Generic Incremental Computation for Regular Datatypes

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Title Explanation – Incremental Computation

Generic Incremental Computation for Regular Datatypes

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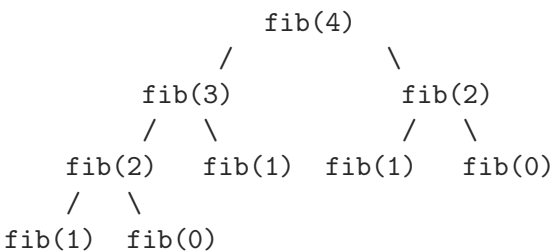
Incremental computation is an approach to improve performance by only recomputing result for changed input

Title Explanation – Example Incremental Computation

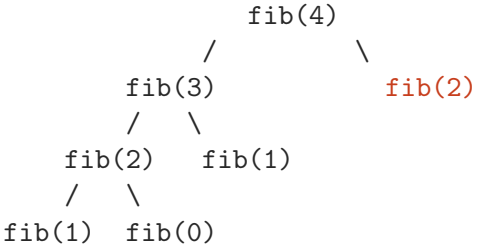
```haskell
fib :: Int -> Int
fib 0 = 0
fib 1 = 1
fib n = fib (n - 1) + fib (n - 2)
```

Call Hierarchy



Title Explanation – Example Incremental Computation

New Call Hierarchy



Function Call	Result
fib(2)	1
fib(3)	2
fib(4)	3

Cached Results

Title Explanation – Generic

Generic Incremental Computation for Regular Datatypes

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Generic refers to *datatype-generic programming*, which is a form of abstraction that allows defining functions that can operate on a large class of datatypes.

Title Explanation – Generic Example

```haskell
data List a = Nil | Cons a (List a) -- Haskell Notation [] | x : []

length :: List a -> Int
length Nil        = 0
length (Cons _ t) = 1 + length t

data Tree a = Leaf | Bin a (Tree a) (Tree a)

length :: Tree a -> Int
length Leaf         = 1
length (Bin _ l r) = 1 + length l + length r
```

Title Explanation – Generic Example

```
gLength :: (Generic f) => f a -> Int
gLength = ...
```

A *single* `length` function can be written, that can operate on lists, trees, and many other datatypes

```
> gLength (Cons 1 (Cons 2 (Cons 3 Nil)))
    2

> gLength (Bin 1 Leaf Leaf)
    3
```

Title Explanation – Regular Datatypes

Generic Incremental Computation for Regular Datatypes

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Regular datatypes are recursive datatypes, which can only recurse into themselves, such as lists, binary trees, etc.

Title Explanation – Regular Datatypes Example

Regular Datatypes

```
data List a = Nil | Cons a (List a)
```

```
data Tree a = Leaf | Bin a (Tree a) (Tree a)
```

Not Regular Datatypes

```
data Tree a = Empty | Node a (Forest a)
```

```
data Forest a = Nil | Cons (Tree a) (Forest a)
```