CSI: Haskell

Fault-Localization in Lazy Languages using Runtime Tracing

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CHALMERS

WASP | WALLENBERG AI, AUTONOMOUS SYSTEMS AND SOFTWARE PROGRAM

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CONSUMER

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PRODUCER

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- So ***producers*** and ***consumers*** are close!
- By *tracing recent expressions*, we can localize faults!

Background: Haskell Program Coverage (HPC) [1]

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- GHC feature that adds *ticks* to every expression
- RTS keeps track of how often each tick occurred
- Used for program coverage
- **Built-in** to GHC:
  - Scalable
  - Easy to use (one flag)
  - Low-cost (bumps an array entry)

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- **Extend HPC**
- **Track** *recently* evaluated expressions in the RTS
- **Summarize** the trace and report!

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DEMO

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PRODUCER

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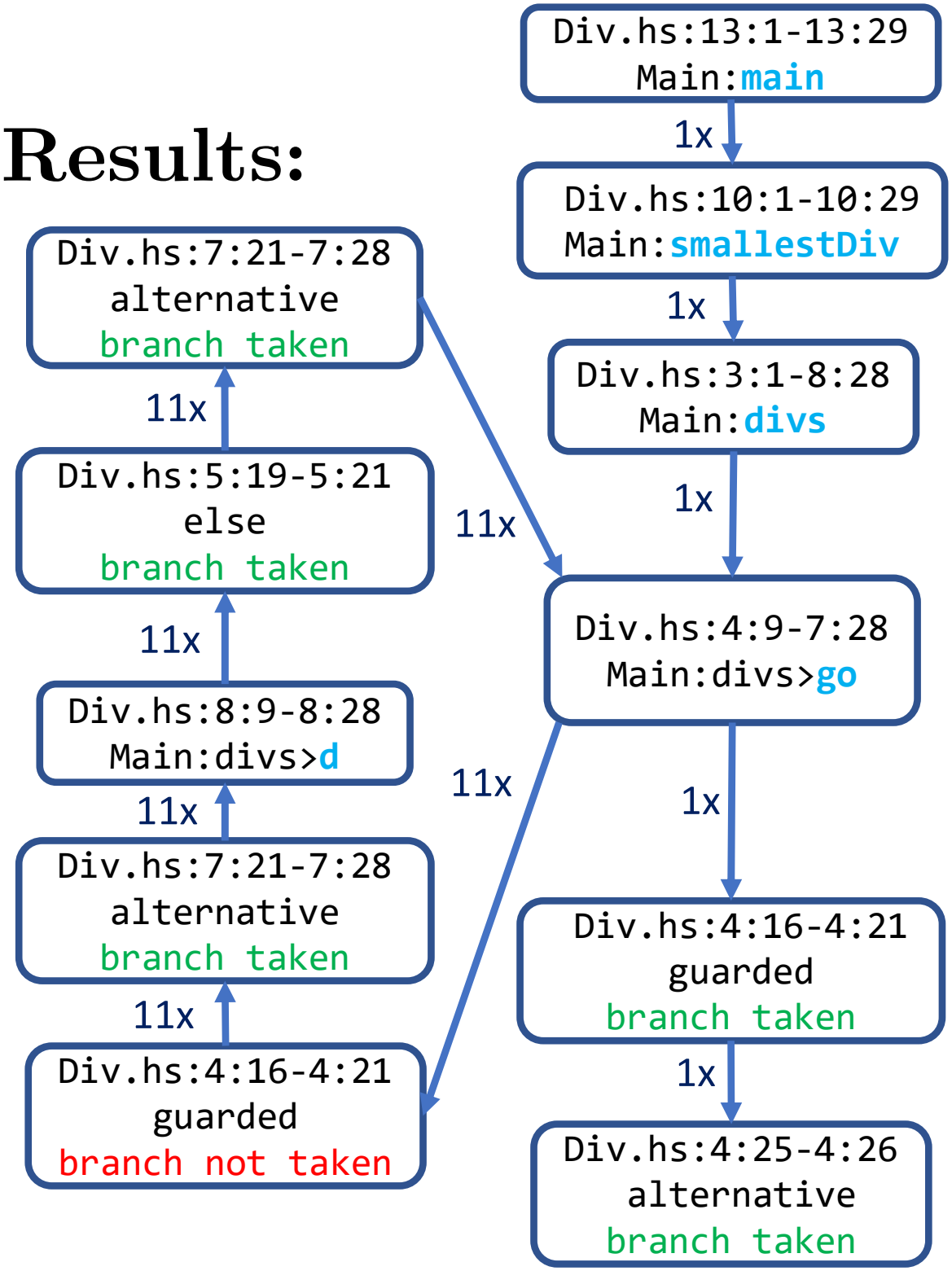


