ICFP Programming Contest 2014 – Supermassive Black Hom-set Post-mortem

P. Lepin

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- Last year I played as "By Wadler's Beard!" Should have kept it.

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2. Write a parser for a stand-alone HLL or implement an eDSL.
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5. ...?
6. **(end goal)** Implement the Lambda-Man AI.

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...some of these decisions were extremely myopic.

Perceived Fun Factor

	Tools	AI
Lambda-Man	**FUN!**	**FUN!**
Ghosts	Less fun.	Less fun.

Lisp-machine CPU, compilers, fairly sophisticated AIs – interesting. 8-bit CPUs and severely resource-constrained programs – not so much.

Effort

	Tools	AI
Lambda-Man	~**9 hrs**, 205 sloc	~**25 hrs**, 654 sloc, 3114 instructions compiled
Ghosts	~**3 hrs**, 259 sloc	~**3 hrs**, 91 instruction

Wild Guesstimate Of Impact

	Tools	AI
Lambda-Man	Some.	
Ghosts	**HUGE!**	

Judging by the results of home-brewed tournaments on reddit.

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467 (def foldl
468     (fun [f init xs]
469         (if [atom? xs]
470             init
471             (recur f (f init (car xs)) (cdr xs)))))
472 (def map-map (fun [f xs] (map (fun [x] (cons x (f x))) xs)))
473 (def map
474     (fun [f xs]
475         (if [atom? xs]
476             NIL
477             (cons (f (car xs)) (map f (cdr xs))))))
```

Figure: Almost looks like the real thing.

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221 cg n env labels (Spec "!1" [Lit x]) = ([Op "LD" [Num x, Num 1]], labels)
222 -- Unsupported: set!
223 cg n env labels expr = (unsafePerformIO $ hPutStrLn stderr $ "WARNING!!! Unable
```

Figure: Not really supported.

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  - No macros.
  - Virtually no diagnostics or static checks – a pain to debug.
- Implementing as eDSL could have given some type safety *almost for free*.

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212 212  cg n env labels (Spec "do" []) = ([], labels)
213     -cg n env labels (Spec "do" (expr : rest)) = (code' ++ code'', labels')
    213 +cg n env labels (Spec "do" (expr : rest)) = (code' ++ code'', labels'')
214 214      where
```

Figure: The fact that it typechecks doesn't *always* mean it's correct. (But encoding the codegen in a monad *could* have helped.)

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```
208 208  -- In general, never apply to unnamed functions: might be expensive
209     -cg n env labels (Spec "recur" args) = ([Op "LD" [Num 0, Num 0]] ++ code' ++ [Op "LD" [Num 0,
    209 +cg n env labels (Spec "recur" args) = ([Op "LD" ("$@recur" `var_lookup` (n, env))] ++ code'
210 210      where
```

Figure: `recur` only worked – occasionally – by accident.

Lambda-Man AI

- Lightning round AI retained as a fall-back – main AI may not return a move in situations it considers hopeless:
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  - If nothing edible found, simple heuristic value function kicks in.
  - Likes running towards nearest power pill when ghosts are nearby.

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```
404 (def q-append
405     (fun [q xs]
406         (q-norm (cons (car q) (foldl (fun [r x] (cons x r)) (cdr q) xs)))))
407 (def q-norm
408     (fun [q]
409         (if [atom? (car q)]
410             (cons (reverse (cdr q)) NIL)
411             q)))
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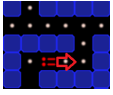

Figure: Initial state.

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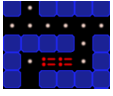

Figure: After 1 step.

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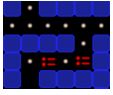

Figure: After 2 steps.

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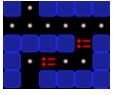

Figure: After 3 steps.

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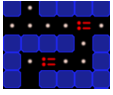

Figure: After 4 or more steps.

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- Propagates ghosts (ignoring differences in speed) as long as they have no choice.
- Value of scared ghosts and fruits discounted by time to expiration.

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- **Not-a-quirk:** Ghost AIs known, but emulation impractical due to cycle limit.

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Figure: OMG!!! Cycle limit!

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Figure: Good luck editing *this*.

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  - Non-tail recursive list HOFs – no artifical limitations on stack depth, `RTN`s are cheaper than reversing the accumulator.

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477             (cons (f (car xs)) (map f (cdr xs))))))
478 ;(def map (fun [f xs] (reverse (map-rev NIL f xs))))
479 ;(def map-rev
480 ;    (fun [acc f xs]
481 ;        (if [atom? xs]
482 ;            acc
483 ;            (recur (cons (f (car xs)) acc) f (cdr xs)))))
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  - Fused `map`s and `filter`s in a few places.
  - Eliminated some unneeded intermediate variables.
- Seems to have worked.

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  - **Problem:** Can get stuck in dead ends easily.

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- Ghost's index affects tie-breaks: different ghosts favour different directions at intersections.
- Simple counter: after a few actual decisions in a row resulting in horizontal or vertical move, that axis is excluded.
- Pretty efficient on non-pathological maps: ghosts tend to surround the Lambda-Man.

Sources

- Submission is available on GitHub, link can be found on ICFPC subreddit, along with many interesting submissions and reports from other teams: `http://www.reddit.com/r/icfpcontest`

How To Win The ICFP Programming Contest

What I learned from past failures and how I used it this time – or not

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Figure: The apparently black background image on the official site has slight brightness variations. This “steganographic message” turned out to be random noise. D’oh!

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  - Classic ghost AIs – could have mislead me.

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  - But can be stressful.

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  - But can be stressful.
  - And I'm in it for the sheer fun of it...

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- Don't forget to rest, eat and sleep. On the other hand...

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```
[comp-thr (fun [m] (if [<= (bstm-w m) 25] 20 (if [<= (bstm-w m) 35] 12 (if [<= (bstm-w m) 50] 8 5))))]
```

Figure: Cutoff depth selection for BFS. Speaks for itself.

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- Read the spec carefully.
  - Signed my submissions with SHA256 instead of SHA1.
  - Only noticed minutes before the deadline.

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- Use C++.
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  - Used Haskell this year.

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- All in all, I have no idea how does this work.

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- Now you know whom to blame.

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- Thankfully, the GHC and GCC in this contest were not the Real Thing.

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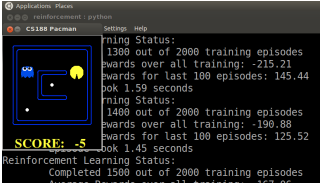

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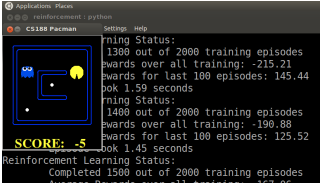

- I'm sure that's sheer coincidence and had *nothing* to do with my performance here.

This was even more awesome than ICFP contests usually are.
Heartfelt thanks to the organizers.
And thank you for listening.

And remember – for the next year, Haskell is the programming tool of choice for discriminating hackers.