

COS 326 Functional programming: an elegant weapon for the modern age



Alonzo Church
Princeton Prof
1929-1967

In 1936, Alonzo Church invented the lambda calculus. He called it a logic, but it was a language of pure functions -- the world's first programming language.

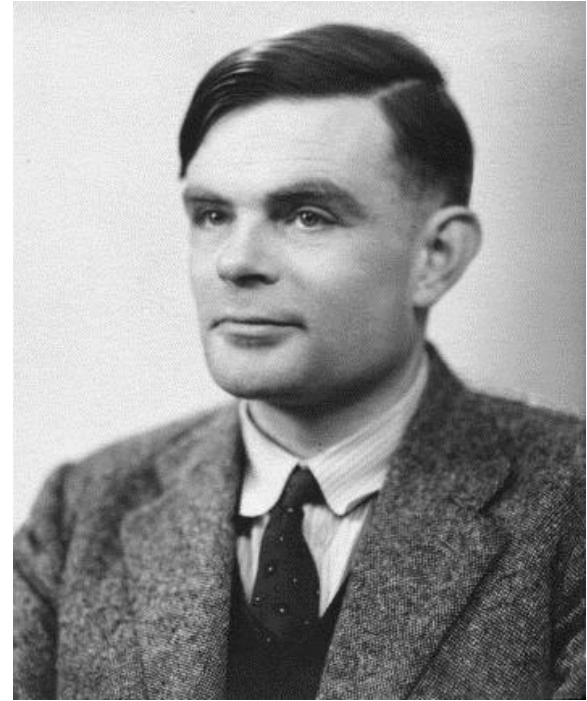
He said:

"There may, indeed, be other applications of the system than its use as a logic."



Alonzo Church

1936 -- developed lambda calculus



Alan Turing

1936 -- developed Turing machines

Robert Harper (CMU): *The lambda directly and immediately relevant to this day, rather than something that collects dust on the shelf. No one cares one bit about the details of a Turing Machine; for it fails to address the central issue of modularity.*

Vastly Abbreviated FP Designer History



Alonzo Church:
lambda calculus
1930's



Guy Steele & Gerry Sussman:
Scheme
late 1970's



Xavier Leroy:
Ocaml
1990's



John McCarthy:
LISP
1958



Robin Milner, Mads Tofte, & Robert Harper
Standard ML
1980's

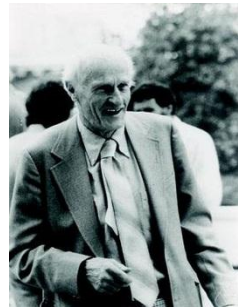


Don Syme:
F#
2000's

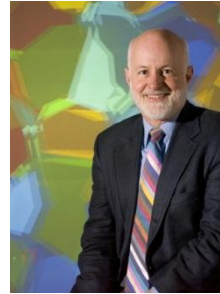
Where do I fit in?



Alonzo Church
Princeton Prof
1929–1967



Steven Kleene
Princeton PhD 1934
IAS 1939-1940



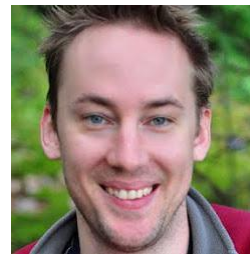
Robert Constable
Developed Nuprl
Theorem Prover



