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Dr. Liam O'Connor University of Edinburgh LFCS UNSW, Term 3 2020

Definition

Let ASSIGNMENTAL Puroject TExam Helpan use induction:

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• Show *P*(0)

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Example (Sum of Integers)

Write a recursive function switzer surpus all integers from oto he input n.

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Example (Sum of Integers)

Write a recursive function sweets and interest from Oto he input n. Show that:

$$\forall n \in \mathbb{N}$$
. sumTo $n = \frac{n(n+1)}{2}$

Haskell Data Types

We calculate the reflection this representation of the structure. We calculate the reflection of the structure of the struct

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Haskell Data Types

We A structure. Physiolicate the Frenchis Indiana position of the Physiolican properties and the structure.

data $Nat = Z \mid S Nat$

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Example

Define addition, prove that $\forall n. \ n + Z = n$.

Haskell Data Types

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Example

Define addition, prove that $\forall n. \ n + Z = n.$

Inductive Structured WeChat powcoder

Observe that the non-recursive constructors correspond to base cases and the recursive constructors correspond to inductive cases



Lists

Lists are Solventine haske five book it is written as x: xs. The value x is called the head and the rest of the list xs is called the tail. Thus:



Lists

Lists Ac SSI MAINTENANCE TICE OF COLOR TO THE LIST OF the tail. Thus:

When we define recursive functions on lists, we use the last form for pattern matching.

Example Add We Chat powcoder

Example

(Re)-define the functions length, take and drop.

If lists weren't already defined in the standard library, we could define them ourselves:

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Induction https://powcoder.com
If we want to prove that a proposition holds for all lists:

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It suffices to



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Induction https://powcoder.com If we want to prove that a proposition holds for all lists:

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It suffices to:

• Show P([]) (the base case from nil)



If lists weren't already defined in the standard library, we could define them ourselves:

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Induction https://powcoder.com If we want to prove that a proposition holds for all lists:

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It suffices to:

- Show P([]) (the base case from nil)
- 2 Assuming the inductive hypothesis P(xs), show P(x:xs)(the inductive case from cons).

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Example (Take and Drop)

• Show that ntet psi. /s/powcoder.com

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Example (Take and Drop)

- Show that not per / POWCOder.com
- Show that take 5 xs ++ drop 5 xs = xs for all xs.

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 - ⇒ Sometimes we must generalise the proof goal.

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Example (Take and Drop)

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- Show that take 5 xs ++ drop 5 xs = xs for all xs.
 - ⇒ Sometimes we must generalise the proof goal.
 - Sometimes we must prove aukiliary lemmas. We char powcoder

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Assignment Project-Exam Help

Induction Principle

To prove a property for all per wooder.com

• Prove the base case P(Lear).

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Induction Principle

To prove a property the story of the provided and the pro

- Prove the base case P(Leaf).
- Assuming the two *inductive hypotheses*:

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Induction Principle

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We must show $P(Branch \times I r)$.

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- Prove the base case P(Leaf).
- Assuming the two *inductive hypotheses*:
 - * P(I) an Add We Chat powcoder
 - We must show $P(Branch \times I r)$.

Example (Tree functions)

Define *leaves* and *height*, and show $\forall t$. *height* t < leaves t

Rose Trees

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Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with any of the Note that Forest and Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with a second control of the Note that Rose are defined with the Note that Rose are define

Rose Trees

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Note that Forest and Rose are defined mutually.

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Example (Rose tree functions)

Define size and Aright and Wterwhat powcoder

 $\forall t. \ \textit{height} \ t \leq \textit{size} \ t$

To prove a property about two types defined mutually, we have to prove two properties

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Inductive Principle

To prove a property (t) about all forests ts simultaneously:

To prove a property about two types defined mutually, we have to prove two properties



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Inductive Principle

To prove a property (t) about all forests ts simultaneously:

• Prove Q(Empty)

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Inductive Principle

To prove a property (t) about all forests ts simultaneously:

- Prove Q(Empty)
- Assuming P(t) and Q(ts) (inductive hypotheses), show $Q(Cons\ t\ ts)$.

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Inductive Principle

To prove a property (t) about all forests ts simultaneously:

- Prove Q(Empty)
- Assuming P(t) and Q(ts) (inductive hypotheses), show $Q(Cons\ t\ ts)$.
- Assuming Q(ts) (inductive hypothesis), show $P(Node \times ts)$.