Práctica 5 CPLP

**Objetivo: Interpretar cómo se organiza la memoria de datos durante la ejecución de un programa con llamados a subrutinas**.

[Ejercicio 1: 1](#_44kw4ujju6ne)

[Ejercicio 2: 2](#_h1q26xyyh6m)

[Ejercicio 3: 6](#_v59sytvkwcxb)

[Ejercicio 4: 11](#_atxkckggsdaq)

[Ejercicio 5: 14](#_1wtxedc4r4pk)

# Ejercicio 1:

**Explique claramente cual es la utilidad del registro de activación y que representan cada una de sus partes.(Basado en el modelo debajo detallado)**

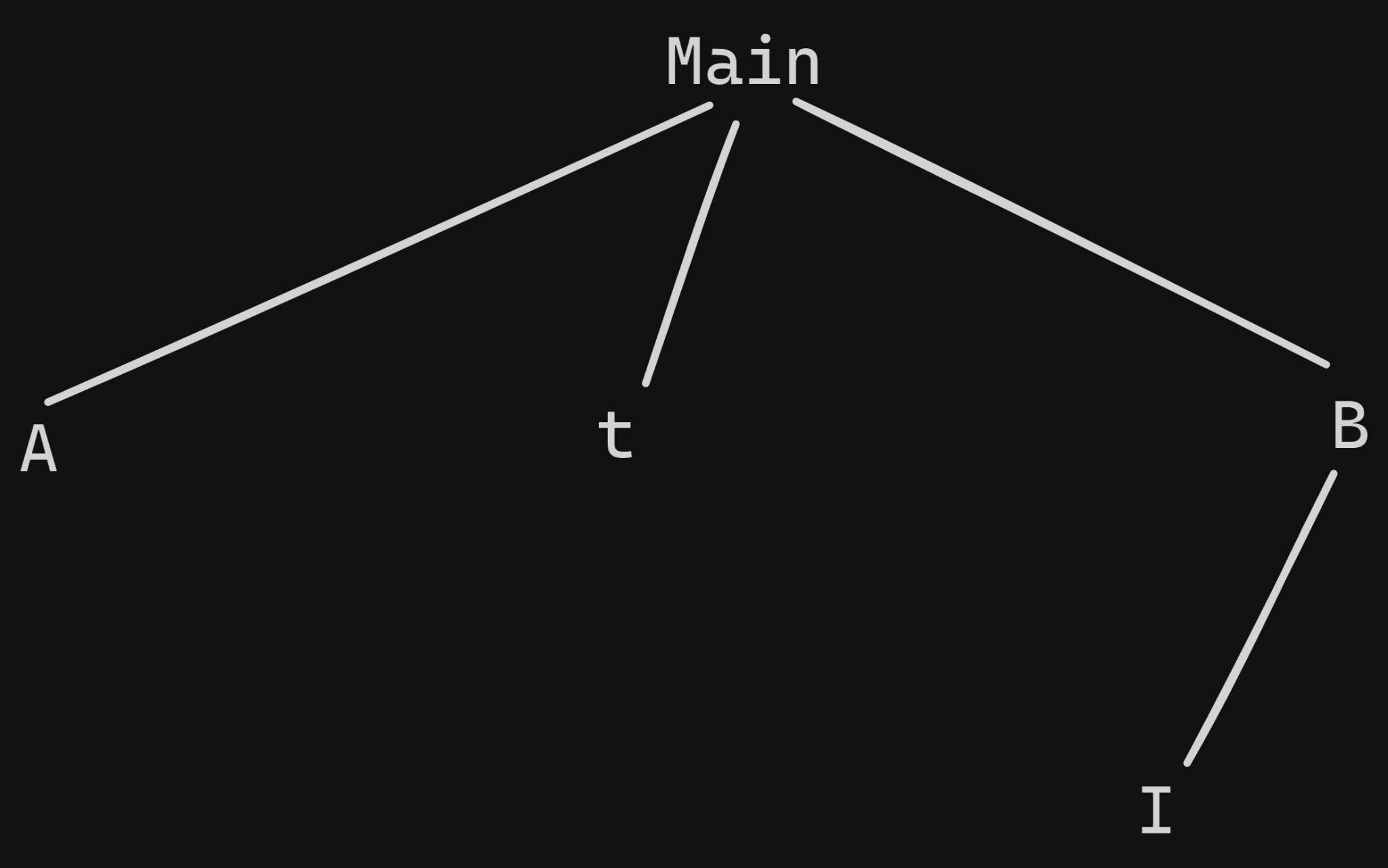
| Registro de activación | Explicación |
| --- | --- |
| Head (prog principal) | Current: Dirección base del registro de activación actual.  Free: Próxima dirección libre en la pila. |
| Pto retorno | Instrucción a la que se vuelve después de ejecutar una subrutina. |
| EE (enlace estático) | Apunta al registro de activación de la rutina que lo contiene estaticamente. |
| ED (enlace dinámico) | Apunta a la dirección base del registro de activación de la rutina que lo llama. |
| Variables… | Variables definidas dentro de la rutina |
| … |  |
| Parámetros… | Variables a ser usadas por la siguiente rutina. |
| … |  |
| Procedimientos… | Procedimientos definidos dentro de la unidad. |
| … |  |
| Funciones… | Funciones definidas dentro de la unidad. |
| … |  |
| Valor de retorno | Valor de retorno de una subrutina llamada dentro de la unidad, ya que cuando termina la rutina se desaloja, se pone aca. |