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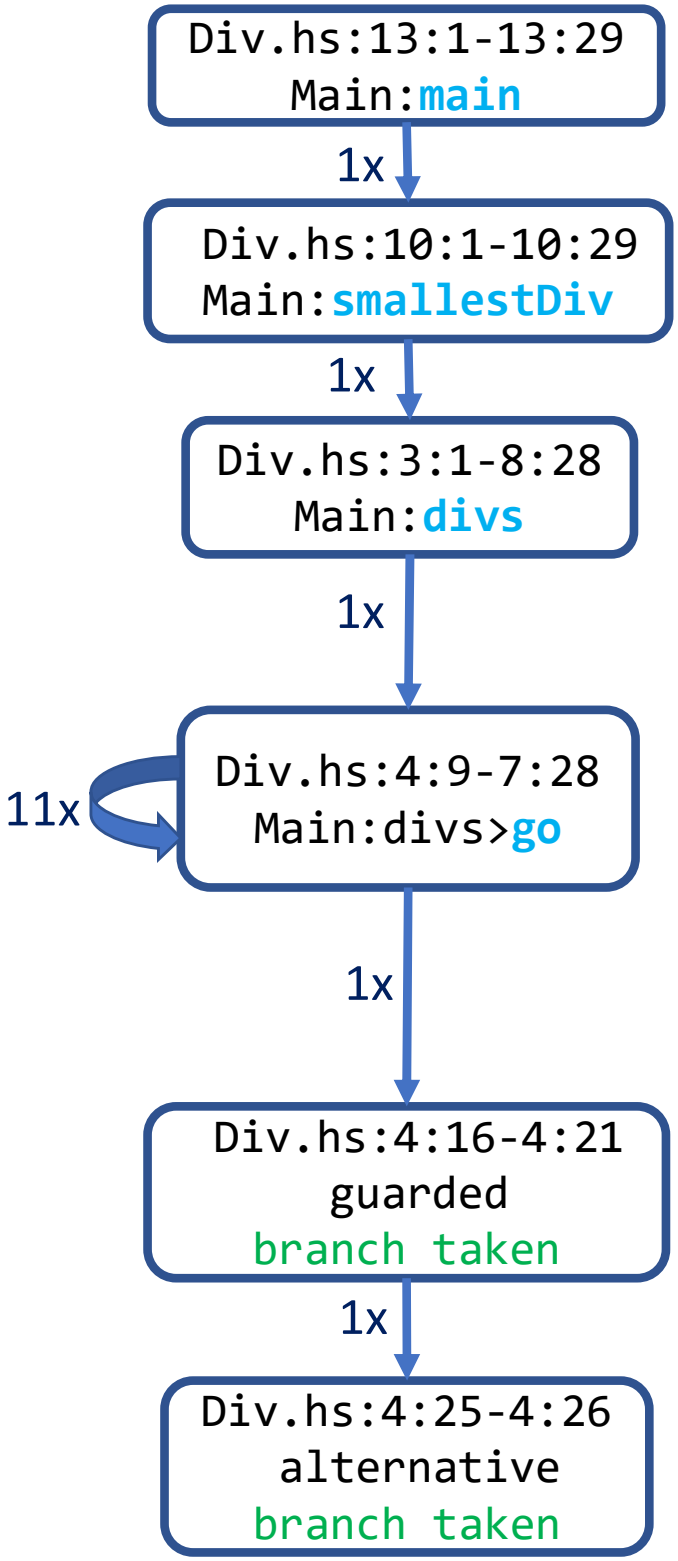


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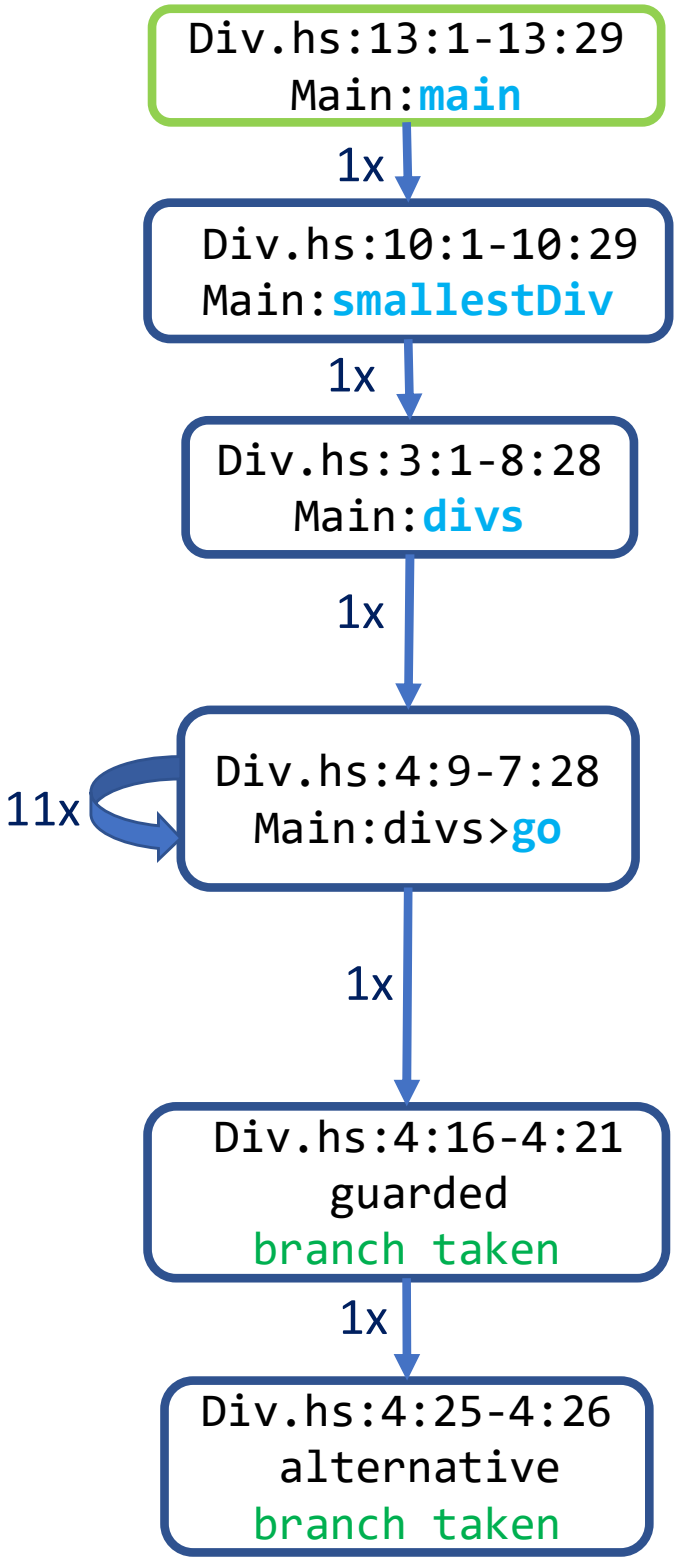


