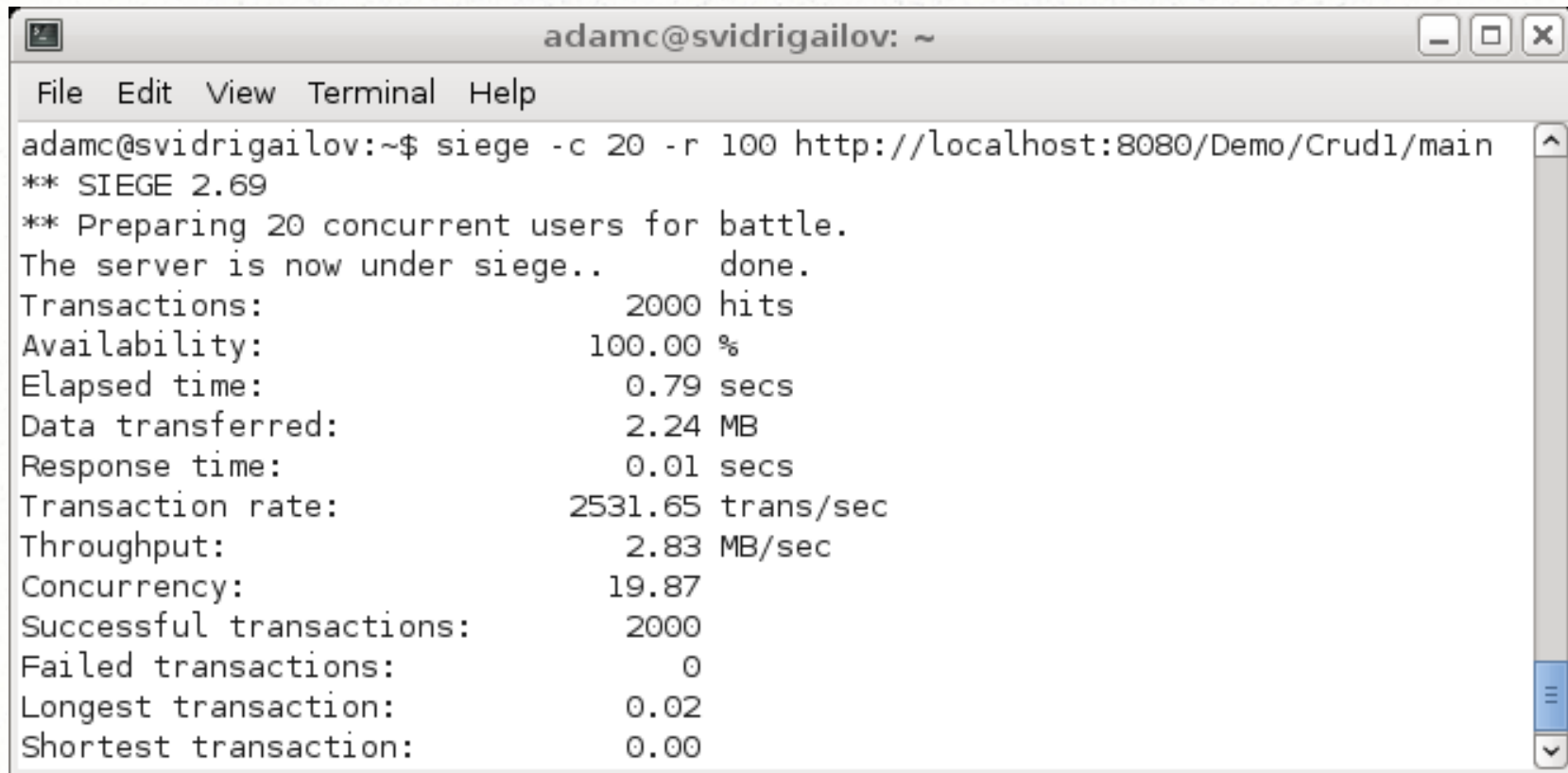
D:

SQL Table Schema

```
table t1 : {Id : int, A : int, B : string,  
           C : float, D : bool}  
PRIMARY KEY Id
```

```
open Crud.Make(struct  
    val tab = t1  
  
    val title = "Crud1"  
  
    val cols = {A = Crud.int "A",  
               B = Crud.string "B",  
               C = Crud.float "C",  
               D = Crud.bool "D"}  
  
end)
```


Nice and Speedy

A terminal window titled 'adamc@svidrigailov: ~' with a menu bar containing 'File', 'Edit', 'View', 'Terminal', and 'Help'. The terminal displays the output of a 'siege' command. The command is 'adamc@svidrigailov:~\$ siege -c 20 -r 100 http://localhost:8080/Demo/Crud1/main'. The output shows the test results for Siege 2.69, including preparation of 20 concurrent users, a list of statistics, and completion of the test.

```
adamc@svidrigailov:~$ siege -c 20 -r 100 http://localhost:8080/Demo/Crud1/main
** SIEGE 2.69
** Preparing 20 concurrent users for battle.
The server is now under siege..      done.
Transactions:                2000 hits
Availability:                 100.00 %
Elapsed time:                 0.79 secs
Data transferred:            2.24 MB
Response time:                0.01 secs
Transaction rate:            2531.65 trans/sec
Throughput:                   2.83 MB/sec
Concurrency:                 19.87
Successful transactions:      2000
Failed transactions:          0
Longest transaction:         0.02
Shortest transaction:         0.00
```

Low Memory Footprint

```
adamc@svidrigailov: ~
File Edit View Terminal Help
top - 08:20:08 up 21:40, 3 users, load average: 0.25, 0.24, 0.18
Tasks: 170 total, 2 running, 165 sleeping, 0 stopped, 3 zombie
Cpu(s): 12.2%us, 28.5%sy, 0.0%ni, 37.5%id, 21.0%wa, 0.5%hi, 0.3%si, 0.0%st
Mem: 2060380k total, 2036556k used, 23824k free, 475372k buffers
Swap: 1060248k total, 604k used, 1059644k free, 696556k cached

  PID USER      PR  NI  VIRT  RES  SHR S %CPU  %MEM    TIME+  COMMAND
 21430 adamc    40   0 653m 165m  74m S   0  8.2   4:55.47 soffice.bin
 19727 adamc    20   0 898m 153m  34m S   0  7.6   9:56.86 iceape-bin
 19741 adamc    40   0 519m  46m  26m S   0  2.3   0:16.17 liferea
```

⋮

```
25068 adamc    40   0 126m 6180 3320 S   0  0.3   0:01.19 script-fu
 2732 adamc    40   0 210m 5408 3560 S   0  0.3   0:00.25 gnome-volume-ma
23904 adamc    40   0 23416 5348 1576 S   0  0.3   0:00.45 bash
24765 adamc    40   0 23368 5248 1520 S   0  0.3   0:00.46 bash
21269 adamc    40   0 23248 4952 1372 S   0  0.2   0:00.48 bash
 2697 adamc    40   0 149m 4032 3016 S   0  0.2   0:00.09 bonobo-activati
 2686 adamc    40   0 89196 3772 2928 S   0  0.2   0:00.48 gvfs-gdu-volume
 2752 adamc    40   0 64208 3224 2636 S   0  0.2   0:00.02 gvfsd-trash
24661 adamc    40   0 236m 3224 2164 S   0  0.2   0:01.56 demo.exe
 2716 adamc    40   0 164m 2984 1540 S   0  0.1   0:00.50 gnome-screensav
 2693 adamc    40   0 69984 2644 2188 S   0  0.1   0:02.14 gvfs-afc-volume
```


Ur/Web Available At:

`http://www.impredicative.com/ur/`

Including online demos with syntax-highlighted source code