Bob Harper
Developed
Standard ML



Greg Morrisett
Developed
Typed Assembly Language



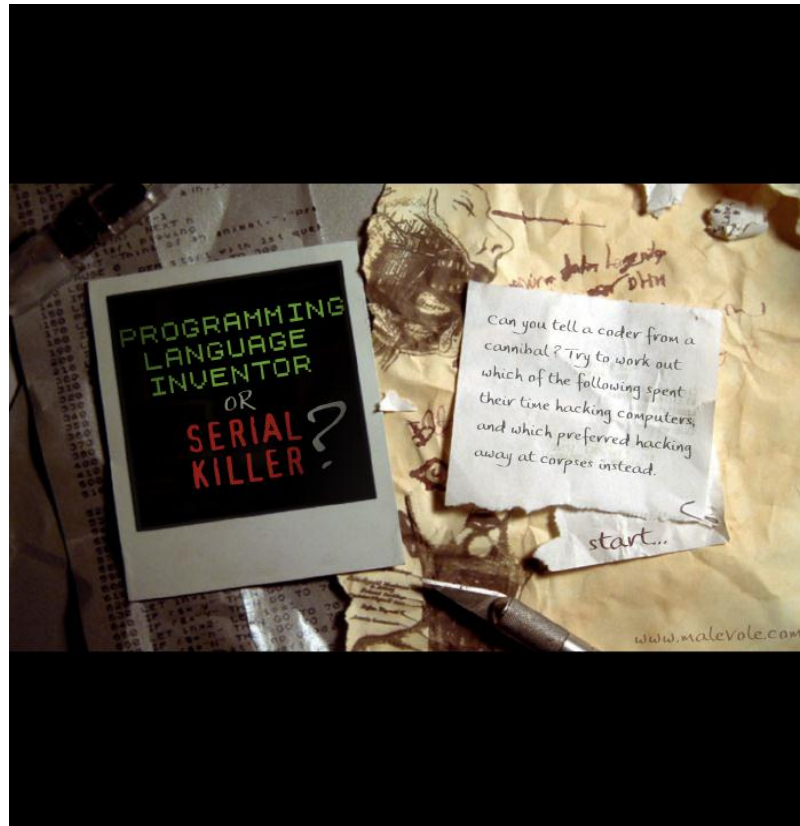
David Walker
Princeton Prof 2002-

A bit of fun:

- <http://www.malevole.com/mv/misc/killerquiz/>

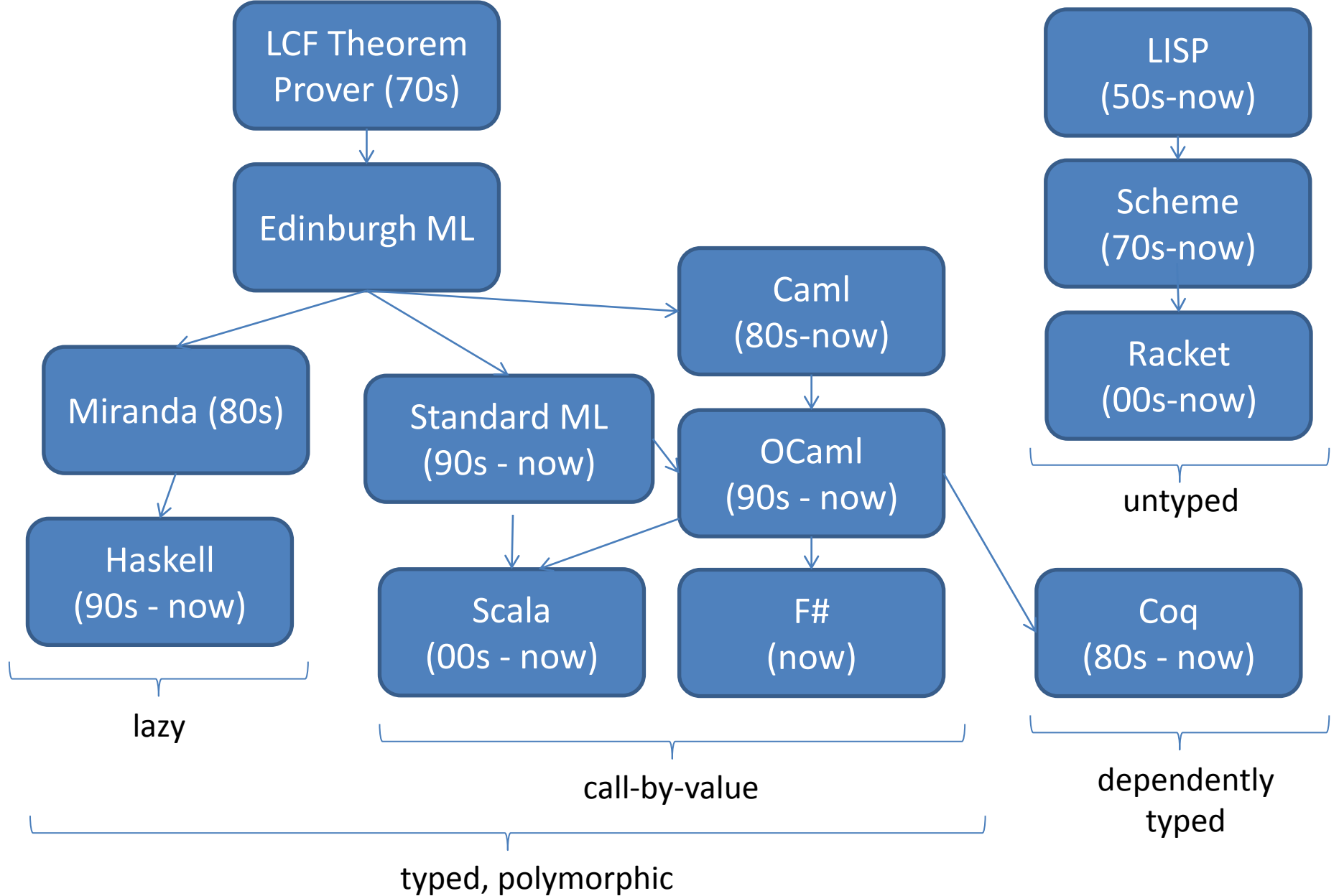
malevole - Programming Language Inventor or Serial Killer?

