

PS #2 Thu 9/22 11:59 PM

Q #2 Thu 9/22 First 10 min

- Through today

9/27 - Walker white, no RDZ O.H.

P1 review Wed evening 9/28

2.8

3.3

Correctness of software

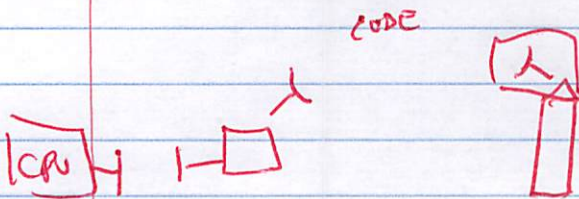
"Hey it worked!" (on my examples)

Coverage

run-time checks      assert

Pair programming

Verification: proof code works  
on all inputs



All outputs obey  
specification

# Program correctness proofs

Guest Stars in P1 + F

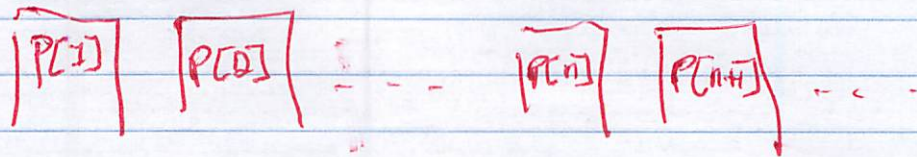
TOOLS:

- Induction
- Substitution model

Induction recipe

1. Statement  $\sum_{i=1}^n i = \frac{n(n+1)}{2}$   $P[n]$
2. Variable  $n$
3. Proof of base case  $P[1]$
4. Proof that  $\forall n (P[n] \Rightarrow P[n+1])$

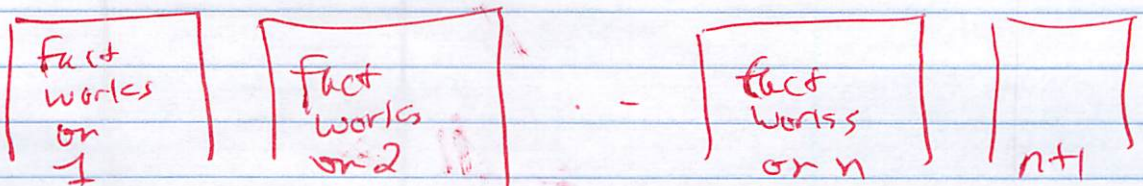
Pick an  $n$ , assume  $P[n]$ , prove  $P[n+1]$   
I.H.



let rec fact(n) =

if n = 1 then 1 else n \* fact(n-1)

$P[n]$  =  $\{$  The value of the expression  $\underbrace{\text{fact } n}$  is  $n!$   $\}$



1. Statement "fact works on n"

For integer  $n \geq 1$ , value of fact n is  $n!$

2. n

3.  $P[n]$

fact 1 by substitution model apply function

if  $1=1$  then 1 else  $1 * \text{fact}(1-1)$

By b.s.m. if, =

if true then 1 else  $1 * \text{fact}(1-1)$

b.s.m. if

1

4.  $\forall n \geq 1, P[n] \Rightarrow P[n+1]$

Assume fact works for n, show works for n+1

fact n+1

b.s.m. (apply)

if  $n+1=1$ , then 1 else  $n+1 * \text{fact}(n+1-1)$

Since  $n \geq 1, n+1 \geq 2 \therefore n+1 \neq 1$

the value of  $n+1=1$  is false b.s.m. (=)

if false then - - -

b.s.m. (if)

$n+1 * \text{fact}(n+1-1)$

b.s.m. (if)  $n+1-1 = n$

$n+1 * \text{fact}(n)$

BY INDUCTION HYPOTHESIS

fact(n) is  $n!$

$n+1 * n!$

$(n+1)! \quad \text{QED}$