Abusing Ants for Fun and Profit

How Haskell won the ICFP 2004 Programming Contest

Ian Lynagh, Andres Löh, Ganesh Sittampalam and Duncan Coutts

ICFP

- International Conference on Functional Programming
- Most important Functional Programming conference

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- Therefore most important Computer Science conference
- Had an associated programming contest for 7 years

Languages

The programming contest is being conducted by ICFP, which has a desire to promote functional languages. However, rather than debate the definition of a “functional programming language,” we will accept submissions implemented using *any language whatsoever*.

The team

Team Dunkosmiloolump consisted of:

- Duncan Coutts
- Andres Löh (kosmikus)
- Ian Lynagh (Igloo)
- Ganesh Sittampalam (Heffalump)

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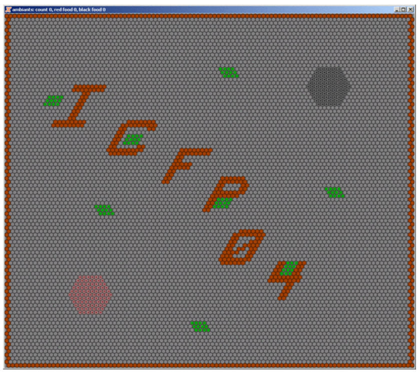
Format

- Contest start, task posted:
  Friday June 4 at 17:00 BST
- Lightning division deadline:
  Saturday June 5 at 17:00 BST
- Contest finish:
  Monday June 7 at 17:00 BST

The board



The aim

- $8 * 3 * 4 * 5 = 480$ food initially
- 100,000 timesteps
- Ants are a state machine, max 10,000 states
- Team with most food dropped on their anthill at the end wins

Programming ants

- Move st1 st2
- Turn Left st
- PickUp st1 st2
- Drop st
- Flip p st1 st2
- Mark i st
- Unmark i st

Conditions

Sense LeftAhead st1 st2 cond

- Foe
- FriendWithFood
- FoeWithFood
- Food
- Rock
- Marker i
- FoeMarker
- Home
- FoeHome

Fighting

- After moving, if next to 5 enemy ants, die
- Otherwise, if now the 5th ant surrounding an enemy ant, it dies
- Dead ants turn into 3 food
- Each team has 91 ants. Potentially $(2 * 91 - 5) * 3 = 531$ extra food.

The Bird slide

The PRNG — From half an A4 page down to:

```
mkRng :: Int -> [Int]
mkRng = drop 4
      . map ((‘mod‘ 16384)
           . (‘div‘ 65536))
      . iterate ((‘mod‘ (65536*16384))
               . (1 +)
               . (22695477 *))
```

Tasks

- Simulator
- Visualiser
- Ant DSL
- Ant

Simulator

- Given 2 ants and a world, print out info for visualiser
- Slow (used immutable datastructures)
- Worked!
- Clear code allowed easy extensibility

Visualiser

- Andres had some code lying around from a hex map based game
- Slow (using wxHaskell incorrectly?)
- Worked!

Ant

- Always know direction ant is facing
- Walk around looking for food, making home marker if none already
- Randomly turn after a few steps
- If you find a trail to food, follow it
- If you find food, take it home leaving a trail to where you came from
- Action after hitting something depends on what you hit

Ant DSL

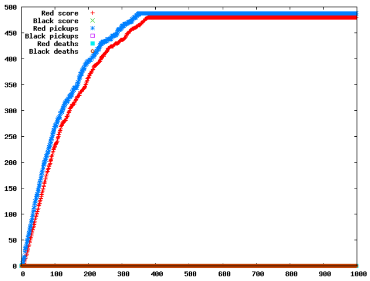
- Gotos and labels
- Monadic combinators for fresh label generation
- Inline gotos, common continuation elimination, remove pointless code

Ant Stats

- 3,104 and 3,134 states (max allowed 10,000)
- Against `DoNothing.ant`, take 30,000-40,000 timesteps to get all the food (runs to 100,000)

Profiler

- Simulator prints stats every 100 timesteps
- gnuplot graphs stats



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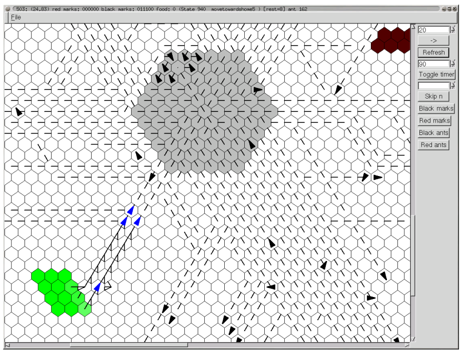
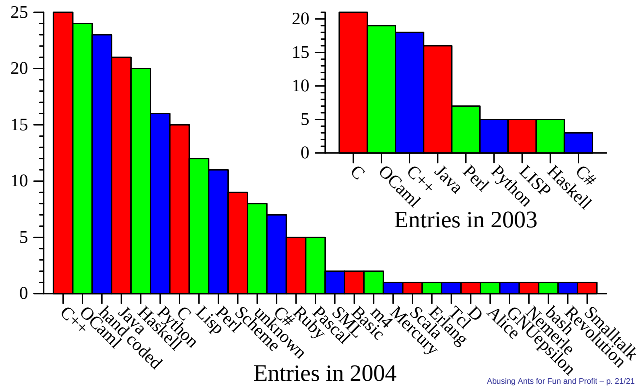
- Team OCant are an extremely cool bunch of hackers!
- Java and C++ are very suitable for rapid prototyping. (Red Team)
- Haskell and C++ are fine programming tools for many applications. (Frictionless Bananas)
- Haskell is the language of choice for discriminating hackers! (Dunkosmiloolump)

Demos



503: (24,83) red marks: 000000 black marks: 011100 food: 0 (State 940 movetowardshome5) [rest=8] ant 162

Languages



C++
OCaml
hand coded
Java
Haskell
Python
C
Lisp
Perl
Scheme
unknown
C#
Ruby
Pascal
SML
Basic
m4
Mercury
Scala
Erlang
Tcl
D
Alice
GNUepsilon
Nemerle
bash
Revolution
Smalltalk
Entries in 2004
C
OCaml
C++
Java
Perl
Python
LISP
Haskell
C#
Entries in 2003