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FACTORIAL

def fac (n):

fac-iter (n, 1)

fac-iter (i, a) = a & i c=0

= fac-iter (i-1, axi) otherwise

assume fac(K) = ! K for K>0, then

= fac-iter (k, K+1)

= fac-iter (o, 1)

BASE CASE

fac (o)

= 1

INDUCTION STEP

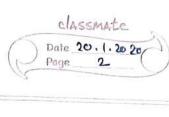
Show facker) = 1 (k+1)

fac (K) = fac-iter (K,1)

fac (K+1) = fac-iter (K+1,1)

RTP: fac(n) returns with in

I: M - M



TRANSITION SYSTEM

(i, a) -> (i-1, a*i)

F: NXN -> MXN

(i, a) -> (i', a')

ex $(3,7) \rightarrow (2,21) \rightarrow (1,42) \rightarrow (0,42) \rightarrow$

(0,5) \$

theorm:

Di= 1-1

S is terminating

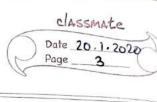
given any state m1x1 every run as finite.

mixi < mix

if (i, a) -> (i', a') then

pendulum amplitude reducing

- well ordered - minimum



c'hvariant generation, 2 parts (1) termination

(D correctness (partial)

ex (3,1) -> (2,3) -> (1,6) -> (0,6) +> (markov chains).

INVARIANT

P is an invariant of

OP(xo) is true where no GX°

 \emptyset if $x \to x'$ and P(x), then P(x')

(n,1) -> ... -> (0, n!)

(i, a) -> (i', a') -> ... (i', a'n)

P(i,a) = df = i! * a (= n!)

prove that Pn is an invariant for a when stating (1)

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check on verify that Pn (xo) is true? 0 Pn (10, a0) = Pn (n, 1) L bi bonacei Pn (n, 1) = n1 * 1 = n! trivially true @ assume Pn Cisa) (i,a) -> (i', a') show Pn (i', ai) i'l * a = (i-1)| * a * i Pn Ci, a) = i! * a Un = 0 (team)

 $\Rightarrow a = n! \xrightarrow{\Rightarrow} done$

20 b 42 3 2