**1. Random (WP To Semantic Function):**

T: SF 01:

Texto

Descripción generada automáticamenteP: Given P, choose its semantic function with arity 1:

begin

X3:=X1+X2;

while X3 ≠ X2 do

   begin

   X3:=pred(X3);

   X2:=succ(X2);

   end

X1:=X3;

end

R: φP(1)(x) = x/2 if x is even, undefined otherwise

T: SF 02:

Texto

Descripción generada automáticamenteP: Given P, choose its semantic function with arity 2:

begin

X2:=X1-X3;

X4:=1;

while X2≠0 do

   begin

   X4:=X4\*X2;

   X2:=pred(X2);

   end

X1:=X4;

end

R: φP(2)(x, y) = x!

T: SF 03:

P: Given P, choose its semantic function with arity 2:

Texto

Descripción generada automáticamente

begin

while X1 ≠ X3 do

   begin

   X1:=pred(X1);

   X2:=succ(X2);

   X2:=succ(X2);

   end

X1:=X2;

end

R: φP(2)(x, y) = 2x + y

T: SF 04:

P: Given P, choose its semantic function with arity 2:

Texto

Descripción generada automáticamente

begin

X3:=0;

while X1 ≠ 0 do

   begin

   X1:=X1-X2;

   X3:=succ(X3);

   end

X1:=pred(X3);

end

R: φP(2)(x, y) = (x-1/y) if y ≠ 0, otherwise undefined

**2. Random (Semantic Function To WP):**

T: WP 01:

P: Given the WP, P:

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Descripción generada automáticamente

begin

X2:=X1;

((1))

while X2≥2 do

   begin

   X2:=pred(X2);

   ((2))

   end

X1:=X3;

end

Which instruction should you add in ((1)) and in ((2)) so that the 1-ary semantic function associated to this WP is: φP(1)(x) = (x-1)!

R: In ((1))  "X3:=1;" and in ((2)) put "X3:=X3\*X2;"

T: WP 02:

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Descripción generada automáticamenteP: Let  P be the following WP:

begin

X2:=X1;

((1))

while X2≠X4 do

   begin

   X2:=pred(X2);

   ((2))

   end

X1:=X3;

end

Fill the gaps ((1)) and ((2)) to get a WP whose 1-ary semantic function is: φP(1)(x) =

R: In ((1)) put "X3:=0;" and in  ((2)) put "X3:=X3+X2;"

T: WP 03:

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Descripción generada automáticamenteP: Let P be the following WP:

begin

X2:=X1;

((1))

while X2≠X4 do

   begin

   X2:=pred(X2);

   ((2))

   end

X1:=X3;

end

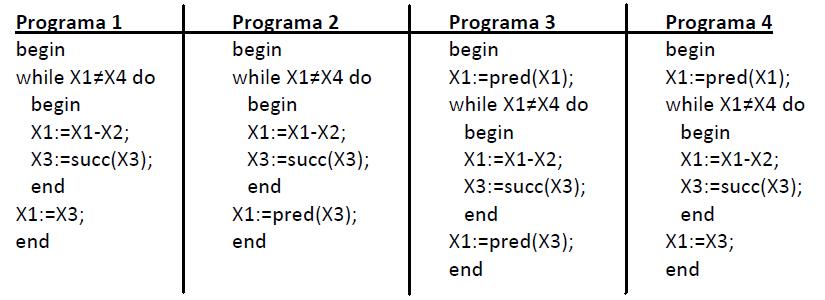
Fill the gaps ((1)) and ((2)) to get a WP whose 1-ary semantic function is: φP(1)(x) = 2(x+1)

R: In ((1)) put "X3:=2;" and in ((2)) put "X3:=X3+X3;"

T: WP 04:

P: Which one of the following While programs compute the 2-ary semantic function:

φP(2)(x, y) = (x+y-1) / y if y ≠ 0 , undefined otherwise

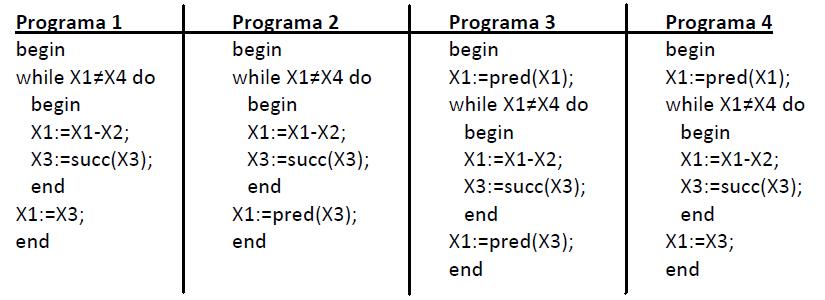


R: Program 1

T: WP 05:

P: Which one of the programs described below is associated to the semantic function with arity  2

φP(2)(x, y) = (x-1) / y if y ≠ 0 and undefined otherwise?



R: Program 2.

**3. Random (Macro-Tests):**

T: MT 01:

P: Let T : “ X = Y ” be a test. Then an algebraic expression with value >0 when T is true and 0 otherwise is:  
Remark:  “ – “ means positive difference.

R: (1-(X-Y)) x (1-(Y-X))

T: MT 02:

P: Consider the test T : “X < Y ^ Y ≥ Z”  Then an algebraic expression with value >0 when T is true and 0 otherwise is:  
Remark:  “ – “ means positive difference.

R: (Y-X) x (1-(Z-Y))

T: MT 03:

P: Consider the algebraic expression 1 - (X-Y). It is the expression with value >0 when true and value 0 when false for one of the following tests. Which one?  
Remark:  “ – “ means positive difference.

R: X ≤ Y

T: MT 04:

P: Consider the algebraic expression (Y-X) + (X-Y). It is the expression with value >0 when true and value 0 when false for one of the following tests. Which one?  
Remark:  “ – “ means positive difference.

R: X ≠ Y

**4. Random (Change State):**

T: CS 01:

P: Let  1 1 1 q1  0 1 1 1 be an instantaneous description of a TM, and let q1 1 0 R q2 and q1 0 0 L q1  be two quintuples

R: The next instantaneous description is 1 1 q1 1 0 1 1 1

T: CS 02:

P: Let 1 1 q 0 1 0 be an instantaneous description of a TM. If the next description of this machine is 1 1 1 q 1 0, the action the machine made was:

R: q 0 1 R q

T: CS 03:

P: Given the following instantaneous descriptions of a TM: 1 1 1 q1 1 0 1 and 1 1 q2 1 0 0 1

The transition to obtain 1 1 q2 1 0 0 1 from 1 1 1 q1 1 0 1 is

R: q1 1 0 L q2

**5. Random (TM Construction):**

T: Calculate 2x:

P: Determine which one of the following Turing Machines (all of them having a single final state f) computes the function f(x)=2x

|  |  |  |  |
| --- | --- | --- | --- |
| *q0 1 0 R q1*  *q1 1 1 R q1*  *q1 0 1 R q2*  *q2 0 1 L q3*  *q3 1 1 L q3*  *q3 0 0 R q0*  *q0 0 0 N f* | *q0 1 0 R q1*  *q1 1 1 R q1*  *q1 0 0 R q2*  *q2 0 1 R q2*  *q3 0 1 L q4*  *q4 1 1 L q4*  *q4 0 0 R q0*  *q0 0 0 N f* | *q0 1 0 R q1*  *q1 1 1 R q1*  *q1 0 0 R q2*  *q2 1 1 R q2*  *q2 0 1 L q3*  *q3 1 1 L q3*  *q3 0 0 L q4*  *q4 1 1 L q4*  *q4 0 1 R q0*  *q0 0 0 N f* | *i 1 0 R q0*  *M3* |
| M1 (initial state *q0*) | M2 (initial state *q0*) | M3 (initial state *q0*) | M4 (initial state *i*) |

R: M4

T: Calculate x/2:

P: Let M=({0,1}, {*q0, ..., q5, f*}, T, q0, {*f*}) a TM defined according to:

|  |  |  |
| --- | --- | --- |
| *q01 0 R q1* | *q3 0 0*L*q5* | *q41 0 R q1* |
| *q11 1 R q2* | *q5 1 0 N f* |  |
| *q21 1 R q3* | *q3 1 1*L*q4* |  |

 Then, choose the function computed by M for any strictly positive *x.*

R: φM(1)(x) =

T: Calculate x+2 if x even:

P: Consider the following Turing Machine:

|  |  |  |
| --- | --- | --- |
| i 1 1 R q0 | q0 1 1 R q1 | q1 1 1 R q0 |
| i 0 1 N f | q0 0 0 N i |  |

where i is its initial state and f the only final state. Indicate the unary function computed by this Turing Machine.

R: φM(1)(x) =

T: Calculate x + y:

P: Determine which one of the following Turing Machines (all of them with initial state q0 and final state f) computes the function f(x,y) = x+y

|  |  |  |  |
| --- | --- | --- | --- |
| *q0 1 0 R q1*  *q1 1 1 R q1*  *q1 0 1 L q2*  *q2 1 1 L q2*  *q2 0 0 R q3*  *q3 1 0 R q4*  *q4 1 0 N f* | *q0 1 0 R q1*  *q1 1 0 R q2*  *q2 1 0 R q3*  *q3 1 1 R q3*  *q3 0 1 N f* | *q0 1 0 R q1*  *q1 1 1 R q1*  *q1 0 1 N f* | *q0 1 0 R q1*  *q1 1 0 R q2*  *q2 1 1 R q3*  *q3 0 1 N f* |
| M1 | M2 | M3 | M4 |

R: M1

T: Calculate max(x,y):

P: Let M be a TM defined by the following quintuples with initial state q0 and final states {q3, f}

|  |  |  |  |
| --- | --- | --- | --- |
| q0 1 0 R q1 | q1 0 0 R q2 | q3 1 0 L q4 | q5 1 1 L q5 |
| q0 0 0 L q6 | q2 1 1 R q2 | q4 1 1 L q4 | q5 0 1 R q0 |
| q1 1 1 R q1 | q2 0 0 L q3 | q4 0 0 L q5 | q6 1 0 N f |

R: φM(2)(x,y) = Max(x,y)

**6. Random (TM Composition):**

T: Calculate g(0,x):

P: Let M1 a TM computing f(x, y) with states {q0, q1, q2, q3} and q0 its initial state. We want to construct another TM M whose semantic function with unary semantic funtion is g(x) = f(0, x). To obtain M it is necessary to:

R: Add the tuples i 1 1 L i, i 0 0 L q4, q4 0 1 N q0, being i the new initial state.

T: Calculate g(x+y):

P: Let Mg be a Turing Machine that computes a unary function g, with initial state ig and final state fg, and let Mf be the following Turing Machine, with initial state q0 and final state fg.

q0 1 0 R q1

q1 1 1 R q1

q1 0 1 L q2

q2 1 1 L q2

q2 0 0 R q3

q3 1 0 R ig

      Mg

Let f be the binary function it computes. Then:

R: f(x,y) = g(x+y)

T: Calculate g(y):

P: Let Mg be a Turing Machine that computes a unary function g, with initial state ig and final state fg, and let Mf be the following Turing Machine, with initial state q0 and final state fg.

q0 1 0 R q0

q0 0 0 R ig

      Mg

If f is the binary function it computes, then:

R: f(x,y) = g(y)

T: Calculate g(y) if x=0:

P: Let M1 be a Turing Machine that computes the function g(x). We want to build a Turing Machine that computes the following binary function:

f(x,y) =

If the states of M1 are {q0, q1, q2, q3} and its initial state is q0, then the new Turing Machine is formed adding to M1 the following quintuples and using i as the new initial state.

R:

i 1 0 R q4

q4 0 0 R q0