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Have a go at these I recently made for E4: [Janey Thomson's Marathon](#) · [Captcha Invaders](#) · [The Rather Difficult Game](#)

Vastly Abbreviated FP Genealogy



But Why Functional Programming *Now*?

- Functional programming will introduce you to new ways to *think about* and *structure* your programs:
 - new reasoning principles
 - new abstractions
 - new design patterns
 - new algorithms
 - elegant code
- Technology trends point to increasing parallelism:
 - multicore, gpu, data center
 - functional programming techniques such as map-reduce provide a plausible way forward for many applications

Functional Languages: Who's using them?



map-reduce in their data centers



Scala for correctness, maintainability, flexibility



Erlang for concurrency, Haskell for managing PHP



O'Caml for reliability



F# in Visual Studio



Haskell for specifying equity derivatives



Haskell to synthesize hardware



Coq proof of 4-color theorem

www.artima.com/scalazine/articles/twitter_on_scala.html

<http://gregosuri.com/how-facebook-uses-erlang-for-real-time-chat>

<http://www.janestcapital.com/technology/ocaml.php>

<http://msdn.microsoft.com/en-us/fsharp/cc742182>

<http://labs.google.com/papers/mapreduce.html>

http://www.haskell.org/haskellwiki/Haskell_in_industry

Functional Languages: Join the crowd

- Elements of functional programming are showing up all over
 - **F#** in Microsoft Visual Studio
 - **Scala** combines ML (a functional language) with Objects
 - runs on the JVM
 - **C#** includes “delegates”
 - delegates == functions
 - **Python** includes “lambdas”
 - lambdas == more functions
 - **Javascript**
 - find tutorials online about using functional programming techniques to write more elegant code
 - **C++** libraries for map-reduce
 - enabled functional parallelism at Google
 - **Java** has generics and GC
 - ...

COURSE LOGISTICS

Course Staff



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Resources

- Web: <http://www.cs.princeton.edu/~dpw/courses/cos326-12/>
- Lecture schedule and readings:
 - [\\$\(coursehome\)/lectures.php](#)
- Assignments:
 - [\\$\(coursehome\)/assignments.php](#)
 - first assignment **due next week: tuesday sept 25!**
- Precepts (Friend 007, 50min, Th 7:30, Fr 11)
 - first half of semester (intermittent in 2nd half)
- Install OCaml: [\\$\(coursehome\)/resources.php](#)