ε-serde / mem_dbg / sux / dsi-bitstream / webgraph:

A Rust ecosystem for large-graph processing

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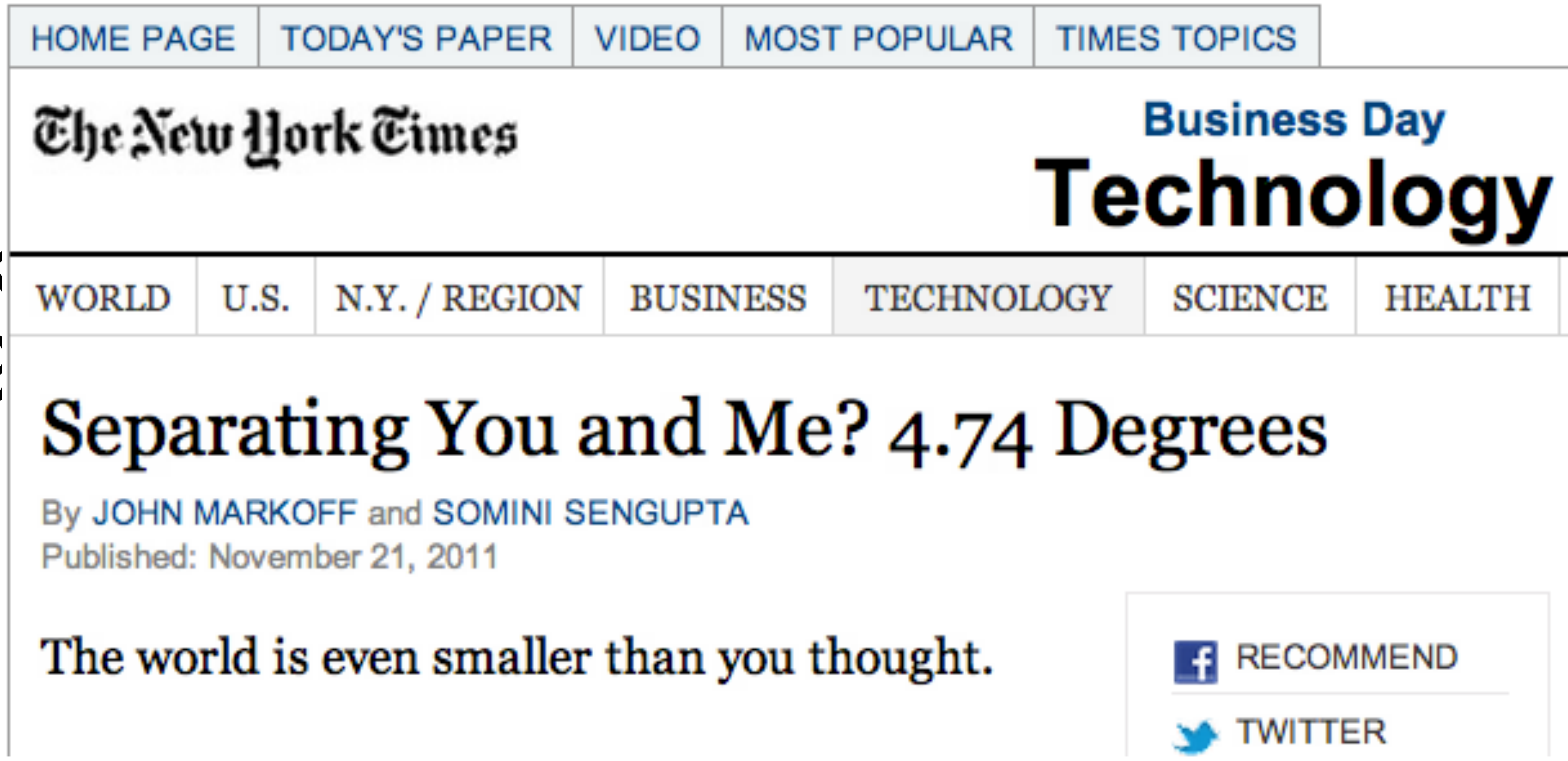
The WebGraph Framework

- An open-source framework for compressed representation of graphs
- One of the most long-lived projects of this kind (>20 years!)
- Hundreds of publications in major conferences and journals using it (>1500 references)
- In 2011 news went around the world: Facebook had four degrees of separation
- The measurement was performed at Facebook using WebGraph (at that time, 721M nodes, 69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Separating You and Me? 4.74 Degrees

By JOHN MARKOFF and SOMINI SENGUPTA
Published: November 21, 2011

The world is even smaller than you thought.