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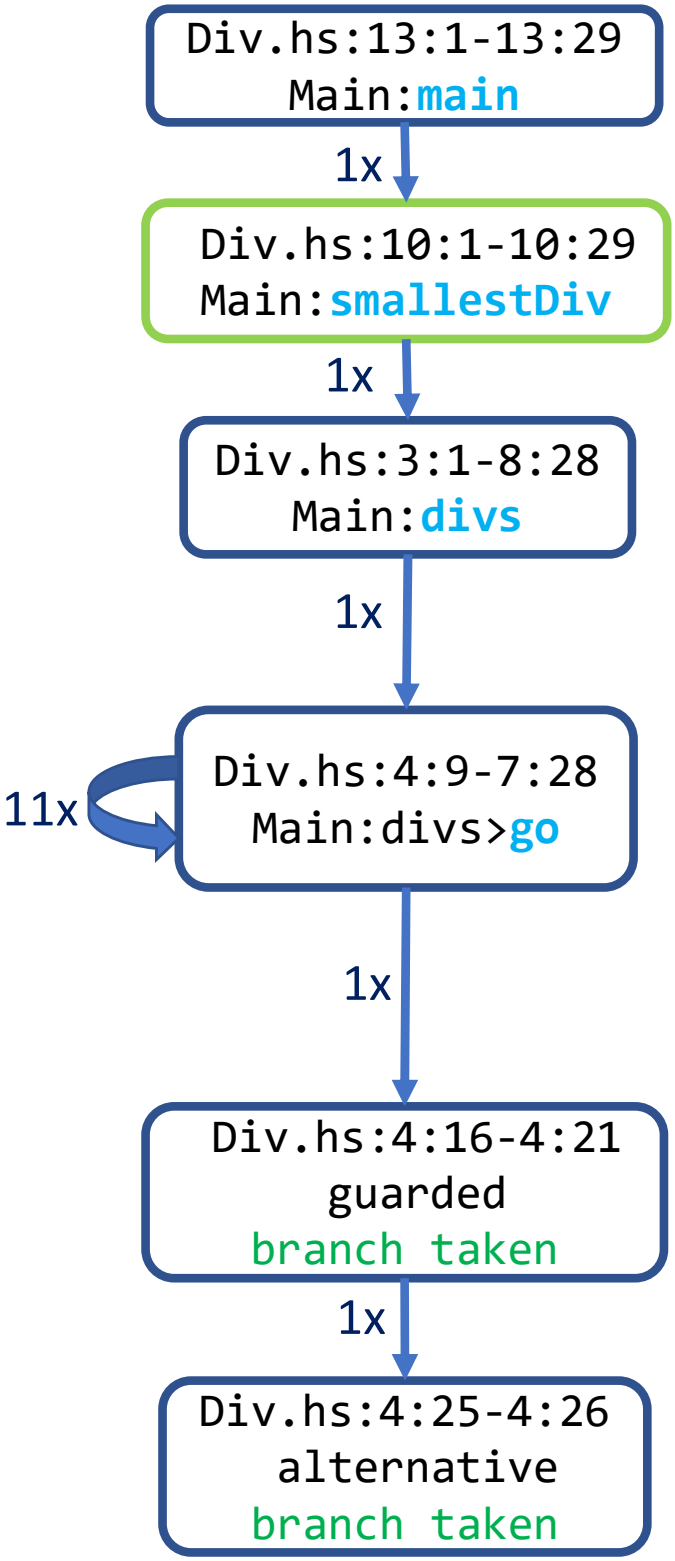


