Declarative Debugging with Buddha

5th International Summer School on Advanced Functional Programming Tartu, Estonia

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Practicalities

For the past 50 years, software engineers have enjoyed tremendous productivity increases as more and more tasks have become automated. Unfortunately, debugging — the process of identifying and correcting a failure's root cause — seems to be the exception, remaining as labor intensive and painful as it was five decades ago.

A. ZELLER

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If you are thinking of researching declarative debugging this might be a good place to start.

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- trust and suspicion can be declared statically in `.opt` files (one per module)
- static declarations can be made cheap by changing the transformation of trusted functions

Judgement

Buddha provides four judgement values:

- correct
- erroneous
- inadmissible
- unknown

Inadmissible

```
[32] Main 12 merge
   arg 1  = [3,1,2]
   arg 2  = [5,6]
   result = [3,1,2,5,6]
```

A derivation is inadmissible when the function was applied to arguments for which it has no intended meaning.

It has the same effect as answering correct, but it is closer to intuition.

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As a last resort you can declare a derivation to be unknown. This has the same effect as “correct” except buddha will remind you when a bug diagnosis depends on unknown derivations.

I/O

```
main
   = do c <- getChar
        d <- foo c
        print (c, d)

foo x
   = do putChar x
        getChar
```

The value of an I/O function has two parts:

- the “returned” result (main returns unit, foo returns a character)
- a sequence of primitive I/O actions

I/O tabling

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Question: how to handle threaded execution?

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- idempotency can be implemented on top of tabled I/O

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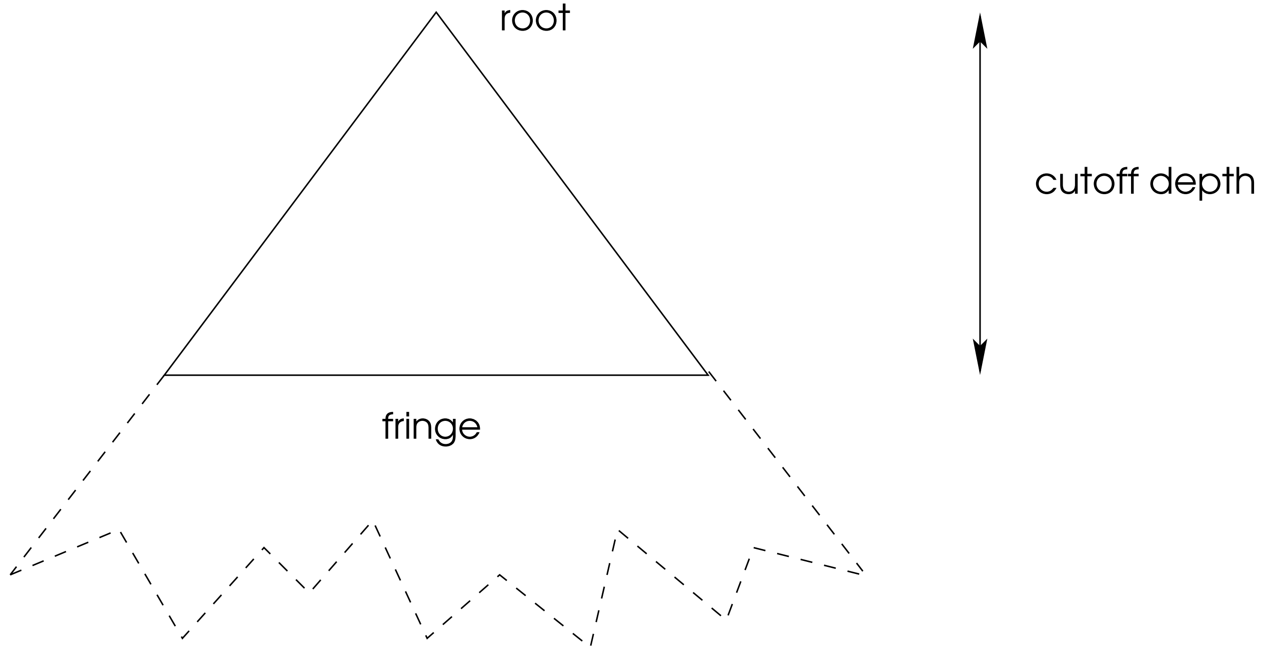