La utilidad del registro es guardar de manera estructurada en memoria toda la información necesaria para la ejecución de una unidad de código.

# Ejercicio 2:

Dado el siguiente programa escrito en Pascal-like, continuar la realización de las pilas de ejecución hasta finalizar las mismas.

a) Siguiendo la cadena estática b) Siguiendo la cadena dinámica



| 1. Program Main 2. Var a: array[1..10] of integer; 3. x,y,z:integer 4. Procedure A () 5. var y,t: integer; 6. begin 7. a(1):= a(1)+1;z:=z+1; 8. t:=1; y:=2; 9. B(); a(y):=a(y)+3; y:=y+1; 10. If z=11 Then Begin 11. a(z-1):=a(z-2) + 3; 12. z:=z-4; 13. a(z-y):=a(z) – a(y) + 5; 14. End; 15. end; 16. Function t():integer 17. begin 18. y:=y+1; z:=z-6; 19. return(y+x); 20. end; 21. Procedure B() 22. var d:integer; 23. Procedure I () 24. begin 25. x:=0; x:=x+6; 26. end; 27. begin 28. x:=x+t; d:=0; 29. while x>d do begin 30. I(); x:=x-1; 31. d:=d + 2; 32. end; 33. end; 34. begin 35. For x:=1 To 10 do a(x):=x; 36. x:=5; y:=1; z:=10; 37. A(); 38. For x:=1 To 10 do write(a(x),x); 39. end. | | Cadena estática | | | --- | --- | |  | **\*\*\* Reg Activ Main** | | \*1 | Pto retorno | |  | A(1)= 1-> 2 | |  | A(2)= 2 -> 5 | |  | A(3)= 3 | |  | A(4)= 4 | |  | A(5)= 5 | |  | A(6)= 6 | |  | A(7)= 7 | |  | A(8)= 8 | |  | A(9)= 9 | |  | A(10)= 10 | |  | X= 1..10 -> 5 -> 13 -> 0 -> 6 -> 5 -> 0 -> 6 ->5 -> 0 -> 6 ->5 -> 1..10 | |  | Y= 1 –> 2 | |  | Z=10 –> 11 –> 5 | |  | Procedure A | |  | Function T | |  | Procedure B | |  | **VR . . . . . . . .** | | **\*2** | **\*\*\*Reg Activ A** | |  | Pto Retorno | |  | **EE (\*1)** | |  | ED (\*1) | |  | **Y = 2 -> 3** | |  | T = 1 | |  | VR . . . . . . . . | | \*3 | \*\*\* Reg Activ B | |  | **Pto Retorno** | |  | **EE(\*1)** | |  | **ED(\*2)** | |  | D = 0 -> 2 -> 4 -> 6 | |  | Procedure I | |  | **VR . . 8 . .** | | \*4 | **\*\*\* Reg Activ t** | |  | Pto retorno | |  | EE(\*1) | |  | ED(\*3) | |  | **VR** | |  | ---- | | \*5 | **\*\*\* Reg Activ I** | |  | Pto retorno | |  | EE(\*3) | |  | ED(\*3) | |  | **VR** | |  | ---- | | \*5 | **\*\*\* Reg Activ I** | |  | Pto retorno | |  | EE(\*3) | |  | ED(\*3) | |  | **VR** | |  | ---- | | \*5 | **\*\*\* Reg Activ I** | |  | Pto retorno | |  | EE(\*3) | |  | ED(\*3) | |  | **VR** | |  | ---- |   Imprime:  2, 1  5,2  3,3  4,4  5,5  6,6  7,7  8,8  9,9  10,10   | Cadena dinamica | | | --- | --- | |  | **\*\*\* Reg Activ Main** | | \*1 | Pto retorno | |  | A(1)= 1-> 2 | |  | A(2)= 2 -> 5 | |  | A(3)= 3 | |  | A(4)= 4 -> 9 | |  | A(5)= 5 | |  | A(6)= 6 | |  | A(7)= 7 | |  | A(8)= 8 | |  | A(9)= 9 | |  | A(10)= 10 -> 12 | |  | X= 1..10 -> 5 -> 6 -> 0 -> 6 -> 5 ->0 -> 6 -> 5 ->0 -> 6 -> 5 -> 1…10 | |  | Y= 1 –> 2 | |  | Z=10 –> 11 -> 7 | |  | Procedure A | |  | Function T | |  | Procedure B | |  | **VR . . . . . . . .** | | **\*2** | **\*\*\*Reg Activ A** | |  | Pto Retorno | |  | **EE (\*1)** | |  | **ED (\*1)** | |  | Y = 2 -> 3 | |  | T = 1 | |  | VR . . . . . . . . | | \*3 | \*\*\* Reg Activ B | |  | **Pto Retorno** | |  | **EE(\*1)** | |  | **ED(\*2)** | |  | D = 0 -> 2 -> 4 -> 6 | |  | Procedure I | |  | **VR . . . .** | | \*4 | **\*\*\* Reg activ I** | |  | **Pto retorno** | |  | **EE(\*3)** | |  | **ED(\*3)** | |  | **VR** | |  | **--** | |  |  |   Imprime  2, 1  5,2  3,3  9,4  5,5  6,6  7,7  8,8  9,9  12,10 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