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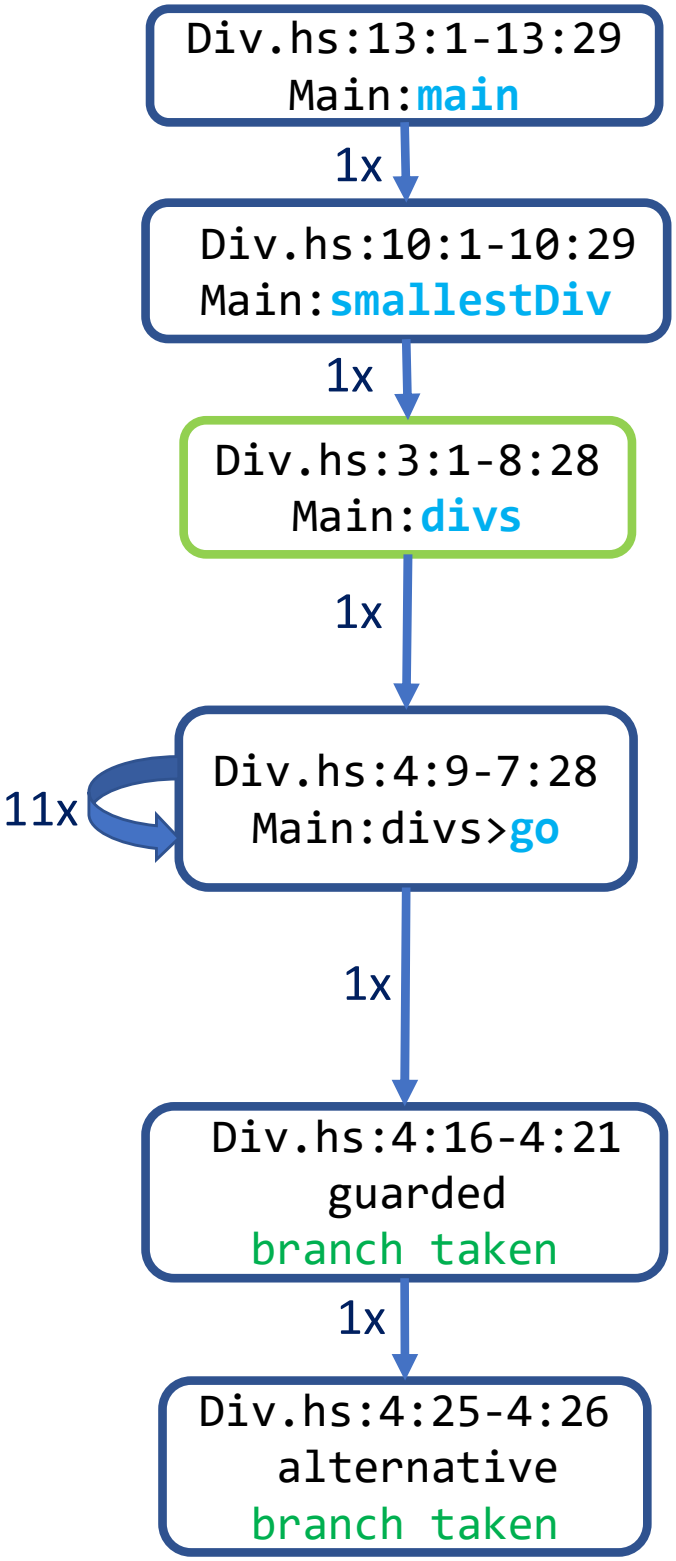


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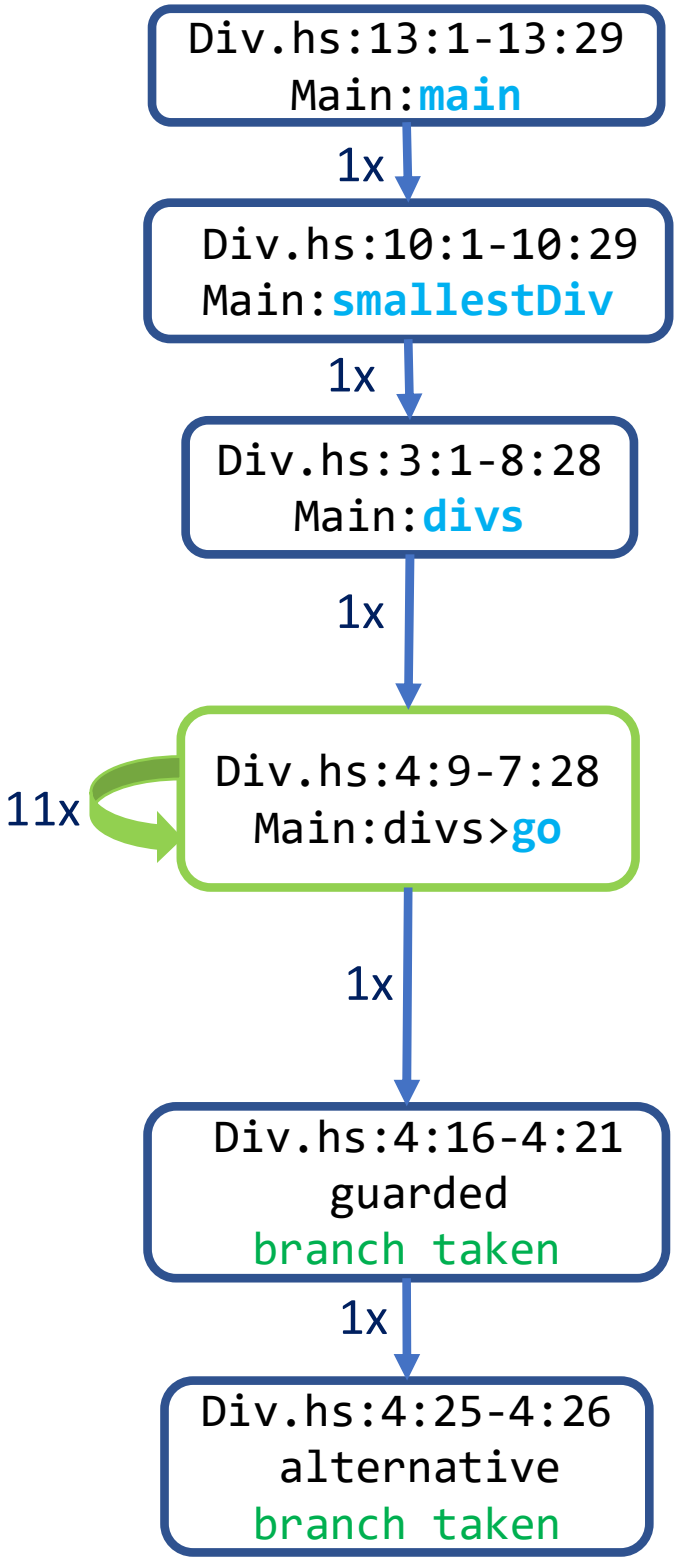