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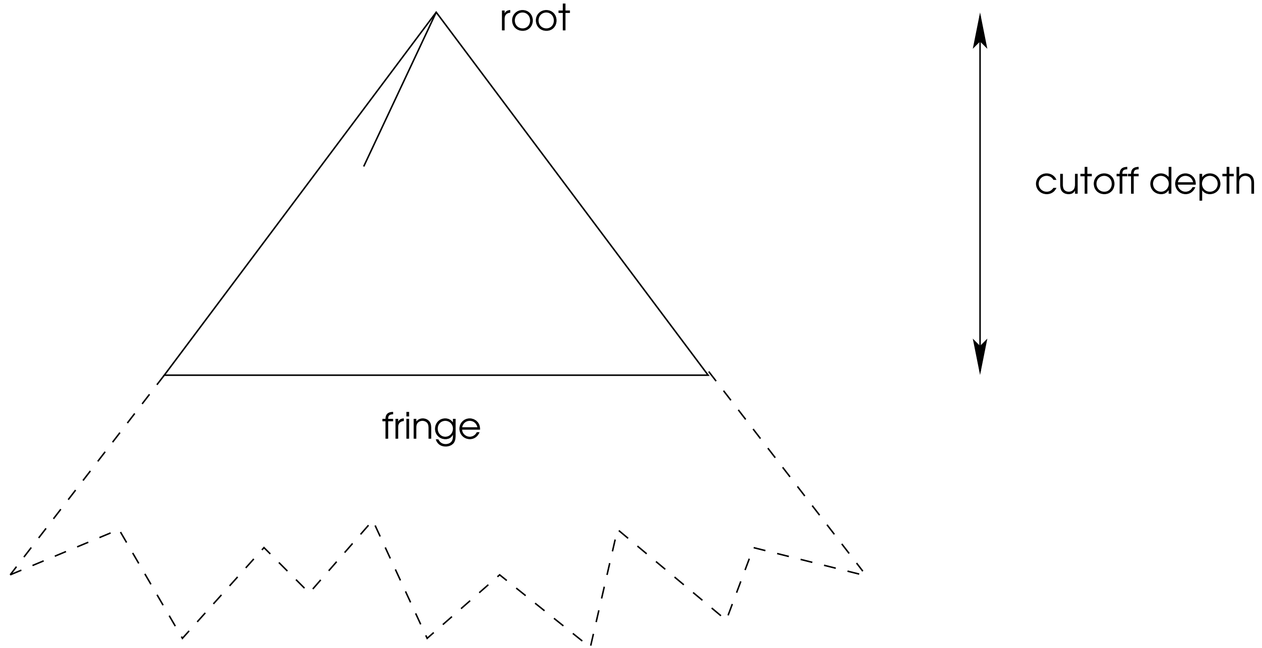

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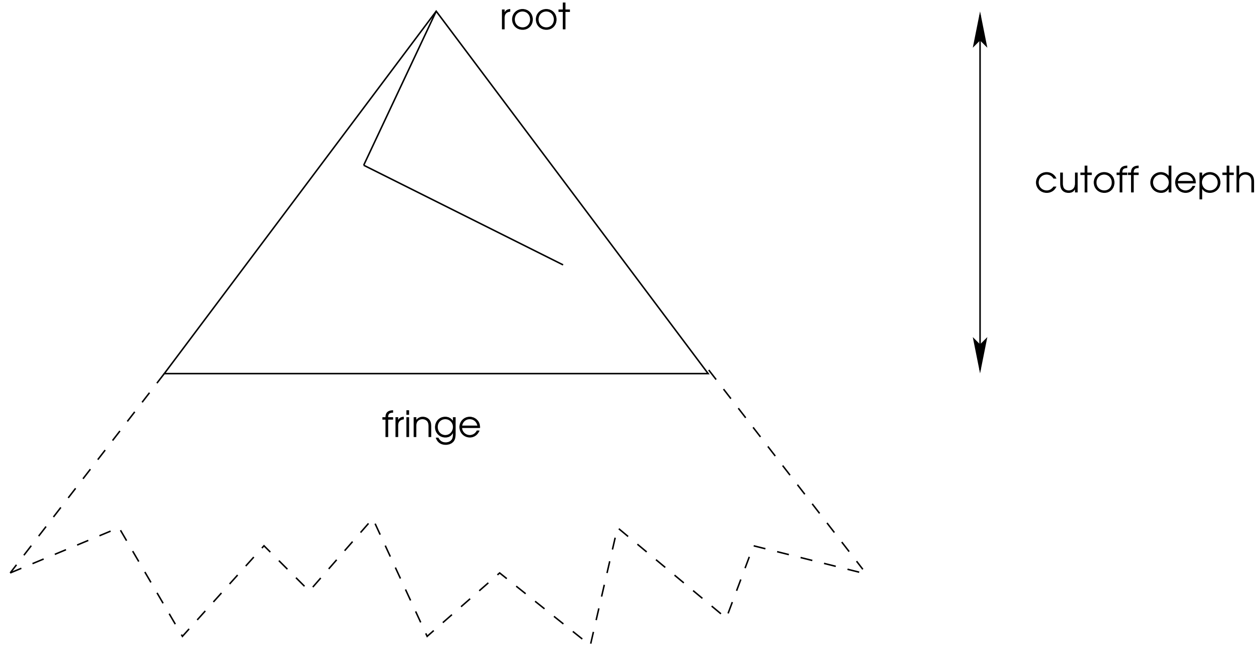