# Ejercicio 3:

**Sea el siguiente programa escrito en Pascal-like. Realice la pila de ejecución**

**a) Siguiendo la cadena estática**

**b) Siguiendo la cadena dinámica**

| 1. PROGRAM P1; 2. var 3. a:integer; 4. b:char; 5. c: array[1..10] of integer 6. Procedure PP1; 7. var 8. a:char; 9. p:integer; 10. Function x: integer; 11. var 12. z:integer; 13. begin 14. a:="j"; 15. z=-1; 16. return z; 17. end; 18. Begin 19. p:=x; 20. write(a); 21. p:=x+3; 22. c[p]=8; 23. p:=x+2; 24. c[p]=x; 25. end; 26. Procedure x; 27. var 28. b:char; 29. Procedure PP2; 30. Begin 31. write("para qué estoy aquí?"); 32. end; 33. Begin 34. a:=1; 35. c[a]:=4; 36. b:="a"; 37. write(concat(c[1],b)); /\*concat convierte a string los 38. parámetros, concatena y retorna un string;\*/ 39. PP1(); 40. b:="b"; 41. write(concat(c[5],b)); /\*concat convierte a string los 42. parámetros, concatena y retorna un string;\*/ 43. End; 44. BEGIN 45. a:=3; 46. b:="c"; 47. for a:=3 to 10 do 48. begin 49. c[a]:=2\*a; 50. end; 51. x; 52. write(b); 53. write(a); 54. for a:=1 to 10 do 55. write(c[a]-3); 56. END. | | Cadena estática | | | --- | --- | | \*1 | **\*\*\* Reg activ P1** | |  | P.R | |  | a = 3-> 3..10 -> 1 -> 1..10 | |  | b = “c” | |  | c(1) = 4 -> -1 | |  | c(2) = 8 | |  | c(3) = 6 | |  | c(4) = 8 | |  | c(5) = 10 | |  | c(6) = 12 | |  | c(7) = 14 | |  | c(8) = 16 | |  | c(9) = 18 | |  | c(10) = 20 | |  | Procedure PP1 | |  | Procedure X | |  | **VR** | | \*2 | **\*\*\* Reg activ x** | |  | P.R | |  | EE(\*1) | |  | ED(\*1) | |  | b = “a” -> “b” | |  | Procedure PP2 | |  | VR | | \*3 | **\*\*\* Reg activ PP1** | |  | P.R | |  | EE(\*1) | |  | ED(\*2) | |  | a = “j” -> “j” -> “j” -> “j” | |  | p = -1 -> 2 -> 1 | |  | Function x | |  | V.R -1 -> -1 -> -1 -> -1 | | \*4 | **\*\*\* Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | | \*5 | **\*\*\* Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | | \*6 | **\*\*\* Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | | \*7 | **\*\*\* Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | |  |  |   Imprime:  4a  j  10b  c  1  -4  5  3  5  7  9  11  13  15  17   | Cadena dinámica (es igual q la estática) | | | --- | --- | | \*1 | **\*\*\* Reg activ P1** | |  | P.R | |  | a = 3 -> 3..10 -> 1 -> 1..10 | |  | b = “c” | |  | c(1) = 4 -> -1 | |  | c(2) = 8 | |  | c(3) = 6 | |  | c(4) = 8 | |  | c(5) = 10 | |  | c(6) = 12 | |  | c(7) = 14 | |  | c(8) = 16 | |  | c(9) = 18 | |  | c(10) = 20 | |  | Procedure X | |  | Procedure PP1 | |  | V.R | | \*2 | **Reg activ X** | |  | P.R | |  | EE(\*1) | |  | ED(\*1) | |  | b = “a” -> “b” | |  | **Procedure PP2** | |  | V.R | | \*3 | **Reg activ PP1** | |  | P.R | |  | EE(\*1) | |  | ED(\*2) | |  | a = “j” -> “j” -> “j” -> “j” | |  | p = -1 -> 2 -> 1 | |  | Function x | |  | **V.R -1 -> -1 -> -1 -> -1** | | \*4 | **Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | | \*5 | **Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | **V.R** | | \*6 | **Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R | | \*7 | **Reg activ X** | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | z = -1 | |  | V.R |   Imprime  4a  j  10a  c  1  -4  5  3  5  7  9  11  13 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

# Ejercicio 4:

**Sea el siguiente programa escrito en Pascal-like. Realice la pila de ejecución**

**a) Siguiendo la cadena estática**

**b) Siguiendo la cadena dinámica**

// Elijo creer. El dinámico lo hice como 4 veces porque estaba quemado.