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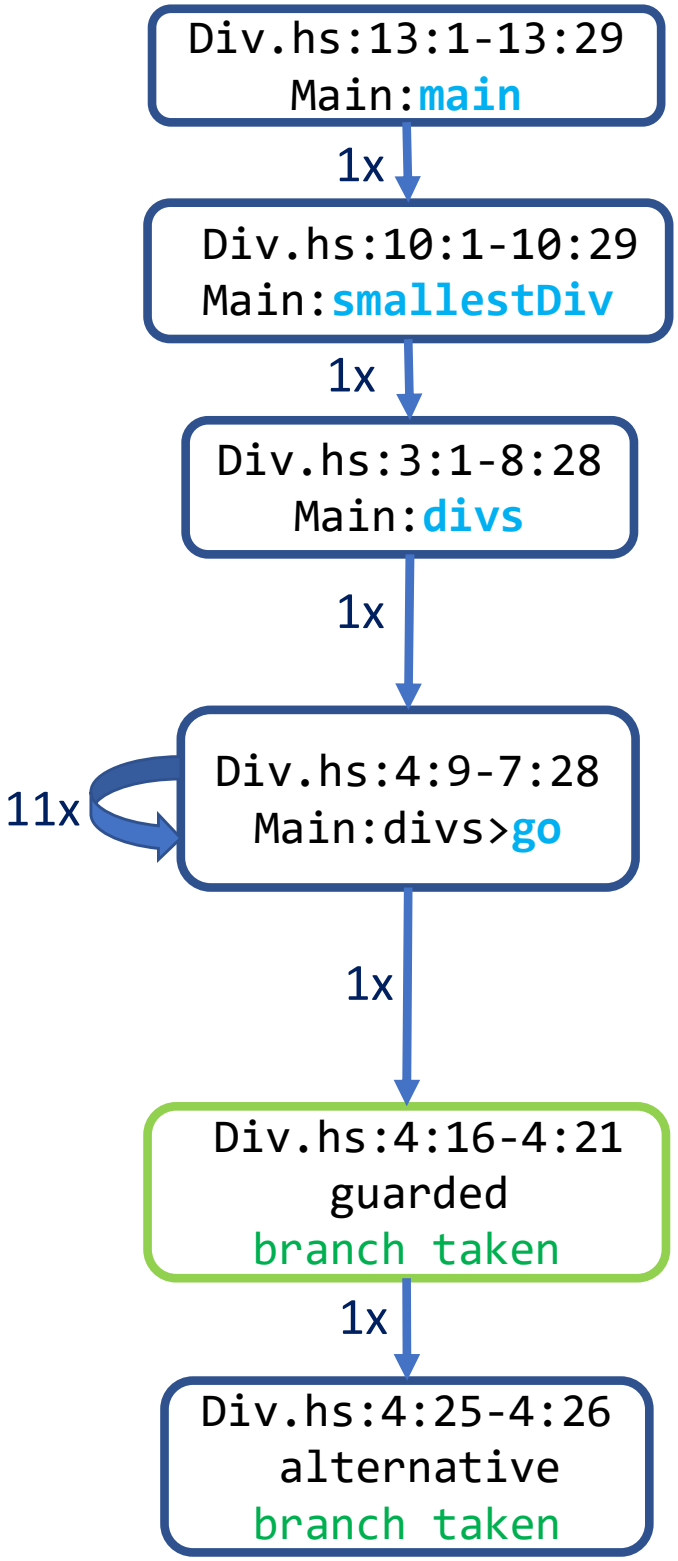


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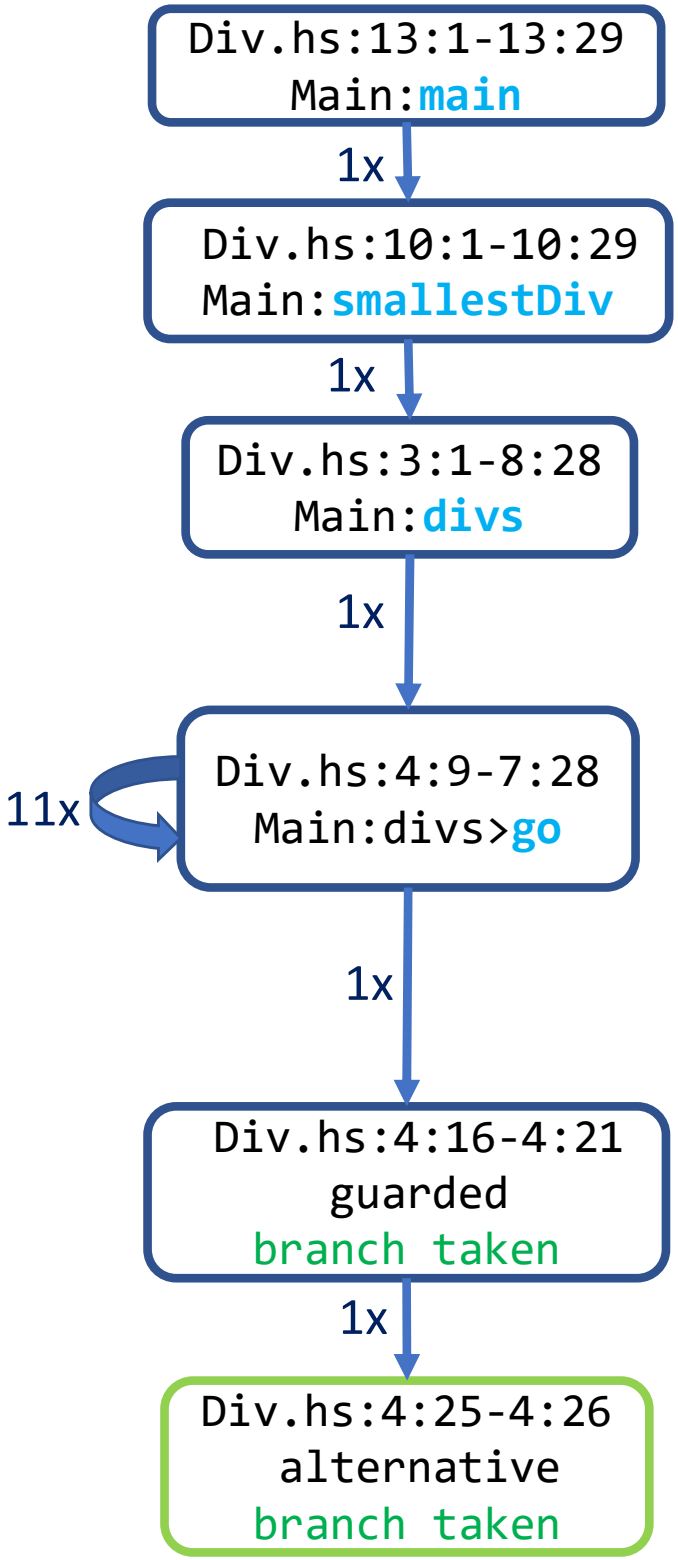