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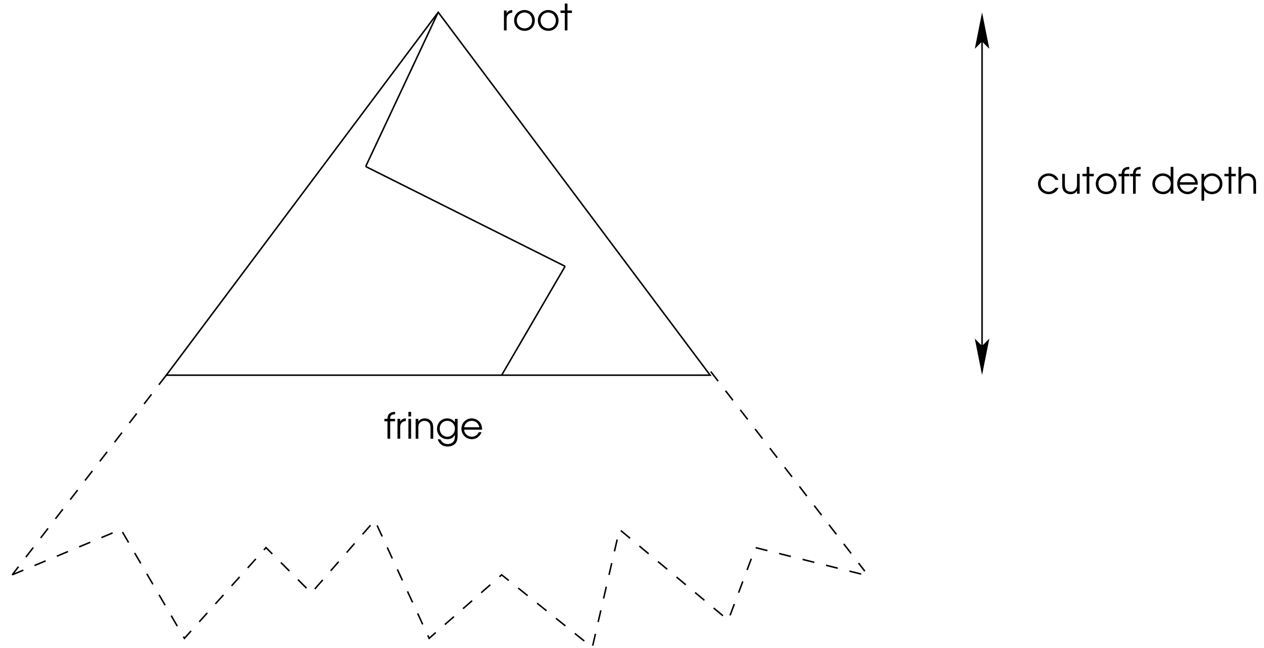