| **Código** | **Cadena estática** | **Cadena dinámica** |
| --- | --- | --- |
| 1. Procedure Main; 2. var x, y: integer; 3. vec: array[1..7] of integer; 4. Function B:integer; 5. var y:integer; 6. begin 7. y:=4; x:= y - 2; 8. return (x); 9. end; 10. Procedure D; 11. var i, x: integer; 12. vec: array[1..7] of integer; 13. Procedure A; 14. var y:integer; 15. begin 16. y:=x + 5; vec(i + 2):= 17. vec(i + 2) + y; 18. x:= x +B; C; 19. end; 20. Function B:integer; 21. begin 22. vec(i):= y + 2; i:=i+2; 23. vec(i):= vec(1) \* i; 24. return ( vec(i)-vec(1) ); 25. end; 26. begin 27. for x:= 1 to 7 do vec(x):= 1; 28. x:=1; i:= 2; 29. if y = 7 then A; else C; 30. for x:= 1 to 7 do write(vec(x)); 31. end; 32. Procedure C; 33. var i, y: integer; 34. begin 35. i:= 1; y:= 6; x:= x + B; 36. vec(2):= vec(2) \* x; 37. while (i < y) do begin 38. vec(i):= vec(i) + B - 1; 39. i:= i + 3; 40. end; 41. y:= y - 4; 42. end; 43. begin 44. for x:= 1 to 7 do vec(x):= x; 45. x:= 3; y:= B+5; D; 46. if (x = 2) then begin 47. vec(x):= vec(x) + 2; 48. vec(x + 3):= vec(x) \* 3; 49. end; 50. for x:= 1 to 7 do write(vec(x)); 51. end. | | \*1 | Reg main | | --- | --- | |  | P.R | |  | X = 1..7 -> 3 -> 2 -> 2 -> 4 -> 2 -> 2 -> 1..7 | |  | Y = 7 | |  | Vec(1) = 1 -> 2 | |  | Vec(2) = 2 -> 8 -> 10 | |  | Vec(3) = 3 | |  | Vec(4) = 4 -> 5 | |  | Vec(5) = 5 -> 30 | |  | Vec(6) = 6 | |  | Vec(7) = 7 | |  | Function B | |  | Procedure D | |  | Procedure C | |  | V.R 2 | | \*2 | Reg activ B | |  | P.R | |  | EE(\*1) | |  | ED(\*1) | |  | Y= 4 | |  | V.R | | \*3 | Reg activ D | |  | P.R | |  | EE(\*1) | |  | ED(\*1) | |  | I = 2 -> 4 | |  | X= 1..7 -> 1 -> 4 -> 1..7 | |  | Vec(1) = 