Ur/Web: A Simple Model for Programming the Web

Adam Chlipala – MIT CSAIL POPL 2015 January 15, 2015

Ur / Web

<u>Ur</u> A new general-purpose typed functional language



<u>Web</u> Tools for implementing modern three-tier web applications

Motto: "the compiler understands the structure of your web app."

Focuses on:

- Programmer productivity
- Security
- Performance (especially server-side, for scaling)

There are at least several users whom I have never met!

The first commercial *Ur/Web application:* BazQux Reader, by Vladimir Shabanov

Feed reader with comments

http://www.bazqux.com/

On the order of 1000 paying users daily

000	BazQux Reader									
BazQux Reader	Search									
Add subscription	4/590 New - ≅ Skip ⊘ Later % Up ♦ Prev	8 Next								
■All Items 1000+/1000 ■Blogs 270/3 © Iconic Photos 15/3 © kottke.org 253	 Linus Torvalds, 2 Oct 02:42 (2 weeks ago) I wish there were more people in the legal profession like Judge Posner. The man has his head screwed on right! Do patent and copyright law restrict competition and creativity excessively? Posner - The Becker-Posner Blog ». I am concerned that both patent and copyright protection, though particularly the former, may be excessive. To evaluate optimal patent protection for an invention, one has to consider both the cost of 141 comments C Keep unread <share< li=""> Michael Cohen, 2 Oct 02:43 (2 weeks ago) This article might violate Betteridge's Law of Headlines I'm surprised. </share<>									
■Tech 1000+/1000- □ Engad 1000+/1000- □ TechCrunch 10/0 □ Twitter / ParOux 10	Jan Wildeboer, 2 Oct 02:46 (2 weeks ago)									

TechEmpower Web Framework Benchmarks

<http://www.techempower.com/benchmarks/>

- 3rd-party benchmarking initiative
- 93 frameworks in test to the right
- Ur/Web's performance:
 - 4th best throughput (~100 krps)
 - Best latency (2.1 ms)
- At the top of the chart in the preview results for the next round

ortunes													
Results													
Best (bar chart)	Data table	Latency	Framework overhead										
	Best fortunes	responses per seco	nd, Dell R720xd dual-Xeon E5	v2 + :	10 Gb	E (10)4 tes	ts)					
Framework	Best performance	(higher is better)		Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
cpoll_cppsp-raw	188,585		100.0%	Plt	C++	Cpl	Non	Lin	Му	Lin	Raw	Rea	
gemini	166,103		88.1%	Ful	Jav	Svt	Res	Lin	Му	Lin	Mcr	Rea	
servlet-raw	159,178		84.4%	Plt	Jav	Svt	Res	Lin	Му	Lin	Raw	Rea	0
urweb-postgres	112,807		59.8%	Ful	Ur	Ur/	Non	Lin	Pg	Lin	Mcr	Rea	0
undertow	110,277		58.5%	Plt	Jav	Utw	Non	Lin	Mo	Lin	Raw	Rea	0
undertow	107,704		57.1%	Plt	Jav	Utw	Non	Lin	Му	Lin	Raw	Rea	
undertow edge	107,037		56.8%	Plt	Jav	Und	Non	Lin	Мо	Lin	Raw	Rea	
undertow edge	106,306		56.4%	Plt	Jav	Und	Non	Lin	Му	Lin	Raw	Rea	
■ plain	99,626	53	2.8%	Ful	Sca	Pla	Non	Lin	Му	Lin	Mcr	Rea	
php-raw	97,508	51	7%	Plt	PHP	FPM	ngx	Lin	Му	Lin	Raw	Rea	
undertow edge	95,900	50	.9%	Plt	Jav	Und	Non	Lin	Pg	Lin	Raw	Rea	
undertow	93,324	49.	5%	Plt	Jav	Utw	Non	Lin	Pg	Lin	Raw	Rea	
■ hhvm	68,286	36.2%		Plt	PHP	hhv	HPH	Lin	Му	Lin	Raw	Rea	
lapis	62,527	33.2%		Ful	Lua	OpR	ngx	Lin	Pg	Lin	Ful	Rea	
yaf-raw	58,015	30.8%		Ful	PHP	FPM	ngx	Lin	Му	Lin	Raw	Rea	
grizzly-jersey	44,879	23.8%		Mcr	Jav	Svt	Grz	Lin	Му	Lin	Ful	Rea	
php-phalcon-micro	42,754	22.7%		Mcr	PHP	FPM	ngx	Lin	Му	Lin	Ful	Rea	
treefrog	42,743	22.7%		Ful	C++	Tre	Non	Lin	Му	Lin	Mcr	Rea	
bottle-mysql-raw	33,283	17.6%		Mcr	Ру	Gun	Non	Lin	Му	Lin	Raw	Rea	
plain-servlet-linux	31,839	16.9%		Ful	Sca	Pla	Non	Lin	Му	Lin	Ful	Rea	
urweb-mysql	31,529	16.7%		Ful	Ur	Ur/	Non	Lin	Му	Lin	Mcr	Rea	

This is reasonably real.

You can download it and build some nifty Web apps.

<u>Open source at:</u> http://www.impredicative.com/ur/

Bonus talk content:

Background: a general model for programming distributed applications
 Background: the mess that is today's mainstream Web development techniques
 Ur/Web's simpler model for programming Web apps, with 2 big ideas:

 a) Encapsulation that crosses nodes of a distributed system
 b) A simple concurrency model for distributed systems

 Code demo

Distributed Systems (Hard)



Why Distributed Systems?

- Physics forces distribution in space to scale performance.
- Mutually distrusting users controlling distinct resources

Challenges:

- Mutable state
- Concurrency
- Security

The Restricted Model of Many Web Apps



What Web programmers expect today



The Ur/Web model

An application is written entirely in Ur/Web source code, exposing this view:



Big Language Design Idea #1: Encapsulation



Big Language Design Idea #2: Concurrency



Demo time!



<u>Open source at:</u> http://www.impredicative.com/ur/