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4    where go i | i == n = []
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                  else go (i+1)
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12 main :: IO ()
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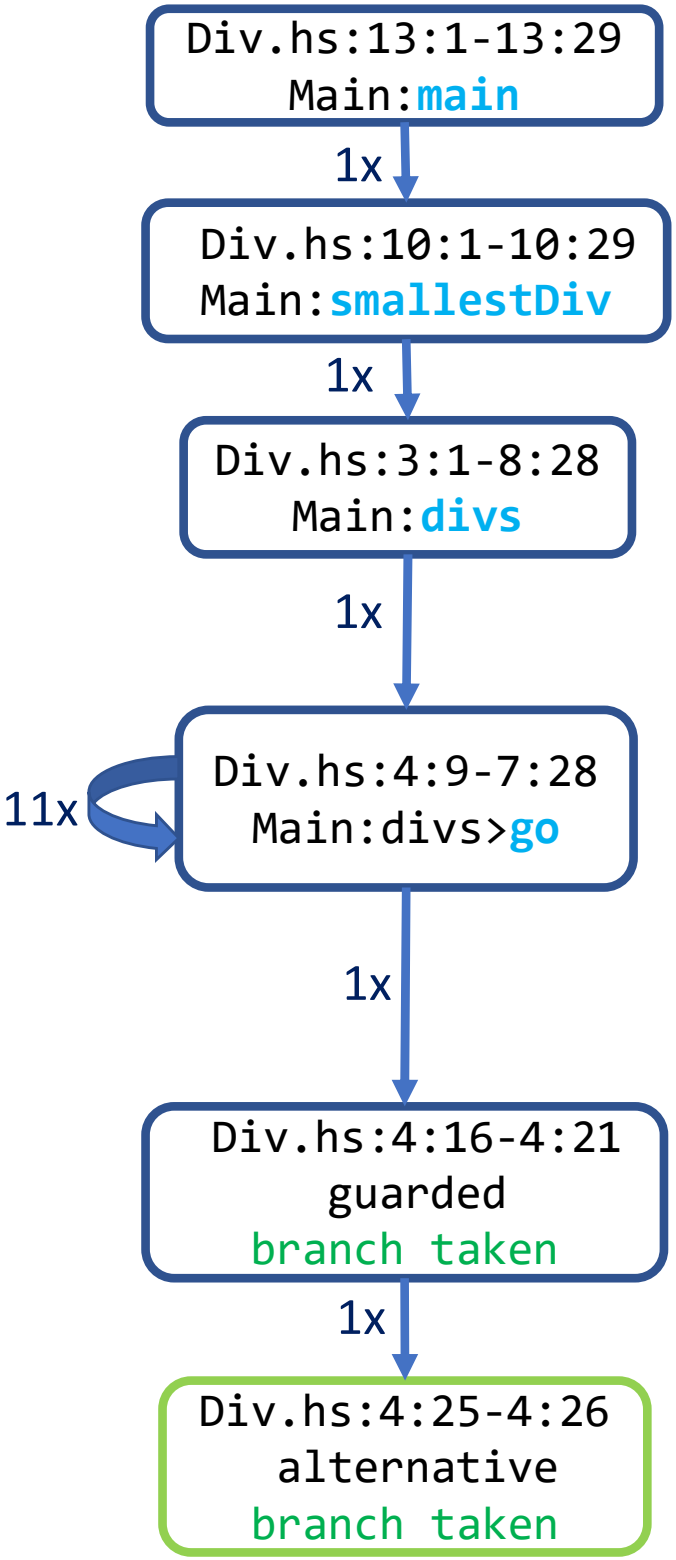
Results:



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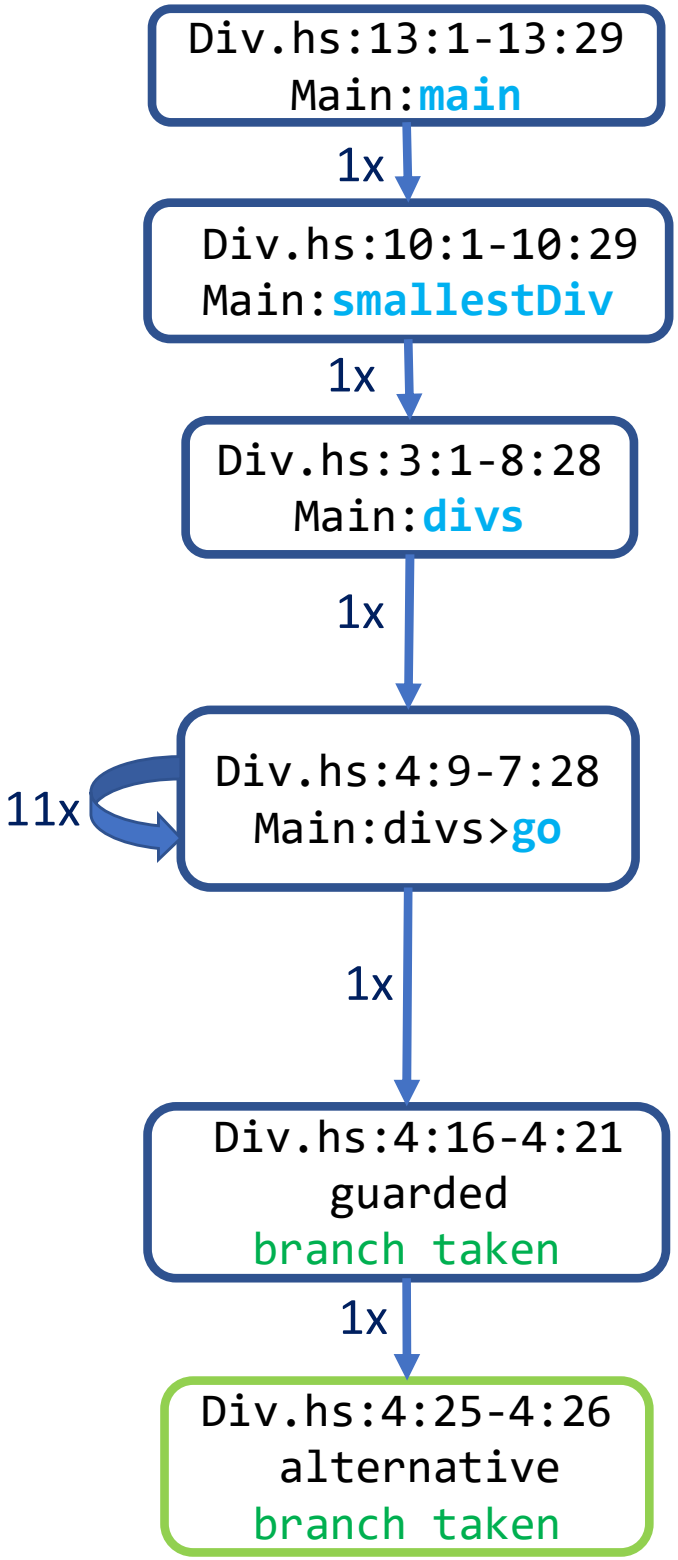

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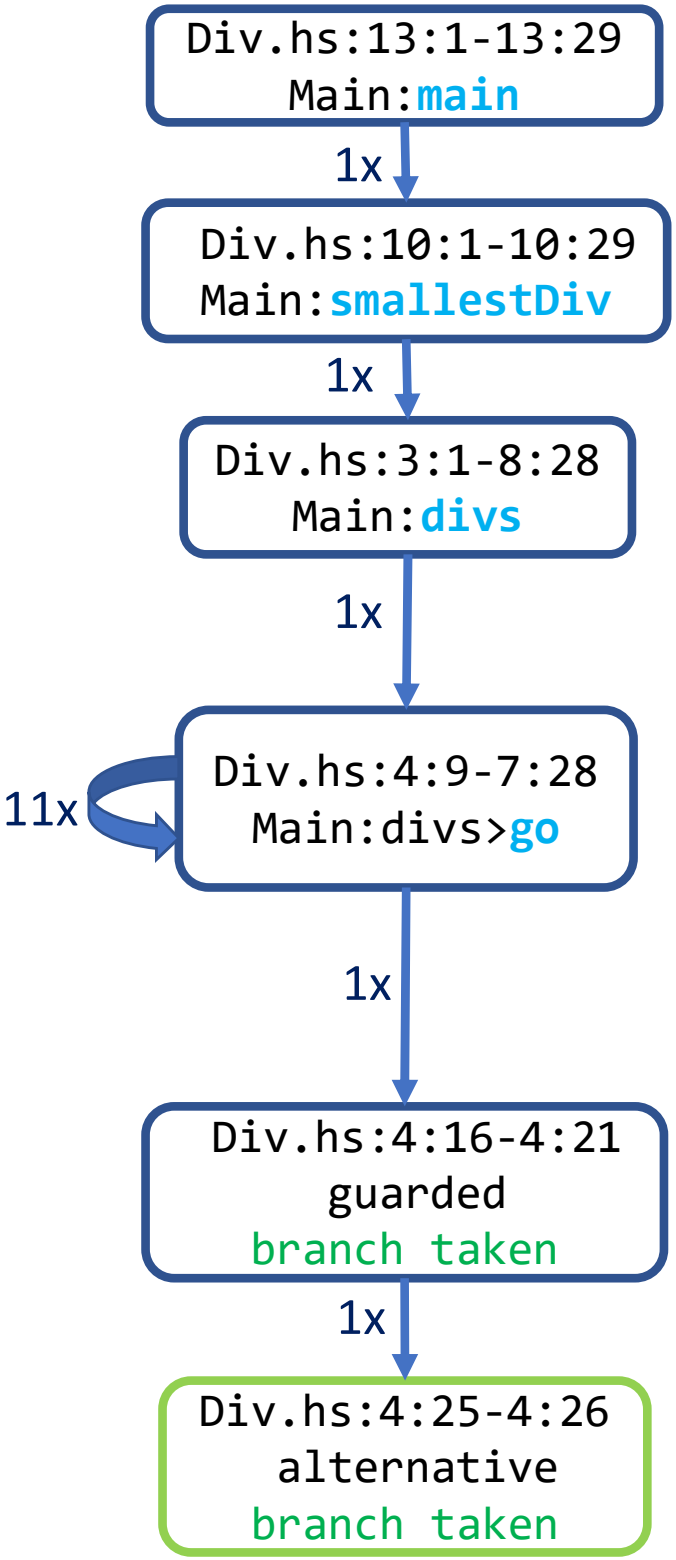