1 -> 4 | |  | Vec(2) = 1 -> 9 | |  | Vec(3) = 1 | |  | Vec(4) = 1 -> 7 | |  | Vec(5) = 1 | |  | Vec(6) = 1 | |  | Vec(7) = 1 | |  | Procedure A | |  | Function B | |  | V.R | | \*4 | Reg activ A | |  | P.R | |  | EE(\*3) | |  | ED(\*3) | |  | Y = 6 | |  | V.R 3 | | \*5 | Reg activ B | |  | P.R | |  | EE(\*3) | |  | ED(\*4) | |  | V.R | | \*6 | Reg activ C | |  | P.R | |  | EE(\*1) | |  | ED(\*4) | |  | I= 1 -> 4 -> 7 | |  | Y = 6 -> 2 | |  | V.R 2 -> 2 -> 2 | | \*7 | Reg activ B | |  | P.R | |  | EE(\*1) | |  | ED(\*6) | |  | Y = 4 | |  | V.R | | \*8 | Reg activ B | |  | P.R | |  | EE(\*1) | |  | ED(\*6) | |  | Y = 4 | |  | V.R | | \*9 | Reg activ B | |  | P.R | |  | EE(\*1) | |  | ED(\*6) | |  | Y = 4 | |  | V.R |   **Imprime:**  **4**  **9**  **1**  **7**  **1**  **1**  **1**  **2**  **10**  **3**  **5**  **30**  **6**  **7** | \*1 REG Main  P.R  X = 1..7 -> 3 -> 2 -> 1..7  Y = 7  VEC(1)= 1  VEC(2)= 2 -> 4  VEC(3)= 3  VEC(4)= 4  VEC(5)= 5 -> 12  VEC(6)= 6  VEC(7)= 7  FUNCTION B  PROCEDURE D  PROCEDURE C  V.R = 2  \*2 REG B (SUPERIOR)  P.R  EE (\*1)  ED (\*1)  Y = 4  V.R  \*3 REG D  P.R  EE(\*1)  ED(\*1)  I = 2 -> 4  X = 1..7 -> 1 -> 4 -> 20  VEC(1)= 1 -> 8  VEC(2)= 1 -> 8 -> 160  VEC(3)= 1 -> 24 -> 8 -> 39  VEC(4)= 1 -> 7 -> 4  VEC(5)= 1 -> 40  VEC(6)= 1  VEC(7)= 1  PROCEDURE A  FUNCTION B  V.R  \*4 REG A  P.R  EE(\*3)  ED(\*3)  Y= 6  V.R 3  \*5 REG B (INFERIOR)  P.R  EE(\*3)  ED(\*4)  V.R  \*6 REG C  P.R  EE(\*1)  ED(\*4)  I = 1 -> 3 -> 5 -> 8  Y = 6 -> 2  V.R 16 -> 32  \*7 REG B(INFERIOR)  P.R  EE(\*3)  ED(\*6)  V.R  \*8 REG B(INFERIOR)  P.R  EE(\*3)  ED(\*6)  V.R  Imprimimos:  8  160  39  4  40  1  1  1  4  3  4  12  6  7 |