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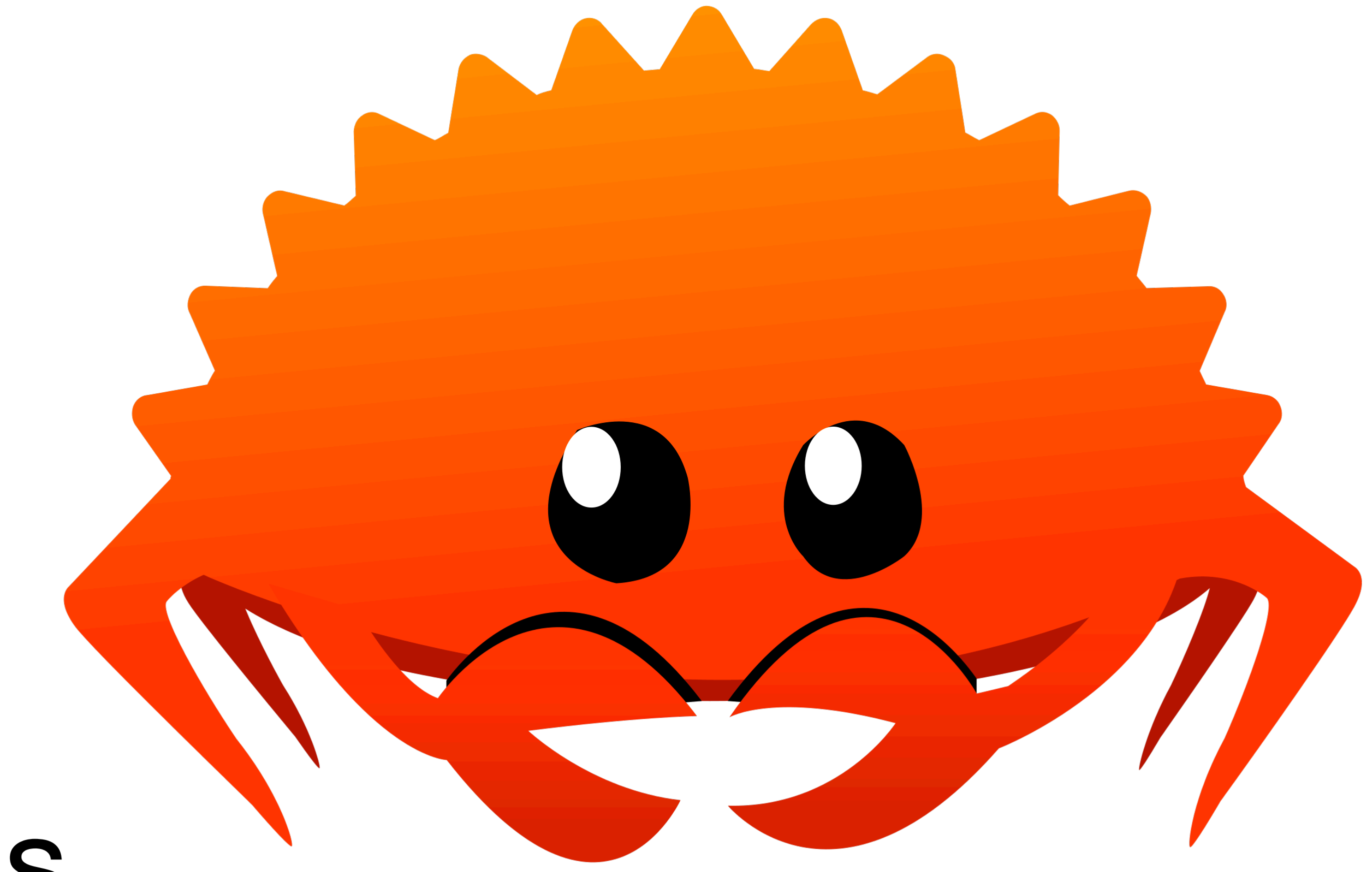
Moving to Rust



- A high-performance, safe language
- Memory safe (as Java), but with zero-cost abstractions
- Arrays as large as memory allows
- Fine-grained access to OS facilities (memory mapping)
- Lazy iterators
- Moving to Rust required porting a number of ideas

ε-serde

- *ε*-copy
- Like ze
- Unlike immuta
- Unlike tures
- Unlike d no impact

```rust
use epserde::prelude::*;

▶ Run | Debug
fn main() -> anyhow::Result<()> {
    let s = vec![0; 1000];

    s.store("foo.eps")?;
    let t = <Vec<i32>>::mmap("foo.eps", Flags::RANDOM_ACCESS)?;
    Ok(())
}
```

- Requires collaboration from the underlying struct

mem

- High-
- Levera
  collect
- Additi

```
Alloca
get_si
deep_s
size_o
mem_si
```

```
size:     815
capacity: 1215

 985 B 100.00% ●: example::Struct<example::TestEnum, example::Data<al
  16 B   1.62% ├─a: example::TestEnum
               │ ├─Variant: Unnamed
   8 B   0.81% │ ├─0: usize
   1 B   0.10% │ └─1: u8
 823 B  83.55% ├─b: example::Data<alloc::vec::Vec<u8>>
 724 B  73.50% │ ├─a: alloc::vec::Vec<u8>
  64 B   6.50% │ ├─b: alloc::vec::Vec<i32>
  35 B   3.55% │ └─c: (usize, alloc::string::String)
   8 B   0.81% │   ├─0: usize
  27 B   2.74% │   └─1: alloc::string::String
   8 B   0.81% ├─test: isize
 138 B  14.01% └─s: std::collections::hash::set::HashSet<usize>
```

sux

- Succinct data structures
- Partial port of sux (C++ project) and Sux4J (Java project)
- There are some existing crates (some porting the projects above)
- We provide compositional constructor for mix-and-match between ranking and selection structures
- Mainly used for the Elias–Fano representation of monotone sequences (e.g., pointers into records)

dsi-bitstream

- High-performance bit streams
- Read/write data by word (settable)
- Supports little and big endian files
- Instantaneous codes for compression: Elias γ, Golomb, etc.
- Flexible architecture and benchmarks to tune to your hardware (use decoding tables or not?)
- A γ code read in less than 2ns (for data with the intended distribution)

webgraph

- Rust port of the Java version
- Uses dsi-bitstream for instantaneous codes, sux for pointers into the bitstream
- On the Software Heritage graph (34 billion nodes, 517 billion arcs) a BFS visit is three time faster (3h)
- Unbelievably better ergonomics WRT Java
- Still in development on Github, soon into crates.io
- Composition-based labeling
- Lender- (rather than Iterator-) based architecture for iterators that depend on the graph state