COMP30026 Models of Computation Assignment In Puckary Encycles Exam Help

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Lecture Week 5 Part 2 (Zoom)

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This Lecture is Being Recorded



Mathematical Induction

Ansirgument Project Examullelp numbers, N.

We're usually given a statement "for all n, S(n)."

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We proceed in two steps.

- In the hardstep, we take 3(n) as the mouction hypothesis
- In the inductive step, we take S(n) as the induction hypothesis and use it to establish S(n+1).

Proof by Induction

Theorem: For all n > 0.

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Proof: In the pass step out that the part of the for n = 0.

For the inductive step, assume the statement is true for some fixed n, and we shall show that it also holds true with n+1 substituted for n. So the statement to prove is

$$\sum_{i=1}^{n+1} i^2 = \frac{(n+1)(n+2)(2n+3)}{6}$$

Proof by Induction

But the claim

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is the same as

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$$\frac{n(n+1)(2n+1)}{6} + (n+1)^2 = \frac{(n+1)(n+2)(2n+3)}{6}$$

This is done by simple polynomial algebra.



More General Induction

Sometimes more base cases may be needed.

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Theorem: For all $n \ge 8$, n can be written as a sum of 3s and 5s.

Proof: For the basis step, observe that S(8), S(9), and S(10) are true.

For the inequality estern seeing inequality (n, n) are true. Since S(n-2) is true, also n+1 can be written as a sum of 3s and 5s – just add 3 to the sum we had for n-2. Hence we have established S(n+1).

We conclude that S(n) holds for all $n \ge 8$.

Course-of-Values Induction

We can take the generality of "general induction" all the way:

Assignment), Peroject texamtir Help conjunction

 $P(0) \wedge P(1) \wedge \cdots \wedge P(n-1)$ as our inflitting potherowcoder.com

This variant is called course-of-values induction.

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But the base case is implicitly included in the inductive step, because we have to prove P(0) from nothing, that is, from *true*, the empty conjunction.

Recursive Structure and Induction

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The set of well-formed propositional logic formulas is another example https://powcoder.com

We will later meet context-free grammars; the language defined by such a grammar is a third example.

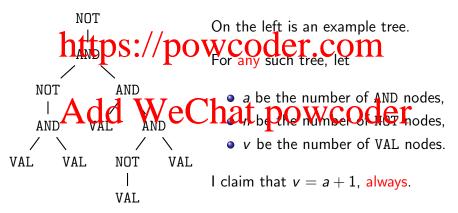
Add WeChat powcoder Induction is the natural way of proving assertions about such objects.

In many cases we then rely on structural induction.

Structural Induction: An Example

Consider the Haskell type Exp defined like so:

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Structural Induction: An Example

The claim v = a + 1 applies to all trees that are inhabitants of Exp.

Assignment Project Exams Help we need to deal with:

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 a tree of form (AND t_1 t_2), where t_1 and t_2 are trees,
- \bigcirc a tree of form (NOT t), where t is a tree.

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The first is a base case for induction.

It is straight-forward to prove v = a + 1 for the base case, since for VAL, a is 0 and v is 1.

Structural Induction: An Inductive Case

For the inductive case AND t_1 t_2 , we proceed by assuming that the Assignment Project Exam Help

That is, if the number of AND nodes in t_1 and t_2 is a_1 and a_2 , respectively, and the number of VAL nodes is v_1 and v_2 , respectively, then we make possessumples were the red com 1.

To get the number a of AND nodes in AND t_1 t_2 , we need to add the number of AND nodes in t_1 and t_2 , and then add 1: $a = a_1 + a_2 + 1$.

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To get the number of VAL nodes, we just have to add the number of

VAL nodes in t_1 and t_2 : $v = v_1 + v_2$.

So $v = v_1 + v_2 = a_1 + 1 + a_2 + 1 = a + 1$. Just as we claimed!

Structural Induction: A Second Inductive Case

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Clearly the number of AND nodes in NOT t is the same as the number in t, and similarly for the VAL nodes. Oder.com So again we have that v = a + 1.

Since we have established that y = a + 1 in each of the three cases, we conclude that it really is an invalignt of the same possible Exp trees.

Structural and Mathematical Induction

Structural induction is a natural generalisation of course-of values 1 ASSISIBAIMENT Project Exam Help

In Haskell we could mimic the natural numbers with this definition:

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Then structural induction over this type corresponds exactly to

course-of-values induction. Chat powcoder

Conversely, if you prefer mathematical induction, we could have shown v = a + 1 for the Exp trees, by doing induction on the height of the trees.

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We shall take another helping of mathematical vegetables (a large dish of sets functions/and relations). Oder.com

This will be our sustenance for the remaining parts of the course,

This will be our sustenance for the remaining parts of the course, namely automata, formal language theory, and computability.

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