Lazy	eval	luation	
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<b>CSc 372</b>	Haskell evaluates expressions using a technique called lazy evaluation:
Comparative Program Languages 14 : Haskell — Lazy Evalua	2. No shared expression is evaluated more than once; if the expression is ever evaluated then the result is shared between all those places in which it is used
Christian Collberg	Lazy functions are also called non-strict and evaluate their arguments lazily or by need.
collberg+372@gmail.com Department of Computer Science University of Arizona	C functions and Java methods are strict and evaluate their arguments eagerly.
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## **Don't Evaluate Until Necessary**

The first of these ideas is illustrated by the following function:

```
ignoreArgument x = "I didn't evaluate x"
```

Since the result of the function ignoreArgument doesn't depend on the value of its argument x, that argument will not be evaluated:

```
$ hugs +s
> ignoreArgument (1/0)
I didn't evaluate x
(246 reductions, 351 cells)
```

## Don't Evaluate Until Necessary...

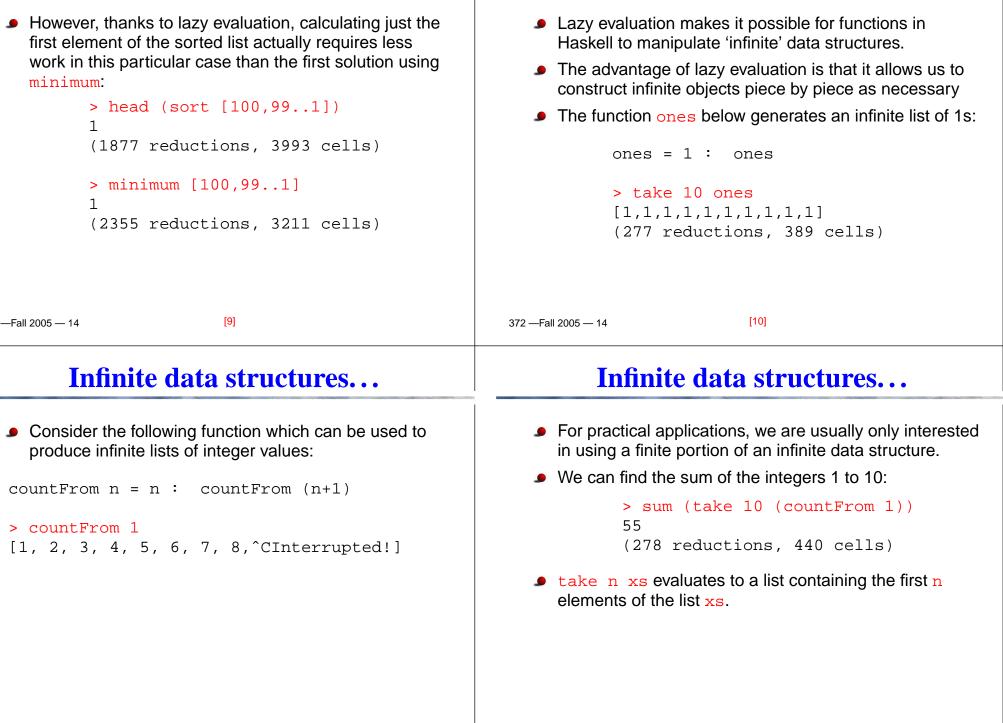
The function seq forces strict evaluation when that is necessary:

```
> seq ignoreArgument (1/0)
Inf
(32 reductions, 78 cells)
```

<b>Evaluate Shared Expressions Once</b>
<ul> <li>Notice that the first expression requires fewer reduction than the second.</li> <li>A reduction is the basic step of evaluating a Haskell expression, by applying a function to its argument.</li> </ul>
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Taking the Minimum
<ul> <li>Consider the task of finding the smallest element of a list of integers.</li> <li>minimum [100,991] <ol> <li>(2355 reductions, 3211 cells)</li> </ol> </li> <li>[100,991] denotes the list of integers from 1 to 100 arranged in decreasing order.</li> <li>Instead, we could first sort and then take the head of the result: <ol> <li>:load List</li> <li>sort [100,991]</li> <li>2, 3, 4, 5, 6, 7, 8,, 99, 100]</li> <li>(3430 reductions, 8234 cells)</li> </ol> </li> </ul>

## Taking the Minimum...

## Infinite data structures



Infinite data structures	Infinite data structures
<ul> <li>Infinite data structures enable us to describe an object without being tied to one particular application of that object.</li> <li>The following definitions for infinite list of powers of two [1, 2, 4, 8,]:         powersOfTwo = 1 : map double powersOfTwo             where double n = 2*n         <ul> <li>take 10 powersOfTwo             [1, 2, 4, 8, 16, 32, 64, 128, 256, 512]</li> </ul> </li> </ul>	<ul> <li>xs!!n evaluates to the n:th element of the list xs.</li> <li>We can define a function to find the nth power of 2 for any given integer n:</li> <li>powersOfTwo = 1 : map (*2) powersOfTwo</li> <li>twoToThe n = powersOfTwo !! n</li> <li>twoToThe 5</li> <li>32</li> </ul>
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Fibonacci	Acknowledgements
<ul> <li>Here's a definition of a function that generates an infinite list of all the fibonacci numbers:         <pre>fib = 1:1:[a+b  a,b &lt;-zip fib (tail fib)]</pre> </li> <li>take 10 fib         <pre>[1,1,2,3,5,8,13,21,34,55]</pre> </li> </ul>	<ul> <li>These slides were derived mostly from the Gofer manual.</li> <li>Functional programming environment, Version 2.20</li> <li>© Copyright Mark P. Jones 1991.</li> </ul>