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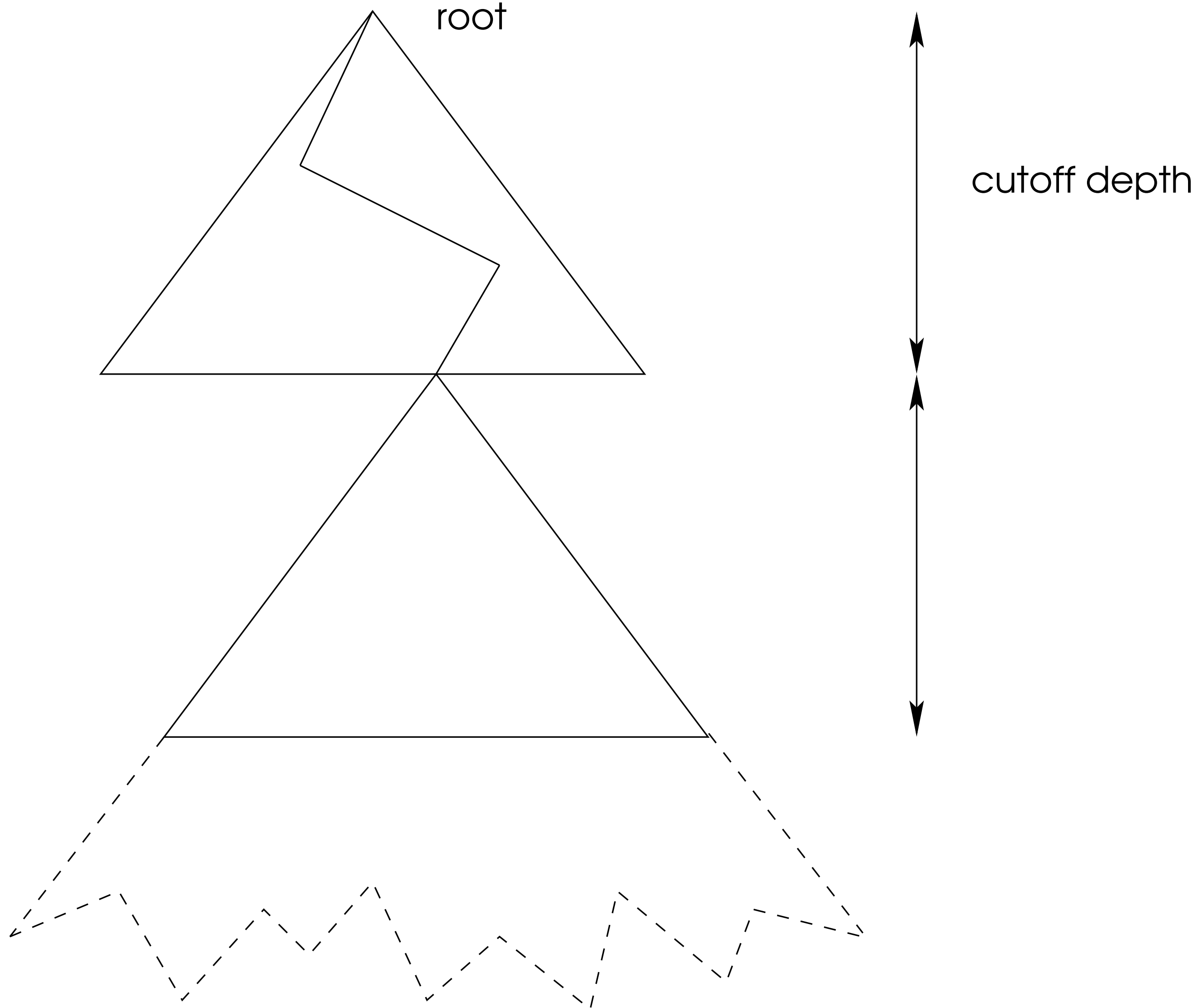