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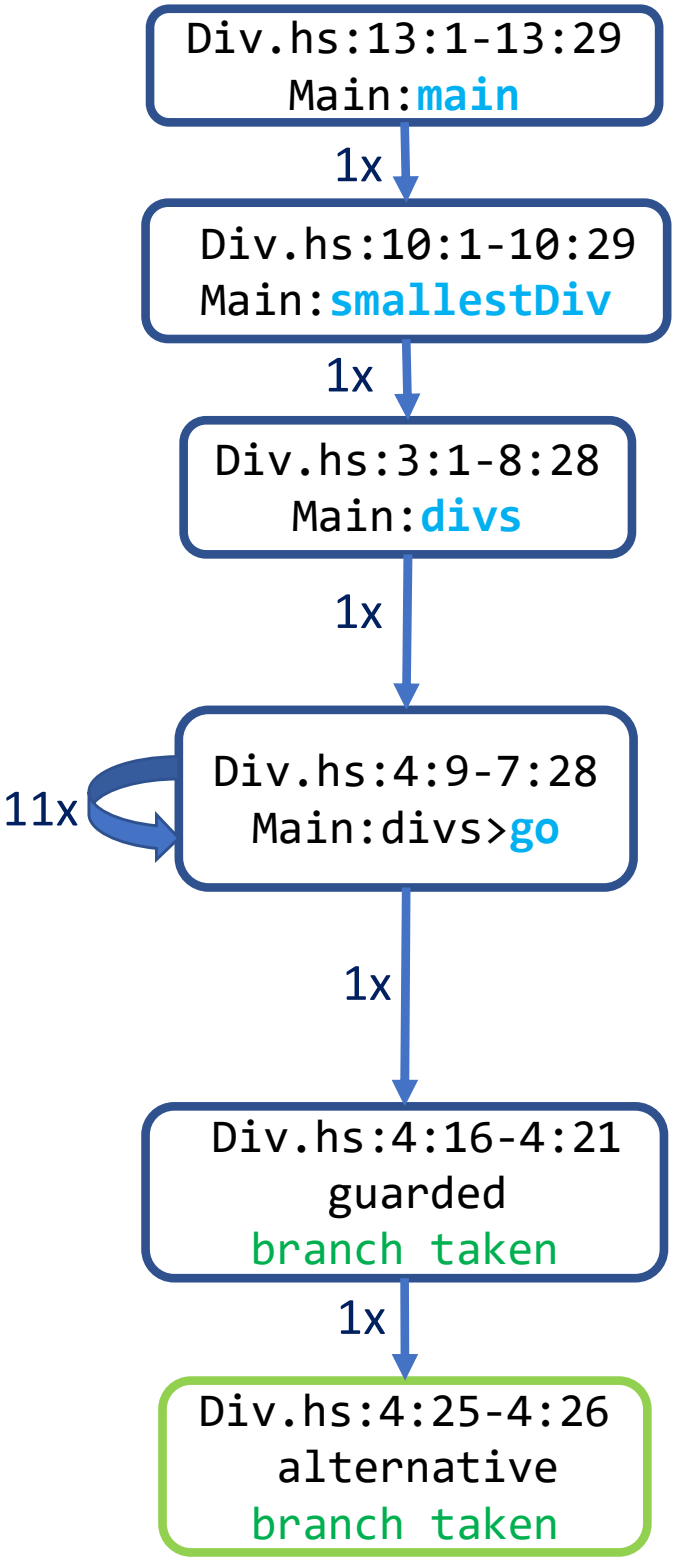

Like **HPC**, **CSI** is:

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- Low-overhead

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  - Could we turn these off? [2,3,4]

[2] Buiras, Pablo, and Alejandro Russo. "Lazy programs leak secrets." *Nordic Conference on Secure IT Systems*. Springer, Berlin, Heidelberg, 2013.
[3] Vassena, Marco, Joachim Breitner, and Alejandro Russo. "Securing concurrent lazy programs against information leakage." *2017 IEEE 30th Computer Security Foundations Symposium (CSF)*. IEEE, 2017.
[4] Breitner, Joachim. "dup--Explicit un-sharing in Haskell." *arXiv preprint arXiv:1207.2017* (2012).

Thank You!

Questions?

@tritlo

Artifact available!

https://l.mpg.is/ghc-csi

Bonus:
Comparison to HAT[5]

- No program transformation beyond HPC
- Easy to use (two flags)
- Low-cost (write to circular buffer)
- Only traces *recent* expressions, bounding costs
- Extendible by external tools

[5] Olaf Chitil, Colin Runciman, and Malcolm Wallace. 2002. Transforming Haskell for tracing. In *Symposium on Implementation and Application of Functional Languages*. Springer, 165–181.