# Ejercicio 5:

**Sea el siguiente programa escrito en Pascal-like. Realice la pila de ejecución**

**a) Siguiendo la cadena estática**

**b) Siguiendo la cadena dinámica**

**c) La sentencia x:= c + 5 +x, podría reemplazarse por x:= x + c + 5? Justifique la respuesta**

| **Código** | **Estático** | **Dinámico** |
| --- | --- | --- |
| 1. **Program Main;** 2. **Var x, y, z:integer;** 3. **a, b: array[1..6] of integer;** 4. **Procedure B;** 5. **var y,x: integer;** 6. **Procedure C;** 7. **var c:integer;** 8. **begin** 9. **y:= y + 2; c:=2;** 10. **a(x):=a(x)\*y;** 11. **if (y >7) then** 12. **b(y-6)=b(4)\*2+b(y-6);** 13. **D;** 14. **end;** 15. **begin** 16. **x:=2; y:= x + 3;** 17. **C; x:= x + 1; write (x,y);** 18. **End;** 19. **Procedure D;** 20. **begin** 21. **x:= c + 5 + x;** 22. **y:= y + 2;** 23. **end;** 24. **Function C: integer;** 25. **begin** 26. **b(x):= b(x) + 1;** 27. **x:= x + 1;** 28. **a(y):=a(y)+b(x)+3;** 29. **a(x+2)=a(x) + 2;** 30. **return b(x);** 31. **end** 32. **begin** 33. **x:= 1; Y:= 2;** 34. **for z:=1 to 6 do begin** 35. **a(z):= z;** 36. **b(z):= z + 2;** 37. **end;** 38. **B;** 39. **for z:= to 6 do write (a(z), b(z));** 40. **end.** | \*1 REG ACTIV MAIN  P.R  X = 1 -> 2 -> 11  Y = 2 -> 4  Z = 1..6 -> 1..6  A(1) = 1  A(2) = 2-> 14 -> 21  A(3) = 3  A(4) = 4 -> 23  A(5) = 5  A(6) = 6  B(1) = 3 -> 4  B(2) = 4  B(3) = 5  B(4) = 6  B(5) = 7  B(6) = 8  PROCEDURE B  PROCEDURE D  FUNCTION C  V.R  \*2 REG ACTIV B  P.R  EE(\*1)  ED(\*1)  Y= 5 -> 7  X= 2 -> 3  PROCEDURE C  V.R  \*3 REG ACTIV C (INFERIOR)  P.R  EE(\*2)  ED(\*2)  C=2  V.R  \*4 REG ACTIV D  P.R  EE(\*1)  ED(\*3)  V.R 4  \*5 REG ACTIV C (SUPERIOR)  P.R  EE(\*1)  ED(\*4)  V.R  IMPRIME:  3,7  1  21  3  23  5  6  4  4  5  6  7  8 | \*1 REG ACTIV MAIN  P.R  X= 1  Y= Y  Z= 1..6 -> 1..6  A(1) = 1  A(2) = 2 -> 14  A(3) = 3  A(4) = 4  A(5) = 5  A(6) = 6  B(1) = 3  B(2) = 4  B(3) = 5  B(4) = 6  B(5) = 7  B(6) = 8  PROCEDURE B  PROCEDURE D  FUNCTION C  V.R  \*2 REG ACTIV B  P.R  EE(\*1)  ED(\*1)  Y=5 -> 7 -> 9  X=2 -> 9 -> 10  PROCEDURE C  V.R  \*3 REG ACTIV C (INFERIOR)  P.R  EE(\*2)  ED(\*2)  C= 2  V.R  \*4 REG ACTIV D  P.R  EE(\*1)  ED(\*3)  V.R  IMPRIME  10,9  1,3  14,4  3,5  4,6  5,7  6,8 |

C. No es lo mismo en la estática ya que ahí es una función que modifica x, pero en la dinámica c se reconoce como una variable.