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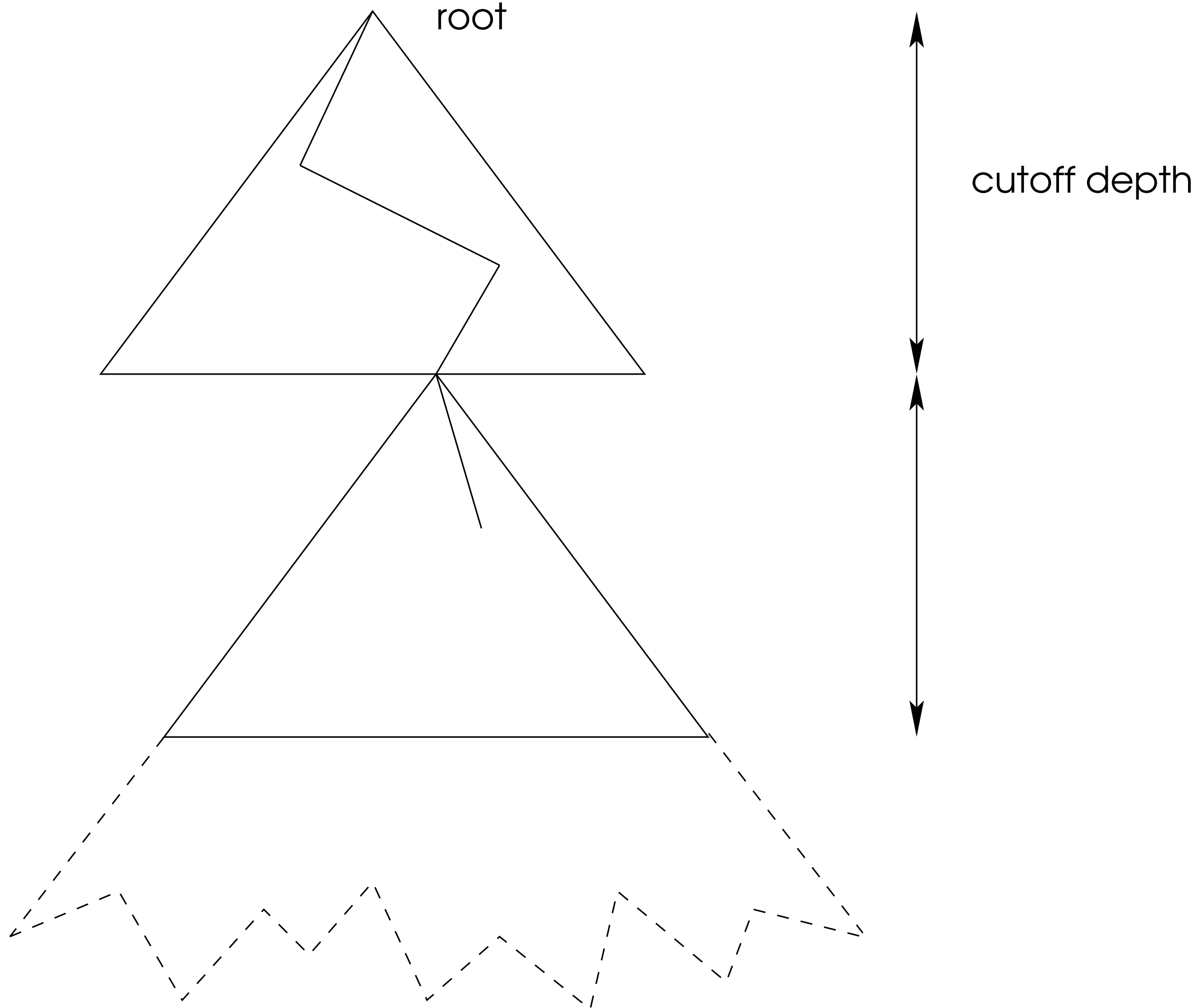

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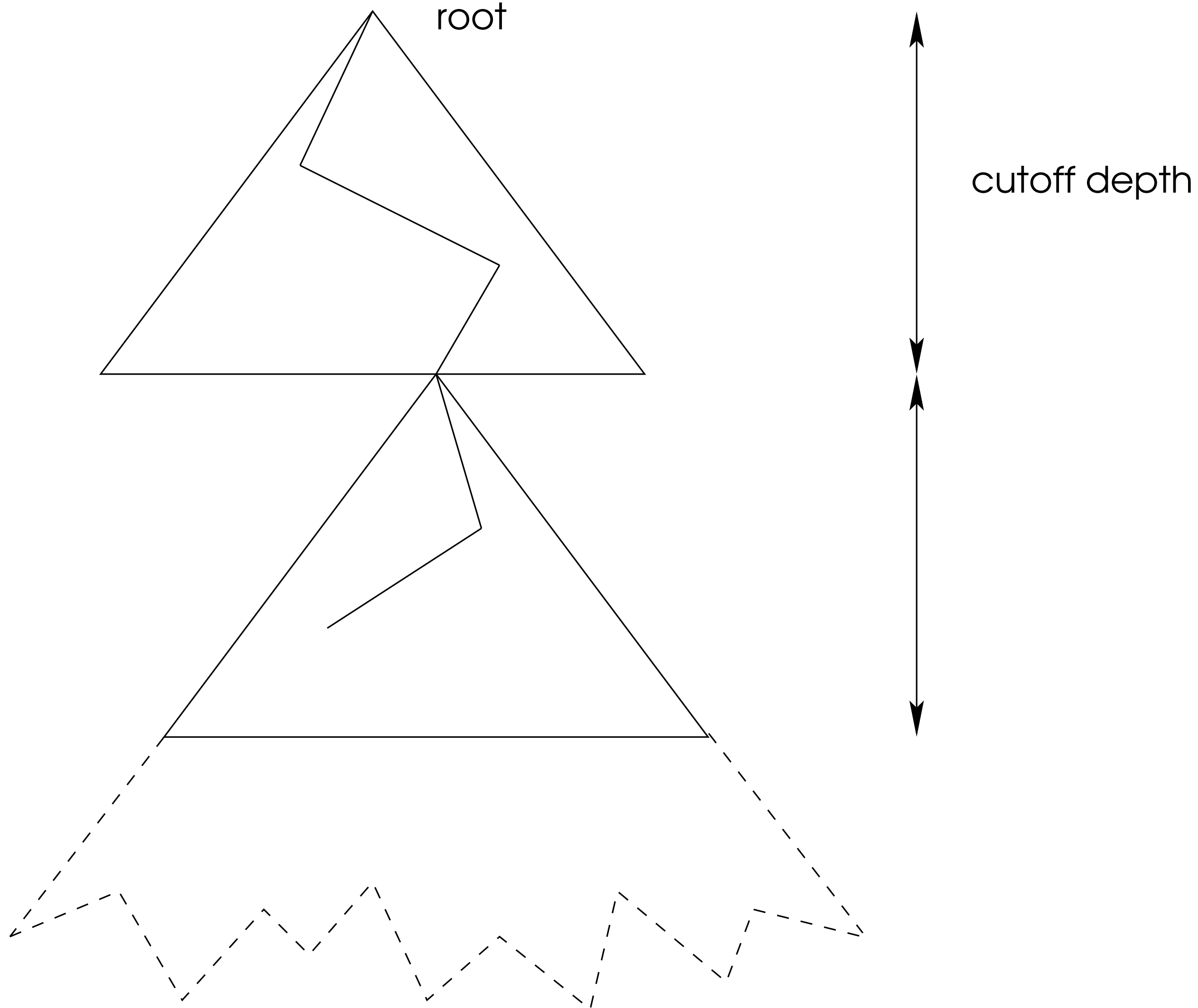

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- easy to implement on top of the tabled construction of the EDT

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```
reverse ::  [a] -> [a]
```

No need to completely show the values in the list, a (small) label will do.

Search strategies

The current simple search strategy:

```
debug :: Diagnosis -> [EDT] -> IO Diagnosis
debug diagnosis [] = return diagnosis
debug diagnosis (node:siblings)
   = do let d = derivation node
        judgement <- askOracle d
        case judgement of
           Correct
              -> debug diagnosis siblings
           Erroneous
              -> debug (Buggy d)
                       (children node)
```

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- deep recursive chains (binary search)
- probabilistic search — where are bugs more likely to occur, based on nodes we have already seen and other hueristics (Lee Naish)
- we want the search path to be comprehensible to the programmer (jumping all over the tree is a bad idea)

Related Work

- Hat
- Hood
- Freya
- Mercury debugger
- Curry debugger

Conclusion

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> *... debugging can be a messy problem, if one creates a messy environment in which it has to be solved, but it is not inherently so. The theory of algorithmic debugging suggests that if the programming language is simple enough, then programs in it can be debugged semi-automatically on the basis of several simple principles.*

EHUD SHAPIRO